USGS
science for a changing world

CoalVal—A Coal Resource Valuation Program

Open-File Report 2009–1282

U.S. Department of the Interior
U.S. Geological Survey

CoalVal—A Coal Resource Valuation Program

By Timothy J. Rohrbacher and Gary E. McIntosh

Open-File Report 2009–1282

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia: 2010

Suggested citation:
Rohrbacher, T.J., and McIntosh, G.E., 2010, CoalVal—A coal resource valuation program: U.S. Geological Survey Open-File Report 2009–1282, 265 p.

Contents

Figures

Tables

Conversion Factors

Units of measure—length, weight, and area

To convert from	To	Multiply by
acre (ac)	square feet (ft^2)	43,560
inch (in.)	centimeter (cm)	2.54
foot (ft)	meter (m)	0.3048
mile (mi)	kilometer (km)	1.609344
pound (lb)	kilogram (kg)	0.4536
short ton (2,000 lb)	metric tonne (2,204.6 lb)	0.90718474
square mile (mi^2)	square kilometer (km^2)	2.590
square foot (ft^2)	square meter (m^2)	0.929

Abbreviations Used in This Report

$/t	dollar per ton
ac	acre
cm	centimeter
d	day
ft	foot
ft^2	square foot
ft^3	cubic foot
h	hour
hp	horsepower
in.	inch
lb	pound
mi	mile
min	minute
mo	month
sq ft	square feet
t	short ton
t/ac-ft	ton per acre-foot
t/h	ton per hour
t/yr	ton per year
yr	year
BCY	bank cubic yard
BLM	U.S. Bureau of Land Management
Btu	British thermal unit
CIS	cost indexing system
CM	continuous miner machine
COLA	cost of living adjustment
CSV	comma-separated value
CTL	coal to liquid
CY	cubic yard
D&I	direct and indirect (costs)
DBF	dBase IV file structure
DCF	discounted cash flow
DCF-ROR	discounted cash flow–rate of return
DL	dragline
F&L	fuel and lube
FEL	front-end loader
FOB	free on board
GIS	geographic information system
GPS	global positioning system
ID	identification
LCY	loose cubic yard
LPU	logical production unit
LW	longwall mining machine
MM	million
MMF	mineral-matter-free
MSHA	Mine Safety & Health Administration
NAP	Northern Appalachian
NPV	net present value
O&M	operating and maintenance
OB	overburden
PC	personal computer
PDF	portable document file
PPI	producer price index
PRB	Powder River Basin
RAM	random access memory
ROM	run of mine
ROR	rate of return
RTF	rich text format
SMCRA	Surface Mining Control and Reclamation Act
TS	truck-shovel
TS-DL	truck-shovel–dragline
TXT	plain text
USGS	U.S. Geological Survey

CoalVal—A Coal Resource Valuation Program

By Timothy J. Rohrbacher and Gary E. McIntosh

Abstract

CoalVal is a menu-driven Windows program that produces cost-of-mining analyses of mine-modeled coal resources. Geological modeling of the coal beds and some degree of mine planning, from basic prefeasibility to advanced, must already have been performed before this program can be used. United States Geological Survey mine planning is done from a very basic, prefeasibility standpoint, but the accuracy of CoalVal's output is a reflection of the accuracy of the data entered, both for mine costs and mine planning. The mining cost analysis is done by using mine cost models designed for the commonly employed, surface and underground mining methods utilized in the United States.

CoalVal requires a Microsoft Windows® 98 or Windows® XP operating system and a minimum of 1 gigabyte of random access memory to perform operations. It will not operate on Microsoft Vista®, Windows® 7, or Macintosh® operating systems. The program will summarize the evaluation of an unlimited number of coal seams, haulage zones, tax entities, or other area delineations for a given coal property, coalfield, or basin. When the reader opens the CoalVal publication from the USGS website, options are provided to download the CoalVal publication manual and the CoalVal Program.

The CoalVal report is divided into five specific areas relevant to the development and use of the CoalVal program:

1. Introduction to CoalVal Assumptions and Concepts.
2. Mine Model Assumption Details (appendix A).
3. CoalVal Project Tutorial (appendix B).
4. Program Description (appendix C).
5. Mine Model and Discounted Cash Flow Formulas (appendix D).

The tutorial explains how to enter coal resource and quality data by mining method; program default values for production, operating, and cost variables; and ones own operating and cost variables into the program. Generated summary reports list the volume of resource in short tons available for mining, recoverable short tons by mining method; the seam or property being mined; operating cost per ton; and discounted cash flow cost per ton to mine and process the resources. Costs are calculated as loaded in a unit train, free-on-board the tipple, at a rate of return prescribed by the evaluator.

The recoverable resources (in short tons) may be grouped by incremental cost over any range chosen by the user. For example, in the Gillette coalfield evaluation, the discounted cash flow mining cost (at an 8 percent rate of return) and its associated tonnage may be grouped by any applicable increment (for example, $0.10 per ton, $0.20 per ton, and so on) and using any dollar per ton range that is desired (for example, from $4.00 per ton to $15.00 per ton). This grouping ability allows the user to separate the coal reserves from the nonreserve resources and to construct cost curves to determine the effects of coal market fluctuations on the availability of coal for fuel whether for the generation of electricity or for coal-to-liquids processes. Coking coals are not addressed in this report.

Introduction

CoalVal is a menu-driven Windows® program (fig. 1) that produces cost-of-mining analyses of mine-modeled coal resources. Geological modeling of the coal beds and some degree of mine planning, from basic prefeasibility to advanced, must already have been performed before this program can be used. U.S. Geological Survey (USGS) mine planning is done from a very basic, prefeasibility standpoint, but the accuracy of CoalVal's output is a reflection of the accuracy of the data entered, both for mine costs and mine planning (fig. 2). The mining cost analysis is done by using mine cost models (appendix A) designed for the commonly employed, surface mining methods and underground mining methods utilized in the United States (tables 1 and 2).

CoalVal requires a Microsoft Windows® 98 or Windows® XP operating system and a minimum of 1 gigabyte of random access memory to perform operations. It will not operate on Microsoft Vista®, Windows® 7, or Macintosh® operating systems. The program will summarize the evaluation of an unlimited number of coal seams, haulage zones, tax entities, or other area delineations for a given coal property, coalfield, or basin. When the reader opens the CoalVal publication from the United States Geological Survey's website, options are provided to download the

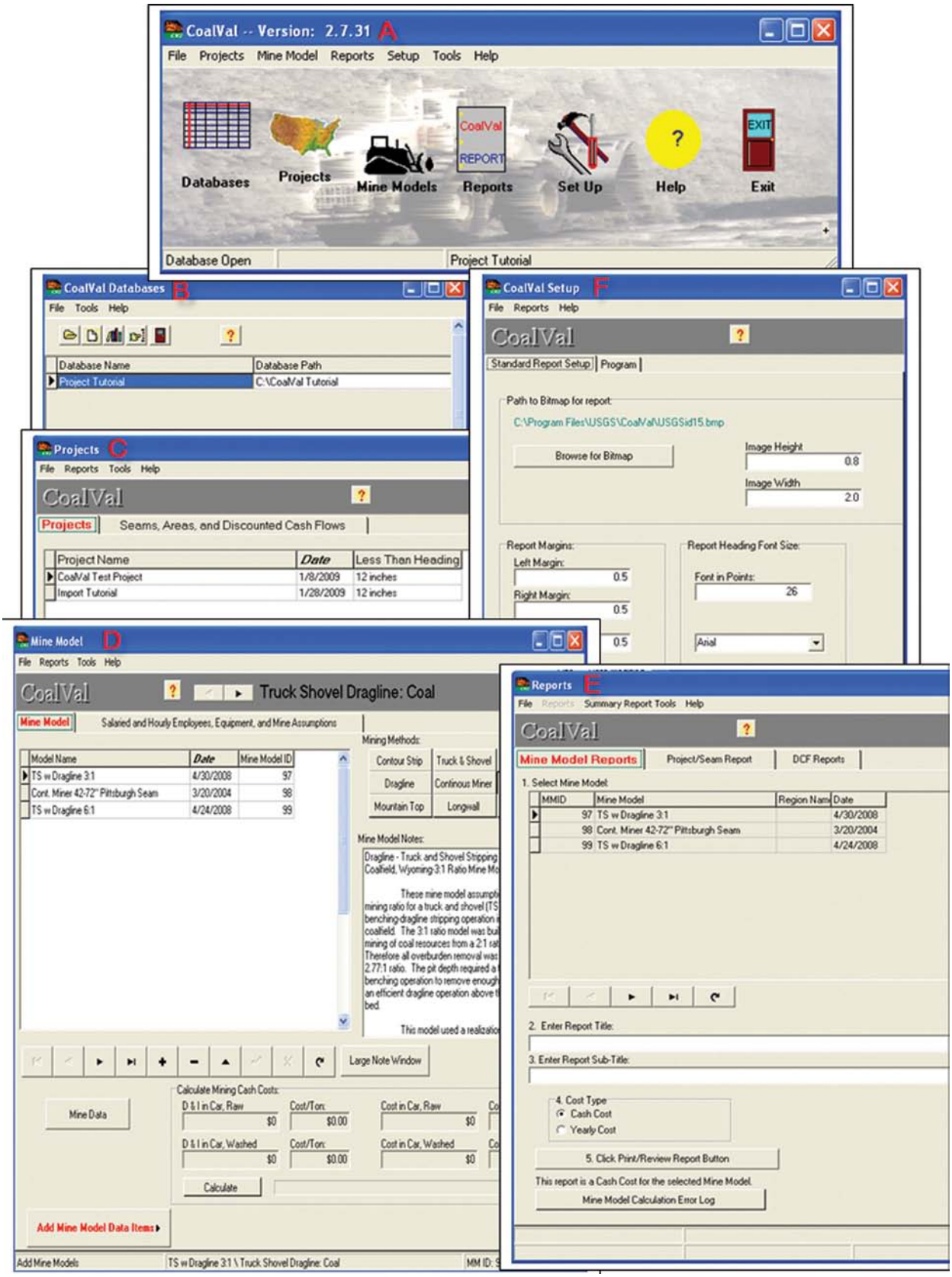


Figure 1. CoalVal's main menus: *A*, Main Menu, *B*, CoalVal Databases, *C*, Projects, *D*, Mine Models, *E*, Reports, and *F*, CoalVal Setup.

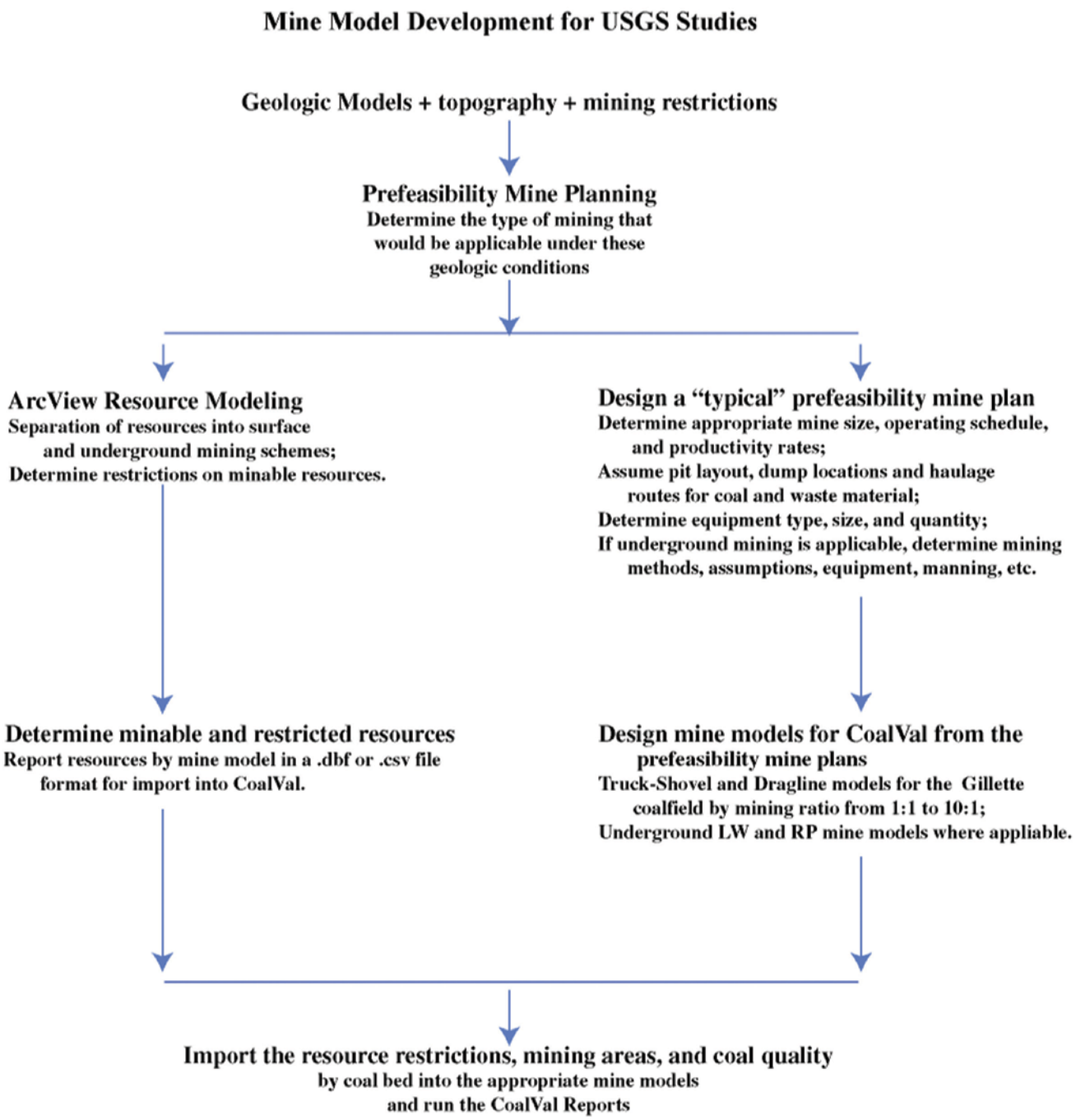


Figure 2. Flow diagram of Mine Model development.

Table 1. Surface mining methods, minimum coal thicknesses, average production per year, effective ratio, coal recovery rate, minimum mine life, and minimum resource needed for mine development in the CoalVal program.

[in., inch; yr, year; BCY, bank cubic yard; CM, continuous miner; DL/TS, dragline and truck-shovel; LW, longwall; R/P, room and pillar mining; ROM, run-of-mine; TS, truck-shovel; NA, not applicable]

Mining Technology	Coal Thickness (in.)	ROM Coal Production (tons/yr)	Stripping (BCY/yr × 10^6)	Maximum Effective Ratio	Mining Recovery factor	Mine Life (years)	Minimum Resource (tons × 10^6)
Contour Strip (CS12)	12–36	966,697	5.800	6.00	0.78	5	6.197
Contour Strip (CS36)	>36	1,071,429	7.500	7.00	0.93	5	5.760
Area Mining (AM12)	>12	1,555,556	14.000	9.00	0.93	5	8.363
Auger (AU12)	12–36	87,500	0	NA	0.30	5	1.458
Auger (AU36)	>36	175,000	0	NA	0.30	5	2.917
TS (1:1 Ratio)	>60	20,000,000	20.000	1.0	0.95	10	210.53
TS (2:1 Ratio)	>60	20,000,000	40.000	2.0	0.95	10	210.53
TS (3:1 Ratio)	>60	20,000,000	60.000	3.0	0.95	10	210.53
TS (4:1 Ratio)	>60	20,000,000	80.000	4.0	0.95	10	210.53
TS (5:1 Ratio)	>60	20,000,000	100.000	5.0	0.95	10	210.53
TS (6:1 Ratio)	>60	20,000,000	120.000	6.0	0.95	10	210.53
DL/TS (1:1 Ratio)	>60	35,000,000	17.904	0.51	0.92	10	380.43
DL/TS (2:1 Ratio)	>60	35,000,000	54.038	1.54	0.92	10	380.43
DL/TS (3:1 Ratio)	>60	35,000,000	90.029	2.57	0.92	10	380.43
DL/TS (4:1 Ratio)	>60	35,000,000	126.101	3.60	0.92	10	380.43
DL/TS (5:1 Ratio)	>60	35,000,000	162.079	4.63	0.92	10	380.43
DL/TS (6:1 Ratio)	>60	35,000,000	198.065	5.66	0.92	10	380.43
DL/TS (7:1 Ratio)	>60	35,000,000	234.055	6.69	0.92	10	380.43
DL/TS (8:1 Ratio)	>60	35,000,000	270.052	7.72	0.92	10	380.43
DL/TS (9:1 Ratio)	>60	35,000,000	306.057	8.74	0.92	10	380.43
DL/TS (10:1 Ratio)	>60	35,000,000	342.066	9.77	0.92	10	380.43

Table 2. Underground mining methods, minimum coal thicknesses, average production per year, effective ratio, coal recovery rate, minimum mine life, and minimum resource needed for mine development in the CoalVal program.

[in., inch; yr, year; BCY, bank cubic yards; CM, continuous miner; LW, longwall; ROM, run-of-mine; R/P, room and pillar mining; NA, not applicable]

Mining Technology	Coal Thickness (in.)	ROM Coal Production (tons/yr)	Stripping (BCY/yr × 10^6)	Maximum Effective Ratio	Mining Recovery Factor	Mine Life (years)	Minimum Resource (tons × 10^6)
R/P with CM (CM24)	24–42	1,147,500	NA	NA	0.62	10	18.508
R/P with CM (CM42)	42–72	1,575,000	NA	NA	0.65	10	24.231
R/P with CM (CM72)	72–96	2,025,000	NA	NA	0.68	10	29.997
R/P with CM (CM96)	>96	2,475,000	NA	NA	0.71	10	34.859
Longwall (LW42)	42–72	4,927,680	NA	NA	0.73	10	67.502
Longwall (LW72)	72–96	6,456,960	NA	NA	0.73	10	88.452
Longwall (LW96)	>96	6,082,500	NA	NA	0.75	10	81.100

CoalVal publication manual and the CoalVal Program. It is recommended that the user complete the Tutorial Chapter, appendix B, before trying to modify or use the CoalVal mine models and that copies of the program files and associated folders are archived before those files and folders are modified by use.

This report is divided into five specific areas relevant to the development and use of the CoalVal program:

1. Introduction to CoalVal Assumptions and Concepts.
2. Mine Model Assumption Details (appendix A).
3. CoalVal Project Tutorial (appendix B).
4. Program Description (appendix C).
5. Mine Model and Discounted Cash Flow Formulas (appendix D).

The first-time user will need to examine the entire CoalVal project tutorial prior to using the CoalVal Program for mine costing or coal resource assessment. The tutorial explains how to enter coal resource and quality data by mining method; program default values for production, operating, and cost variables; and one's own operating and cost variables into the program. Generated summary reports list the volume of resource in short tons available for mining, recoverable short tons by mining method; the seam or property being mined; operating cost per ton; and discounted cash flow cost per ton to mine and process the resources. Costs are calculated as loaded in a unit train, free-on-board the tipple, at a rate of return prescribed by the evaluator. In CoalVal, the term *coal seam* is used as a mining term; that is, it refers to the coal and to parting, floor, and roof dilution (sandstone, siltstone, or shale) extracted during coal mining. The term *coal bed* in this document refers only to a coal unit named for the purpose of geologic mapping, such as Pittsburgh Bed or coal Bed A and does not necessarily refer to a mineable unit. All tonnages discussed in this paper are reported in short tons. The user can export the coal resource and quality data including recoverable quantities and revised coal quality along with threshold prices and mine model information. Economic analysis, such as the construction of cost curves, may then be performed.

The recoverable resources (in short tons) may be grouped by incremental cost over any range chosen by the user. For example, in the Gillette coalfield evaluation, the discounted cash flow (DCF) mining cost (at an 8 percent rate of return (ROR)) and its associated tonnage may be grouped by any applicable increment (for example, $0.10 per ton, $0.20 per ton, and so on) and using any dollar per ton range that is desired (for example, from $4.00 per ton to $15.00 per ton). This grouping ability allows the user to separate the coal reserves from the nonreserve resources and to construct cost curves to determine the effects of coal market fluctuations on the availability of coal for fuel whether for the generation of electricity or for coal-to-liquids (CTL) processes. Coking coals are not addressed in this report.

Objectives

CoalVal was developed and reviewed by peers in the U.S. Bureau of Mines (USBM) and refined and peer-reviewed in the USGS. The objective of its development was to be able to calculate the amount of reserves in a coal resource mineable by use of commonly employed surface or underground mine methods. To move toward that objective, CoalVal development included the construction of mine cost models capable of determining the recoverability of a selected coal resource and the cost to mine that resource. Initially CoalVal was used to develop mine operating costs for the USBM's Coal Recoverability Project. Later refinements by the USGS in its Coal Resource Assessment Project added discounted cash flow–rate of return (DCF-ROR) analyses in an effort to more closely refine the line between coal reserves and coal resources. CoalVal has been used by the USGS to assess coal resources in central and northern Appalachia, the Colorado Plateau, the Gillette coalfield, and coalfields in the Illinois, San Juan and Green River Basins.

History

In order to more accurately quantify the domestic coal reserves, the USGS and the Kentucky Geological Survey in 1986 began a pilot coal availability study of the Matewan, Kentucky quadrangle (Carter and Gardner, 1989). That study determined the amount of coal in the quadrangle that was available to mine after certain technical, environmental, and societal restrictions were considered. The study was later expanded into West Virginia and Virginia and then into the other coal-producing states of the United States. In late 1988 the USGS asked the USBM to (1) review the information generated by the pilot Coal Availability Study, and (2) determine if a joint program could establish the costs associated with mining the identified coal resources, and (3) quantify the economically recoverable coal (Rohrbacher and others, 1993b). The USBM concluded that such a program was feasible and subsequently began to assemble human resources, hardware, and software to accomplish the task.

Cost models were created by the USBM in the early stages of the Matewan study (Rohrbacher and others, 1993a). These models were developed in an early version of Lotus 1-2-3 (Lotus Development Corporation, 1988) spreadsheets for the five different mining methods being used in the quadrangle: contour strip, area mining, auger mining, continuous miner, and longwall mining. Evaluators input into these models included the production, operating, and cost variables that pertained to each mining method, seam, seam thickness, and haulage cost combination in the quadrangle. The result of this process was a determination of the cost per clean ton to mine and process the quality of coal represented by each seam, which then led to calculations of the mining costs for all coal resources within the Matewan study area.

These original models could then be used to evaluate resources with similar geological and mining conditions. If the conditions or costs changed, then the models were modified accordingly. In the course of evaluating the Matewan quadrangle, it became apparent that the process was too tedious and required constant data verification to make sure hand-transferred data were correct. It was then decided to automate the entire process by writing a series of Lotus 1-2-3 macro equations that would generate cost figures and create summary tables once pertinent base data were input. The resulting software package was entitled, "CoalVal," version 1.0" (Plis and others, 1993).

The success of CoalVal 1.0 and mine models produced for eastern coal resource evaluations resulted in updating CoalVal 1.0 with DCF routines and publishing the program as: CoalVal 2.0 (Suffredini and others, 1994). However, Lotus 1-2-3 did not keep up with advancements in spreadsheet programs and the scripts were modified in 1996 to work in Microsoft Excel (Microsoft Corporation), using the Windows® 1995 platform. Unfortunately, each time Microsoft updated Excel®, as in 1997, 1998, and 2000, the scripts had to be revised because they were not compatible with the new spreadsheet program. In 2000 the USGS elected to change CoalVal to a publically available, stand-alone program using the Delphi language (Embarcadero Technologies, 2007), which is not affected by the changes incurred by Microsoft (McIntosh, 2003, McIntosh and others, 2005). At that time, CoalVal used the Borland Software Corporation's database manager for file structure and database management. Borland proved to be very difficult to install and modify as needed with the USGS's computer security systems. Therefore, in 2009 the CoalVal program was modified to use the publically available Nexus Software, Inc. database management and add-on applications.

In 2004, the USGS conducted an external peer review of the Energy Program's Coal Assessment Project including the assumptions and calculations of the CoalVal program (Rohrbacher and others, 2005).

Geological Model Construction

A brief review of background information from figure 2 will be useful in understanding where and how the geologic models and basic mine planning produce the mine models used in coal resource assessments. The following general methodology description was used to construct the program's Geologic Models at the USGS; however, other evaluators may use different methodologies that will produce the same input data.

The USGS uses StratiFact (GRG Corporation software, 1998) for coal bed correlations and SURFER (Golden Software, 2002) and PC/Cores (Mentor Consultants, 2005) to produce grids and maps of geologic models on a regional or basin-wide basis (Luppens and others, 2008). The geologic model grids are then converted into ASCII files.

Resulting ASCII grid files are then imported into the Geographic Information System (GIS) programs, ArcGIS (ESRI, 2006) and ArcView (ESRI, 2000a). GIS is used to differentiate coal resources (fig. 2) into resources restricted from mining and those resources that are available for mining (Carter and Gardner, 1989, Rohrbacher and others, 1993a and 1993b, and Luppens and others, 2008). ArcView Spatial Analyst (ESRI, 2000b) is used to calculate total resource tonnages and separate resources by ownership, political area, and different mining methods, whether surface or underground. The resulting tonnages are then placed into an ArcView Spatial Analyst value attribute table which is subsequently exported to an Excel spreadsheet then converted to a dBase IV (DBF) file or a comma separated value (CSV) file (Luppens and others, 2008).

Coal-resource and related data can be placed into CoalVal tables either manually or by importing spreadsheet data similar to that shown in figure 3 by use of a DBF or CSV file format. In figure 3, AREAID is an identification number that can represent any number of items in the geographical area being assessed. Those items are identified and explained in the Tutorial, appendix B (under the Database and the Coal Resource Area Calculations sections) and in the Program

	A	B	C	D	E	F	G	H	I
1	Tutorial Coal Resource Data Spreadsheet used for the CoalVal Tutorial.								
2									
3	AREAID	AREANAME	TONSCOAL	TONSPART	AREA	HAULID	TAXID	MODELID	WASHED
4	1	113	62197280	50060944	6266	88	17	1	0
5	2	114	548458592	38497320	5208	88	17	3	1
6	3	115	435596736	23539216	4093	88	71	3	1
7									
8									

Figure 3. Coal resource data spreadsheet example.

Description, appendix C. In figure 3 the AREANAME field identifies a specific resource area that has tons of in-place coal (TONSCOAL), tons of in-place parting material (TONSPART), the acres (AREA), a coal haulage identifier (HAULID), tax entity identifier (TAXID), the mine model that will be used to assess the mining costs (MODELID), and whether the produced coal will need to be washed to become a saleable product (WASHED). In addition to entries such as resource tonnage, acres of resources, mine models, coal-quality parameters (for example, percent sulfur, percent ash, Btu, and percent moisture) can also be imported.

Projects that involve the assessment of large areas, such as entire coalfields, will contain many Areas and many Mine Models and would require many hours to manually enter and verify resource data. Therefore, importing that data by using schemas to link spreadsheet information to data fields in CoalVal tables is a more time effective and accurate method of data entry. Importing data and the design of schemas is discussed and examples developed in the Tutorial appendix B.

Mine Model Construction

Prefeasibility mine plans for surface and underground mining (fig. 4) were originally designed for the Matewan quadrangle in eastern Kentucky by engineers and scientists at the USBM (appendix A). These plans utilized mining methods similar to those being employed in the Central and Northern Appalachian coalfields – contour stripping, mountain-top removal (area mining), highwall mining, and room and pillar and longwall mining. Basic mine plans were laid out on 7.5-minute topographic quadrangles on a bed-by-bed basis, and configurations mirrored current coal mining practices (fig. 4) (Rohrbacher and others, 1993b, 2000). Later, as the evaluation of coal resources moved west into the Illinois Basin, the Powder River Basin (PRB), and the coal basins of Colorado, Utah, and New Mexico, the mine plans and models were modified to reflect the mining in those areas. For example, new plans were developed (fig. 5) to mirror the large truck-shovel and dragline/truck-shovel mines of the PRB (Rohrbacher, and others, 1998; Osmonson and others, 2000; and Luppens and others, 2008).

CoalVal is not a mine planning program, such as the MineScape (Mincom, 2009), Minex (Gemcom, 2009), Techbase (TECHBASE, 2009) or Vulcan (MAPTEK, 2009) programs, nor does it produce mine models. Evaluators must develop mine plans and can then modify the mine models provided or develop similar mine models within CoalVal. The USGS uses very basic, prefeasibility mine planning to estimate the size and amount of equipment and the manpower necessary to produce a planned coal tonnage.

CoalVal mine models were first developed for surface and underground mining scenarios to evaluate one coal seam at a time. Owing to the complexity of multiple-seam mine planning, both in the sequencing of equipment and the blending of the produced coal, a composite package of coal seams using ratios of total waste to total in-place coal was used for surface mining evaluations. When the composite package of coal seams in the USGS's Gillette coalfield study (Luppens, 2008) was evaluated, it was assumed that a dragline operation (and cast-blasting) would remove the upper 200 feet (ft) of overburden and that the remainder of the overburden and interburden would be removed by truck-shovel operations. All of the seams in that composite package were evaluated with the same ratio and same mine model, regardless of whether or not the individual seam had a ratio higher or lower than the ratio for that package. In the case of the Gillette coalfield assessment, an average coal quality was assumed for all the seams within the package. However, since the thickest and highest quality coal seams were known to have different coal qualities from area to area (coal pod to coal pod) in the coalfield, those quality variations and their associated sales price changes were factored into the mining cost. The authors have provided several surface and underground mine models as examples that can be used or modified by the evaluator. These mine models are discussed in appendix A, Mine Model Assumptions Details.

Equally important to the mining costs in the mine models is the coal quality. Since the coal resources are mine modeled on a single-seam basis, then an average percent sulfur, percent ash, Btu, and percent moisture are required in the mine model as well as a sales price on a cost-per-ton basis. The sold coal quality is not calculated in CoalVal. The user can enter the in-place coal quality and the sold coal quality into the CoalVal **Area Tables** and those values will be shown on the Discounted Cash Flow Report, only as a reference. Because CoalVal evaluates only one coal bed at a time, when multiple beds are blended together, the user will have to calculate the appropriate blended coal quality and sales price for the sold product and enter those values into the CoalVal **Area Table** and CoalVal's **Tax Tables**.

The CoalVal program was developed from mine costing models employed by the major coal producers in the United States. Its accuracy is as good as the data used in the mine models. CoalVal's DCF calculation is accurate to ±$0.01 based on testing and validation by Philip Freeman of the USGS. The mine planning used to develop the mine models used in CoalVal was considered to be at a prefeasibility level. Prefeasibility normally refers to an accuracy of ±25% depending on the company and the commodity. The prefeasibility level of accuracy is dependent upon the coal bed models, the thoroughness of mine planning, the accuracy of the coal-quality data, and the cost data that are used in the mine models (Pincock Allen & Holt, 2004). Every effort has been made to justify the costs in CoalVal's Mine Models by comparing the models to producing mines in the coalfield being assessed, by using analogs to coalfields where no production is taking place, and by comparing the CoalVal-calculated productivity (in tons per man-shift) to the productivity reported by mines to the Department of Labor, Mine Safety & Health Administration. The CoalVal Manual contains many figures to guide the user

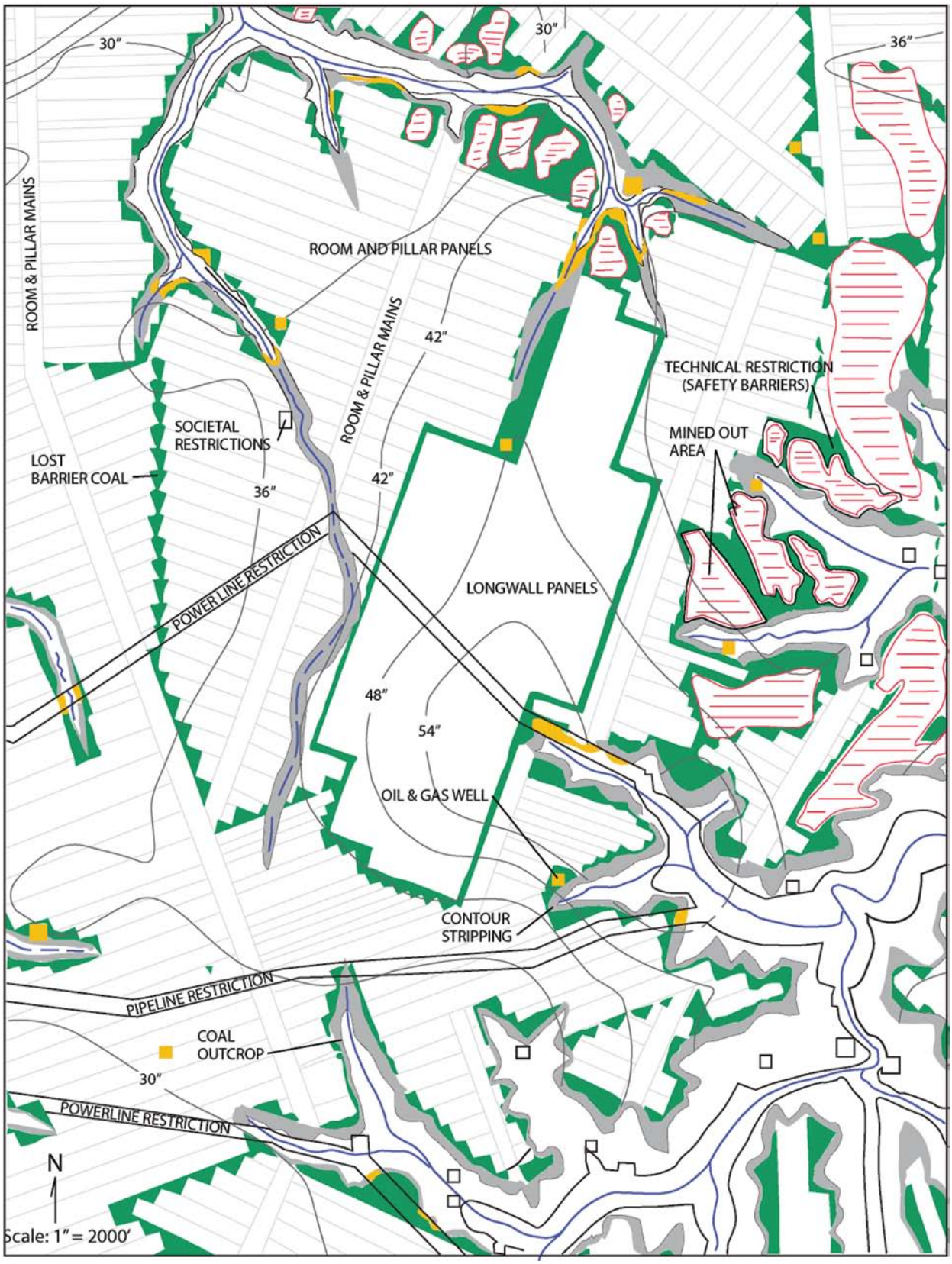


Figure 4. Surface and underground prefeasibility mine model layout for a single bed, Appalachian Basin coal resource.

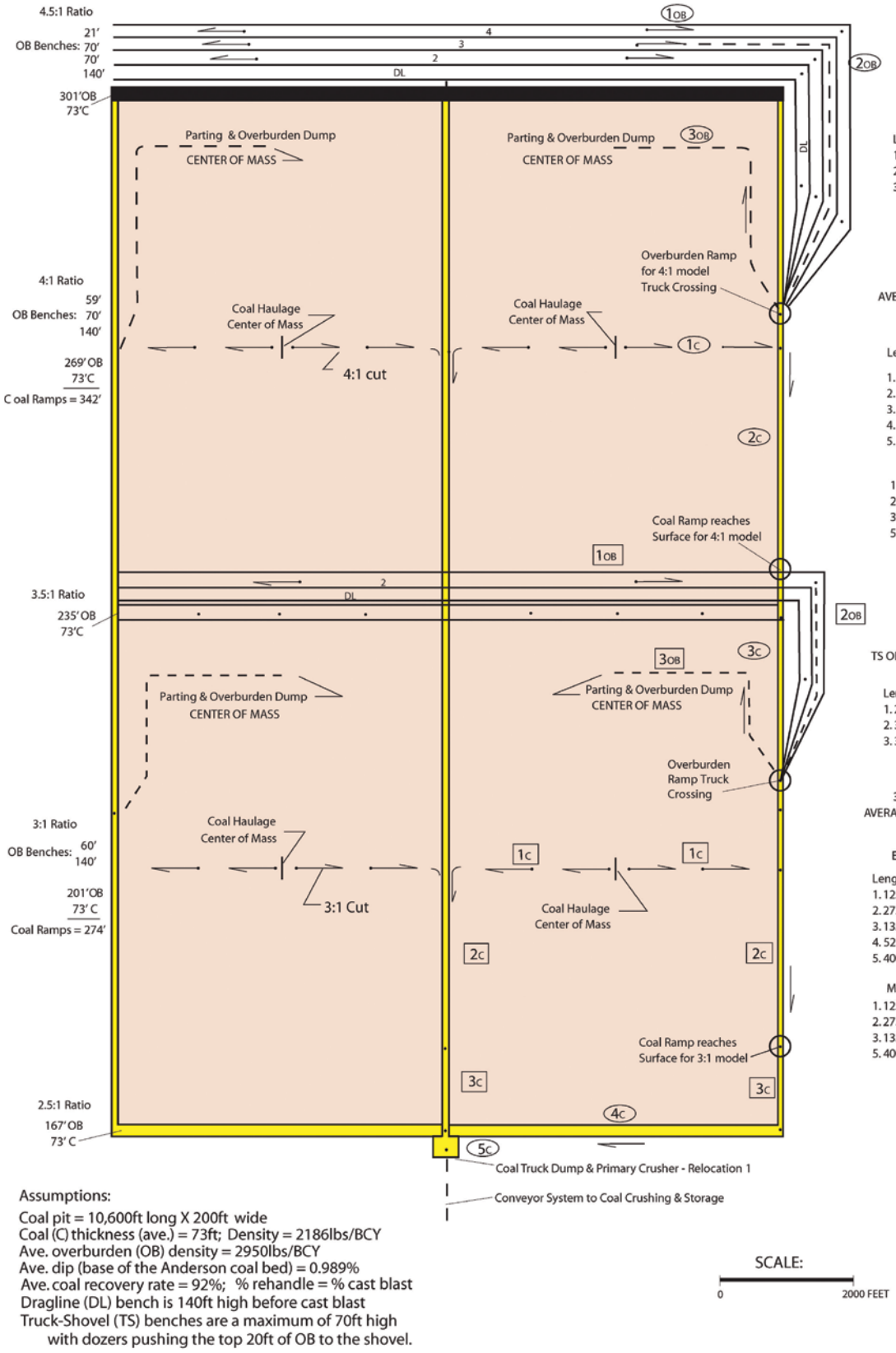


Figure 5. Basic layout for a 3:1 and 4:1 ratio, prefeasibility surface mine model in the Gillette coalfield.

through Tutorial, appendix B, in a step by step fashion, and to add further understanding to the program as described in Program Description, appendix C.

General assumptions for USGS prefeasibility mine planning and mine model development were as follows:

1. Federal and state environmental and safety mining regulations were followed.
2. Restrictions to mining and mined out areas were delineated and excluded from mine planning.
3. All seams of mineable thickness, regardless of coal quality, were planned to be mined. The coal sales realization and mining costs were the economic determination for coal reserves.
4. Surface mining preceded underground mining where possible, and similar mining methods were divided by different bed thicknesses to represent the higher or lower production rates (table 1) found in those operations.
5. Highwall mining followed surface mining, and mine reclamation followed the highwall mining or was contemporaneous with mining.
6. The underground mineable resources that remained were divided into "longwall minable" and "room-and-pillar minable," depending on their thickness and continuity. Resources were further divided into different mining heights with different production rates observed in active operations (table 2).
7. Minimum longwall panel widths, lengths, and coal bed thicknesses were laid out in the resource. If there was not enough resource to accommodate longwall mining, the resources were modeled by using only room-and-pillar methods.
8. Secondary mining (recovering support pillars) was considered for all room-and-pillar mining but support pillars for entryways and belt lines were left intact.
9. Mining was assumed to be from the topmost coal beds downward and pillars and development mains were stacked from one bed to another to maintain as much rock competency as possible (Mark, 2007).
10. Equipment requirements and manpower estimates were modeled by using mining engineering handbooks (Society of Mining Engineers, 1973, 1992a,b; Stefanko, 1983; and Peng, 2006), author experience, field confirmation, and comparing productivity (tons per man-hour) in the Mine Model Reports with productivity reported by the Mine Safety & Health Administration (MSHA). The MSHA reports are available at *www.msha.gov* from the Data Retrieval System and have been updated every Friday since 1983.
11. Mining costs were developed from databases of field evaluations of operating mines, from reference handbooks (U.S. Bureau of Mines, 1975a, b and 1987; Barnes, 1980; Runge, 1998; and Stermole, 2000), databases and coal industry newsletters, such as Platts COALdat (2007a), Platts Coal Outlook (2007b), and Platts Coal Trader (2007c), and other proprietary databases, from the Department of Energy, Energy Information Administration (EIA) publications (1997 and 2007), and from industry reports, such as those of Hill and Associates (2006).

Mine modeling designs and productivity were modified from basin to basin to reflect the local geology, potential mining conditions, and mining practices. Thus, the longwall methods, assumptions, and costs used for the Pittsburgh bed in Northern Appalachia are similar to, but not the same as, the same factors in the Herrin bed in the Illinois Basin or the Hiawatha bed in the Wasatch Plateau of Utah.

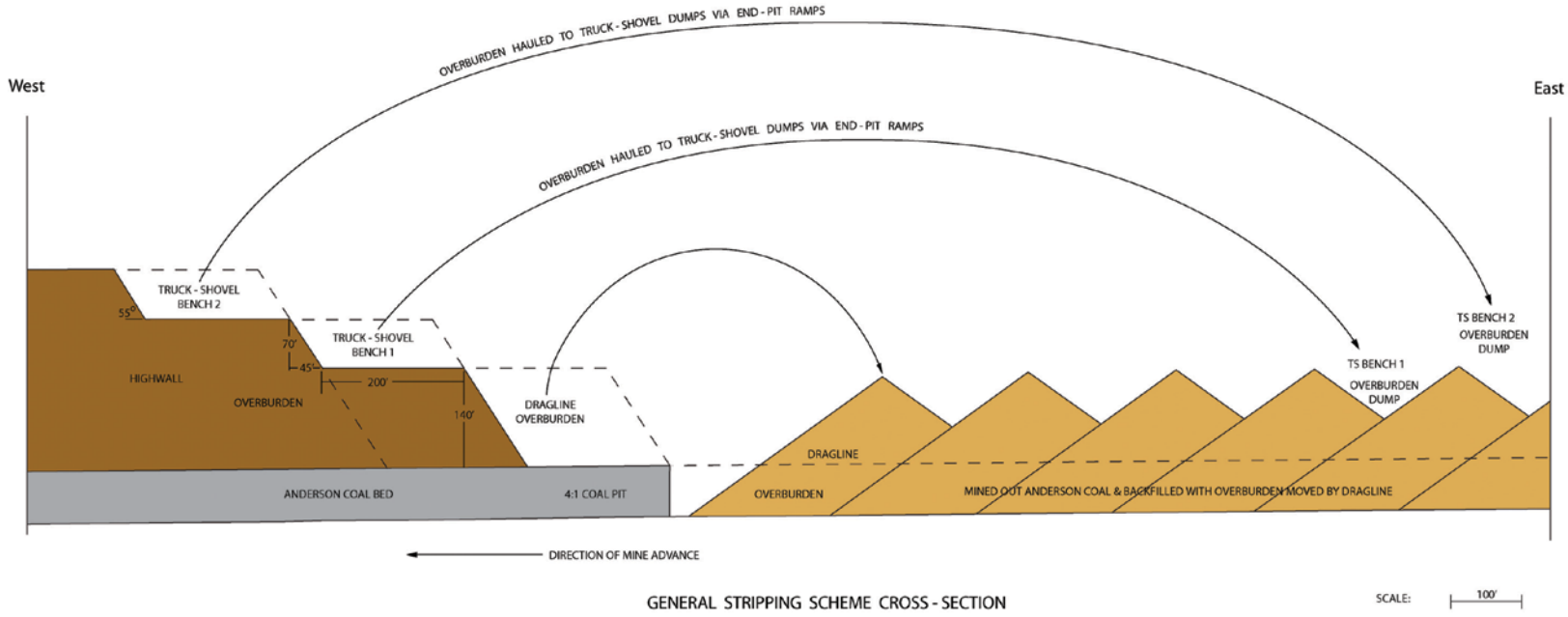
The large surface prefeasibility mine plans (figs. 5 and 6) of the Powder River Basin were developed for "super" mines with annual production of 35 million tons per year operations. These models were designed on an effective ratio basis (total bank cubic yards (BCY)) moved per year divided by the tons of raw coal recovered per year (Luppens and others, 2008). The basic layout for the 4:1 ratio model is shown in figure 5 as is a west-to-east cross section (fig. 6) showing average dip of the coal beds and surface topography in the mine areas of the south part of the Gillette coalfield.

Mine models were developed by using USBM equipment, manpower, productivity, and other cost criteria developed from interviews with operators and evaluations of more than 200 coal mines in the United States and major coal producing-nations of the world during the 1980s and 1990s. These criteria were updated through further interviews in the 1999 to 2007 time period and supplemented by material from standard mining-engineering and mineral-economics references books; papers and oral presentations for meetings of the Society of Mining Engineers (1973); Society of Mining, Metallurgy, and Exploration books (1992a, b); Keystone Coal Industry Manual, 2003; Platts COALdat (2007a) and Coal Outlook (2007b) databases (and by newsletters, proprietary databases, personal experience of the authors, and a myriad of other references). Methods and assumptions were originally reviewed and confirmed by peer reviews within the USBM and USGS (Rohrbacher and others, 2005) and the coal mining industry.

Surface Mine Models - General Assumptions

Twenty-one mine models were developed for five surface mining methods (table 1).

Contour stripping – mining in steep-sloped, hilly areas:



Generalized stripping scheme for a 4:1 mine model in the Gillette coalfield.
Average dip of the Anderson coal bed in the southern area is 1 percent to the west. Average Anderson bed coal thickness = 73ft.
Average coal recovery rate = 92 percent and average overburden swell = 15 percent.
General direction of mining is assumed to be from east to west (down-dip).
Overburden from the Truck-Shovel operations on benches 2 and 3 is hauled around the pit to the overburden dumps on the low side (east side) of the pit via end-wall ramps and dumped between the dragline spoil peaks.

Figure 6. West to east, Gillette overburden removal cross-section of the 4:1 ratio mining area, showing truck-shovel and dragline highwall benches, low wall dumps, schematic truck haulage routes, and the Anderson coal bed.

Thin-seam mining – 12 in. to 36 in. coal and parting bed (seam) thickness
Moderate-seam mining – > 36 in. coal and parting bed (seam) thickness

Area mining–mountaintop or moderate ground slope areas:

Thin to thick seams – >12 in. coal and parting bed (seam) thickness

Auger or Highwall mining–nonsupported entry into abandoned highwalls

Thin-seam mining – 12 in. to 36 in. coal and parting bed (seam) thickness
Moderate seam mining – >36 in. coal and parting bed (seam) thickness

Truck-Shovel mining – large scale mining < 5 MM tons/year production

1 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
2 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
3 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
4 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
5 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
6 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness

Dragline and Truck-Shovel mining – large scale mining < 35 million tons/year production

1 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
2 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
3 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
4 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
5 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
6 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
7 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
8 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
9 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness
10 to 1 mining ratio – >60 in. coal and parting bed (seam) thickness

Seven surface mine models are described in Mine Models Assumption Details, appendix A. Two of these mining models, 3:1 ratio Dragline and Truck-Shovel and 6:1 ratio Dragline and Truck-Shovel, can be found in the MineModels (database) file that is included with the CoalVal program files, *see* the Tutorial, appendix C.

Underground Mining Models - General Assumptions

Seven mine models were developed for two underground mining methods. They are:

Room and Pillar – development and production panel mining:

Thin-seam mining – 24 in. to 42 in. mining height
Moderately thin-seam mining – 42 in. to 72 in. mining height
Moderate-seam mining – 72 in. to 96 in. mining height
Thick-seam mining – >96 in. mining height, and

Longwall mining- mine and longwall panel development using continuous miners and longwall operations for the major production output:

Moderately thin-seam mining – 42 in. to 72 in. mining height
Moderate-seam mining – 72 in. to 96 in. mining height
Thick-seam mining – >96 in. mining height

Two underground mining methods with seven associated mining models are described here. A mining model example for the Longwall mining method can be found in the MineModels (database) file that was included with the CoalVal program files, *see* the Tutorial, appendix B.

CoalVal Concepts

To better understand CoalVal's concepts, instructions or commands are shown in italicized type. Major topics in the CoalVal flow diagram, such as MINE MODEL (fig. 7) are shown in capital letters and CoalVal program menu items, such as **Databases** (fig. 8) are shown capitalized in bold type to the program "tab" level. In many cases the CoalVal program menu items and the CoalVal program flow diagram terms are the same. When this case exists the type will characterize the term being discussed. If the flow diagram term and menu item cannot be separated, such as in referencing MINE MODEL in the program flow diagram (fig. 7) and as a program menu item, **Mine Model,** the term will be shown in all capital letters and in bold, for example, **MINE MODEL**. If the term does not refer to either the flow diagram or a program menu item, it will not be in capital letters or bolded. Many notes, items, buttons, and headings in the CoalVal program are addressed below the hierarchy level of "tab." These headings are found in quotations, such as "Mine Model ID," "Open," and "Minable Resource Recovery."

The CoalVal program outline diagram (fig. 7) contains four heading boxes below the CoalVal title box (in gray) that represent four of the items on CoalVal's **Main Menu Bar** (fig. 8). These four items are **PROJECTS** (in cyan), **MINE MODEL** (in yellow), **REPORTS** (in red) and **SETUP** (in green). Mining Data input is shown in the tan colored boxes. The relations of coal seams and areas were previously discussed; discussions of the other items follow.

Databases

CoalVal is a program that allows the user to enter data into its databases by typing or by importing data into its database files. The program is used for USGS coal resource studies, and therefore the information stored is concerned with mine models and associated coal resource assessment projects. In CoalVal, unlike many other programs that use database files, more than one database can be created and used. This feature allows the user the option of dividing large study areas into small areas and creating a database for each such area rather than having one large database, which can become unwieldy.

Projects

PROJECTS are created in CoalVal for the purpose of estimating the operating cost per ton of coal to the mine's wash plant and coal-loading facility. A **PROJECT** can have several coal seams, with each seam having several mineable areas. **Projects**, **Seams**, and mineable **Areas** are discussed in appendix B (a tutorial for running the CoalVal Program), and in the **PROJECTS** section under Program Description in appendix C. The terms are also defined in the Glossary (appendix E). The number of seams and areas a **Project** can have is limited by the size of the computer's hard drive, not the program. Any personal computer with 100 megabytes of hard-drive space can handle thousands of projects. However, the personal computer must have a Windows® 98 or newer operating system with a least 1 gigabyte of random access memory (RAM) to run CoalVal.

It is important to understand the terminology used in CoalVal. The following discussion will describe and define the more important terms. A CoalVal **PROJECT** is a geographic location, coal basin, coalfield, or property where a coal resource mining evaluation is desired (fig. 9). The **PROJECT** location can contain more than one coal seam or need more than one **MINE MODEL,** MINING METHOD, **TAX TABLE**, or **HAULAGE COST TABLE** to evaluate the mineable resources. A **PROJECT** can have an unlimited number of coal seams, but it must have at least one coal seam. An **Area** is a geographic location (fig. 9) with one **MINE MODEL** using one MINING METHOD, and having one **TAX TABLE** and one **HAUL COST TABLE** Each coal seam can have many areas, but it must have at least one **Area**. An **Area** is a subset of a **Seam**, and a **Seam** is a subset of a **Project**. An **Area** is used to summarize the calculation of recoverable coal resources and the operational and discounted cash flow costs. For **Projects,** the following relations should be understood:

- A **Project** may have many **Seams** but must have at least one **Seam**; and
- A **Seam** may have many **Areas** but must have at least one **Area**

Before a **Project** can be created, the haul cost and tax rates must be entered into the CoalVal **Haul Cost Table** and **Tax Table** lookup tables. The haul costs are the costs incurred in moving the coal from the mine to the coal preparation facility or the train loadout. Where the mine is adjacent to the coal preparation facility (crushing facility or wash plant) and the train loadout, the haulage costs are included in the mining costs. The tax rates must be defined for each individual political entity: county, state, Federal and other entities within a location. In addition to tax and haulage information, a mine model must be available to create a **Project**.

Mine Models

As with **PROJECTS**, there is no limit to the number of **MINE MODELS** developed and employed in CoalVal. Figure 7 indicates that a **MINE MODEL** has a MINING METHOD. Eight general mining methods have been utilized in CoalVal: contour strip, mountain top removal (area mining), auger, truck-shovel, dragline, dragline/truck-shovel, room and pillar (with continuous miner), and longwall. A **MINE MODEL** generally contains one MINING METHOD and is an extraction plan for a given portion of a coal deposit. There are two exceptions to this comment. The first exception is the longwall mining method and the second is the dragline–truck and shovel mining method. There are two mining methods used in the longwall mine model, longwall for primary production and room and pillar using continuous miners for development. Likewise, the dragline/truck-shovel mining method utilizes truck-shovel mining methods for prestripping followed by the dragline mining method stripping operation to remove the final overburden above the coal seam. For each **Mining Method** there can be only one set of **Mine Model Assumptions**, but there can be as many **Equipment Groups**, **Salaried Employee Groups**, and **Hourly Employee Groups** as needed. Grouping the **Equipment** into several different categories, such as production and auxiliary equipment and surface infrastructure allows it to be segregated by use for taxation and costing. **Employees** can be segregated into different groupings also to allow the break-out of costs by mining function. For each group created, there can be as many pieces of equipment or employees as needed.

These relationships of **Equipment** and **Employees** to **Mining Models** are similar to the relationships of coal **Seams** and **Areas** to **Projects**. The following relationships of **Equipment** and **Employees** to **Mine Models** are used by CoalVal:

1. A **Mine Model** may have many **Salaried Employee Groups** but must have at least one.
2. A **Mine Model** may have many **Hourly Employee Groups** but must have at least one.
3. A **Mine Model** may have many **Equipment Groups** but must have at least one.

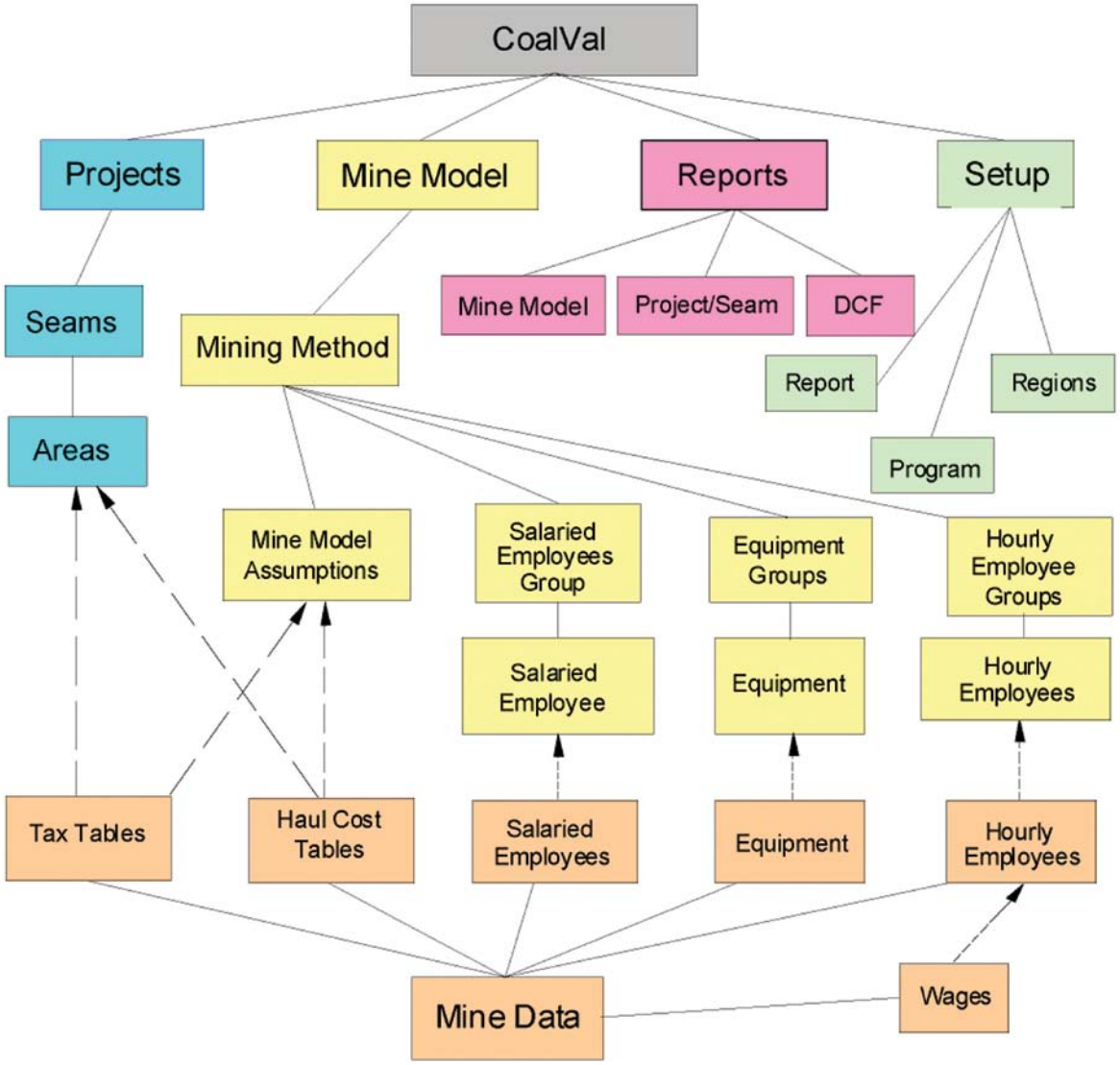


Figure 7. CoalVal's program organization diagram.

Figure 8. CoalVal's Main Menu window.

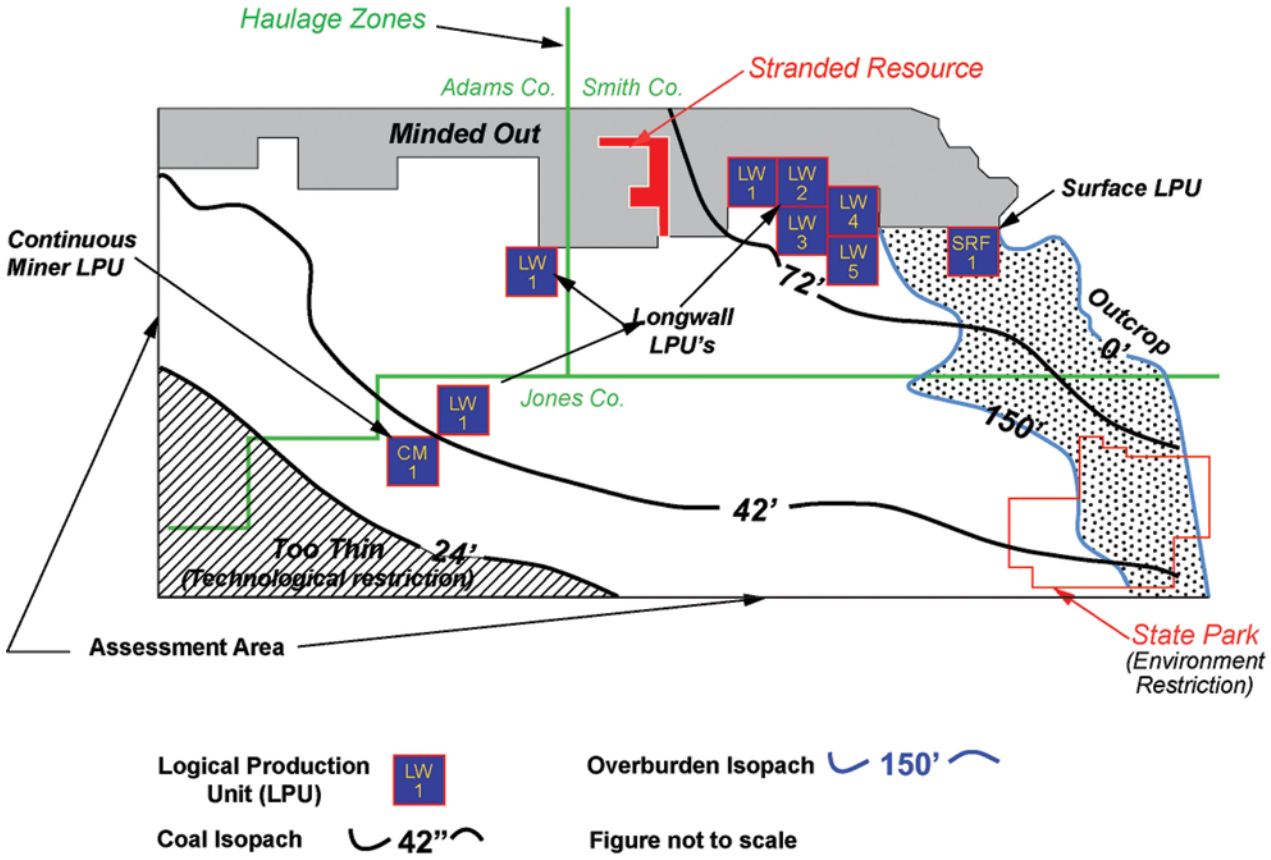


Figure 9. Regional mining modeling concepts, modified from Luppens (2008).

4. A **Mine Model** has a **Mine Model Assumptions** page.

5. A **Salaried Employee Group** may have many **Salaried Employees** but must have at least one salaried employee.

6. An **Hourly Employee Group** may have many **Hourly Employees** but must have at least one hourly employee.

7. An **Equipment Group** can have many pieces of **Equipment** but must have at least one equipment item.

Look-Up Tables

CoalVal's look-up tables (orange boxes, fig. 7) relate to the **Mine Models** and indirectly to the **Projects**. When a piece of equipment or employee is added to **Equipment** or **Employee Groups**, that piece of equipment or employee must be selected from the equipment, salaried or hourly employee look-up table. An example of **Equipment** look-up table is shown in figure 10.

Mine Models and **Projects** both use the **Tax** and **Haul Cost** look-up tables. The concept behind a look-up table is that an item can be entered once and used by many **Mine Models** (as in the case of tax and haul cost tables). This feature also means that when a **Tax Table** is changed, every **Mine Model** or **Project** that uses that specific tax table will be updated by using the modified tax table, which allows for fast updates of equipment cost, salaries, wages, taxes, and haul cost. However, changing a look-up table means that all projects and mine models that use the information will now use the changed information. If this result is not wanted, then new tax, haul cost, hourly employee, salaried employee, or equipment tables will be required.

The look-up tables (fig. 10) are accessed through the **Mine Data** dialog window. There are buttons on the **Area** page of the **Projects** dialog and on the **Mine Model Assumptions** page of the **Mine Model** dialog window for accessing **Tax Tables** and **Haul Cost Tables**. It is important to note that the **Hourly Employees** look-up table uses the **Wages** look-up table for hourly wage rates. Therefore, the **Wages** look-up table should be developed before adding employees to the **Hourly Employees** look-up table. All of the look-up tables should be planned and created before developing a mine

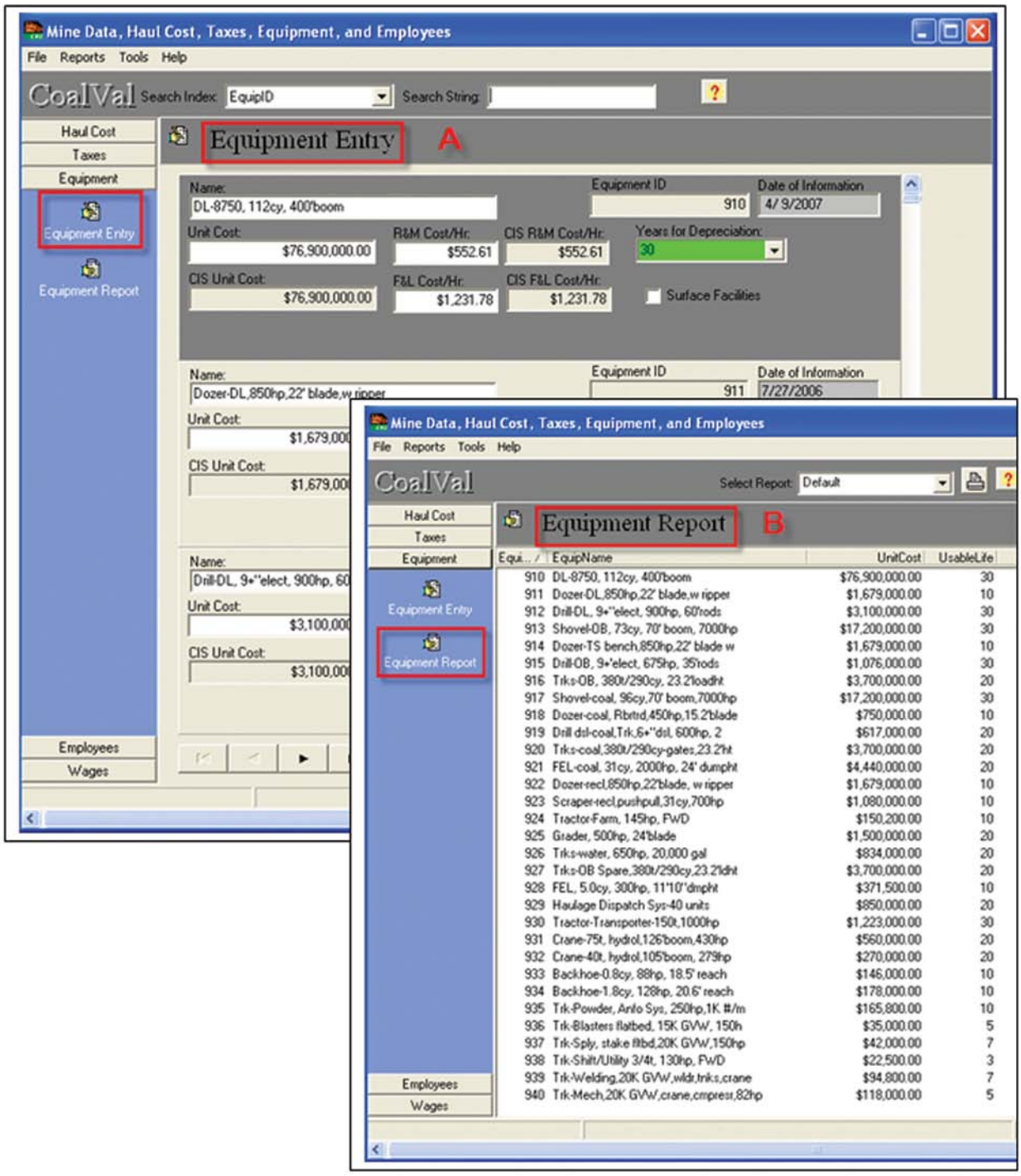


Figure 10. CoalVal Mine Data dialogs showing (A), Equipment Entry and (B), Equipment Report look-up table contents.

model. Additional information may be added to the look-up tables as the information is needed.

Reports

CoalVal has three types of information reports (figs. 7 and 8), one for **Mine Models**, one for **Projects**, and one for discounted cash flow (DCF) calculations. The **Mine Model** report will calculate and print out yearly cash cost for any CoalVal mine model. This report does not use **Project** resource data. The **Project** report incorporates user-input coal resource data and prints out a cost per ton for operating costs (no DCF-ROR calculations) in user-specified increments. The **DCF Report** module calculates and prints out the DCF costs for each coal seam by mining area and as a summary by incremental cost.

Setup

The **Setup** (fig. 8) dialog window allows the user to change the default settings for the output reports and forces the **Main Menu Bar** to be on top of all other CoalVal windows.

Mine Model and Discounted Cash Flow Formula

Appendix D contains the formula used to make the Mine Model calculations, such as formula used to calculate coalmine and preparation-plant recoverability and annual production, or formula used to calculate direct and indirect mining costs, or formula used to calculate royalty, tax, and fee costs, and formula used to calculate total mining costs.

Summary

CoalVal was originally developed by the USBM for its Coal Recoverability Project and later enhanced by the USGS to assess coal resources in the United States. It is a menu-driven, Windows® program that can be used to calculate the recoverable coal and estimate the cost to mine and process that coal and thus produce an estimate of coal reserves from a coal resource. Geological modeling of the coal seams, prefeasibility mine planning (or other more advanced mine planning), and Mine Models are assumed to have been completed by the evaluator prior to using CoalVal. The initial mine cost models were designed for the commonly employed surface mining methods and underground mining methods utilized in the United States. These Mine Models were developed from equipment, labor, productivity, and other cost criteria data obtained by the USBM from more than 120 United States coal mines during the 1980s and 1990s and updated through 2007 by company interviews and cost indexes. The program design will allow modifications to its databases by the evaluator to determine the effect of increases in labor, equipment, or consumables on the break-even mining cost of a coal reserve, and to evaluate an unlimited number of coal beds, haulage zones, tax entities, or other delineations for a given property, coalfield, or basin.

CoalVal mine models were first developed for surface and underground mining scenarios to evaluate one coal seam at a time. Owing to the complexity of multiple-seam mine planning, a composite package of coal seams using ratios of total waste to total in-place coal were used for Gillette coalfield-type surface mining evaluations (Luppens, 2008). When a composite package of coal seams was evaluated, it was assumed that a dragline operation (and cast-blasting) would remove the upper 200 ft of overburden and that the remainder of the overburden and interburden would be removed by truck-shovel operations. All of the seams in the composite package were evaluated with the same ratio and same mine model, regardless of whether or not an individual seam had a higher or lower rate than the ratio for the composite seam package.

CoalVal is not a geologic bed modeling program, nor is it a mine modeling or mine planning program. At the USGS, coal beds are correlated by using StratiFact and modeled by using SURFER and PC Cores to produce grids and maps of geologic models. The resulting files are converted into ASCII grid files and then imported into the GIS programs ArcGIS and ArcView to differentiate coal resources into resources restricted from mining from those resources that are available for mining. These programs then calculate total resource tonnages by ownership, political area, and different mining methods. The resulting tonnages are then placed into Excel spreadsheets and then converted to spreadsheets that use DBF or CSV file formats.

Prefeasibility mine plans for surface and underground mining were originally designed by engineers and scientists at the USBM. These plans utilized mining methods similar to those being employed in the Central and Northern Appalachian coalfields. For surface mining, contour stripping, mountain-top removal (area mining), and highwall mining methods were used; for underground mining, room and pillar and longwall mining methods were used. Later, as the evaluation of coal resources moved west into the Illinois Basin, the Powder River Basin (PRB), and the coal basins of Colorado, Utah, and New Mexico, the mine plans and models were modified to reflect the mining in those areas. New plans were developed to mirror the large dragline and truck and shovel benching operations and normal truck and shovel mines of the PRB and the underground and surface mines in Colorado, Utah, and New Mexico.

The user must input coal resource data by mining method into CoalVal tables, either manually or by importing spreadsheet data similar to the data shown in figure 3. Program default values can be used for production, operating, and cost variables, or the evaluator can substitute proprietary operating and cost variables into the program. Building new mine models will depend on the availability of pertinent information, such as coal resource and quality data, mine productivity rates, equipment costs, and the detail needed for this level of

evaluation. In-place and sold coal quality must be entered into the CoalVal tables and are reported in the DCF Reports. The sold coal quality is used to estimate the sales price of the coal, which in turn determines several tax costs in the tax tables. Models may take from 1 to 5 days to create if all the mine planning has been completed.

CoalVal's Summary reports list the resource tons available for mining, recoverable tons (by mining method, coal seam, or property), operating cost per ton, and DCF cost per ton to mine and process the recoverable resources (free on board (FOB) at the tipple), at a rate of return (ROR) prescribed by the evaluator. The user can export the coal resource and quality data, including recoverable coal quantities and estimated sold coal quality, along with threshold prices and mine model information.

The recoverable resources (in short tons) may be grouped by incremental cost of production per ton over any range chosen by the user. In the Gillette coalfield evaluation (Luppens, 2008), the DCF mining cost (at an 8 percent ROR) and its associated tonnages were grouped by several increments (for example, $0.10 per ton and $2.00 per ton) and used any dollar per ton range desired (for example, from $4.00 per ton to $20.00 or more per ton). This grouping ability allowed separation of the coal reserves from the nonreserve resources and the construction of cost curves to determine the effects of coal market fluctuations on the availability of coal for fuel, whether for generation of electricity, use of heat in heavy industry, or for the conversion of coal to liquids (CTL).

This report contains a Tutorial (appendix B) designed to teach a new user how to construct and develop CoalVal **Projects** and how to use and modify CoalVal **Mine Models**. One underground mine model associated with Northern Appalachian Basin resource evaluations and its databases and two Gillette coalfield surface mine models and their databases are attached to the CoalVal program. The user will learn how to manually enter coal resource and quality data or how to import it into CoalVal by means of DBF or CSV tables. The CoalVal Tutorial can be perused in about 16 to 24 hours.

Acknowledgments

The authors would like to acknowledge the former USBM and USGS management for their support in the development of this coal resource evaluation tool. In particular, the support and direction of Galen Knutsen, George Schottler, and Mike Kaas of the USBM and M. Devereux Carter, Harold Gluskoter, and James Luppens of the USGS were invaluable. Philip Freeman of the USGS provided programming equations and review for the DCF-ROR economic analysis and provided early programming reviews of CoalVal. Program and manuscript reviewers and editors Michael Brownfield, Harold Gluskoter, Richard Keefer, and David Scott gave insight and direction into making the program description and tutorial more user-friendly.

More than 120 coal mines throughout the United States volunteered mining information concerning production rates, labor, equipment sizing, and cost data to help build the mine models found in CoalVal and used in USGS coal resource assessments. Without the help and guidance of mine management, engineers, and geologists the mine models built for this program could not have been field tested.

References Cited

ASTM International, 2008, ASTM Standard, Volume 05.06 Gaseous fuels, coal and coke: ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pa. 19428.

Barnes, M.P., 1980, Computer assisted mineral appraisal and feasibility: Society of Mining Engineers of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., 167 p.

Carter, M.D., and Gardner, N.K., 1989, An assessment of coal resources available for development: U.S. Geological Survey Open-File Report 89–362; 52 p.

Caterpillar, Inc., 2006, Caterpillar performance handbook (36th ed.): A CAT publication, Caterpillar Inc., Peoria, Ill., 768 p.

Coal Age, 2000, Consol's Bailey preparation plant: Mining Media, 10 Sedgwick Drive, Englewood, Colo. 80110, v. 105, no. 4.

ComponentSource Corporation, 2006, Help and manual software version 5.0.3: EC Software, ComponentSource, 650 Claremore, Professional Suite 100, Woodstock, Ga. 30188.

Eggleston, J.R., Carter, M.D., and Cobb, J.C., 1990, Coal resources available for development—A methodology and pilot study: U.S. Geological Survey Circular 1055, 15 p.

Embarcadero Technologies, 2007, Delphi programming language: Embarcadero Technologies, 100 California Street, 12th Floor, San Francisco, Calif. 94111.

Energy Information Agency, 1997, U.S. Coal Reserves—1997 Update: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels and Office of Integrated Analysis and Forecasting, U.S. Department of Energy, DOE/EIA–0529(97), 60 p., available at *http://tonto.eia.doe.gov/FTPROOT/coal/052997.pdf*; accessed January 1, 2008.

Energy Information Agency, 2007, 2006 Annual Coal Report: available at *http://www.eia.doe.gov/cheaf/coel/page/acr/acr_sum.html*; accessed January 1, 2008.

ESRI, Environmental Systems Research International, 2000a, ArcView software version 3.2a: Environmental Systems Research International, Inc., 380 New York Street, Redlands, Calif. 92373.

ESRI, Environmental Systems Research International, 2000b, ArcView Spatial Analyst Extension software version 2.0, Environmental Systems Research International, Incorporated, 380 New York Street, Redlands, Calif. 92373.

ESRI, Environmental Systems Research International, 2006, ArcGIS software version 9.2, Environmental Systems Research International, Incorporated, 380 New York Street, Redlands, Calif. 92373.

Gemcom, 2009, Minex programs—Geology and mine planning for stratified deposits software: Gemcom International Inc., Suite 1100, 1066 West Hastings Street, Vancouver, British Columbia, Canada V6E 3X1.

Golden Software, Inc., 2002, Surfer8 software: Golden Software, Inc., 809 14th Street, Golden, Colo. 80401–1866.

GRG Corp., 1998, StratiFact software version 4.57: GRG Corporation, 4175 Harlan Street, Wheat Ridge, Colo., 80033–5150.

Hill and Associates, Inc., 2006, Powder River Basin, coal supply, demand, and prices, 2006–2015: Hill and Associates, Inc., 222 Severn Avenue, Annapolis, Md. 21403, 139 p. and appendixes.

Keystone Coal Industry Manual, 2003, Coal Age: Mining Media, Inc, Regency Tower, Suite 708, 9550 Regency Square Blvd., Jacksonville, Fla. 32225, 832p.

Lotus Development Corporation, 1988, Lotus 1-2-3, version 2.0 Program: owned by International Business Machines Corporation, New Orchard Road, Armonk, New York 10504.

Luppens, J.A., 2008, USGS Gillette coalfield assessment methodology [abs.]: Society of Mining Engineers Annual Meeting, February 2008, Salt Lake City, Utah.

Luppens, J.A., Scott, D.S., Haacke, J.E., Osmonson, L.M., Rohrbacher, T.J., and Ellis, M.S., 2008, Assessment of coal geology, resources, and reserves in the Gillette coalfield, Powder River Basin, Wyoming: U.S. Geological Survey Open-File Report 2008–1202; 52 p.

MAPTEK, 2009, Vulcan geology and mine planning solutions: MAPTEK/KRJA Systems Ltd., 165 S. Union Blvd., Suite 888, Lakewood, Colorado 80228.

Mark, Christopher, and Tuchman, R.J., eds., 2007, Proceedings—New technology for ground control in multiple-seam mining: National Institute for Occupational Safety and Health Information Circular 9495, 88 p.

McIntosh, Gary E., 2003, CoalVal 2001—A computer program to establish economically recoverable resources [abs.]: Society of Mining Engineers Annual Meeting, February 2003, Cincinnati, Ohio.

McIntosh, Gary E., Rohrbacher, T.J., Osmonson, L.M., and Freeman, P.A., 2005, COALVAL—A coal resource valuation program [abs.]: Society of Mining Engineers Annual Meeting, February 2005, Salt Lake City, Utah.

Mentor Consultants, 2005, PC/Cores: Post Office Box 3147, Glen Ellyn, Illinois, 60137.

Microsoft Corporation, 1995, Microsoft Excel: Microsoft Corporation, One Microsoft Way, Redmond, Wash. 98052–6399.

Mincom Corporation, 2009, MineScape mining software: Mincom Corporation, 6455 S. Yosemite Street, Suite 800, Greenwood Village, Colo. 80111.

Mine Safety & Health Administration (MSHA), 2007, Data retrieval system, mine information search: *http:/www.msha.gov/drs/drshome.htm*; accessed January 1, 2008.

Molnia, C.L., Osmonson, L.M., Wilde, E.M., Biewick, L.R.H., Rohrbacher, T.J., and Carter, M. D., 1999, Coal availability and recoverability studies in the Powder River Basin, Wyoming and Montana, *in* Fort Union Coal Assessment Team, 1999 resource assessment of selected Tertiary coal beds and zones in the Northern Rocky Mountains and Great Plains region: U.S. Geological Survey Professional Paper 1625–A, 119 p.

Osmonson, L.M., Rohrbacher, T.J., Molnia, C.L., and Sullivan, G.L., 2000, Coal recoverability in the Hilight quadrangle, Powder River Basin, Wyoming—A prototype study in a western coalfield: U.S. Geological Survey Open-File Report 00–103, 23 p.

Peng, S.S., 2006, Longwall mining: Department of Mining Engineering, West Virginia University, Morgantown, W. Va., 621 p.

Pincock Allen & Holt, 2004, Pincock perspectives—Feasibility study does not mean feasible: Pincock Allen & Holt, a division of Hart Crowser, Inc., 274 Union Blvd., Suite 200, Lakewood, Colo. 80228, 4 p.

Platts, 2007a, COALdat (a database program): Platts, a division of McGraw-Hill Companies, Inc., 3333 Walnut Street, Boulder, Colo. 80301, CD ROM.

Platts, 2007b, Coal Outlook: Platts, a division of The McGraw-Hill Companies, Two Penn Plaza, 25th Floor, New York, N.Y. 10121–2298.

Platts, 2007c, Coal Trader: Platts, a division of The McGraw-Hill Companies, Two Penn Plaza, 25th Floor, New York, N.Y. 10121–2298.

Plis, M.N., Rohrbacher, T.J., and Teeters, D.D., 1993, COALVAL—A prefeasibility software package for evaluating coal properties using Lotus 1-2-3, release 2.2: U.S. Bureau of Mines Information Circular 9348, 93 p.

Rohrbacher, T.J., Carter, M.D., Sullivan, G.L., Molnia, C.L., and Biewick, L.R.H., 1998, New methods for coal availability, reserve evaluation and socio-economic impact analysis—Quantum leaps in project productivity [abs.]: Society of Mining, Metallurgy and Exploration Annual Meeting, Orlando, Florida, March 9–10, 1998.

Rohrbacher, T.J., Luppens, J.A., Osmonson, L.M., Scott, D.C., and Freeman, P.A., 2005, An external peer review of the U.S. Geological Survey Energy Resource Program's economically recoverable coal resource assessment methodology—Report and comments: U.S. Geological Survey Open-File Report 2005–1076, 21 p.

Rohrbacher, T.J., Molnia, C.L., Osmonson, L.M., Carter, M.D., Eakins, W., Hoffman, G.K., Tabet, D.E., Schultz, J.E., Scott, D.C., Teeters, D.D., Jones, G.E., Quick, J.C., Hock, B., and Hanson, J.A., 2000, Coal availability, recoverability, and economic evaluations of coal resources in the Colorado Plateau—Colorado, New Mexico, and Utah: U.S. Geological Survey Professional Paper 1625–B, Ch. F, 64 p.

Rohrbacher, T.J., Teeters, D.D., Sullivan, G.L., and Osmonson, L.M., 1993a, Coal reserves of the Matewan quadrangle, Kentucky—A coal recoverability study: U.S. Bureau of Mines Information Circular 9355, 36 p.

Rohrbacher, T.J., Teeters, D.D., Sullivan, G.L., and Osmonson, L.M., 1993b, Coal resource recoverability—A methodology: U.S. Bureau of Mines Information Circular 9368, 48 p.

Runge, I.C., 1998, Mining economics and strategy: Society for Mining, Metallurgy, and Exploration, 295 p.

Society of Mining Engineers, 1973, Elements of practical coal mining, Cassidy, S.M., ed.: The American Institute of Mining, Metallurgical, and Petroleum Engineers, 614 p.

Society of Mining Engineers, 1979, Coal preparation (4th ed.), J.W. Leonard, ed.: The American Institute of Mining, Metallurgical, and Petroleum Engineers, 1189 p.

Society of Mining, Metallurgy, and Exploration, 1992a, SME Mining engineering handbook (2d ed.), Hartman, H.L., senior ed.: Society for Mining, Metallurgy, and Exploration, v. 1, 1301 p.

Society for Mining, Metallurgy and Exploration, 1992b, SME Mining engineering handbook (2d ed.), Hartman, H.L., senior ed.: Society for Mining, Metallurgy, and Exploration, v. 2, 1070 p.

Stefanko, Robert, 1983, Coal mining technology, theory and practice: Society of Mining Engineers of the American Institute of Mining, Metallurgy, and Petroleum Engineers, 410 p.

Stermole, F.J., and Stermole, J.M., 2000, Economic evaluation and investment decision methods [10th ed.]: Investment Evaluation Corporation, 3070 South Newcombe Way, Lakewood, Colo. 80227, 398 p.

Stricker, G.D., Flores, R.M., McGarry, D.E., Stillwell, D.P., Hoppe, D.J., Stillwell, C.R., Ochs, A.M., Ellis, M.S., Osvald, K.S., Taylor, S.L., Thorvaldson, M.C., Trippi, M.H., Grose, S.D., Crocket, F.J., and Shariff, A.J., 2006, Gas desorption and adsorption isotherm studies of coals in the Powder River Basin and adjoining basins in Wyoming and North Dakota: U.S. Geological Survey Open-File Report 2006–1174, 250 p.

Stricker, G.D., Flores, R.M., Trippi, M.H., Ellis, M.S., Olson, C.M., Sullivan, J.E., and Takahashi, K.I., 2007, Coal quality and major, minor, and trace elements in the Powder River, Green River, and Williston Basins, Wyoming and North Dakota: U.S. Geological Survey Open-File Report 2007–1116, 31 p.

Suffredini, C.D., Plis, M.N., Rohrbacher, T.J., and Teeters, D.D., 1994, CoalVal 2.0, a prefeasibility software package for evaluating coal properties: U.S. Bureau of Mines Open-File Report 35–94, 198 p.

TECHBASE International, Ltd, 2009, Techbase mining software, TECHBASE International, Ltd, P.O. Box 1140 Morrison, Colo. 80465

United Mine Workers of America (UMWA), 2007, Working Agreement with the Bituminous Coal Operators Association, International Headquarters: 8315 Lee Highway, Fairfax, Va. 20031, 137 p.

U.S. Bureau of Mines, 1975a, The reserve base of coal for underground mining in the Western United States: U.S. Bureau of Mines Information Circular IC 8678, 238 p.

U.S. Bureau of Mines, 1975b, The reserve base of U.S. coals by sulfur content, part 2. The Western States: U.S. Bureau of Mines Information Circular IC 8693, 322 p.

U.S. Bureau of Mines, 1987, Bureau of Mines cost estimating system handbook, part 1. Surface and underground mining: U.S. Bureau of Mines Information Circular IC 9142, 631 p.

U.S. Department of Labor Bureau of Labor Statistics, 2008, Producer price index (PPI): *www.bls.gov/PPI*.

Wood, G.H., Jr., Kehn, T.M., Carter, M.D., and Culbertson, W.C., 1983, Coal resource classification system of the U.S. Geological Survey: U.S. Geological Survey Circular 891, 65 p.

Zipf, R.K., 2005, Ground control design for highwall mining: Society for Mining, Metallurgy and Exploration Annual Meeting, preprint 05–82, 2005, 9 p.

Appendix A

Contents

Figure

Mine Model Assumptions Details

Surface Mining Assumptions

Appalachian and Illinois Basin Surface Mine Models

Surface mine models were first constructed for the Central Appalachian Coal Region. These models assumed annual production rates from 87,000 to 1,560,000 tons of coal per year (table 1) and consisted of area mining or mountain top mining, contour strip, and auger mining. All tonnages are discussed and reported in short tons. The area mining models were used to model surface mining in the Illinois Basin. Larger truck and shovel and dragline mines, although present, are rare in the eastern United States and difficult to permit and, therefore, were not modeled at this time.

Area Mining or Mountain Top Mining

One single model was designed for area mining. A minimum seam thickness of 12 in. was used for mineability, although some mines in the Central Appalachian Basin and the Western Interior Basin were observed to mine high quality coal seams to an 8 in. minimum thickness. Normal thicknesses observed in the Appalachian and Illinois Basin mines were more on the order of 36 in. to 50 in. or thicker with 93 percent coal recoverability (table 1). A density of 1,800 tons per acre foot (ac-ft) was used for coal in the Appalachian and Illinois Basins with an overburden density of 2,400 tons per ac-ft (the density of in-place coal and waste material can be modified in CoalVal if desired by the user).

The area mining model was developed for a maximum stripping ratio of 9:1 (but could be used for higher ratios), using two spreads of tandem 14-cubic yard (CY) front end loaders (FELs) to load 55-ton end-dump haul trucks for overburden removal. Stripping production was 14,000 bank cubic yard (BCY) per 8-h shift, 2 shifts per day, 250 days per year or 7,000,000 BCY per year. The stripping operation was supported by two 520-hp dozers used to keep the loading area clean, develop ramps, and assist with the stripping; one 370-hp dozer was used to maintain a clean truck dump; and three 6 in., truck-mounted, diesel drills were used for interburden and overburden blasting. All of the support equipment was scheduled with the stripping equipment. Depending on the effective ratio, coal production could vary from 3,111 to 28,000 tons per shift or, at a 9:1 ratio, 777,778 tons per year. Production was based on loading a leased fleet of 28-ton, over-the-road coal trucks with two 7-CY FELs, one 8-h shift per day, 250 days per year. Coal production was supported by one 4 in. truck-mounted diesel drill, scheduled two 8-h shifts per day, 250 days per year. One 215-hp grader was used to maintain haul roads, and all equipment was backed up with spare or stand-by equipment: two 55-ton haul trucks, one 520-hp dozer, one 215-hp grader, and one 7-CY FEL. The maintenance staff was scheduled three 8-h shifts per day, 250 days per year.

Contour Stripping

Two contour strip models were developed for the Appalachian Basins for thin (12 to 36 in.) and thick (>36 in.) coal seams (table 1). Recovery factors ranged from 78 to 93 percent for thin to thick seams. The contour strip operation was designed to mine to a highwall limit of 18:1 effective ratio. All initial fills were planned to be placed in valleys without flowing water, then after several thousand feet of face was available, highwall mining or auger mining would take place. After highwall mining was completed, spoil from the overburden removal operation was backfilled against the highwall. Bench widths were designed to be a minimum of 2.5 truck-widths wide plus a safety berm and a drainage ditch.

Contour strip mining was modeled using two spreads of stripping equipment, each with three 42-CY, end-dump trucks loaded by one 14-CY FEL and supported by one 520-hp dozer for dump maintenance and for road, bench, and drill pad construction. Overburden drilling was done with one 6 in., truck-mounted, diesel drill. All stripping equipment was scheduled for two 8-h shifts per day, 250 days per year.

Coal production utilized two spreads of equipment to follow the stripping equipment. Each spread contained one 7-CY FEL to load 28-ton over-the-road contracted trucks. This operation was supported by one 350-hp dozer for ramp building, coal ripping, and stockpiling coal. Haul roads were maintained by a 215-hp grader. Coal production was conducted on day shift only, owing to the difficulty of mining thin coal seams. Due to the thin nature of the coal seams in the thin-seam model, the coal was ripped for production rather than drilled. In the thick-seam model, coal seams were ripped for production to a thickness of 5 ft; thicker seams were drilled with a 4 in. truck-mounted diesel coal drill. Produced coal was hauled directly from the pit to a central crushing and loadout facility or wash plant (if necessary). Tons hauled were paid on a fee plus cost per ton-mile basis, and crushing, washing and train loading were assessed on a cost per ton basis (both of the rates are inputs on CoalVal's "Mine Model Assumptions" window).

The mining operation maintained as spare equipment one 42-CY end-dump truck, one 520-hp dozer, one 7-CY FEL, and one 215-hp grader, in addition to a central office, warehouse, and maintenance shop. The model contained a total of 20 production employees, 35 auxiliary (such as coal loading and maintenance) employees, 11 supervisors, and 4 management

staff. Maintenance crews were scheduled three 8-h shifts per day, 250 days per year.

In the thin-seam model, a total of 5,800 BCY overburden was moved per spread-shift, 2 shifts per day, 250 days per year, equating to a total of 5,800,000 BCY per year. An average of 1,933 tons of coal was moved by each equipment spread (two spreads), 1 shift per day, 250 days per year for a total of 966,778 tons of run-of-mine coal per year. The average effective ratio for the thin-seam model was 6:1.

Equipment and labor were the same for both the thin-seam model and the thick-seam model; however, productivity was set higher for the thick-seam model, at 7,500 BCY of overburden per spread. Using two spreads of equipment, operating 8-h per shift, 2 shifts per day, 250 days per year, a total of 7,500,000 BCY per year of overburden was moved. An average of 2,143 tons of coal per spread, with two spreads working one 8-h shift per day, 250 days per year produced 1,071,429 tons per year. The average effective ratio for this model was 7:1.

Highwall Mining or Auger Mining

Two similar mining methods are employed to extract coal from the highwall after stripping operations have become uneconomic. Auger mining has been used for more than 50 years to recover additional coal beyond the highwall without removing additional overburden. During the past 30 years, highwall mining has utilized continuous mining machines and conveying apparatus that have increasingly replaced auger equipment. This version of CoalVal employs auger mining equipment for highwall mining. The next version of CoalVal will include highwall miners employing continuous miner equipment.

Like the contour stripping models, two auger mining models were divided into thin-seam and thick-seam models (table 1). The same equipment and labor requirements were used for each model, but productivity increased with the thick-seam model. Auger mining was originally developed to access the coal beyond the final highwall of contour strip or area (mountain top) mines. The auger could recover a low cost resource that would otherwise be left behind—coal that might lay between the final highwall and an underground mine or, in the case of area strip mines, coal that might not border an underground mineable resource. Thousands of miles of abandoned highwall benches in the Appalachian region provided the opportunity for secondary resource recovery using augers. The chief problems with auguring are (1) the accurate depth of penetration of the auger head is hard to determine, and (2) the coal recovery is normally not more than 30 percent of the in-place resource owing to round holes and the web design necessary to maintain highwall stability.

During the 1980s and 1990s, highwall miners were developed with the ability to (1) penetrate more than 1,000 ft into the highwall, (2) to maintain the mining machine in the coal seam, and (3) to maintain entries parallel to each other for roof stability (Zipf, 2005). Our models do not address highwall-miner equipment at this time. Interviews with mining companies and personal experience with auger mining have led to the conclusion that an average penetration of 60 ft was normal (even though many of the holes were in excess of 180 ft) and that the average recovery rate was 30 percent. In thick seams, multiple auger holes were stacked from the top to the bottom of the seam. These methods and numbers were used in the mine modeling and CoalVal cost models.

The CoalVal models consider the auger operations as part of the contour strip system, monitored by the contour strip management but having assigned supervision and wage employees. The auger equipment consisted of one twin-head auger with an assortment of head and flight sizes, one 4.5-CY FEL for cleanup around the auger and for loading a 28-ton end-dump, contracted trucks for hauling the coal to the wash plant or loadout, and a 285-hp dozer for operating pad and road building and 215-hp grader for road maintenance. The work force was composed of 6 production employees and 2 supervisors working two 8-h shifts per day, 250 days per year. Coal production was 175 tons per shift or 87,905 tons per year for the thin-seam model and 350 tons per shift and 175,000 tons per year for the thick-seam model.

Gillette Surface Mine Models

General Assumptions

Six truck-shovel and 10 dragline with truck-shovel-support models were developed for use in Gillette coalfield evaluations (table 1). Four mine models (two truck-shovel and two dragline with truck-shovel benching models) will be described in this report. Only two dragline and truck-shovel prestripping (DL/TS) mine models will be presented for reference in the CoalVal program.

The Gillette coalfield mine models were originally designed for a coal production rate of 20 million tons per year using truck and shovel stripping methods for different effective ratio models (effective ratio = BCY waste material moved divided by the tons of coal produced). Equipment, manpower, and other input factors were calculated for mine models with stripping ratios from 1:1 to 6:1. Truck and shovel mine models with ratios greater than 6:1 were not addressed in the initial Gillette evaluations. Stratigraphic information was correlated and stored in StratiFact (GRG, 1999). The geology was modeled and stripping ratios calculated with ArcView Spatial Analysis (ESRI, 2000b).

It was assumed that overburden, interburden, and parting waste material for the original box cut was placed outside the pit for later reclamation. Box-cut topsoil was assumed to be stockpiled outside the active pit area and replaced on the box-cut spoil after regrading had taken place. During the mine's life, topsoil was removed from the active stripping area and placed directly on regraded spoils or stockpiled outside the pit. Topsoil removal and replacement was assumed to be done

by contractor and the associated cost per ton is found in the "Mine Model Assumptions" window.

The original mine infrastructure was designed for a mine producing 20 million tons of coal per year and assumed to be located down-dip from the coal outcrop. All sampling and weighing equipment was considered to be state-of-the-art when installed and in compliance with American Standard Testing and Materials (ASTM International, 2008) standards. Duplication of equipment was limited and safeguards used for major equipment, such as shovels, by assuming that an in-pit coal inventory of 30 days is carried at all times. Equipment availability for haul trucks and other major equipment was taken into account, and an average haul distance was assumed for each ratio mine model when determining the number of pieces of equipment needed for sustained production. Haul ramps out of the pits and overburden dump ramps were designed to be at a 10 percent or less grade.

Truck-shovel stripping was used owing to its simple nature and the ease of planning and sequencing, and because it was the most common stripping scenario for most of the Gillette coalfield mines when they first opened. The stripping equipment spread was originally developed by matching 255-ton trucks with appropriate shovel size (to fill the truck in 3 to 5 bucket passes). Although truck size has grown to 360 tons or larger, the equipment size was left as originally designed with the idea of updating the equipment size when the Gillette coalfield standards were modified. Overburden, interburden, and thick parting material were assumed to be backfilled into the abandoned pit after coal removal and in a sequence to satisfy regulatory objectives. The number of haul trucks for overburden removal was increased from ratio model to ratio model as the amount of waste was increased from 20 million BCY per year in the 1:1 mine model to 120 million BCY in the 6:1 mine model. A computer haulage dispatch system was assumed to be used on all the trucks and loading equipment.

An overburden to interburden to parting density of 2,400 tons per acre-foot (tons/ac-ft) was used for waste calculations and a density of 1,770 tons/ac-ft was used for coal. Swell factors of 16 percent were used for waste material. Equipment availability was obtained from equipment handbooks, U.S. Bureau of Mines (USBM) and U.S. Geological Survey (USGS) interviews and unpublished reports (1990–2008), and mine observations and evaluations in the Gillette Coalfield.

As the haul distance for coal increased, additional trucks were added until an average distance of three miles (one way) was reached. At that point in time, an in-pit crusher and two-mile long conveyor system to the original truck dump was installed and the truck fleet was reduced.

All of the produced coal in the Gillette coalfield mine model was planned to be hauled from the pit to a crushing facility where it is sized and placed in storage silos for loadout into unit coal trains. No off-property truck haulage is anticipated, therefore the over-the- road truck haulage costing is assumed to be zero. However, CoalVal needs a value for over-the-road haulage to calculate mine costs. Therefore, a value of $0.01/ton will be entered into the "Haul Cost Table" for Gillette coalfield mines.

Truck-Shovel Stripping in the Gillette Coalfield, Wyoming – 2:1 Ratio Mine Model

In the 2:1 ratio mine model, 60 truck-shifts per week were needed from the fleet of 255-ton coal haul end-dump trucks. A 5-days-per-week schedule required 4 trucks per 8-h shift, three shifts per day, 251 days per year to haul 20 million or more tons of coal per year. That truck-fleet schedule would be abbreviated as: 3(4+4+4)5 = 60 truck-shifts per week. The number of coal production days per year was found by: 365 total days per year minus 104 weekend days per year minus 10 holidays per year = 251 days per year. Daily production = 6,800 tons per truck-shift × 4 trucks per shift = 27,200 tons per shift × 3 shifts per day = 81,600 tons per day. If the annual production equals 20 million tons, then (20,000,000 tons per year) ÷ (81,600 tons per day) = 245 days per year. The 5 days per week schedule gives the potential of 6 extra production days per year to haul parting waste material. If the schedule required the coal haulage equipment to be operated 24 h per day, 7 days per week, 355 days per year, it would be abbreviated as: 3(3+3+3+3)7 or 3 trucks on first shift, 3 trucks on second shift, 3 trucks on third shift, and 3 trucks on swing shift (the swing shift accounts for the weekend shifts, there are many different scheduling scenarios for using four crews of workers for a 24 h per day, 7 days per week operation).

The fleet size increase from the 1:1 ratio mine model was due to the longer haul from the coal face in the pit to truck dump. Coal loading was done with one 68-CY electric shovel, and supported by one 450-hp, rubber-tired dozer for clean-up at the shovel. Road maintenance was done with one 275-hp and two 500-hp graders.

Stripping volumes increased to 40 million BCY in this model and required the fleet of 193-CY end-dump trucks to be scheduled 3(10+9+9+0)5 to move overburden (OB), interburden (IB), and thick parting material. The abbreviated schedule means 10 trucks per shift for the first shift and 9 trucks per shift for the second and third shifts each day, 5 days per week, 251 days per year. The trucks were loaded by one 52-CY overburden shovel and one 33-CY, 1800-hp front-end loader (FEL) and supported by one 370-hp dozer for shovel clean-up and two 520-hp dozers for maintenance of the spoil dumps. One extra OB truck was held as a spare truck to maintain the necessary truck availability for production. Stripping production was based on one 197-CY truck hauling 5,710 BCY per shift per truck, or the truck fleet hauling 159,880 BCY per day or 40.1 million BCY of overburden during the year. The effective ratio for this operation was 2.005 to 1.

Other functions included:

1. Overburden blast-hole drilling was done with two 450-hp, electric drills with 60 ft drill steel, scheduled

3(2+2+2+0)5; 8-h per shift, two drills scheduled 3 shifts per day, 251 days per year.

2. Coal blast-hole drilling was done with two 75-hp, diesel powered, truck-mounted drills, scheduled 2(2+1+0+0)5; 8-h per shift, with two coal drills scheduled on first shift and one coal drill scheduled on second shift, 251 days per year.

3. Reclamation regrading and contouring used two 770-hp dozers, scheduled 3(2+2+1+0)5; 8-h per shift, two units on the first and second shifts and one unit on third shift per day, 251 days per year.

4. Total employment is 212 employees composed of the following: production labor, 87 employees; auxiliary labor, 89 employees; mine operations staff, 23 employees; and mine management staff (overhead), 13 employees.

Truck-Shovel Stripping in the Gillette Coalfield, Wyoming – 3:1 Ratio Mine Model

The truck fleet for the 3:1 Gillette coalfield ratio mine model was designed to produce a minimum of 20 million tons per year of coal and strip a minimum of 60 BCY of waste per year. With the minimum of 4 coal trucks, on a 3(4+3+3)5 schedule (see schedule explanation in the previous section), actual coal production was estimated at 20,481,600 tons per yr. To keep to an approximate 3:1 ratio, a truck fleet of 13 OB trucks was scheduled at 3(12+11+11+12)7, which is a 7 days per week, 355 days per year schedule. This equated to an OB production of 64,312,850 BCY per year and a waste to produced coal ratio of 3.14:1.

In this model coal production had an increase in coal haul distance to approximately 3 miles, one-way and at that distance; a 2 mile overland conveyor system and coal dump can be justified to keep the coal haul distance to a minimum. Coal production of 20 million tons of coal per year is achieved by using a 68-CY coal-loading shovel and four 255-ton trucks. Coal production is scheduled 3(4+3+3)5 or three 8-h shifts per day, 262 days per year with one truck on standby during the second and third shifts of each day. One rubber-tired, 450-hp dozer is assigned to the coal shovel during its production hours.

Overburden and interburden removal production of greater than 60 million BCY per year is achieved by using a 54-CY overburden shovel, two 33-CY FELs and a total of 13 trucks. Stripping is scheduled 3(12-11-11-12)7 or three 8-h shifts per day, 7 days per week, 355 days per year, with two trucks on standby during the second and third shifts of each day and one truck is on standby during the first shift and swing shift. This equated to an overburden production of 60,388 BCY per shift or 64,312,850 BCY per year. One 370-hp dozer is assigned to the overburden shovel for clean-up and assistance during its production hours.

Two 33-CY FEL's compose the other overburden loading contingent. They are able to keep the loading area clean and level without dozer assistance. Six overburden haul trucks are assigned to the FEL loading operation, 5 overburden trucks are assigned to the overburden loading shovel. Two 520-hp dozers are assigned to the waste dumps to keep the dump areas drained and clean.

Other functions:

1. Overburden blast-hole drilling was done with two 450-hp, electric drills with 60 ft drill steel, scheduled 3(2+2+2+2)7, or 8-h per shift, three shifts per day, 355 days per year.

2. Coal blast-hole drilling was done with two 75-hp diesel powered, truck mounted drills, scheduled 3(2+1+0)5, or 8-h per shift, three shifts per day, 251 days per year.

3. Coal and overburden haul roads are maintained by two 500-hp motor graders, scheduled with the stripping equipment.

4. Two 770-hp dozers are scheduled 3(2 +2+0+2)7 for regrading the waste dumps. Topsoil removal and replacement and seeding are contracted to outside sources. Global Positioning Systems (GPS) for accurate grading are used on the reclamation dozers.

5. Total employment is 261 employees composed of production labor, 114 employees; auxiliary labor, 98 employees; mine operations staff, 35 employees; and mine management staff (overhead), 14 employees.

6. Maintenance staff are scheduled three 8-h shifts per day, 7 days per week, 355 days per year.

Dragline and Truck-Shovel Stripping in the Gillette Coalfield, Wyoming – 3:1 Ratio Mine Model Assumptions

These mine model assumptions reflect a 3:1 mining ratio for a truck and shovel (TS) benching–dragline stripping operation in the Gillette coalfield (figs. 4 and 5) The 3:1 ratio model was built to model the mining of coal resources from a 2:1 ratio to a 3:1 ratio. Therefore all overburden removal was averaged at a 2.57:1 ratio. The pit depth required a truck-shovel benching operation to remove enough overburden for an efficient dragline operation above the Anderson coal bed.

This model used a realization of $14.50 per ton and assumed the tons were shipped from a blend of the Anderson and Canyon coal beds in the south mining area of the Gillette coalfield (fig. A.1). Coal sales realization can be modified on a model by model or area by area basis to reflect other coalfield areas and conditions. The models assumed the purchase of new equipment, normal equipment life and 8-h per shift scheduling. The model developers realized that 12-h shifts were

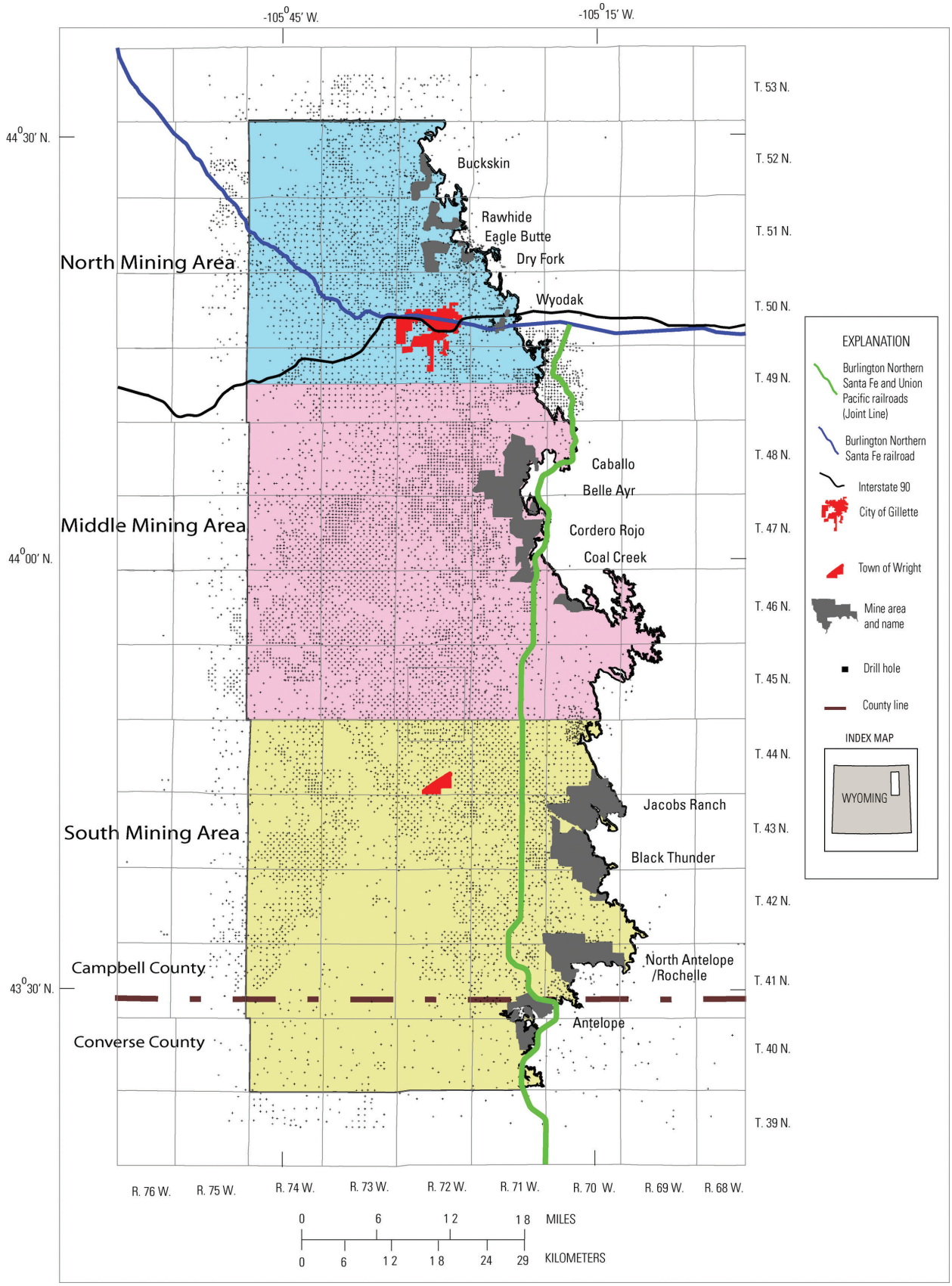


Figure A1. Gillette coalfield with mining areas and mine names.

more productive than 8-h shifts, however, the same number of employees and amount of equipment will be used in the 8-h schedules and the schedules are somewhat easier to follow. The discounted cash flow–rate of return (DCF–ROR) was set for 8 percent in these mine models but may be adjusted for any rate desired by the evaluator.

The standard coal pit was designed to be 10,600 ft long and 200 ft wide with haulage ramps from the TS benching operation located on the end-walls of the pit map (fig. 4.). No cross-pit haulage with highwall ramps was assumed. The TS pit design assumed 200 ft wide, 70 ft high benches with a 55 degree highwall slope angle (fig. 5). The dragline stripping operation assumed a 200 ft wide, 140 ft high bench and 55 degree highwall slope angle with ramp access from both ends of the pit. Access for the coal haulage was done through three ramps, one on each end of the pit and one ramp entering in the center of the pit (fig. 4).

Overburden, interburden, and parting densities ranged from 3,200 lb per BCY to 2,700 lb per BCY (data obtained from Gillette coal mines) so an average of 2,950 lb per BCY (2379.7 tons per ac-ft) was used for waste calculations and a density of 80.965 lb per cu ft or 2,186.1 lb per BCY (1769.7 tons per ac-ft) was used for coal (swell factors of 16 percent for overburden and 26 percent for coal were used). Coal density analyses were averaged from more than 900 core samples of the Smith, Anderson, and Canyon coal beds in the PRB (Stricker and others, 2006, 2007). These samples were located west of the current mining area from a depth of 300 ft to a depth of 2,000 ft. Equipment availability was determined using equipment handbooks, USBM and USGS unpublished mine reviews and reports (1990–2007), and mine observations and evaluations in the Gillette coalfield.

Coal production of greater than 35 million tons per year was achieved by using a 97-CY coal loading shovel (4 dippers per truck load) and five 380-ton (290-CY) trucks. Coal production was scheduled three 8-h shifts per day, 7 days per week, and 355 days per year. Trucks and drivers are scheduled 3(5+5+4+ 4)7 which means: 5 trucks on first shift, 5 trucks on second shift, 4 trucks on third shift, and 4 trucks on swing shift (the swing shift accounts for the weekend shifts - there are many different scheduling scenarios for using 4 crews of workers in a 24 h per day, 7 days per week operation). Haulage ramps were maximized at 10 percent slope; the shovel, load-swing-dump-return to face time of 34 seconds per bucket load was assumed; and haul times were calculated using the Caterpillar Handbook (2006) haulage simulation. Trucks were assumed to be loaded from both sides of the shovel and spotting and dumping at a 3-bay, 900-ton hopper was assumed to take 60 seconds. Three spare 380-ton capacity trucks were scheduled for standby each shift for substitution into coal or overburden removal haulage. One rubber-tired, 450-hp dozer was assigned to the coal shovel during its production hours and two 31-CY front end-loaders were scheduled to supplement coal loading, fill in for the shovel during maintenance downtime or for parting removal. The schedule was calculated using the following data: 365 days per year minus 10 holidays per year = 355 days per year, 355 days per year × 3 shifts per day × 32,864 tons per shift = 35 million tons per year. Coal explosives costs were estimated from Gillette coalfield mine data.

It is important to note that the average mineable coal bed thickness of the Anderson bed in the model area is 682 in., composed of 675 in. of coal and 7 in. of in-seam parting (parting less than 24 in. thick). Partings greater than 24 in. thick are assumed to be removed separately from the coal production operation. Parting removal, where necessary, will employ two 31-CY FELs, at least two 290-CY trucks, and one 850-hp dozer for ripping or a coal drill for partings thicker than 10 ft. This function is scheduled with the coal production operation.

A total of 90 million BCY of overburden and interburden will be removed per year using a TS benching operation (20.0 million BCY per year) and one 112 CY, 10,000-hp dragline, bench dozers and cast blasting to move the last 140 ft of overburden from above the coal (70.0 million BCY per year). The total volume included the material moved for the TS end-wall ramps. Dragline operations are scheduled 363 days per year, 24 hours/day. Seven 850-hp dozers are assigned to the dragline for pad preparation, ramp building, key cuts, spoil pushing, and other operations (average bench push distance = 350 ft).

One 73-CY overburden shovel and 5 trucks were planned for the prebenching operations using a stripping schedule of 3(5 + 4 + 4)5 or three 8-h shifts per day, 5 days per week, 252 days per year. One truck is on standby during all shifts of each day. One 850-hp dozer was assigned to the overburden shovel to push the top 10 to 15 ft of the bench to the shovel and for bench clean-up during its production hours. All haul roads and ramps were designed for a maximum of 10 percent or less slopes. Truck loading was assumed to be done from both sides of the shovel to reduce spotting time. Shovel swing time was estimated at 34 seconds per swing while 4 bucket loads were required to fill the 290-CY trucks. Spotting and dump time in the overburden dumps was assumed to be 60 seconds. Truck haulage cycle-time was determined using Caterpillar Handbook simulation models. The schedule was calculated using the following production data: 365 days per year minus 10 holidays = 355 days per year, 355 days per year minus 104 weekend days per year = 251 production days per year × three shifts per day × 18,807 BCY per shift = 20.0 million BCY per year.

Total employment is 335 employees composed of production labor, 145 employees; auxiliary labor, 124 employees; mine operations staff, 51 employees; and mine management staff (mine overhead), 15 employees. Annual productivity for Truck-Shovel and Dragline mines in the Gillette coalfield for 2005 averaged 44.44 tons per man-shift (Mine Safety & Health Administration, 2007; Platts, 2007; not including temporary workers); the 3:1 ratio model has 48.37 tons per man-hour productivity. Maintenance and support staff was scheduled three 8-h shifts per day, 7 days per week, 355 days per year. Production and maintenance supervisory staff schedules followed their wage staff schedules and management and

technical staff were scheduled for 5.2 days per week (270 days per year).

Coal and overburden haul roads were maintained by two 500-hp motor graders, scheduled with the coal and stripping equipment and were surfaced with scoria from the mine property. A computer haulage dispatch system was assumed to be in use on all loading and mobile equipment.

Two 850-hp dozers were scheduled 3(2 + 2 + 2)5 for regrading the waste dumps and to keep dumps drained and cleaned and for reclamation regrading. Topsoil removal and replacement was done with two 34-CY push-pull scrapers. Global Positioning Systems on the reclamation dozers were used for accurate grading of waste dumps.

One two-mile long, 54 in. wide × 6,300 tons per hour overland conveyor systems and one 3-bay, coal dump with grizzly, 900 ton hopper, and primary crusher were used to maintain a minimum haulage distance between the active working area and the crushing and loadout facilities.

Mine overhead costs were estimated and valued but corporate overhead costs were not estimated for the mine models. Wage and salary rates and benefit rates were taken from the United Mine Workers of America contract (2007) and the USBM and USGS unpublished mine reviews and reports (1990–2007).

Taxes were developed from conversations with the Campbell County, Wyoming Tax Assessor (T. Clements, 2007, oral commun.), the Wyoming State Office of Revenue and Taxation (C. Grenvek, 2007, oral commun.), and personnel associated with the Gillette coalfield mines.

Fuel, lube, repair and maintenance costs were derived from USBM and USGS unpublished mine reviews and reports (1990–2007), and verified by mine observations and evaluations in the Gillette coalfield.

Explosives, miscellaneous and general operating costs, equipment rentals, professional services, and reclamation provisions were taken from mine observations and evaluations for the Gillette coalfield. Electrical power costs for production equipment, such as shovels, crushers, conveyors, and other equipment were derived from the USBM and USGS unpublished mine reviews and reports (1990–2007), and include a fuel and lube equipment cost component. General utilities were estimated for the office, shop, and warehouse complex. Ancillary support equipment costs for the Auxiliary Equipment were estimated to be 2 percent of the auxiliary capitalization and Ancillary Support for surface support facility capitalization was estimated at 1 percent of the total surface capital.

Dragline and Truck-Shovel Stripping in the Gillette Coalfield, Wyoming – 6:1 Ratio Mine Model Assumptions

These mine model assumptions reflect a 6:1 mining ratio for a TS benching operation and dragline stripping operation in the Gillette coalfield. The 6:1 ratio Mine Model was built to model the mining of coal resources between 5:1 and 6:1 mining ratio. Therefore, all overburden removal, including lay-back of the pit ends for overburden haulage ramps was averaged to a 5.61:1 effective ratio. The depth to coal requires an average of four truck-shovel operational benches above the dragline bench.

This model used a realization of $14.50 per ton and assumed the tons were shipped from a blend of the Anderson and Canyon coal beds in the south area of the Gillette coalfield. Coal sales realization can be modified on a model-by-model or geographic area–by–geographic area basis to reflect other coalfield areas and conditions. The models assumed the purchase of new equipment, normal equipment life, and 8-h per shift scheduling. The model developer realized that 12-h shifts are more productive than 8-h shifts. However, the same number of employees and same amount of equipment were used in the 8-h schedules, and those schedules are somewhat easier to follow. The DCF-ROR was set for 8 percent in the mine models but may be adjusted for any rate desired by the evaluator.

The standard coal pit was designed to be 10,600 ft long with haulage ramps from the TS benching operation located around the ends of the pit. No cross-pit haulage with highwall ramps was used. The TS pit design was planned to be similar to pit designs in present operations: 200-ft-wide, and 70-ft-high benches with a 55-degree, bench-to-bench highwall slope angle. The dragline stripping operation was planned for a 200-ft-wide, 140-ft-high bench and 55-degree highwall with ramp access from both ends of the pit. Access for coal haulage is by 3 ramps, 1 on each end of the pit and 1 ramp entering in the center of the pit. During the Gillette coalfield evaluation it was realized that the center pit coal ramp, beginning with the 5:1 ratio model, would so greatly reduce the amount of low-wall dragline spoil room that an alternative stripping and or coal haulage method would have to be devised. The coal haulage-stripping methodology envisioned is the utilization of a multiplate tunnel design for a coal conveying system with a mobile dump-crusher system in the pit. Capital and operating cost estimates will be incorporated in the next CoalVal update.

Overburden, interburden, and parting densities ranged from 3,200 lb/BCY to 2,700 lb/BCY (data obtained from Gillette coal mines) so an average of 2,950 lb/BCY was used for waste calculations and a density of 80.965 lb/ft^3 or 2,186.1 lb/CY was used for coal (swell factors of 16 percent for overburden and 26 percent for coal were used). The coal density analysis is an average from more than 900 core samples of the Smith, Anderson, and Canyon coal beds in the Powder River Basin (Stricker and others, 2006, 2007). These samples were located west of the current mining area from a depth of 300 ft to a depth of 2,000 ft. Equipment availability was determined using equipment handbooks, USBM and USGS unpublished interviews and reports (1990–2007), and mine observations, evaluations and personal contacts in the Gillette coalfield.

Coal production greater than 35 million tons per year is achieved by using one 97-CY coal loading shovel (4 dippers per truck load) and seven 380-ton (290-CY) trucks. Coal

production is scheduled three 8-h shifts per day, 7 days per week, 355 days per year. Trucks and drivers are scheduled 3(7+7+7+ 6)7, which means 7 trucks on first shift, 7 trucks on second shift, 7 trucks on third shift, and 6 trucks on swing shift (the swing shift accounts for the weekend shifts; there are many different scheduling scenarios for using four crews of workers in a 24-h per day, 7 days per week operation). Haulage ramps were maximized at 10 percent slope; the shovel, load-swing-dump-return to face time of 34 seconds per bucket load was assumed; and haul times were calculated using the Caterpillar Handbook (2006) haulage simulation. Trucks were assumed to be loaded from both sides of the shovel, and spotting and dumping at a 3-bay, 900-ton hopper was assumed to take 60 seconds. Two spare 380-ton coal trucks are scheduled for standby each shift. One rubber-tired, 450-hp dozer is assigned to the coal shovel during its production hours and two 31-CY FELs are available to supplement coal or overburden loading or to fill in for the shovel during maintenance downtime or to use for in-pit parting removal. The schedule was calculated using the following data: 365 days per year minus 10 holidays per year = 355 days per year; 355 days per year × 3 shifts per day × 32,864 tons per shift = 35 million tons per year. Coal explosives costs were estimated from Gillette coalfield mine data.

It is important to note that the average mineable coal bed thickness (Anderson bed) in the Gillette coalfield area is 682 in., composed of 675 in. of coal and 7 in. of in-seam parting (parting less than 24 in. thick). Partings greater than 24 in. thick are assumed to be removed during the coal production operation. Parting removal, where necessary, will employ two 31-CY FELs, at least two 290-CY trucks, and one 850-hp dozer for ripping or a coal drill for partings thicker than 10 ft. This function is scheduled with the coal production operation.

A total of 197.7 million BCY of overburden and interburden will be removed per year using a TS prebench operation (127.7 million BCY per year) and one 112-CY, 10,000-hp dragline, bench dozers, and cast blasting to move the last 140 ft of overburden from above the coal (70.0 million BCY per year). The total volume included the material moved for the TS end-wall OB haulage ramps. Dragline operations are scheduled 363 days per year, 24 hours per day. Seven 850-hp dozers are assigned to the dragline for operations such as pad preparation, ramp building, key cuts, and spoil pushing (average bench push distance, 350 ft).

Four 73-CY overburden shovels and 28 trucks were planned for the prebenching operations by using a stripping schedule of three 8-h shifts per day, 7 days per week, 355 days per year. Trucks and drivers are scheduled 3(28+28+28+28)7. This notation means that operations are scheduled 3 shifts per day, 7 days per week, with 28 trucks on first shift, 28 trucks on second shift, 28 trucks on third shift, and 28 trucks on swing shift (the swing shift accounts for the weekend shifts; there are many different scheduling scenarios for using 4 crews of workers for a 24 h per day, 7 days per week operation). Eight trucks were scheduled for standby during all shifts of each day. One 850-hp dozer is assigned to each overburden shovel to push the top 10–15 ft of the bench to the shovel and for bench clean-up during its production hours. All haul roads and ramps were designed for a maximum of 10 percent or less slopes. Truck loading is done from both sides of the shovel to reduce spotting time. Shovel swing time was estimated at 34 seconds per swing, while 4 bucket loads were required to fill the 290-CY trucks. Spotting and dump time in the overburden dumps are assumed to be 60 seconds. Truck haulage cycle time was determined using Caterpillar Handbook simulation models. The schedule was calculated using the following data: 355 production days per year × 3 shifts per day × 119,911 BCY per shift = 127.7 million BCY per year.

Total employment is 627 employees composed of production labor, 340 employees; auxiliary labor, 195 employees; mine operations staff, 71 employees; and mine management staff (mine overhead), 21 employees. Annual productivity for the 3:1 TS-DL mines in the Gillette coalfield for 2005 averaged 44.44 tons/man-shift (not including temporary workers); the 6:1 ratio model has a 24.99 tons/man-shift productivity. Maintenance and support staff are scheduled three 8-h shifts per day, 7 days per week, 356 days per year on four rotating shifts per week. Production and maintenance supervisory staff schedules followed their wage staff schedules, and management and technical staff were scheduled for 5.2 days per week (270 days per year).

Coal and overburden haul roads are maintained by five 500-hp motor graders, are scheduled with the coal and stripping equipment, and are surfaced with scoria from the mine property. A computer haulage dispatch system is assumed to be in use on all loading and mobile equipment.

Three 850-hp dozers are scheduled 3(3+3+3+3)7 for regrading the waste dumps and to keep dumps drained and cleaned and for reclamation regrading. This notation means that operations are scheduled 3 shifts per day, 7 days per week with 3 dozers on first shift, 3 dozers on second shift, 3 dozers on third shift, and 3 dozers on swing shift (the swing shift accounts for the weekend shifts; there are many different scheduling scenarios for using 4 crews of workers for a 24 h per day, 7 days per week operation). Topsoil removal and replacement is done with two 34-CY push-pull scrapers. GPS grading systems are used on the reclamation dozers.

Two 2-mi-long, 54-in.-wide × 6,300 tons per hour overland conveyor systems and one 3-bay coal dump with a grizzly, 900-ton hopper, and primary crusher are used to maintain a minimum haulage distance between the active working area and the crushing and loadout facilities.

Mine overhead costs were estimated and valued but corporate overhead costs were not estimated for the models. Wage, salary and benefit rates were obtained from USBM and USGS unpublished mine reviews and reports (1990–2007).

Taxes were developed and verified by the Campbell County, Wyoming Tax Assessor and the Wyoming State Office of Revenue and Taxation (T. Clements and C. Grenvek, respectively, oral commun., 2007), and Gillette coalfield mines.

Fuel, lube, repair and maintenance costs were derived from USBM and USGS unpublished mine reviews and reports (1990–2007) and verified by mine observations and evaluations in the Gillette coalfield.

Explosives, miscellaneous and general operating costs, equipment rentals, professional services, and reclamation provisions were taken from mine observations and evaluations for the Gillette coalfield. Electrical power costs for production equipment, such as shovels, crushers, and conveyors, were derived from the USBM and USGS unpublished mine reviews and reports, (1990–2007) and include a fuel and lube equipment cost component. General utilities were estimated for the office, shop, and warehouse complex. Ancillary support equipment costs for the Auxiliary Equipment were estimated to be 2 percent of the auxiliary capitalization and Ancillary Support for surface support facility capitalization was estimated at 1 percent of the total surface capital.

Underground Mining Assumptions

Room and Pillar Mining Assumptions

Mine Model for the Appalachian Basin for Moderate Seam Thickness – 42 in. to 72 in. Mining Height Model Using Continuous Miner Machines for Room and Pillar Methods.

This room and pillar mine model assumed that main entries would use one continuous miner (CM) section and that two production panels would each use a CM section. All coal would be transported from underground dump sites (pockets) to the surface facilities by means of a conveyor system. Where the coal resources were isolated from the outcrop, slope entries for the conveyor and ventilation systems and for equipment and manpower access were designed. Vertical shafts were used for ventilation and manpower entry into the mine when necessary. The room and pillar mine model was designed using standard technical references, mine visits, industry consultation, and personal experience where the mineable seam thickness ranged from 42 in. to 72 in. Average mining height for the mine model area was 62.3 in. and was composed of 53.0 in. of coal, 5.3 in. of in-seam parting, and 4 in. of out-of-seam dilution; average coal bed mine recovery rate was 65 percent. It was assumed that roof and floor conditions were stable and only 4 in. of dilution was experienced during mining.

The model used a realization of $111.50 per ton (Platts, Coal Outlook, November 3, 2008) and assumed the ROM production was transported to an offsite preparation and loadout facility. Realization can be modified on a mine model-by-mine model or area-by-area basis to reflect other coal quality and coalfield conditions. The models assume the purchase of new equipment upon mine start-up, normal equipment life, and 8-h use per operating shift. The DCF-ROR was set for 8 percent in the mine models but can be adjusted for any rate desired by the evaluator.

CoalVal includes a coal beneficiation routine for washing (Society of Mining Engineers, 1979) the ROM product or can assume sale of the ROM product with no washing for either surface or underground mine models. The user must decide whether the coal quality of the ROM product will allow sale of the product without beneficiation. The CoalVal evaluator can use the default rates for the cost of washing and recovery rates for coal and dilution material, as listed on the Assumptions dialog page of the Mine Model, or can insert proprietary wash plant cost and recovery rates. If the ROM product is not washed, the user must show a 100 percent recovery rate through the wash plant for coal and dilution material on the Assumptions dialog page of the Mine Model.

Mine development was modeled with a five entry system for the main entries and seven to nine entries for the production panels. Each of the three mining sections contained 1 CM, assumed to be controlled by a remote operator; 3 diesel shuttle cars to transport the coal from the working coal face to the pocket; 1 roof bolter working after the CM and using a standard bolting layout; and 1 utility scoop (front end loader) for working-area cleanup. Pillar extraction was assumed to take place as a retreat mining practice, but barrier pillars were left intact. Production was scheduled for 8-h per shift, 3 shifts per day, 7 days per week, using four rotating crews. Eleven paid holidays per year were observed. Preventive maintenance and belt moves were scheduled during the third shift. A production rate of 700 raw tons per shift was used for each CM section. These production rates resulted in an annual production of 2.2 million (MM) raw tons per year or 1.2 MM tons of saleable product at a 53 percent wash plant yield (60 percent coal recovery and 25 percent parting + dilution recovery, D. Alexander, 2005, oral commun.).

Total employment was estimated to be 247 employees composed of production labor, 96 employees; auxiliary labor (including maintenance), 108 employees; mine operations staff, 34 employees; and management and technical staff, 9 employees. Annual productivity for similar mining configurations in the eastern coalfields ranges from 2.0 to 8.2 tons per man-hour with an average of 4.6 tons per man-hour (Mine Safety & Health Administration, 2007, not including temporary workers). This room and pillar mine model using three CMs resulted in 4.2 tons/man-hour productivity. Production and auxiliary employees were scheduled for 250 days per year with an estimated 10 percent overtime. Operations staff followed their wage employee schedules, and management and technical staff were scheduled for 5.5 days per week (276 days per year).

Fuel, lube, repair, and maintenance costs were derived from data gathered by USBM and USGS and verified through mine observations and evaluations in the Northern Appalachian (NAP) coalfields. Explosives, miscellaneous and general operating costs, equipment rentals, professional services, and reclamation provisions were taken from mine observations and

evaluations for the coalfield. Electrical power costs for production equipment, such as shovels, crushers, and conveyors were derived from the USBM and USGS mine interviews and reports and include a fuel and lube equipment cost component. General utilities were estimated for an office, shop, and warehouse complex. Ancillary support equipment costs for the Auxiliary Equipment were estimated to be 2 percent of the auxiliary capitalization and Ancillary Support for surface support facility capitalization was estimated at 1 percent of the total surface capital.

Mine overhead costs were included in the cost models; however, corporate overhead costs were not estimated. Wages, salaries, and benefits rates were taken from data gathered by the USBM and USGS mine interviews and reports adjusted to the 2008 Department of Labor Bureau of Labor Statistics Cost of Living Adjustment (COLA) (U.S. Department of Labor, 2008) Taxes were developed from interviews with county tax assessors in Ohio, Pennsylvania, and West Virginia.

Longwall Mining Assumptions

Mine Model for the Appalachian Basin in Moderate Seam Thickness – 42 in. to 72 in. Mining Height Model For A Longwall Mine Model

This longwall mine model assumed that three continuous miners (CM) sections were used for main entry (one section) and longwall panel development (two sections). Conveyor belts were used to transport the coal from underground dump sites (pockets) or from the tailgate feeder-breaker to the surface facilities. Where the coal resources were isolated from the outcrop, slope entries for the conveyor and ventilation systems and equipment and manpower access were designed. Vertical shafts were used to assist in mine ventilation and manpower entry where necessary into the active mine. The longwall mine (LW) model was designed by using standard technical references, mine visits, industry consultations, and personal experience in coal seams where the mining height ranged from 42 in. to 72 in. Average coal bed thickness was 57.6 in. with an average of 11.5 in. of in-seam parting material. The model assumed that the roof and floor conditions were optimum and that only 4 in. of out-of seam dilution was experienced in both the development and longwall areas. These assumptions yielded a total average mine model height of 73.1 in. and resulted in a total coal recovery from the mine of 76 percent.

The model used a realization of $111.50 per ton (Platts, Coal Outlook, 11/3/2008) and assumed the run-of-mine (ROM) production was transported to an offsite preparation and loadout facility. Realization can be modified on a mine model by mine model or area by area basis to reflect other coal-quality and coalfield conditions. The models assume the purchase of new equipment upon mine start-up, normal equipment life, and 8-h use per operating shift. The DCF-ROR was set for 8 percent in the mine models but can be adjusted to any rate desired by the evaluator.

CoalVal includes a coal beneficiation routine for washing the ROM product or can assume sale of the ROM product with no washing for either surface or underground mine models. The user must decide whether the coal quality of the ROM product will allow sale of the product without beneficiation. The CoalVal evaluator can use the default rates for the cost of washing and recovery rates for coal and dilution material as listed on the Assumptions dialog page of the Mine Model or can insert his own wash plant cost and recovery rates. If the ROM product is not washed, the user must show a 100 percent recovery rate for coal and dilution material on the Assumptions dialog page of the Mine Model.

Mine development was modeled with a seven-entry system for the main entries and three longwall panel entries using CM sections. Equipment and manpower for the mine were scheduled 3(1+1+1+1)7 or 8-h per shift, 3 shifts per day, 7 days per week, 354 days per year (11 holidays per year were observed). The CM sections were scheduled for 3 shifts per day and 7 days per week, with maintenance and belt moves scheduled during the third shift. Longwall production was scheduled for 3 shifts per day and 7 days per week, with maintenance scheduled during the third shift. A production rate of 3,053 raw tons per shift was used for the LW section and 530 raw tons per shift were used for each CM section. These production rates resulted in 10.2 million (MM) raw tons per year being produced from the mine and 5.2 MM tons per year of saleable product on the basis of a 50.4 percent wash plant yield (65 percent coal recovery and 10 percent parting + dilution recovery; Coal Age, 2000; D. Alexander, 2005, oral commun.).

Total employment was estimated to be 336 employees composed of production labor, 125 employees; auxiliary labor (including maintenance), 125 employees; mine operations staff, 73 employees; and management and technical staff, 13 employees. Productivity for similar configurations in the Appalachian coalfield range from 6.5 tons/man-hour to 15 tons/man-hour (Mine Safety & Health Administration, 2007, not including temporary workers). This LW mine model resulted in 13.7 tons/man-hour productivity.

Fuel, lube, repair, and maintenance costs were derived from data gathered by USBM and USGS and verified through mine observations and evaluations in the NAP coalfields. Explosives, miscellaneous and general operating costs, equipment rentals, professional services, and reclamation provisions were taken from mine observations and evaluations for the coalfield. Electrical power costs for production equipment, such as shovels, crushers, and conveyors, were derived from the USBM and USGS mine interviews and reports and include a fuel and lube equipment cost component. General utilities were estimated for the office, shop, and warehouse complex. Ancillary support equipment costs for the Auxiliary Equipment were estimated to be 2 percent of the auxiliary capitalization and Ancillary Support for surface support facility capitalization was estimated at 1 percent of the total surface capital.

Mine overhead costs were included in the cost models; however, corporate overhead costs were not estimated. Wages, salaries, and benefits rates were taken from data gathered by the USBM and USGS mine interviews and reports adjusted to 2008 Department of Labor Bureau of Labor Statistics Cost of Living Adjustment (COLA).

Taxes were developed from interviews with county tax assessors in Ohio, Pennsylvania, and West Virginia. All non-production items required for development of the mine, prior to the first ton of production from the longwall, were amortized. The remainder of the nonproduction equipment, such as feeder breakers, ventilation system and other equipment was not amortized.

Appendix B

Contents

Figures

Tables

CoalVal Project Tutorials

Introduction

This appendix of the CoalVal document was written as a tutorial to help construct a model to evaluate the economically mineable coal resources in a coal deposit. The tutorial explains how to install the CoalVal program and associated files and to create a CoalVal **Project** that is a coal resource evaluation project. Coal **Seams** will be added to the **Project** and **Project Areas** will be added for each **Project** coal **Seam**. The creation of **Tax** and **Haul Cost Tables** for each **Area** and how to select and develop a **Mine Model** is discussed, and data are imported from an ArcView (ESRI, 2000a) data table into a **Project Area**. After the **Project** is developed the user can create reports that can be printed, previewed, or saved to a text file. This Tutorial appendix provides examples of data input and is supported by the Program Description, appendix C, which discusses how the program works.

CoalVal requires a Microsoft (MS) Windows® 98 or Windows® XP operating system and a minimum of 1 gigabyte of RAM (random access memory) memory to perform operations. It will not operate on MS Vista®, Windows® 7, or Macintosh® operating systems. Also, CoalVal requires a computer screen resolution of at least 800 pixels by 600 pixels. If the resolution is less than 800 × 600 pixels, a portion of the information on the dialog window will not be shown.

There are two methods for program installation. The first is to download directly from the USGS website. Many worksite facilities have intricate security measures that will allow program installation only by the Systems Administrator. CoalVal's USGS website has instructions for installation, and a section under "CoalVal Installation" in appendix C (Program Description) contains installation instructions. Later in this chapter, in the Starting CoalVal section, a description of the technique used by the USGS computer system administrators to load the program on local personal computers is reviewed. The second method for installation is to download the self-installing CoalVal program from a CD-ROM. Regardless, the computer system administrator may have to complete loading the CoalVal program.

CoalVal's program organization is shown in figure B.1. After CoalVal has been started, the **Main Menu Bar** will become active and show the three main boxes that will be discussed in this tutorial (fig. B.1), "**Projects**," "**Reports**," and "**Setup**." These items are the building components as CoalVal evaluates the mineability, resource recovery, and mining economics of a coal resource.

Several associated files and **Mine Models** are provided in CoalVal that can be used in the creation of a **Tutorial Project**. This tutorial will demonstrate the creation of **Projects** within CoalVal. The creation of **Mine Models** will not be reviewed in this document, but default **Mine Models** are provided for use and modification. A review of the installed **Mine Models** is needed to determine which one or ones are appropriate for the **Project** of interest. All **Projects** need a **Mine Model** to be associated with each **Project Area**. **Projects** and **Areas** will be discussed and defined in the following text. CoalVal dialog windows use a component called a Navigation Bar (fig. B.2). These components will be discussed in appendix C, Program Description Chapter, Navigation Bar section. However, a brief review of the most important buttons on the navigation bar shows that the Insert Button (+); Delete Button (-); and Refresh Button (checkmark); will be the most commonly used buttons for inserting or deleting data in database tables and refreshing the CoalVal program with new information. Posting data after a table has been built is a good idea, but CoalVal has an Autosave routine that saves new or modified data without requiring the user to "Post" the data.

Starting CoalVal

If the user exits the **Project** development at any time, CoalVal will store all of the data into a database. Once data has been posted (see Navigation Bar) or changed to another form or dialog, the data are placed into a database and autosaved. All **Projects** and **Mine Models** are stored and updated in CoalVal databases. It is not necessary to actively save work as CoalVal is used. Also, there is no "undo" command in CoalVal; if something is entered incorrectly, it will have to be deleted or edited. If something is deleted by mistake, it must be reentered.

CoalVal Installation Instructions

CoalVal requires the computer's Administrator to install the program. Run CoalVal version 2.14.66nx program and install CoalVal on the PC's hard drive. Notice that the program executable file and icon file are installed under: C:\Program Files\USGS\CoalValnx (fig. B.3); but the CoalVal program file folders were installed in the My Documents Folder: C:\Documents and Settings\(your file name)\My Documents\ CoalVal. The CoalVal user can now access all CoalVal databases and modify them as needed rather than needing the Administrator to access the files. There are also several Application files that run the CoalVal program. These files are found in C:\ Documents and Settings\(All Users)\Application Data\SlickRockSoftwareDesign \CoalVal. When the CoalVal Program is uninstalled, these files will continue to reside in their folders; however, they will not interfere with a CoalVal reinstallation.

The occasion may arise where a user has a pre-CoalVal version 2.14.66nx database that requires conversion from CoalVal version 2.14.46 or earlier, which used the Borland database manager. If the database was from a CoalVal version

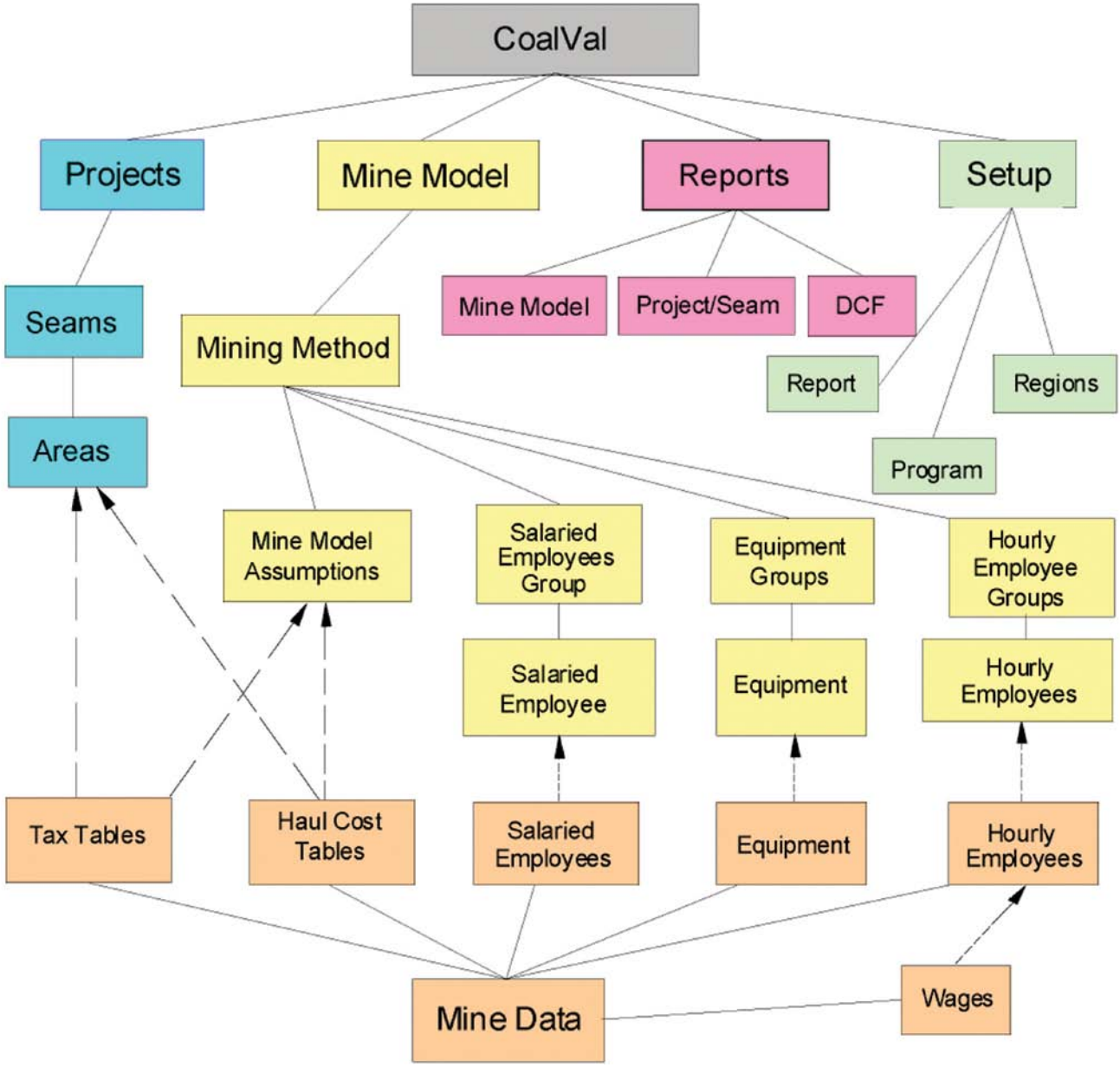


Figure B.1. CoalVal's program organization diagram.

Figure B.2. CoalVal's Navigation Bar.

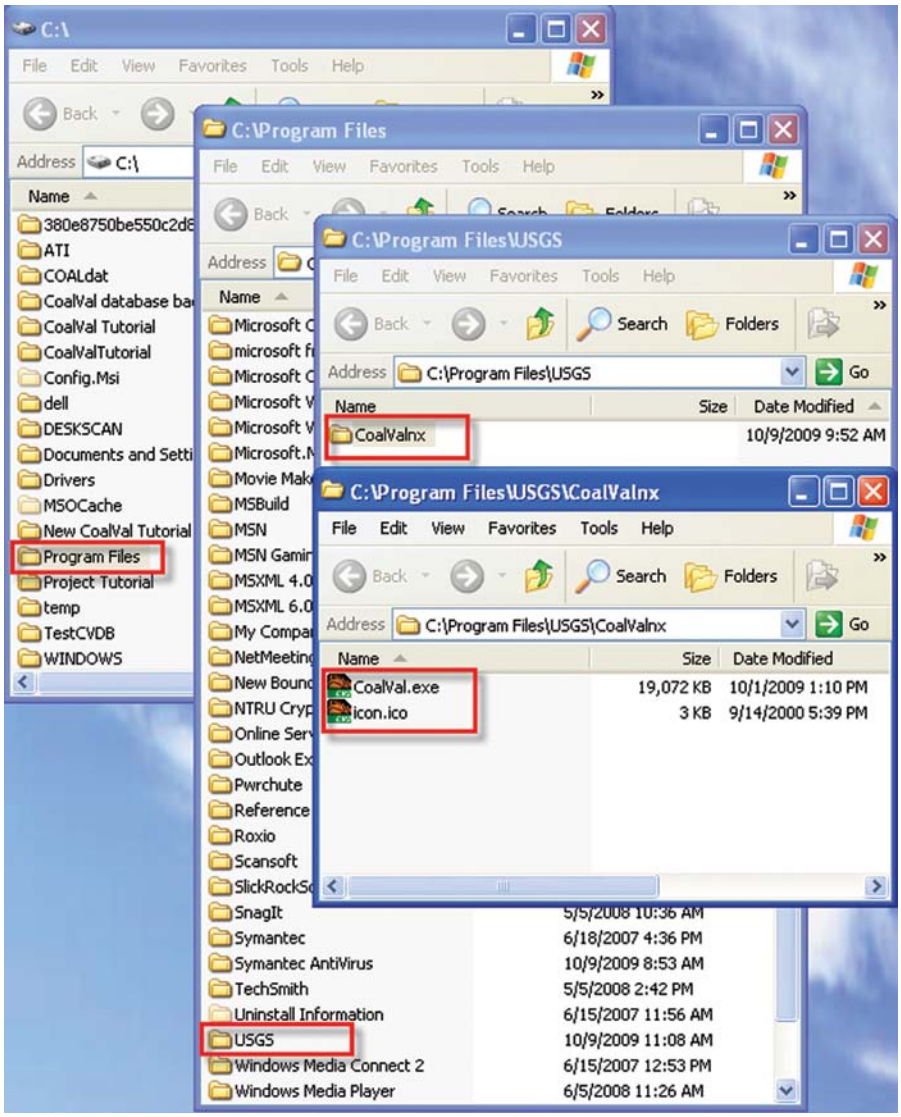


Figure B.3. Installation of CoalValnx under Program Files on the C:\ drive.

earlier than 2.14.46, that database must be updated to version 2.14.46 before attempting to convert to the new CoalValnx version 2.14.66nx. The following steps are used to convert CoalVal, version 2.14.46 files (pre 9/17/2009) to CoalVal 2.14.66nx files (for USGS staff only):

1. A copy of CoalVal 2.14.46 (using the Borland database manager, BDE) must be maintained until all of the older databases have been upgraded to CoalVal version 2.14.46. This text describes the conversion technique from CoalVal version 2.14.46BDE to CoalVal version 2.14.66nx.

2. Install CoalVal version 2.14.66nx on the same PC as the older version, CoalVal 2.14.46 resides.

3. Converting the old CoalVal v.2.14.46 BDE databases to the new CoalVal v.2.14.66nx format requires the CoalVal BDE Program (v2.14.46) to be open. *Open the BDE to NX Converter Program by double clicking on the BDEtoNexus.exe program file*. Directions for using the program are found on the program dialog window. Other databases that are not NX CoalVal databases but reside in the old CoalVal 2.14.46 program will be automatically shown in the list of Database Names along with their Database Path.

4. *Select a database to be updated and then enter the* new *name of the NX database in box #2* (or leave the Database Name the same). The path to the new database will be shown in the yellow highlight area under: Path to new NX formatted database. *Then select the* #4. Convert BDE to NX button and the new database will show up in the CoalValnx **Databases** dialog area. If an error message: "No Tables to input" is observed, *click on another database in the* "Non NX CoalVal Databases": listing and *then click on the* "4. Convert BDE to NX" button." The green database in the activity lines on the left side bottom of the dialog window will show the conversion activity. *Now go back to the original database that gave the error message* and it too will convert to the NX format.

5. *Open CoalVal, version 2.14.66nx and click on a Database Name*. An Error Message will appear saying: "1. Data Table could not be opened—MineDataMMTT. *Try using the Restructure tool* under the Tools menu on this Database page." Follow the instructions and *click on Tools*. *Then click on Restructure Update Database*. CoalVal will complete the restructuring and ask if you want to replace the existing file. *Click on yes* and the new program and new database are now compatible and may be used for coal resource evaluation.

CoalVal Program Uninstall Instructions

Uninstalling the CoalVal program is done through the Microsoft "Add and Remove Program" feature on the System Control Panel. After the Uninstall is ordered, CoalVal will identify the files and routines to be removed. This window may look like another install; however, after a few seconds the Uninstall window will show that CoalVal NX has been uninstalled successfully. CoalVal will save any databases the user may have developed in: C:\Documents and Settings\(your file name)\My Documents\CoalVal\Databases.

CoalVal Terminology

In CoalVal, a dialog window is the screen display seen when the window or page tab is activated (fig. B.4). In figure B.4, the dialog is the whole window. In the case of this dialog window, there are tabs that allow for the access of different pages (new windows) on the dialog window. There are two tabs in figure B.4 that can be clicked to access three pages. Not all dialogs have tabs. However, most dialog windows have menus in the upper left hand corner of the window and are links to other dialog windows or pages from a dialog window.

The CoalVal shortcut icon is placed on the PC desktop during program installation. *Click on the CoalVal Icon on the desktop.* Once CoalVal has started, the CoalVal **Main Menu** will be displayed (fig. B.5) with the **Databases**, **Help**, and **Exit** icons being active (the other icons are initially inactive).

Databases

In CoalVal, the user must first create a database before any analysis can be done or before any of the other menus from the **Main Menu** can be accessed. Click on the **Databases** icon on the CoalVal **Main Menu** and a **CoalVal Database** window showing no databases will be shown for the first time start-up of the **CoalVal Tutorial** (fig. B.6). In the upper left corner of the dialog window there is a menu item bar and a button or icon bar. Either bar can be used to create a new database. By placing the mouse cursor over the second button from the left where the icon looks like a blank piece of paper (fig. B.7), a "hint" window will appear displaying "Create New Database." *Click this button*. The **"**Create CoalVal Database" (fig. B.7) will appear in the bottom portion of the dialog.

In the field named "1. Database Name:" the field may be showing "None" (fig. B.7). *Highlight the "None" with the cursor and type in* ***Project Tutorial*** *(fig. B.8).* Any time the window shows the word "None," the user *can highlight "None" and type over the word or erase the word by backspacing and then typing in the heading. Next click the button labeled: "2. Click to set Database Path" and the window "Select Directory" is shown. Select the C: drive from the "Drives:" pull-down box*. In the "Directory Name:" edit box, *type in* ***CoalVal Tutorial*** *after the C:\Documents and Settings\(your file name)\My Documents\CoalVal\Databases (fig. B.8)*.

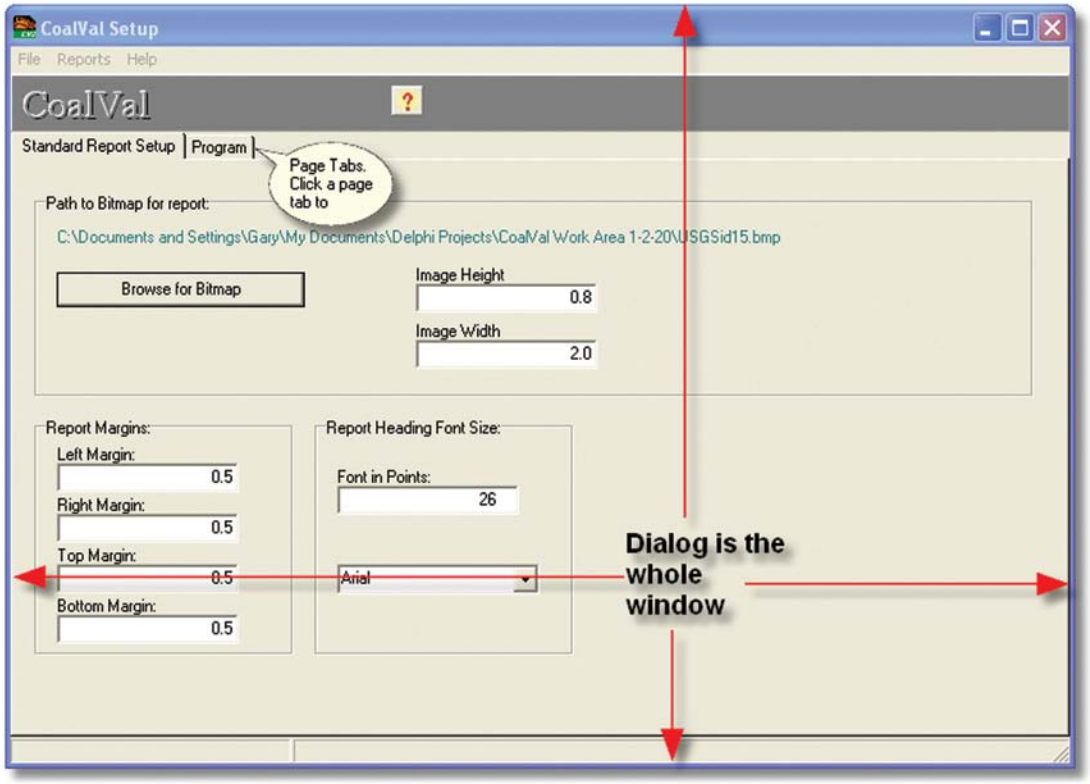


Figure B.4. CoalVal windows terminology.

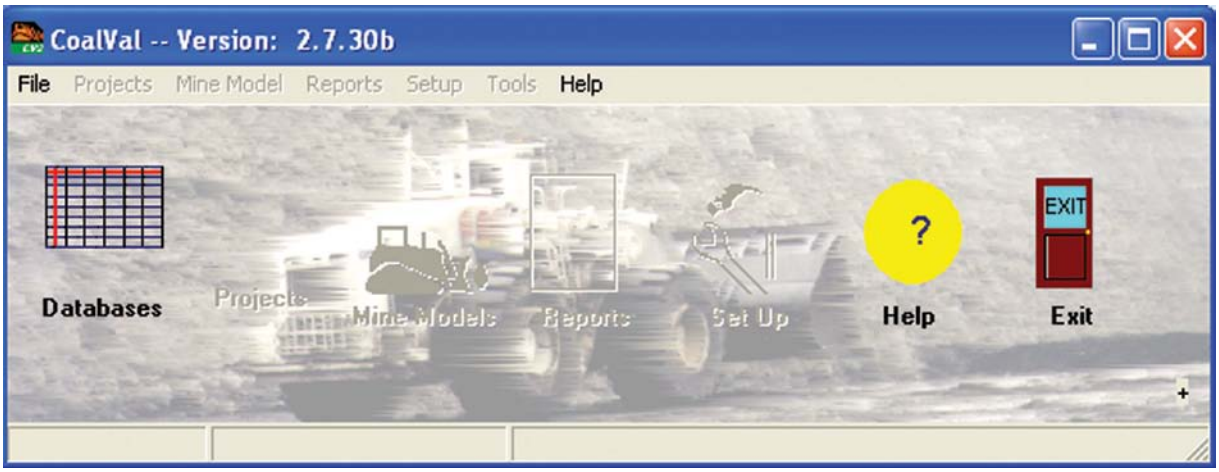


Figure B.5. Main Menu window when first starting CoalVal.

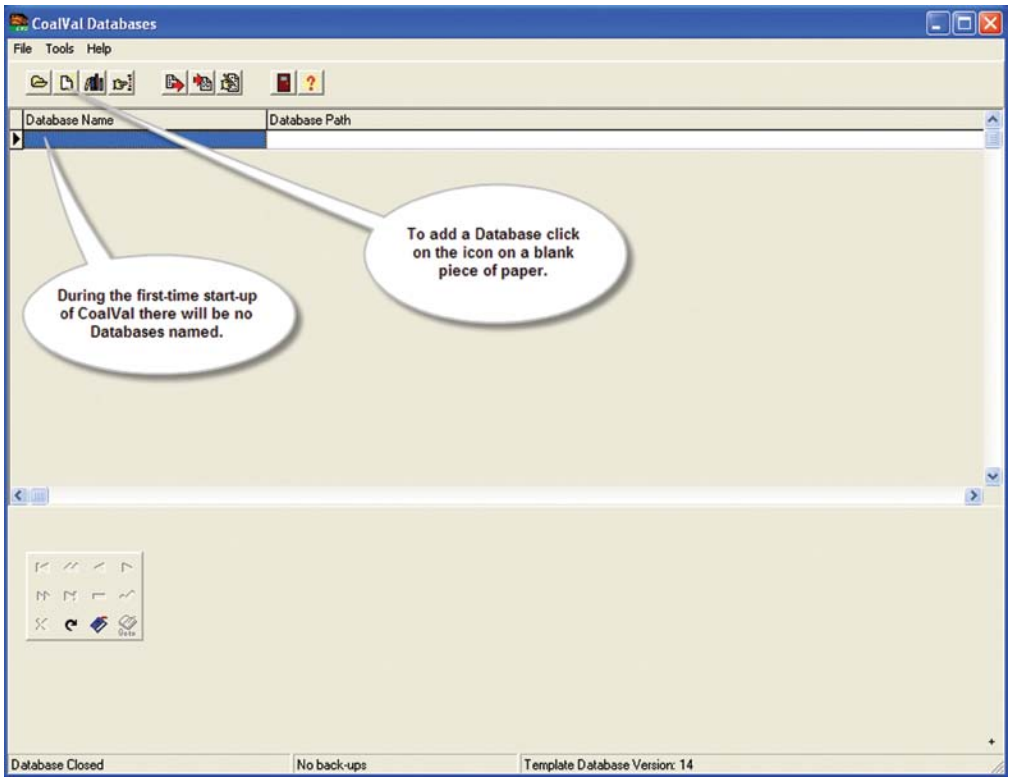


Figure B.6. CoalVal's Databases dialog window for first-time start-up of CoalVal Tutorial.

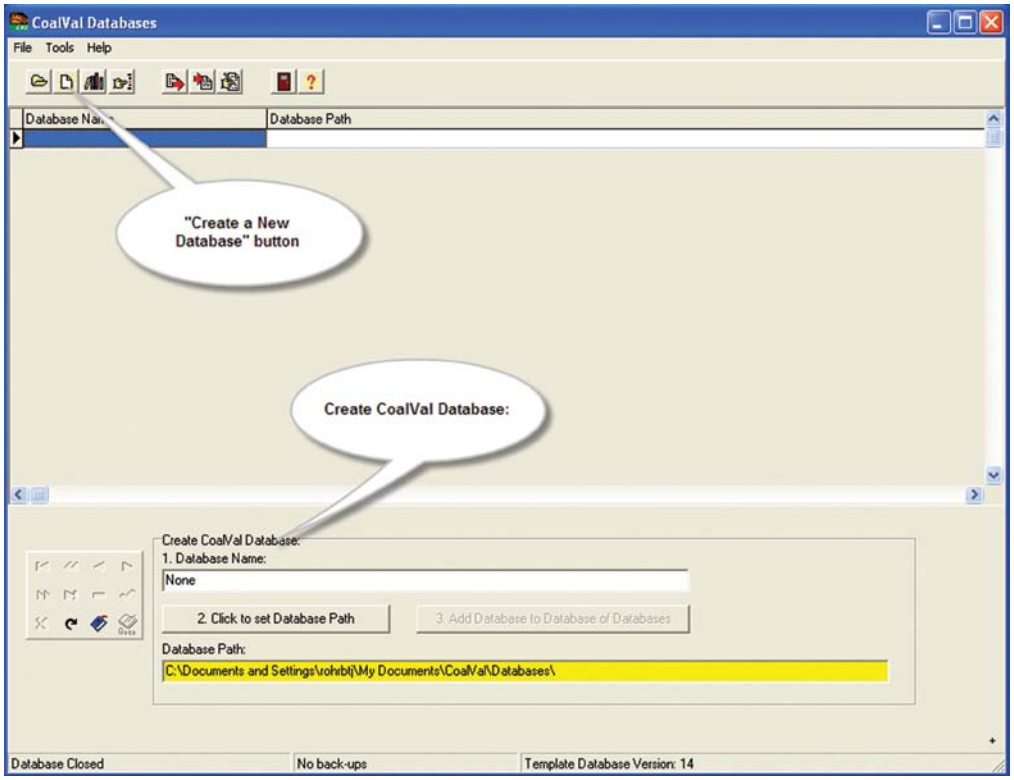


Figure B.7. Clicking on the "Create a New Database" button results in opening the dialog window containing three steps to producing a new CoalVal Database.

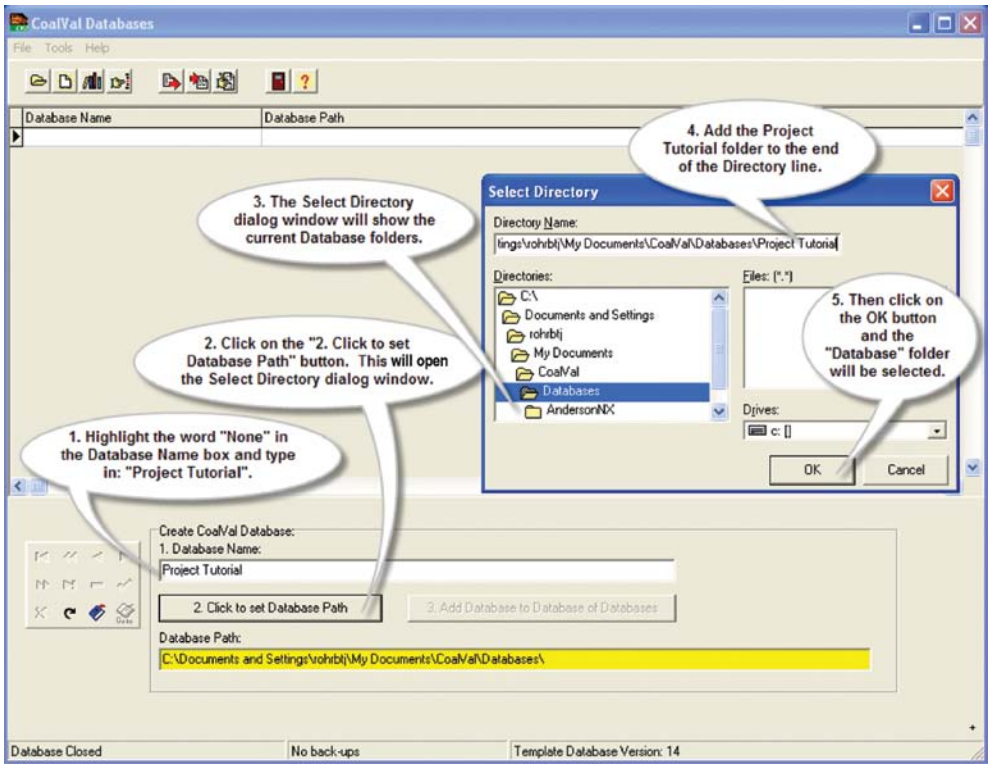


Figure B.8. CoalVal's Databases dialog window showing the "Database Path" to add the Project Tutorial database to the CoalVal Directory.

This entry will create a folder called **CoalVal Tutorial**. *Click the OK button to* ***create the new folder*****. A warning: "The specified directory does not exist. Create it?" will be** shown. *Click the "Yes" button.* Now *click the button labeled: "3. Add Database to Database of Databases***"** (fig. B.9). This entry will create a new database, named **Project Tutorial**, under the **Database Name** column (fig. B.10). *Select the* ***Project Tutorial*** *database by clicking the indicator button on the left side of the* ***Database Name***. Now *click on the "4. Open Selected Database***"** *button* (first button on the left side of the icon list—it looks like an open file), then *click on the "Exit" door to close the* ***CoalVal Databases*** *window and activate CoalVal's* ***Main Menu*** *(fig. B.10)*. As soon as the **Main Menu** is activated, the CoalVal Database window will disappear and the **Main Menu** icons (fig. B.11): **Databases**, **Projects**, **Mine Models**, **Reports**, **Setup**, **Help**, or **Exit** will be shown.

Creating a Project

The **Projects** icon is found on CoalVal's **Main Menu** dialog (fig. B.11). Clicking on the **Projects** icon will display the **Projects** dialog (fig. B.12). *Press the "insert" button (+) on the database Navigation Bar at the bottom of the screen. Click on the Project Name box and type in: CoalVal Test Project.* For the date, either *type the date or quickly left-click twice on the right side of the date field until a button appears. Clicking on this button will display a calendar from which a date can be selected for the date field*. Then *click on the "Checkmark" button on the Navigation Bar to "Post" the data and then on the "Refresh" button on the right end of the Navigation Bar to update the database*. CoalVal will normally automatically post the data update. This action will be seen when the "Checkmark" (Post button) is not shown to be active on the navigation bar; however, if the "Checkmark" is active, then the user should post the data as a general rule.

Deleting a project is done by clicking on the **Projects** icon on the **Main Menu Bar** (fig. B.11) which will open the **Projects** dialog window (fig. B.12). Click on the **Project** needing to be deleted under the Project Name and click on the "Delete" (-) button on the Navigation Bar. Once the "Delete" button has been executed the entire Project will be removed in an unretrievable, irrevocable action.

CoalVal Projects

The foundation of CoalVal is the CoalVal "**Project**." A CoalVal "**Project**" is a geographic location for which the user can determine the feasibility of mining a coal resource. The **Project** may have more than one coal **Seam** and require more than one "Mining Method," **Tax** rate, or **Haulage Cost** for its evaluation. A **Project** can contain many coal **Seams** and each coal **Seam** can be divided into many **Project Areas or Areas** (these terms are used in the same context in the description of a **Project**). ~~**Project**~~ **Areas** are geographical subdivisions of the **Project**, such as geographical areas relating to surface mining ratios or geographical areas relating to different coal qualities. The following mining scenario example will be used to define a **Tutorial Project** for the CoalVal Tutorial.

The **Tutorial Project** geographical area is assumed to be in a location containing rolling hill topography that increases in elevation to the west and is dissected by a north-south state boundary (fig. B.13). Two coal beds (Upper Bed and Lower Bed) are found in the **Project Area** and dip 1 to 3 degrees to the west. Overburden above the Upper Bed ranges from 30 to 125 ft thick and the interburden between the two beds is 650 ft. The terms **coal bed** and **coal seam** cannot be used interchangeably. They are defined here and in the Glossary (appendix E). The term **coal bed** refers to a geological description or name of a coal unit whose thickness is measured after all parting material less than 1 in. thick has been removed from the coal unit. Therefore, the coal bed is more or less pure coal. The term **coal seam** refers to the same coal unit with the thickness representing all of the coal material, all of the parting material, and out-of-seam dilution acquired during mining. Since it is difficult to impossible to separate the parting material and out-of-seam dilution from the coal material during the mining process, the term coal seam is used in this manual to describe the coal unit being mined.

Project Tutorial Mining Scenario Example

The description of the **Project Area** – mining scenario example describes two coal beds, one shallow and one deep. This means that at least two different "Mining Methods" will be used for the **Tutorial Project**. It is assumed that the Upper Bed will be mined by a dragline and truck-shovel mining method with a 3:1 average mining ratio in State B and by a similar mining method in the 6:1 average mining ratio area also in State B (fig. B.13). A dragline and truck-shovel mining method with an average mining ratio of 6:1 will be used for the State A area. Room and pillar mining using continuous miners will be used to mine the Lower Bed (fig. B.13). It is assumed that each state will have different taxation rates and, because the Upper Bed will be mined by surface mining methods and the Lower Bed by underground mining methods, that each coal bed will require a different **Tax Table**. Therefore, four different **Tax Tables** are required for the mining scenario example. One tipple and train loadout will be used for the entire **Project,** and haulage costs to the tipple are considered in the mine models.

In summary, this **Project** has two coal beds. Each will require different mining methods and the Project resides in two different states, requiring different taxation rates. Remember that an **Area** is a subset of a **Seam**, and a **Seam** is a subset of a **Project,** and an **Area** is a geographic location with one **Mine Model** using one "Mining Method," and having one **Tax Table** and one **Haul Cost Table**. Therefore, the **Tutorial Project** will need at least two **Areas**, because it has two coal beds. However, owing to different taxations and different "Mining

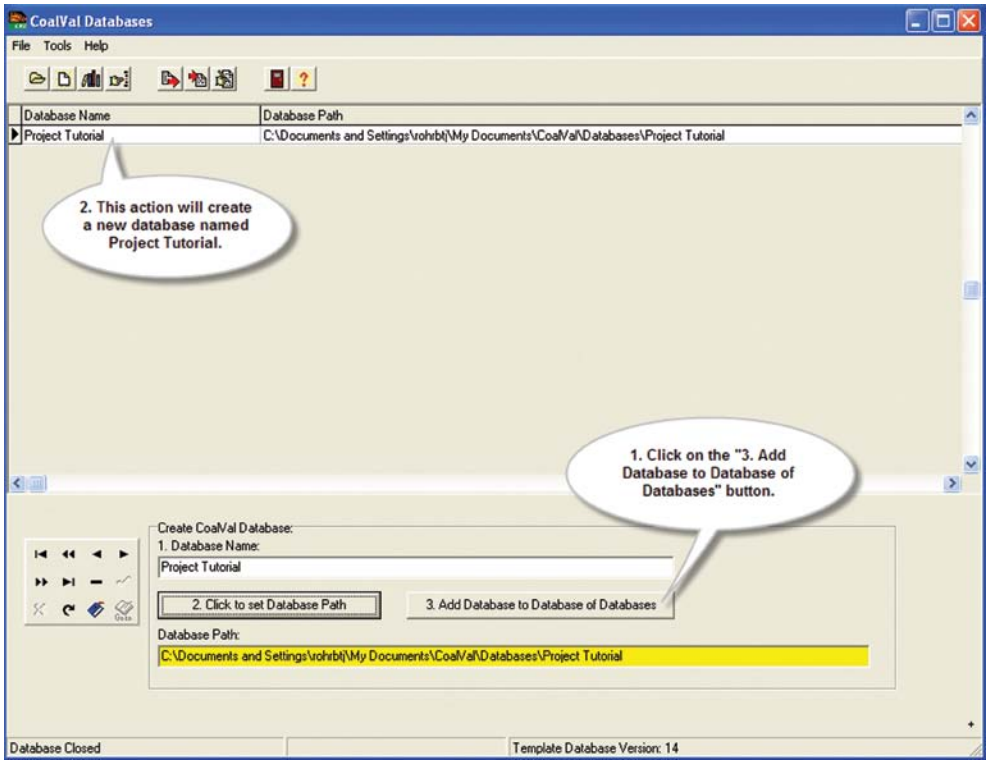


Figure B.9. Adding CoalVal's Project Tutorial Database to the Database files by clicking on number "3. Add Database to Database of Databases."

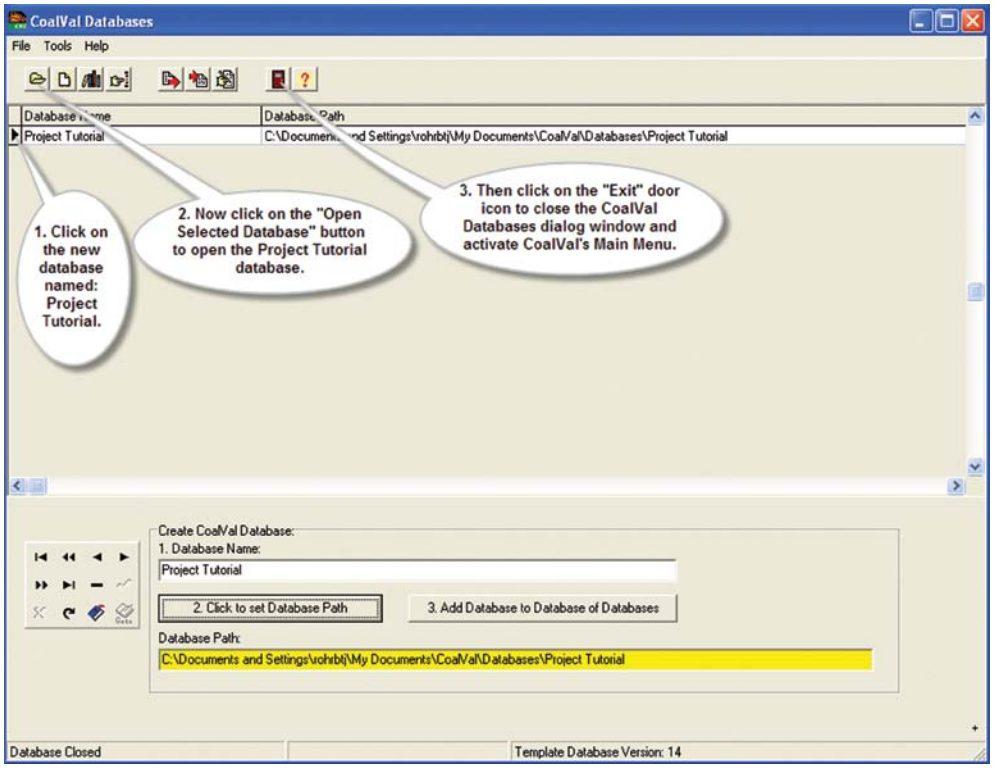


Figure B.10. CoalVal's Database dialog window after the Project Tutorial Database is added to the CoalVal Database files. The Database dialog is used to open current or develop new databases in CoalVal.

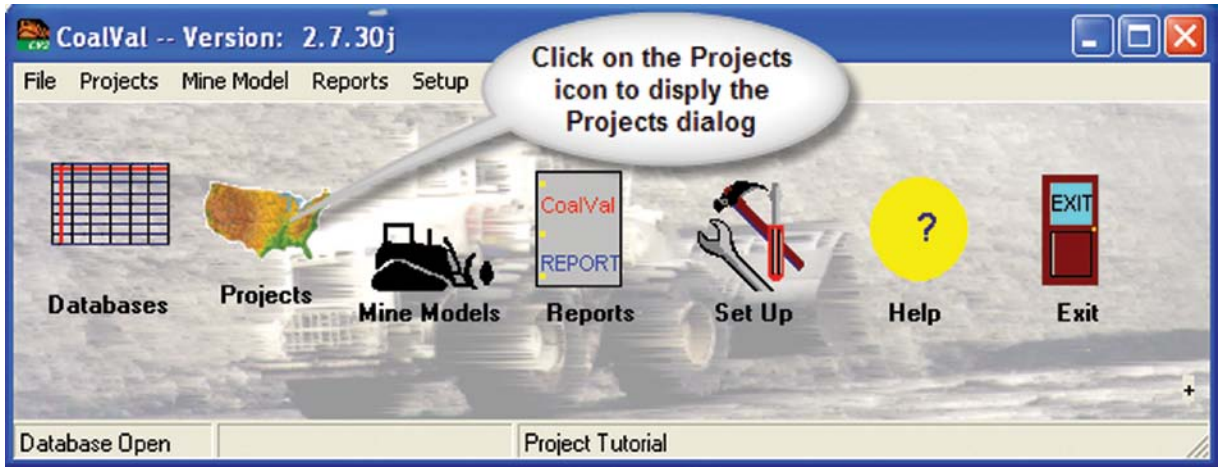


Figure B.11. CoalVal's Main Menu showing the Projects icon.

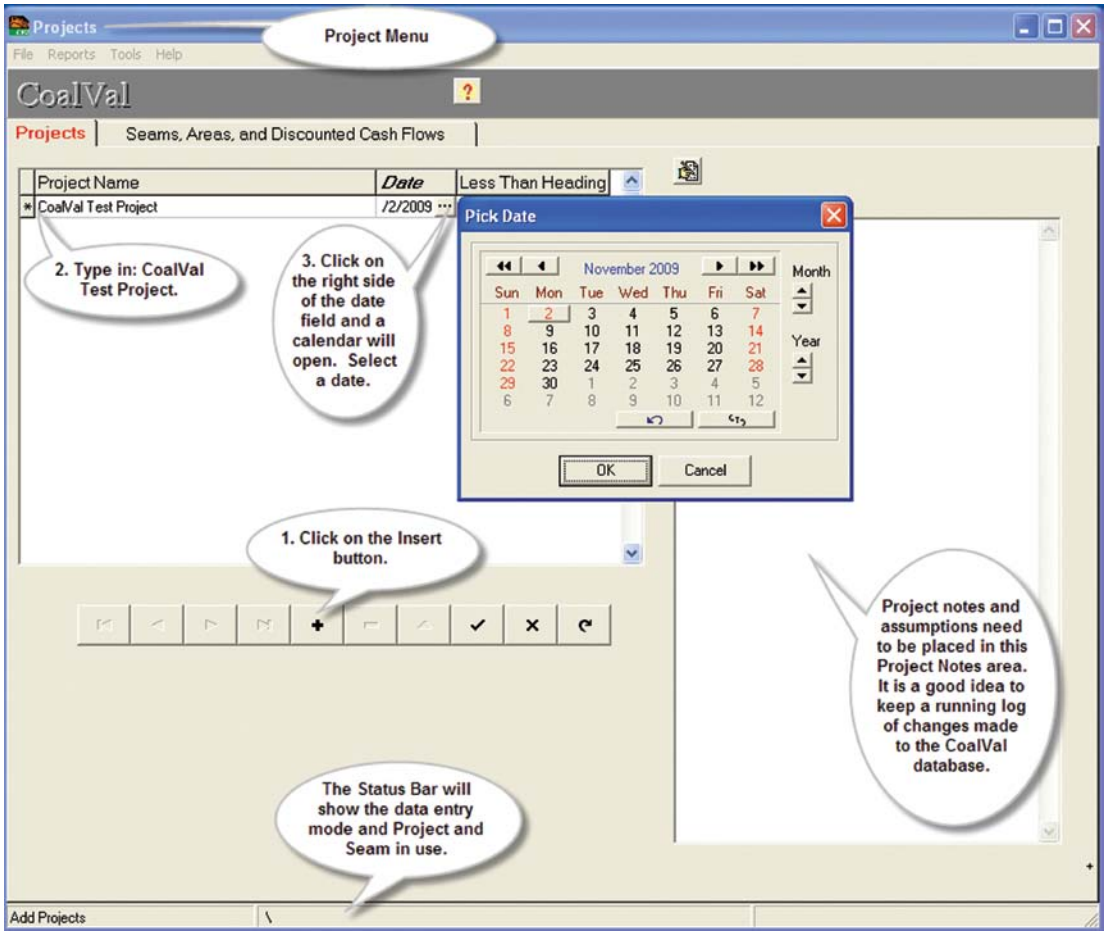


Figure B.12. CoalVal's Project dialog window showing the Navigation Bar and the pop-up calendar.

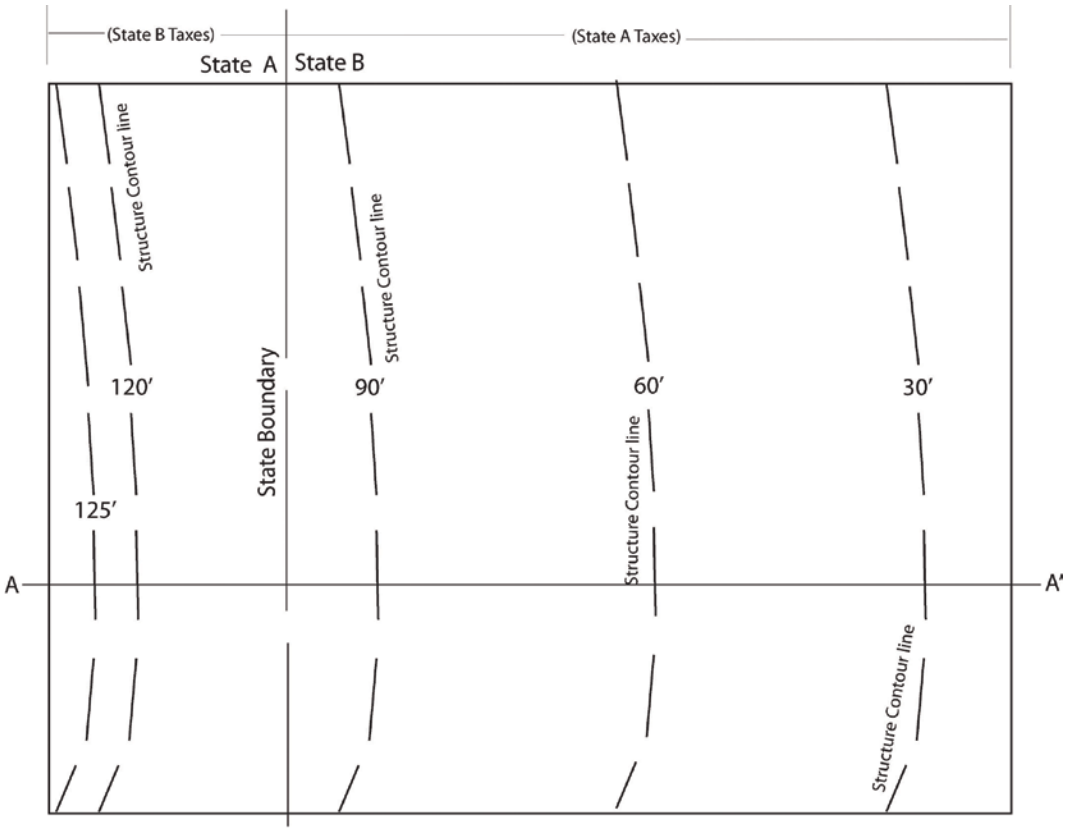


Figure B.13. CoalVal's Tutorial Project Area coal resource mining scenario example, plan view map and cross-section.

Methods," additional **Areas** will be necessary to describe the **Project**.

The Lower Bed will be mined by one "Mining Method," but since resources are in two states (two different tax entities) conveying to one central loadout, two **Areas** will be needed to describe the **Project**. Likewise, the Upper Bed lies within two states with one mining model (3:1) used in State A and State B and the second mining model (6:1) used only in State A. Therefore, two **Areas** will be needed for the 3:1 dragline and truck-shovel model and one **Area** will be needed for the 6:1 dragline and truck-shovel model. Therefore, a total of five **Areas** will be needed for both **Seams** in this **Tutorial Project**. Note that the **Project** scenario is hypothetical and does not represent the geology, including coal quality, of any coal bed within the United States.

Seam/Groupings

When opening the **Seams, Areas, and Discounted Cash Flows** tab dialog window for the first time the user will not see any **Seams** in the database, and the window will look like figure B.14. *Click on the **Seams, Areas, and Discounted Cash Flows** tab and the resulting dialog window will show the collapsed data entry fields for coal quality and coal resource data (fig. B.14). When the expand button (+) is clicked to the left of the data entry field the data group heading will be expanded, resulting in a dialog window similar to figure B.15*. This window will allow information to be entered into the data entry fields.

Progress in the tutorial cannot proceed until a **Seam Name** is entered. Therefore, *click on the "insert record" button (+) on the database Navigation Bar;* the word "None" will appear. *Highlight "None" and type in the name of the first coal bed: Lower Bed. Click the "insert" button on the database Navigation Bar again and add the second coal seam: Upper Bed.* Then *post the changes by clicking on the check-mark on the Navigation Bar*. The **Seam** page should look like figure B.16 with expanded data entry fields.

Coal-quality data are used in the CoalVal **Report** to determine whether the coal can be mined and processed to produce a compliance-quality coal. This tutorial will use the coal quality and resource information found in table B.1. *Entering a value for a field on the coal seam form is done by clicking on the plus button (+) adjacent to the menu item in the hierarchical section.* Clicking on the minus sign (-) will close a hierarchical layer. Zeros cannot be entered into the data field boxes in the **Seam** dialog window. If the data field box is empty, CoalVal will assume the value is zero. Likewise, the user does not need to type in commas when entering large numbers. CoalVal will recognize that a comma is necessary and will add it where needed.

The **Hurdle Rate** for the Lower Bed in table B.1 is zero while the **Hurdle Rate** for the Upper Bed is 16.5 percent. The reason for different **Hurdle Rates** is that associated Discounted Cash Flow (DCF) analyses are planned only for the Upper Bed in this Tutorial. No DCF analysis will be run on the Lower Bed so the hurdle rate should be set to zero.

Enter the data from table B.1 into the data table for the two beds in the **Seam** dialog window. The user will note that the "Moist Mineral Matter Free (MMF) Btu" is calculated by CoalVal using the ASTM Standard (ASTM International, 2008). After the data are entered *click on the checkmark on the Navigation Bar or close the CoalVal window and the coal quality and resource and restrictions data will be saved (fig. B.17)*. Note that the Coal Quality fields also contain data fields for estimated sold coal quality. Data will not be entered into these fields in the Tutorial Test Project. Also, the last group on this dialog page is "Densities." The default densities are Coal = 1,800 tons per ac-ft; Parting = 2,500 tons per ac-ft; and Out-of-Seam Dilution = 2,400 tons per ac-ft. If the user desires to use different densities for the calculations in CoalVal, this is the dialog page on which to make those changes.

Coal Resource Area Calculations

*Click on the **Coal Resource and Discounted Cash Flow Areas** tab to display the **Coal Resource and Discounted Cash Flow Areas** page of the **Projects** dialog (fig. B.18)*. This page is shown with the hierarchical sections both expanded and collapsed. To view this page with the hierarchical section expanded, *click th*e "Expand All" *button (fig. B.19)*. After opening the **Coal Resource and Discounted Cash Flow Areas** tab the first time, CoalVal will remember the hierarchical status left by the user, and the next time the dialog window is opened it will have the same status.

The **Project Tutorial** mining scenario example (fig. B.13) contains three areas for the Upper Bed and two areas for the Lower Bed. Figure B.18 shows the selection of the **CoalVal Test Project** and the Lower Bed (*look at the bottom status bar of the dialog window*). Any areas that are entered will be added to the **Project** and the **Seam** will be displayed in the status bar. If this was not the **Project** or **Seam** needed, the **Seam** desired could be found by *clicking on the **Seam** tab and selecting the appropriate seam.*

The items that can be placed in the data columns of the **Area Table** (fig. B.19) need to be reviewed before proceeding with data entry. The mandatory items are underlined in the following list. Following that review, **Tax Tables** and **Haul Cost Tables** will be developed to add that information into the **Coal Resource and Discounted Cash Flow Areas**.

1. Area Name
2. Washed – If checked, the washed cost will be used for the reports.
3. Tax Table – User selects the Tax Table to use for the reports.
4. Haul Cost Table – User selects the haul cost for the reports.

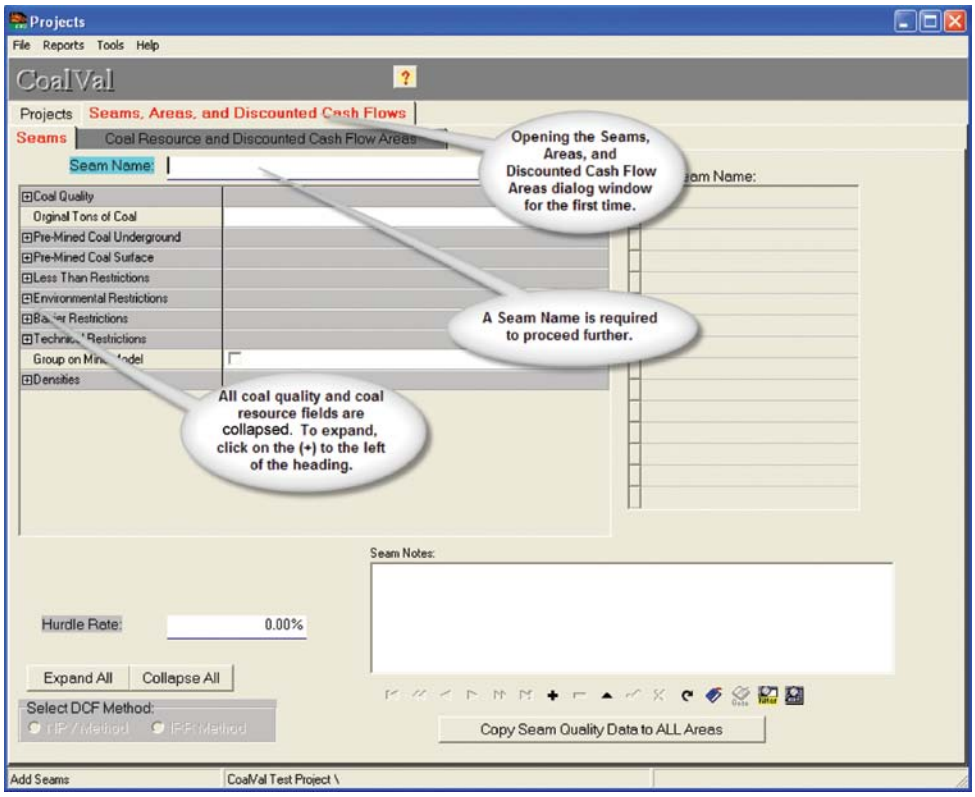


Figure B.14. Opening CoalVal's Seams, Areas, and Discounted Cash Flow dialog window in the Projects dialog for the first time.

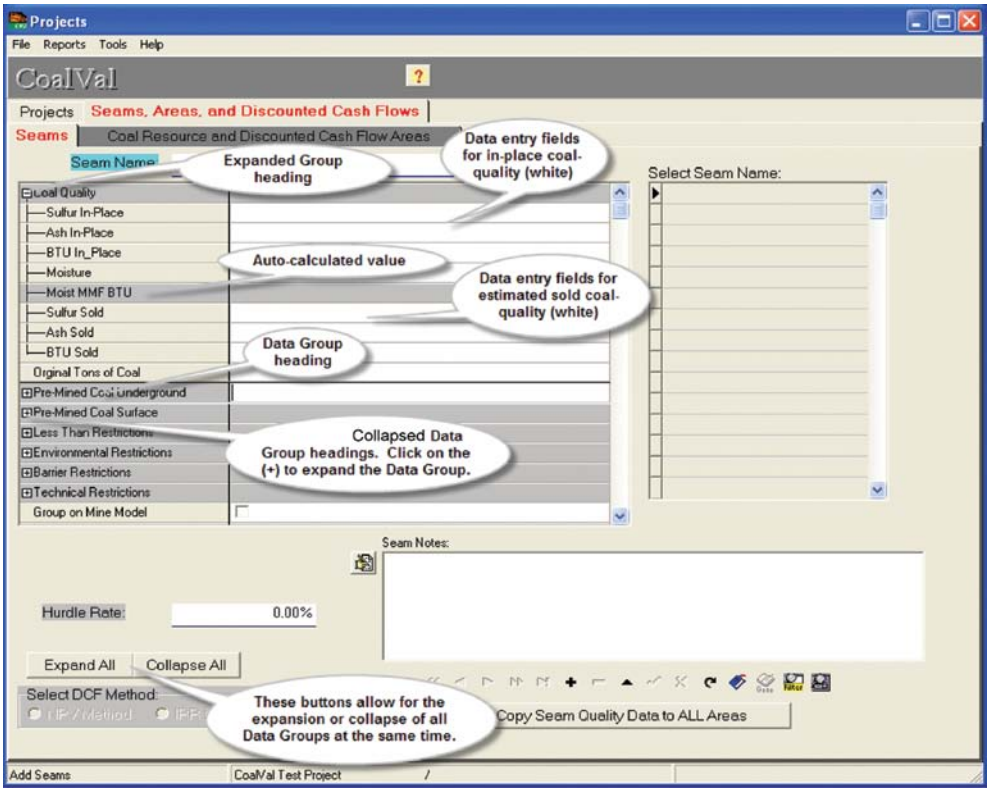


Figure B.15. CoalVal's Projects window showing the expanded data entry fields in the Seams, Areas, and Discounted Cash FLow dialog window.

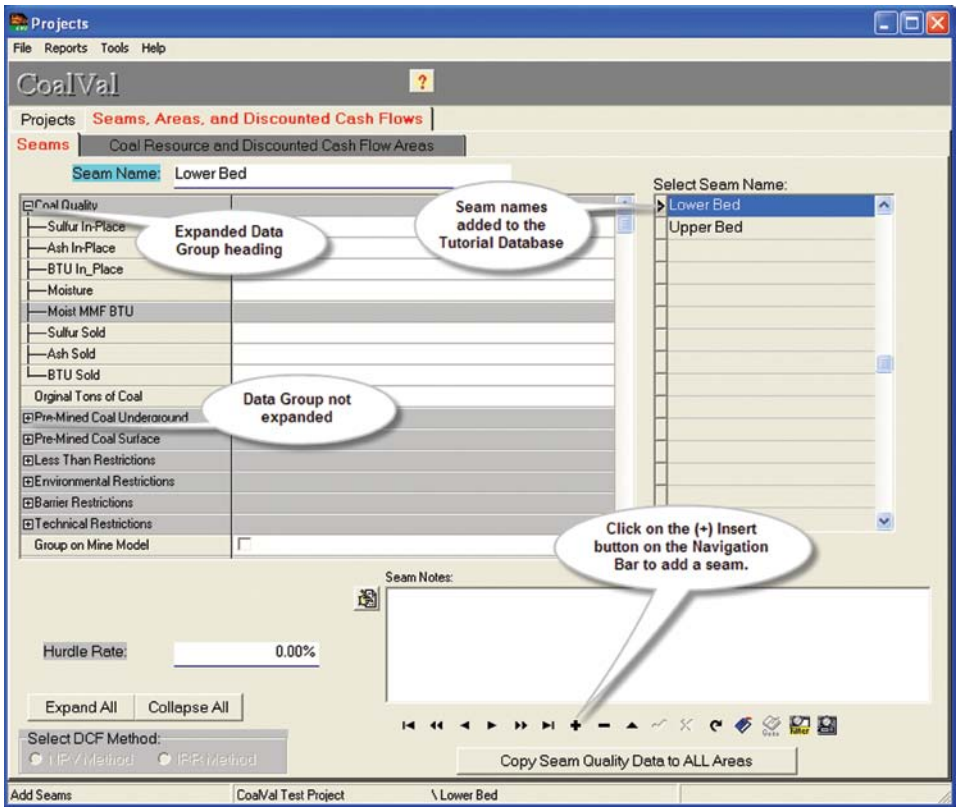


Figure B.16. CoalVal's Seam dialog window in the Projects dialog after seam names have been added.

Table B.1. Coal quality data and coal resources for the lower and upper beds in the tutorial project area.

[Btu, British thermal unit]

Coal Quality and Resources	Lower Bed	Upper Bed
Sulfur (in weight percent)	1.6	1.8
Ash (in weight percent)	5.4	8.0
Btu	12,100	11,500
Moisture (in weight percent)	5.2	5.8
Original Tons of Coal	549,749,808	1,046,252,608
Pre-Mined Coal Underground	0	0
Pre-Mined Coal Surface	0	1,200,000
Less Than Restrictions—Coal (tons)	123,000	1,000,000
Environmental Restrictions—Coal (tons)	0	0
Barrier Restrictions—Coal (tons)	200,000	32,500
Technical Restrictions—Coal (tons)	1,050,000	566,000
Hurdle Rate (in percent)	0	16.5

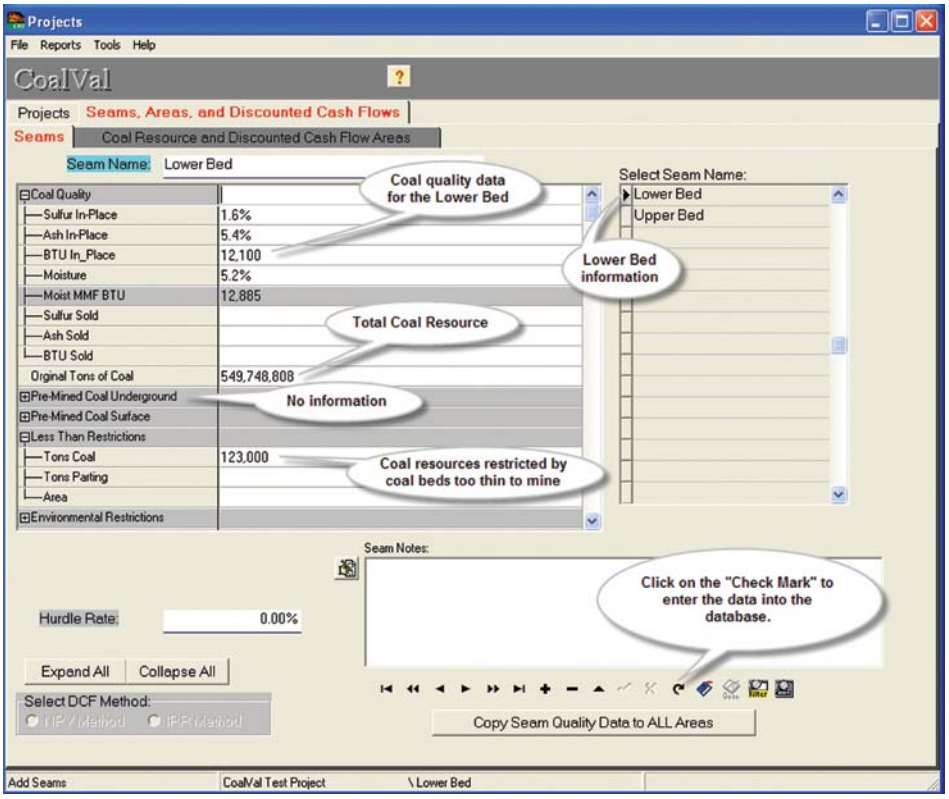


Figure B.17. Coal quality information entered into the Lower Bed database in the Coal Resource and DCF Areas dialog.

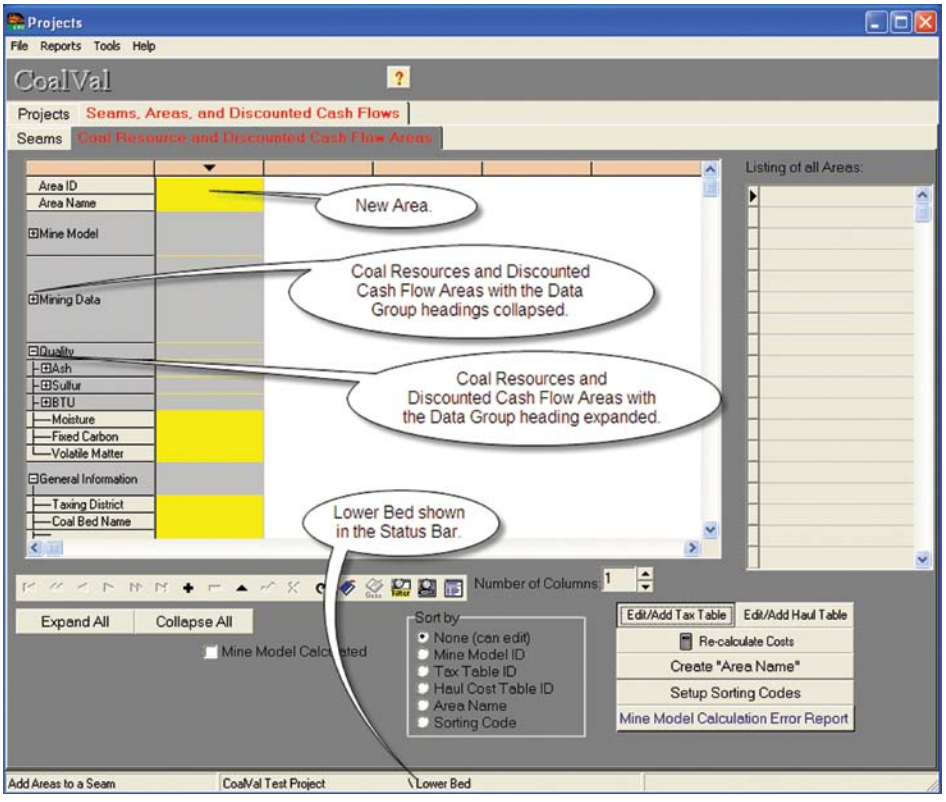


Figure B.18. Coal Resource and Discounted Cash Flow Areas dialog page in the Projects dialog with the "Data Group" headings collapsed and expanded.

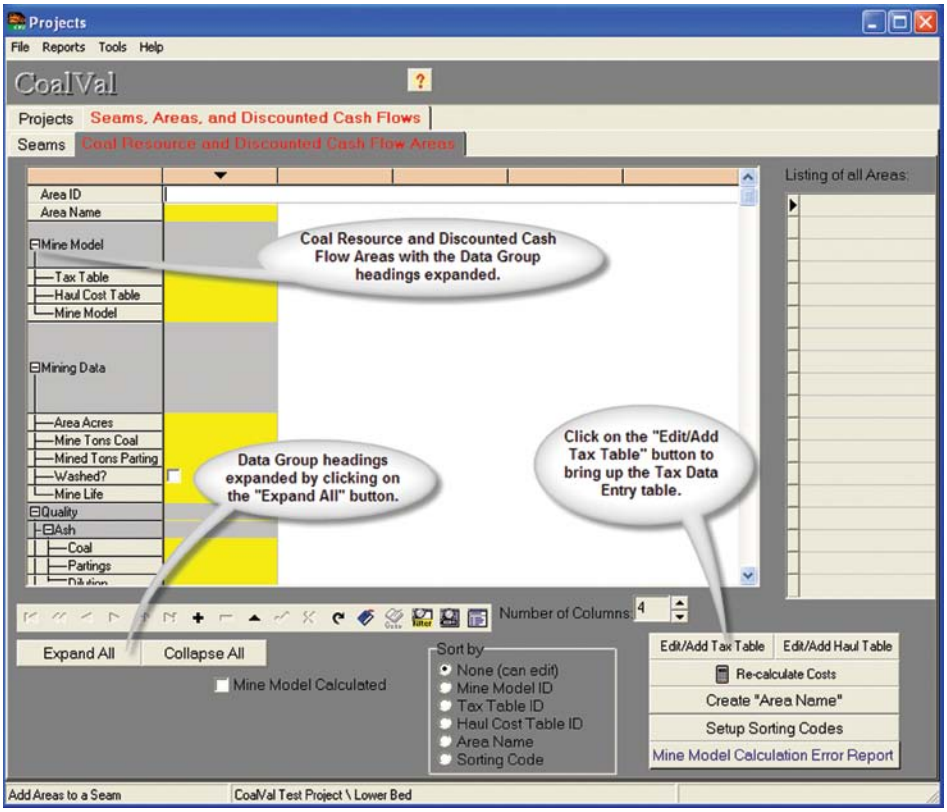


Figure B.19. CoalVal's Coal Resource and Discounted Cash Flow Areas dialog page in the Projects dialog with the "Data Group" headings expanded.

5. Area Acres –Total acres for the area of interest. An acre value must be added.

6. Mined Tons of Coal – The amount of coal that will be mined in this area.

7. Mined Partings Tons –The parting in tons that will be mined.

8. Mine Model – A Mine Model for a Seam or Project report must be selected.

9. Quality – Detailed quality for each Area if it is available. If the individual Area coal quality is not available for all Areas, the quality for one Area can be used by *inputting the coal quality into one* Area *and clicking the* Copy Seam Quality Data to ALL Areas *button on the* Seam *page*. That average quality for one Area will be copied into all Areas.

Tax Terms

To access a Tax Table *click on the* "*Edit/Add Tax Table" button in the lower right hand corner of the* ***Coal Resources and Discounted Cash Flow Areas*** *dialog window (fig. B.19)*. The CoalVal Tax Tables (also known as Tax Data Entry dialogs, fig. B.20) contain estimated coal sales prices, tax rates, and valuation rates that will be used for each coal taxation district. The Tax Tables also include the cost of acquiring undeveloped coal resources and surface rights. In CoalVal, the "Name of Tax Zone" may indicate in which Tax district it is located and mineral rights ownership. Royalties, Taxes and Fees use the Contract per Ton price in the formula used to calculate the annual cash cost statement in the Mine Model and Seam reports. The "Cash Cost Statement" summarizes the cash cost of continued mining operations, but it does not include sunken costs such as capital expenses, property acquisition, and property exploration and development costs. The threshold price for individual coal Resource Areas is calculated during the Discounted Cash Flow (DCF) Analysis. At the threshold price, the net present value of after-tax income over the mine life equals the capital investment where price-based royalties and taxes are calculated on the threshold price independent of market pricing.

Before entering additional tax data, the nature of possible taxes and acquisition costs must be reviewed. Typically, there is an acquisition cost for the mineral rights and royalty fees. CoalVal requires only one entry under Royalty Rates and Acquisition Costs; otherwise, multiple taxes fees will be calculated. Acquisition Costs cover the cost of acquiring the in-place coal on undeveloped properties and will be different

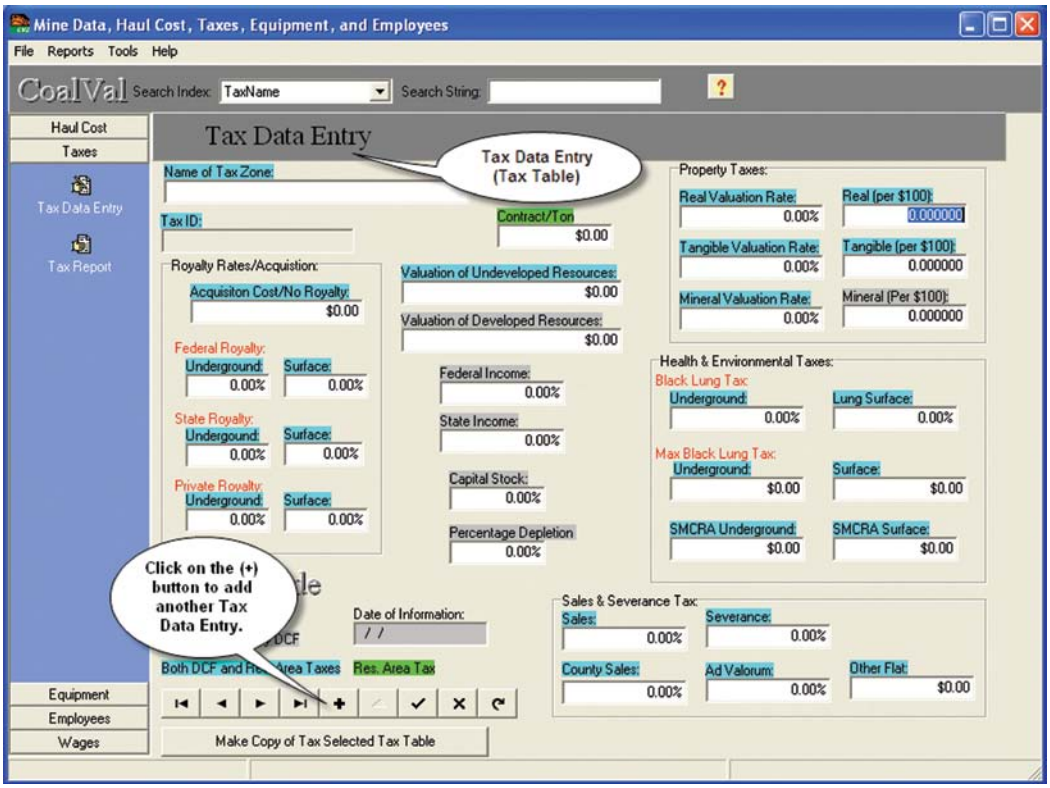


Figure B.20. New CoalVal Tax Data Entry dialog window (Tax Table).

for surface mineable coal and for underground mineable coal. The dollar-per-ton value entered will be multiplied by the amount of coal in the ground.

Royalty Rates are paid annually as a percentage of the sales price on the coal sold that year and, like the Acquisition Costs, the Royalty Rates are normally different for surface and underground mineable coal resources. The CoalVal **Tax Table** allows for the entry of Royalty Rates by mineral ownership and whether the mining is surface or underground. Mineral ownership can be Federal, state or private. Surface land ownership fees, if applicable, can be entered into the Other Flat tax category under the Sales and Severance Tax section of the table.

The CoalVal **Tax Table** enables assignment of common Royalty Rates to particular ownership categories and the royalties can be summarized in a report according to ownership. A separate **Tax Table** for each Royalty Rate or Acquisition Cost category will be needed. Most fields in the Tax Tables are completed with data that has one or two decimal places; however, Property Taxes may be reported by the county or state Tax Assessor in more than two decimal places, and mils are reported to six decimal places in some counties. **Tax Table** items are listed in appendix C, Program Description, Tax Table section and associated definitions are found in appendix D, Glossary of Terms.

Tax Table Construction

Determine the number of **Tax Tables** needed. The previously reviewed **Project** mining scenario example (fig. B.13) has two states with different taxes and two coal **Seams**, one requiring underground "Mining Methods" for extraction and one requiring surface "Mining Methods" for extraction. Therefore, four **Tax Tables** are needed. County taxes are considered in CoalVal but are not utilized in this tutorial. In CoalVal, a **Tax Table** or **Haul Cost Table** is stored as a look-up table and can be accessed from the **Tools** menu on CoalVal's **Main Menu**, from the **Coal Resource and Discounted Cash Flow Areas** tab under the **Projects Menu**, or from the **Mine Data** button under the **Mine Models Menu**. This means that once a **Tax** or **Haul Cost Table** has been created it can be used in any area in any **Project**. There are two **Seams** in each state; therefore, two **Tax Tables** will be created for State A and two **Tax Tables** will be created for State B. This **Tutorial Project** will use the information in tables B.2 and B.3 to develop the **Tax Tables** for State A and the information in tables B.4 and B.5 to develop a **Tax Tables** for State B.

When a Tax Table is constructed, the easiest way to enter data is to begin by typing in the name of the Tax Zone and using the Tab key to enter data into the remaining table fields. *Enter the data from table B.2 into the **Tax Data Entry Table***

Table B.2. State A - Lower Bed Tax Table information.

[SMCRA, Surface Mining Control and Reclamation Act]

Tax Data Entry	Value	Tax Data Entry	Value
Name of Tax Zone	State A-Lower Bed	Real Valuation Rate	30.00%
Tax ID	CoalVal Assigned	Real Valuation/$100	0.35
Royalty Rates/Acquisition	$.75	Tangible Valuation Rate	0.00%
Federal Royalty-Underground	0.0%	Tangible Valuation/$100	0.00
Federal Royalty-Surface	0.0%	Mineral Valuation Rate	20.0%
State Royalty-Underground	6.5%	Mineral Valuation/$100	0.68
State Royalty-Surface	0.0%	Black Lung Tax-Underground	4.40%
Private Royalty-Underground	0.0%	Black Lung Tax-Surface	2.20%
Private Royalty-Surface	0.0%	Max Black Lung-Underground	1.10
Contract Cost/Ton	$68.00	Max Black Lung-Surface	0.55
Valuation of Undeveloped Coal	$0.60	SMCRA Tax-Underground	$0.15
Valuation of Developed Coal	$1.20	SMCRA Tax-Surface	$0.32
Federal Income Tax	35.00%	State Sales Tax	5.00%
State Income Tax	7.00%	State Severance Tax	4.00%
Capital Stock	1.99%	County Sales Tax	0.00%
Percentage Depletion	10.00%	State Ad Valorem Tax	0.00%
Date of Information	01/08/2009	Other Flat Tax	0.00%

Table B.3. State A - Upper Bed Tax Table information.

[SMCRA, Surface Mining Control and Reclamation Act]

Tax Data Entry	Value	Tax Data Entry	Value
Name of Tax Zone	State A-Upper Bed	Real Valuation Rate	30.00%
Tax ID	CoalVal Assigned	Real Valuation/$100	0.17
Royalty Rates/Acquisition	$1.50	Tangible Valuation Rate	0.00%
Federal Royalty-Underground	0.0%	Tangible Valuation/$100	0.00
Federal Royalty-Surface	0.0%	Mineral Valuation Rate	20.00%
State Royalty-Underground	0.0%	Mineral Valuation/$100	$0.60
State Royalty-Surface	12.5%	Black Lung Tax-Underground	4.40%
Private Royalty-Underground	0.0%	Black Lung Tax-Surface	2.20%
Private Royalty-Surface	0.0%	Max Black Lung-Underground	1.10
Contract Cost/Ton	$60.00	Max Black Lung-Surface	0.55
Valuation of Undeveloped Coal	$0.55	SMCRA Tax-Underground	$0.15
Valuation of Developed Coal	$1.10	SMCRA Tax-Surface	$0.32
Federal Income Tax	35.00%	State Sales Tax	5.00%
State Income Tax	7.00%	State Severance Tax	4.00%
Capital Stock	1.99%	County Sales Tax	0.00%
Percentage Depletion	10.00%	State Ad Valorem Tax	0.00%
Date of Information	01/08/2009	Other Flat Tax	0.00%

Table B.4. State B - Lower Bed Tax Table information.

[SMCRA, Surface Mining Control and Reclamation Act]

Tax Data Entry	Value	Tax Data Entry	Value
Name of Tax Zone	State B-Lower Bed	Real Valuation Rate	30.00%
Tax ID	CoalVal Assigned	Real Valuation/$100	0.35
Royalty Rates/Acquisition	$.75	Tangible Valuation Rate	0.00%
Federal Royalty-Underground	0.0%	Tangible Valuation/$100	0.00
Federal Royalty-Surface	0.0%	Mineral Valuation Rate	00.0%
State Royalty-Underground	6.5%	Mineral Valuation/$100	0.00
State Royalty-Surface	0.0%	Black Lung Tax-Underground	4.40%
Private Royalty-Underground	0.0%	Black Lung Tax-Surface	2.20%
Private Royalty-Surface	0.0%	Max Black Lung-Underground	1.10
Contract Cost/Ton	$68.00	Max Black Lung-Surface	0.55
Valuation of Undeveloped Coal	$0.00	SMCRA Tax-Underground	$0.15
Valuation of Developed Coal	$0.00	SMCRA Tax-Surface	$0.32
Federal Income Tax	35.00%	State Sales Tax	4.00%
State Income Tax	6.00%	State Severance Tax	4.00%
Capital Stock	2.00%	County Sales Tax	0.00%
Percentage Depletion	10.00%	State Ad Valorem Tax	0.00%
Date of Information	01/23/2009	Other Flat Tax	0.00%

Table B.5. State B - Upper Bed Tax Table information.

[SMCRA, Surface Mining Control and Reclamation Act]

Tax Data Entry	Value	Tax Data Entry	Value
Name of Tax Zone	State B-Upper Bed	Real Valuation Rate	30.00%
Tax ID	CoalVal Assigned	Real Valuation/$100	0.17
Royalty Rates/Acquisition	$1.50	Tangible Valuation Rate	0.00%
Federal Royalty-Underground	0.0%	Tangible Valuation/$100	0.00
Federal Royalty-Surface	0.0%	Mineral Valuation Rate	00.00%
State Royalty-Underground	0.0%	Mineral Valuation/$100	$0.00
State Royalty-Surface	12.5%	Black Lung Tax-Underground	4.40%
Private Royalty-Underground	0.0%	Black Lung Tax-Surface	2.20%
Private Royalty-Surface	0.0%	Max Black Lung-Underground	1.10
Contract Cost/Ton	$60.00	Max Black Lung-Surface	0.55
Valuation of Undeveloped Coal	$0.00	SMCRA Tax-Underground	$0.15
Valuation of Developed Coal	0.00	SMCRA Tax-Surface	$0.32
Federal Income Tax	35.00%	State Sales Tax	4.00%
State Income Tax	6.00%	State Severance Tax	4.00%
Capital Stock	2.00%	County Sales Tax	0.00%
Percentage Depletion	10.00%	State Ad Valorem Tax	0.00%
Date of Information	01/23/2009	Other Flat Tax	0.00%

*for **Tutorial Project: Name of Tax Zone:*** State A-Lower Bed. The **Tax Data Entry** dialog window for State A-Lower Bed should look like figure B.21 after the tax data entry is completed. The filter group subroutine in CoalVal will allow the user to separate this tax table from any others that are currently in CoalVal. When finished with the first tax table, click on the "insert**"** (+) button on the Navigation Bar to provide a new tax table. The next **Tax Data Entry Table** should appear; if not, *click on the "insert button" again and enter the data from table B.3 into the **Tax Data Entry Table** for State A-Upper Bed*. The **Tax Data Entry** dialog window for State A-Upper Bed should look like figure B.22 after the table B.3 has been entered.

*Press the insert (+) button on the Navigation Bar and add another **Tax Data Entry Table**. Enter the information found in table B.4 for State B-Lower Bed*. The **Tax Data Entry** dialog window should look like figure B.23. *Add a fourth **Tax Data Entry Table** and enter the information from table B.5 for the State B-Upper Bed*. The **Tax Data Entry Table** should look like figure B.24. *When finished entering the second tax table, press the "Post" button* (checkmark) *and close the dialog to return to the **Coal Resources and Discounted Cash Flow Areas** dialog window of the **Project** dialog*. If the "Post" button is inactive, CoalVal has automatically saved the data.

Editing a **Tax Table** is done by *clicking the up arrow on the Navigation Bar* (fig. B.25). *To edit an individual number in the **Tax Data Entry** or **Haul Cost Entry** dialog window, place the cursor over the farthest left digit of the number to be modified and double click*. This action will highlight the entire number and a new number can be typed into the box. ~~Another~~ A second method to edit a number is to *set the cursor to the right of the number and single click, then back-space out the number and replace it with the revised number.* Finally, the user can *click on the Tax Table's "Name of Tax Zone" and use the Tab key to move to the number that needs to be modified.*

Haul Cost Table

Haul Costs are used for contract truck haulage only. For example, if the mine is located in an area where a rail access is not possible, then the coal is hauled from the mine to the preparation facility or rail loadout by means of highway trucks. If a mine has its own loadout or has close access to a loadout, where contract trucking is not necessary, it is still necessary to have a **Haul Cost Table**. CoalVal must have **Coal Resources**, a **Mine Model**, a **Haul Cost Table**, and a **Tax Table** for the program to perform normally. If there is no contract haul cost a table must be developed and zero values used for costs and miles.

The next step in the **Tutorial Project** is to develop a **Haul Cost Table** that will be used for all of the **Areas**. It is assumed that all of the **Areas** have the same **Haul Cost** in this tutorial mining scenario example. The **Haul Cost Table** dialog can be accessed from the **Edit or Add Haul Table** button in the lower right corner of the **Coal Resource and Discounted Cash Flow Areas** dialog window (fig. B.26). *Press the "Edit/Add Haul Table" button and the **Haul Cost Table** will appear* (fig. B.27). *Enter the haul cost information from the following list*. When completed the **Haul Cost Entry** dialog should like figure B.28. If another **Haul Cost Table** is needed, *click on the "insert" button and a new **Haul Cost Entry** dialog will appear.*

Enter the following data into the **Haul Cost Entry Table**.
Name: Example Haul Cost
Fixed Costs: $0.55/ton
Variable cost: $.18/ton
Distance: 5 miles
Date of Information: today's date

One **Haul Cost Table** will be used for all five areas in this **Tutorial Project**. When the data entry has been completed, *click on the Checkmark or "post" button*. If the post button is not active, then CoalVal has automatically posted the information into the database and the user can exit the table without losing data. Then *close the dialog to return to the **Coal Resource and Discounted Cash Flow Areas** tab dialog window*.

Area Data Entry

The **Areas** data are derived from separate geological and mine modeling studies that are precursors to the CoalVal evaluation and not part of the CoalVal program. There are two ways to enter the **Areas** data into the **Coal Resource and Discounted Cash Flow Areas** database. The first way is to enter the data: "Area ID," "Area Name," "Mine Model information," "Mining Data," "Coal Quality," and "General Information" by hand. The Lower Bed will be used to demonstrate this method. The second method will demonstrate how to import DBF files directly into the **Coal Resource and Discounted Cash Flow Areas** database. The Upper Bed will be used for this example.

Area Data Entry (Manually Entered)

*Click on the **Seams** tab, and select the Lower Bed*. Then *click on the **Coal Resource and Discounted Cash Flow Areas** tab to return to that dialog window (fig. B.29)*. Two Areas need to be created for the Lower Bed. Make sure the Status Bar at bottom of the screen shows CoalVal Test Project\Lower Bed. Table B.6 contains the mining data that need to be entered into the "Mining Data" Group in the ***Coal Resource, Areas, and Discounted Cash Flow Areas*** dialog.

The first row of data in Table B.6 is information for the **Area** in State A and the second row is information for the **Area** in State B for the Lower Bed. *Click on the "insert" (+) button on the Navigation Bar to add a new **Area** record* ("None" may be displayed in the "Area Name" box). *Highlight "None" and type in "State A" in the "Area Name" box*

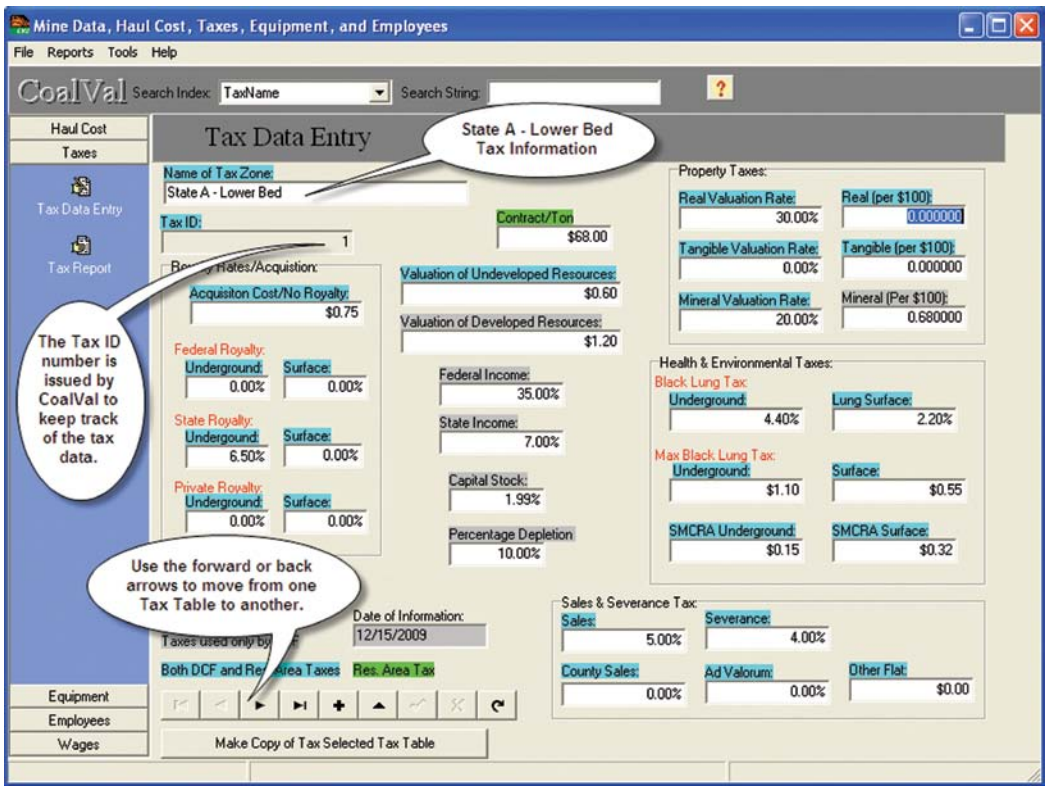


Figure B.21. CoalVal's Tax Table dialog window for the Lower Bed in State A.

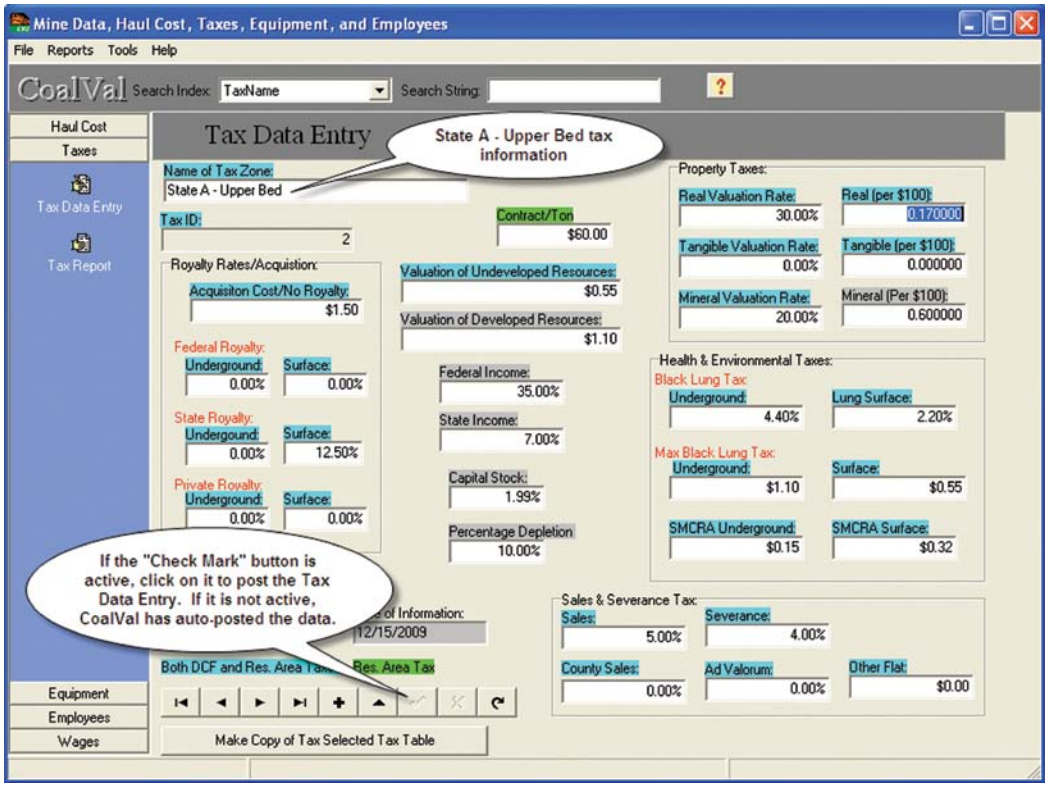


Figure B.22. CoalVal's Tax Table dialog window for the Upper Bed in State A (if the "Check Mark" button is not activated on the Navigation Bar, CoalVal has auto-saved the data entry).

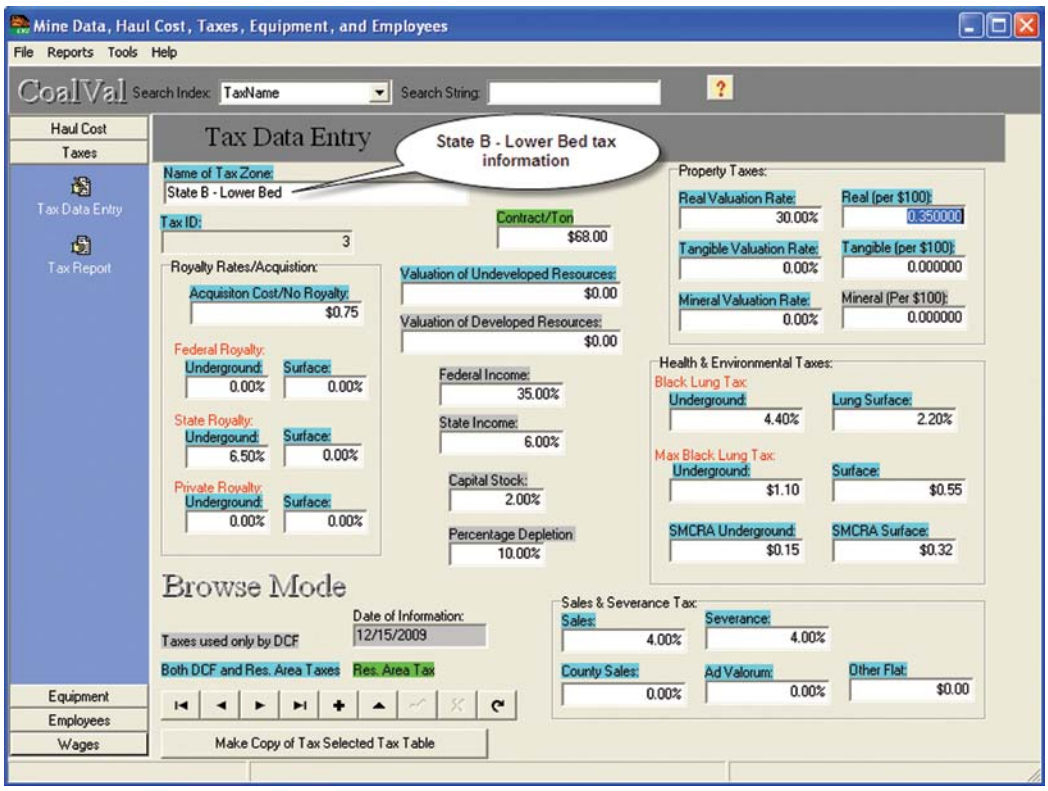


Figure B.23. CoalVal's Tax Table dialog window for the Lower Bed in State B.

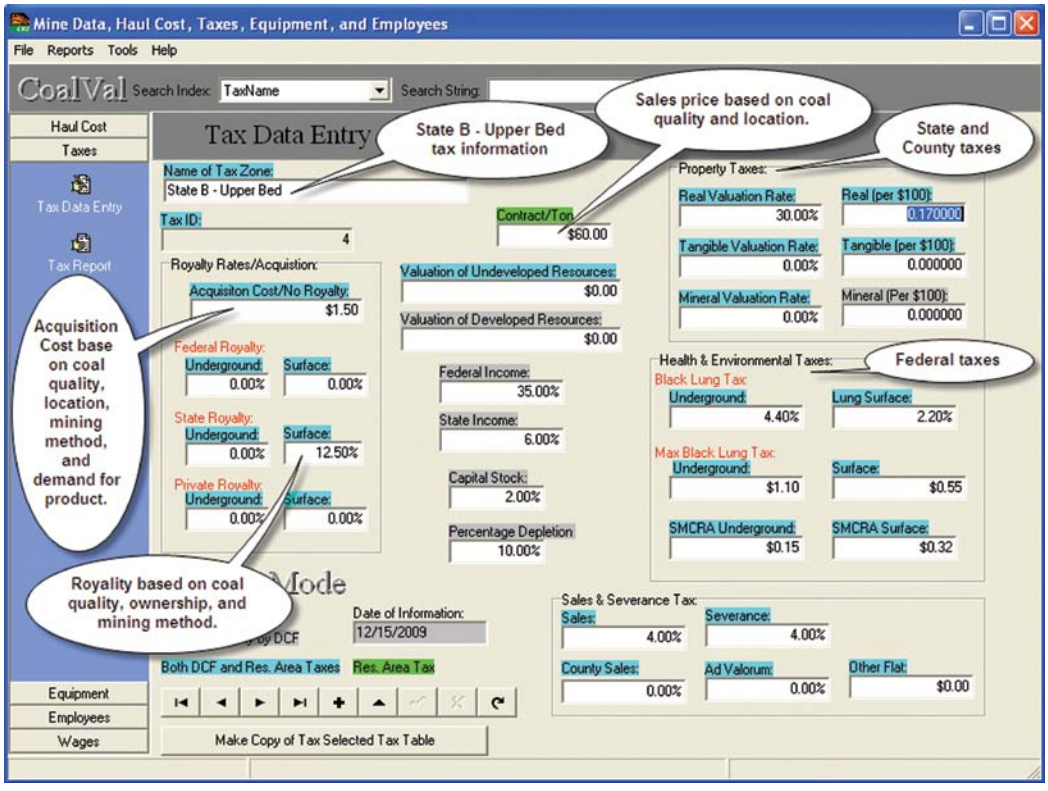


Figure B.24. CoalVal's Tax Table for the Upper Bed in State B.

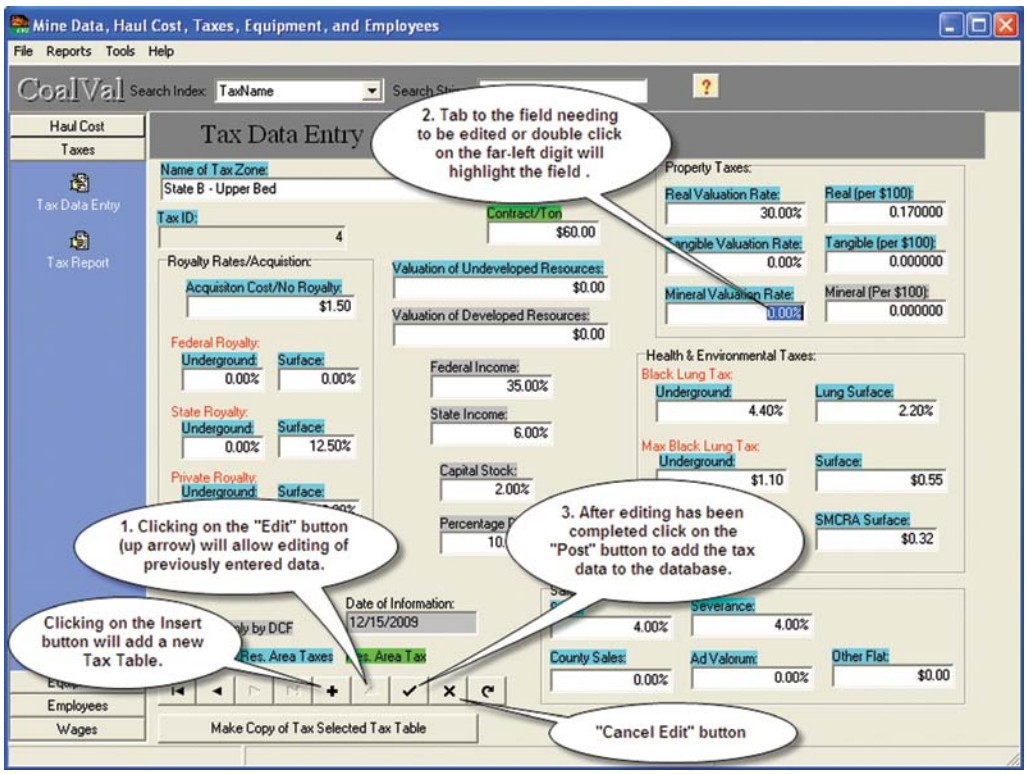


Figure B.25. CoalVal's Tax Data Entry Table showing the "Edit Mode" and defining Navigation Bar buttons.

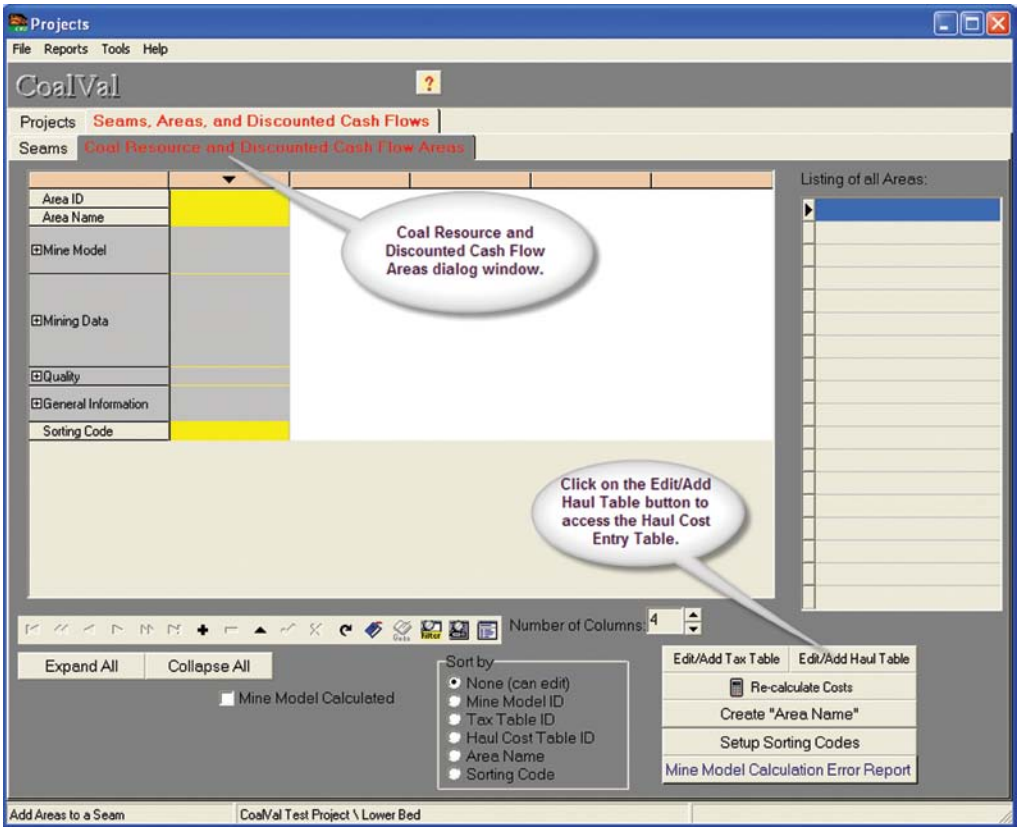


Figure B.26. Adding a Haul Cost Table by clicking on the "Edit/Add Haul Table" button in the Coal Resource and Discounted Cash Flow Areas dialog window.

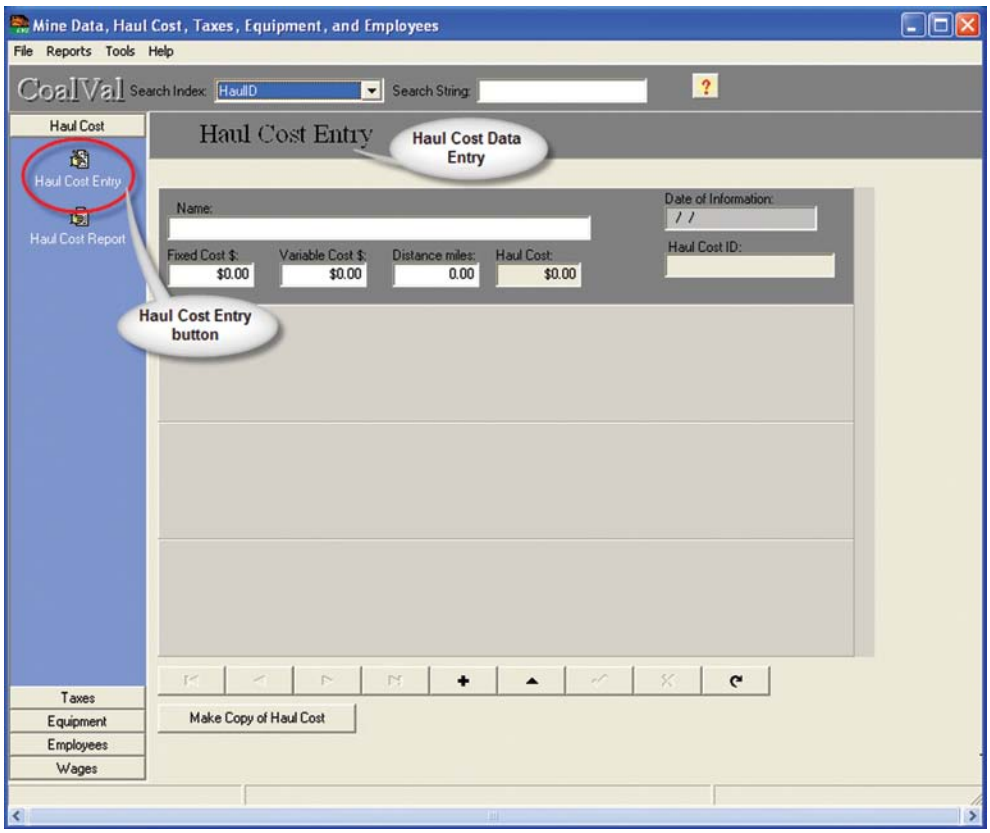


Figure B.27. CoalVal's Haul Cost Data Entry dialog window.

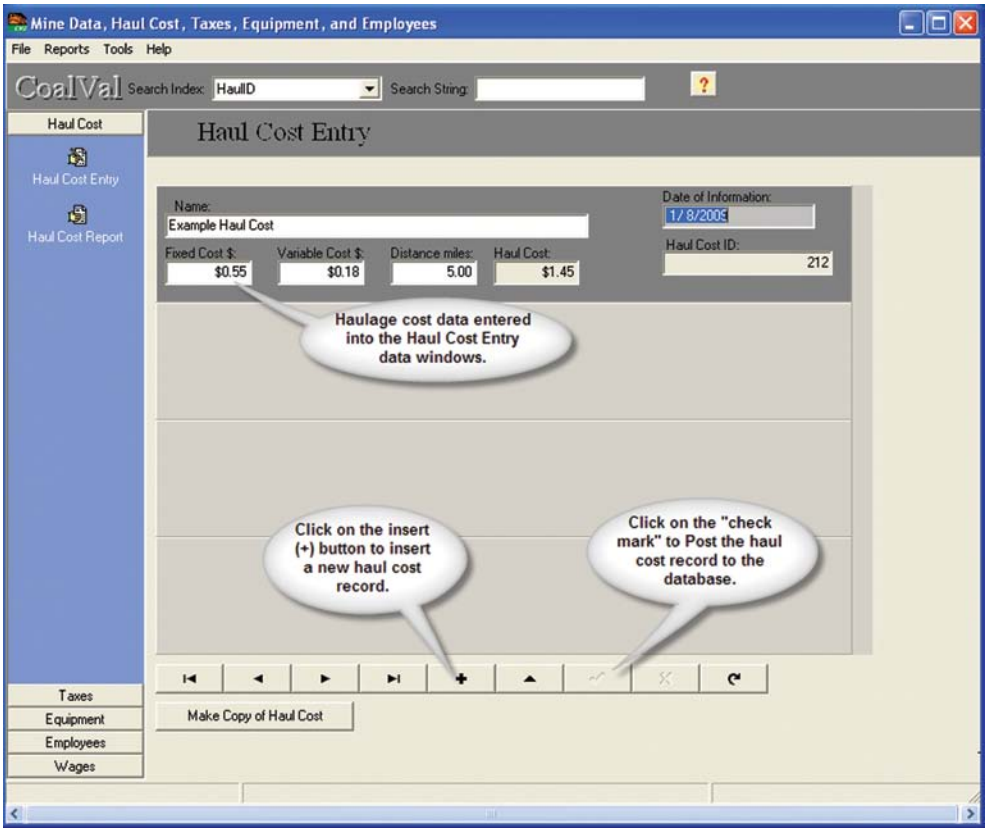


Figure B.28. Haul cost data entered into CoalVal's Haul Cost Table.

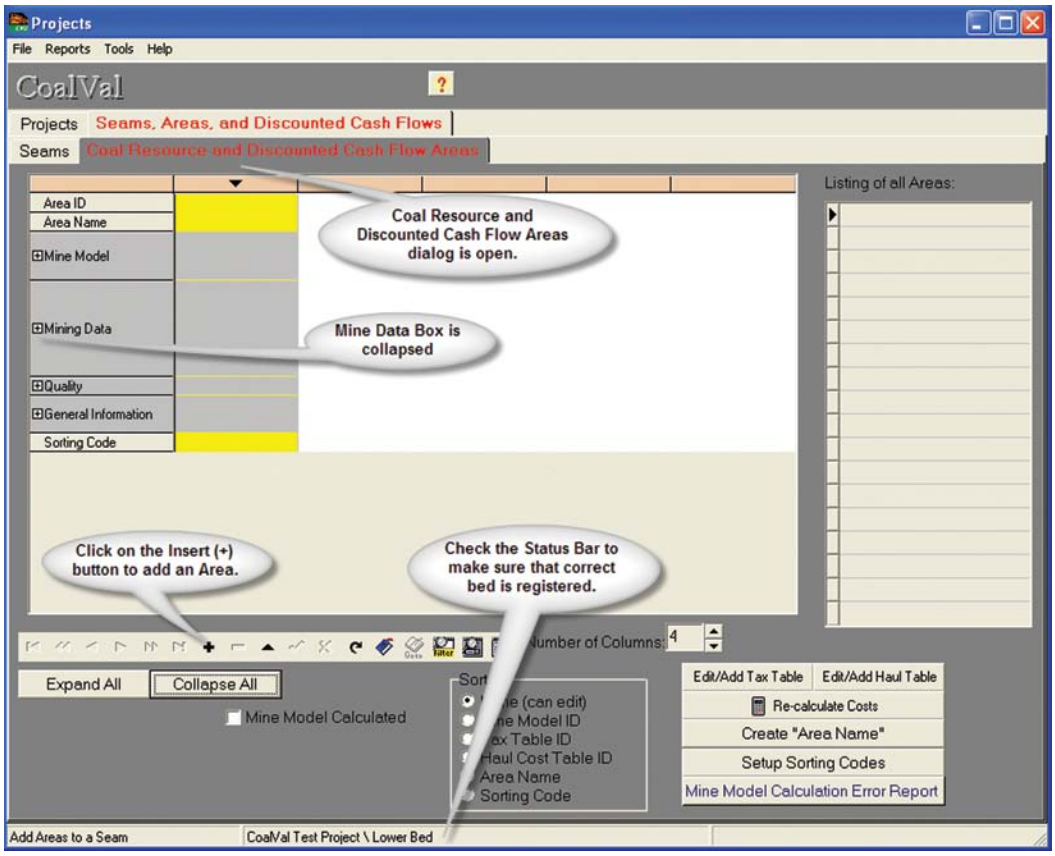


Figure B.29. CoalVal's Coal Resource and Discounted Cash Flow Areas dialog window showing the "Insert" (+) button on the Navigation Bar.

Table B.6. Mineable Coal and Parting Data for the Lower Bed, State A and State B.

Area Name	Area (acres)	Lower Bed Coal (tons)	Lower Bed Parting (tons)
State A	2,050	199,293,904	7,257,020
State B	3,869	350,455,904	18,554,696

(fig. B.30). *Then click the "insert" (+) button on the Navigation Bar to add a second new record and type in State B for that "Area Name."* Now *post the records by clicking on the "Checkmark" button on the Navigation Bar*. It is important to note that the "Area ID" numbers shown in figure B.30 may not match the numbers in the user's **Tutorial Project**. Now *click the (+) or expand button to the left of "Mining Data" box*. The drop-down boxes for "Area Acres," "Mine Tons of Coal," and "Mined Tons of Parting" are shown in figure B.31. *Enter the mining data from table B.6 into the appropriate data fields for State A and State B.*

The Lower Bed will be mined using underground mining methods that add dilution to the produced coal thus requiring the coal to be washed. Make sure the "Washed" boxes in the Mining Data Group are checked for both **Areas.** The user will note that the mine life default value is 10 years. If a different mine life is desired that number can be changed in this group. The resulting dialog window should look like figure B.31.

The **Tax** and **Haul Cost Tables** will be added to the database next. *Click on the (+) or expand button to the left of **Mine Model** allowing the drop-down boxes to show the list of tables (fig. B.32)*. Now *click on the "Tax Table" box under State A and an "Open File" button will appear (fig. B.33)*. This action will also make the State A **Area** (Area #6273) active as shown by the yellow colored boxes. *Click on the "Open File" button, and the **Tax Tables** that were developed in the preceding section will be shown (fig. B.33)*. Next*, select State A - Lower Bed in the "Select Tax Table" menu and click on OK*. The **Tax Table** title "State A" will appear in the drop-down **Tax Table** box (fig. B.34). *Click on the checkmark on the Navigation Bar to post the entry*. *Follow the same procedure for State B taxes and for both State A and State B with the Example Haul Cost Table*. Then *post the additions by clicking on the checkmark or closing the dialog window*. The resulting dialog window should look like figure B.35.

When the CoalVal program was installed, several files used in the Tutorial were placed in the CoalVal folder found in C:\Documents and Settings\(your file name)\My Documents\ CoalVal (fig. B.36). These folders and files (fig. B.37) allow author-developed data to be directly imported into the CoalVal Tutorial, thereby providing the user with examples of working data.

Mine Models are needed to complete the data fields in the **Coal Resource and Discounted Cash Flows Areas** tab. No **Mine Models** currently exist in this database. To facilitate this tutorial example, two dragline and truck-shovel **Mine Models** and a room and pillar-continuous miner **Mine Model** developed by the authors will be imported into the **Mine Model** dialog. Development of **Mine Models** is explained in appendix A, **Mine Model** Assumption Details, and in the **Mine Model** section in the Program Description Chapter, appendix C.

To import a **Mine Model** *exit out [X] of the **Coal Resource and Discounted Cash Flows Areas**, and click on the **Mine Model** icon on CoalVal's **Main Menu** (fig. B.38)*. After the **Mine Model** Menu is opened, *click on the file menu (fig. B.39), then click on the **Mine Model Data Exchange** item (fig. B.39)*. *Select the **Import Mine Model Exchange** file tab and click on the: "1. Select File**"** button to open the "**Open CoalVal Import Export File**" dialog window (fig. B.40)*. This dialog window will show the "MineModel" folders used for the CoalVal Tutorial with three mine models. *Click on the TSDTest.CVMM file* (which contains a 3:1 ratio, Truck-Shovel/Dragline **Mine Model**, and click on the "Open" button (fig.B.40). NOW *select: "2. Import" (fig. B.41)*, *and the "Mine Model" file will be imported into the **Mine Model** database*. To import the second mine model, *click on the "1. Select" button and select the file named: PittsConMiner.CVMM* (which contains a room and pillar, continuous miner, **Mine Model**, fig. B.42). *Click "Open" and then click on the "2. Import**"** button*. A third mine model is found in the DTS6-1.CVMM file (this contains a 6 to 1 ratio Truck-Shovel/Dragline mine model) which will be needed later in the Tutorial. Follow the previous steps and *import the third **Mine Model** at this time (fig. B.43)*. *Exit out of the **Import Mine Model Exchange File** dialog window to the **Mine Model** dialog window*. The dialog window should contain three mine models and look like figure B.44. If it does not contain three **Mine Models**, then *click on the checkmark to update (post) the data and all three mine models will show in the dialog window*. *Close the **Mine Model** dialog window and return to CoalVal's **Main Menu***.

Finally, referencing the project mining scenario example (fig. B.13), note that room and pillar mining using continuous miners was used to mine both state areas in the Lower Bed. *Click on the **Projects Menu**, click on the **Seams, Areas, and Discounted Cash Flows** tab, then click on the **Seams** tab and check that the Lower Bed is still selected.* Then *click on the **Coal Resource and Discounted Cash Flow Areas** tab*. Next, *click on the **Mine Model** data entry box under State A and then on the "Open File" button*. *Select the "Cont. Miner 42-72" Pittsburgh Seam **Mine Model**, and click OK (fig. B.45)*. *Do the same for State B, selecting the same mine model.* The completed entries for the room and pillar **Mine Models** should look like figure B.46.

ArcView DBF (dBase IV) File Importing

One of the output formats for ArcView data is in a DBF (dBase IV) file or DBF table with a .dbf file extension. The table contains rows and columns and can be imported into Microsoft Windows® XP Excel 2003 or earlier versions. CoalVal was first written to import DBF tables. (See: Import GIS and Quality Data Tutorial for more information.)

After the data for both Lower Bed **Areas** has been entered, *click on the **Seams** tab (fig. B.47)*. The next process will be to import data for the Upper Bed into the **Project Area**. *Select the Upper Bed, and then click on the **Coal Resource and Discounted Cash Flow Areas** tab to begin to create the next three **Areas***. Instead of typing in data, as in the previous section, data will be imported from an ArcView database (in a .dbf file format) into the **Area Table**. From the **Projects** dialog window, *click on the **Tools** drop-down menu*

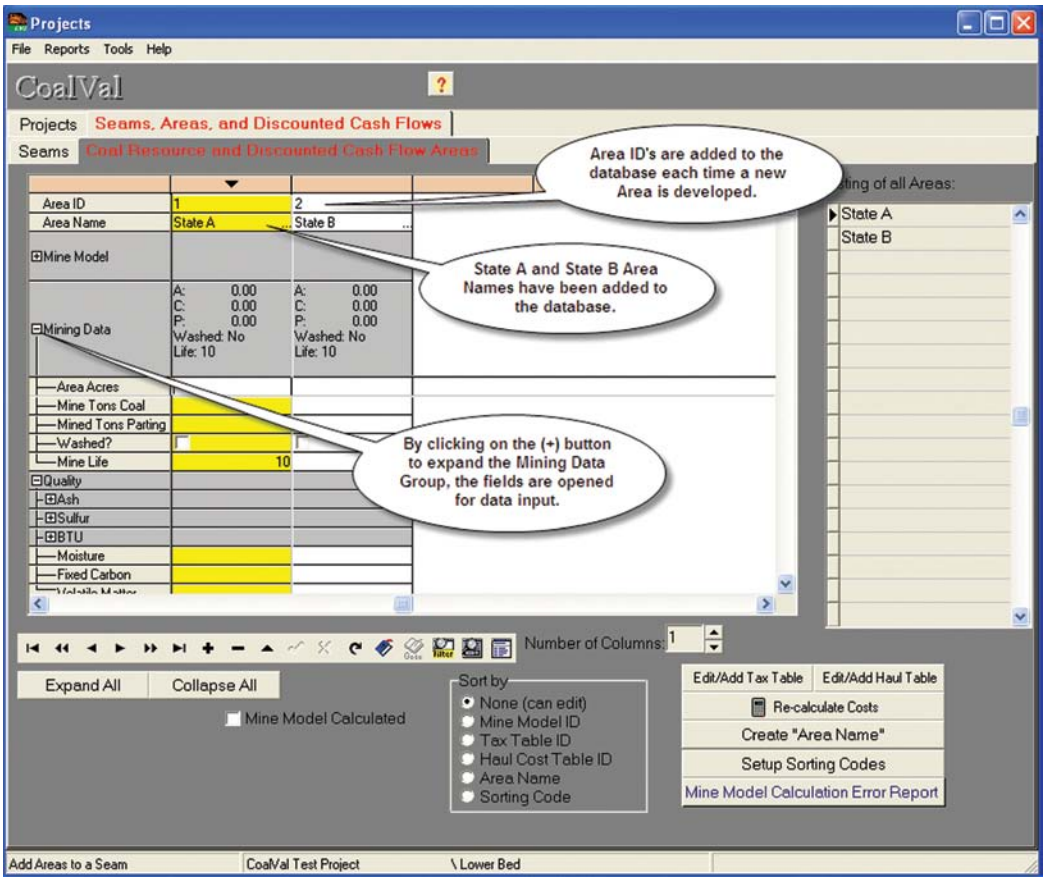


Figure B.30. Using the "Plus" (+) button to expand the "Mining Data" Group Fields.

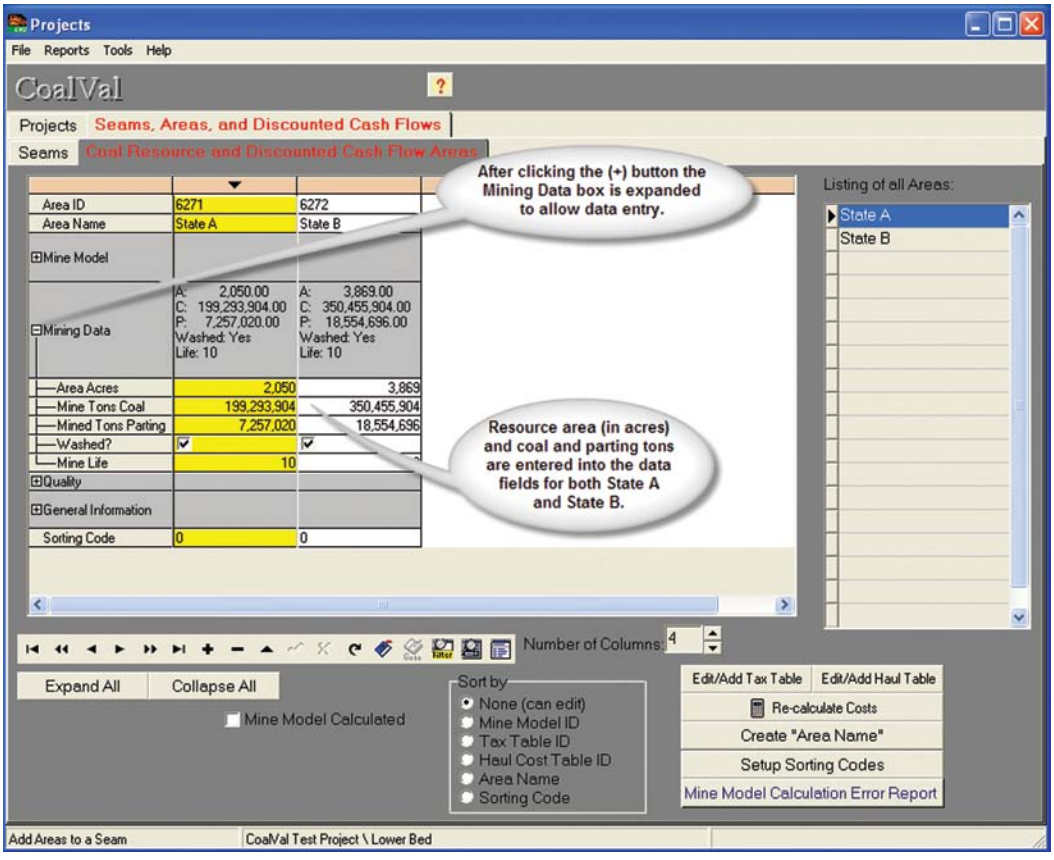


Figure B.31. CoalVal's "Mining Data" field was expanded and data entered into appropriate area fields by hand.

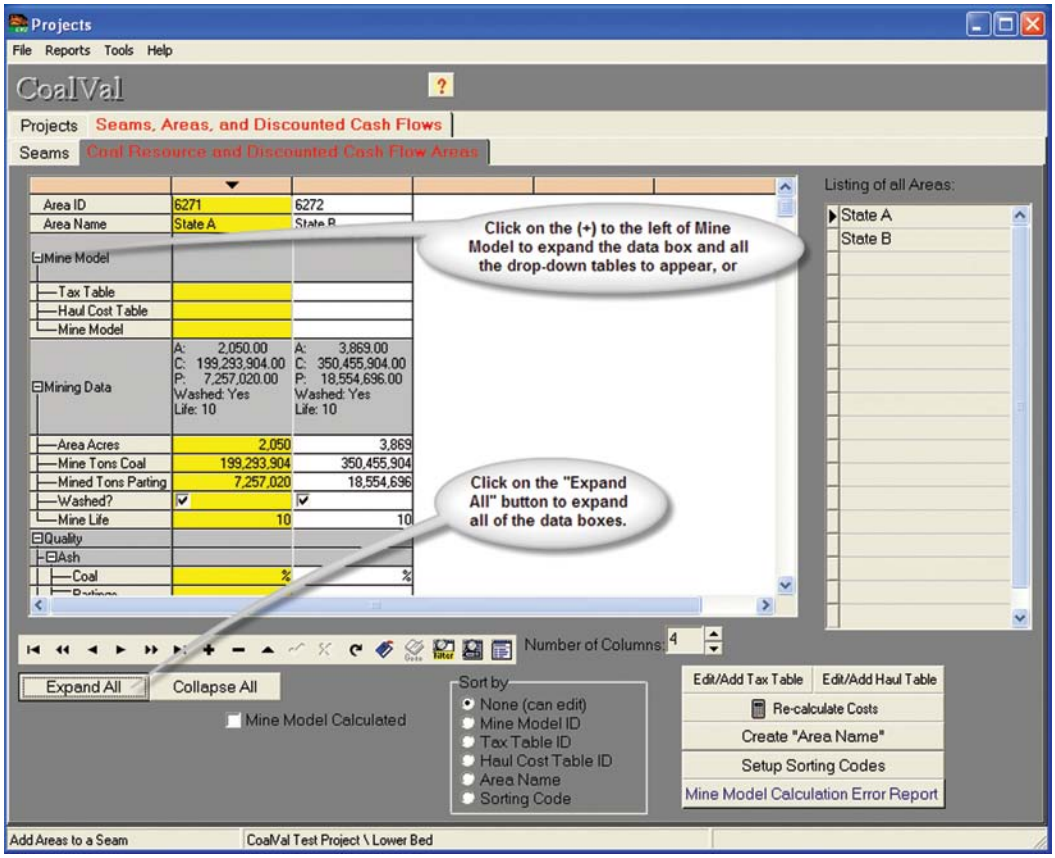


Figure B.32. Expanding the "Mine Model" field using the "Plus" (+) button to allow the drop-down tables to appear in the Coal Resource and Discounted Cash Flow Areas dialog page.

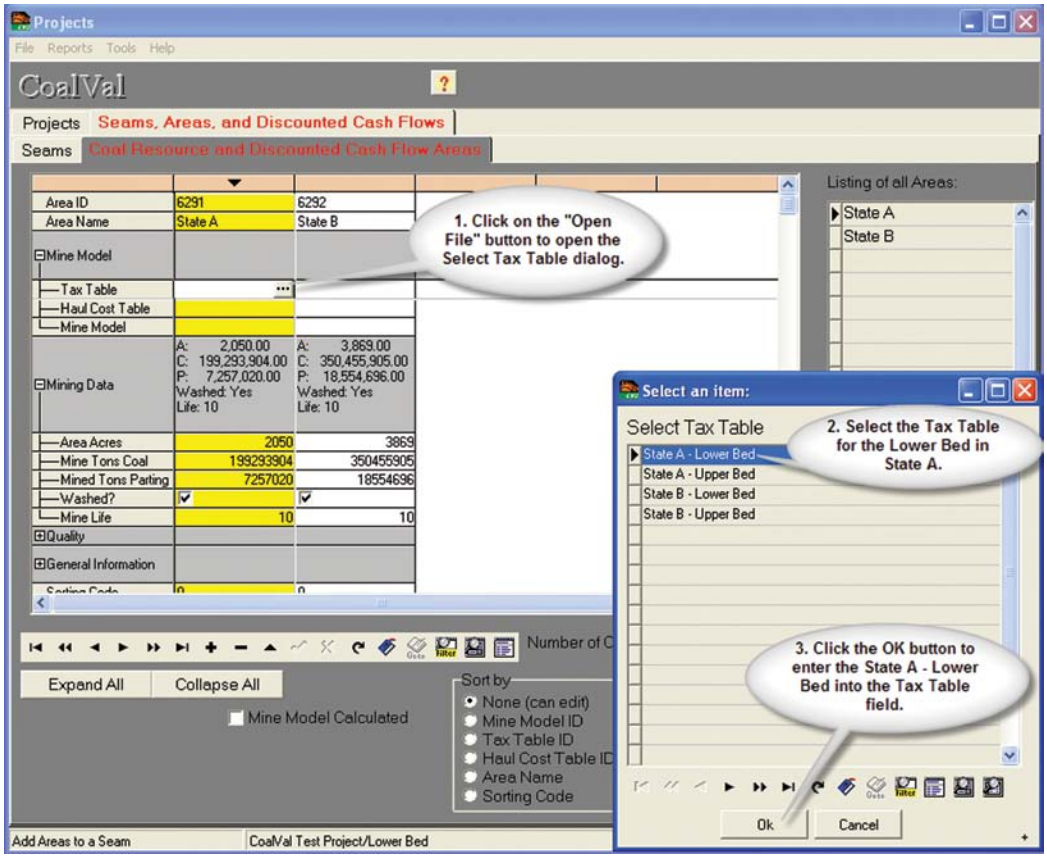


Figure B.33. Click on the "Open File" button in the "Tax Table" field on the Coal Resource and Discounted Cash Flow Areas dialog to allow access to the previously developed Tax Tables.

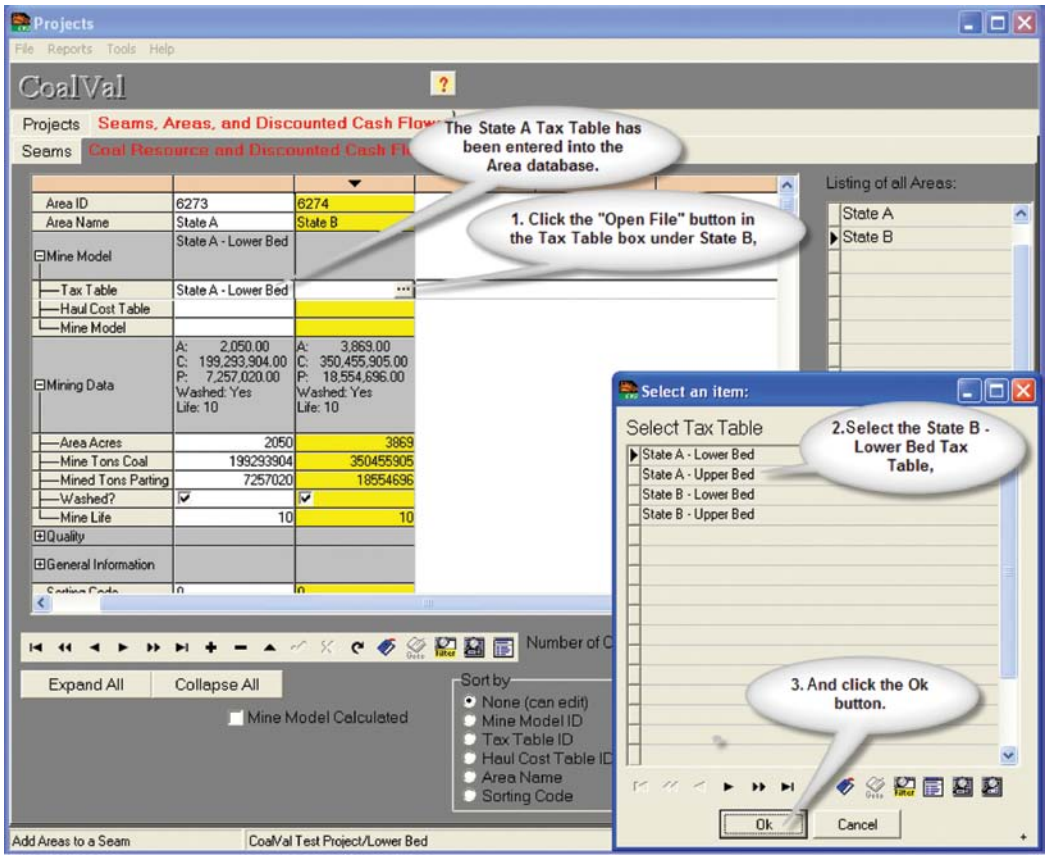


Figure B.34. CoalVal's Lower Bed in State A Tax Table is added to Area number 6273 and 6274 and the Tax Table for the Lower Bed in State B is ready for entry.

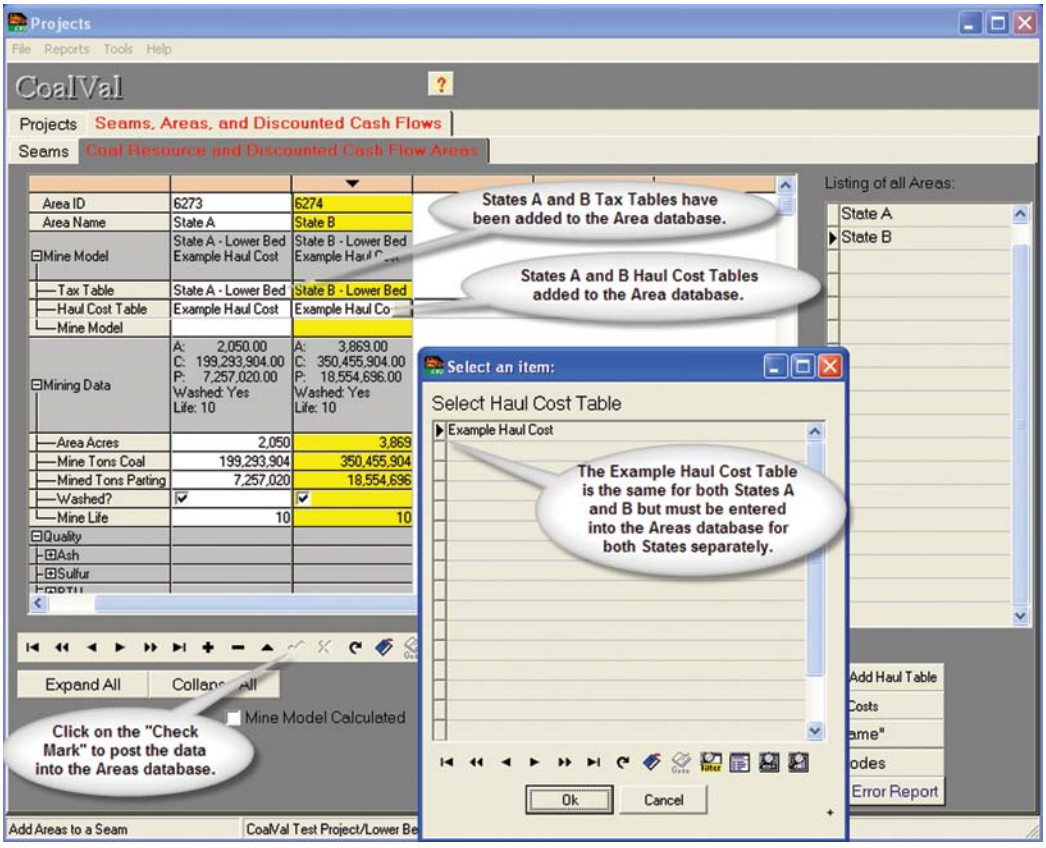


Figure B.35. CoalVal's Haul Cost and Tax Table information has been added into the Areas database.

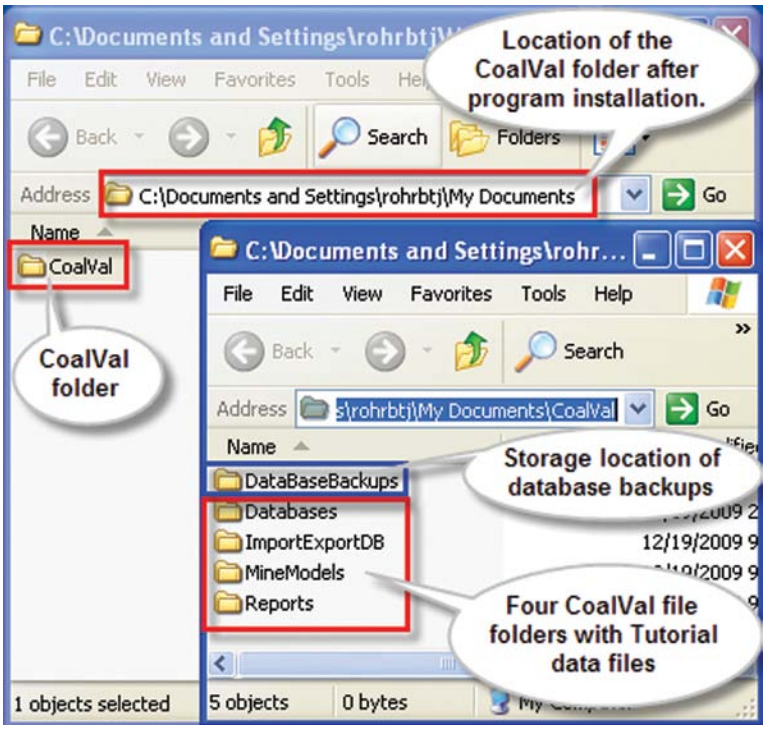


Figure B.36. Click on the Mine Model icon shown on CoalVal's Main Menu.

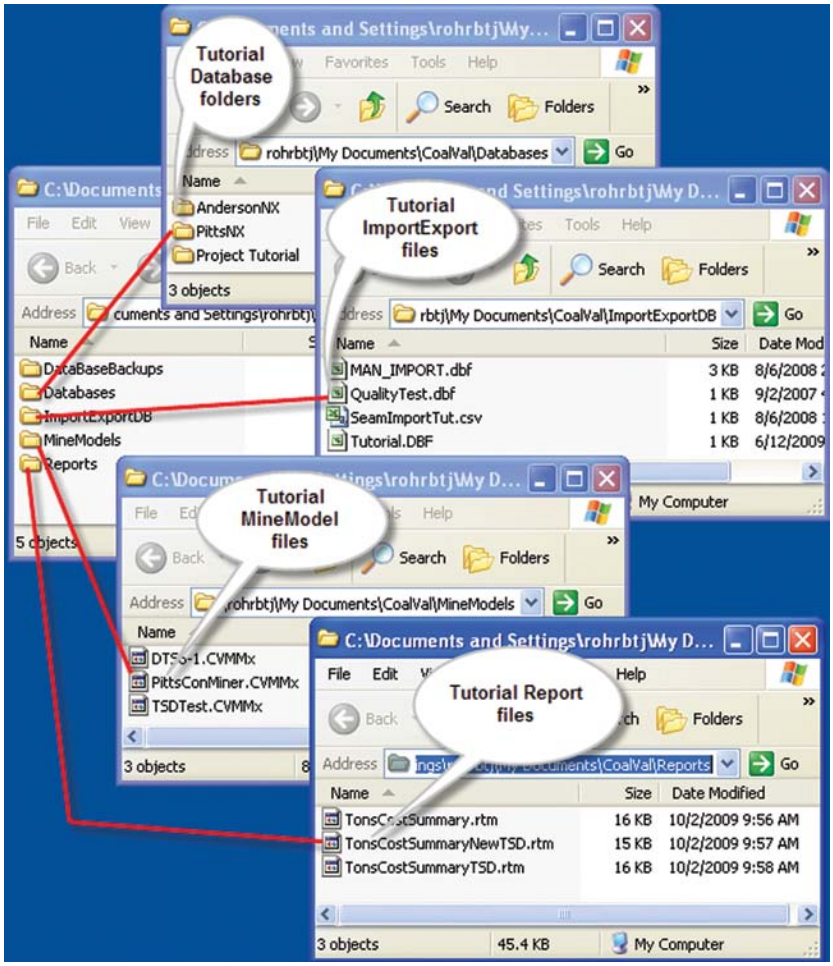


Figure B.37. CoalVal's Mine Model dialog window showing the drop-down File menu and highlighted Mine Model Data Exchange item.

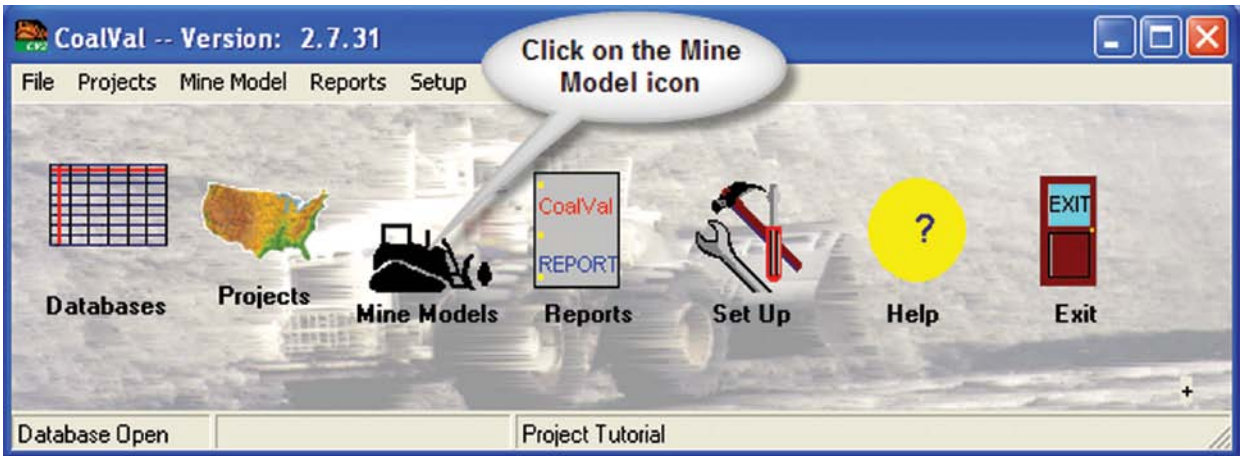


Figure B.38. Click on the Mine Model icon on CoalVal's Main Menu to locate the File Menu and the Mine Model Data Exchange.

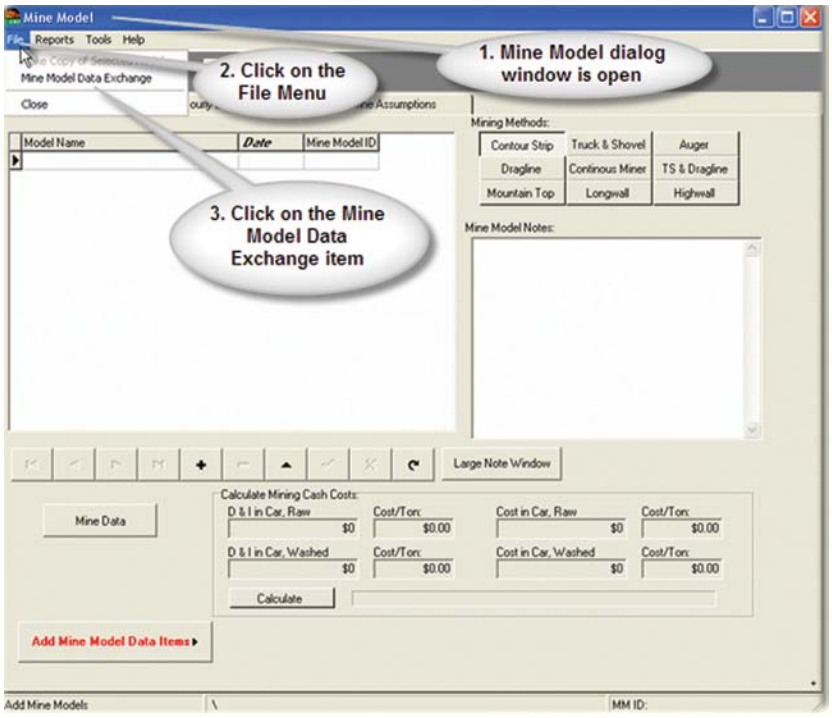


Figure B.39. After the Mine Model Data Exchange window is opened, browse to the CoalVal install location and open the "MineModels" folder.

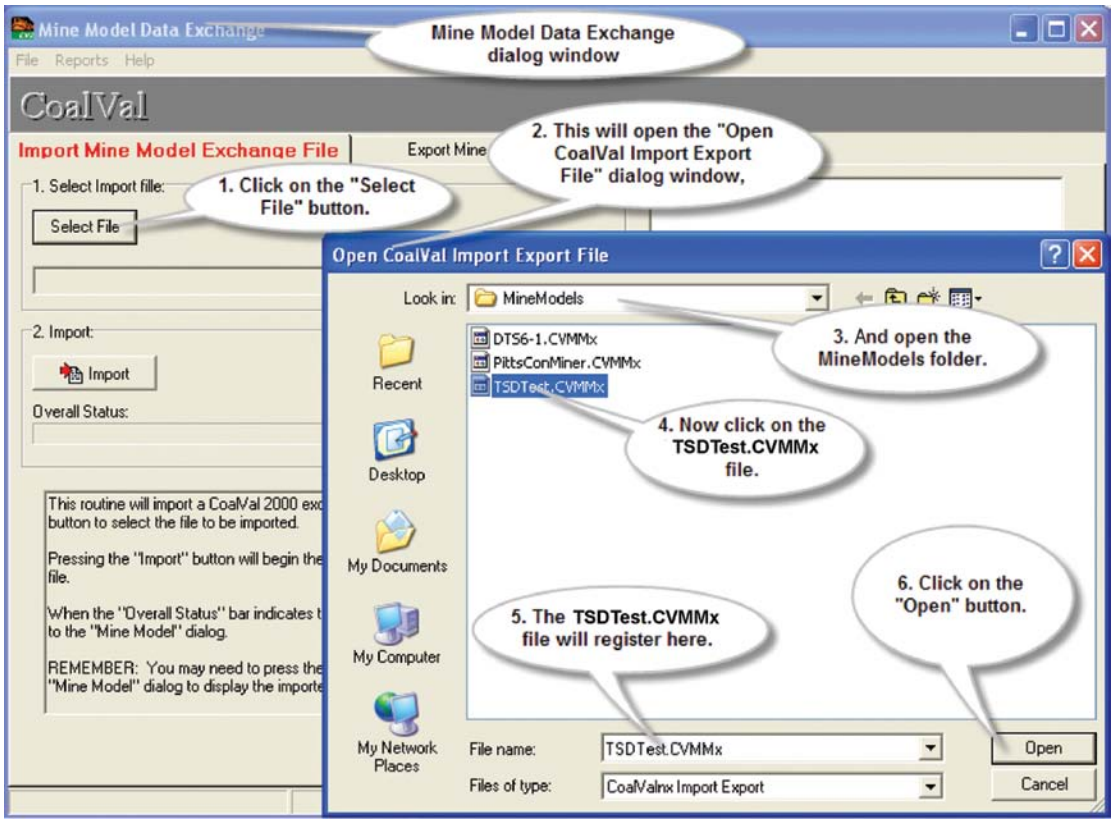


Figure B.40. Open CoalVal's "MineModels" folder, click on the "TSDTEST.CVMM" file, then click on "Open."

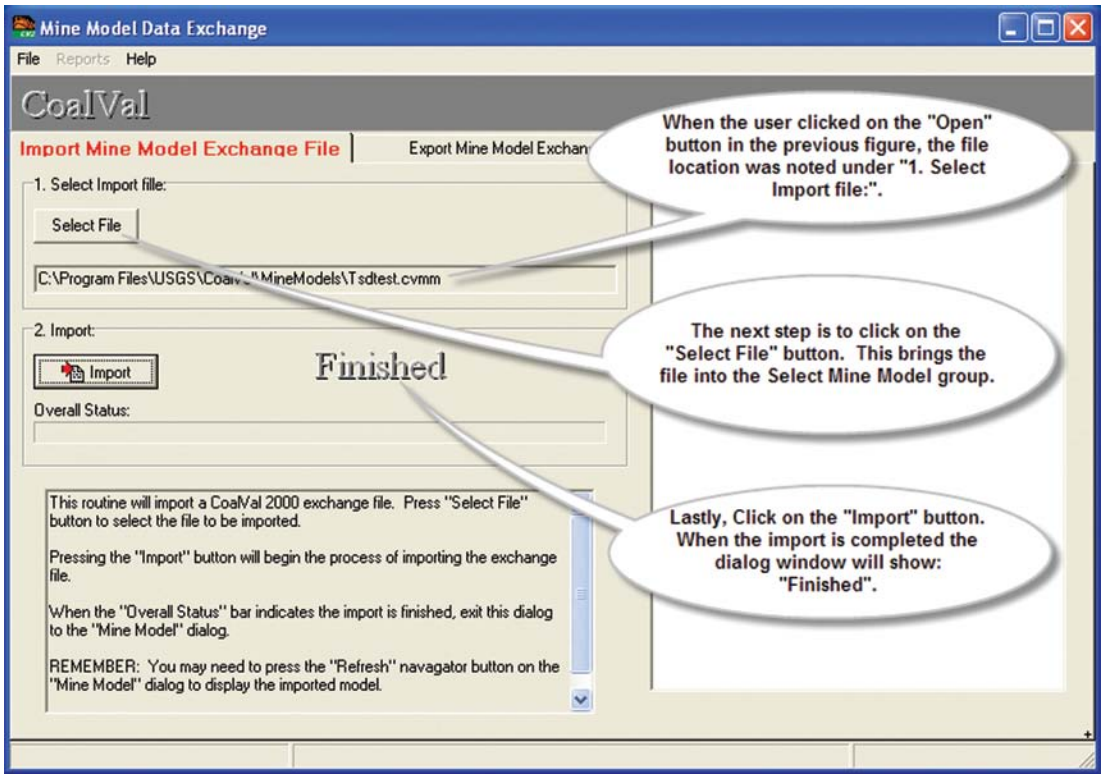


Figure B.41. After clicking on the "Open" button, the "Import file" is selected for importing, and the "TSDTEST.CVMM" file will be imported into the "Select Mine Model" group.

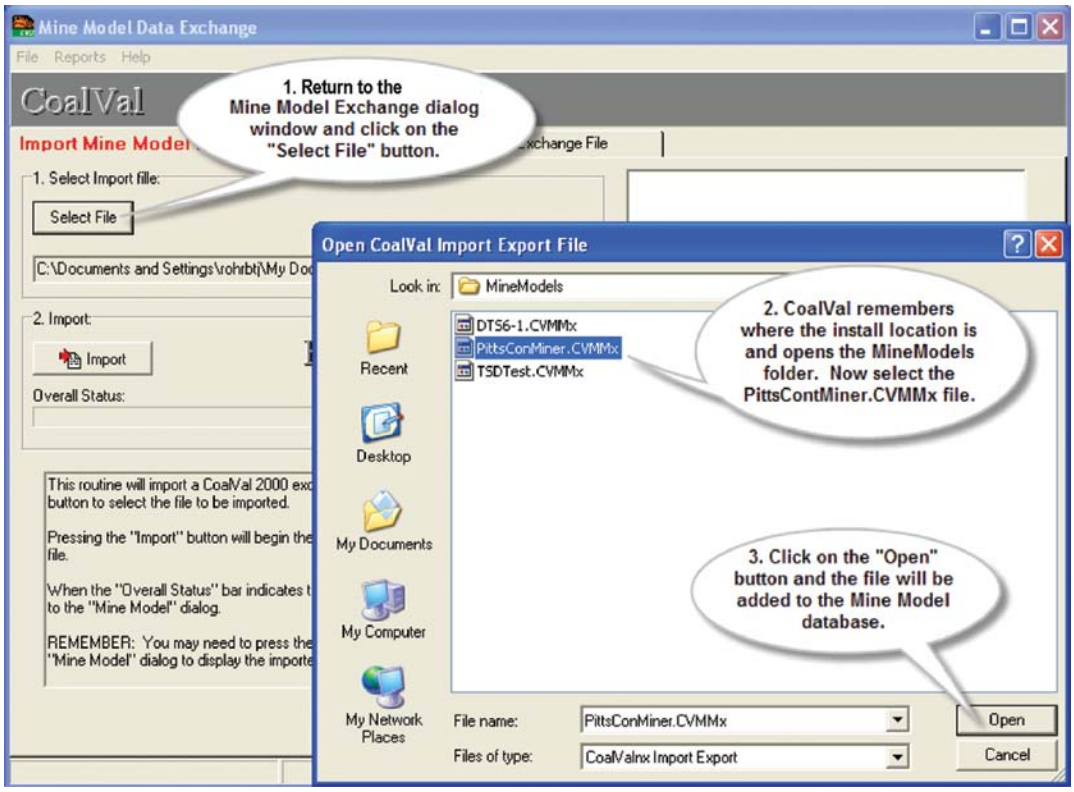


Figure B.42. The room and pillar mine model, "PittsConMiner.CVMM", is selected to be included in CoalVal's "Mine Model" group after clicking on the "Open" button.

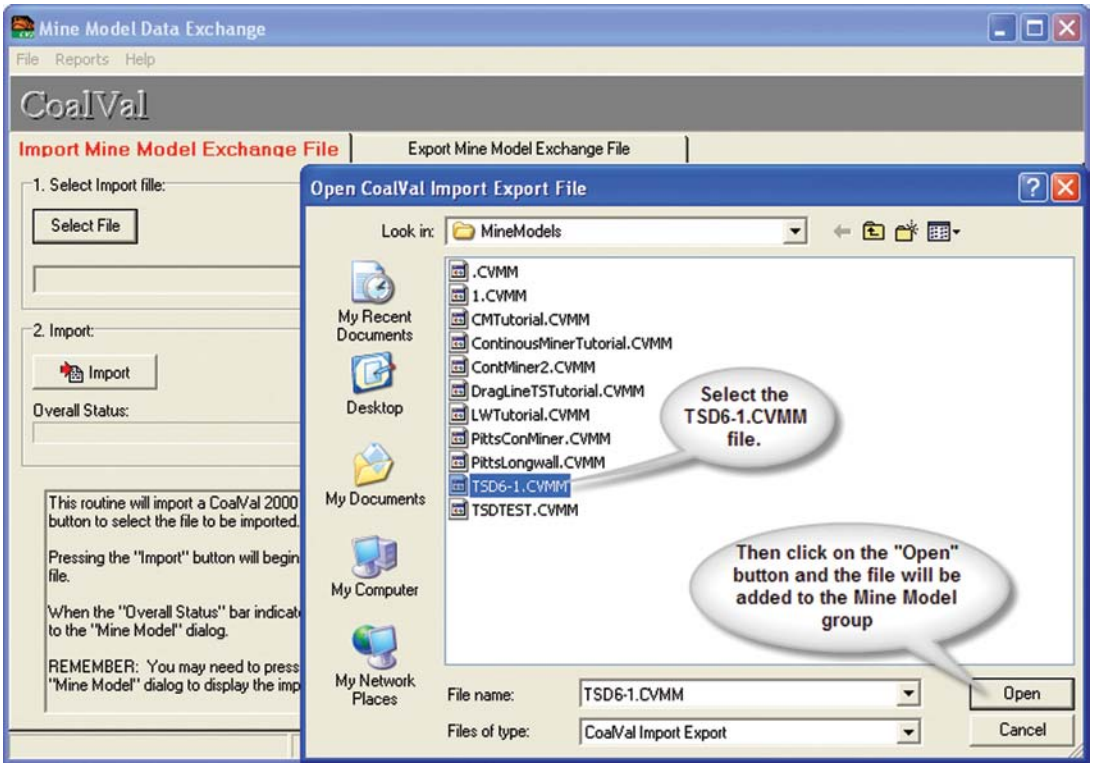


Figure B.43. The Truck-Shovel/Dragline, 6:1 ratio mine model, "TSD6-1.CVMM", is selected to be included in CoalVal's "Mine Model" group after clicking on the "Open" button.

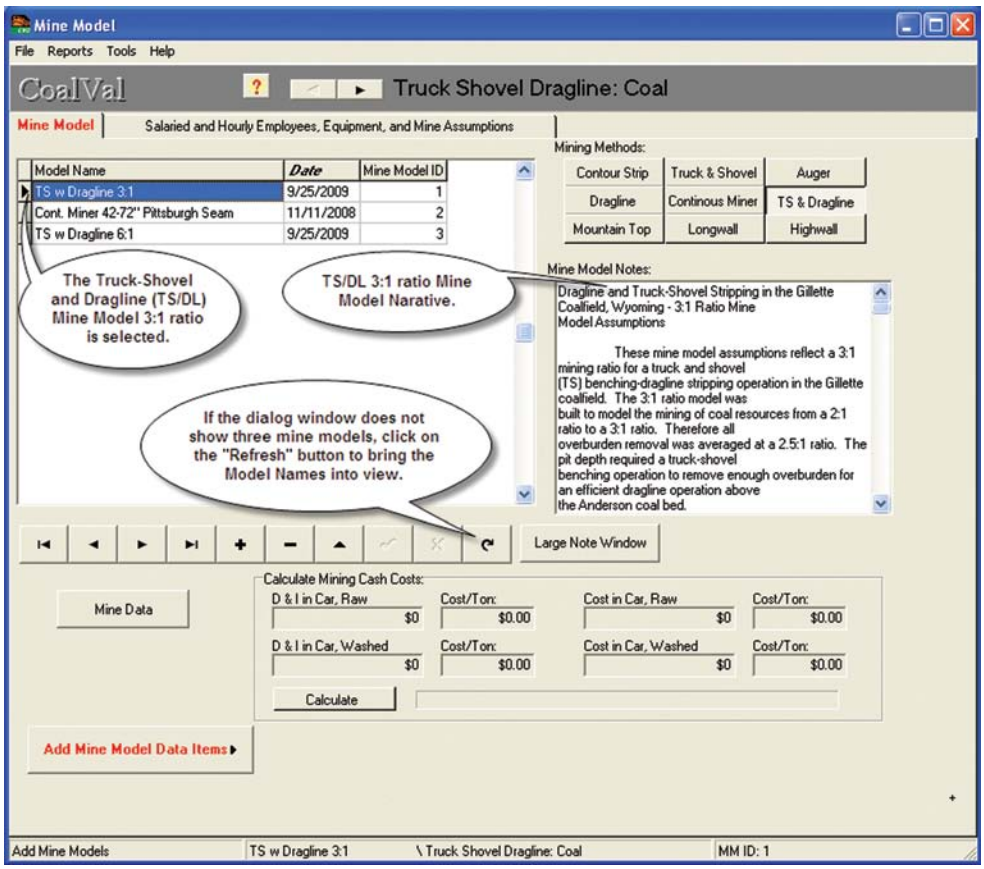


Figure B.44. When all three mine models have been imported into CoalVal's Mine Model database, the dialog window should look like this figure.

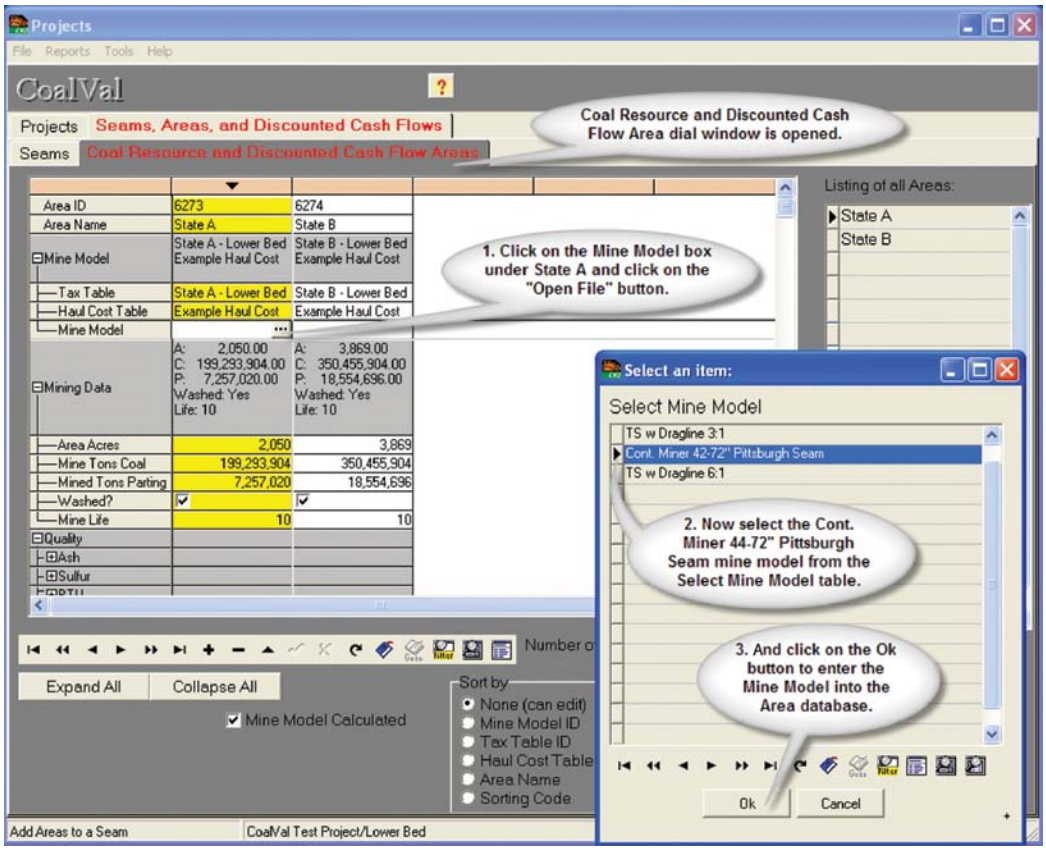


Figure B.45. Entering the room and pillar mine models into CoalVal's Coal Resource and Discounted Cash Flow Areas dialog window.

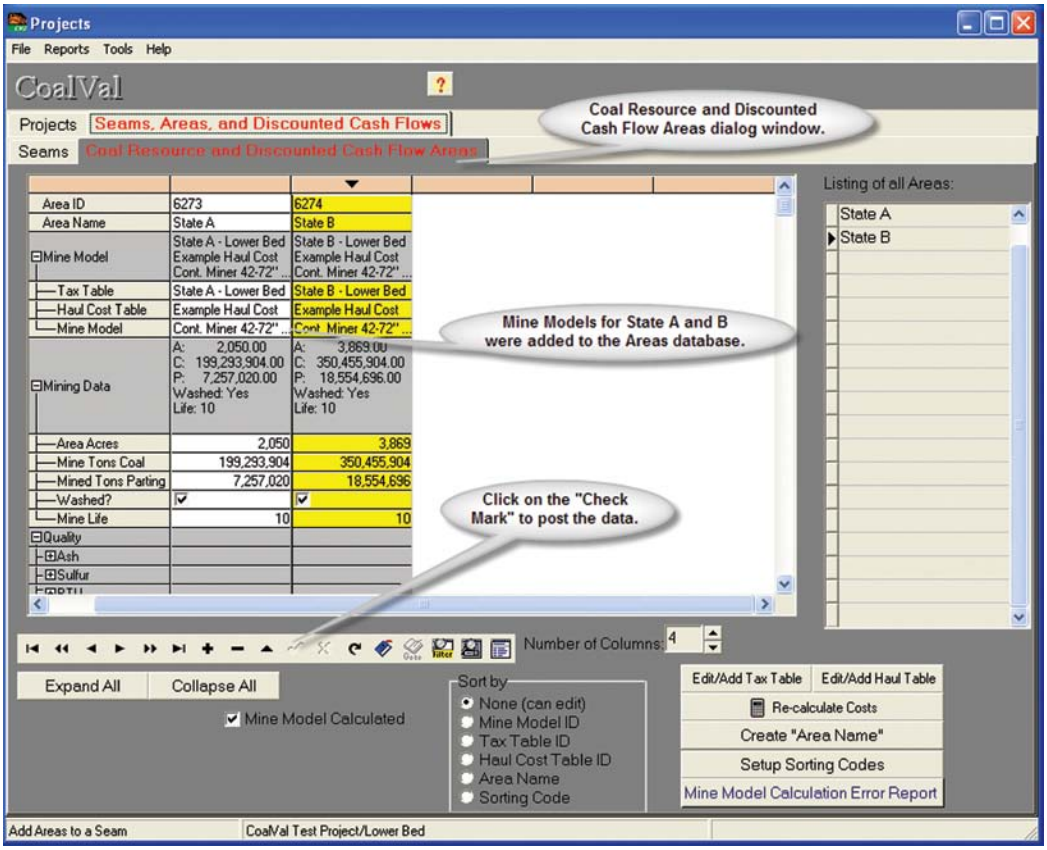


Figure B.46. Lower Bed with "Mine Model" and "Mining Data" imported into CoalVal's Areas database.

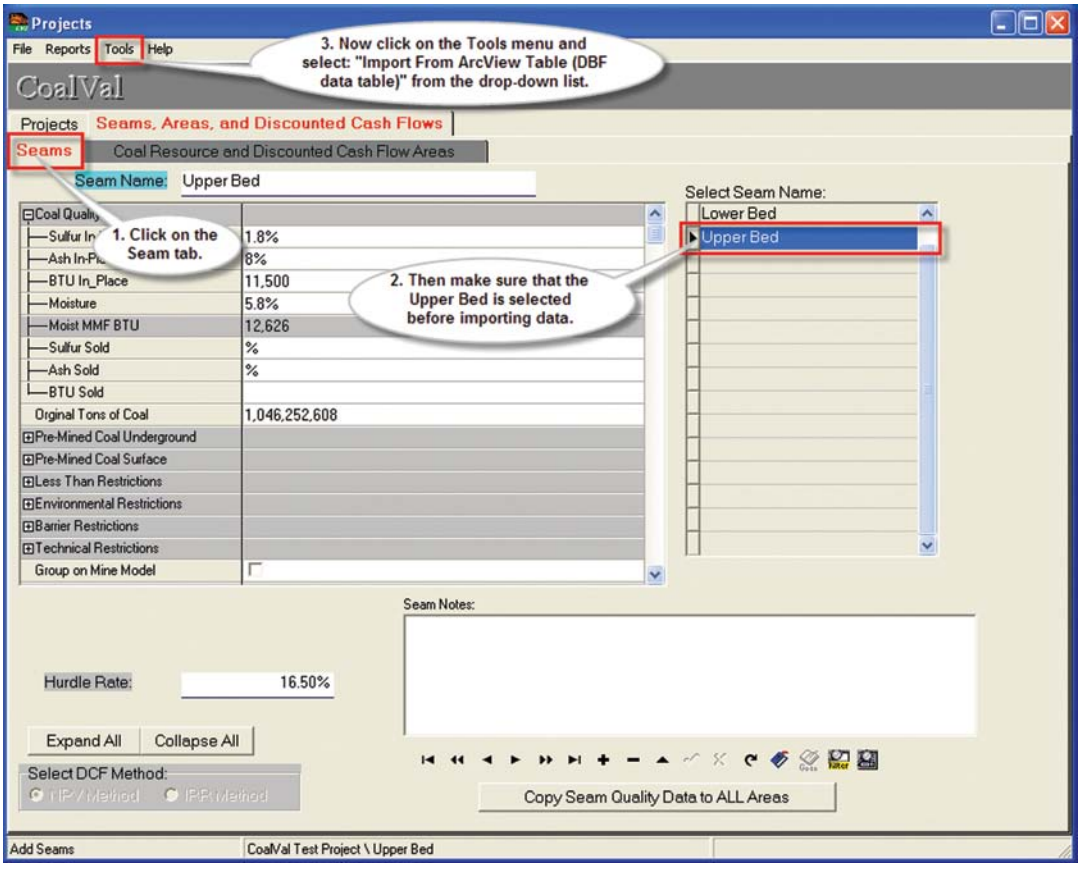


Figure B.47. Finding the Import From ArcView DBF Table dialog from CoalVal's Project Seams dialog window.

list and select ***Import From ArcView Table*** *(DBF data table, (fig. B.48)*.

The **ArcView Import and Export** dialog window (fig. B.48) is used to import an ArcView DBF table. However, before a DBF file can be imported into CoalVal it is necessary to know how to relate the outside import file to CoalVal's database. This is done through the creation of a schema. A schema is a relational statement relating one item to another. Once created, the schema can be used any time to import a file with the same data structure as the one used to create the schema.

To create a schema for importing data, *click on the* ***Create DBF or CSV Import Schema*** *tab* (DBF refers to dBase IV files (.dbf) and CSV refers to Comma Separated Values). The first step is to open an **ArcView DBF** table. *Click on the:* ***"1. Open DBF Table"*** *button (fig. B.49)*. A dialog window similar to figure B.50 will be displayed. With the **Open** dialog displayed, *browse to the CoalVal Install Location Directory, then to the* ***ImportExportDB*** *folder where the* ***Tutorial.DBF*** *file will be found (fig. B.50)*. *Select the* ***Tutorial.DBF*** *file and click "Open."* Next, *click the:* "*2. Create DBF/CSV Scheme" button and type in* ***Tutorial Schema*** *for the name for the schema* (fig. B.51. Then *click on the OK to complete the schema name.*

The next step is to *import the name of the area by clicking on the down arrow of the* "*3. DBF/CSV Fields*" *component and select the* "*AREANAME" field (fig. B.52)*. Next, from the **CoalVal:** field list, *select* "*Areas–Area Name" as shown in figure B.53*. If the user leaves CoalVal at this point, it will be necessary to *reopen:* "*1. Open the DBF Table*" *and select the Tutorial.DBF file (fig. B.52) before continuing the exercise.*

A relationship between "AREANAME" in the Tutorial. DBF file (an outside database) and "Areas–Area Name" in the CoalVal database has now been established. *To complete or accept the relationship, click the "4. Accept Relationship" button (fig. B.54)*. Now *create the following relationships for the* "*DBF/CSV Field: AREA" with* "*Area Acres," "TONSCOAL" with* "*Tons of Coal to be mined,"* "*TONSPART" with "Tons of Parting to be mined," "MODELID" with "Mine Model ID," and "WASHED" with "Washed?"* The relationships selected appear in the **DBF/CSV Import Schema** list shown in figure B.55. The ordering of the fields in the schema file is not important. The "CoalVal field, Washed" uses a value in the DBF/CSV table to be imported of "0" to mean the coal is not washed. A value of "1" means the coal is washed. The **Create DBF/CSV Import Schema** page can also be used to import data into the **Project's Seams Table**. Figure B.56 shows some of the **Seam Table** fields that can be used for importing. It is important not to create a schema file with both **Areas** and **Seam** import fields.

Exit out of the ***Create DBF or CSV Import Schema*** *tab and* ***Seams*** *tab to CoalVal's* ***Main Menu*** *and click on the* ***Mine Models*** *icon*. One **Mine Model** for underground mining in the Northern Appalachian Basin and two **Mine Models** for mining in the Gillette coalfield have been imported for use in this **Tutorial Project** and can be accessed in the **Mine Models** menu. Previously a **Tutorial Schema** was developed to import a "Mine Model ID" into the tutorial **Project Area** (Areas–Mine Model ID = [MODELID]{6}). This "Mine Model ID" corresponds to a highlighted "Mine Model ID" in the main **Mine Model** menu dialog window (fig. B.57). If the Tutorial.DBF table has a field with a "Mine Model ID," that **Mine Model** can be imported into the **Project Area Table**. In the case of figure B.57, the "Mine Model ID" of 97 (Truck-Shovel and Dragline 3:1 ratio mine model**)** would be imported into the **Project Area.** The "Mine Model ID" must agree with the imported DBF file for the correct data import to be successful.

Tax ID and **Haul Cost ID** can also be imported from a DBF file into a **Project Area**. The IDs for **Tax Table** and **Haul Cost Table** can be found by *clicking on the* ***Mine Data*** *button on the* ***Mine Model*** *dialog window* (lower left hand corner of fig. B.57). The **Tax Data Entry** and **Haul Cost Entry** pages are shown in figure B.58. These Tax and Haul Cost IDs will be used in the following section

Now that a schema file has been created, the next step is to import the DBF file, Tutorial.DBF, into CoalVal's **Project Area Table**. *Return to the* ***ArcView Import and Export*** *dialog window* by *clicking on the* ***Projects*** *icon, then the* ***Tools*** *drop-down list, and then the* ***Import From ArcView Table*** *item. Now, click on the* ***Use Schema for Import of DBF Table or CSV file*** *tab*. When the **Use Schema for Import of DBF Table or CSV file** dialog is displayed, *click on the Tutorial Schema listed in the "Select Schema" list*. The file to import (Tutorial.DBF) has been previously opened; however, if the user has restarted CoalVal's **Project Tutorial**; *reopen the Tutorial.DBF file by clicking on the "Open DBF Table" button (fig. B.59) and browsing through the* ***ImportExportDB*** *folder to the Tutorial.DBF file*. *Select the Tutorial.DBF file, then click on the "Open" button* (*fig.B.59*). After the Tutorial.DBF file is opened, the table will be displayed in the bottom section of the **Use Schema for Import of DBF Table or CSV file** dialog (fig. B.60).

The **Use Schema for Import of DBF Table or CSV file** page allows the user to place a constant value into "Haul Cost ID," "Tax Table ID," and "Mine Model ID." The haul cost for all the **Project Areas** uses the same **Haul Cost Table**; that value is a constant and can be used at this time. Figure B.61 shows a **Haul Cost Entry** page from the **Mine Data** dialog window. Note that the "Haul Cost ID" for this table is 1. The "Haul Cost ID" developed by the user in this Tutorial may have a different ID. To find the **Haul Cost Table** previously developed in this Tutorial, *click the* "*Edit/Add Haul Table" button on the* ***Coal Resource and Discounted Cash Flow Areas*** *tab under the* ***Projects*** *dialog. Browse through the list of tables to find the Example Haul Cost Table and note its Haul Cost ID number*.

Close the ***Haul Cost*** *dialog and return to the* ***ArcView Import and Export*** *dialog*. Under the "Place a constant into CoalVal Data Record" box, *click on the* "*Haul Cost ID" check box and type in the "Haul Cost ID" number for the Example Haul Cost Table (fig. B.62)*. Note that the "Haul Cost ID" developed in this Tutorial may be different from the example shown.

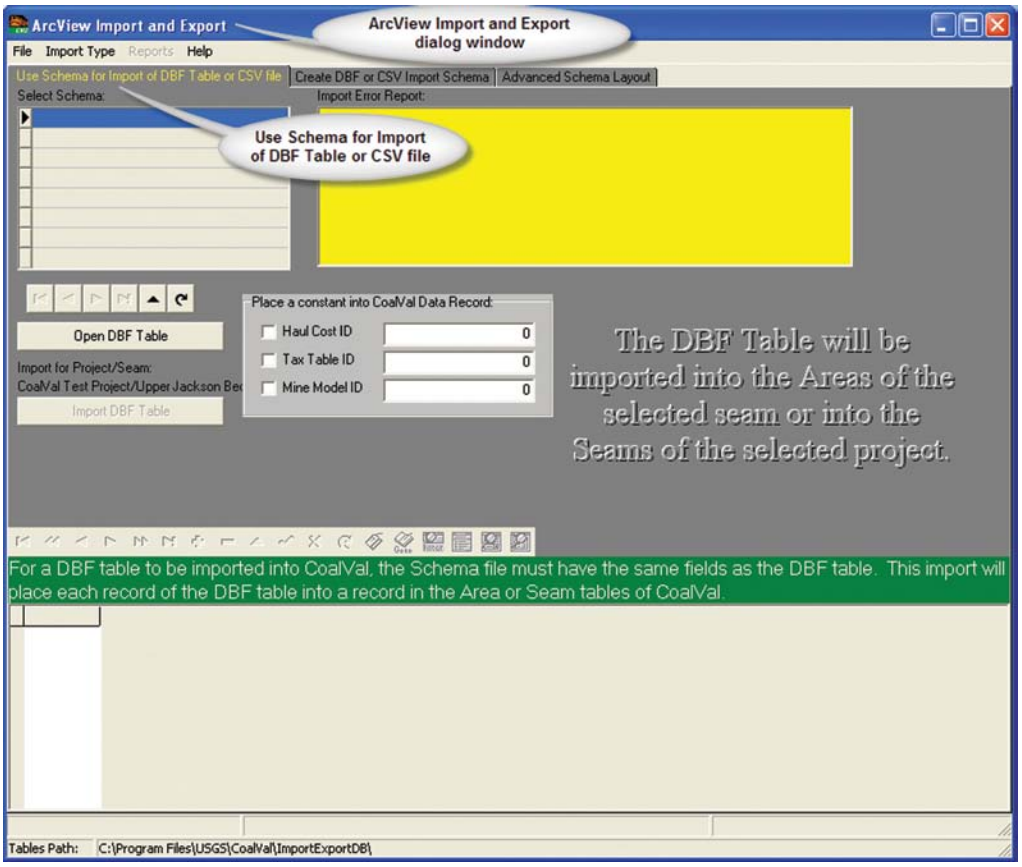


Figure B.48. CoalVal's ArcView Import and Export dialog window showing the Use Schema for Import of DBF Table or CSV file tab.

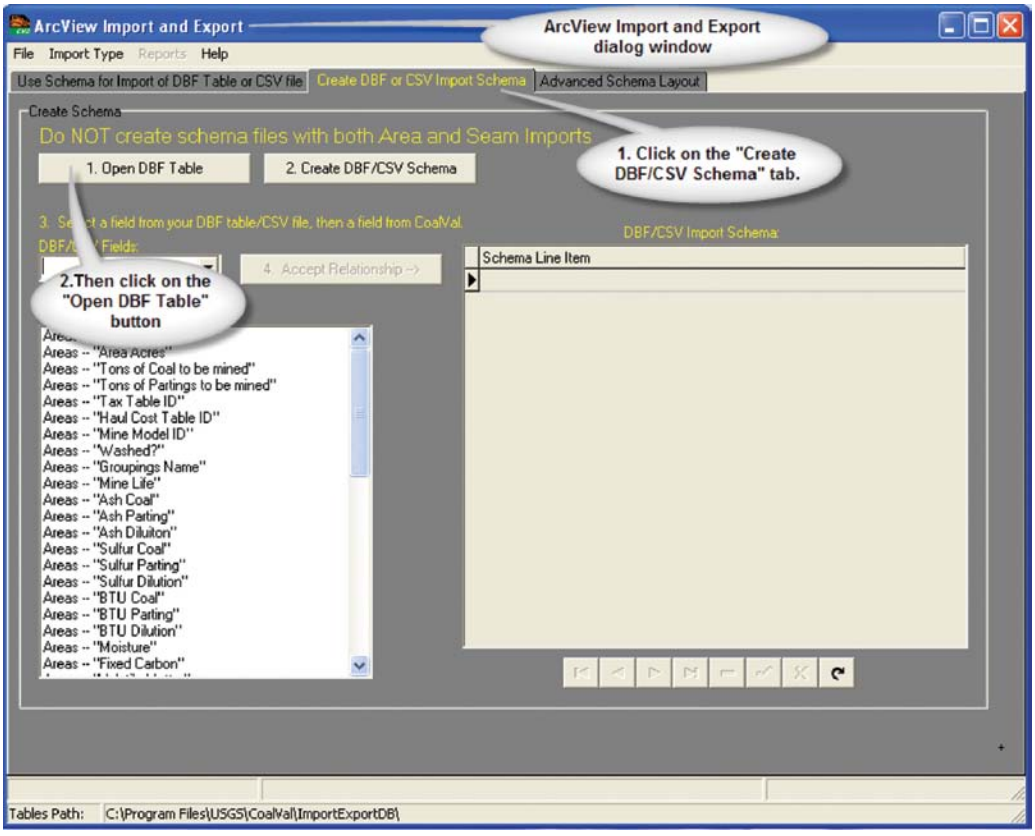


Figure B.49. Opening CoalVal's Create DBF or CSV Import Schema from the ArcView Import and Export menu.

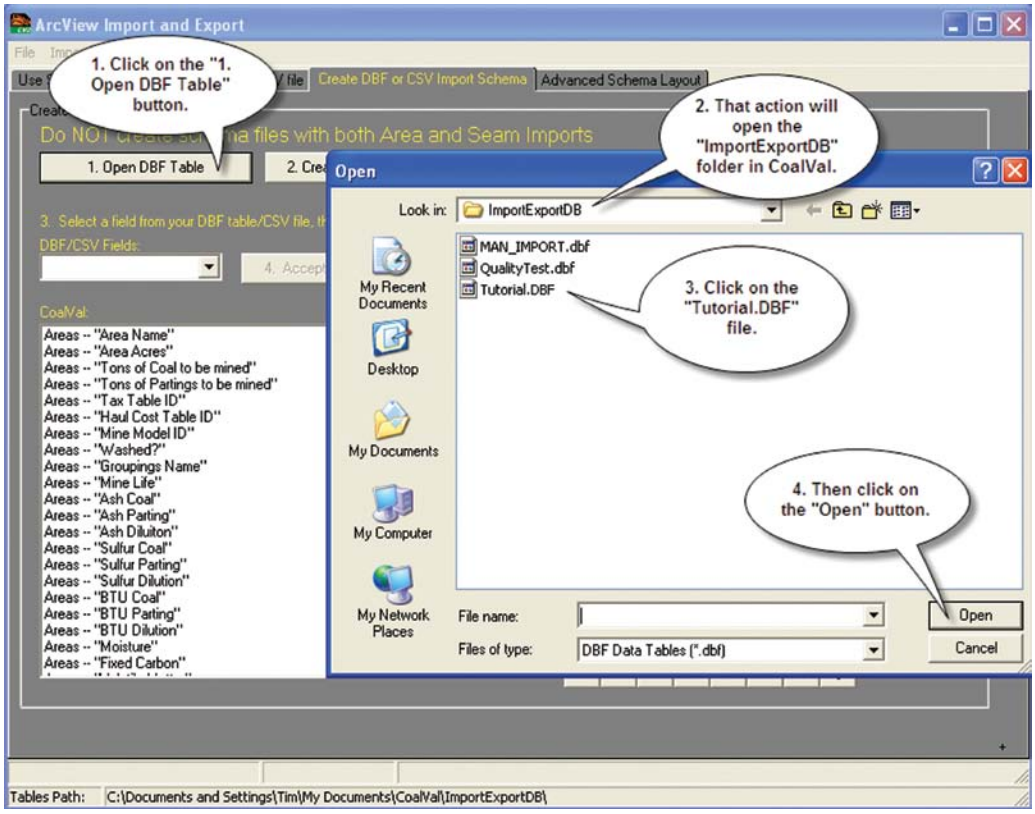


Figure B.50. Navigating from CoalVal's ArcView Import dialog window through the Create DBF or CSV Import Schema tab to select and import the "Tutorial.DBF" file into CoalVal.

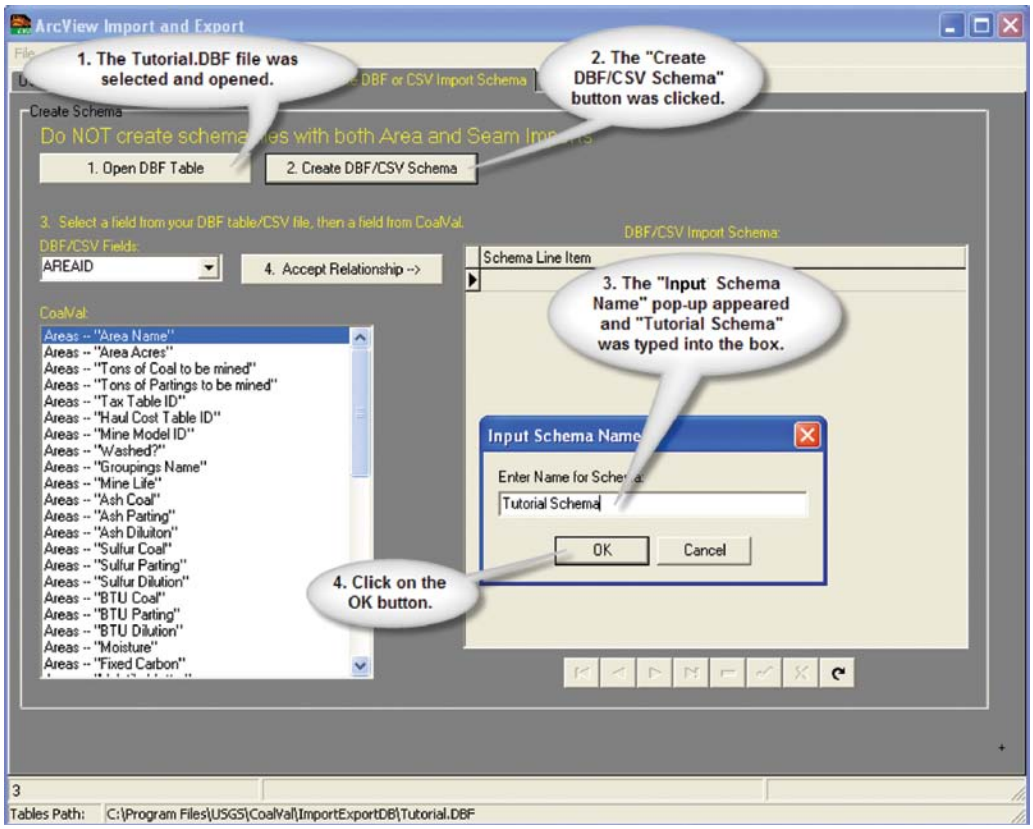


Figure B.51. Creating a DBF/CSV Schema and developing the "Input Schema Name."

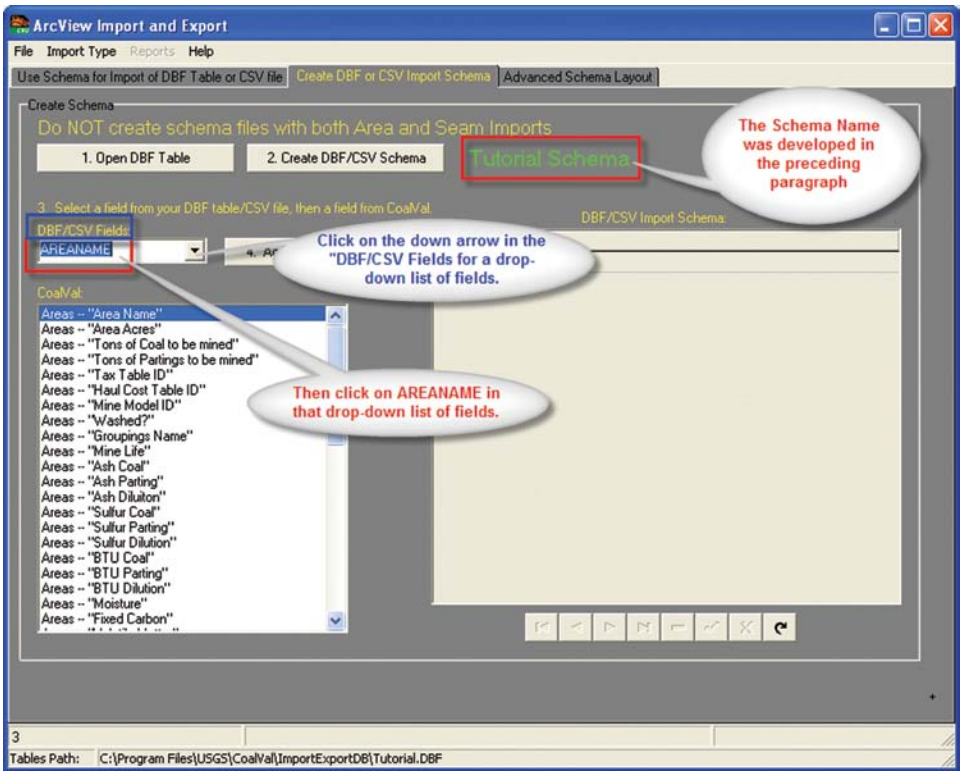


Figure B.52. Developing CoalVal's Schema relationship in the Create DBF or CSV Import Schema tab dialog for the "DBF-CSV fields" (from an outside database).

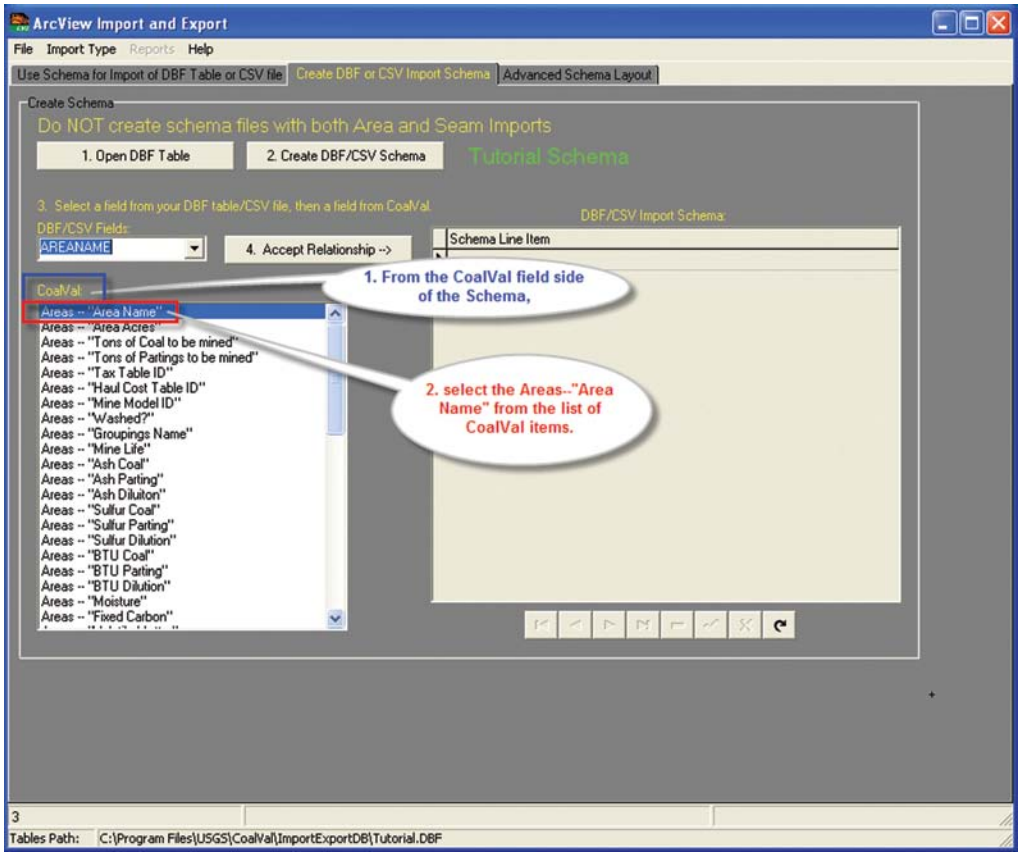


Figure B.53. Developing the relationship for the "CoalVal: field" side of the Schema in the Create DBF or CSV Import Schema tab dialog.

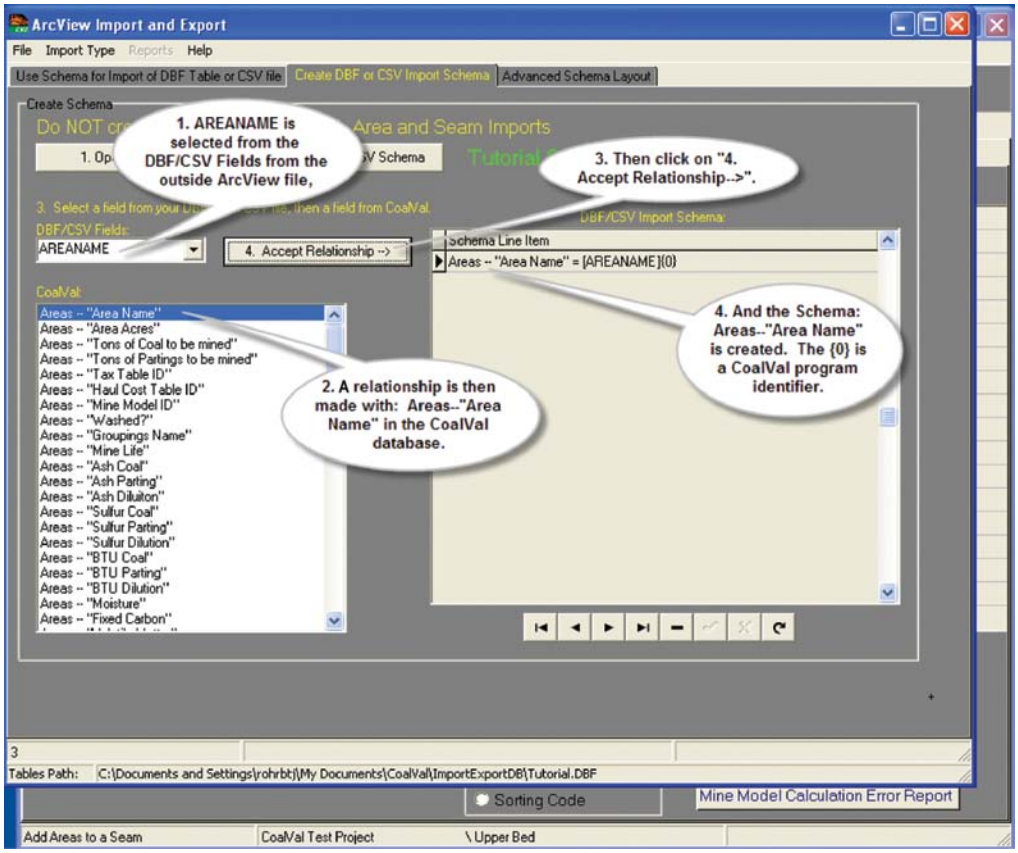


Figure B.54. Combining the DBF/CSV Field data and CoalVal's field data into an import relationship for development of the first Import Schema.

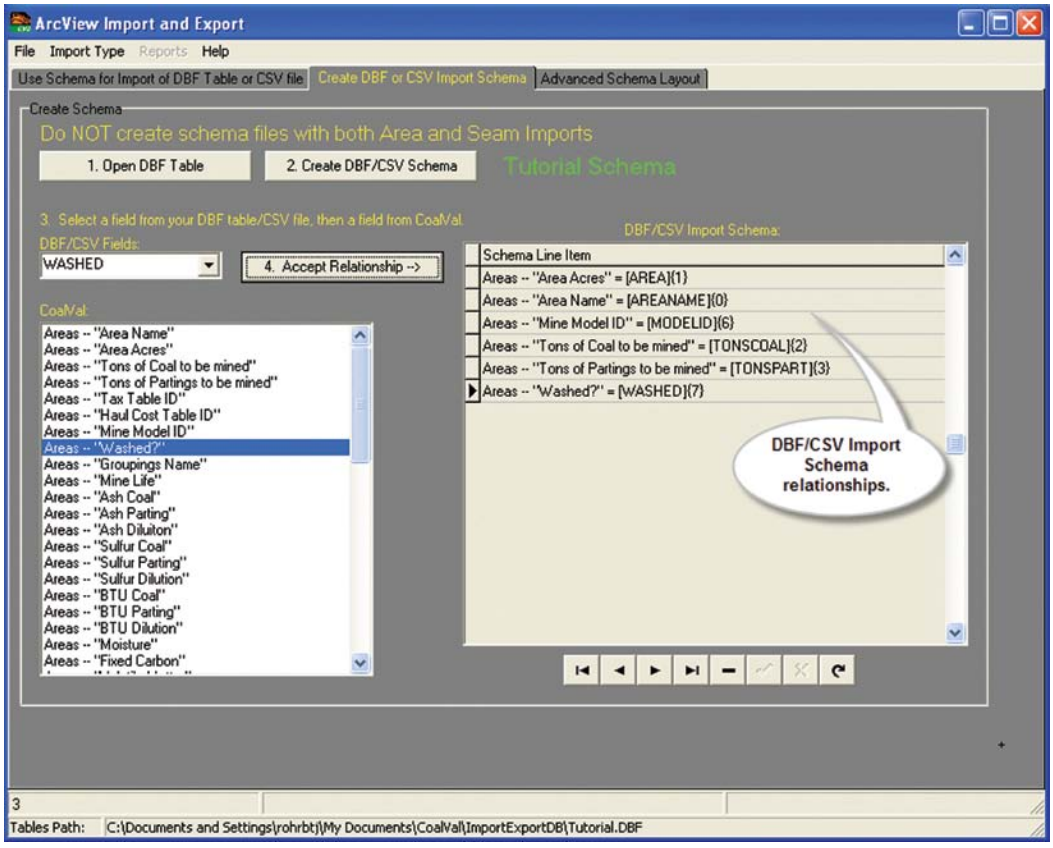


Figure B.55. CoalVal's DBF-CSV Import Schema relationships developed to import Area fields into the CoalVal database in the Create DBF or CSV Import Schema dialog tab.

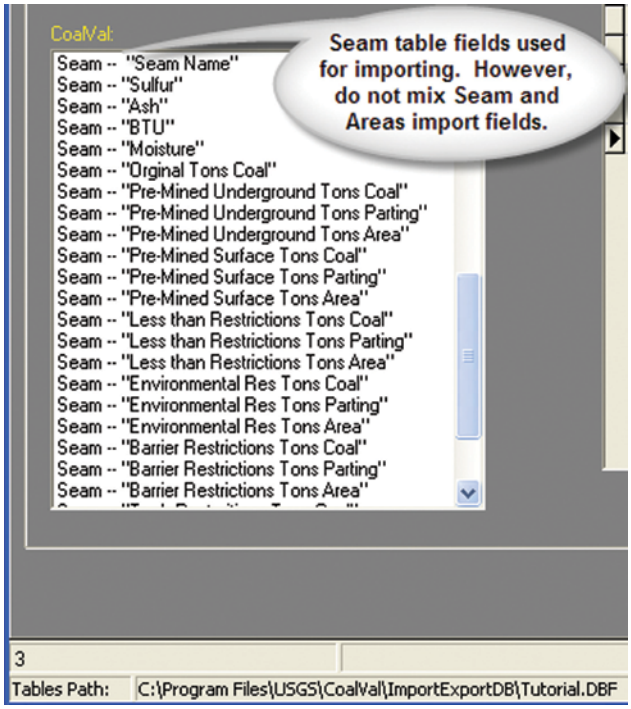


Figure B.56. CoalVal's "CoalVal: Seam Table" fields used for importing data into the database.

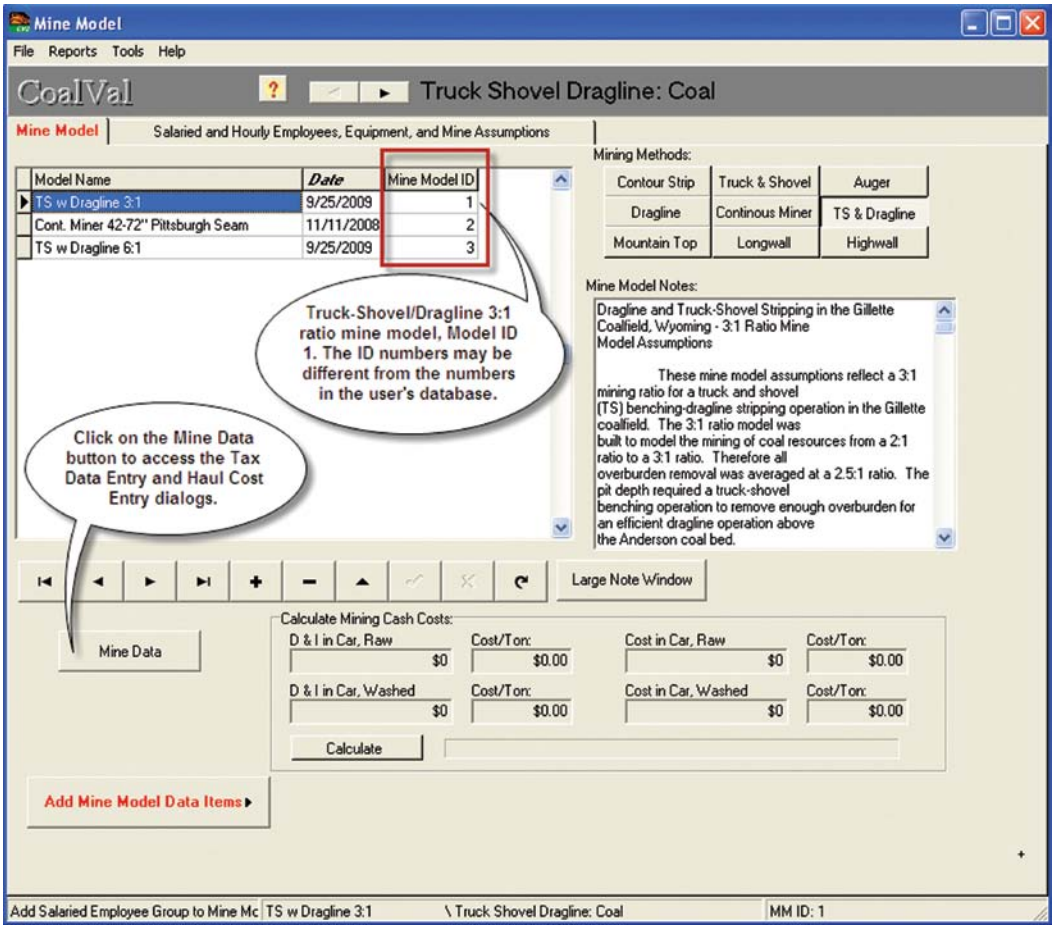


Figure B.57. Importing a "Mine Model ID" into a CoalVal Area.

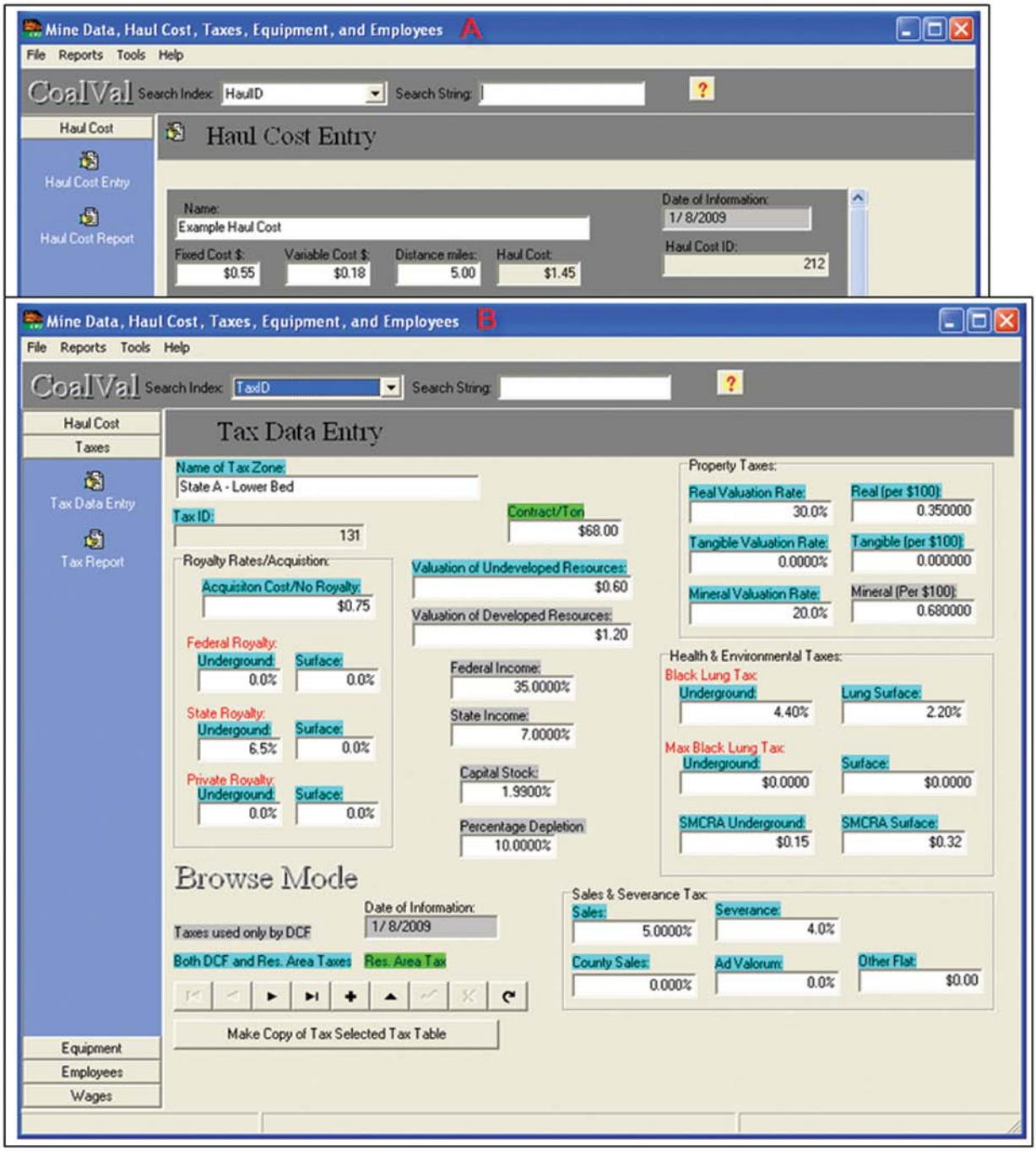


Figure B.58. CoalVal's Haul Cost (A) and Tax (B) Entry Table dialogs.

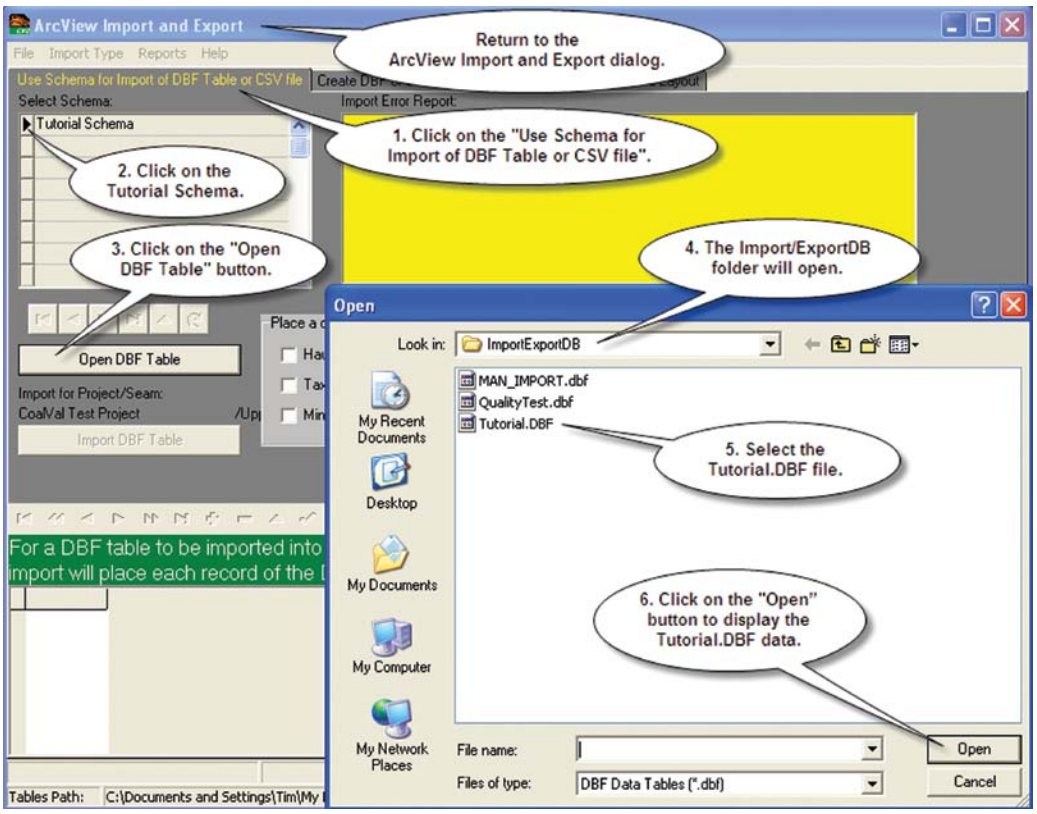


Figure B.59. Steps for Importing a DBF table (Tutorial.DBF) into a CoalVal Area using the Use Schema for Import of DBF Table or CSV file tab.

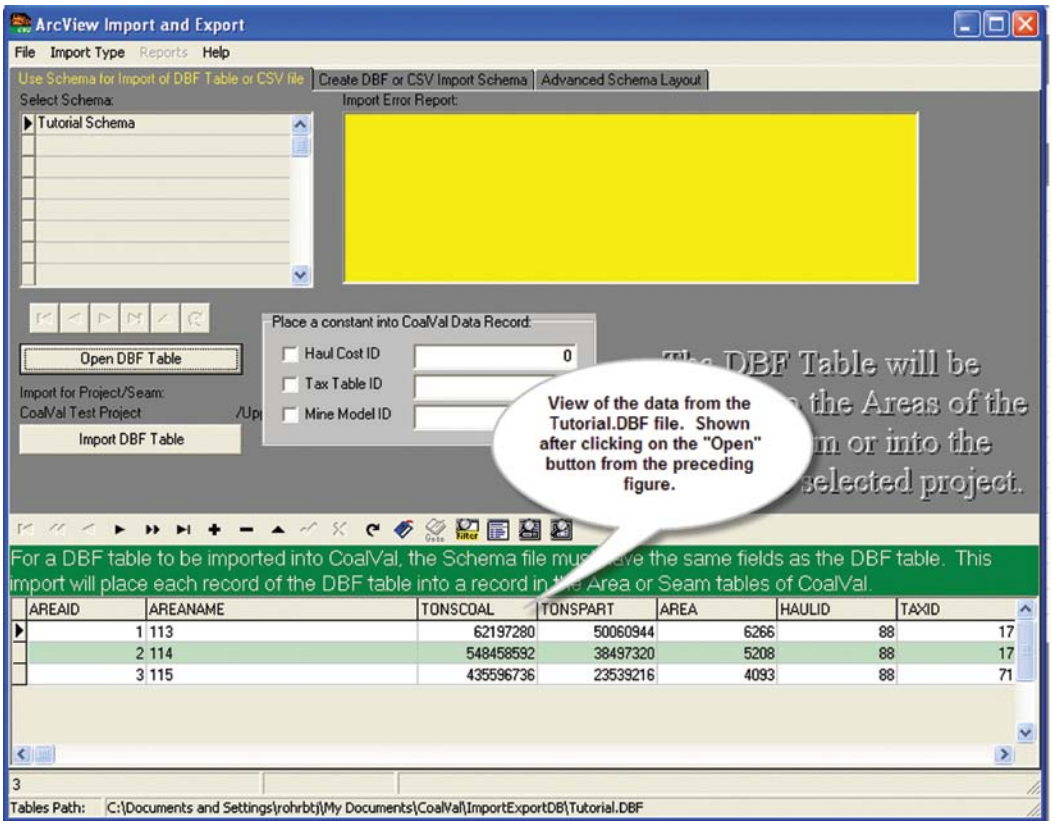


Figure B.60. "Tutorial.DBF" data displayed on CoalVal's Use Schema for Import of DCF Table or CSV file dialog window.

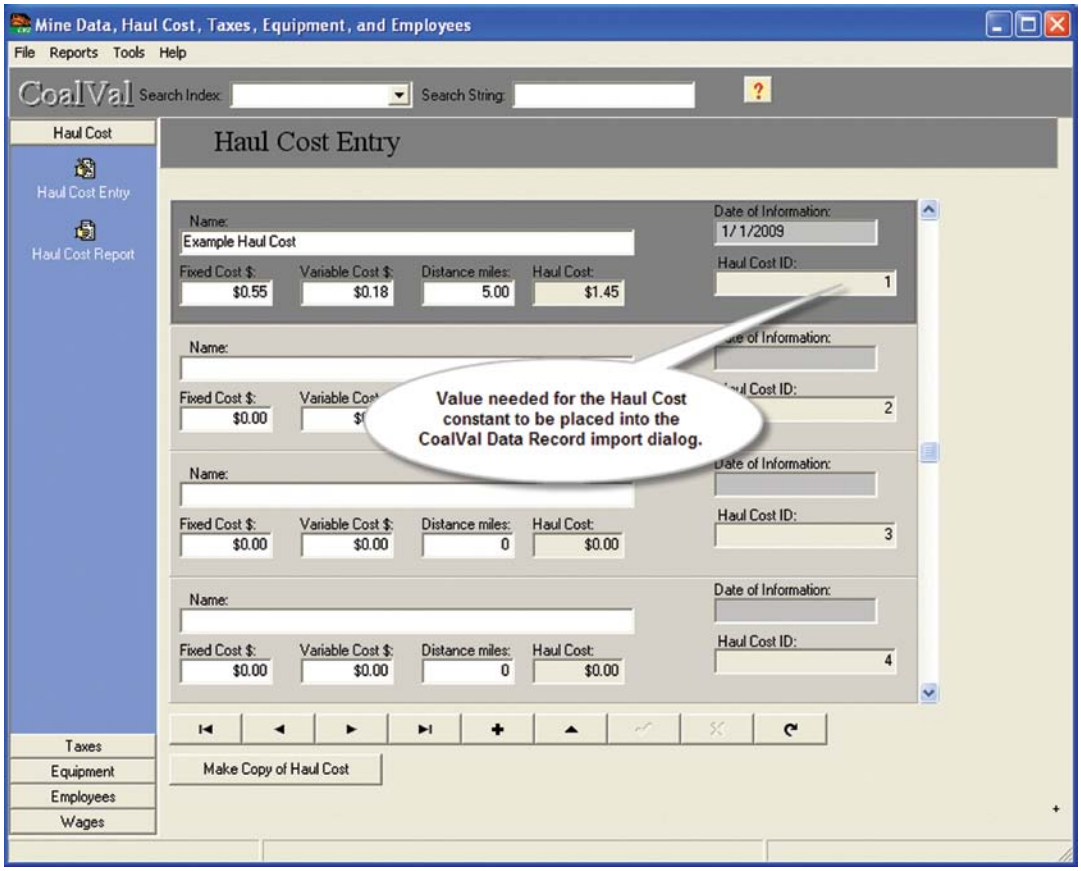


Figure B.61. CoalVal's Haul Cost Entry dialog page showing the "Haul Cost ID" (1) to be used to place a constant in the CoalVal Data Record portion of the Use Schema for Import of DCF Table or CSV file dialog window.

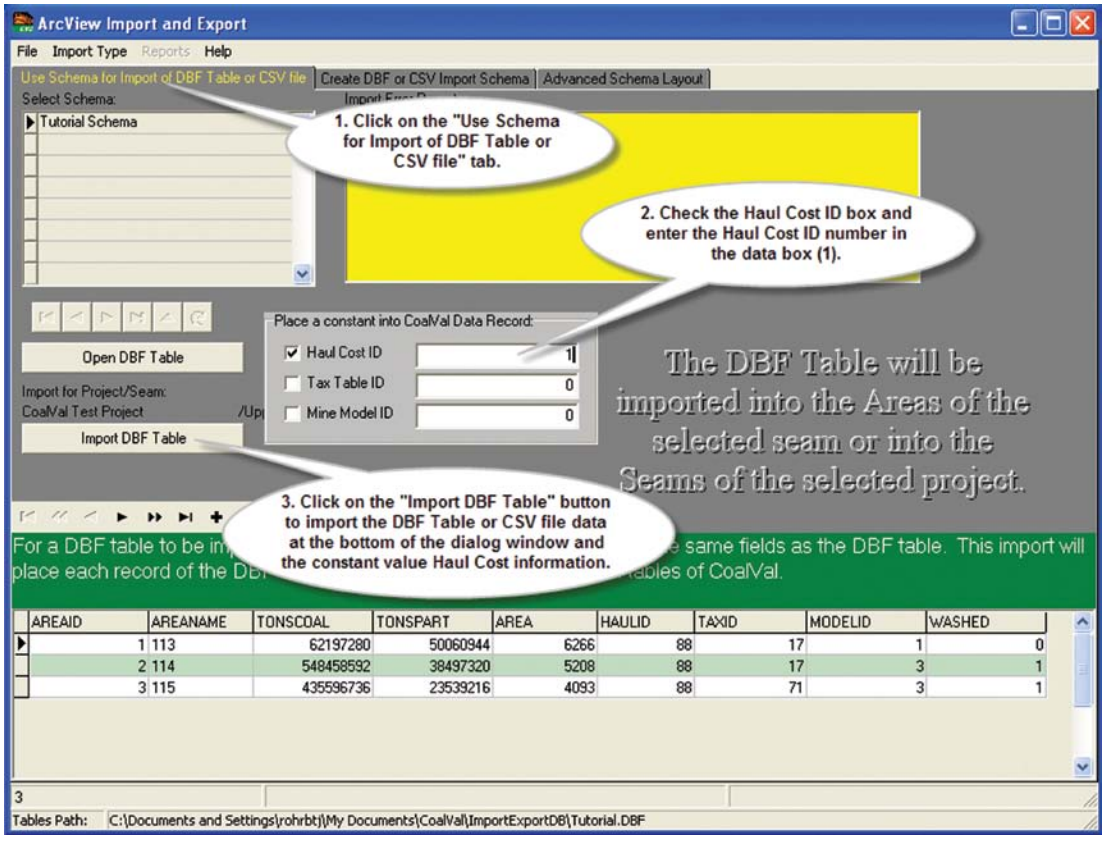


Figure B.62. Importing CoalVal's Haul Cost data as a constant (ID number) and the "DBF Table" into the "Areas Table" through the Use Schema for Import of DBF Table or CSV file dialog tab.

To import the data file at the bottom of figure B.62 into the Area database, *click the* **"***Import DBF Table" button on the* ***Use Schema for Import of DBF Table or CSV file*** *tab and click on the "yes" button to confirm the import*. After importing, *close the* ***ArcView Import and Export*** *dialog and return to the* ***Coal Resource and Discounted Cash Flow Areas*** *page*. That page should look similar to figure B.63 with the **Mine Model** group having been expanded. The **Tax Tables** for these **Areas** must also be placed in the appropriate **Tax Table** boxes. For **Areas** 113 and 114 use the State B-Upper Bed Tax Table and for **Area** 115 use State A-Upper Bed Tax Table by clicking on the **Tax Table** *box for Area 113*, then *click on the drop-down button and select the* ***Tax Table*** *for State B–Upper Bed. Do likewise for* ***Area*** *114, then select State A–Upper Bed Tax Table for* ***Area*** *115*. When completed the page should look like figure B.64. This import may take a few seconds to several minutes to complete depending on the size of the import file and the speed of the user's PC.

What to Look For When the Import File Will Not Import Into CoalVal

If, after several minutes, the import is not complete, the user can key in: Cont/Alt/Delete to navigate to the Windows® Task Manager. The Task Manager will give a status to all open programs. If CoalVal is running, then the Task Manager can be exited to allow CoalVal to continue running. If the Windows® Task Manager, Status indicates that CoalVal is not responding, then click on the End Task button to close CoalVal. Generally, rebooting the PC is necessary to reopen the CoalVal program.

Three user problems have been observed: (1) the most common is that the .dbf import file has an error in the data structure; (2) the PC does not have enough storage or swap memory to complete the action; or (3) the operating speed of the PC is too slow. The authors have imported huge files for the Gillette coalfield evaluation into CoalVal and found that some require 10 to 15 minutes to import.

Reports

There are two locations in CoalVal where **Reports** can be generated. The first is found under the **Report Icon** on CoalVal's **Main Menu** (fig. B.65), the second is in the **Reports** drop-down menu on the **Projects** dialog page (fig. B.66). CoalVal will generate three different types of **Reports**. Those **Reports** will be reviewed in the following sections.

All of these **Reports** can be printed out for reference or copied to a file for reference at a later time. **Reports** can be filed as: Rich Text Format (RTF), Rave Snapshot Files (*.ndr); Adobe Acrobat (PDF) files, or Plain Text (TXT) files. Once the **Report** has been exited, it cannot be recalled except in saved files or by recalculating the **Report** in CoalVal.

Mine Model Reports

The first report deals with the **Mine Models** (fig. B.67) and will review the **Mine Modeling Assumptions**, **Operating Statements**, **Management**, **Supervisory**, and **Wage** staffing and **Capital and Operating Equipment** costs. Costs can be derived on a **Cash Cost** basis which does not include **Depreciation**, **Acquisition**, **Amortization**, **Corporate Overhead**, and some **Taxes** or it can be derived on a **Yearly Cost** basis (fig. B.67) which includes all costs except for **Corporate Overhead**. Generally the Yearly Cost basis is a preferred report because the Discounted Cash Flow reports need items such as the Depreciation and Taxes for the calculation.

First, select the Mine Model from the list of Mine Models; in this case, *select TS w/Dragline 3:1* and *enter a report title: CoalVal Tutorial Report*. Then *click on the* "*5. Click Print/Review Report" button the* ***Output Options*** *dialog will appear (fig. B.68). Determine the* "*Report Destination" on the left side of the dialog.* **Preview** the **Report** is the default setting. The **Setup** button allows the user to access the Print Setup dialog (fig. B.69) to designate the printer and print functions, and the OK button instructs CoalVal to make the calculations for the **Report**. Calculations for the **Reports** take from a few seconds to many minutes depending on the size of the resource database that is being used and the speed of the computer processor. From the **Output Options** dialog page the **Report** can be sent to a printer, previewed on the screen, or saved to a file. The first page is the title page followed by several comment pages and then the **Mining Assumptions** pages (fig. B.70) and the **Operating Statement** (fig. B.71) pages.

Project/Seam Reports

The second category of **Reports** produces summaries of the **Project** or the **Seam** resource **Areas**. All of these reports provide the operating cost per ton for the resources within each area and show the coal resources and resources restricted from mining that were input into the Coal Resource and Discounted Cash Flow Areas Table. Other information, such as mining dilution, mining recovery, and wash plant recovery found in the Mine Models and needed to calculate the recoverable resources are shown in this report. *Select the* ***Reports*** *icon from CoalVal's* ***Main Menu****, then click on the* ***Project/Seam Report*** *tab to display that dialog window (fig. B.72)*. The **Project** (all **Seams**) or an individual **Seam** (such as the Lower Bed) can be selected by checking or leaving blank the number "5" box. Using the option "2. Select Seam," *click on the Lower Bed*, then *click on "3. Enter Report Titles" and enter: "Lower Bed Seam Report*." If the "**5. Calculate Seam Report**," is checked, only a **Seam Report** will be created (fig. B.73). *Check the "5. Calculate Seam Report" box*, then c*lick on the* "*10. Click Print/Review Report*" *button to print the Lower Bed Seam* ***Report*** *(fig. B.74)*.

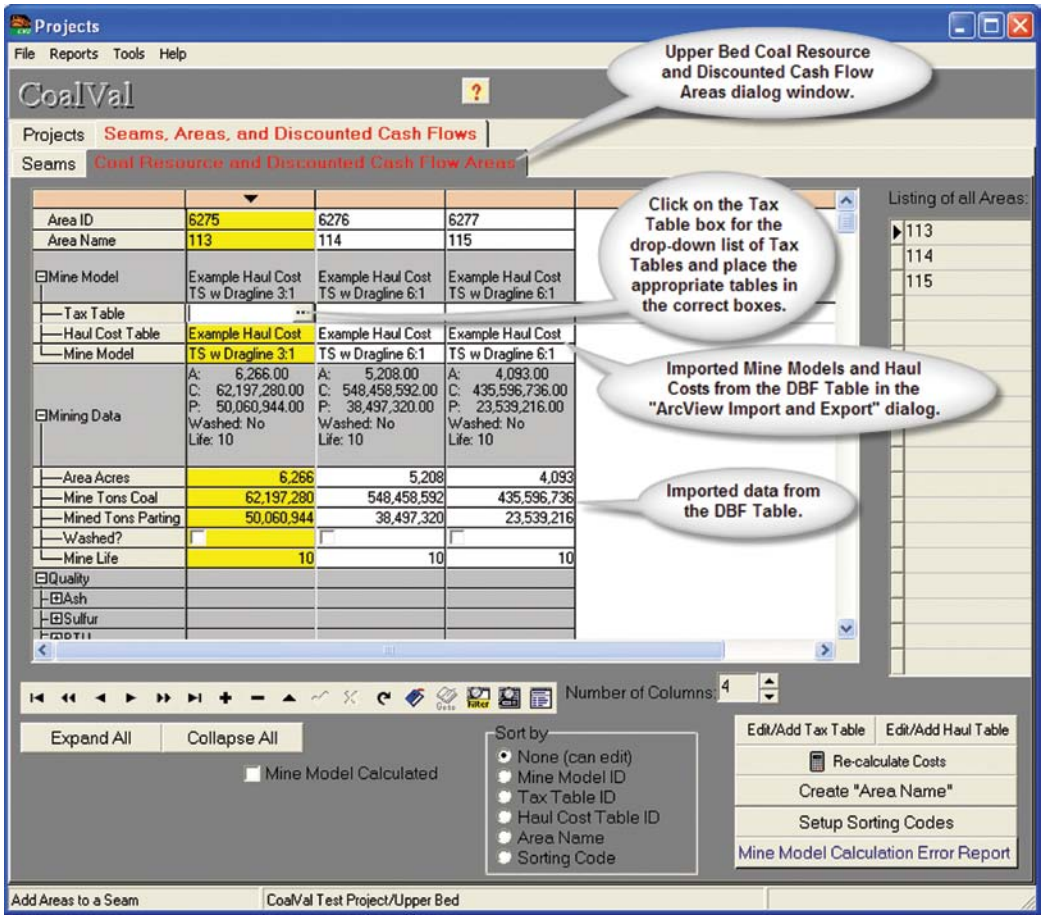


Figure B.63. Imported "Mining Data," "Mine Model," and "Haul Cost" data into CoalVal's Coal Resource and Discounted Cash Flow Areas dialog page using the ArcView Import and Export function and Tutorial Schemas.

After clicking on "10. Click Print/Review Report Button," the **Output Options** dialog page will appear and the **Report** can be sent to a printer, previewed on the screen, or saved to a file. *Click the OK button on the Output Options and the report can be reviewed*. The first page of the Lower Bed Seam Report is the title page; the second report page should look like figure B.75. The **Reports** dialog window has an area on the right side of the bottom line that will have a yellow highlighted message: "Calculating: Preparing Report" while the report is being calculated. On occasion the CoalVal Report Output Options window may get stuck in the back of the **Reports** dialog window. If, after you wait for a few minutes for the report calculation but the Output Options window does not appear, the status may be checked *by selecting* "Ctrl-Alt-Delete" on the keyboard. This action will allow the Task Manager to check to see if the program is responding. *Click on the Task Manager button* and if CoalVal is running, *exit from the window* and the Output Options window will appear. If the Report Manager shows that CoalVal is not running, *exit from CoalVal, reopen CoalVal, check the input data, and rerun the Project Report*.

Returning to the **Project/Seam Report** tab dialog and figure B.72, if the number "5" and the number "7" boxes are left unchecked, then a **Project Report** including all the seams will be created by default (fig. B.76). *Enter the report title: "CoalVal Test Project" in the "3. Enter Report Title" box and "Coal Resources from both the Lower and the Upper Beds" in the "4. Enter Report Sub-Title" box. Clicking on the number "10. Click Print/Review Report Button" will allow the user to review, print, or file a* ***Project Report*** *containing all the resource* ***Seams*** *in the database (fig. B.77)*.

All the costs in the **Mine Models** will be recalculated if the number "7. Re-calculate Mine Models," check box is marked (fig. B.78). This recalculation adds to the amount of time it takes to create a **Seam** or **Project Report**. If there have been no changes to data in any **Mine Models** since the **Project** was created, then there is no need for a recalculation and the **Reports** will be created faster.

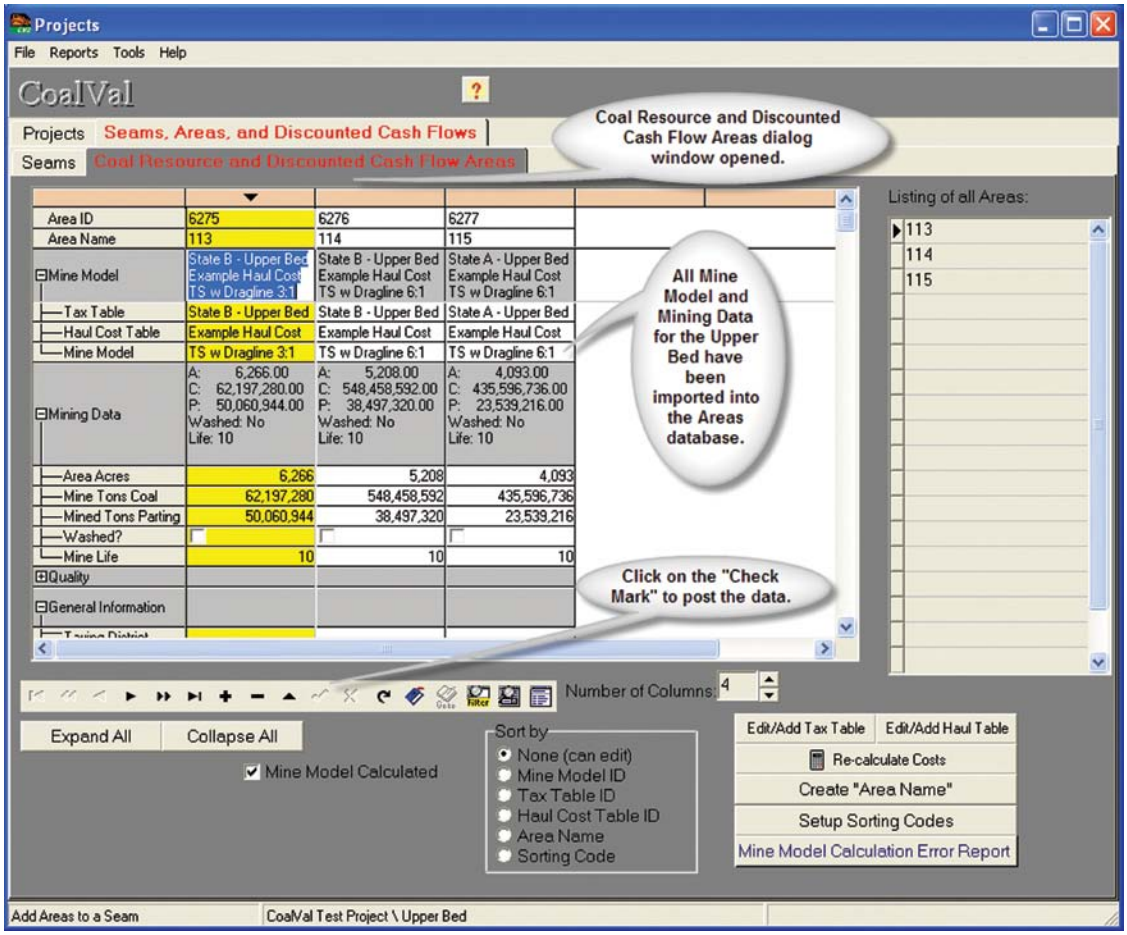


Figure B.64. CoalVal's Coal Resource and Discounted Cash Flow Areas dialog window for the Upper Bed showing the imported "Mining Data," "Mine Model," "Haul Cost" and "Tax" tables.

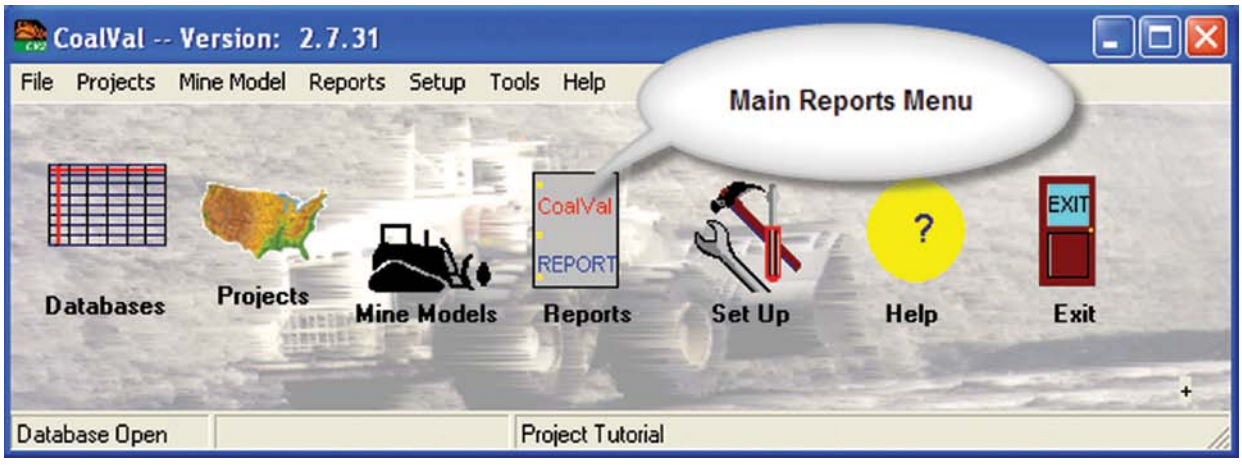


Figure B.65. CoalVal's Reports icon on CoalVal's Main Menu window.

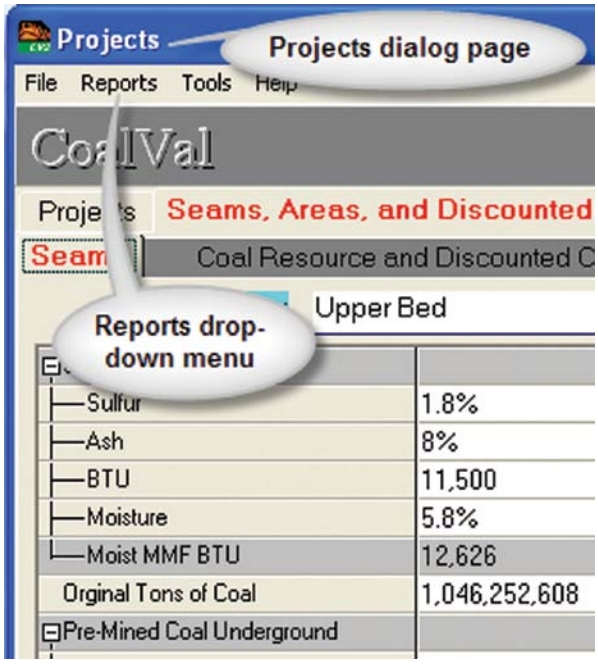


Figure B.66. Selecting the Reports drop-down menu from CoalVal's Projects dialog window.

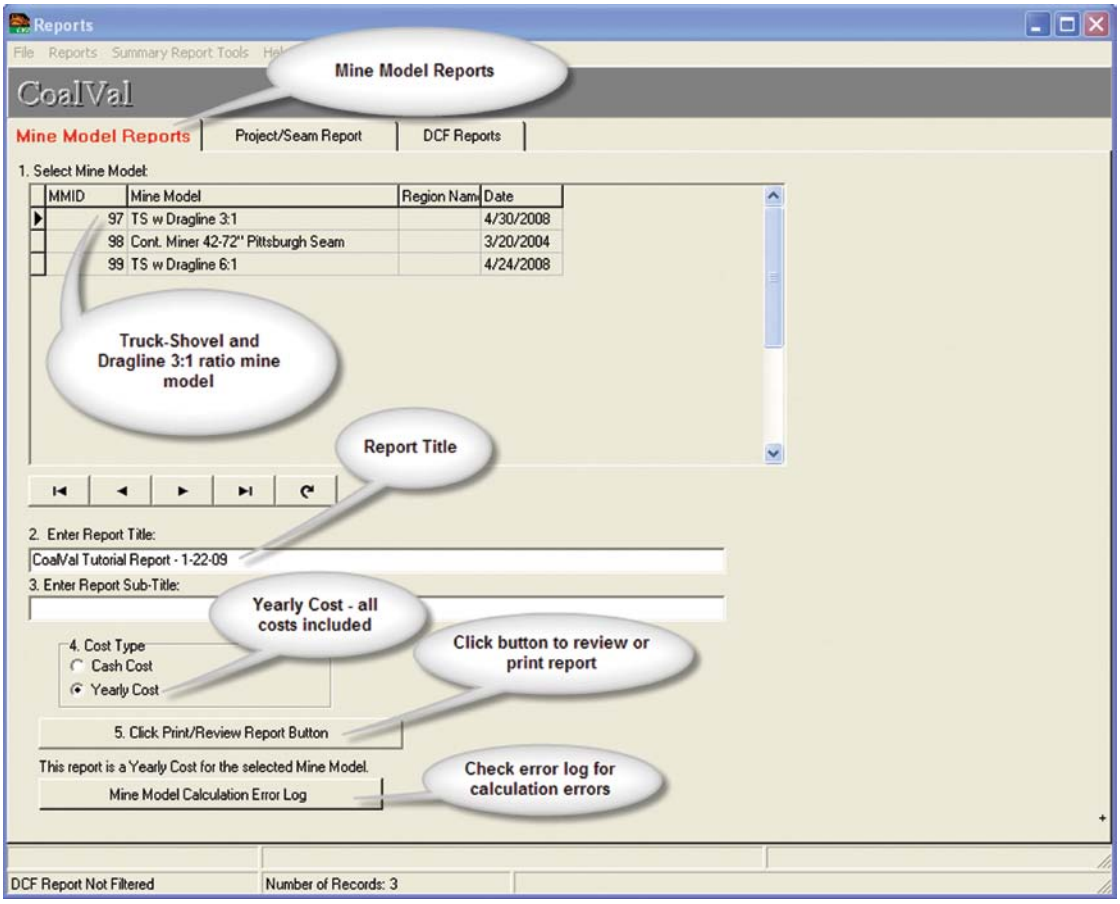


Figure B.67. CoalVal Mine Model Reports dialog window.

Figure B.68. Mine Model Report printing "Output Options" dialog window.

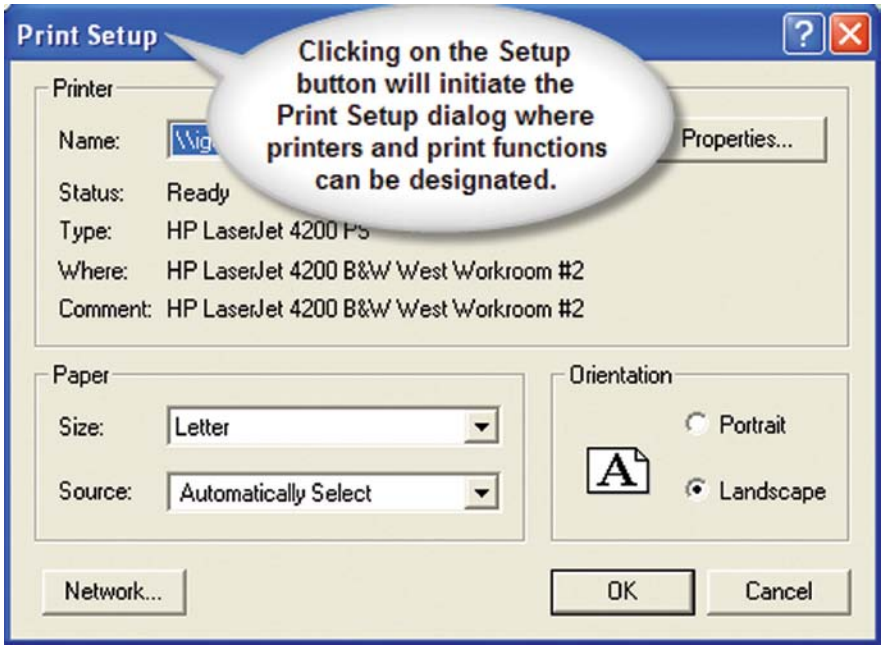


Figure B.69. CoalVal's "Print Setup" dialog window for report printing.

Truck Shovel Dragline: Dragline Mining Assumptions

Coal	Benching	Dragline	Combined	
92%	92%	0%	92%	Minable Resource Recovery
277.6	277.6	277.6	277.6	Ave. inches in-seam coal
1.7	1.7	1.7	1.7	Ave. inches in-seam parting
0.0	0.0	0.0	0.0	Total out of seam dilution
279.4	279.4	279.4	279.4	Ave. mining height
32,772.00	0.00	0.00	32,772.00	Raw tons produced/spread shift
0.00	26,494.00	64,279.00	90,773.00	BCY overburden / Spread-Shift
355	252	363	355	Days worked/year production employees
355	252	363	355	Days worked/year auxiliary employees
1	1	1	3	Number spreads
3	3	3	9	Shifts/day production
7	7	7	7	Days/week production employees
7	7	7	7	Days/week auxiliary employees
0.0	0.0	0.0	2.8	:1 effective stripping ratio
$0.050	$0.000	$0.000	$0.050	Explosive cost/BCY coal
$0.000	$0.080	$0.150	$0.230	Explosive cost/BCY overburden
47%	47%	47%	47%	Burden rate -- salaried
47%	47%	47%	47%	Burden rate -- hourly
$90.00	$25.00	$0.00	$115.00	Operating supplies/unit/shift
$900.00	$0.00	$0.00	$900.00	Equipment rental/unit/month
$3,000.00	$0.00	$0.00	$3,000.00	General utilities/month
$0.00	$500.00	$0.00	$500.00	Auto rental/month/salaried employee
$0.00	$0.00	$0.00	$0.00	Maintenance truck rental/month/mechanic
$0.10	$0.10	$0.10	$0.10	Property insurance/$100 of capital valuation
$0.02	$0.02	$0.02	$0.02	$/ton professional services (permitting, engineering)
$100.00	$25.00	$25.00	$150.00	General expenses/unit/shift(contract services)
$0.75	$0.75	$0.75	$0.75	Royality rate ($/sold ton)
$0.32	$0.32	$0.32	$0.32	$/ton reclamation tax (SMRCRA)
$0.01	$0.01	$0.01	$0.01	Acquistion cost (depletion %/ton of coal in-place
$381,200.00	$381,200.00	$0.00	$762,400.00	Overhead allocation/year
$0.15	$0.15	$0.15	$0.15	Reclamation provision (cost/raw ton)
$1.45	$1.45	$1.45	$1.45	Coal haulage cost/ton
$0.05	$0.05	$0.05	$0.05	$/ton rail loadout cost
$0.00	$0.00	$0.00	$0.00	Preparaton plant cost/raw ton of coal
100%	100%	100%	100%	% parting recovered from wash plant
100%	100%	100%	100%	% Coal recovered from wash plant
100%	100%	100%	100%	% Run-of-mine product recovered form wash plant
8%	8%	8%	8%	% Factor for hourly payroll
8%	8%	8%	8%	% 2nd Factor for hourly payroll
8%	8%	8%	8%	% 3rd Factor for hourly payroll
$0.00	$0.00	$0.00	$0.00	Hoist cost/hour
$3,196,000.00	$0.00	$0.00	$3,196,000.00	Exploration cost

Figure B.70. CoalVal's Mine Model Report: Truck-Shovel and Dragline Mining Assumptions report.

Operation Statement

DirectCosts		Cost/Ton		Cost/Ton		Cost/Ton		Cost/Ton
Payroll	$16,394,669	$0.47	$2,670,175	$0.00	$4,211,462	$0.00	$23,276,306	$0.67
Burden	$7,705,495	$0.22	$1,254,982	$0.00	$1,979,387	$0.00	$10,939,864	$0.31
Fuel and Lubes	$17,819,264	$0.51	$10,222,229	$0.00	$13,464,570	$0.00	$41,506,063	$1.19
Explosives	$1,729,335	$0.05	$1,602,357	$0.00	$10,499,975	$0.00	$13,831,667	$0.40
Operating Supplies	$95,850	$0.00	$18,900	$0.00	$0	$0.00	$114,750	$0.00
Repair Parts/Maintenance Supply	$9,537,608	$0.27	$4,952,364	$0.00	$6,776,194	$0.00	$21,266,166	$0.61
Utilities	$36,000	$0.00	$0	$0.00	$0	$0.00	$36,000	$0.00
All Rentals	$10,800	$0.00	$18,000	$0.00	$0	$0.00	$28,800	$0.00
ProfessionalService	$698,044	$0.02	$0	$0.00	$0	$0.00	$698,044	$0.02
Reclamation Provision	$5,235,327	$0.15	$0	$0.00	$0	$0.00	$5,235,327	$0.15
General Expenses	$106,500	$0.00	$18,900	$0.00	$27,225	$0.00	$152,625	$0.00
Hoisting Cost	$0	$0.00	$0	$0.00	$0	$0.00	$0	$0.00
Direct Cost, Raw	$59,368,891	$1.70	$20,757,908	$0.00	$36,958,813	$0.00	$117,085,611	$3.35

IndirecCosts		Cost/Ton		Cost/Ton		Cost/Ton		Cost/Ton
Depreciation	$3,956,023	$0.11	$2,740,600	$0.00	$3,102,900	$0.00	$9,799,523	$0.28
Acquisition/Depletion	$319,600	$0.01	$0	$0.00	$0	$0.00	$319,600	$0.01
Amortization	$1,665,262	$0.05	$0	$0.00	$0	$0.00	$1,665,262	$0.05
Overhead	$381,200	$0.01	$381,200	$0.00	$0	$0.00	$762,400	$0.02
ProperyInsurance	$116,025	$0.00	$53,707	$0.00	$96,503	$0.00	$266,235	$0.01
State Sales Tax	$1,171,974	$0.03	$673,310	$0.00	$1,230,719	$0.00	$3,076,003	$0.09
Real Property Tax	$0	$0.00	$0	$0.00	$0	$0.00	$0	$0.00
Tangible Property Tax	$0	$0.00	$0	$0.00	$0	$0.00	$0	$0.00
Total Indirect Cost	$7,610,084	$0.22	$3,848,817	$0.00	$4,430,122	$0.00	$15,889,023	$0.46

OtherCosts		Cost/Ton		Cost/Ton		Cost/Ton		Cost/Ton
Wash Plant Cost, Washed	$0	$0.00	$0	$0.00	$0	$0.00	$0	$0.00
Loadout Cost, Sold	$1,745,109	$0.05	$0	$0.00	$0	$0.00	$1,745,109	$0.05
D & I in Car, Raw	$68,724,084	$1.97	$24,606,725	$0.00	$41,388,934	$0.00	$134,719,743	$3.86
D & I in Car, Washed	$68,724,084	$1.97	$24,606,725	$0.00	$41,388,934	$0.00	$134,719,743	$3.86
Coal Haulage Cost, Raw	$50,608,161	$1.45	$0	$0.00	$0	$0.00	$50,608,161	$1.45

Figure B.71. CoalVal's Mine Model Report: Operating Statement, page 1, Direct, Indirect, and Other Costs report.

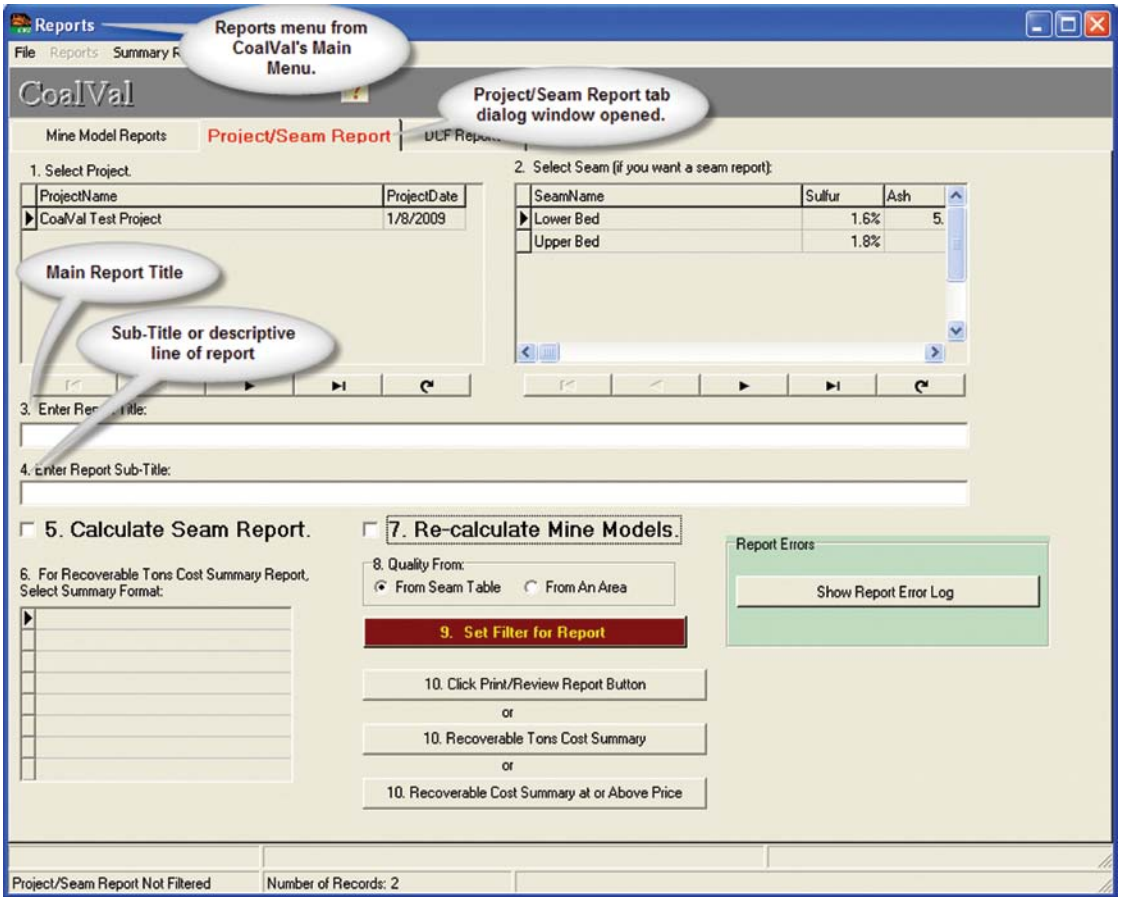


Figure B.72. CoalVal's Project/Seam Report tab in the Reports dialog window.

There are two more summary **Reports** that can be calculated for an individual **Seam Report** or for all the **Seams** in the **Project.** Those are found on the "10. Recoverable Tons Cost Summary" and "10. Recoverable Cost Summary at or Above the (market) Price**"** buttons (fig. B.79). However, before these summary **Reports** can be run, the user must develop **Range Tables** in the **Setup Summary Ranges** dialogs. The **Range Tables** are found by *selecting the main* Reports *menu and clicking on the* ***Summary Report Tools*** *item found in the top menu row (fig. B.80). Click on* ***Summary Report Tools*** *and a drop-down list* will appear*:*

Summary Report Tools drop-down list:
- Setup Summary Ranges
- Chart
- End User Reports, and
- DCF Mine Type Production References.

Click on ***Setup Summary Ranges*** *and two tables will appear (fig. B.81). Type in the Cost Summary Name: Tutorial Project.* Then c*reate the ranges for the "Starting," "Ending," and "Incremental" values in the box on the right side of figure B.81 using the values in figure B.81 and click on the "Create Range" button*. The ranges may be reviewed and changed if necessary. Now *return to the* ***Project/Seam Report*** *tab and click on "10. Recoverable Tons Cost Summary" (fig. B.79)*. The resulting **Report** can be a **Summary Report by Seam** or by all **Project Seams**. Assuming that the "**5. Box**" is not checked the default report will be a distribution summary for all evaluated **Seams** in the **Project** (fig. B.80). If the **Range Tables** are not developed, the **Repor**t will be blank and an error message under "Show Report Error Log" (fig. B.81) will indicate that the ranges have not been developed.

Discounted Cash Flow Reports

The third category of reporting is the **DCF** (Discounted Cash Flow) **Report**. Three set of DCF reports can be selected by clicking the **DCF Reports** tab from the **Main Reports** dialog window (fig. B.82) or selecting the Discounted Cash Flow item from the drop-down list under the Projects Icon on CoalVal's main menu. The first set of reports provides a summary and details of DCF Yearly Flow for the life of the project

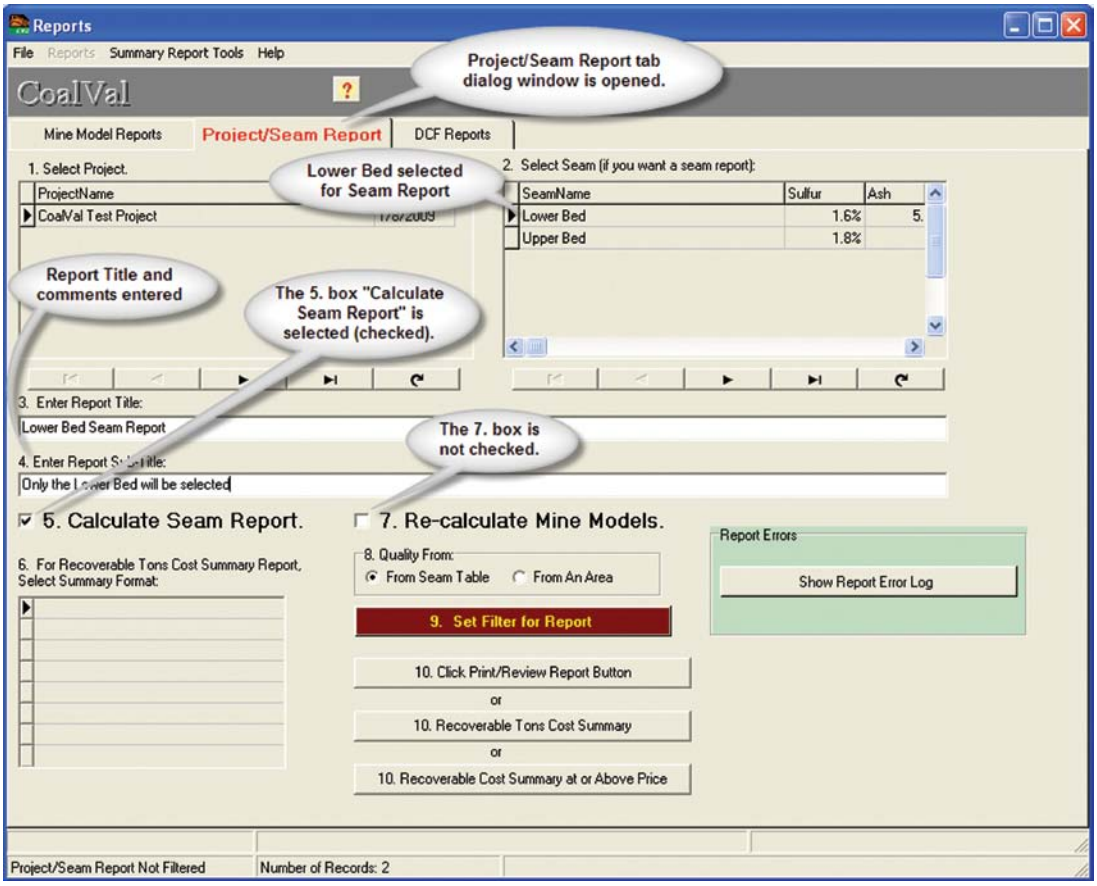


Figure B.73. Selecting the "5. Calculate Seam Report" for the Lower Bed on the Project/Seam Report tab of the Reports dialog window.

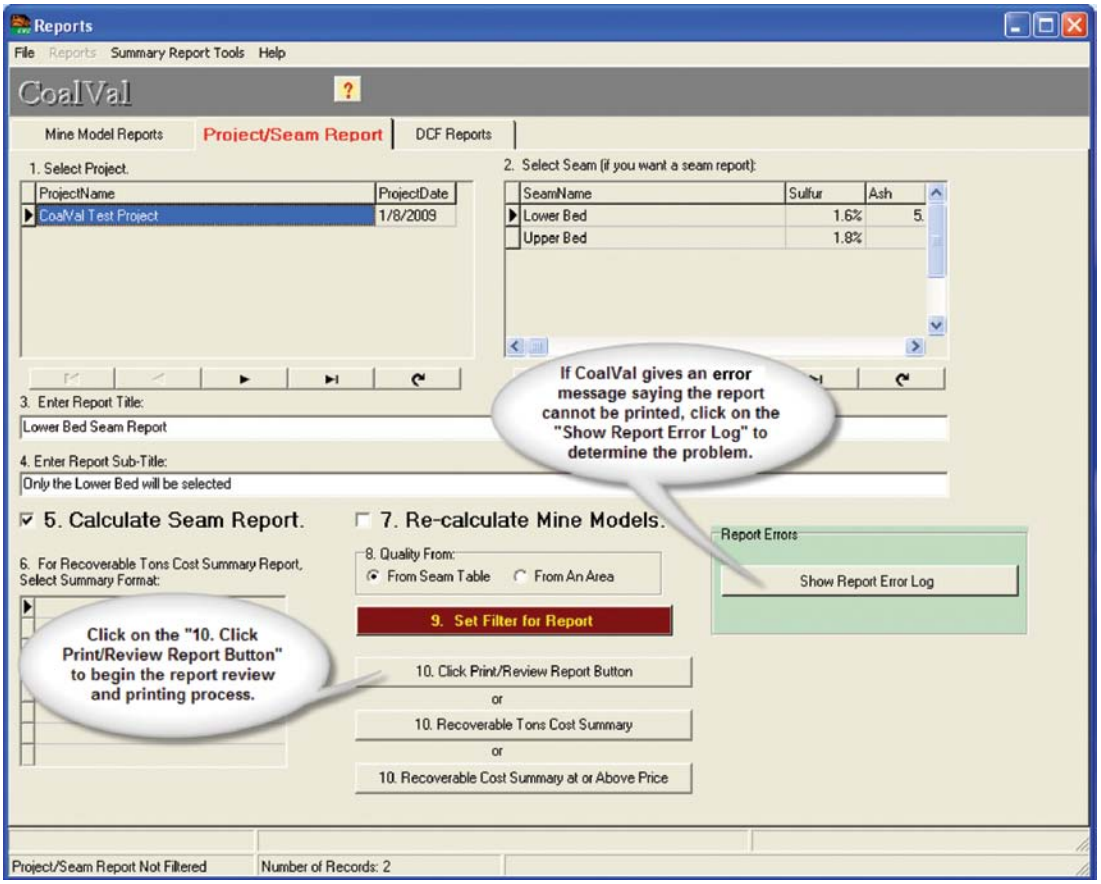
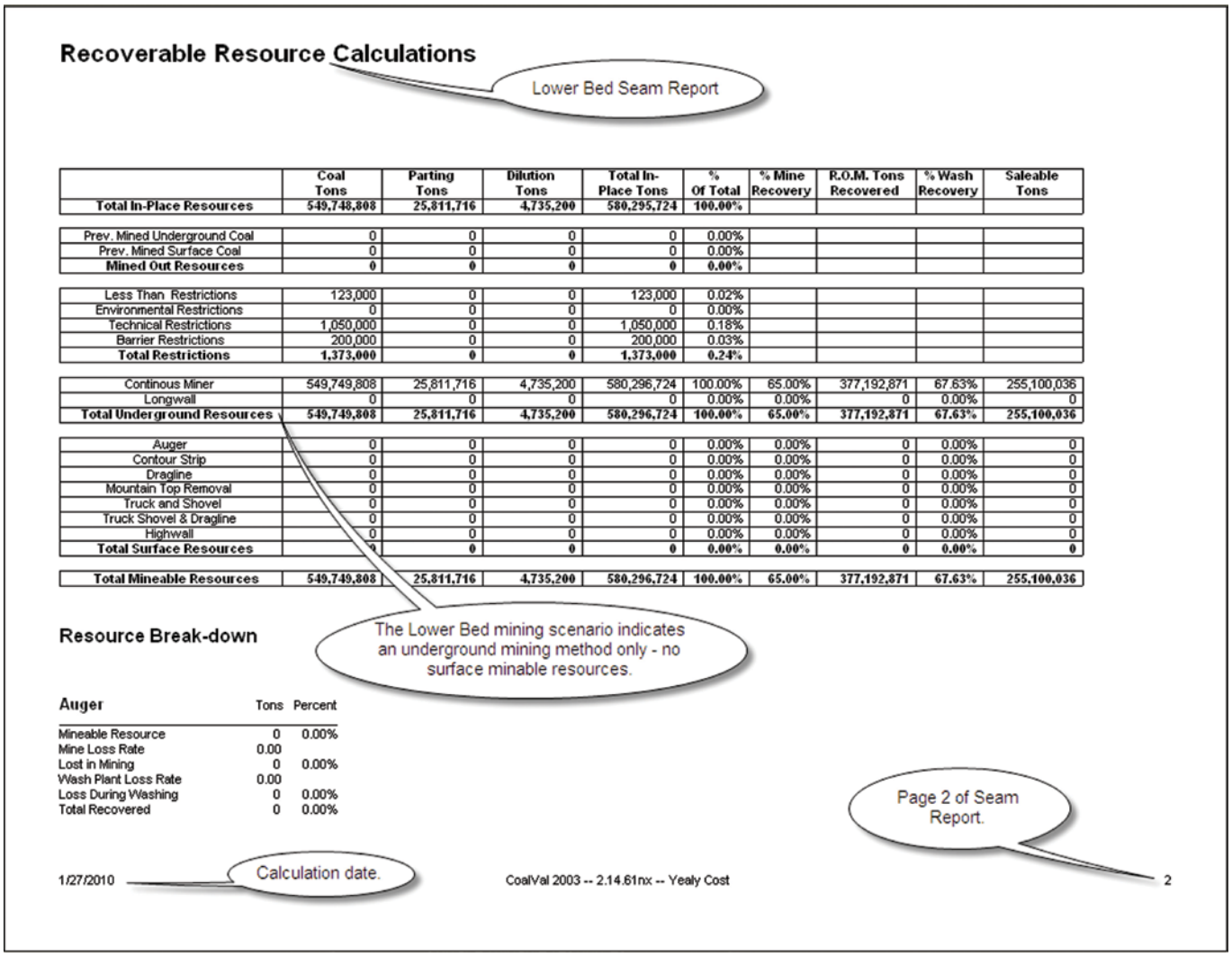


Figure B.74. Reviewing and printing the Lower Bed Seam Report from the Project/Seam Report tab in the Reports dialog window.



Recoverable Resource Calculations

Lower Bed Seam Report

	Coal Tons	Parting Tons	Dilution Tons	Total In-Place Tons	% Of Total	% Mine Recovery	R.O.M. Tons Recovered	% Wash Recovery	Saleable Tons
Total In-Place Resources	**549,748,808**	**25,811,716**	**4,735,200**	**580,295,724**	**100.00%**				
Prev. Mined Underground Coal	0	0	0	0	0.00%				
Prev. Mined Surface Coal	0	0	0	0	0.00%				
Mined Out Resources	**0**	**0**	**0**	**0**	**0.00%**				
Less Than Restrictions	123,000	0	0	123,000	0.02%				
Environmental Restrictions	0	0	0	0	0.00%				
Technical Restrictions	1,050,000	0	0	1,050,000	0.18%				
Barrier Restrictions	200,000	0	0	200,000	0.03%				
Total Restrictions	**1,373,000**	**0**	**0**	**1,373,000**	**0.24%**				
Continous Miner	549,749,808	25,811,716	4,735,200	580,296,724	100.00%	65.00%	377,192,871	67.63%	255,100,036
Longwall	0	0	0	0	0.00%	0.00%	0	0.00%	0
Total Underground Resources	**549,749,808**	**25,811,716**	**4,735,200**	**580,296,724**	**100.00%**	**65.00%**	**377,192,871**	**67.63%**	**255,100,036**
Auger	0	0	0	0	0.00%	0.00%	0	0.00%	0
Contour Strip	0	0	0	0	0.00%	0.00%	0	0.00%	0
Dragline	0	0	0	0	0.00%	0.00%	0	0.00%	0
Mountain Top Removal	0	0	0	0	0.00%	0.00%	0	0.00%	0
Truck and Shovel	0	0	0	0	0.00%	0.00%	0	0.00%	0
Truck Shovel & Dragline	0	0	0	0	0.00%	0.00%	0	0.00%	0
Highwall	0	0	0	0	0.00%	0.00%	0	0.00%	0
Total Surface Resources	**0**	**0**	**0**	**0**	**0.00%**	**0.00%**	**0**	**0.00%**	**0**
Total Mineable Resources	**549,749,808**	**25,811,716**	**4,735,200**	**580,296,724**	**100.00%**	**65.00%**	**377,192,871**	**67.63%**	**255,100,036**

The Lower Bed mining scenario indicates an underground mining method only - no surface minable resources.

Resource Break-down

Auger	Tons	Percent
Mineable Resource	0	0.00%
Mine Loss Rate	0.00	
Lost in Mining	0	0.00%
Wash Plant Loss Rate	0.00	
Loss During Washing	0	0.00%
Total Recovered	0	0.00%

Page 2 of Seam Report.

1/27/2010 Calculation date.

CoalVal 2003 -- 2.14.61nx -- Yealy Cost

2

Figure B.75. CoalVal's "Recoverable Resource Calculations Seam Report" summary for the Lower Bed.

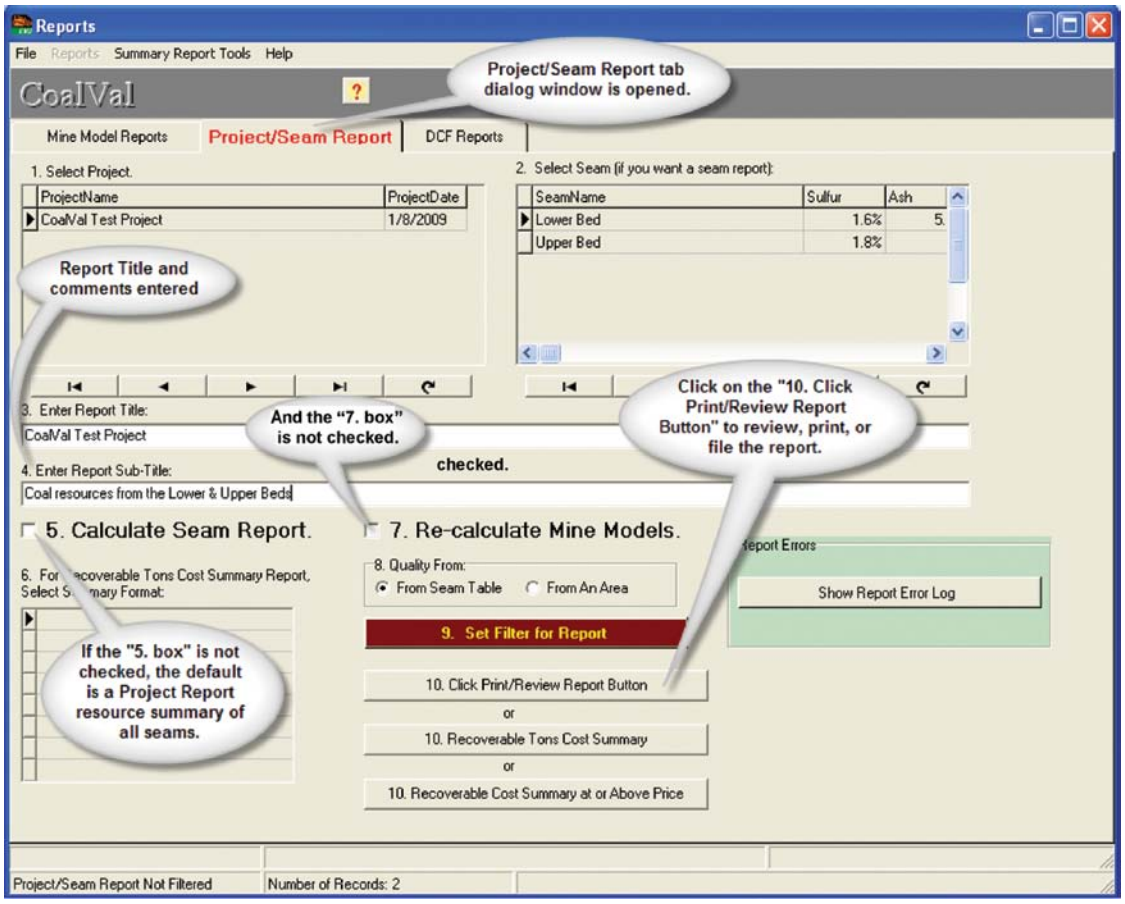
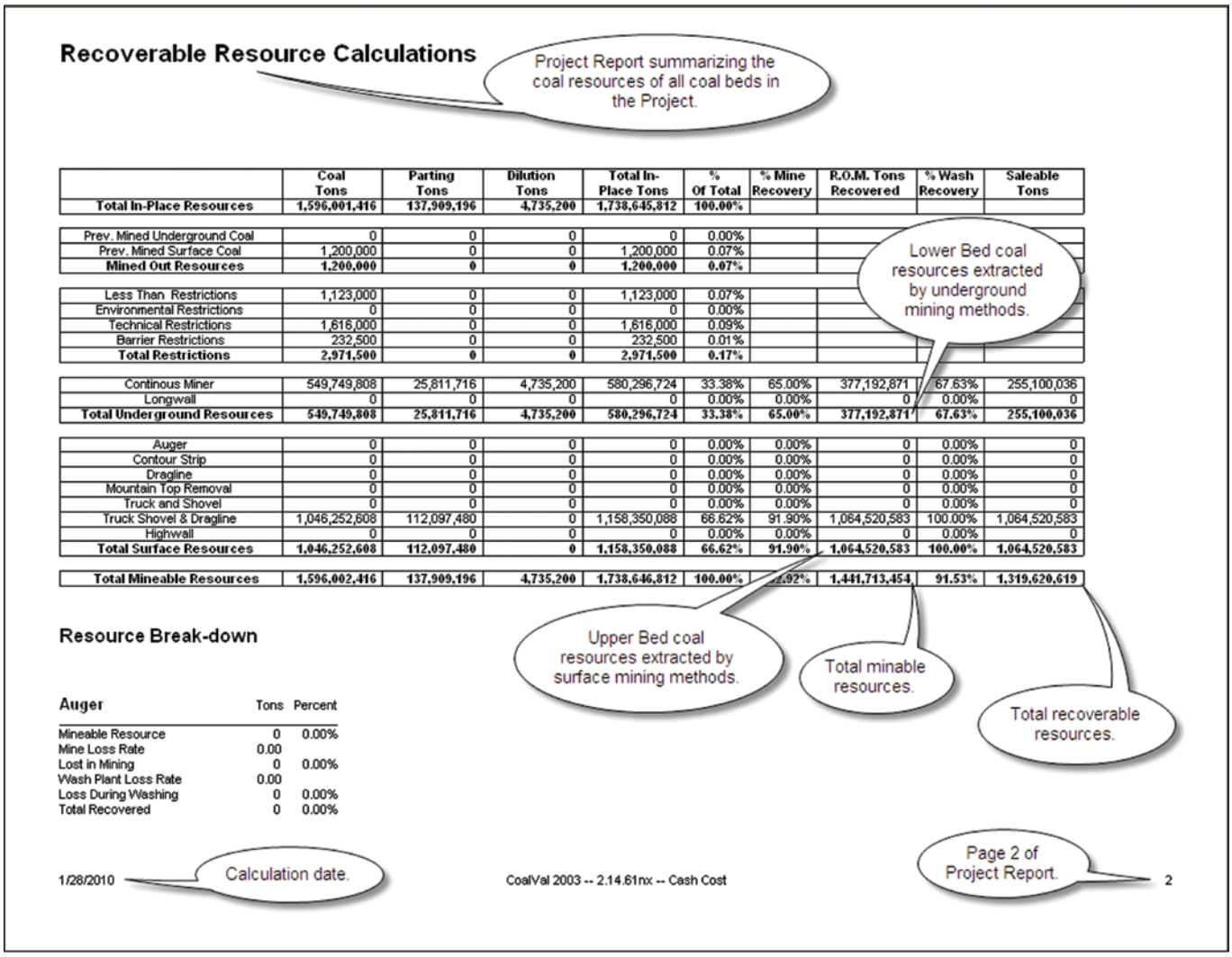


Figure B.76. Producing a CoalVal Project/Seam Report that includes all the seams.



	Coal Tons	Parting Tons	Dilution Tons	Total In-Place Tons	% Of Total	% Mine Recovery	R.O.M. Tons Recovered	% Wash Recovery	Saleable Tons
Total In-Place Resources	**1,596,001,416**	**137,909,196**	**4,735,200**	**1,738,645,812**	**100.00%**				
Prev. Mined Underground Coal	0	0	0	0	0.00%				
Prev. Mined Surface Coal	1,200,000	0	0	1,200,000	0.07%				
Mined Out Resources	**1,200,000**	**0**	**0**	**1,200,000**	**0.07%**				
Less Than Restrictions	1,123,000	0	0	1,123,000	0.07%				
Environmental Restrictions	0	0	0	0	0.00%				
Technical Restrictions	1,616,000	0	0	1,616,000	0.09%				
Barrier Restrictions	232,500	0	0	232,500	0.01%				
Total Restrictions	**2,971,500**	**0**	**0**	**2,971,500**	**0.17%**				
Continous Miner	549,749,808	25,811,716	4,735,200	580,296,724	33.38%	65.00%	377,192,871	67.63%	255,100,036
Longwall	0	0	0	0	0.00%	0.00%	0	0.00%	0
Total Underground Resources	**549,749,808**	**25,811,716**	**4,735,200**	**580,296,724**	**33.38%**	**65.00%**	**377,192,871**	**67.63%**	**255,100,036**
Auger	0	0	0	0	0.00%	0.00%	0	0.00%	0
Contour Strip	0	0	0	0	0.00%	0.00%	0	0.00%	0
Dragline	0	0	0	0	0.00%	0.00%	0	0.00%	0
Mountain Top Removal	0	0	0	0	0.00%	0.00%	0	0.00%	0
Truck and Shovel	0	0	0	0	0.00%	0.00%	0	0.00%	0
Truck Shovel & Dragline	1,046,252,608	112,097,480	0	1,158,350,088	66.62%	91.90%	1,064,520,583	100.00%	1,064,520,583
Highwall	0	0	0	0	0.00%	0.00%	0	0.00%	0
Total Surface Resources	**1,046,252,608**	**112,097,480**	**0**	**1,158,350,088**	**66.62%**	**91.90%**	**1,064,520,583**	**100.00%**	**1,064,520,583**
Total Mineable Resources	**1,596,002,416**	**137,909,196**	**4,735,200**	**1,738,646,812**	**100.00%**	**82.92%**	**1,441,713,454**	**91.53%**	**1,319,620,619**

Resource Break-down

Auger	Tons	Percent
Mineable Resource	0	0.00%
Mine Loss Rate	0.00	
Lost in Mining	0	0.00%
Wash Plant Loss Rate	0.00	
Loss During Washing	0	0.00%
Total Recovered	0	0.00%

1/28/2010

CoalVal 2003 -- 2.14.61nx -- Cash Cost

2

Figure B.77. CoalVal's Project/Seam Report summarizing the "Recoverable Resource Calculations" report for all coal beds in the Tutorial database.

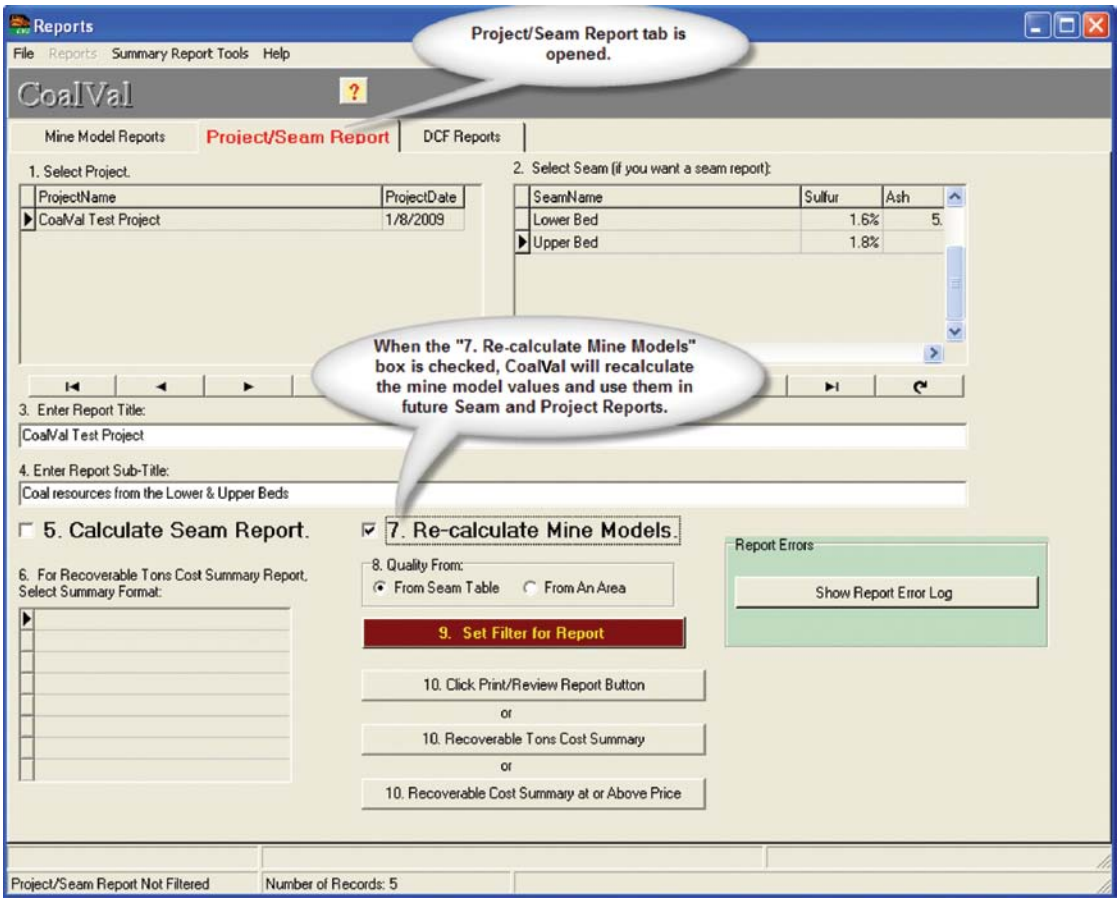


Figure B.78. Recalculation of CoalVal's Mine Model Reports when the number "7. Recalculate Mine Models" box is checked.

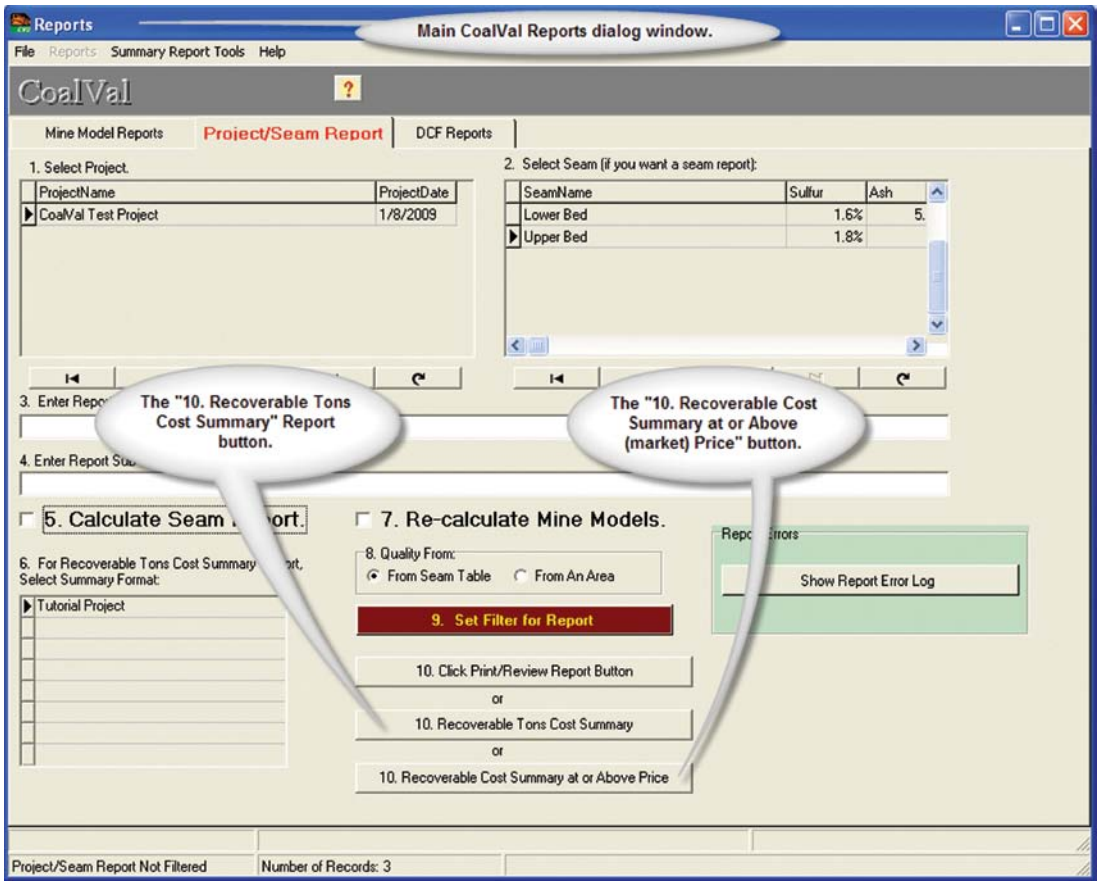


Figure B.79. CoalVal's "Recoverable Tons Cost Summary" reports on the Project/Seam Report tab of the Reports dialog window.

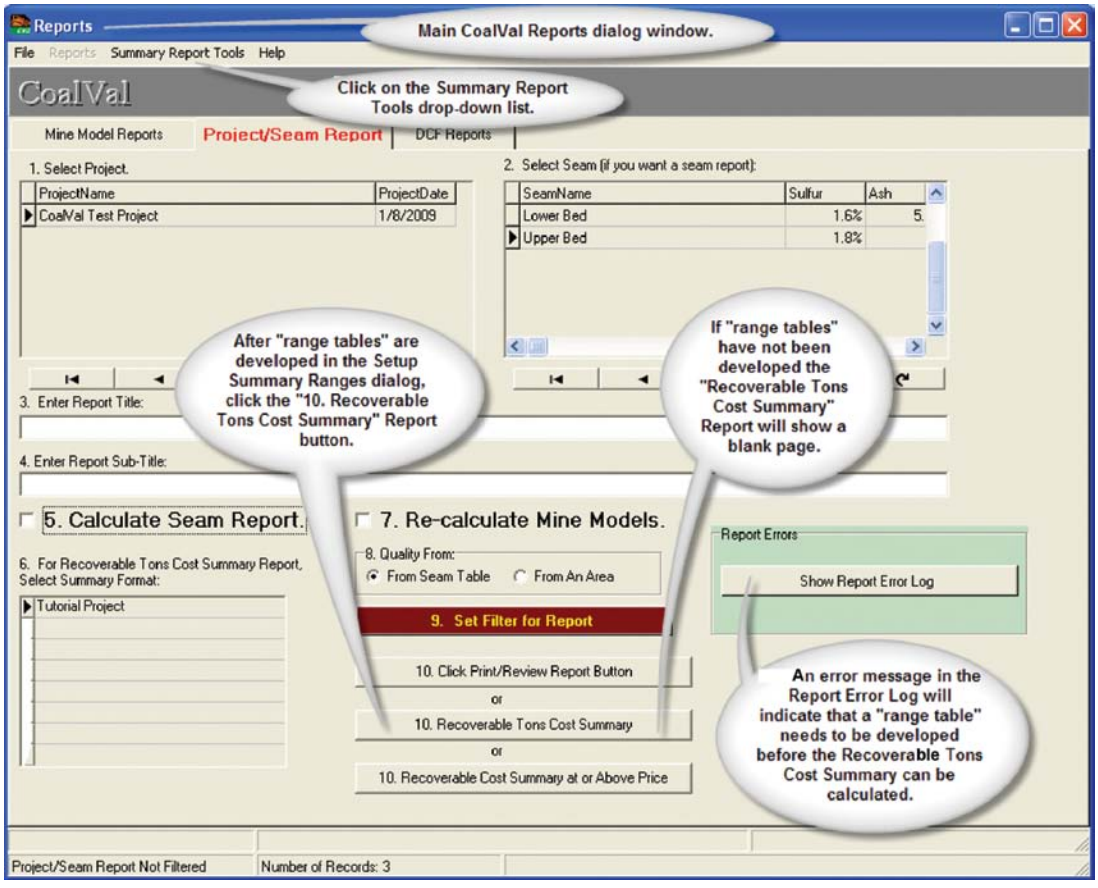


Figure B.80. CoalVal's Reports dialog window showing the Summary Report Tools drop-down menu location – where the Summary Ranges dialog is available.

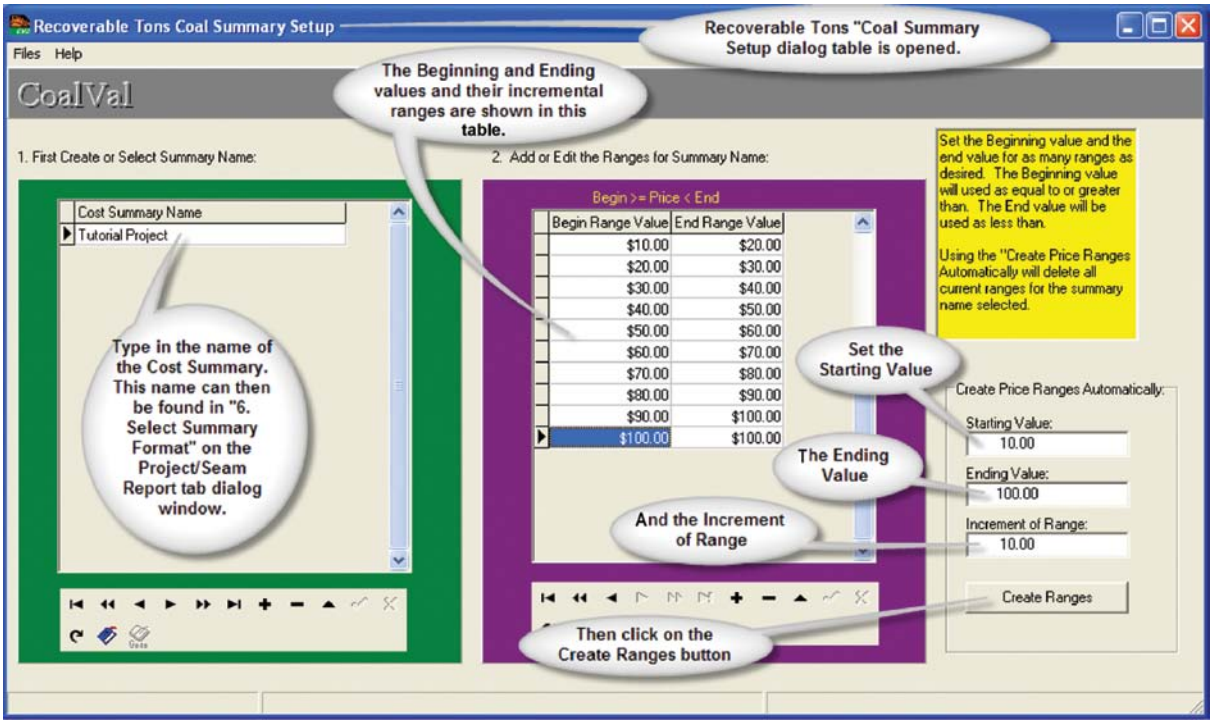


Figure B.81. CoalVal's Recoverable Tons Coal Summary Setup dialog window showing the steps needed to develop range tables.

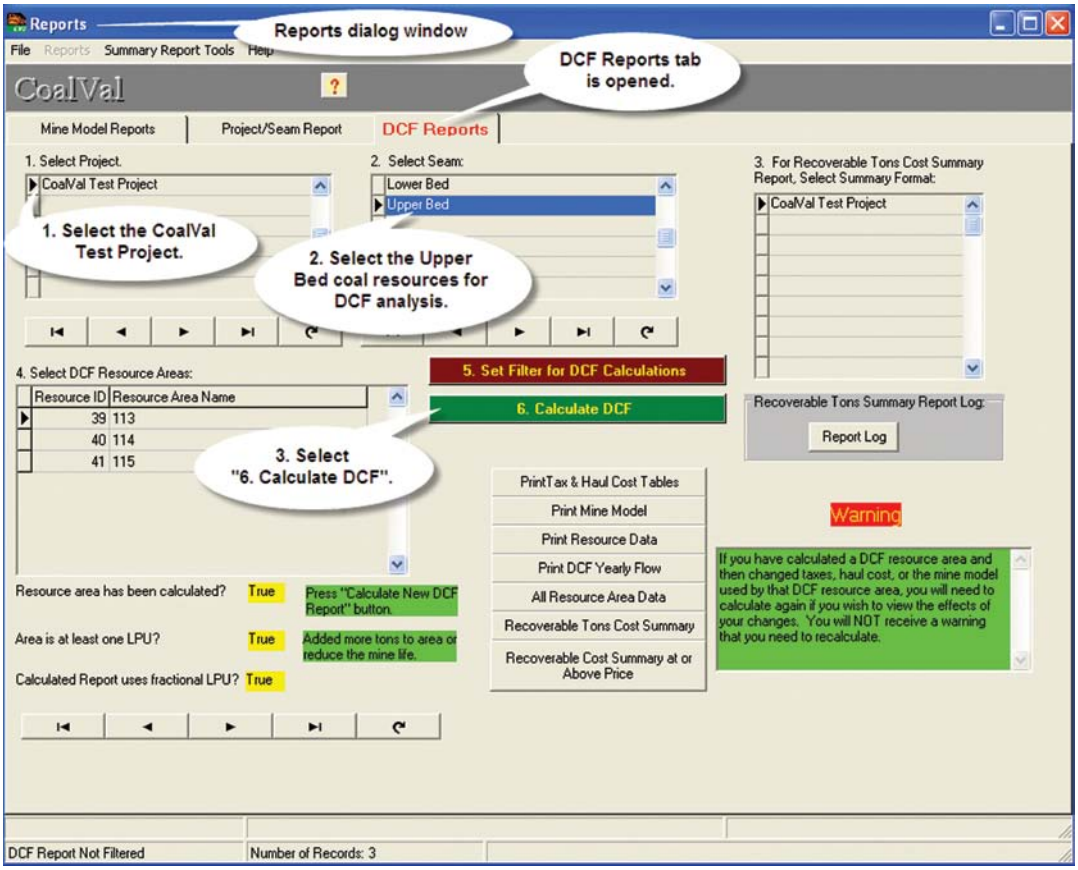


Figure B.82. Selecting CoalVal's number "6. Calculate DCF" button for the Upper Bed on the DCF Reports tab in the Reports dialog window.

by resource area. The other reports provide summaries of the DCF costs to mine the coal resources by allocating the costs into cost ranges as described in the previous section.

To set up a Discounted Cash Flow (DCF) calculation and the **DCF Report**, *click on the DCF Reports tab, then select the **CoalVal Test Project** from the* **"***Select Project" field* (**number 1** in fig. B.82); *select the Upper Bed from the **Select Seam** field* (**number 2**, in fig. B.82). *Click on the* "*number 6 button*, *Calculate DCF***"** to calculate a **DCF Report** (fig. B.82). The **DCF Calculator** dialog will be opened (fig. B.83). *Select the **CoalVal Test Project** under* "***1. Select Project***," *and the Upper Bed under the* "2. Select Seam**,"** then *click on the blue*, ***Calculate All Areas, LPU DCF Reports** button*. An LPU is the abbreviation for **Logical Production Unit**, an amount of coal resource large enough to develop one mine-life using the assigned "Mining Method" (also see LPU in the Glossary, appendix D). The Discounted Cash Flow calculations may take several minutes to process, depending on the number of "Resource Areas" being evaluated. After all of the **Areas**, such as State A and State B, have been evaluated, *click on the* "*Report Log" button (fig. B.84)* and *check the comments to see if any corrections or changes need to be made.* If there are comments that indicate areas with too small resource amounts, click on the Small Areas Report button for the list and resource amounts in the areas. For a more detailed explanation see the Fractional Logical Production Units section in the Program Description, appendix C. Further, if the calculations appear to be taking too long, the user can check the PC's Task Manager by pressing Control-Alt-Delete at the same time. The Task Manager will show if the program is running or not responding. If it is not responding, then the user will have to look for data input errors in the **Coal Resource and Discounted Cash Flow Areas** dialog window that lack complete data or that contain grossly inaccurate data (that is, boxes were not filled in correctly). Now *exit from the **DCF Calculator** dialog window*.

The lower left corner of the **DCF Report** dialog window contains CoalVal notes that indicate the DCF for the Upper Bed resource area was successfully calculated and the **Area** contained enough coal resources for at least one LPU (fig. B.85). The user can now calculate a minimum threshold price for whole resource **Areas** (or blocks) based on a Discounted Cash Flow (DCF) analysis that recoups investment costs at a specified after-tax **"**Hurdle Rate" that was set by the user. For each "Resource Area" a "Threshold Price" and the coal quality to market can be calculated. In addition, an Internal Rate of Return, based on a DCF analysis (where the net present value of all cash flows equal zero) based on a given contract price for coal can also be calculated.

Several **Reports** based on the user-determined DCF percentage will exhibit the mining costs in different formats. The "Print DCF Yearly Flow" will provide a **Material Flow Tracking Summary Report** with a "Threshold Price," number of Logical Production Units (LPUs) in the "Resource Area," and a distribution of expenses for the life of each LPU. *Click on the **Print DCF Yearly Flow Report** button (fig. B.86) and the **DCF Yearly Flow Report**, **Print Preview** dialog will appear (fig. B.87)*. The first page of the **Material Flow Tracking Summary Report** is a summary (fig. B.88) for one "Resource Area" and contains the "Mine Life," "Tons of Coal Available for Market," "Hurdle Rate," and "Threshold Price." Also included on the summary page are the "Resource Recovery Rate," **Mine Model** used in the evaluation, and coal quality. If the coal was washed before being shipped, the washing losses and recovered tons are shown. The detailed **DCF Flow Report** starts on the second page of the **Report** (fig. B.89) beginning with 2 years of preproduction, followed by 10 years of mine production, and concluding with "After Tax Income" and "Salvage" values (fig. B.90). The detailed **DCF Report** is laid out like a horizontal spreadsheet and contains 12 pages to the right of the first report page.

The other **DCF Reports** summarize the **Recoverable Tons by Area** in cost increments determined by the user. The same "Price Ranges" set up in the **Project/Seams Report** section will be used in this section. *Click on the* "Recoverable Tons Cost Summary" *button on the* **DCF Reports** *dialog window*. A "Report Caption" box will pop up. The user can enter a comment or caption that will show on the title page of the report or else leave the title page blank and exit to the **Print Preview** dialog. The **Print Preview** of the **Recoverable Tons Cost Summary Report** by price range is shown in figure B.91. The final **DCF Report** is the **Recoverable Cost Summary at or Above (market) Price Report**. This **Report** provides a summary of the "Economically Recoverable Tons of Coal" on a cumulative basis from the lowest producible price range to the top of the price range. Figure B.92 shows this **Report** after calculating the Upper Bed DCF analysis. For a further discussion of the reporting options on this dialog see the **Reports** section in the Program Description Chapter, appendix C.

Geographical Information Systems and Coal-Quality Data Importing

Data Import Introduction

This section of the tutorial discusses importing quality and resource data into the **Area Table** of a **Project Seam** or data into the **Seam Table** of a **Project**. Coal-quality data are appended to the **Area Table** when imported and includes the following analyses:

1. Ash yield (for raw coal, parting, and dilution products)
2. Sulfur (for coal, parting, and dilution products)
3. Btu (for coal, parting, and dilution products)
4. Moisture

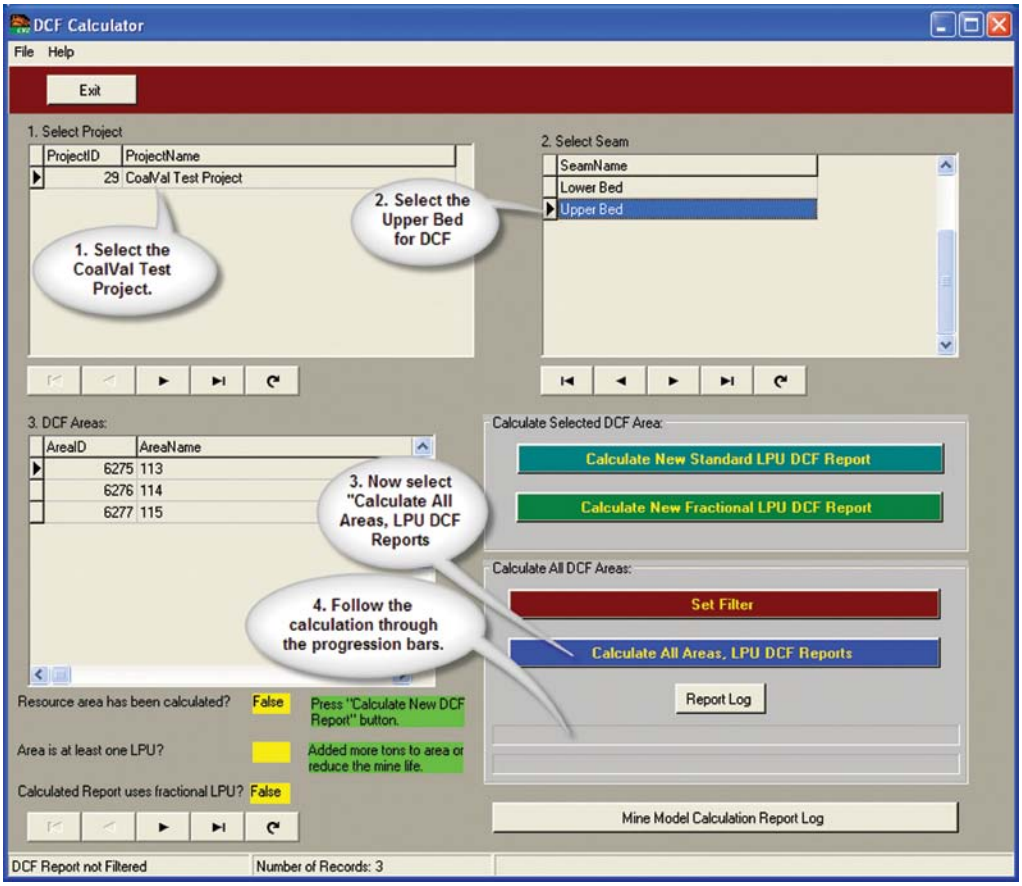


Figure B.83. CoalVal's DCF Calculator dialog window showing the steps to calculate the Upper Bed's Discounted Cash Flow (DCF).

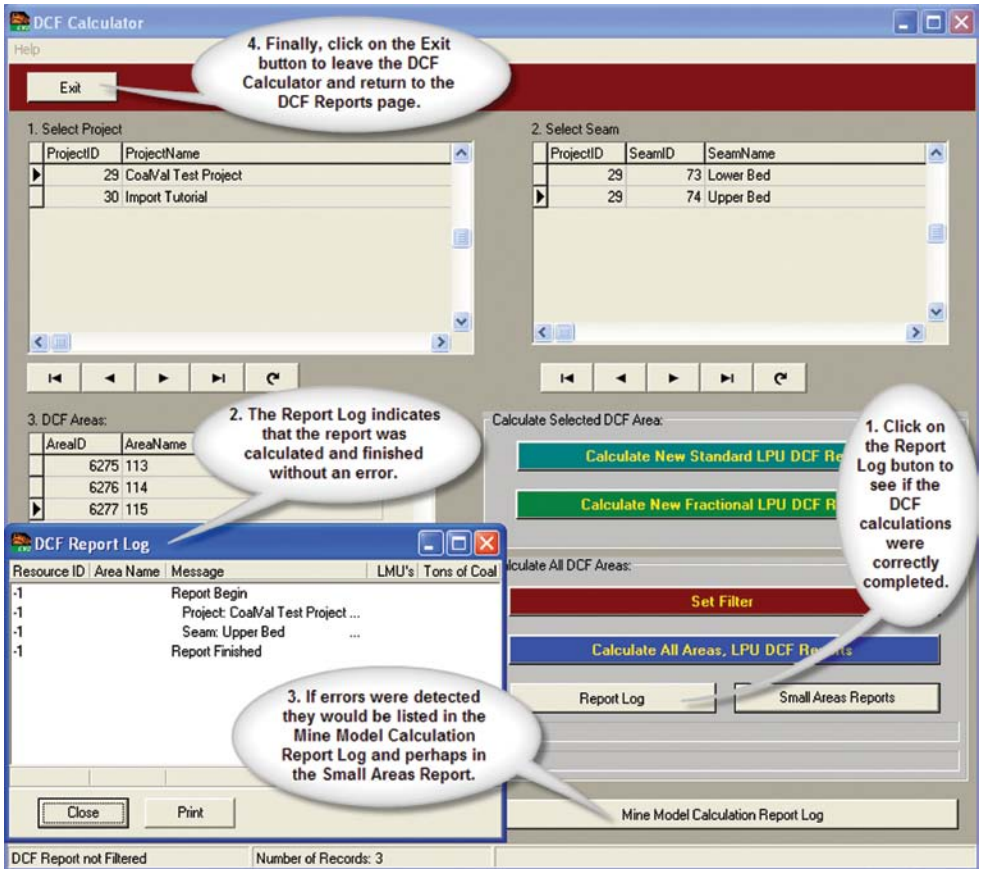


Figure B.84. CoalVal's DCF (Discounted Cash Flow) Calculator dialog window showing the steps for calculating the DCF of a resource and follow-up through the "Report Log" and "Small Areas Reports."

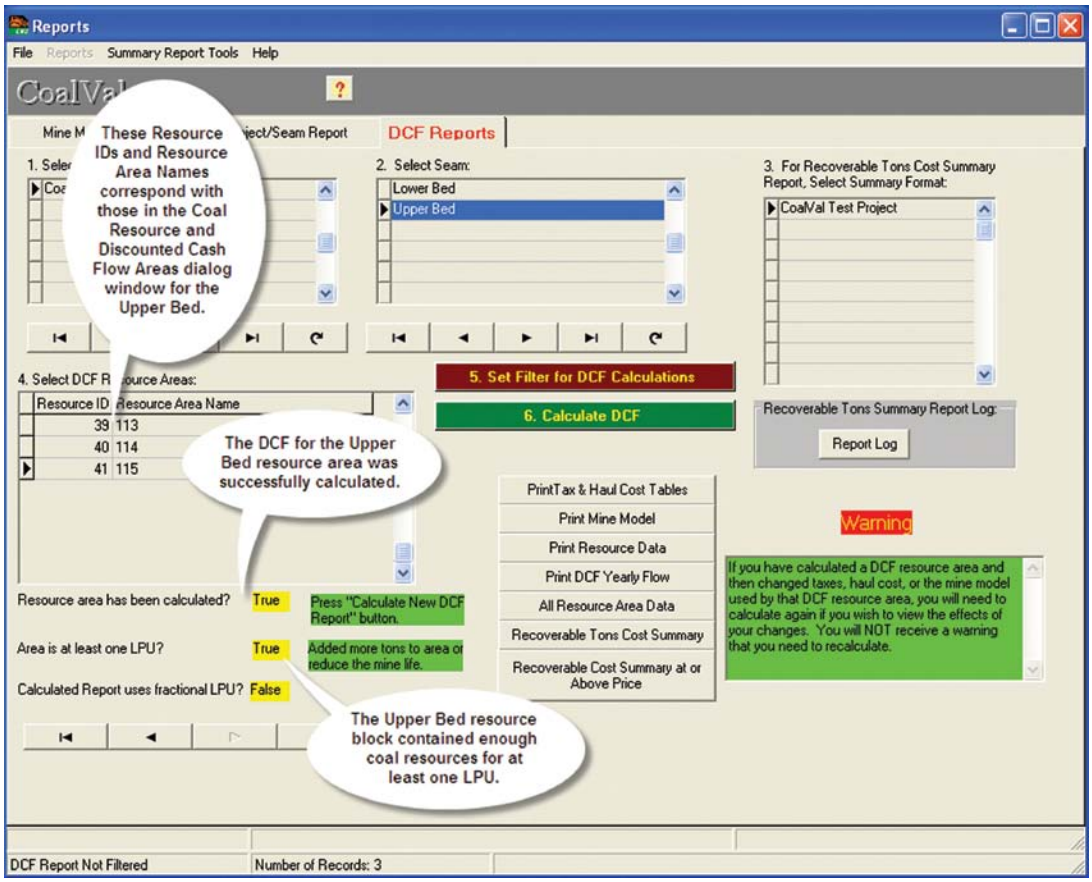


Figure B.85. CoalVal's DCF Reports dialog window showing the Upper Bed's successful Discounted Cash Flow calculation containing at least one LPU (Logical Production Unit).

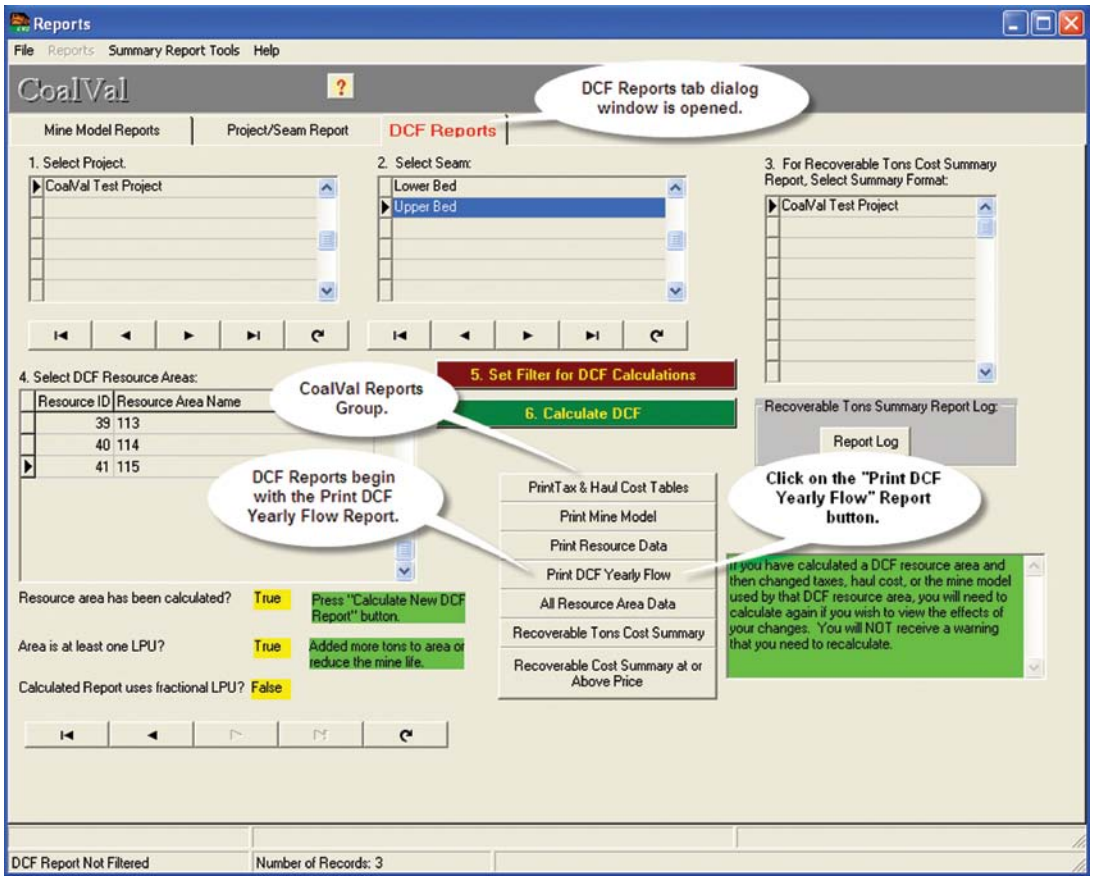


Figure B.86. CoalVal's DCF Reports tab in the Reports dialog window showing print buttons for the "Yearly DCF Flow Report."

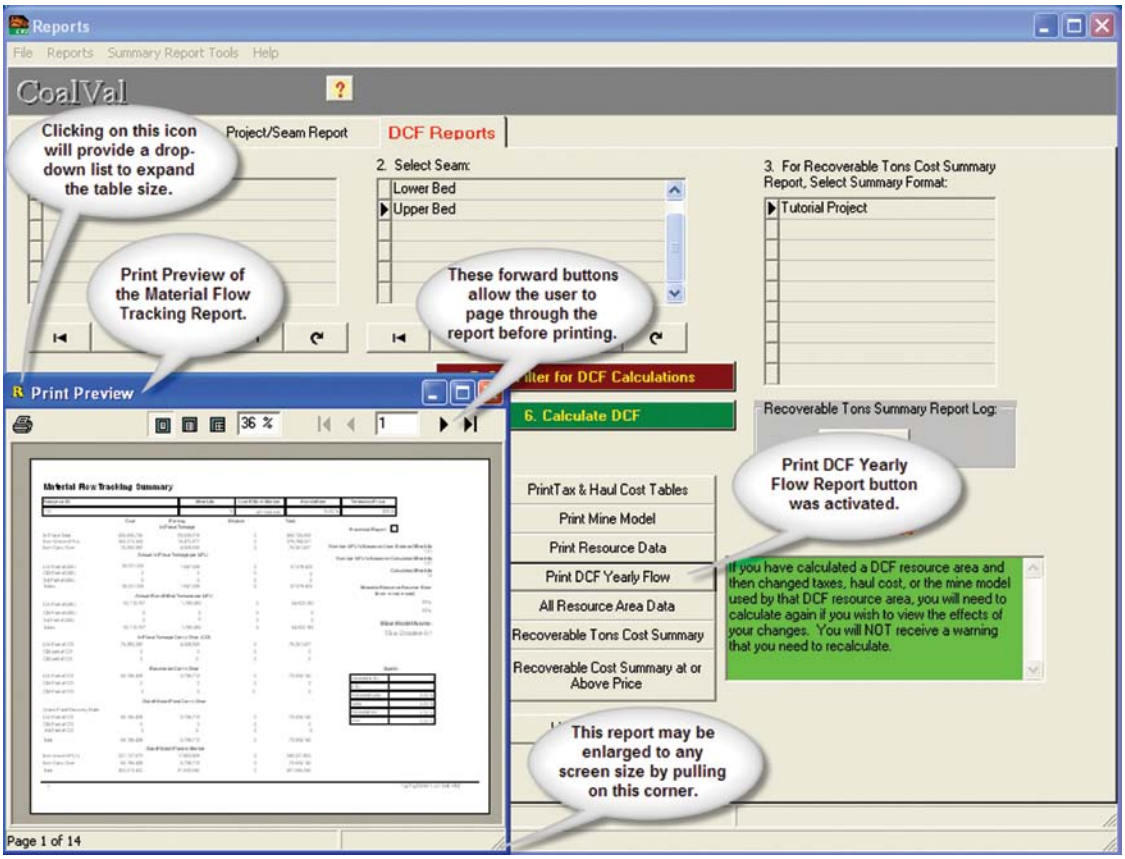
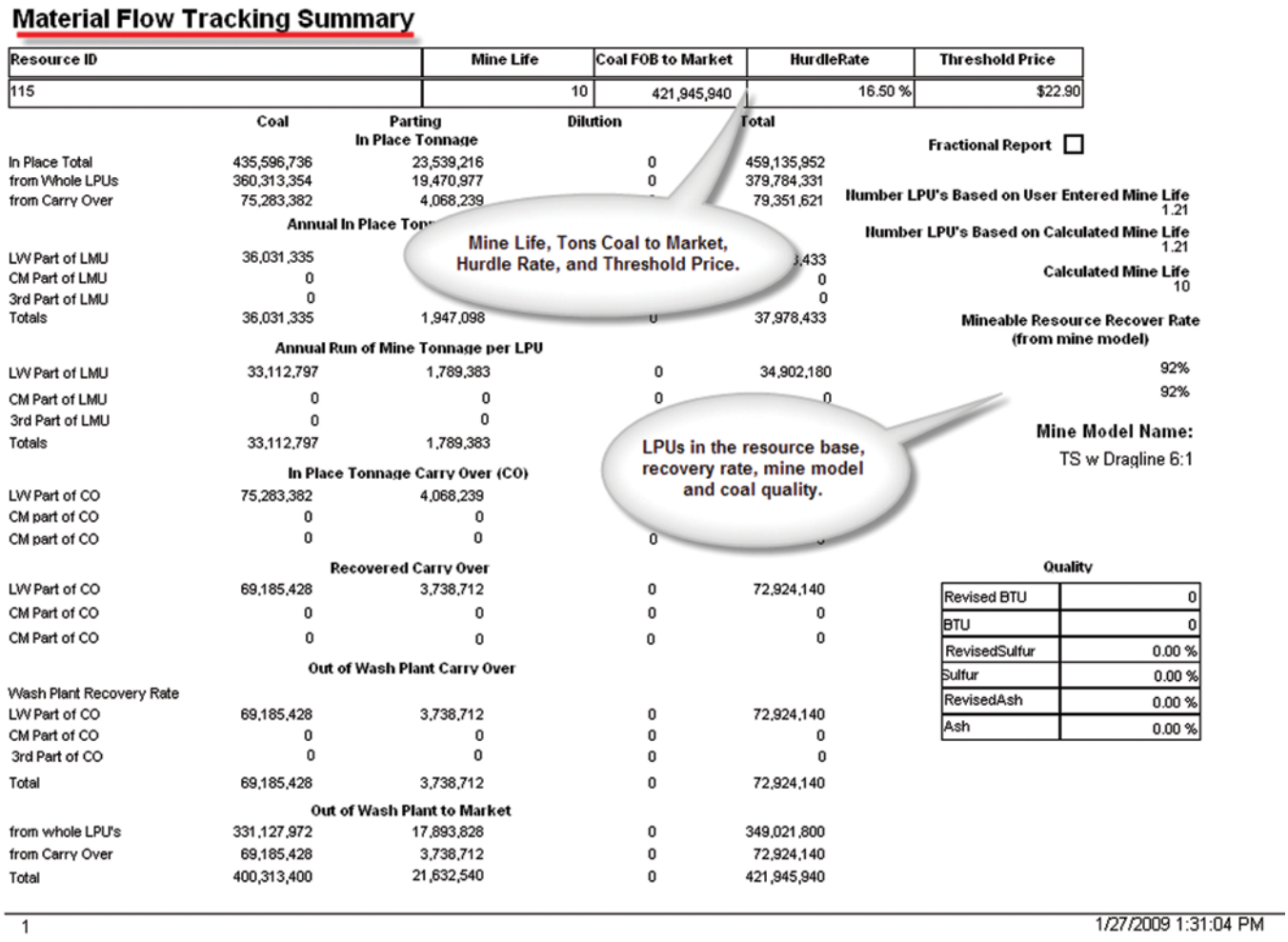


Figure B.87. CoalVal's Print Preview dialog for the "DCF Yearly Flow Report" from the DCF Reports tab on the Reports dialog window.



Material Flow Tracking Summary

Resource ID	Mine Life	Coal FOB to Market	HurdleRate	Threshold Price
115	10	421,945,940	16.50 %	$22.90

	Coal	Parting	Dilution	Total
In Place Tonnage				
In Place Total	435,596,736	23,539,216	0	459,135,952
from Whole LPUs	360,313,354	19,470,977	0	379,784,331
from Carry Over	75,283,382	4,068,239		79,351,621
Annual In Place Ton				
LW Part of LMU	36,031,335			,433
CM Part of LMU	0			0
3rd Part of LMU	0			0
Totals	36,031,335	1,947,098	0	37,978,433
Annual Run of Mine Tonnage per LPU				
LW Part of LMU	33,112,797	1,789,383	0	34,902,180
CM Part of LMU	0	0	0	0
3rd Part of LMU	0	0		
Totals	33,112,797	1,789,383		
In Place Tonnage Carry Over (CO)				
LW Part of CO	75,283,382	4,068,239		
CM part of CO	0	0		
CM part of CO	0	0	0	
Recovered Carry Over				
LW Part of CO	69,185,428	3,738,712	0	72,924,140
CM Part of CO	0	0	0	0
CM Part of CO	0	0	0	0
Out of Wash Plant Carry Over				
Wash Plant Recovery Rate				
LW Part of CO	69,185,428	3,738,712	0	72,924,140
CM Part of CO	0	0	0	0
3rd Part of CO	0	0	0	0
Total	69,185,428	3,738,712	0	72,924,140
Out of Wash Plant to Market				
from whole LPU's	331,127,972	17,893,828	0	349,021,800
from Carry Over	69,185,428	3,738,712	0	72,924,140
Total	400,313,400	21,632,540	0	421,945,940

Fractional Report ☐

Number LPU's Based on User Entered Mine Life
1.21

Number LPU's Based on Calculated Mine Life
1.21

Calculated Mine Life
10

Mineable Resource Recover Rate (from mine model)
92%
92%

Mine Model Name:
TS w Dragline 6:1

Quality

Revised BTU	0
BTU	0
RevisedSulfur	0.00 %
Sulfur	0.00 %
RevisedAsh	0.00 %
Ash	0.00 %

1 1/27/2009 1:31:04 PM

Figure B.88. CoalVal's yearly "Material Flow Tracking Summary" report showing the economically recoverable coal resources (reserves) after Discounted Cash Flow (DCF) analyses have been run at a hurdle rate of 16.5 percent.

Detailed Discounted Cash Flow Analysis by year with two years of pre-production and 10 years of production. p. 1

Year	Pure Coal ROM Production	Partings ROM Production	Dilution ROM Production	Pure Coal To Mkt Production	Partings to Mkt Production	Dilution to Mkt Production	O&M ROM Production	Sales Tax on Consumables	Pure Coal ROM Development
1	0	0	0	0	0	0	$0	$0	0
2	0	0	0	0	0	0	$0	$0	0
3	33,112,797	1,789,383	0	33,112,797	1,789,383	0	$76,000,559	$1,676,646	0
4	33,112,797	1,789,383	0	33,112,797	1,789,383	0	$76,000,559	$1,676,646	0
5	33,112,797	1,789,383	0	33,112,797	1,789,383	0	$76,000,559	$1,676,646	0
6	33,112,797	1,789,383	0	33,112,797	1,789,383	0	$76,000,559	$1,676,646	0
7	33,112,797	1,789,383	0	33,112,797	1,789,383	0	$76,000,559	$1,676,646	0
8	33,112,797	1,789,383	0	33,112,797	1,789,383	0	$76,000,559	$1,676,646	0
9	33,112,797	1,789,383	0	33,112,797	1,789,383	0	$76,000,559	$1,676,646	0
10	33,112,797	1,789,383	0	33,112,797	1,789,383	0	$76,000,559	$1,676,646	0
11	33,112,797	1,789,383	0	33,112,797	1,789,383	0	$76,000,559	$1,676,646	0
12	33,112,797	1,789,383	0	33,112,797	1,789,383	0	$76,000,559	$1,676,646	0

Figure B.89. CoalVal's Detailed Discounted Cash Flow (DCF) Analysis by year report (page 1) showing two years of preproduction costs and 10 years of production.

Discounted Cash Flow Analysis with Taxes, After Tax Income, and Salvage values by year. p.14

Net Depletion Credit	Taxable Income Basis	State Income Tax	Federal Taxabel Income	Federal Tax	After Tax Income	Salvage
						$0
$0	$0	$0	$0	$0	$0	$0
$77,927,167	$207,041,136	$14,492,879	$192,548,256	$67,391,890	($1,020,882,270)	$0
$77,927,167	$213,351,650	$14,934,615	$198,417,034	$69,445,962	$228,270,635	$0
$77,927,167	$213,523,317	$14,946,632	$198,576,684	$69,501,840	$227,699,408	$0
$77,927,167	$213,694,983	$14,958,649	$198,736,334	$69,557,717	$228,478,180	$0
$77,927,167	$213,866,650	$14,970,666	$198,895,985	$69,613,595	$222,640,307	$0
$77,927,167	$214,038,317	$14,982,682	$199,055,635	$69,669,472	$228,010,725	$0
$74,232,074	$194,127,734	$13,588,941	$180,538,793	$63,188,577	$211,838,685	$0
$70,268,627	$198,607,054	$13,902,494	$184,704,560	$64,646,596	$211,698,987	$0
$66,305,180	$203,077,334	$14,215,413	$188,861,921	$66,101,672	$209,762,825	$0
$62,341,733	$207,776,152	$14,544,331	$193,231,822	$67,631,138	$209,314,813	$0
						$61,967,927

Figure B.90. The final page of CoalVal's Detailed Cash Flow Analysis report showing the Tax costs, After-Tax Income, and Salvage values by year.

Recoverable Tons Cost Summary Report showing the economically recoverable tons of coal.

Economically Recoverable Tons Coal

Project: CoalVal Test Project / Upper Bed
DCF: Tons in Each Price Range

CoalVal Test Project Upper Bed DCF cost distribution

Report Caption

Price Range >= price <		Auger	Contour Strip	Dragline	Mountain Top	Truck & Shovel	Continous Miner	Longwall	Total	% of Total Tons
$10.00 -	$20.00	0	0	0	0	0		0	103,165,308	9.86 %
$20.00 -	$30.00	0	0	0	0	0			961,358,423	91.89 %
$30.00 -	$40.00	0	0	0	0	0			0	0.00 %
$40.00 -	$50.00	0	0	0	0	0	0	0	0	0.00 %
$50.00 -	$60.00	0	0	0	0	0	0	0	0	0.00 %
$60.00 -	$70.00	0	0	0	0	0	0	0	0	0.00 %
$70.00 -	$80.00	0	0	0	0	0	0	0	0	0.00 %
$80.00 -	$90.00	0	0	0	0	0	0	0	0	0.00 %
$90.00 -	$100.00	0	0	0	0	0	0	0	0	0.00 %
$100.00 -	$100.00	0	0	0	0	0	0	0	0	0.00 %

Recoverable tons between a cost of $10 and $20 per ton.

Recoverable tons between a cost of $20 and $30 per ton.

Figure B.91. CoalVal's "Economically Recoverable Tons Coal Cost Summary Report" for the Upper Bed showing the economically recoverable tons of coal by incremental cost.

Recoverable Tons Summary at or Above (market) Price Report

Economically Recoverable Tons Coal

Project: CoalVal Test Project / Upper Bed
DCF: Tons Sold for Each Price Range

No Report Caption shown.

Price Range >= price <		Auger	Contour Strip	Dragline	Mountain Top	Truck & Shovel	Continous Miner	Longwall	Total	% of Total Tons
$10.00 -	$20.00	0	0	0	0	0			103,165,308	9.86 %
$20.00 -	$30.00	0	0	0	0	0	0	0	1,064,523,731	101.75 %
$30.00 -	$40.00	0	0	0	0	0	0	0	1,064,523,731	101.75 %
$40.00 -	$50.00	0	0	0	0	0	0	0	1,064,523,731	101.75 %
$50.00 -	$60.00	0	0	0	0	0	0	0	1,064,523,731	101.75 %
$60.00 -	$70.00	0	0	0	0	0	0	0	1,064,523,731	101.75 %
$70.00 -	$80.00	0	0	0	0	0	0	0	1,064,523,731	101.75 %
$80.00 -	$90.00	0	0	0	0	0	0	0	1,064,523,731	101.75 %
$90.00 -	$100.00	0	0	0	0	0	0	0	1,064,523,731	101.75 %
$100.00 -	$100.00	0	0	0	0	0	0	0	1,064,523,731	101.75 %

Cumulative tons of economically recoverable coal.

Figure B.92. CoalVal's "Economically Recoverable Tons Coal Cost Summary at or Above (market) Price Report" showing the cumulative economically recoverable tons of coal for the Upper Bed coal resource.

5. Fixed carbon, and

6. Volatile matter.

Coal resource data are added as new records to either the **Seam** or **Area Table**:

Area Identification (ID)
Area name
Mine model used (underground or surface)
Mining Data
    Acres
    Tons coal to be mined
    Tons parting to be mined
    Is coal washing required?
    Mine life (in years)
Coal quality (Sulfur, Ash, Btu, Moisture)
Restrictions to coal mining (lost coal and parting tons)
    Mined out resources
    Resources in barriers
    Technical restrictions
    Environmental restrictions
Coal, parting, and dilution densities
Coal bed name
Taxing district with appropriate taxes
Haulage costs from wash plant to loadout or to power plant
Desired hurdle rate

Coal resource and quality data can be imported from database tables as .DBF files or Comma Separated Values (CSV) files for both quality and coal production data. To import data into CoalVal use the **Tools** pull-down menu (fig. B.93) on the **Projects** window. Figure B.94 is an image of the **Tools** menu. The first two menu items are for importing coal resource and quality data into **Seam** or **Area Tables** and the last two are for adding coal quality into **Areas** that already exist but do not contain coal-quality data.

Comma Separated Value Data Files

This discussion will address importing from a Comma Separated Value (CSV) text file into a **Seam** and importing a database (DBF file) table into the **Area Table**. The importing of DBF tables is the same as CSV files. In all cases there must be a **Project** entered into the **Project Table** of the **Projects** window before **Seam** data can be imported; and a **Seam** record must be entered into the **Seam Table** before data can be imported into the **Area Table**. Finally, **Area** records must be entered into the **Area Table** before coal-quality data can be imported into the **Area Table**.

When one creates a CSV text file for use in CoalVal, the following rules apply:

1. The first row must be the names of the data fields, separated by commas.

2. Do not put spaces in the field names. For example "Coal Density" will not work, but "CoalDensity" will.

3. Do not place commas after the last field name or field value. For example "Name,Coal_Density," will not work, but "Name,Coal_Density" will (without the comma following "Density").

4. Do not leave a field value blank. For example "2,3,,4.0" will not work, but "2,3,0,4.0" will.

5. Commas are not allowed in the numbers. A CSV text file is a comma separated values file, so a comma in a number is a separation. For example 2.0,3,10,000 has four separations, but 2.0,3,10000 has three separations. So if the last number is 10000, do not use commas in the number.

The following is an example of a CSV text file:

Sulfur,Ash,Btu,Moisture,Org_Coal_Tons,Dilution_
Density,Parting_Density,Name
5.0,6.0,8552,28,9293849015,2900,3200,Fred
5.2,6.2,8700,28,10293849015,3000,3300,Sam

Seam Import

The following coal resource and quality data will be imported into the **Seam Table** of a CoalVal **Project**. Remember that this import will add new records to the **Seam Table** and a **Project** must be created before it can have data imported into it (see the Creating a Project section in the beginning of the Tutorial Chapter). The import will not append data to existing **Seam Table** records.

The first step is to *select or create a new **Project**.* If the user has created working Projects in the past and desires to use a previously created Project, then *select that **Project** and continue.* If, however, the user is working in the Tutorial for the first time, then a new Project must be created. The CoalVal Test Project is displayed in figure B.95 but it contains data in its Areas Table that may be saved for future reference. Therefore, it is necessary to create a new Project. *Click on the "insert" (+) button in the Navigation Bar and type in **Import Tutorial** over the "None Project" name and click on the check mark or post button on the Navigation Bar* (fig. B.95). *Select the **Import Tutorial** Project Name*. The next step is to open the import window. This is done by *clicking the **Import From CSV file** menu item under the **Tools** menu on the **Projects** window (fig. B.96).*

The **ArcView Import and Export** dialog window is now open. CSV data are imported into CoalVal by creating a **Schema** to relate the fields in the CSV file to the fields in the **Seam**/**Area Tables** of CoalVal. The **Tutorial Schema** is already developed and can be selected from the **Use Schema for Import of DBF or CSV file** tab (fig. B.97). However, in this portion of the tutorial a new schema will be created for

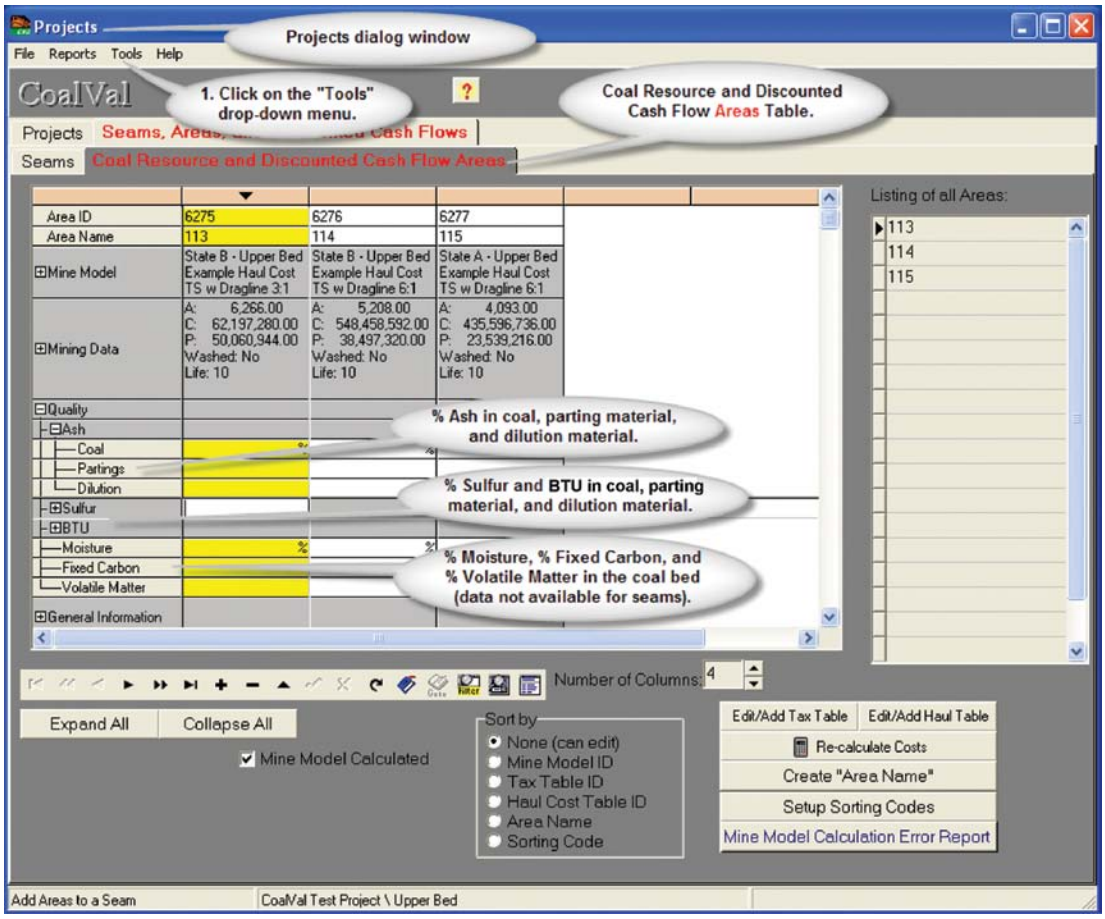


Figure B.93. Importing coal quality into the Coal Resource and Discounted Cash Flow Areas tab in the Projects dialog window from a .DBF or CSV file using the Tools drop-down menu.

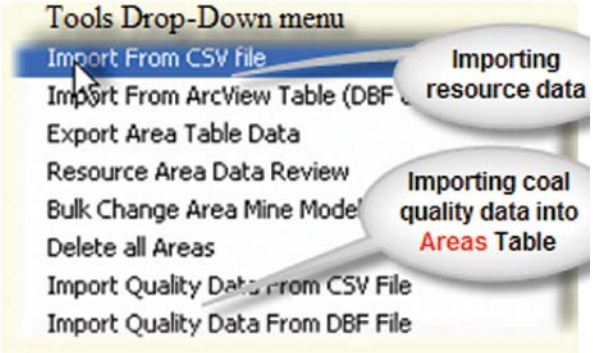


Figure B.94. Using CoalVal's "Importing Quality Data From DBF File" in the Tools drop-down menu to import Upper Bed coal-quality data into the Coal Resource and Discounted Cash Flow Areas table.

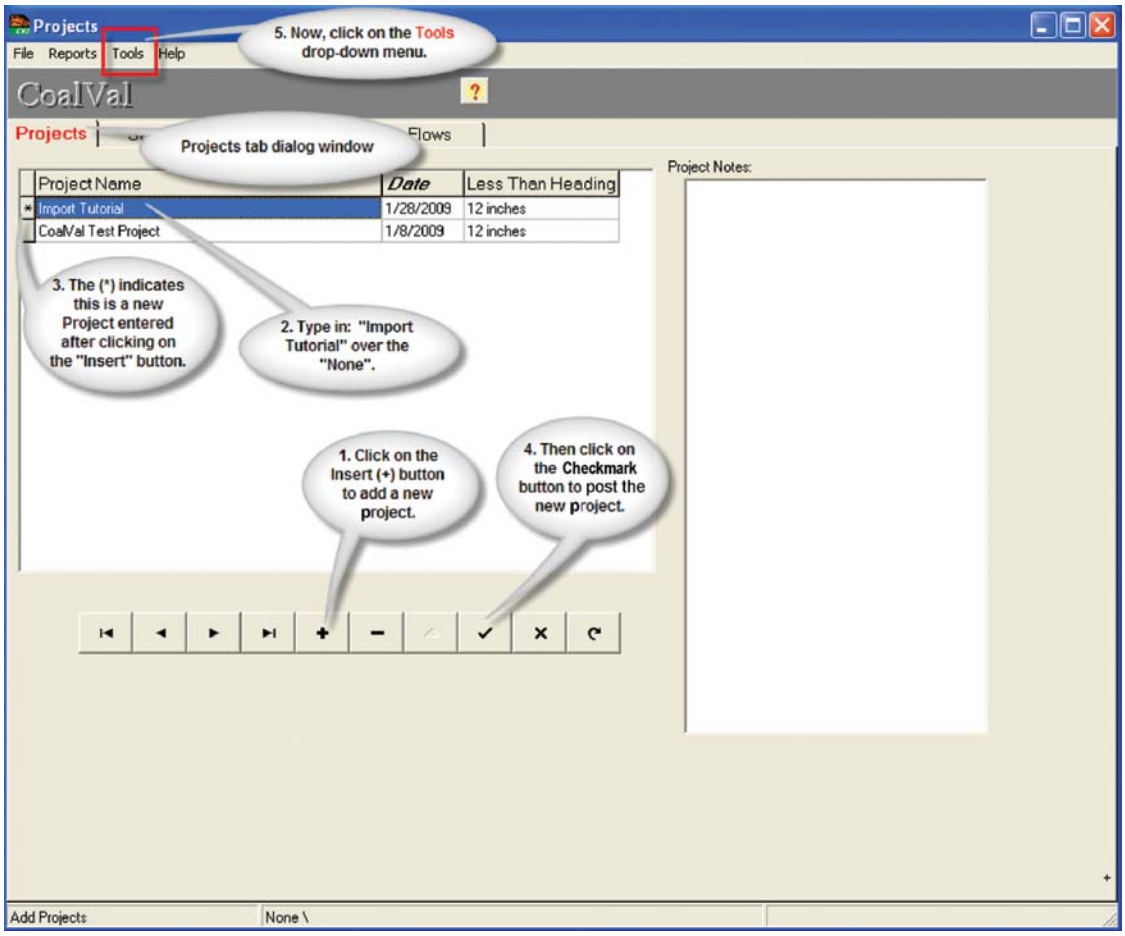


Figure B.95. Adding a new Project under CoalVal's Projects tab and Projects dialog window called "Import Tutorial." Then beginning to import coal-quality files process into the Seam table by clicking on the Tools drop-down menu (item number 5.)

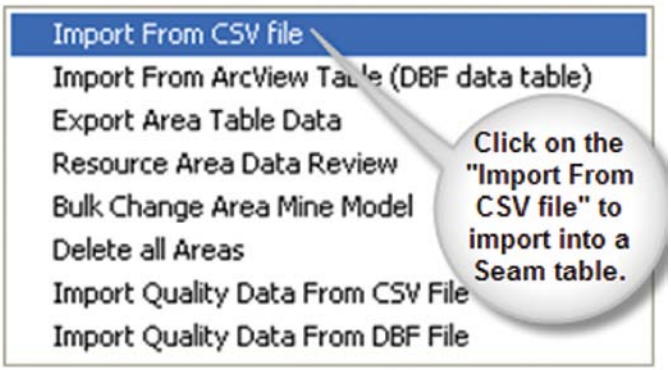


Figure B.96. Importing coal-quality data using CoalVal's Import From CSV file on the Tools drop-down-menu of the Projects dialog window.

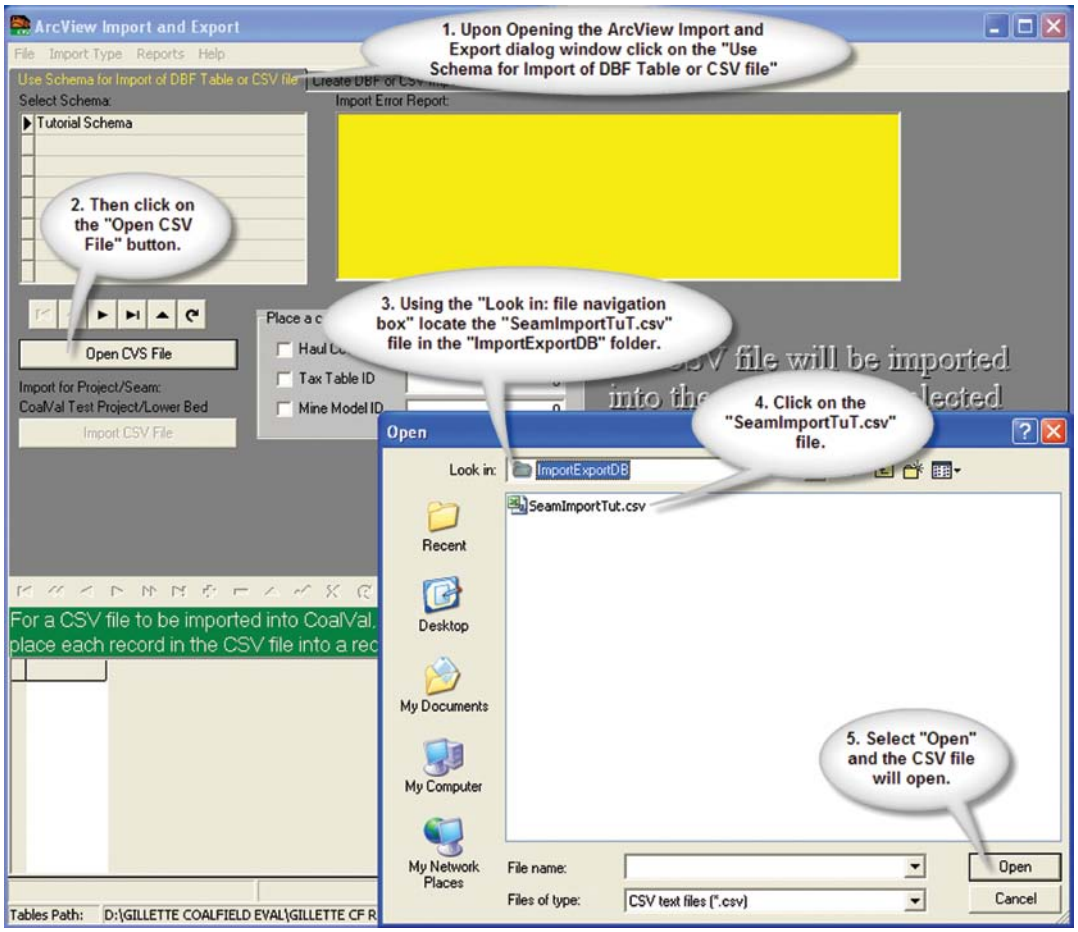


Figure B.97. Opening a Coal Quality CSV file, "SeamImportTut.csv," in CoalVal's Use Schema for Import of DBF Table or CSV file dialog tab in the ArcView Import and Export dialog window.

importing data into the **Seam Table**. The new schema will be named "Seam Import Tutorial" later in this exercise.

The first step in creating a Schema for a CSV import is to open the file desired for import. *Click the "Open CVS File" button on the* ***Use Schema for Import of DBF or CSV file*** *tab and with the "Open dialog box," navigate to the location where CoalVal is installed* (perhaps in C:\Program Files\USGS\CoalVal). This example uses a file named "SeamImportTut.csv," located in the "ImportExportDB" folder (fig. B.97). Open the "ImportExportDB" folder and select the "SeamImportTut.csv" file and click the "Open" button. The file contents are displayed on the bottom half of the **Use Schema for Import of CSV file** tab. Adjusting the column widths is done by holding the left mouse button on the column line and moving it to the left or right to decrease or increase the width. If a column cannot be reached, then the Slide Bar above the Status Bar at the bottom of the dialog window can be used to move the columns. After adjusting the column widths the contents should look like figure B.98.

There are two seams that need to be imported from this file. *Click the* ***Create DBF or CSV Import Schema*** *tab* (fig. B.99). The four steps used to create the schema are as follows:

Step 1. Has already been completed by opening the CSV file.

Step 2. Creates a new schema record to store Schema definitions. To do this, *click on the "2. Create DBF CSZ Schema" button*. An "**Input Schema Name**:" dialog will pop up and the new schema name can be entered. For this example *enter* ***Seam Import Tutorial*** *and click the OK button (fig. B.99)*.

Step 3. Adds the relationship records to the schema to relate the CSV file fields and the Seam Table fields. From the pull-down box labeled "DBF/CSV Fields" *select "Name" (fig. B.100)*. Next *select the field in the* **Seam** ***Table*** *that relates to this CSV field.* This action

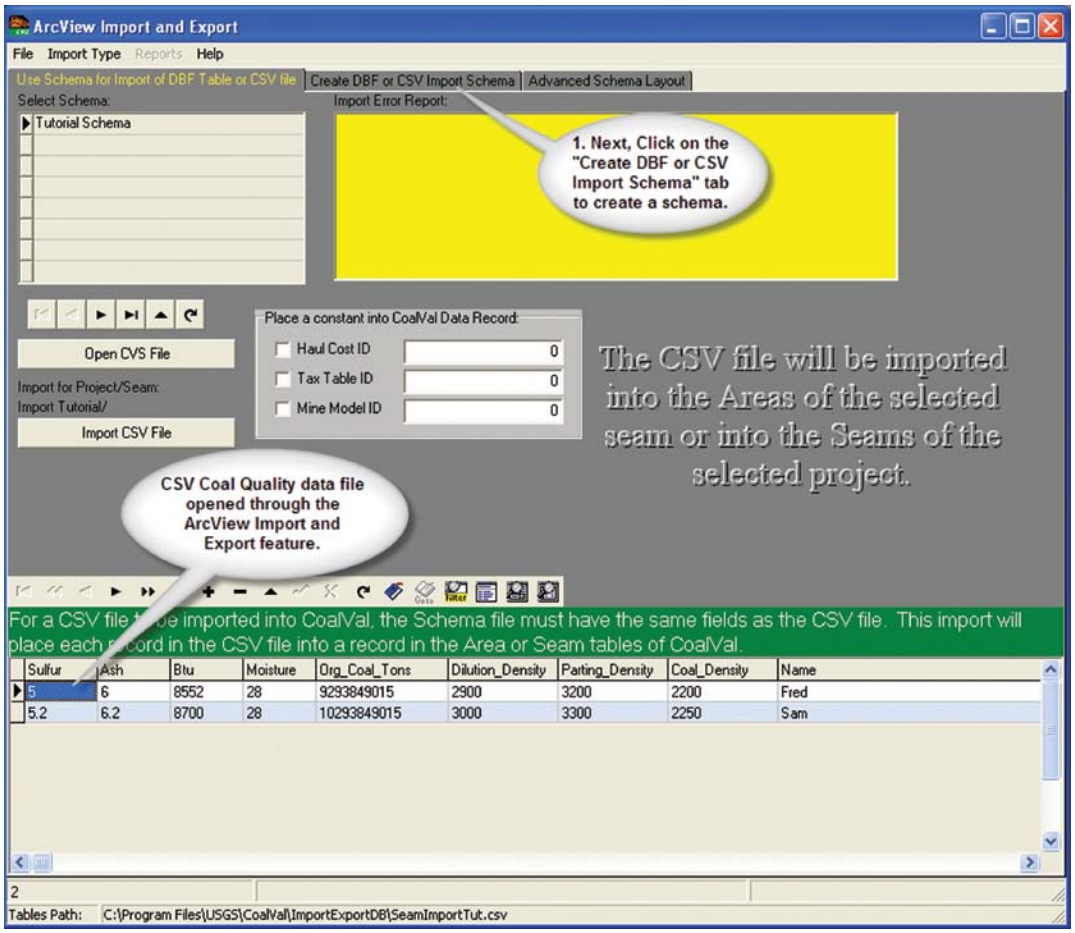


Figure B.98. Coal-quality data opened in CoalVal's Use Schema for Import of DBF Table or CSV file tab of the ArcView Import and Export dialog window.

is done by using the list box under the heading CoalVal (fig. B.101) and *selecting: "Seam–'Seam Name'."*

Step 4. Remember that **Seam** information is being imported, so select only Seam fields for the schema. Now that an item ("Name") has been selected from the CSV file and an item from the CoalVal **Seam Table** ("Seam – Seam Name"), *click the button labeled number "4. Accept Relationship -->" (fig. B.102)*. The first line of the schema is now displayed in the list box titled **DBF/CSV Import Schema**. *Repeat steps 3 and 4 steps for Sulfur, Ash, Btu, Dilution Density, Moisture, and Orig Coal Tons*. The list box should now look like figure B.103.

Now look at one line of the schema to see what this list box is defining. Use the line: "Seam – 'Seam Name'= [Name] {24}" (fig. B.103). The line is broken into four parts. The first part contains two import types. The first type is **Area** and the second type is **Seam**. In this line, data are being imported into the **Seam Table** by the "Seam --". The next part is the **Seam/Area Table** field name, ["Name"]. Here the "Seam Name" field of the **Seam Table** is used to relate to the ["Name"] field of the CSV file. The fourth part {"24"} is the position on the **Seam/Area** field in the CoalVal: list box.

If an item is added to the schema by mistake, the Navigation Bar can be used to delete the record. The **Advanced Schema Layout** tab is used only for importing **Area** data, so it will not be used in this example. The schema is now created and ready for importing data into the **Seam Table**. To import the data *click the **Use Schema for Import of DBF or CSV file** tab*. Make sure that the **Seam Import Tutorial Schema** is selected and then *click on the "Import CSV File" button (fig. B.104)*. A question pop-up will ask if the user wants to import the data into the **Import Tutorial Project**; *click on the OK button and the data import will be completed (fig. B.105)*. The "Import Error Report" list box should contain a message stating that the "Import Finished." *Exit out of the*

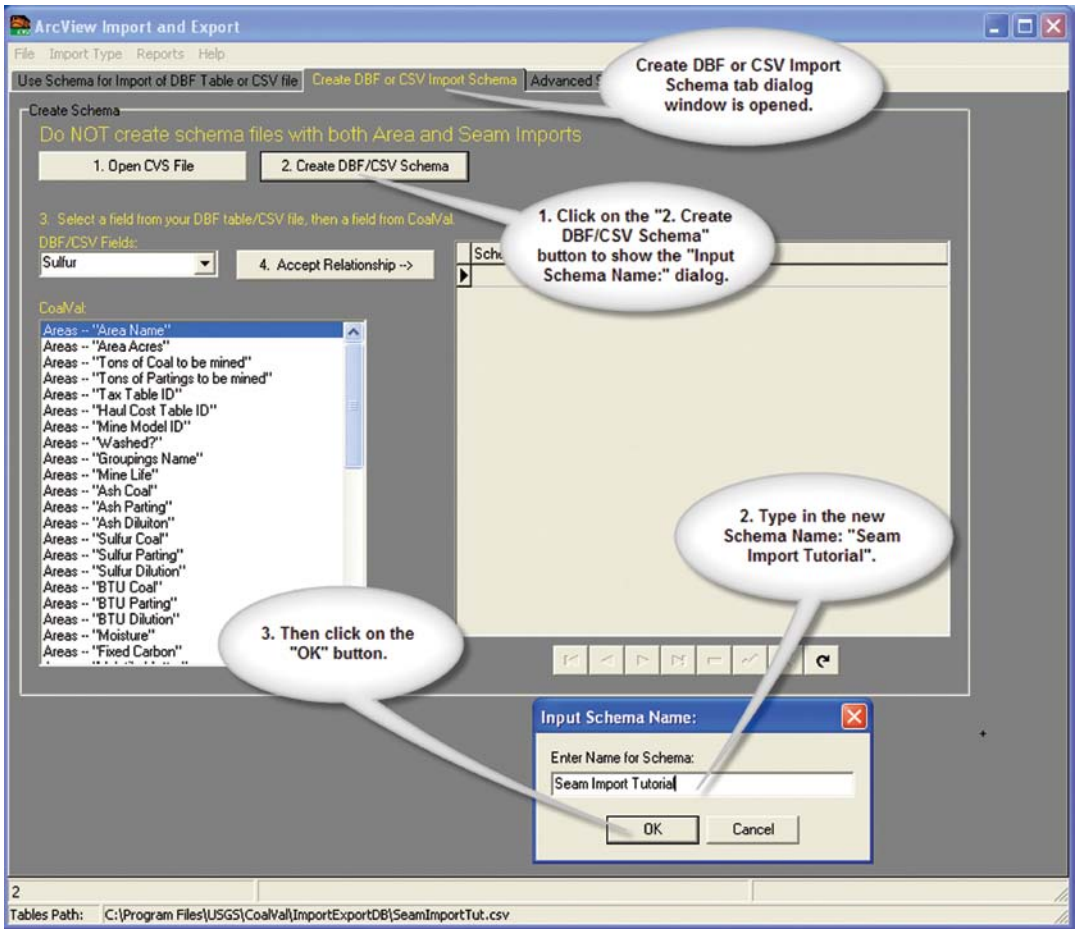


Figure B.99. Creating a new Schema Name, "Seam Import Tutorial," in the "Input Schema Name" box under CoalVal's Create DBF or CSV Import Schema tab and the ArcView Import and Export dialog window.

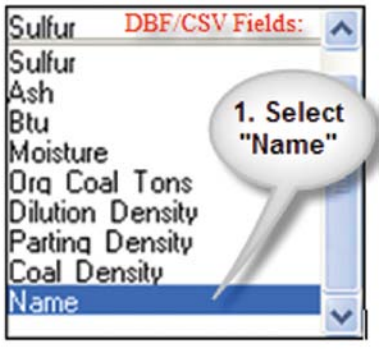


Figure B.100. Selecting the "Name" to related CoalVal's "DBF/CSV Fields:" and the field name in the Seam tables.

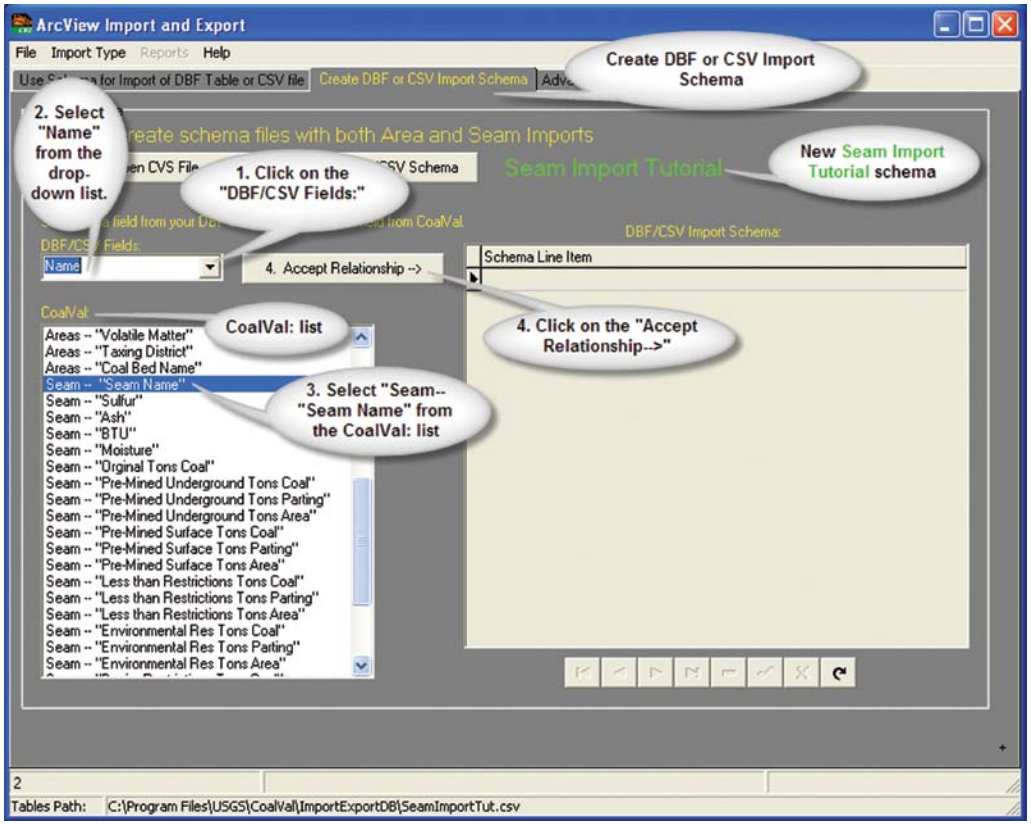


Figure B.101. CoalVal's "Seam Import Tutorial" (shown in green) schema name showing the steps to create the new schema relationships under the Create DBF or CSV Import Schema tab on the ArcView Import and Export dialog window.

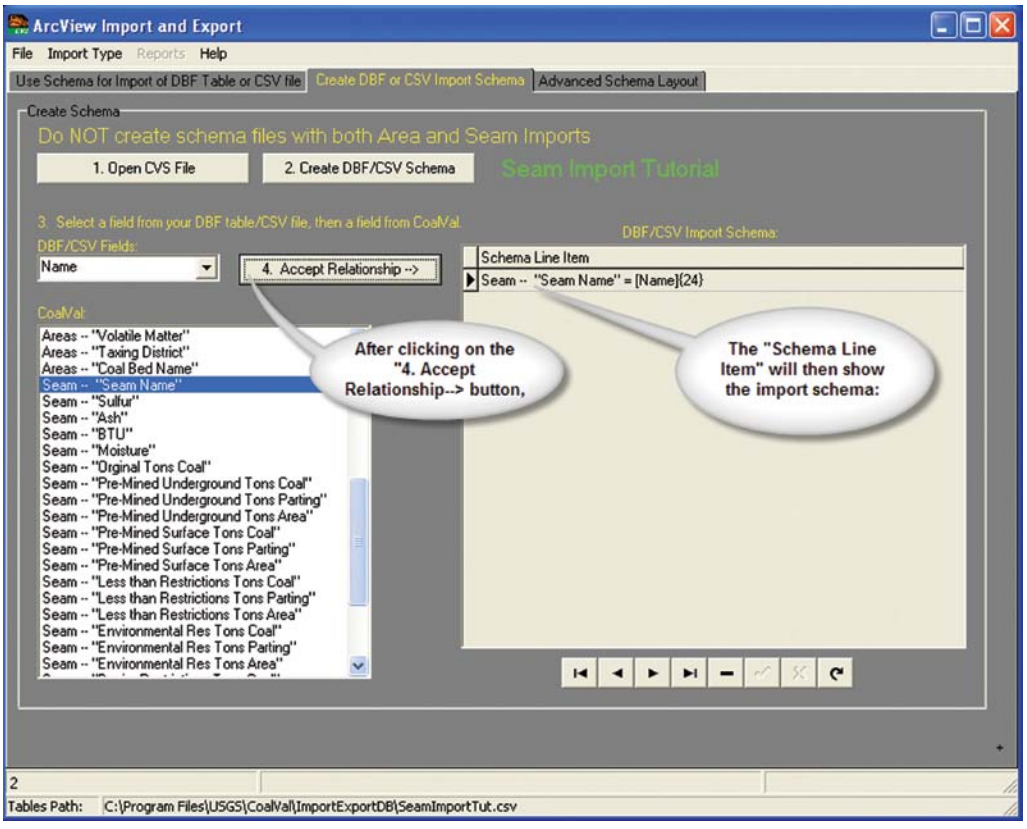


Figure B.102. CoalVal's "Schema Line Item" showing the relationship between the "CoalVal: table" (Seam – "Seam Name") and the "DBF/CSV Fields = [Name]{24}".

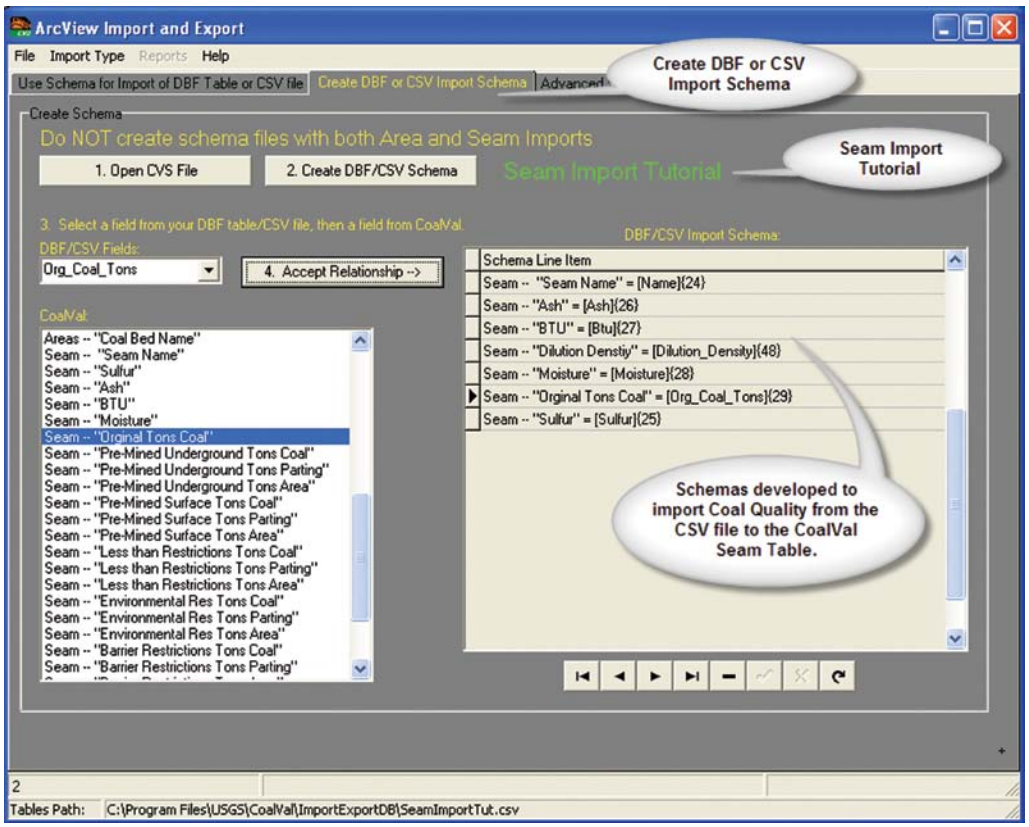


Figure B.103. CoalVal Schemas developed to import coal quality from a CSV file into the "CoalVal: Seam" table on the Create DBF or CSV Import Schema tab under the ArcView Import and Export dialog window.

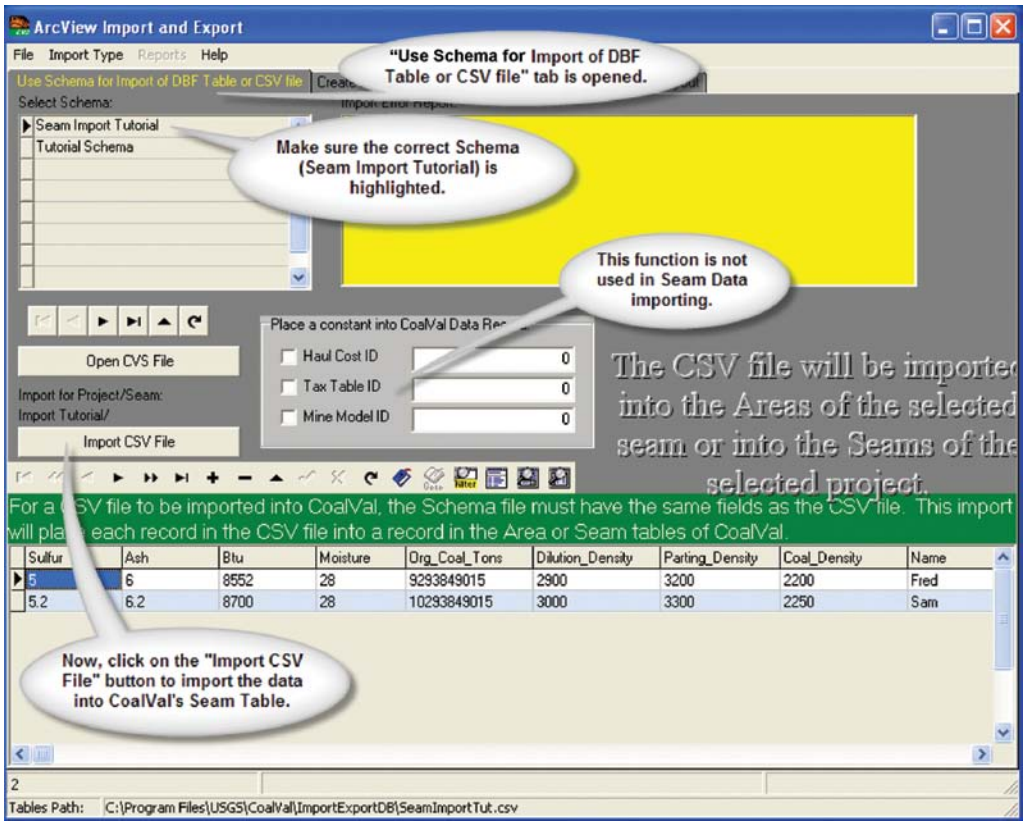


Figure B.104. Using CoalVal's "Import a CSV File" button to import coal quality into a Seam table.

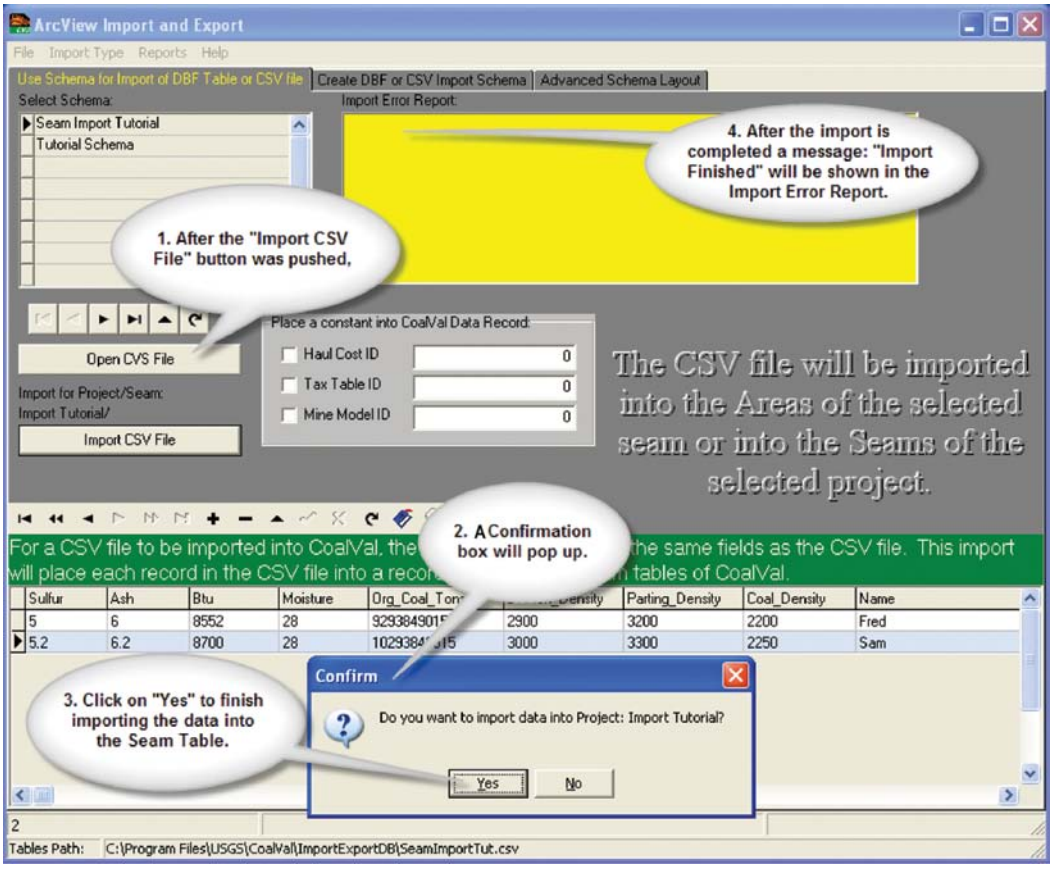


Figure B.105. Confirming the data import into CoalVal's Seam Table.

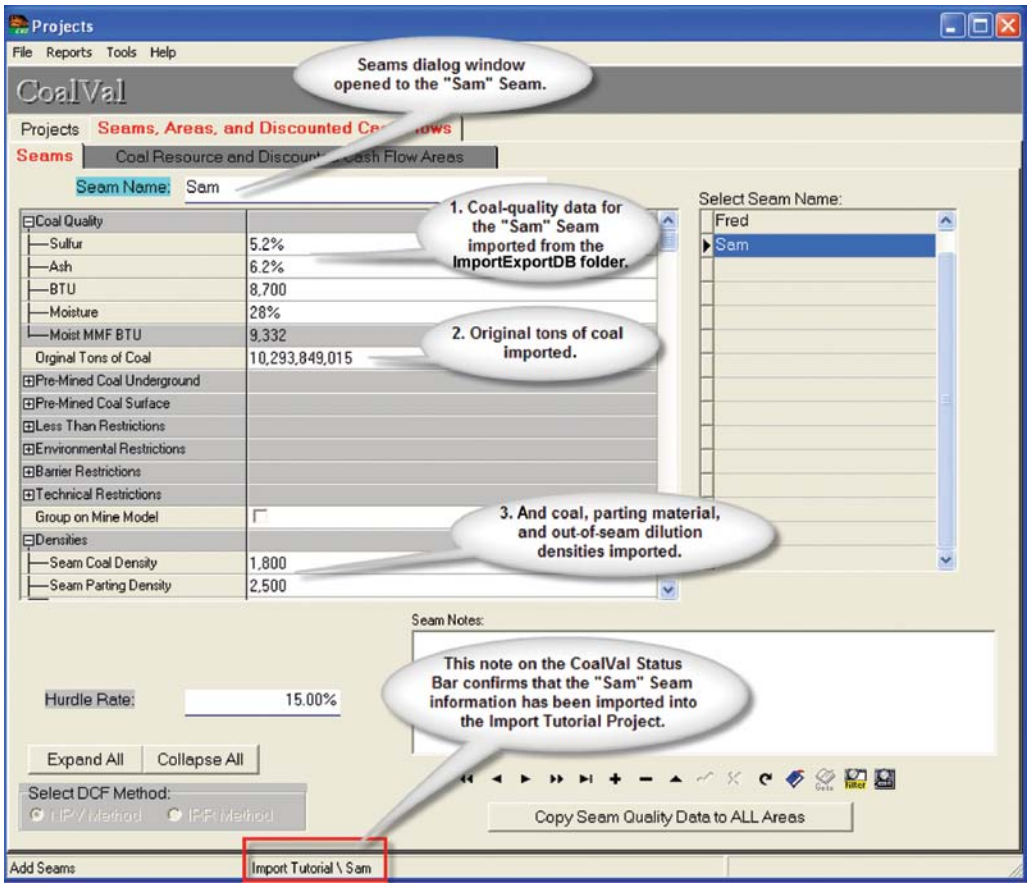


Figure B.106. Coal quality, total tons of coal, and material densities imported into the Sam bed Seam table.

ArcView Import and Export *dialog window and navigate to the* ***Seams*** *tab dialog window under the* ***Main Projects Menu***. Figure B.106 shows the "Seam Name" dialog for the Sam **Seam** with the coal quality and original tons of coal imported.

DBF File Area Data Import

The user will need a CoalVal database with at least two mine models and three tax tables to complete this exercise. These mine model and tax table files are included with the CoalVal program in the ImportExportDB file folder; if the **Project Tutorial** and the **CSV Seam Import** have been completed, then those models and tables have been used.

The figures shown may not match the CoalVal screen exactly. The figures shown depend on which **Tax Tables**, **Haul Cost**, and **Mine Models** have been entered into the CoalVal database. If the **Mine Models**, **Tax Tables**, or **Haul Cost Tables** do not match the examples given, use any **Mine Model**, **Tax Table** or **Haul Cost Table** in the CoalVal database. For this exercise in the Tutorial the name of the **Mine Model**, **Tax Table,** or **Haul Cost Table** is not an issue.

In this section of the **Import GIS** and **Quality Data Tutorial**, data will be imported into the **Area Table** of a **Seam**. This import will add new records to the **Area Table** rather than appending the data to existing **Area Table** records. A **Project** and **Seam Table** need to be created (see **Project Tutorial** and **CSV Seam Import**). The first action is to *select the* ***Project*** *and the* ***Seam***. In the last example (CSV Seam Import) the **Import Tutorial Project** record was created and it had two seam records. Now, *open the* ***Seams*** *tab under the* ***Project Menu*** *and click on the* ***Seam*** *named Sam*. Make sure that the **Project** and **Seam** needed for the import have been properly selected. The **Projects** window status bar should look like figure B.106 (the status bar runs along the bottom of the **Projects** window). The next step is to open the import window. Do so by *clicking on the* ***Tools*** *drop-down menu on the* ***Main Projects*** *Menu (fig. B.107), then clicking on the* ***Import From ArcView Table (DBF data table)*** *menu item (fig. B.108)*.

Importing a Comma Separated Value (CSV) file is the same as importing a DBF table except that a CSV file rather than a DBF table is opened. The **ArcView Import and Export** window should now be open (fig. B.109). Importing data into CoalVal is done by creating a **Schema** that relates the fields in the DBF table or CSV file to the fields in the **Seam** or **Area Tables** of CoalVal. If a **Schema** has been previously developed, it can be selected from the **Use Schema for Import of DBF or CSV file** tab. In this tutorial a schema will be created for importing data into the CoalVal **Area Table**.

The first step in creating a **Schema** is to open the file to be imported. In this case it will be imported from a DBF table. *Click the "Open DBF Table" button on the* ***Use Schema for Import of DBF or CSV file*** *tab*. This will open a dialog allowing navigation to the **Import ExportDB** folder found where CoalVal is installed. Then *select the file named MAN_IMPORT.dbf and click the "Open" button*. The file contents will be displayed on the bottom half of the **Use Schema for Import of DBF or CSV file** tab (fig. B.110).

In this next example the **Advanced Schema Layout** on the **ArcView Import and Export Window** will be used to add CoalVal database information to the **Area Table**. That is, every coal pod (same as a geographical area, see the Glossary, appendix E) number will have a different **Tax Table**. Notice that in figure B.110 there are three different POD numbers requiring three different **Tax Tables**. Also, there are two different stripping ratios (3:1 and 6:1), which will require a **Mine Model** for each ratio.

Creating an Import Schema

To create an **Import Schema**, *click on the* ***Create DBF or CSV Import Schema*** *tab of the* ***ArcView Import and Export*** *window and follow the next four steps*.

Step 1. Creates the actual **Import Schema** for the **Project**. There are four steps to create a schema on this dialog window (fig. B.111). The first step, opening the database **DBF Table** (fig. B.110), was completed in the previous section (DBF file Area Data Import).

Step 2. This step creates a new schema record to store the schema definitions. *Click on the "2. Create DBF/CSV Schema***"** *button* (fig. B.111). A prompt will ask for a Schema Name. *Type in:* ***Area Import Tutorial*** *a*nd *click the OK button*.

Step 3. Relationship records will now be added to the schema to relate the DBF table to the **Area Table**. To establish the first relationship, refer to item "3. Select a field from your DBF table/CSV file, then a field from CoalVal. DBF/CSV Fields:." In the figure B.111 dialog, *click on the pull-down box (fig. B.112) labeled: "DBF/CSV fields" and select "Mine_Cat."* There is no "Area Name" in the DBF table to import, but the "Mine_Cat" field has information that could be useful, so it will be used for the "Area Name." Next *select the field name from the "CoalVal: list" box that relates to this DBF field name, in this case "Area Name" (fig. B.113)*. Remember that **Area** information is being imported, so do not use the **Seam** fields for the schema.

Step 4. Now that an item has been selected from the DBF file and an item from the **Area Table**, *click the button labeled "4. Accept Relationship -->" (fig. B.113)*.

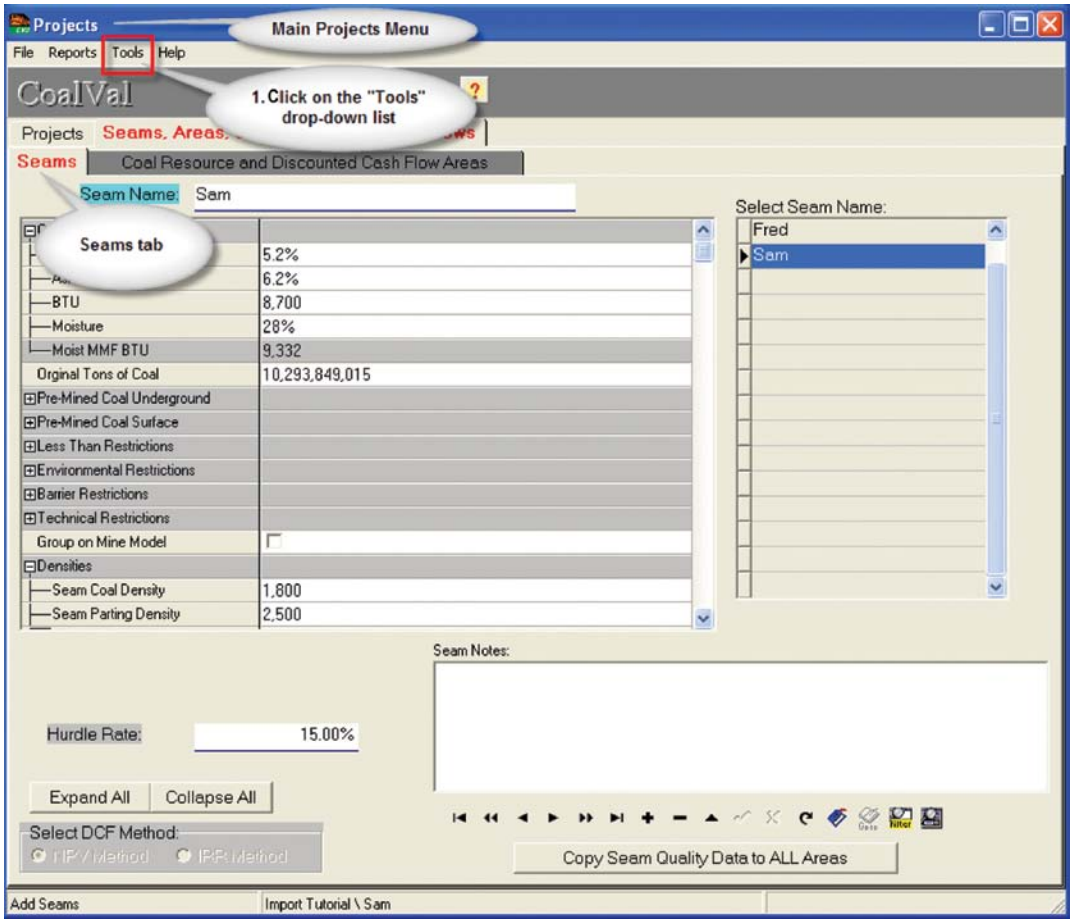


Figure B.107. Setting up for the import of coal resources and locations from an ArcView DBF table by clicking on the Tools drop-down menu with CoalVal's Seams tab open under the Projects dialog window.

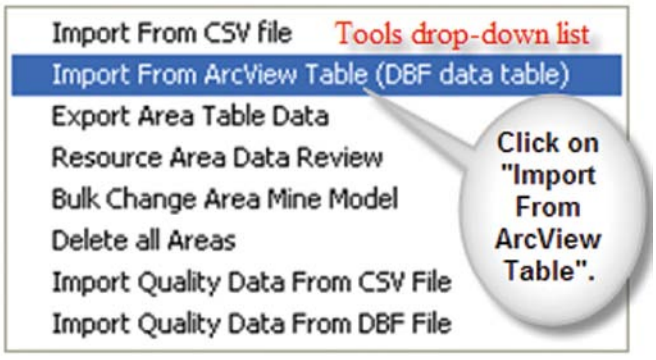


Figure B.108. Opening CoalVal's Tools drop-down menu from the Projects dialog window to use the Import From ArcView Table (DBF data table) item to import coal resources and locations.

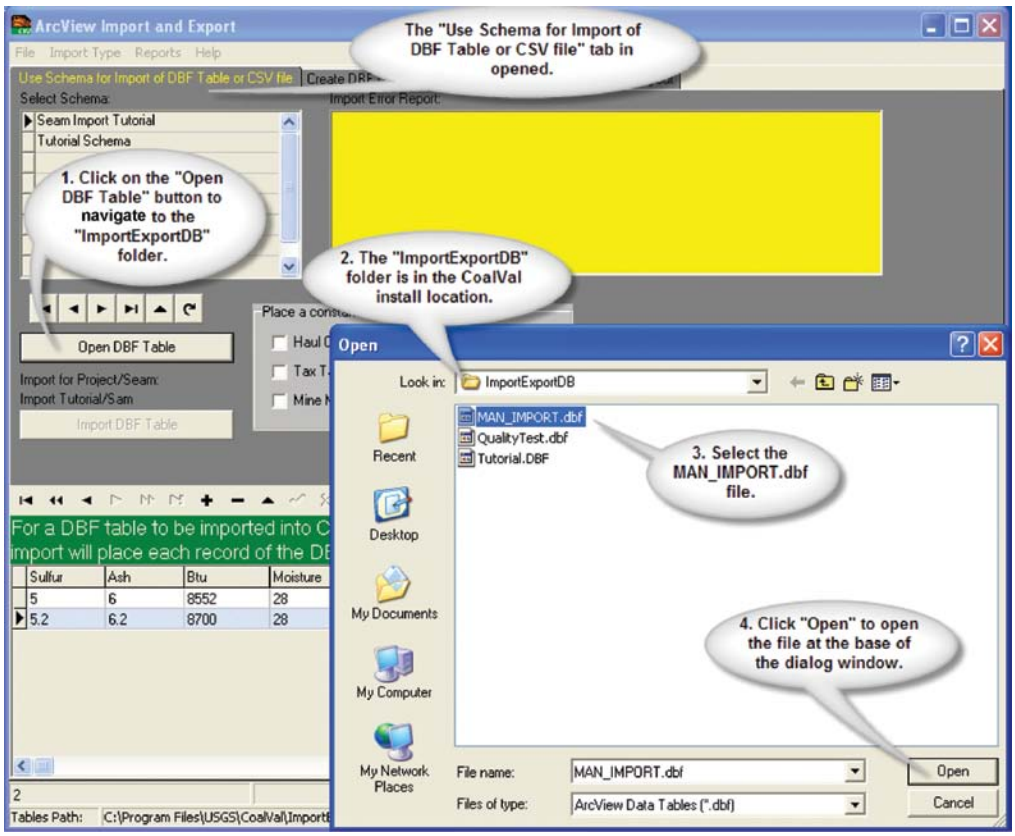


Figure B.109. Exhibiting the "ImportExportDB" folder on CoalVal's Use Schema for Import of DBF Table or CSV file tab under the ArcView Import and Export dialog window. This DBF file contains the coal resources and locations data.

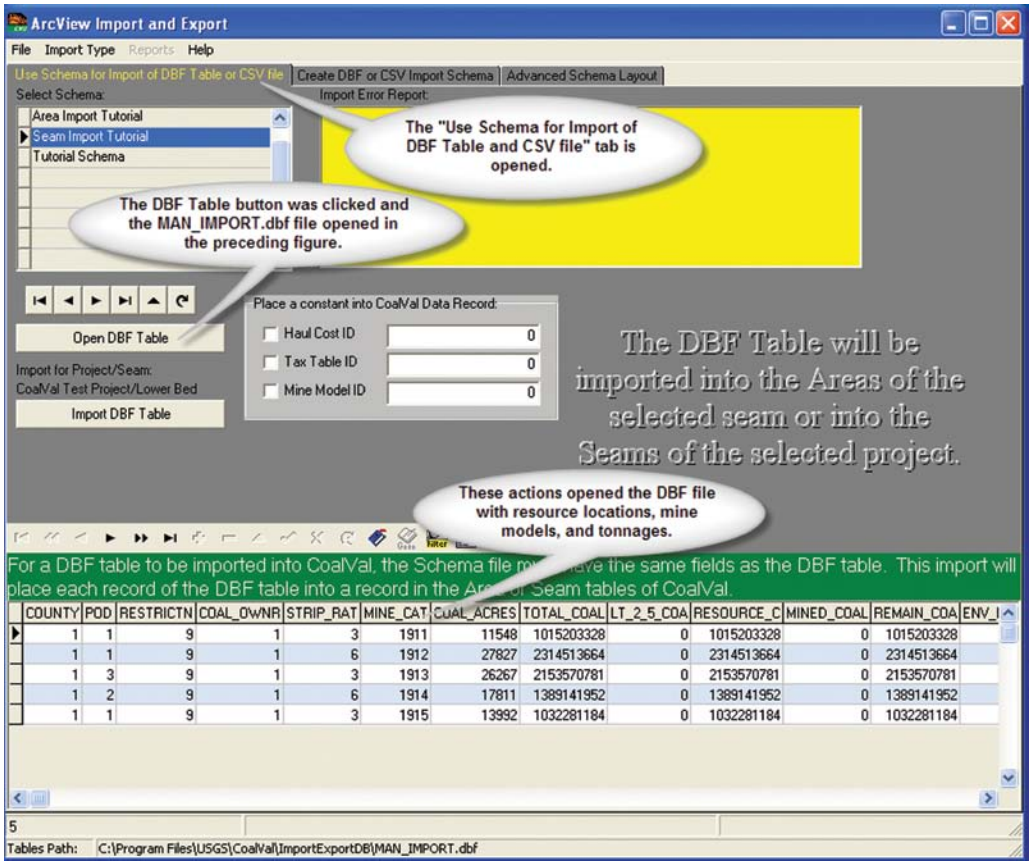


Figure B.110. DBF Table of coal resources and locations is opened in CoalVal's Use Schema for Import of DBF Table or CSV file tab of the ArcView Import and Export dialog window.

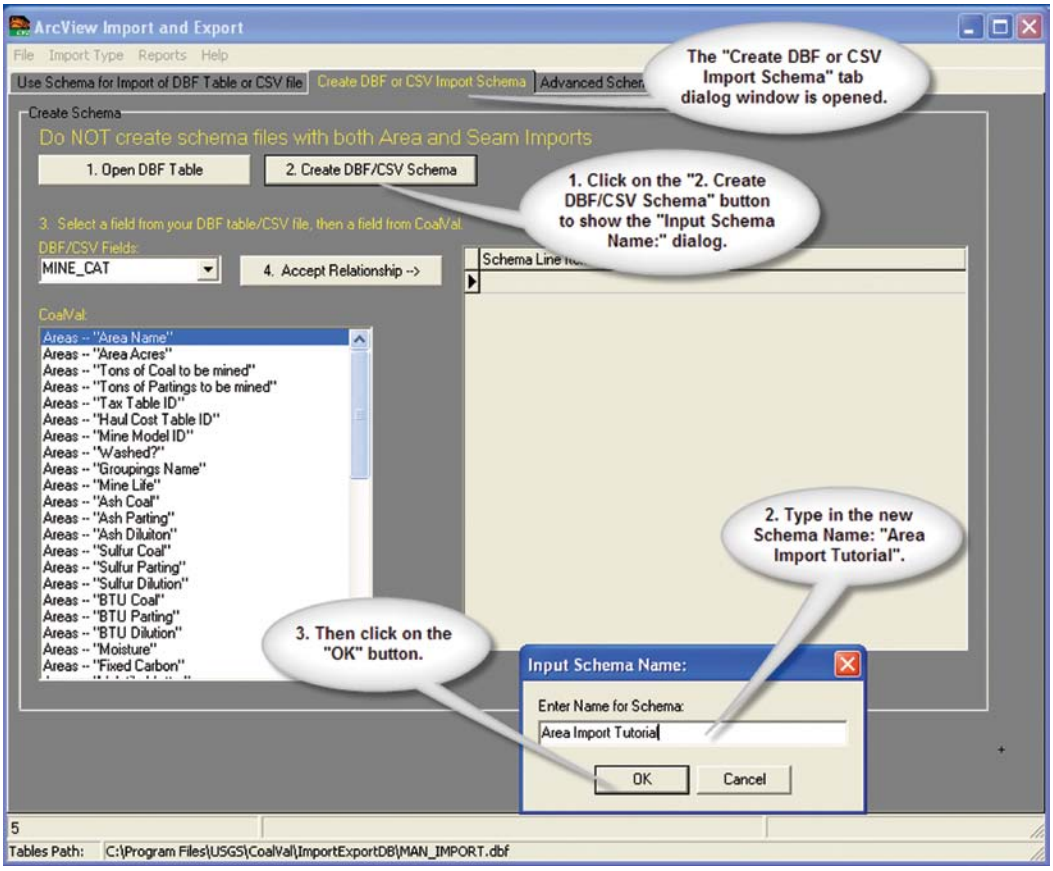


Figure B.111. Creating a new Schema Name, "Area Import Tutorial," to import coal resources and locations into the Area table.

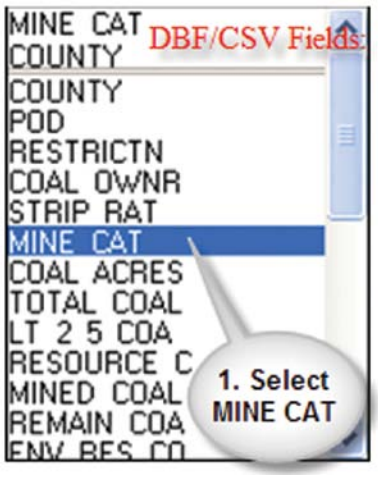


Figure B.112. Records under CoalVal's "DBF/CSV Fields" table, beginning with "MINE CAT", will be related to the "CoalVal: Areas fields" through schemas to import data into the Coal Resource and Discounted Cash Flow Areas table.

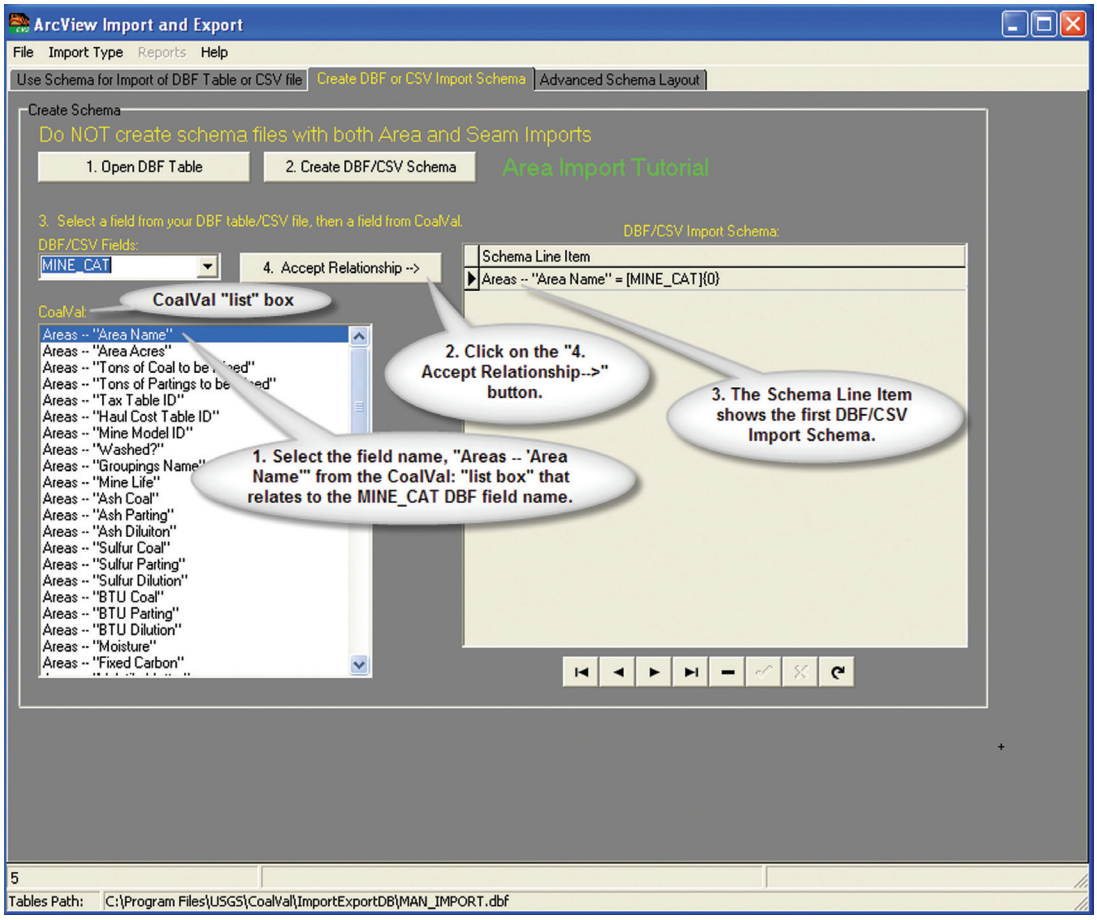


Figure B.113. Selecting the "MINE_CAT field" from the "DBF/CSV Fields" drop-down list to relate to the "CoalVal: field list: Areas—'Area Name'". This figure shows forming and accepting an import schema relationship shown under the Schema Line Item on the Create DBF or CSV Import Schema tab and the ArcView Import and Export dialog window.

The first line of the schema is now displayed in the list box titled **DBF/CSV Import Schema** (fig. B.113). *Repeat steps 3 and 4 for the following items:*

DBF/CSV Fields:	=	CoalVal Area Table
COAL_ACRES	=	Area Acres
POD	=	Coal Bed Name
REMAIN_COA	=	Tons of Coal to be Mined
AVAIL_PTG	=	Tons of Parting to be Mined

The resulting Schema Line Items should look like figure B.114.

The "DBF/CSV Field," "POD" (fig. B.112), will be used for importing coal-quality data into the "Coal Bed Name field" in the **Area Tables** (fig. B.114). The user can import a different set of coal-quality data for each "POD" number. The three different "POD" numbers exhibited on figure B.110 (1, 2, and 3) will be related to the coal-quality data for its import into the **Area Table**. Three "Area Table fields" ("Area Name," "Taxing District," and "Coal Bed Name") are open to the user to place "POD"-like information into the **Area Table**. These fields are not used by CoalVal and are available for the user to import any nonspecific data into CoalVal's **Area Table**. After the schemas are constructed, *post the additions by clicking on the "checkmark" on the Navigation Bar.* The completed import schema should look like figure B.114.

An explanation to one line of the schema in figure B.113 might help to better understand **Import Schemas**. The line: "Areas -- "Area Name"= [MINE_CAT]{0}" can be broken into four parts. The first part is the import type of which there are two types, **Area** and **Seam.** The line shows that import into the **Area Table** is by the "Area –." The third part of the line is the **Seam/Area Table** field name where the "Area Name" field of the **Area Table** is relating to the ["MINE_CAT"] field in the DBF table. The fourth part, {"0"}, is the position on the **Seam/Area** field in the "CoalVal list" box.

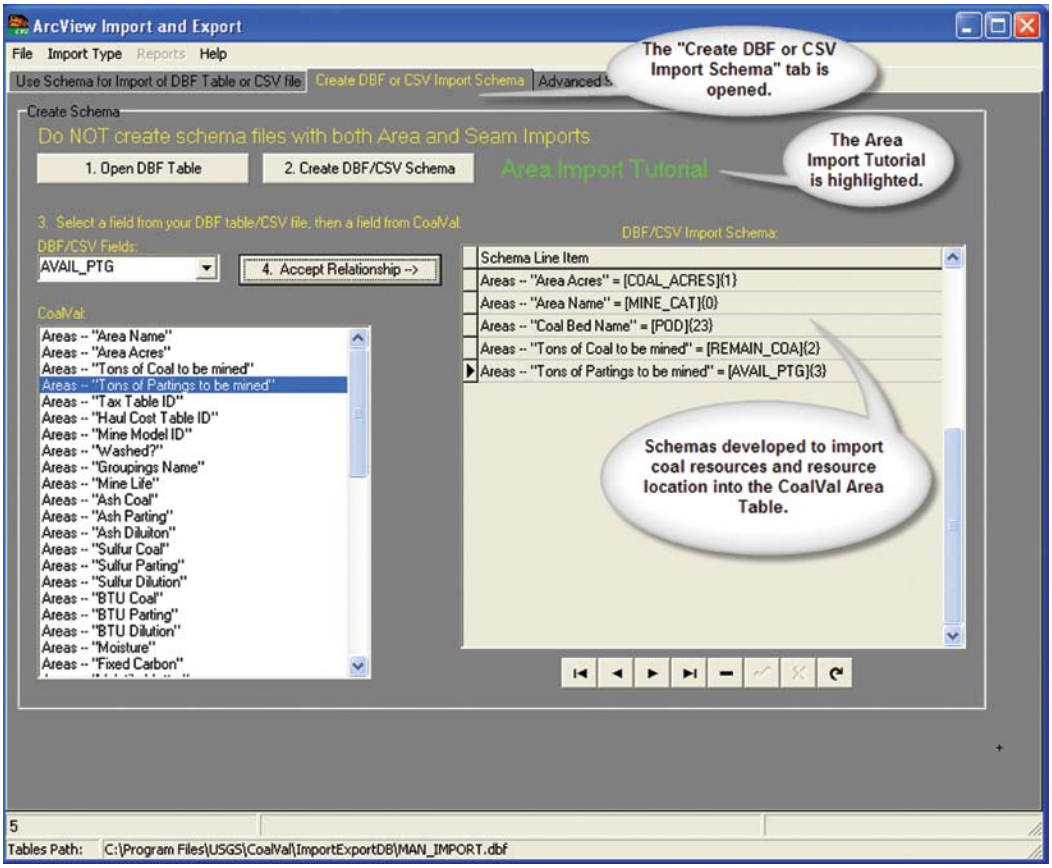


Figure B.114. Five "Schema Line Items" were developed under CoalVal's Create DBF or CSV Import Schema tab and ArcView Import and Export dialog window to import coal resource data into CoalVal's Coal Resource and Discounted Cash Flow Areas table.

Advanced Schema Layout

The third tab in the **ArcView Import and Export** dialog is the **Advanced Schema Layout** tab (fig. B.115). This tab is used only for importing Area data and will be used to add the tax table and mine model information to the **Area Table**. *Click on the **Advanced Schema Layout** tab to open this dialog.* There are two steps shown in this dialog.

Step 1. The first step is to make sure that the correct schema has been selected. The "Schema Names" in the "1. Select Schema: " should be similar to those shown in figure B.115. Be sure that the DBF resource table is still open in the **Use Schema for Import of DBF Table or CSV file** tab (fig. B.110).

Step 2. Step 2 information can be added to the **Area Table** from three items that are in any developed CoalVal database:

1. **Mine Model**
2. **Tax Table**
3. **Haul Cost**

Remember that before **Areas** are imported into CoalVal, the **Mine Model** records, **Tax Table** records, and **Haul Cost** records must already be created. For this tutorial any CoalVal database can be used that has at least three tax tables, two mine models, and one haul cost record. Remember that a **Tax Table** for each different "POD" value (a "POD" is a geographical area defining a particular **Mining Method**, **Tax** information, and coal quality, see appendix E, Glossary of Terms) is needed in the DBF table (fig. B.116). The first step is to *select the "Field Name: POD" from the pull-down list box under the "2. Create Advanced Schema" button*.

There are three values in the "POD" record in the DBF table (fig. B.110). They are 1, 2, and 3, so *type in the number "1" into the "User Entered Value:" edit box; since this entry concerns **Tax Tables**, select **Tax Table** from the list as shown in figure B.117.*

Notice that the list box after the equals sign ("=") displays a list of all the **Tax Tables** that have been entered into the CoalVal **Project** database. *Select the State A-Lower Bed **Tax Table** and click the "Click to Accept Layout" button*. The dialog should look like figure B.118. In this action, the import routine was directed to acknowledge that wherever it finds a "POD" value of "1," place the State A-Lower Bed **Tax Table** into the **Area Table** record along with the associated data set

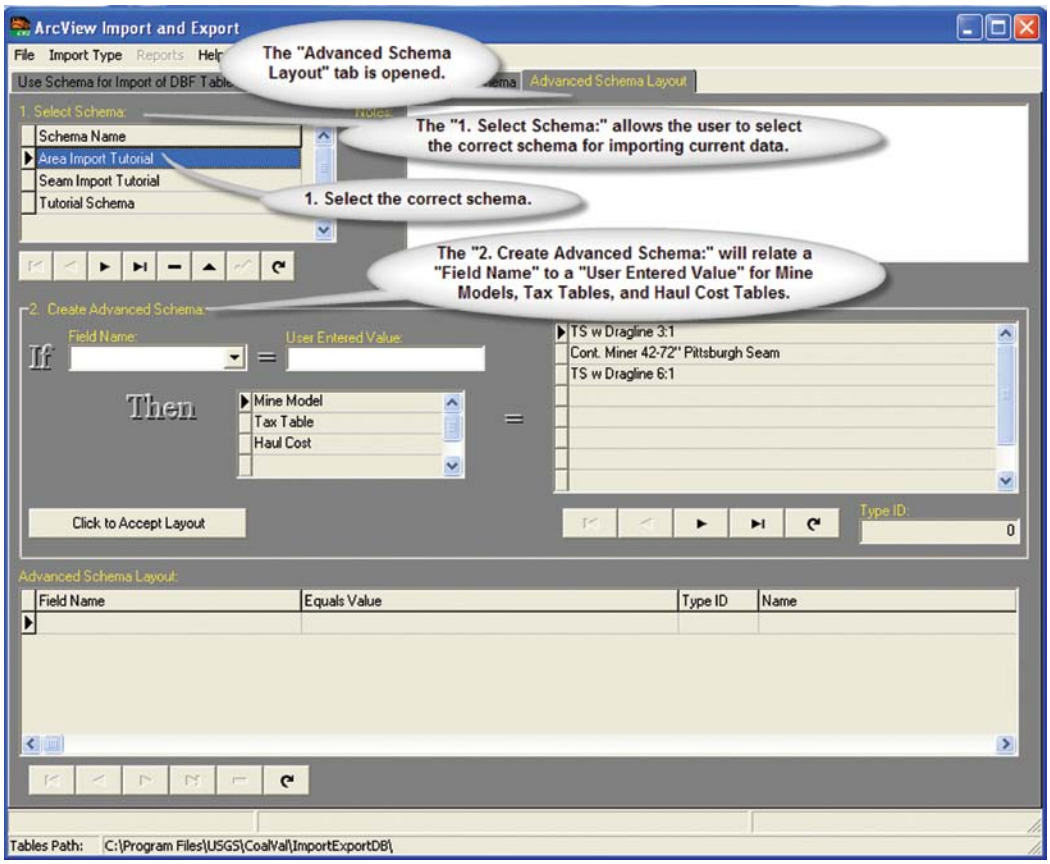


Figure B.115. CoalVal's Advanced Schema Layout tab on the ArcView Import and Export dialog window showing steps 1 and 2 for development of an Advanced Schema.

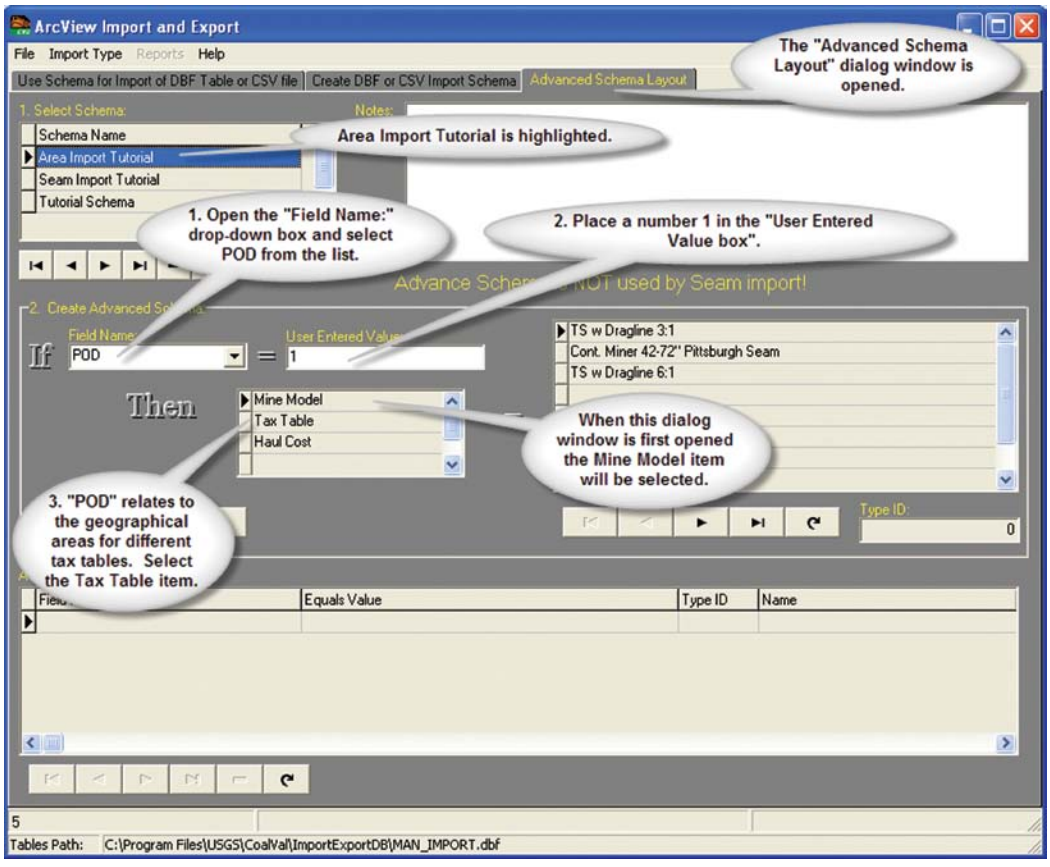


Figure B.116. Developing a Tax Table for each resource location area or "POD" using CoalVal's Advanced Schema Layout to relate the "Field Name: POD" to the DBF table.

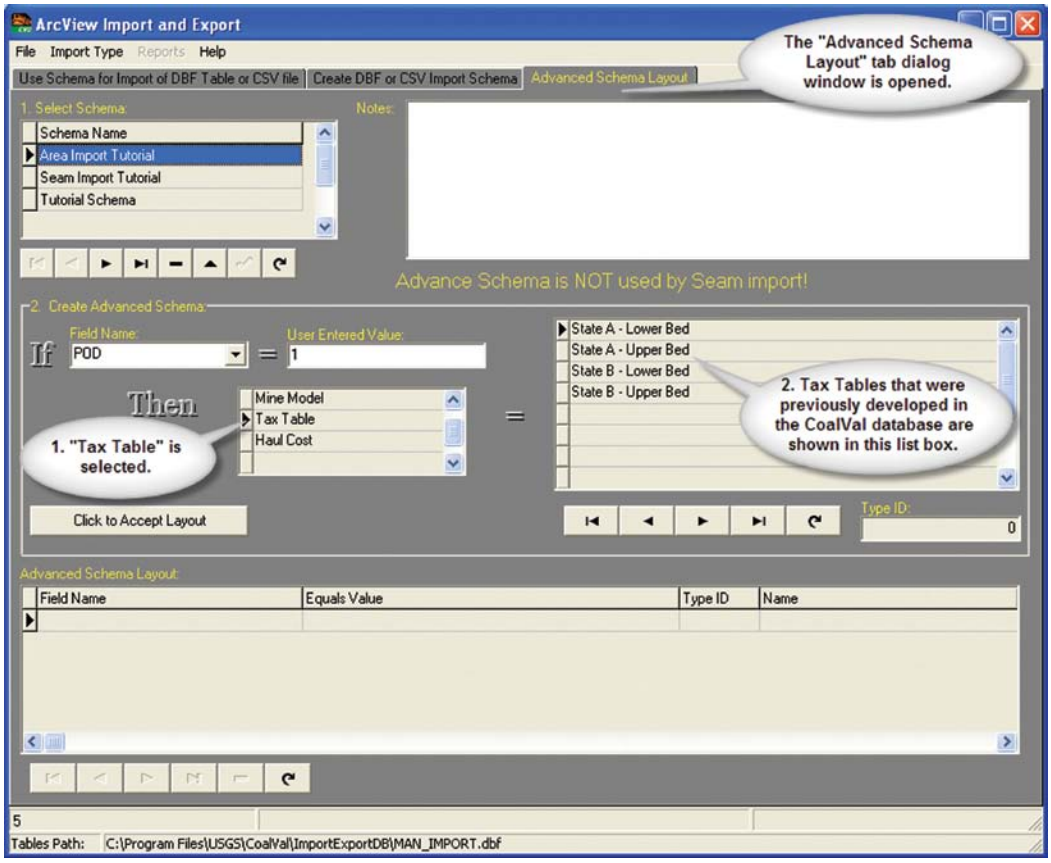


Figure B.117. Under CoalVal's Advanced Schema Layout in the ArcView Import and Export dialog window, "Tax Table" is selected from the field list and the available tax tables in the CoalVal database are revealed in the list box.

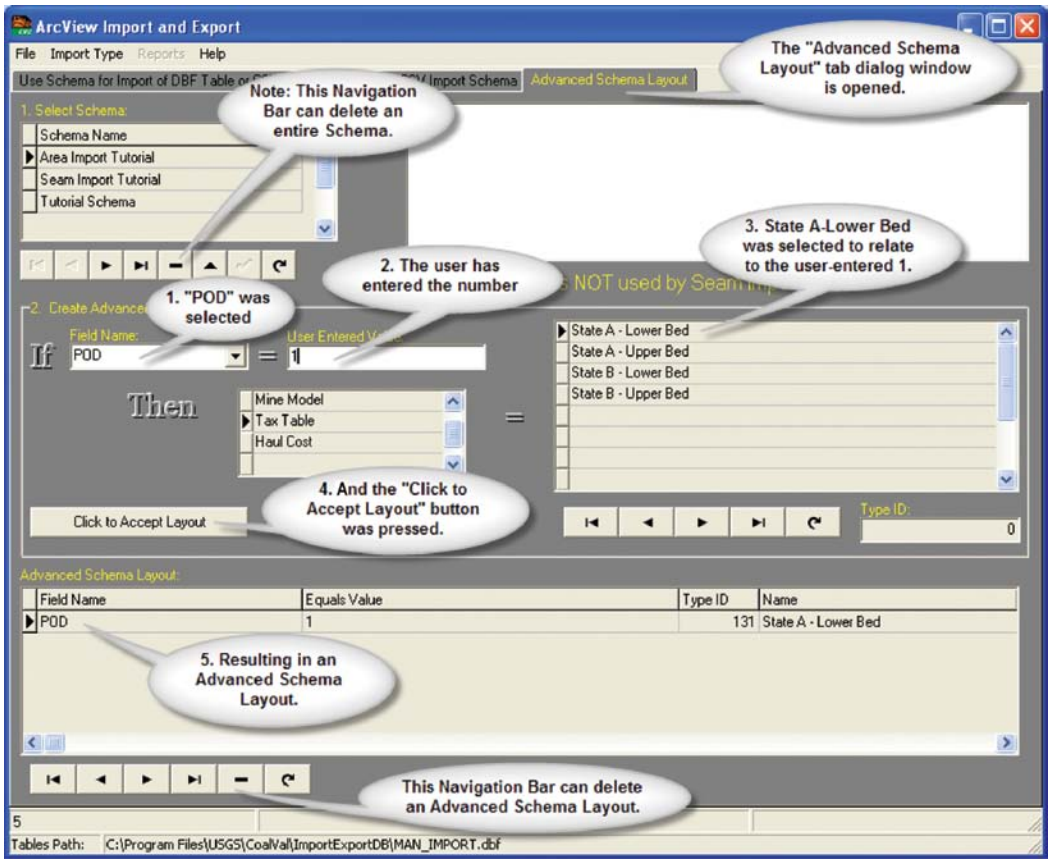


Figure B.118. CoalVal's four steps to the development of an Advanced Schema Layout for the "Tax Tables" on the Advanced Schema Layout tab of the ArcView Import and Export dialog window.

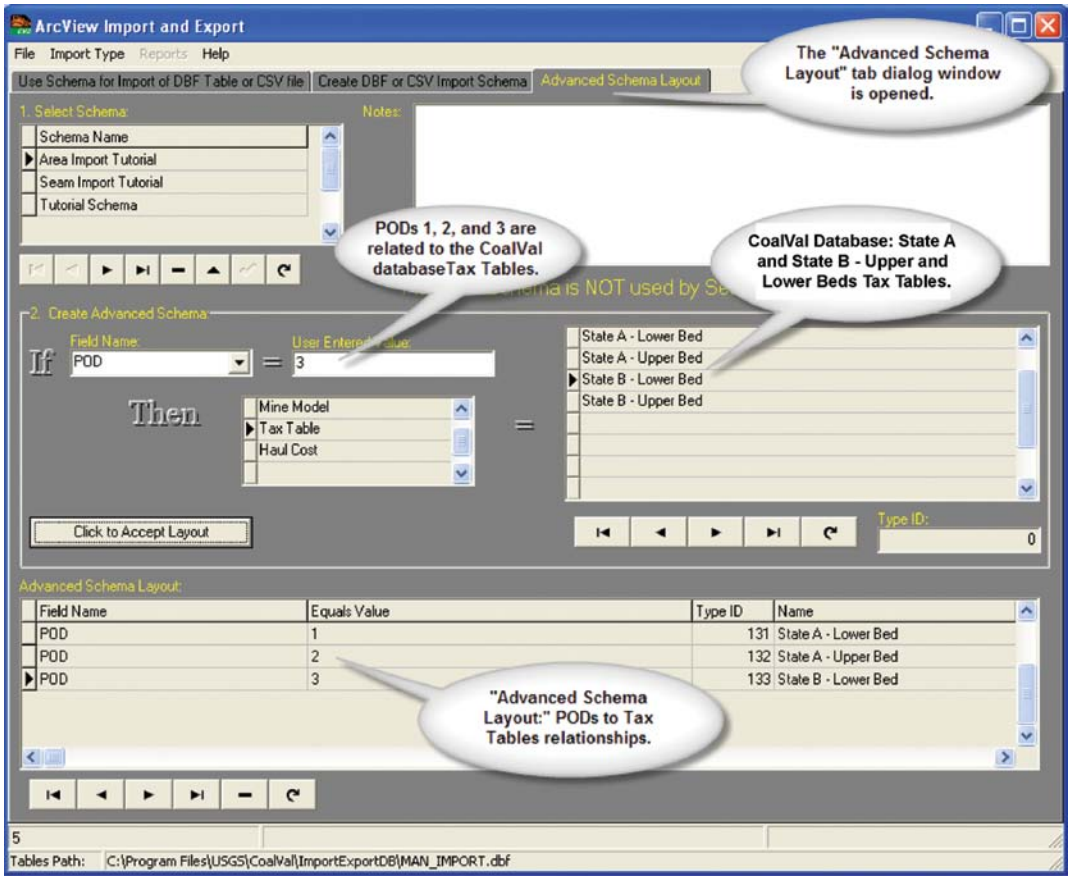


Figure B.119. CoalVal's Advanced Schema Layout for the three "POD" locations, relating the DBF table to CoalVal's Tax Tables.

on the **Create DBF or CSV Import Schema** tab. Now *add an **Advanced Schema Layout** for the other two "PODs" with values of* "2" and "3" using the State A-Upper Bed and State B-Lower Bed **Tax Tables**. The dialog should now look like figure B.119.

Next, the **Mine Model** records need to be added to the import list in the **Advanced Schema**. A **Mine Model** is needed for each different stripping ratio value (the column header is "Strip_Rat," an abbreviation for stripping ratio) in the DBF table (fig. B.110). The first item to *select is the* "*DBF Field Name: Strip_Rat" from the pull-down list box (fig. B.120)*.

There are two values in the "Strip_Rat" record in the DBF table (fig. B.110), "3" and "6," representing a 3:1 stripping ratio and a 6:1 stripping ratio. First, *set the stripping ratio*, "*Strip_Rat" value of "3," by typing the number "3" into the "User Entered Value: edit box."* Since this concerns mine models, *select* Mine Model *as in figure B.120, then select "TS Dragline 3:1, and click the "Click to Accept Layout" button*. Notice that the list box after the equals sign ("=") displays a list of all the mine models that have been entered. The dialog should look like figure B.121.

The import routine was just directed to acknowledge that wherever it finds a stripping ratio, **"**Strip_Rat" value of "3," it is to place the selected mine model into the **Area Table** record along with the data set up on the **Create DBF or CSV Import Schema tab** and any other **Advanced Schema** layouts, such as a **Tax Table**. Now *add an* Advanced Layout *for the other stripping ratio*, "*Strip_Rat" value of "6," then select "TS Dragline 6:1, and press the* "*Click to Accept Layout" button*. The resulting dialog should be similar to figure B.122. If by accident an **Advanced Schema Layout** is entered that is not desired by the user, the Navigation Bar can be used to select and delete the item.

The **Haul Cost Table** developed earlier in the Tutorial Chapter for the CoalVal database will be the only haul cost used in this tutorial exercise. That **Haul Cost Table** named Example Haul Cost will be related to the item, COUNTY, from the "DBF Field Name" drop-down list. *Use the number "1" for the "User Entered Value"* (the county value from the DBF table, fig. B.110), *then select "Example Haul Cost."* After selecting these values, *click on* "*Click to Accept Layout" and the **Advanced Schema Layout** will be developed (fig. B.123)*.

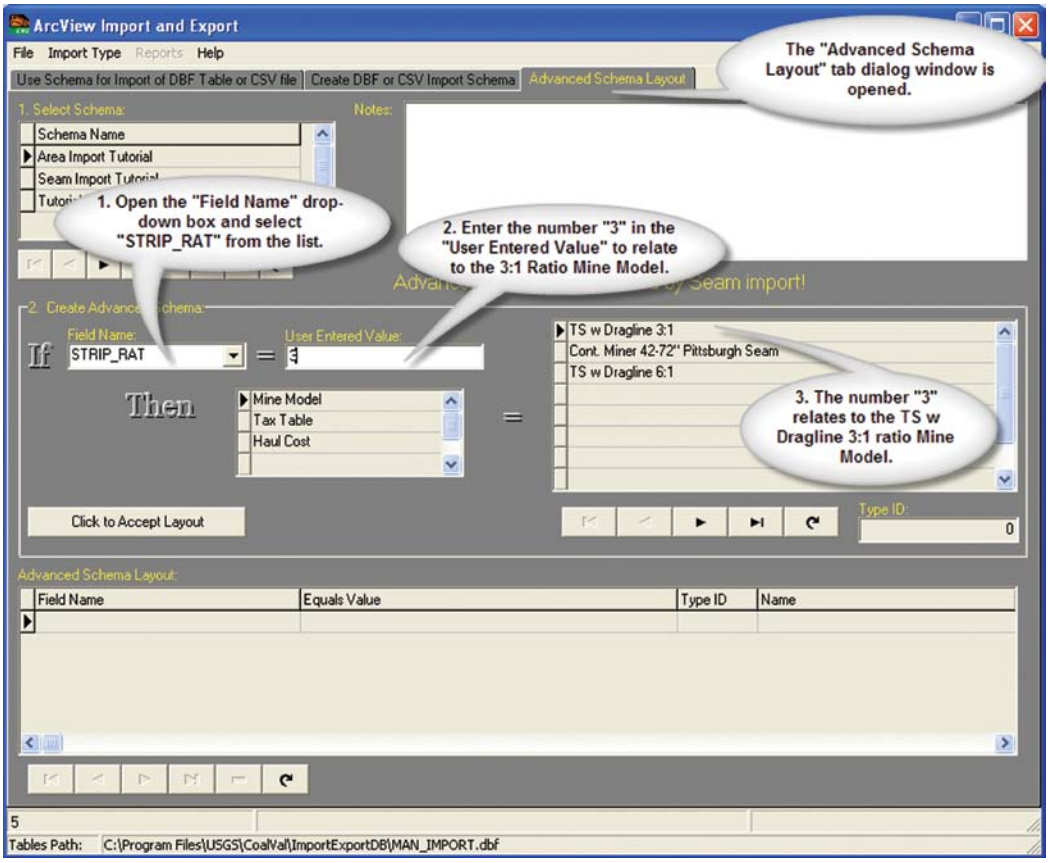


Figure B.120. Steps needed to develop the CoalVal's Advanced Schema Layout DBF table, "Field Name: STRIP_RAT" relationship, to the mine model (TS w Dragline 3:1) in the CoalVal Database.

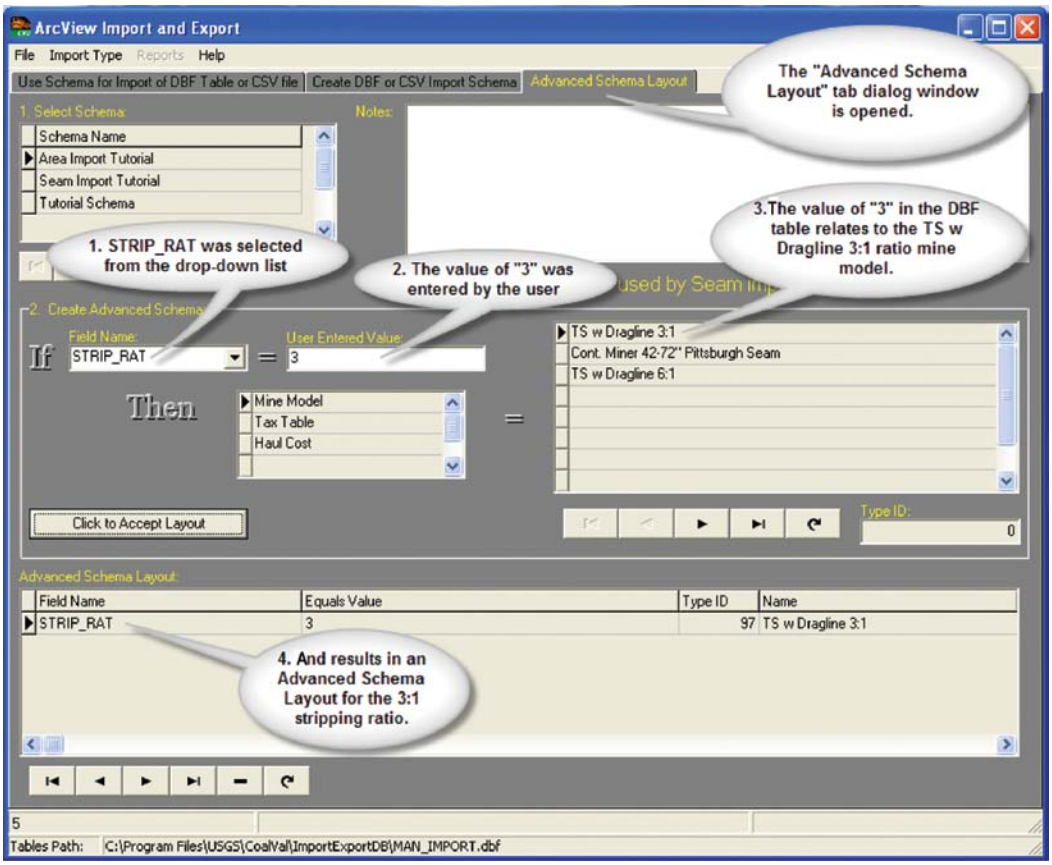


Figure B.121. The Advanced Schema Layout relating the "TS W Dragline 3:1mine model "(Truck-Shovel and Dragline 3:1 ratio) to the DBF table data and accepting the Layout relationship (step 4).

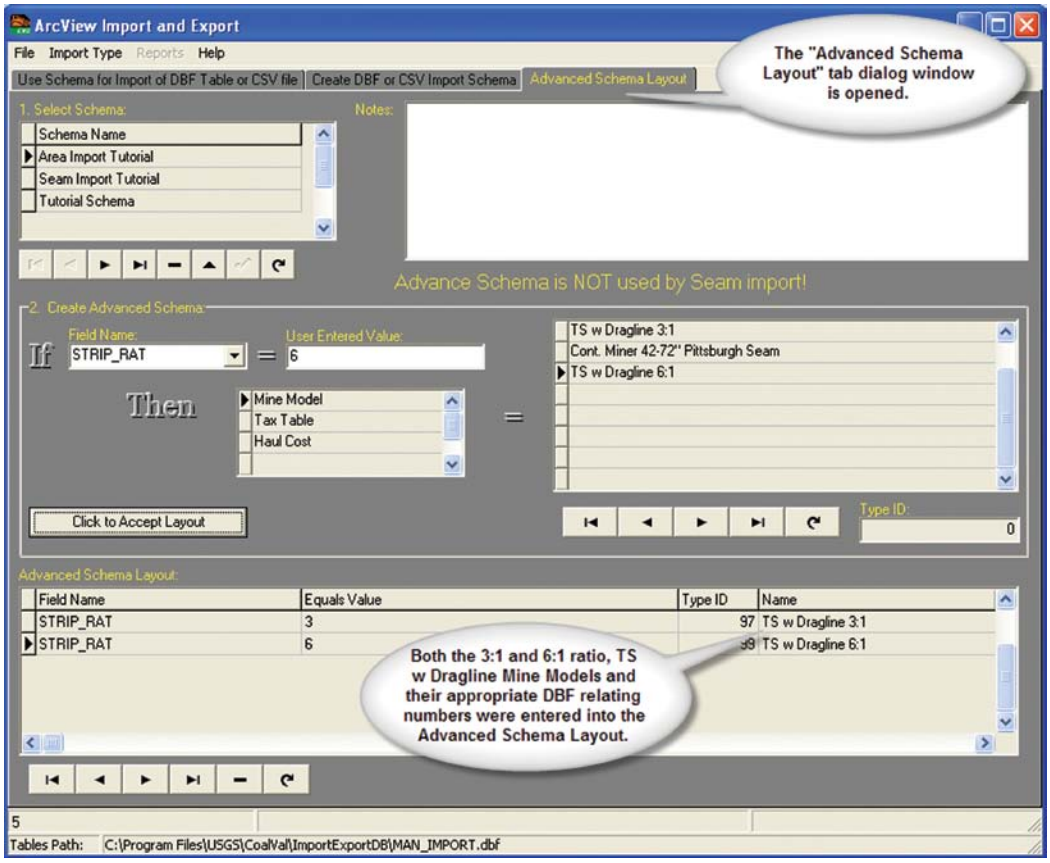


Figure B.122. CoalVal's Advanced Schema Layout under the ArcView Import and Export dialog window showing the surface Mine Model relationships.

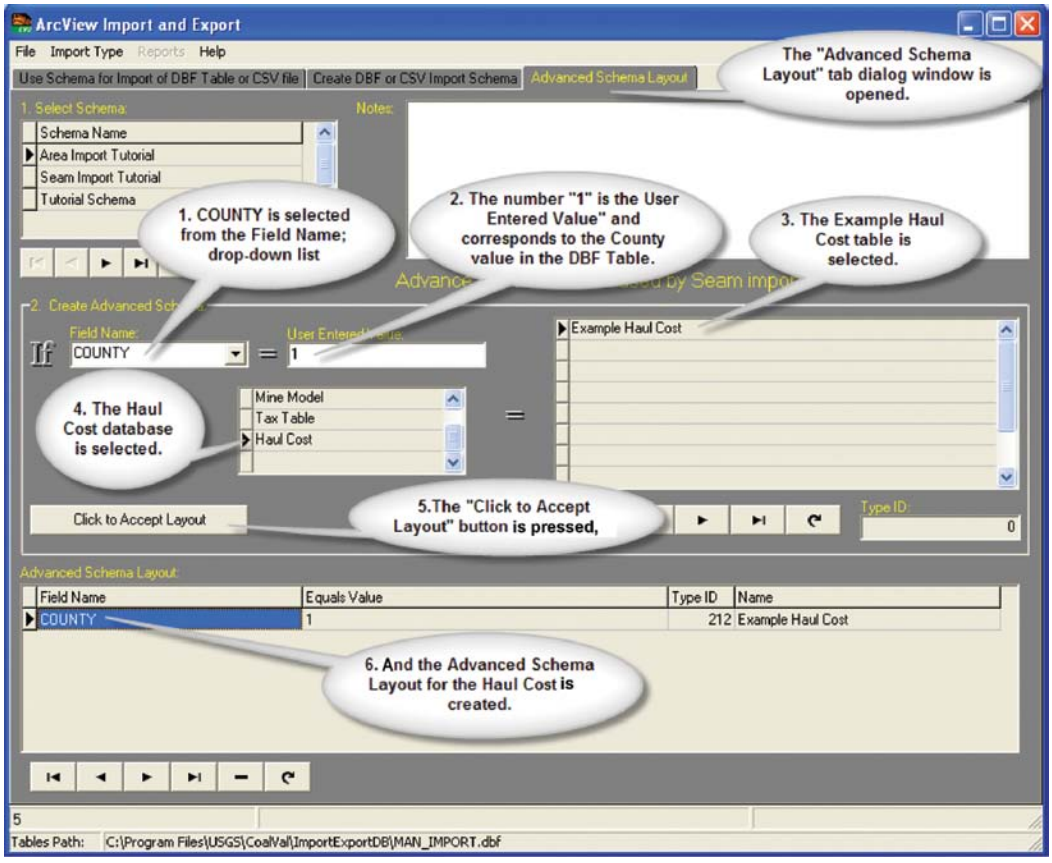


Figure B.123. Process to develop the five steps for CoalVal's Advanced Schema Layout relating the "Field Name: County" to CoalVal Haul Cost tables.

There is a second way that a single source or constant number can be imported into the **Area** Table. This second method is for demonstration and does not need to be completed at this time because the Haul Cost data will be imported through the Area Import Tutorial Schema. Since the same **Haul Cost** will be used for all of the data imported, a constant value for haul costs will be added to all records that are imported. To do this *click the **Use Schema for Import of DBF or CSV file** tab*. In the gray area, under "Place a constant into CoalVal Data Record," *place a checkmark in the* "*Haul Cost ID" box and type in the "Example Haul Cost Entry Table ID," "212" (fig. B.124*). Every **Mine Model**, **Tax Table**, and **Haul Cost Table** has a unique value assigned to it. The **Haul Cost Table** found under the Main CoalVal **Menu/Tools/Mine Data/ Mine Data, Haul Cost, Taxes, Equipment, and Employees** dialog window contains the ID number of "212" (fig. B.125). Identification (ID) numbers were discussed in the **Tax Table** and **Haul Cost Table** Construction sections earlier in this chapter.

Before continuing with the import, make sure that the correct **Project** is selected (Area Import Tutorial) under the **Project Name** on the **Projects** dialog window. Now the data are ready to import into the **Area Table**. *Click on the **Use Schema for Import of DBF table or CSV file** tab dialog window to import the data (fig. B.126) and then click the* "*Import DBF Table" button.* A successful import is indicated by the "Import Finished" message in the "Import Error Report" (fig. B.127*)*. All records will be imported into the **Area Table** in **Projects/Coal Resources and Discounted Cash Flow Areas** tab (fig. B.128).

In the next section the user will import coal-quality data into the Area Table. The coal quality will indicate that the high ash content will require the coal to be washed to become a saleable product. Therefore, *click on the "Washed?" coal boxes in the Mine Data Group of the **Area Table** to activate the coal washing cost and recovery part of CoalVal (fig. B.128)*.

Quality Data Import

The same warnings given in the **DBF File Area Data Import** section of this tutorial are applicable here. In this section, coal-quality data will be imported and appended into the **Area Table** of a **Seam**. As with any of the data imports, it is necessary to have a **Project** created (see the Import GIS and Quality Data Tutorial sections) before importing data. In addition, the **Project** must have a designated **Seam Table** before importing coal-quality data into an **Area Table**. And lastly, since information will be appended to the **Area Table** records, those records are needed in the **Area Table**. The records developed in the **Import Tutorial Project** and **Seam:** "Sam" will be used in this portion of the Tutorial Chapter. The status bar in the **Projects** window should look like figure B.128. *Click on the **Tools** drop-down menu on the **Project** dialog window (fig. B.129); now select **Import Quality Data from DBF File** from the menu list (fig. B.130)*.

The first step in importing data is to open the DBF file. After the **Import Quality Data** dialog window is displayed (fig. B.131), *select the **Import Quality Data** tab* (upper left side), *and click on the "*2. Open Import DBF Table" *button*. When the "Open" dialog box is displayed, *navigate to the* QualityTest.dbf *file* (found in the **ImportExportDB** folder) *where CoalVal was installed, and click on the "Open" button* (fig. B.131). The values in this table (fig. B.132) are not real quality numbers. They are test values that will allow the user to ascertain, after the import, where the values went in the **Area Table**. The next section will show how to create a field name relationship between the fields in the DBF import files, QualityTest.dbf, and CoalVal's **Area Table**.

Field name relationships have been explained in previous sections; however, their importance is paramount and will be reviewed again. These relationships are used to relate database fields in the import files (with a naming convention) to database fields in CoalVal's **Area Table**. In this example the import DBF file has a field name of "Ash C." This "Ash C" field is where the ash content of the coal was stored. CoalVal is not aware of this field relationship until the user relates the DBF file field name to a CoalVal **Area** field. Record relationships are used to tell CoalVal which records of the import file need to be placed into records of CoalVal's **Area Table**. So, to import all DBF file records that have a "1" under "QUALITYNAM" into CoalVal's **Area Table**, the CoalVal **Area Table** field must be set to "Coal Bed Name = Coal '1'."

Create Field Relationships for a Schema

*Click on the **Create Import Schema** tab in the **Import Quality Data** window to see the four steps in this operation*:

Step 1. This step was opening the "QualityTest.dbf" file in the preceding "Quality Data Import" section (fig. B.132).

Step 2. This step begins with *selecting the "Create Field Relationships for a Schema" tab (fig. B.133)* and provides a name to the new schema. *Click on "2. Create a Schema" button and type in "Quality Import Test" over "None" for the name, the click the OK button.*

Step 3. Adds the relationship records to the schema indicating how the import DBF table and the **Area Table** are related. To add the first relationship, *select "Moisture" from the pull-down box labeled Import fields (fig. B.134)*. Next *select the field for the **Area Table** that relates to this DBF field name, in this case "Moisture," by using the list box under the heading* "*CoalVal Fields*" *(fig. B.135)*.

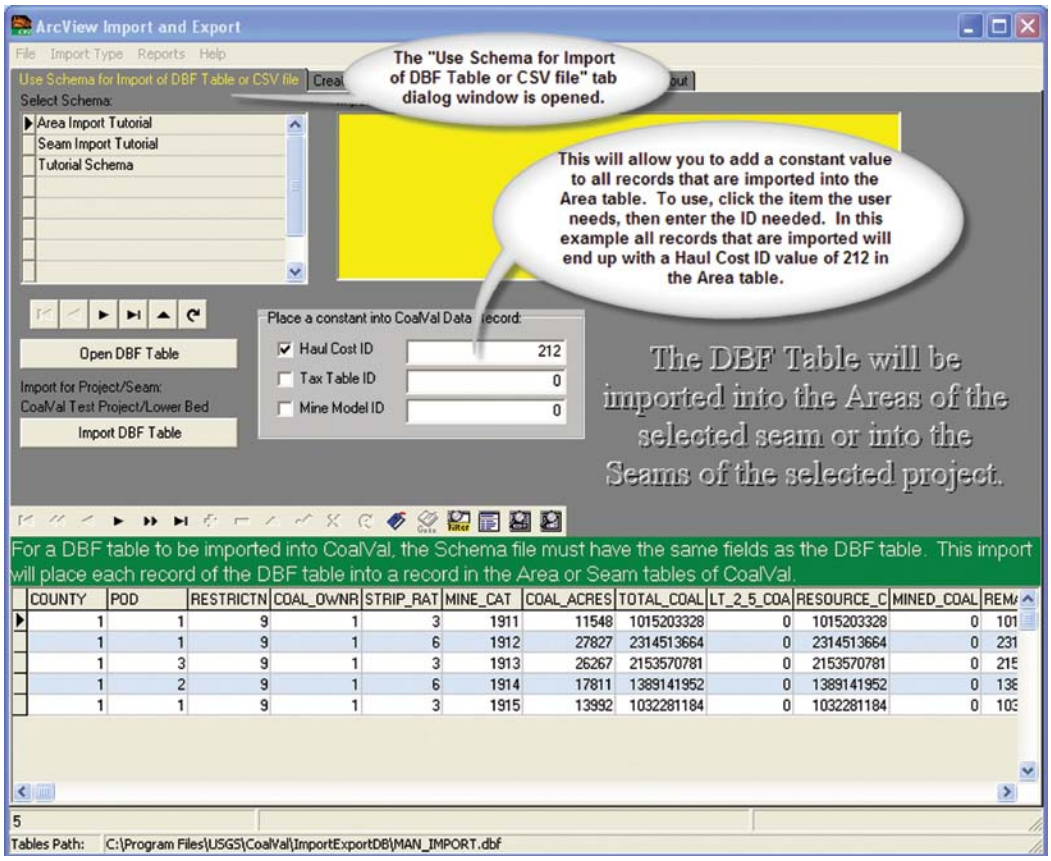


Figure B.124. The Haul Cost Table entered into the CoalVal Data record as a constant for import into the Coal Resource and Discounted Cost Flow Areas table.

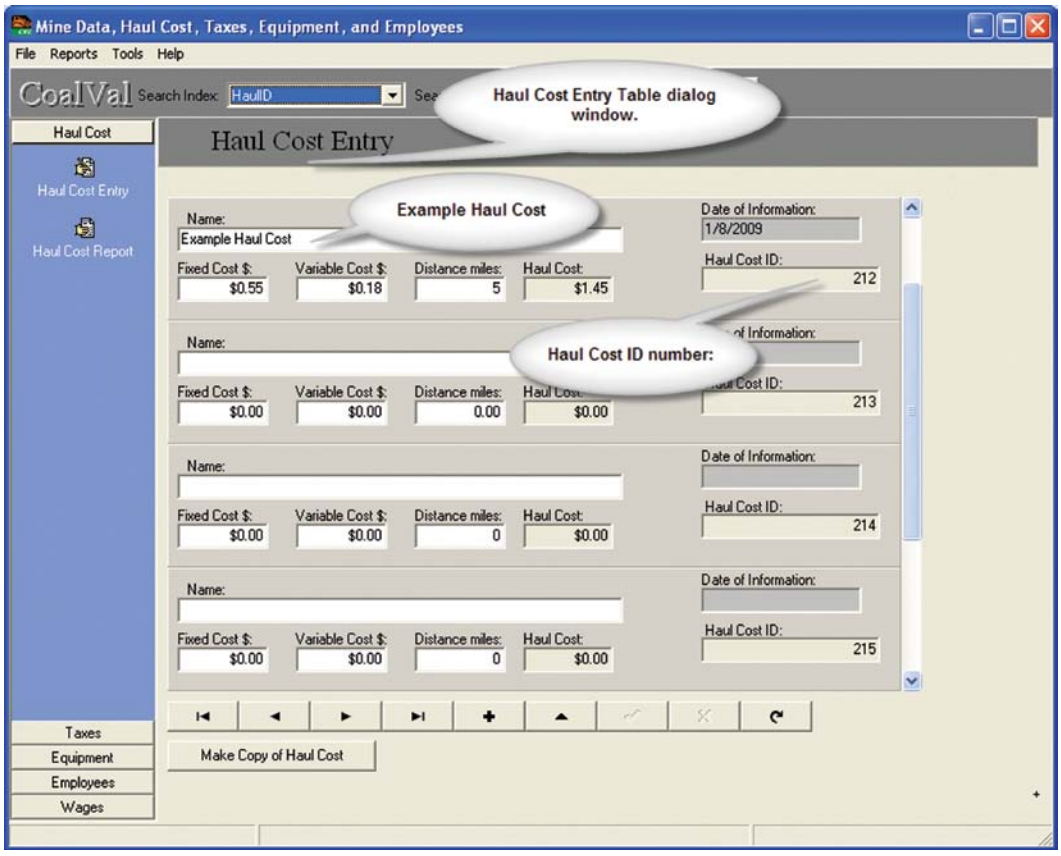


Figure B.125. CoalVal's Haul Cost Entry Table with costs and Haul Cost ID.

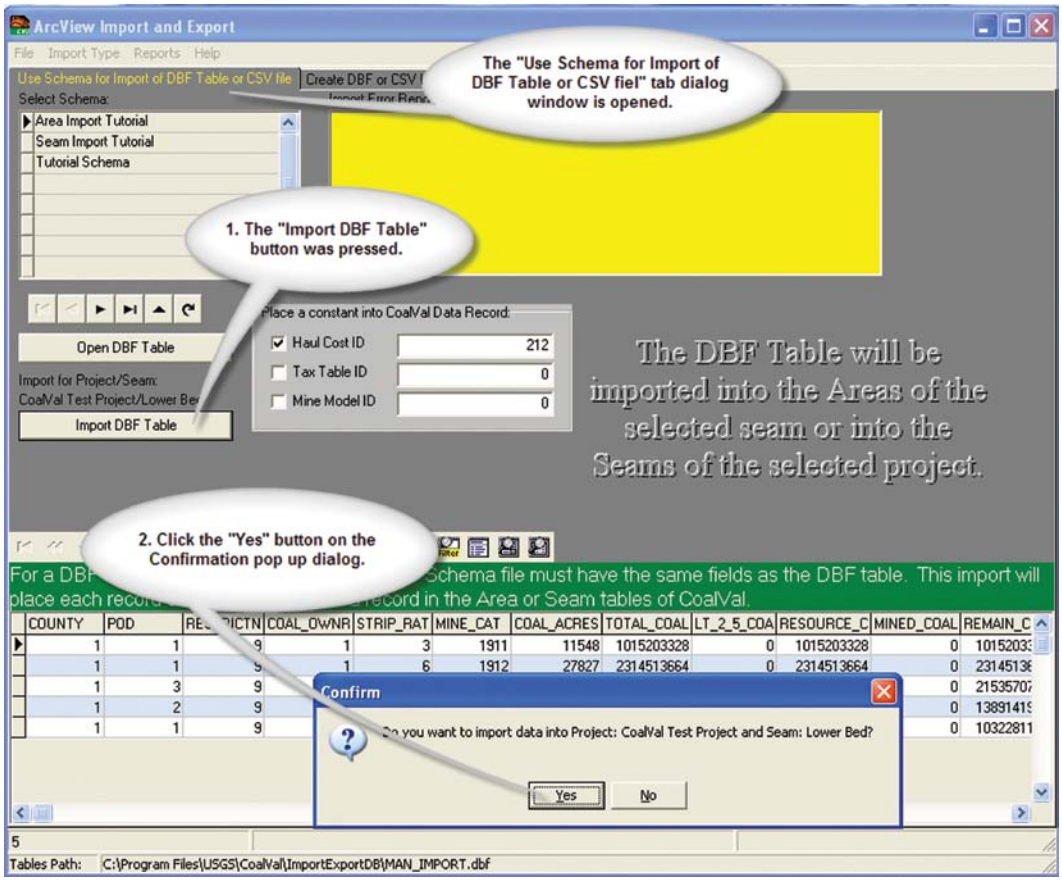


Figure B.126. Importing a DBF table into CoalVal's Coal Resource and Discounted Cash Flow Areas table.

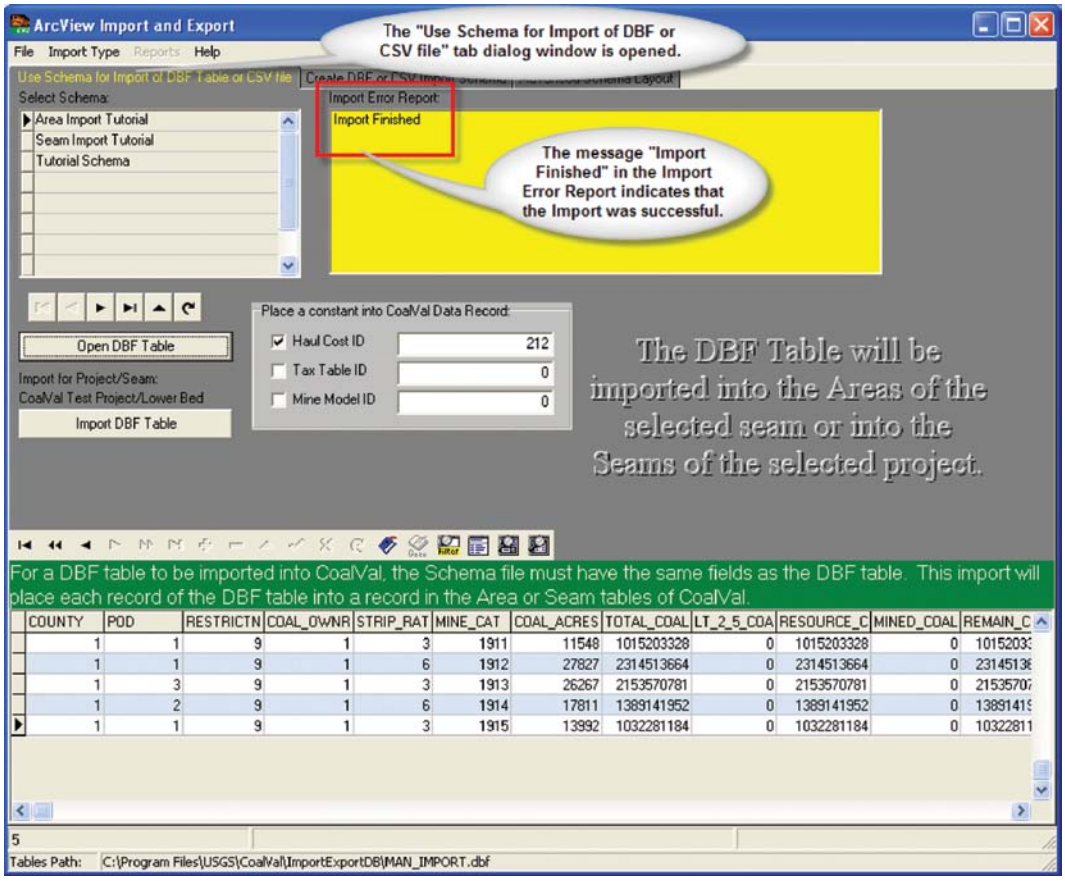


Figure B.127. The "Import Finished" message in the "Import Error Report" under the Use Schema for Import of DBF Table or CSV file tab indicates a successful import into the Coal Resource and Discounted Cash Flow Areas table.

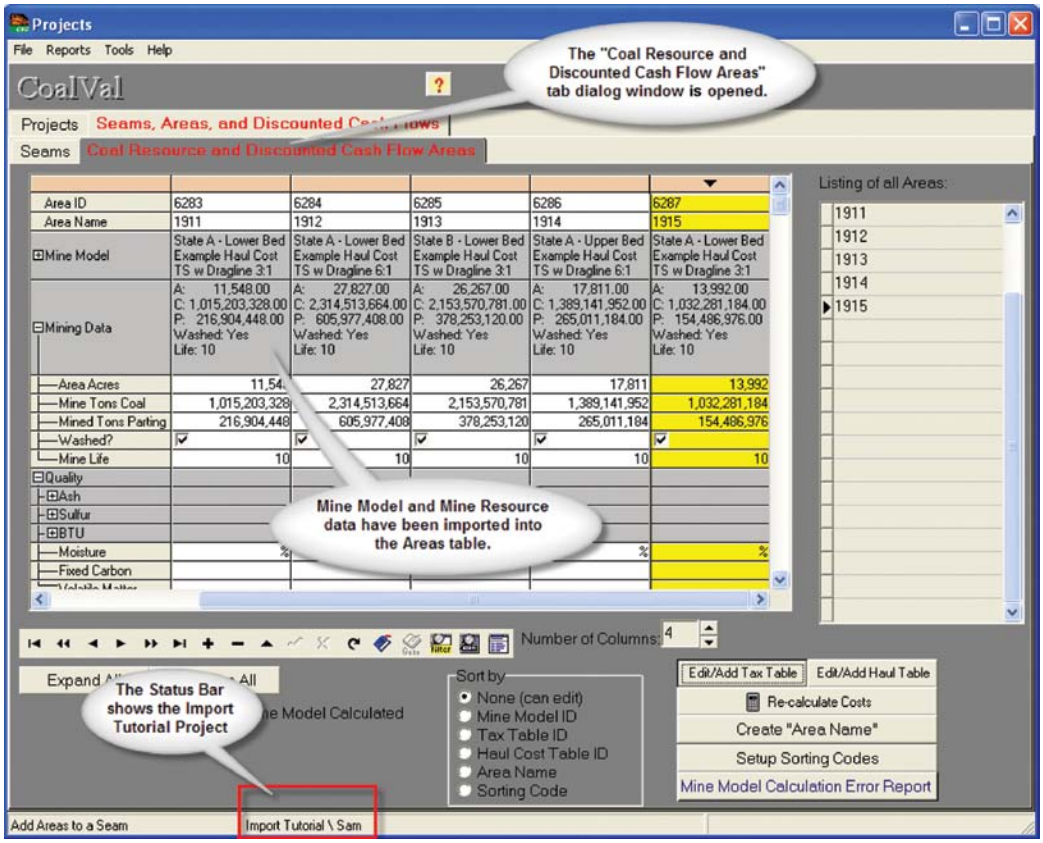


Figure B.128. "Mine Model" and "Mine Resources" import into the Coal Resource and Discounted Cash Flow Areas table under the Projects dialog window for the Sam bed is completed. The yellow highlighted column indicates that the column is active and data modifications are possible.

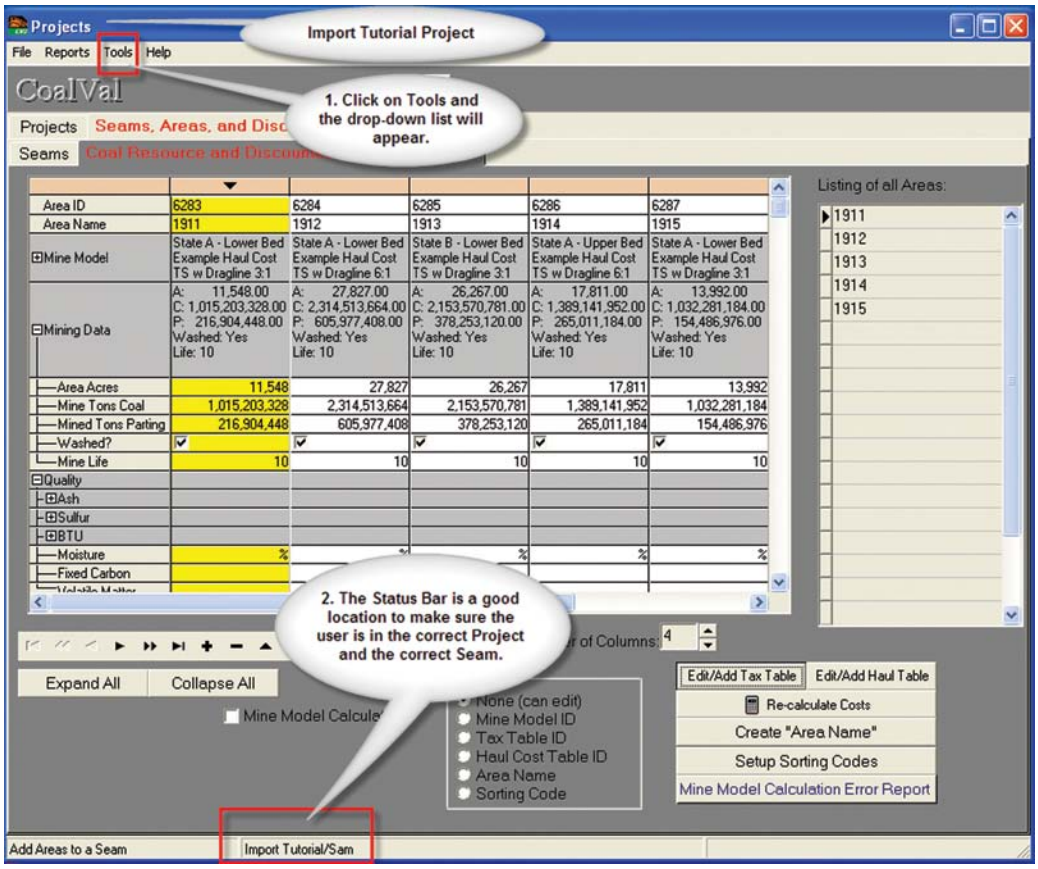


Figure B.129. Finding the Import Quality Data from a DBF File on CoalVal's Tools drop-down menu in the Projects dialog window.

Figure B.130. Opening the Import Quality Data from DBF File on CoalVal's Tools drop-down menu under the Projects dialog window.

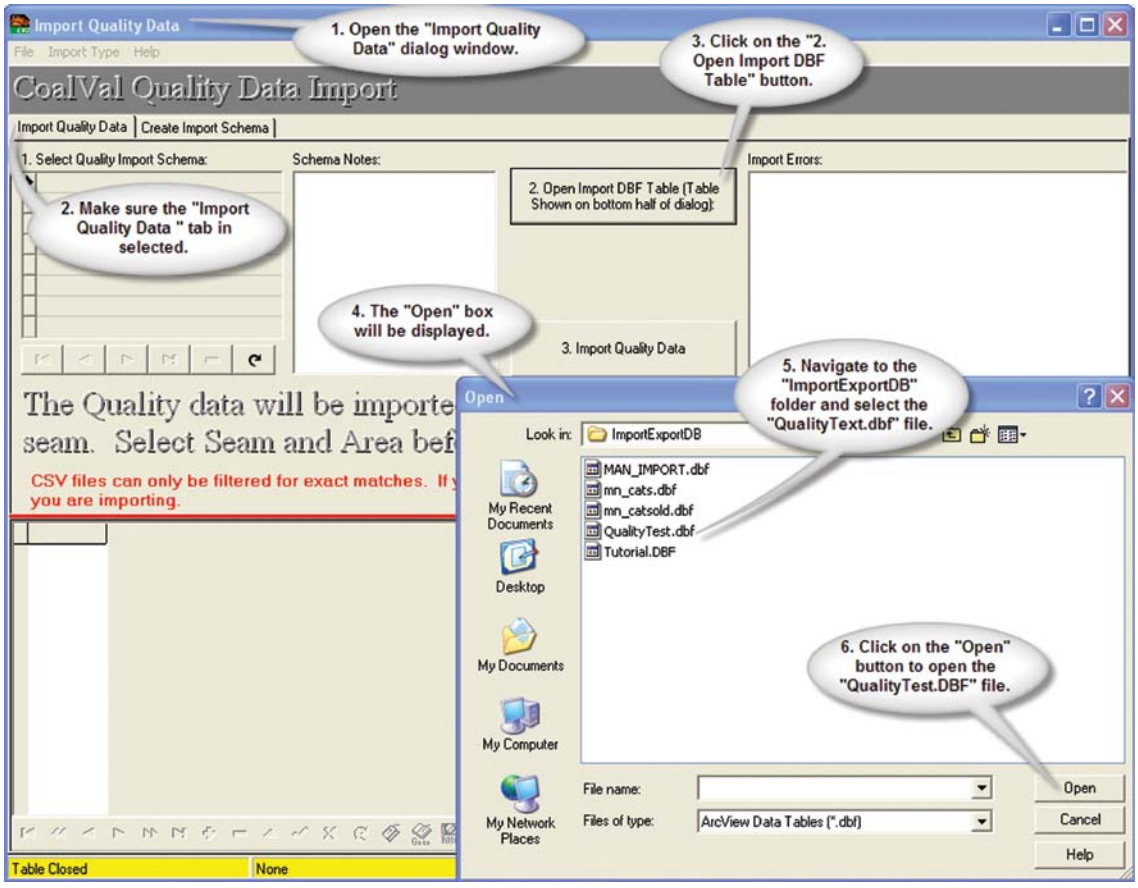


Figure B.131. Navigating to and opening the "QualityTest.dbf" file in CoalVal's "ImportExportDB" folder.

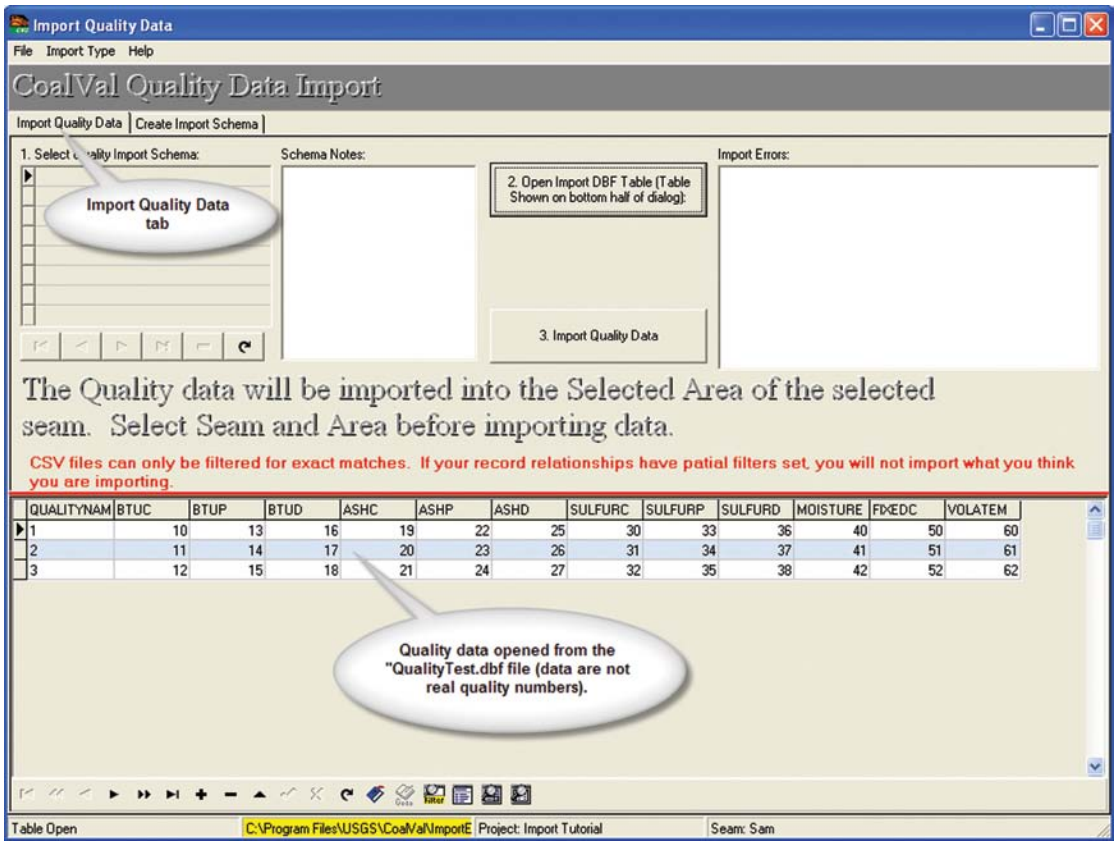


Figure B.132. Opening the "QualityText.dbf" file resulted in the above coal-quality information being displayed on CoalVal's Import Quality Data tab of the Import Quality Data dialog window. These data are not real coal-quality values but rather place-holder examples.

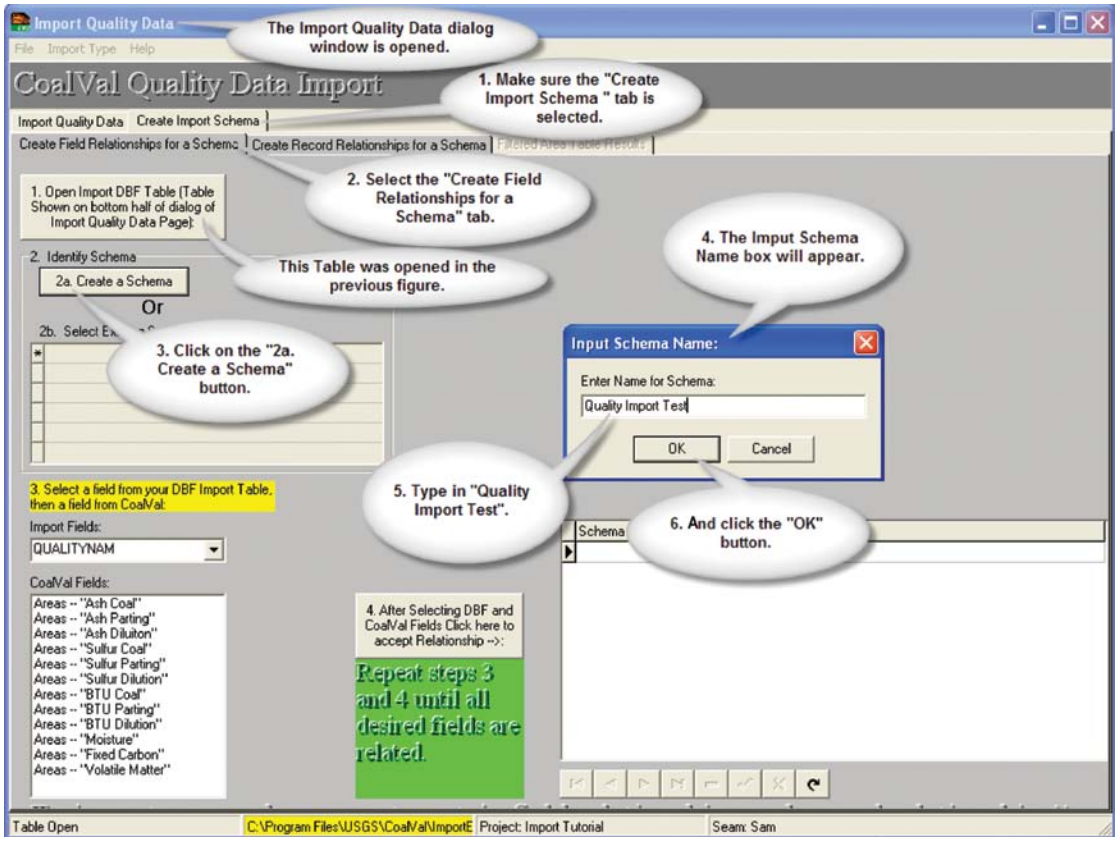


Figure B.133. Developing a Schema Name (Quality Import Test) for the coal quality, import DBF table relationship to CoalVal's Coal Resource and Discounted Cash Flow Areas table.

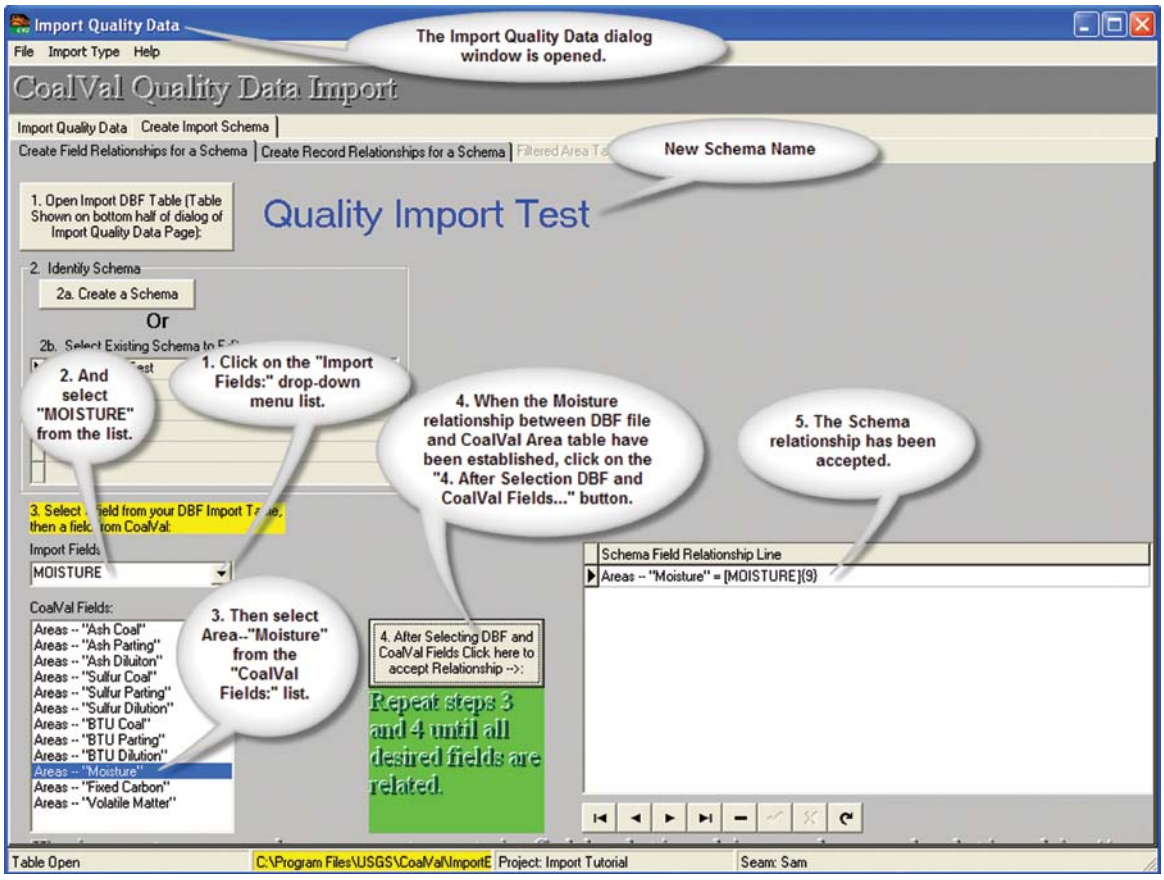


Figure B.134. Developing the coal-quality Schema for a relationship between the "Import Field: (DBF Table): Moisture" and the "CoalVal: Field, Area—'Moisture'" and accepting the relationship (number 4. button).

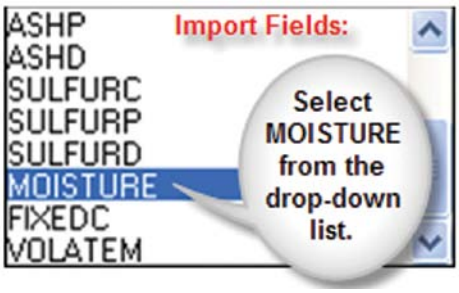


Figure B.135. Selecting the "Moisture field" from the DBF field names on CoalVal's "Import Fields" drop-down list.

Step 4. Now that a field name from the DBF file ("MOISTURE") and a field name for the **AreaTable** ("Areas—Moisture") have been selected, *click the button labeled "4. Accept Relationship -->" (fig. B.134).*

The first line of the schema is now displayed in the list box (fig. B.134). Repeat steps 3 and 4 for:

ASHC = "Ash Coal"

ASHP = "Ash Parting"

ASHD = "Ash Dilution"

When finished the schema should look like figure B.136.

Create Record Relationships for a Schema

There are three records in the imported coal quality table. To review, *click on the "Import Quality Data" tab*. The screen should look like figure B.137. Figure B.138 is an image of the **Area Table** imported in the last example. The "Coal Bed Name" line is displaying the "POD" (or geographic area) numbers that were imported into the "Coal Bed Name" field. As noted in the "DBF File Area Data Import" example, the "POD" value was placed into the Area **Table's** "Coal Bed Name" field. The plan is to import quality data from the record where "QUALITYNAM" is "1" into an **Area Table** record that has a "Coal Bed Name" value of "1" (fig. B.138).

From figures B.137 and B.138 it can be seen that the first record of the quality import table ("QUALITYNAM") needs to be imported into three different **Area Table** records ("POD" "1") and the next two records of the quality import table ("BTUC" and "BTUP") will be imported once each into their respective **Area Table** records ("POD" "2" and "POD" "3"). The import operation follows:

"QUALITYNAM = 1 into Coal Bed Name":

1911, 1912, and 1915

"QUALITYNAM = 2 into Coal Bed Name": 1914

"QUALITYNAM = 3 into Coal Bed Name": 1913

In the first part of the current exercise (Import Quality Data, fig. B.137), CoalVal was directed to relate the field names in the **Area Table** with the field names in the import table. Next, the values in the **Area Table's** "Coal Bed Name" field and the values in the import table's "QUALITYNAM" field need to be related. This is done by first, clicking on the "Create Import Schema" tab and then second, clicking on the "Create Record Relationships for a Schema" tab (fig. B.139).

Step 1. Make sure the correct schema is selected (Quality Import Test).

Step 2. Make sure that the import table has been opened (on the Import Quality Data tab). If it is not open, open it.

Step 3a. Use the pull-down list box and *select the "QUALITYNAM" field from the import table (fig. B.140).*

Step 3b. *Select the first value associated with the "QUALITYNAM" field (fig. B.139).*

Step 3c. Set the filter for the **Area Table** (see the Create Record Relationships section in the Program Description Chapter, appendix C, for an explanation of filtering). *Click the "3c. Set filter for Area Table" button and a dialog box will appear. Select the "Coal Bed Name" from the "Fields" list (fig. B.141), then select the "Partial Match at the Beginning" Search Type, and enter a "1" for the "Field Value."* Lastly, *click the OK button.*

Step 3d. *Click the button labeled "3d. Accept relationship."* The dialog should now look like figure B.142 Now *repeat steps 3b–3d, setting up the filters for the "Select Import Record Value:" of "2" and "3."* The dialog should look like figure B.143. Figure B.143 shows that when "CoalBedName" =1 in the **Area Table**, then the quality data will be imported from the import table record where the field is named "QUALITYNAM" = 1 into the **Area Table**.

Step 4. To see the effect of the "Area Table" filter on the **Area Table,** *press the button labeled "4. View results of the selected filter on Area Table. Select filter from grid below" (fig. B.143)*. Clicking that button with the first relationship layout results in figure B.144.

The coal-quality data are now ready to be imported into the **Area Table**. Only the items set up on the "Create Field Relationships for a Schema" will be imported—that is, the ash contents for coal, parting, and dilution and moisture content. *Click the "Import Quality Data" tab and click the "3. Import Quality Data" button to import the data (fig. B.145)*. Once the "3. Import Quality Data" button is pressed, the data will be imported into the **Areas Table** (fig. B.146).

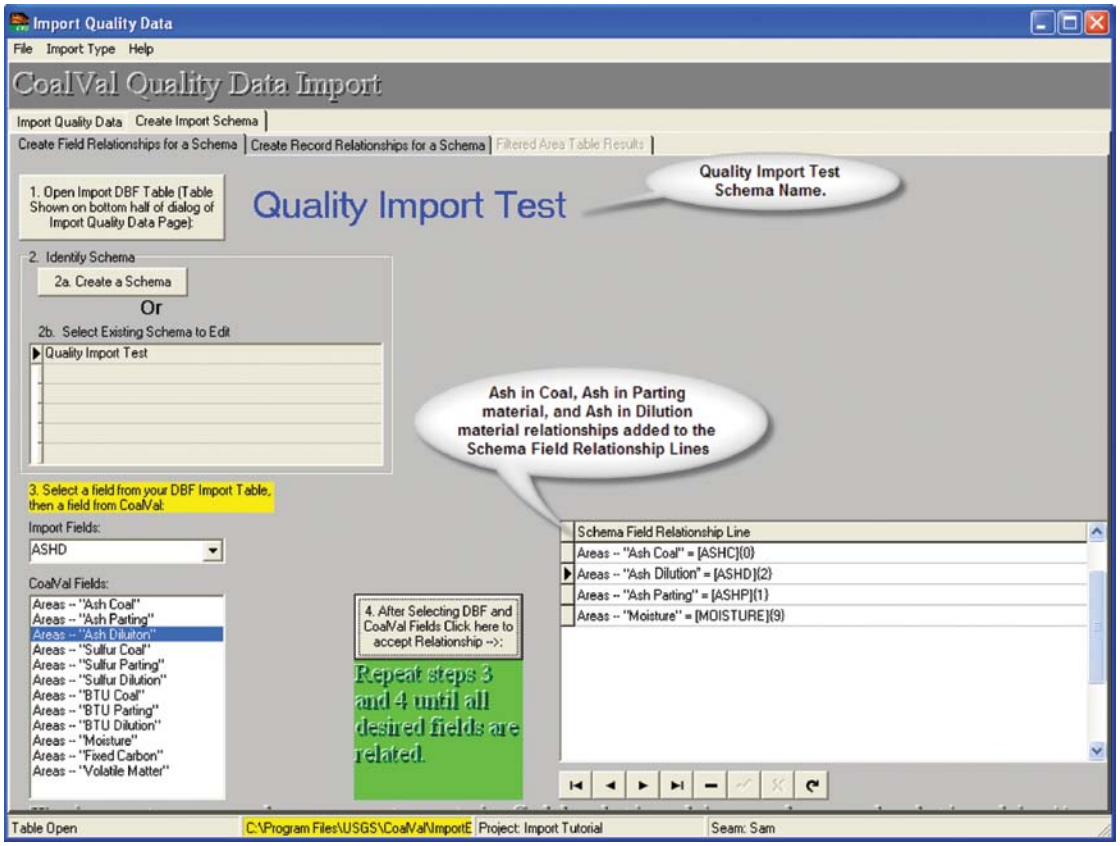


Figure B.136. Accepting the Schema relationships for three field names for "ash" and one field name for "moisture."

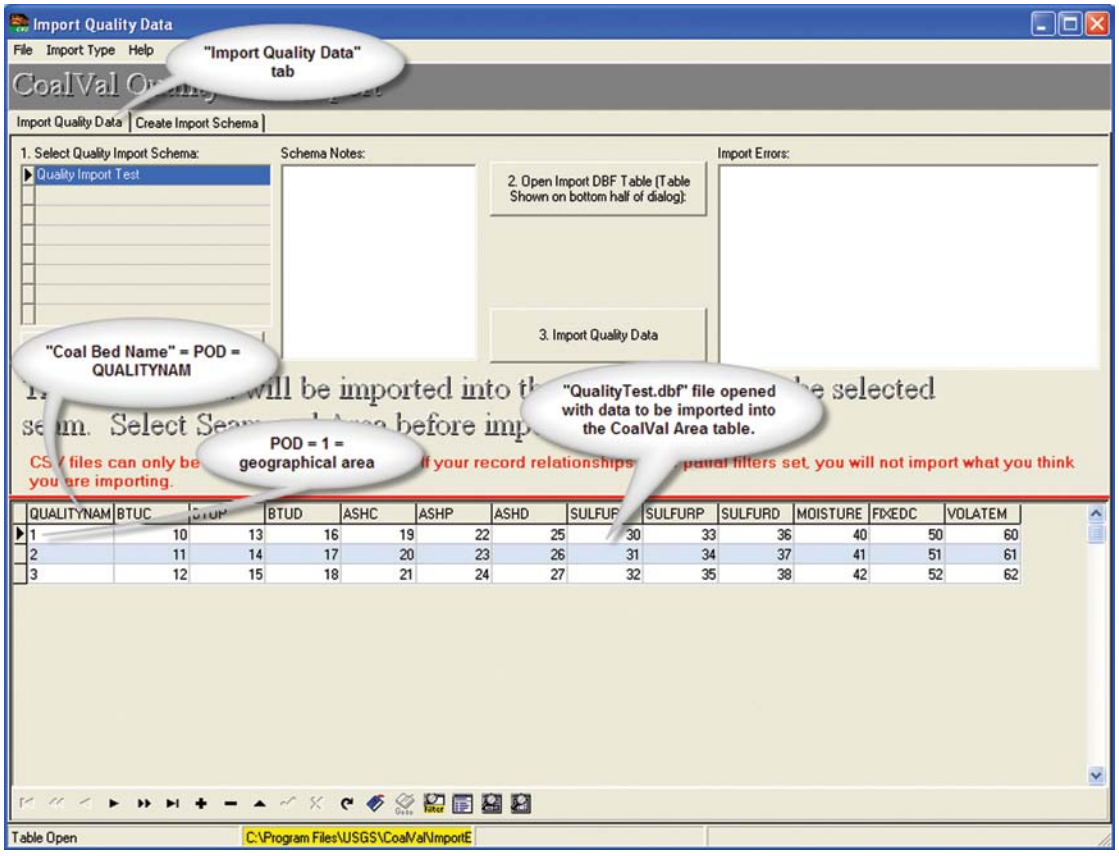


Figure B.137. Import Quality Data tab with coal-quality data ready for import into CoalVal's Coal Resource and Discounted Cash Flow Areas table under the Projects dialog window.

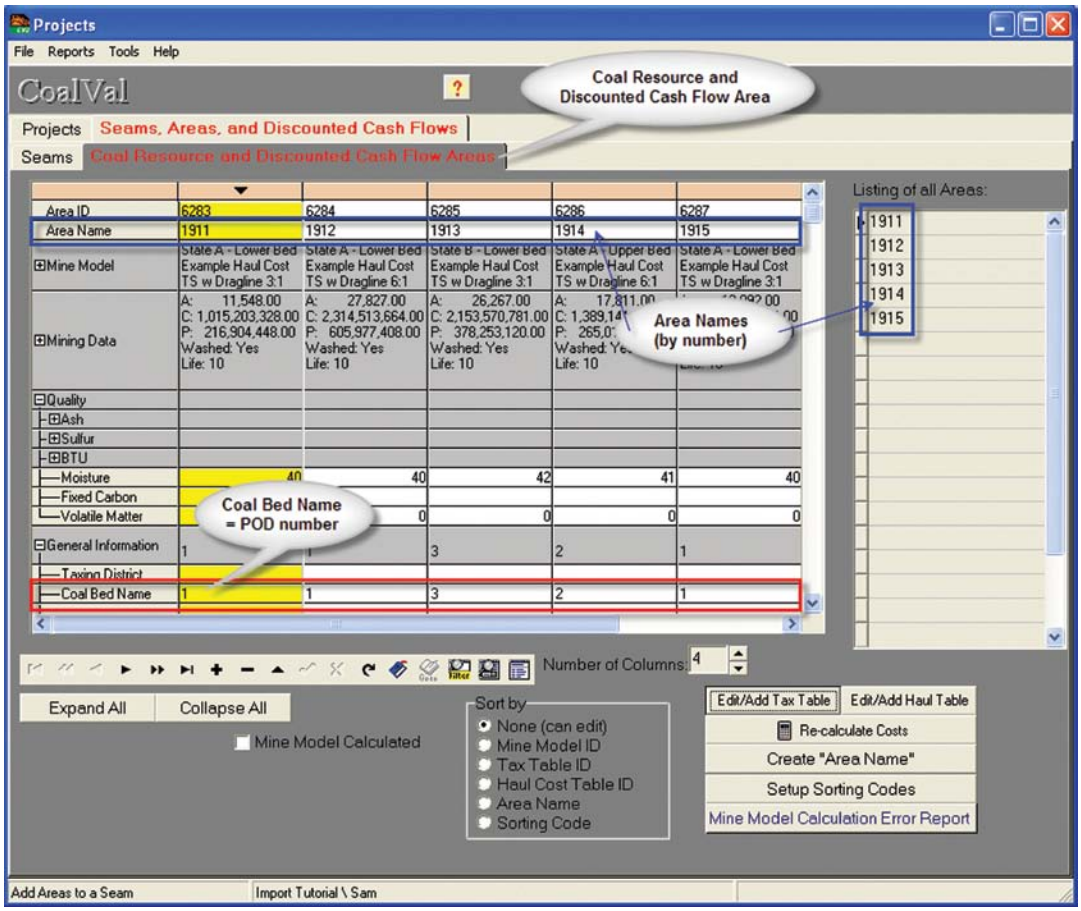


Figure B.138. CoalVal's Area table where "Coal Bed Name fields" containing the "POD" location numbers and Area IDs have been imported and will relate to the "Area field" where coal-quality data for each "POD" will be placed in the table.

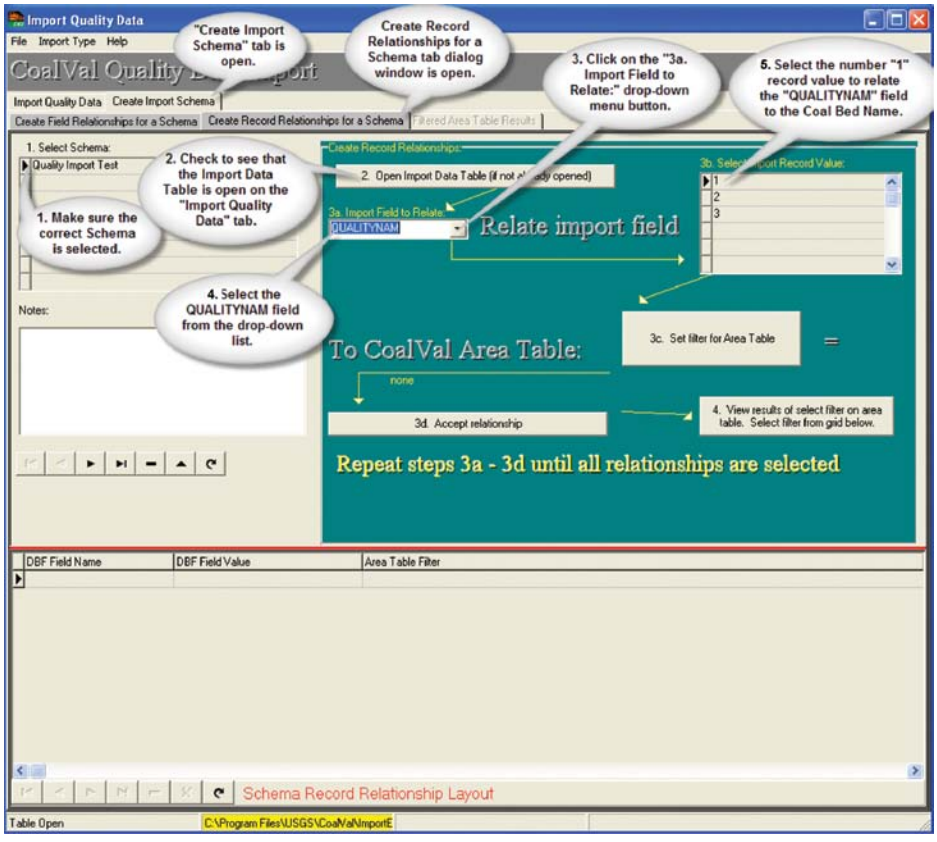


Figure B.139. Use the Create Record Relationships for a Schema by relating fields within the "Import Field" drop-down list to the "Coal Bed Names" in the "Select Import Record Value field."

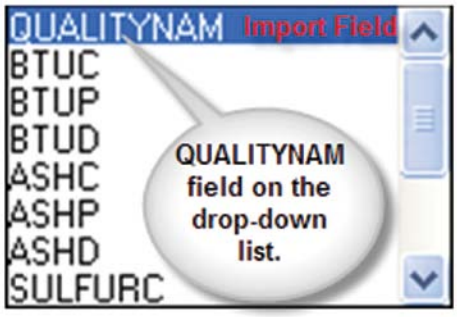


Figure B.140. Selecting the "QUALITYNAM field" from the Import Field drop-down menu under CoalVal's Create Record Relationships for a Schema tab.

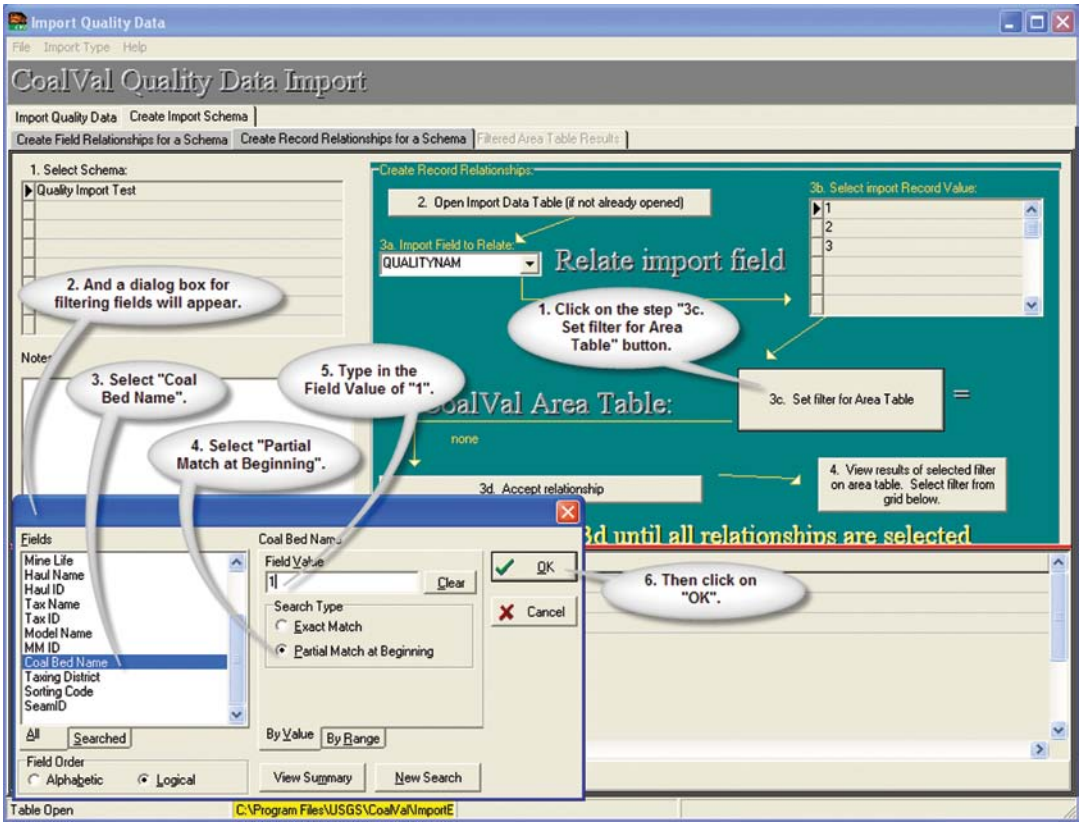


Figure B.141. Developing CoalVal's "Coal Bed Name" filter to import coal-quality data into specific area fields in the Coal Resource and Discounted Cash Flow Areas table.

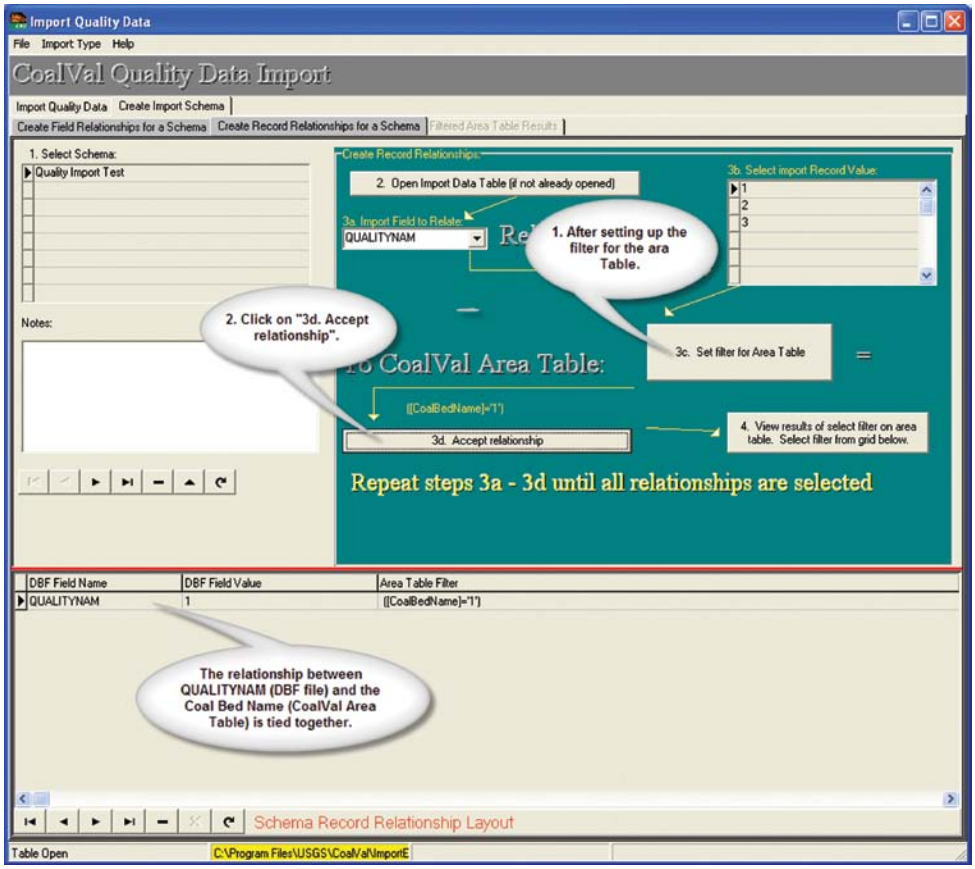


Figure B.142. Accepting the "Coal Bed Name" filtered field relationships to import coal-quality data into the Coal Resources and Discounted Cash Flow Areas.

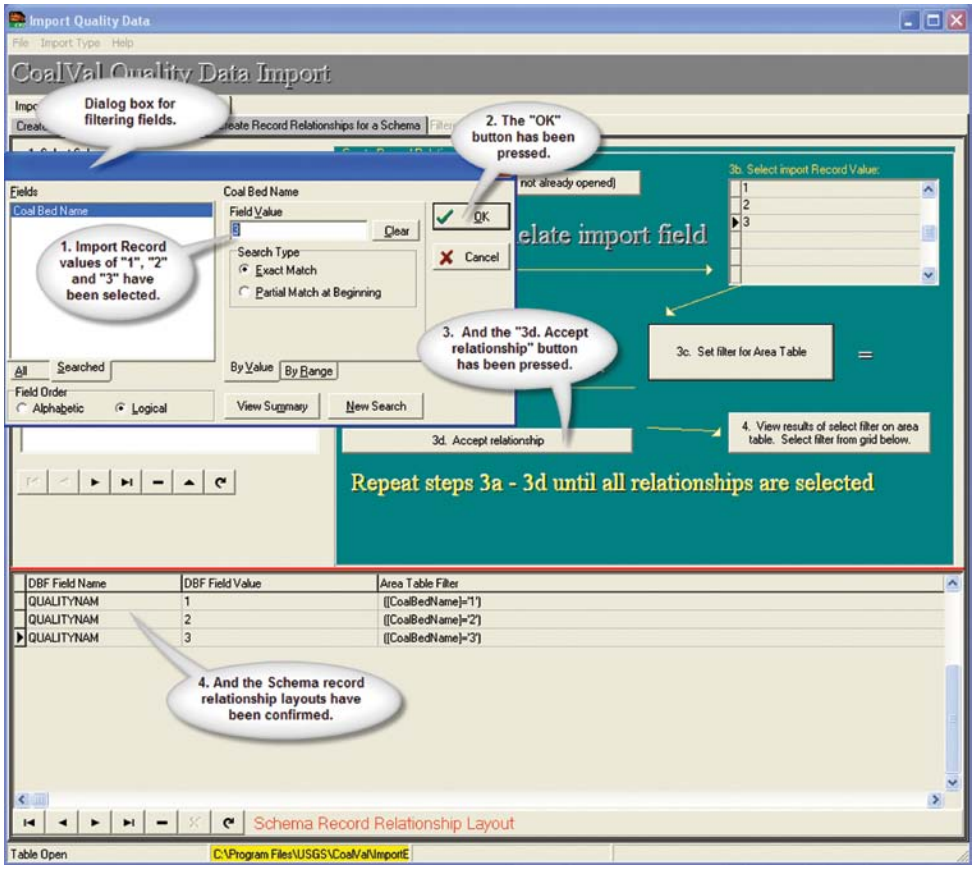


Figure B.143. CoalVal's Create Record Relationships for a Schema tab showing that the relationships for all filtered records have been accepted and the layouts have been confirmed.

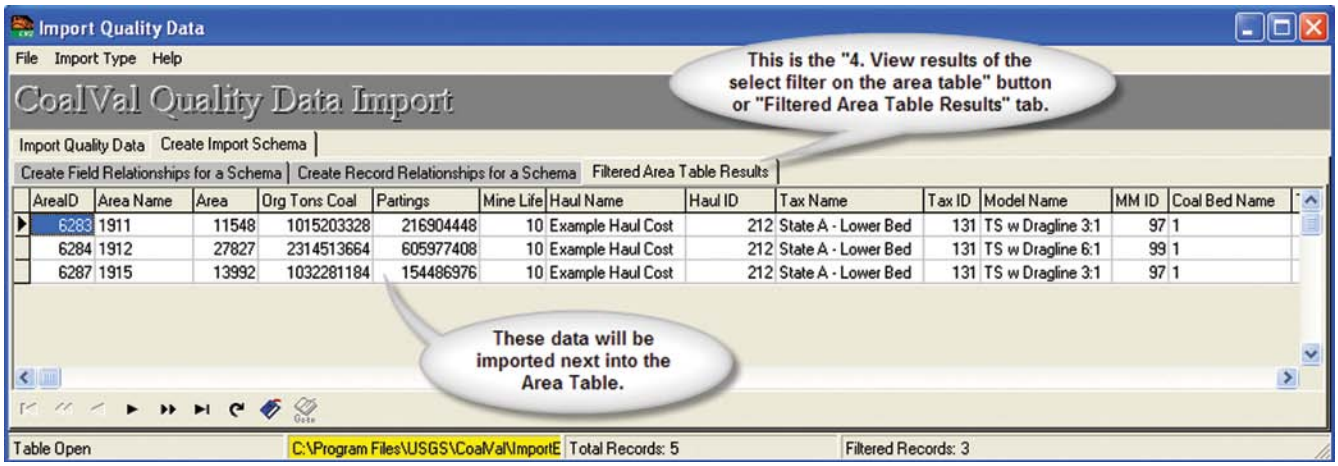


Figure B.144. CoalVal's "Filtered Area Table Results" is a result of selecting the number "4. View results of the select filter on area table" from the preceding figure. These data are ready to be imported into the Coal Resource and Discounted Cash Flow Areas table in the Projects dialog.

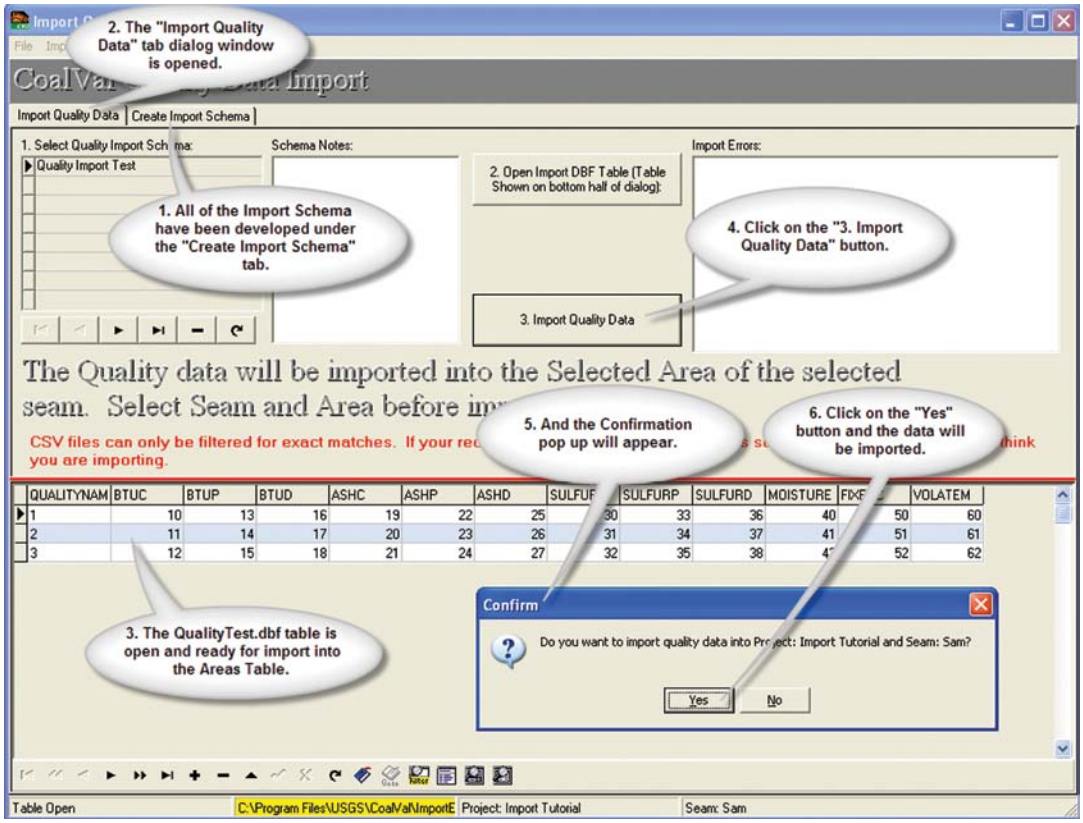


Figure B.145. Importing and confirming the import of coal-quality data from a DBF table into CoalVal's Coal Resource and Discounted Cash Flows Areas table.

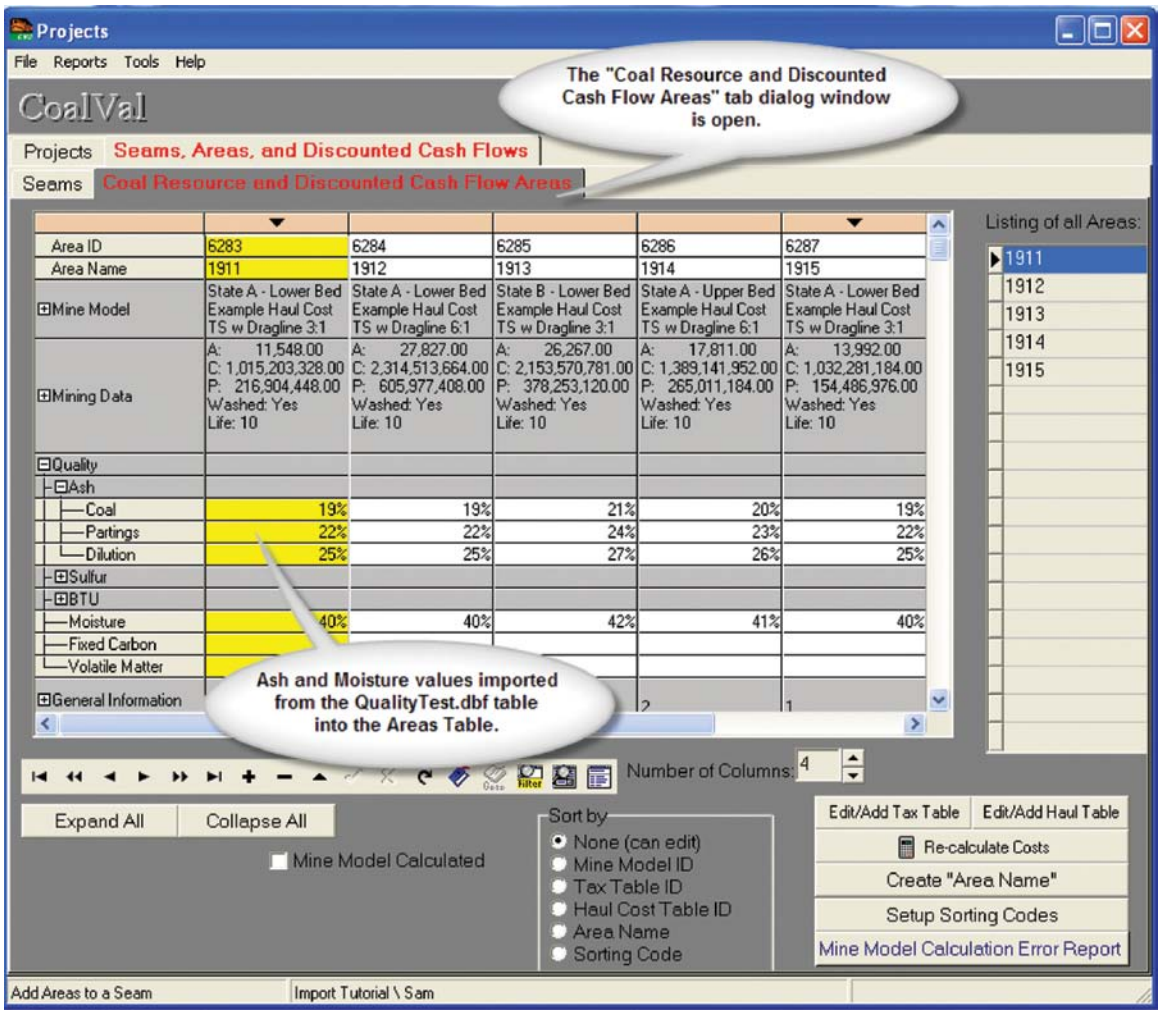


Figure B.146. Results of importing coal-quality data into the Coal Resource and Discounted Cash Flow Areas table.

Appendix C

Contents

Figures

Tables

Program Description

Dialog Window Management and Personal Computer Requirements

CoalVal requires a Microsoft (MS) Windows® 98 or Windows® XP operating system and a minimum of 1 gigabyte of RAM (random access memory) memory to perform operations. It will not operate on MS Vista®, Windows® 7, or Macintosh® operating systems. It is recommended that the user first completely review appendix C, CoalVal Project Tutorials, before continuing with this chapter of program description. Appendix C was designed to allow the first-time user (or as a review for the experienced user) to progress step by step through the CoalVal program. The Program Description chapter assumes that the user has a working knowledge of CoalVal and, therefore, some steps in the process have been omitted or the figures indicate only a general methodology and then get the user into more detailed items in the CoalVal program.

Prior to reviewing the operation of CoalVal, it will be necessary to review basic CoalVal dialog or window management. CoalVal requires a computer screen resolution of at least 800 pixels by 600 pixels. If the resolution is less than 800 x 600 pixels a portion of the information on the dialog window will not be shown. The screen resolution can be changed by right-clicking in an unused portion of the desktop and selecting the Properties item and then the Settings item in the pop-up menu bar (fig. C.1). The resolution can also be set by the following sequence: *click* on the START button on the task bar, *select* the Settings item, *select* the Control Panel item, *and then select* the Display icon. When the Display dialog window is displayed, *click on the* Settings tab and the dialog window view will be displayed. *Click on the slide tab in the screen area and advance it until the desired resolution is reached*.

A dialog window is defined as any CoalVal window. The Main CoalVal Menu dialog window is shown in figure C.2 and is displayed when CoalVal is started. All CoalVal dialog windows have the property to remember the size and screen location between CoalVal sessions.

When a dialog window is first accessed, its size or screen location may not be in a convenient location. CoalVal dialog windows can be moved or resized like any window on a computer using a PC Windows® platform. On occasion the dialog window may not show all the information available. CoalVal windows have a "+" symbol in the lower right corner of the dialog window and, if it is visible, it indicates that all information on that dialog window is displayed. If the "+" symbol is not visible in the dialog window, as in figure C.3, resize the dialog window until the "+" appears (fig. C.4), and the entire window will be viewed. After resizing the dialog window, so the "+" is visible, it is evident that the "Navigation Bar" was hidden.

CoalVal Installation Instructions

CoalVal requires the computer's Administrator to install the program. Run CoalVal version 2.14.66nx program and install CoalVal on the PC's hard drive. Notice that the program executable file and icon file are installed under: C:\Program Files\USGS\CoalValnx, but the CoalVal program file folders were installed in the My Documents Folder: C:\Documents and Settings\(your file name)\My Documents\ CoalVal. The CoalVal user can now access all CoalVal databases and modify them as needed rather than needing the Administrator to access the files. There are also several Application files that run the CoalVal program. These are found in C:\Documents and Settings\(All Users)\Application Data\SlickRockSoftwareDesign\CoalVal. When the CoalVal Program is uninstalled these files will continue to reside in there folders; however, they will not interfere with a CoalVal reinstallation.

The occasion may arise where a user has a pre-CoalVal version 2.14.66nx database that requires conversion from CoalVal version 2.14.46 or earlier, which used the Borland database manager. If the database was from a CoalVal version earlier than 2.14.46, that database must be updated to version 2.14.46 before attempting to convert to the new CoalValnx, version 2.14.66nx. The following steps (for USGS staff only) are used to convert CoalVal, version 2.14.46 files (prior to September 17, 2009) to CoalVal 2.14.66nx files.

1. A copy of CoalVal 2.14.46 (using the Borland database manager—BDE) must be maintained until all of the older databases have been upgraded to CoalVal version 2.14.46. This text describes the conversion technique from CoalVal version 2.14.46BDE to CoalVal version 2.14.66nx.

2. Install CoalVal version 2.14.66nx on the same PC as the older version, CoalVal 2.14.46 resides.

3. Converting the old CoalVal v.2.14.46 BDE databases to the new CoalVal v.2.14.66nx format requires the CoalVal BDE Program (v2.14.46) to be open. *Open the BDE to NX Converter Program by double clicking on the BDEtoNexus.exe program file*. Directions for using the program are found on the program dialog window. Other databases that are not NX CoalVal databases but reside in the old CoalVal 2.14.46 program automatically will be shown in the list of Database Names along with their Database Path.

4. *Select a database to be updated and then enter the new name of the NX database in box #2* (or leave the Database Name the same). The path to the new database will be shown in the yellow highlight area under: Path to new NX formatted database. *Then*

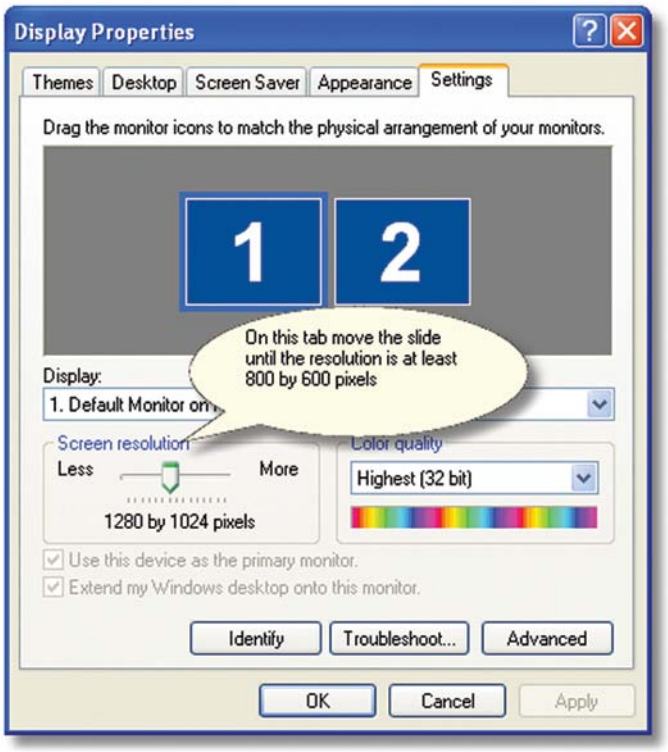


Figure C.1. Microsoft Display Screen window and properties.

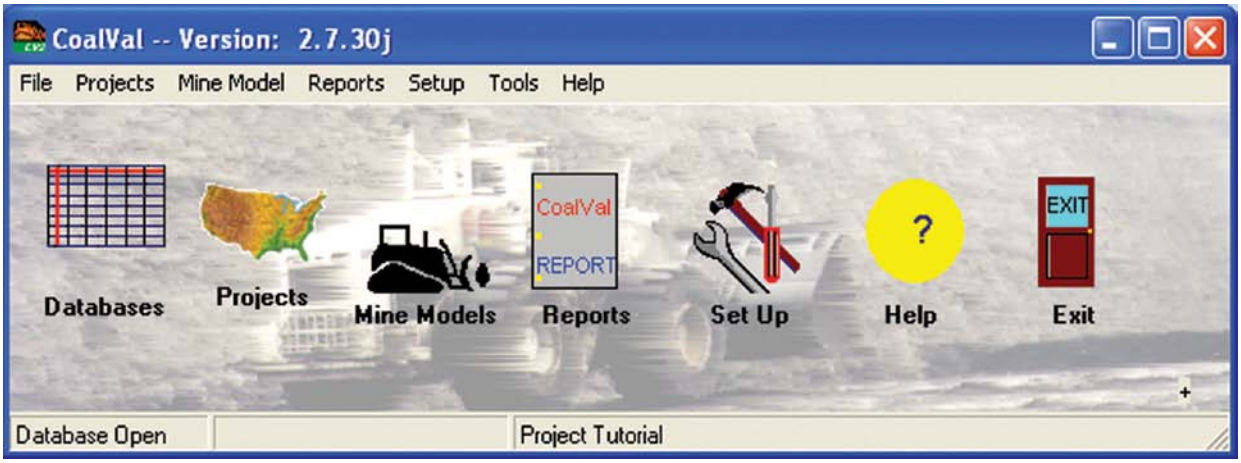


Figure C.2. CoalVal's Main Menu dialog window.

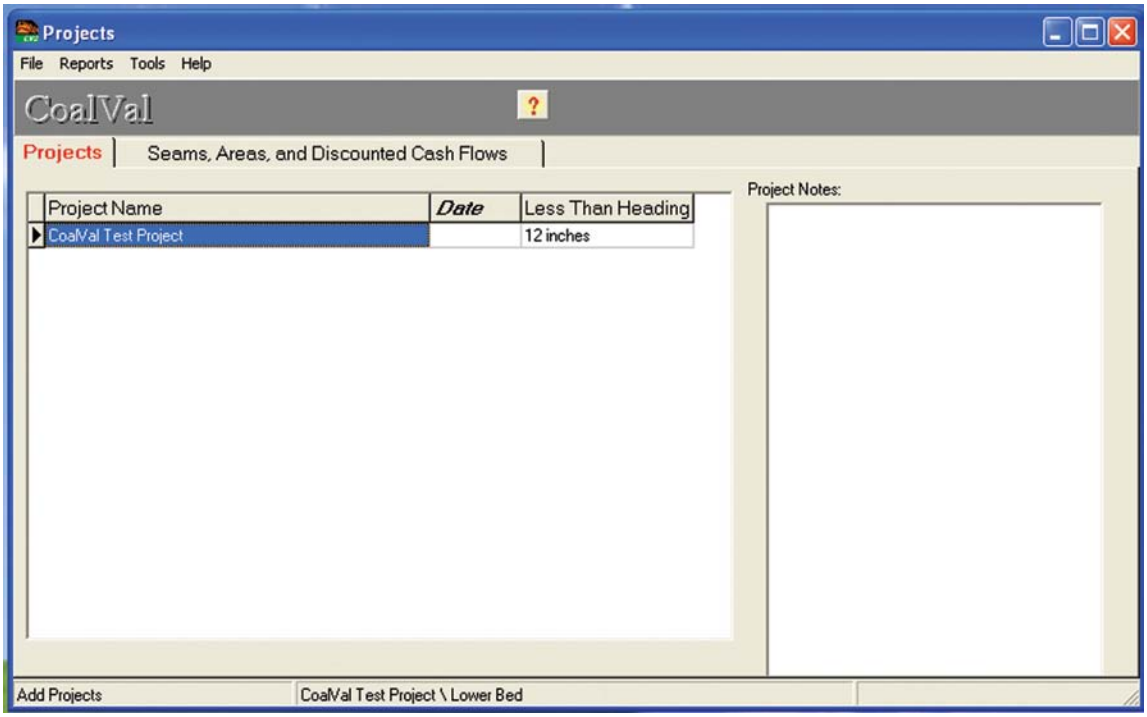


Figure C.3. CoalVal's Projects dialog window with "+" not visible.

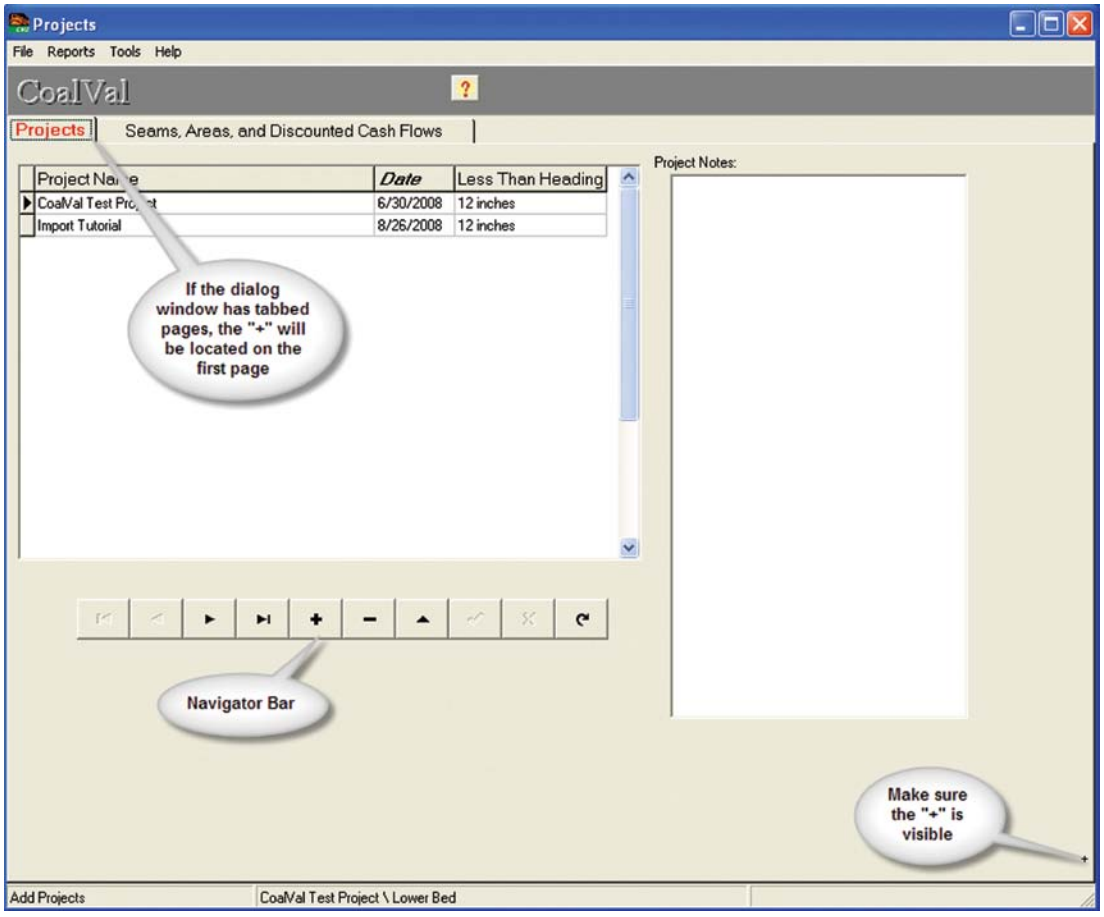


Figure C.4. CoalVal's Projects dialog window with the plus sign and Navigation Bar visible.

select the #4. Convert BDE to NX button and the new database will show up in the CoalValnx Databases dialog area. If an error message: "No Tables to input" is observed, *click on another database in the* "Non NX CoalVal Databases:" listing and *then click on the "4. Convert BDE to NX" button."* The green database in the activity lines on the left side bottom of the dialog window will show the conversion activity. *Now go back to the original database that gave the error message* and it too will convert to the NX format.

4. *Open CoalVal, version 2.14.66nx and click on a Database Name*. An Error Message will appear saying: "1. Data Table could not be opened—MineDataMMTT. *Try using the Restructure Tool* under the Tools menu on this Database page." Follow the instructions and *click on Tools*. Then *click on Restructure Update Database*. CoalVal will complete the restructuring and ask if you want to replace the existing file. *Click on yes* and the new program and new database are now compatible and may be used for coal resource evaluation.

Using the Main Menu Bar

When CoalVal is first started, a portion of the **Main Menu Bar** is the first dialog window to be displayed (fig. C.5). The "+" sign, visible in the lower right-hand corner, indicates that all the information is displayed in the dialog window. There are two parts to this dialog: the **Menu Items Bar** and the **Menu Icons Bar** below the **Menu Items** (fig. C.5). Some of the **Menu Items** (fig. C.6) share the same name as the **Menu Icons**. The **Menu Items** are shown on the following list and the associated definitions can be found in the Glossary of Terms in appendix E.

The **Main Menu Bar** of CoalVal contains seven items and seven icons. Those items and icons are listed here:

Main Menu Bar items:	**Main Menu** icons
1**. Files**	1. **Databases**
2. **Projects**	2. **Projects**
3. **Mine Models**	3. **Mine Models**
4. **Reports**	4. **Reports**
5. **Setup**	5. **Setup**
6. **Tools**	6. **Help**
7. **Help**	7. **Exit**

Those that have identical listings contain identical options. The **Databases** and **Exit Icons** are found only with the **Main Menu Icons,** and **Files** and **Tools** are found only on the **Main Menu Items**.

The **Database** dialog window can be opened only as an individual page. Four of the other main CoalVal **Menu Icons** or main dialog windows (**Projects**, **Mine Models**, **Reports,** and **Setup**) can be opened at the same time. The four main dialog windows shown in figure C.7 were opened at the same time. *Click on the menu item or menu icon and* one window *will open. Click on another item or icon and* another window *will open.* To switch between windows, either *click on the window, click on the menu icon, or menu item.* It is not necessary to close all the main windows to exit CoalVal. The **Exit Icon** or close window button [x] in the upper right corner of the **Main Menu Bar** will provide a single-click exit**.**

CoalVal Databases

When CoalVal is first started there are only three active buttons on CoalVal's Main Menu, **Databases**, **Help**, and **Exit** (fig. C.8). In CoalVal the user can create as many databases as wanted and the CoalVal **Databases** dialog is used to select, create, or delete databases. When the **Databases Icon** on the **Main Menu** dialog is selected the CoalVal **Databases** dialog will open. The first time the **Database** dialog window is opened it will look like figure C.9. The **Database** dialog lists the databases that have been created or added to CoalVal. To use a database, *click on the **Database Name** in the list, and either click the **Open File** button in the menu icons or the **Open Selected Database** menu item under the **File** menu.* If there are no databases listed, the user will have to either add an existing database to the list or create a new one. Those directions are reviewed in the following sections.

Adding an Existing Database to CoalVal

An existing database can be added to the list of **Database Names** (fig. C.10) if it resides on the PC and has a known file path. *Click the: **Add Existing Database to List** button* (third button from the upper left corner of the **Databases** dialog, item 1 in fig. C.10) *or click the: **Add Existing Database to List** menu item under the **File** menu, and a dialog window will open under the database list area of the window* (item 2 in fig. C.10). First, *create a name for the database that will be added to CoalVal* (item 2 in fig. C.10); *then click the: "2. Click to set Database Path" button.* When clicked, a dialog, "Select Directory" will open allowing for the selection of the database path, (item 3 in fig. C.10). *Navigate to the location of the database* (item 4, fig. C.10) *and select the database. Double click on the database file* (item 5, fig. C.10) *and click on the OK button to accept the new database* (item 6, fig. C.10). When these steps are completed, *click the button labeled*: *"3. Add Database to Database of Databases"* (item 7, fig. C.10). Figure C.11 shows the result of adding the Project Tutorial database to the **Database** dialog. To use this database *click on Project Tutorial under the **Database Name** list on the **Databases** dialog window and click the **Open File** button* (first icon on the left side of the icon line) *or the*: ***Open Selected Database** menu item under the **File** menu.*

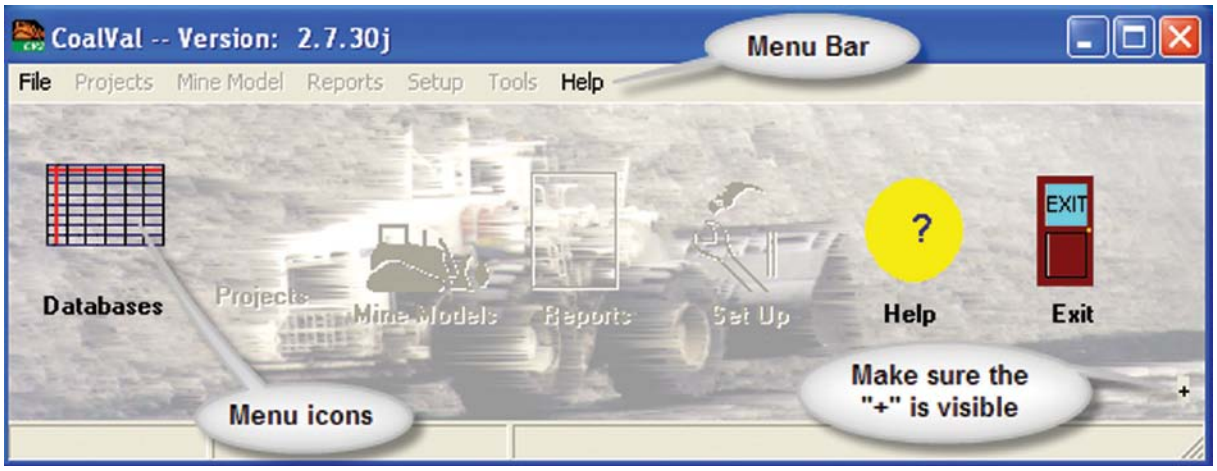


Figure C.5. CoalVal's Main Menu bar with menu items and menu icons at Program Start-Up.

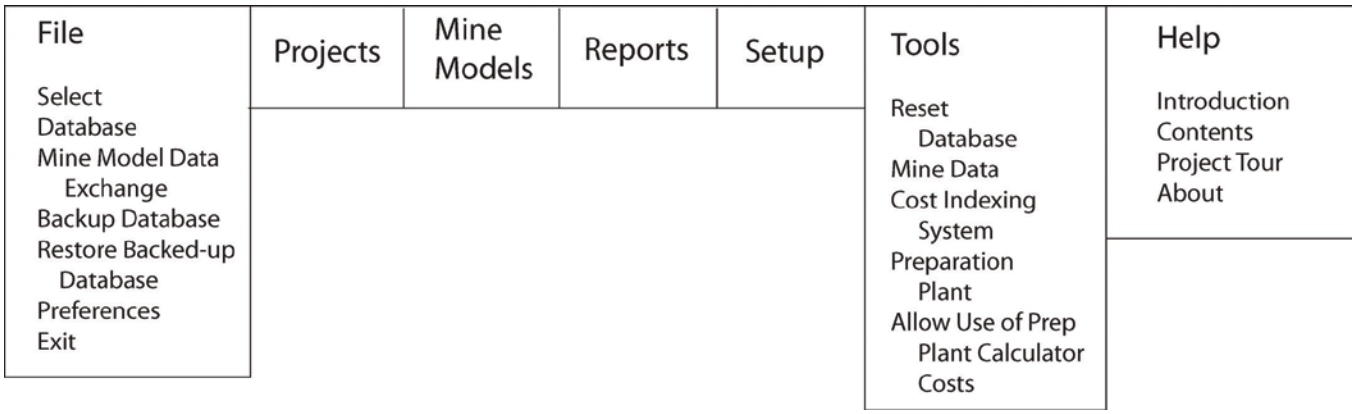


Figure C.6. CoalVal's Main Menu bar drop-down menus.

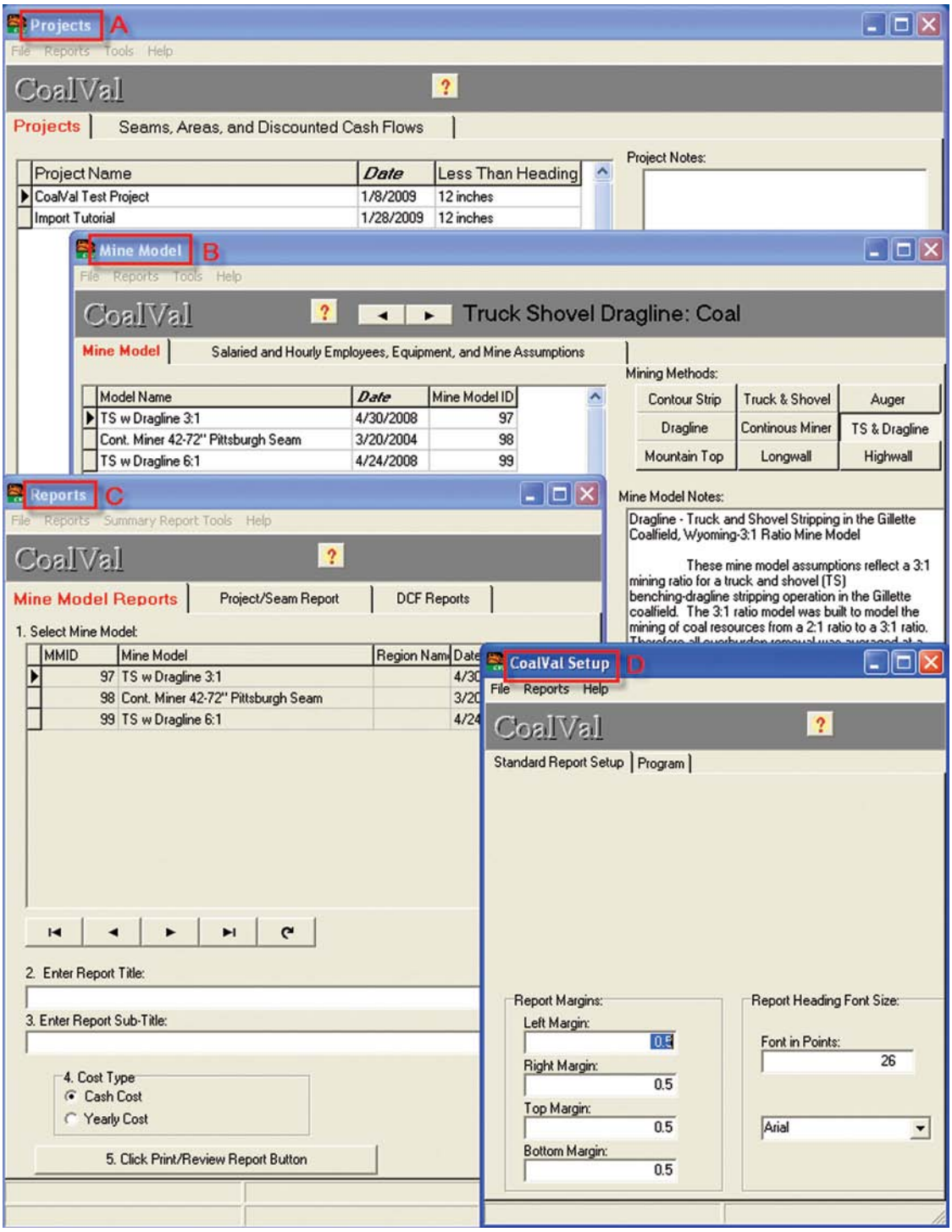


Figure C.7. Four of CoalVal's main dialog windows showing multiple openings: (A) Projects window, (B) Mine Model window, (C) Reports window, and (D) CoalVal's Setup window.

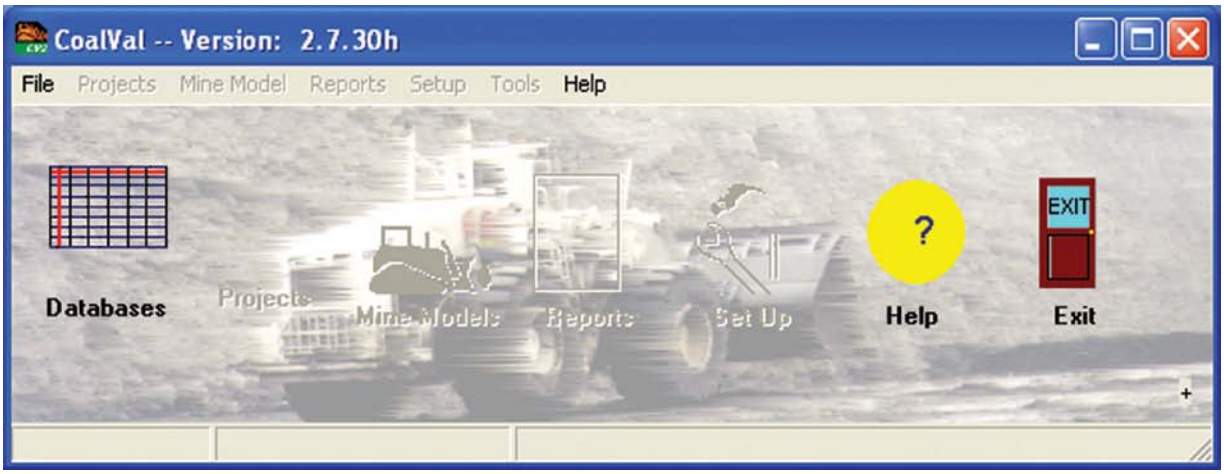


Figure C.8. CoalVal's Main Menu at program start-up.

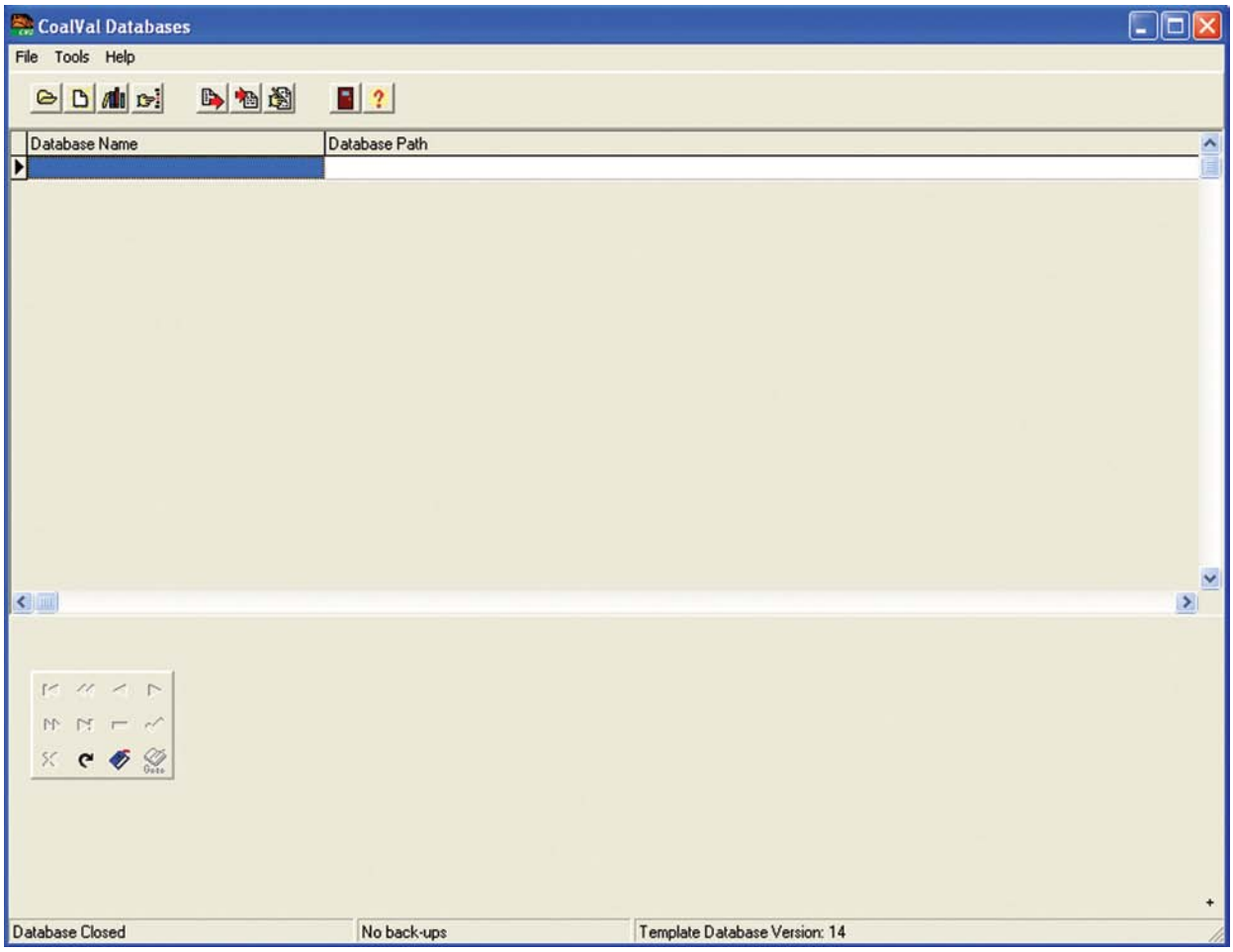


Figure C.9. CoalVal Databases dialog window when opened for the first time.

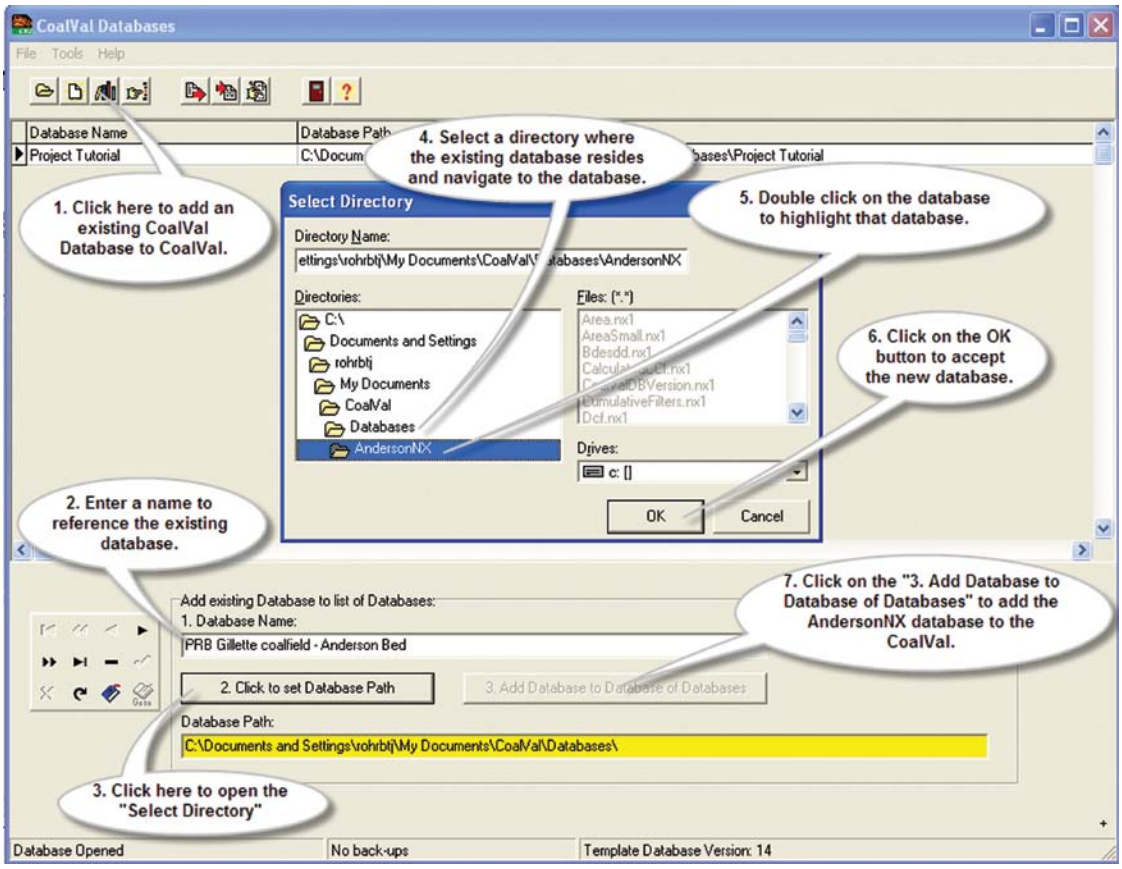


Figure C.10. CoalVal Databases dialog window showing explanations for adding a database.

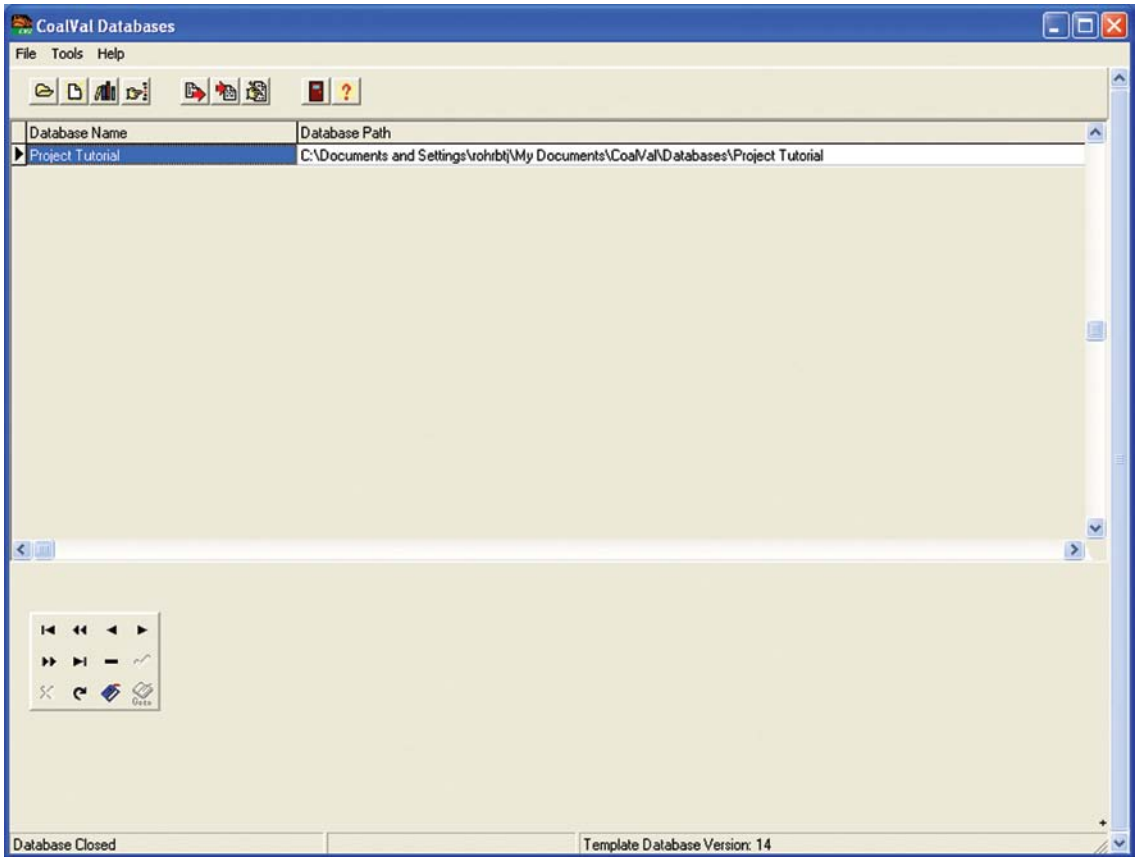


Figure C.11. CoalVal Databases dialog window showing the Project Tutorial database added to the CoalVal Database dialog.

Creating a New Database

This routine allows the user to develop a new database in the CoalVal program. Figure C.11 shows the CoalVal **Database** dialog window at the start to creating a new database. To create a new database, *click the:* ***Create New Database*** *button* (located second from the left in the upper left corner) *or click on the:* ***Create New CoalVal Database*** *menu item under the* ***File*** *menu* (item 1 in fig. C.12). The **Create CoalVal Database** dialog window will appear under the database list area of the window. *Enter a name for the database* (item B in fig. C.12). Next, *click the: "2. Click to set Database Path" button to open a dialog that will allow the selection of the database path* (item C in fig. C.12). Lastly, *click the third button labeled:* ***"****3. Add Database to Database of Databases"* (item D in fig. C.12). Figure C.13 shows the product of creating a new database and adding it to CoalVal's **Database** list. To use the newly created database, *select it and click the open button or click on the:* ***Open Selected Database*** *menu item under the* ***File*** *menu*.

Searching for Existing Databases

Searching for existing databases will allow a user to search a computer for existing CoalVal databases. When the **Find CoalVal Databases** button is selected (fig. C.14) a dialog will appear and allow the selected computer drive to be searched (fig. C.15). *Clicking the "Start Search" button will begin the search*. This search will add any databases that appear to be a CoalVal database to the **Database** list. The name of any CoalVal database found on a drive will be included in the path description. After the search, the names can be edited as desired.

The CoalVal Version Number

The CoalVal version number relates to what happens when a database is opened. If it is determined that the database structure is from an early version of the CoalVal database structure, CoalVal will attempt to update it to the version that is presently being used. If the database is not backed-up, then CoalVal will not open the database. However, after the database is backed-up CoalVal will try to update the structure. If it cannot update the database structure, CoalVal will show an error message (fig. C.16) , noting that the "Database is in the wrong version and cannot be Updated.**"** By clicking the OK button on the Error Message (fig. C.16) on the CoalVal **Databases** window dialog, a Warning dialog (fig. C.17) will list problems the user will experience if the database is not updated. After *clicking on the OK button on the Warning*

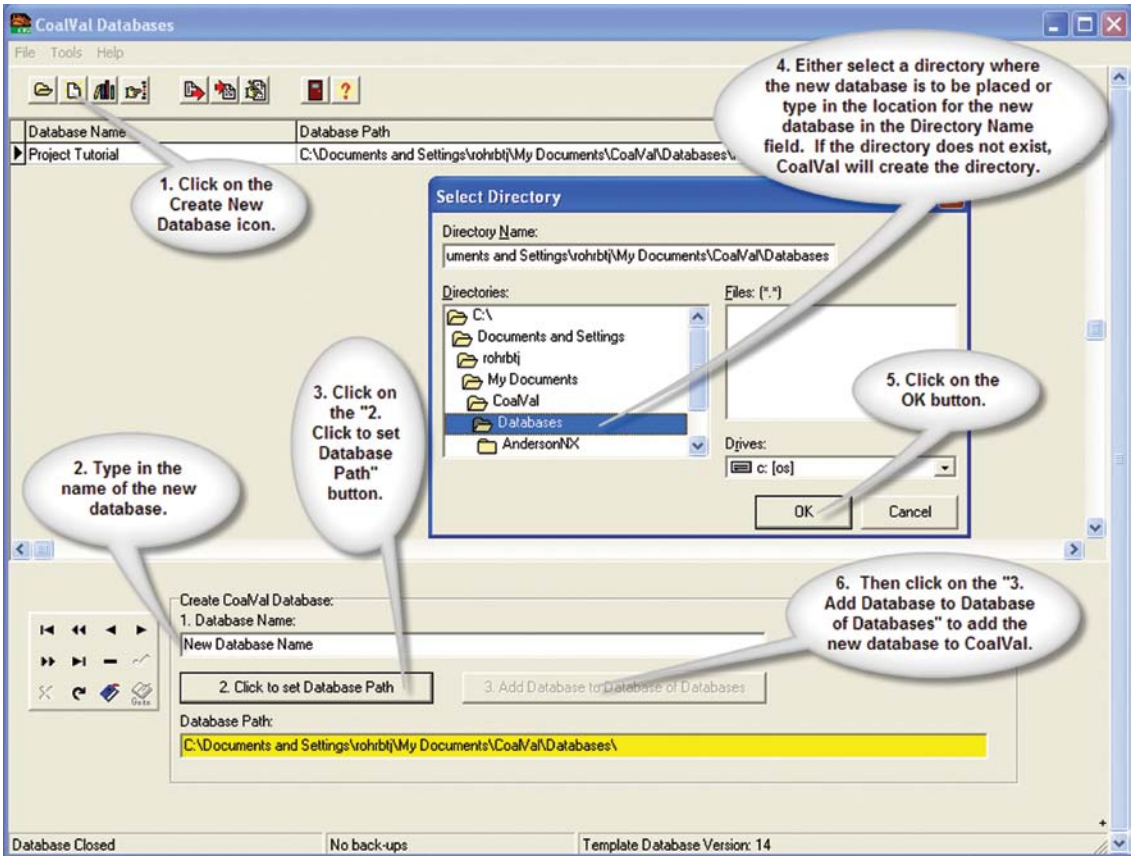


Figure C.12. CoalVal Databases window showing explanations for creating a new database.

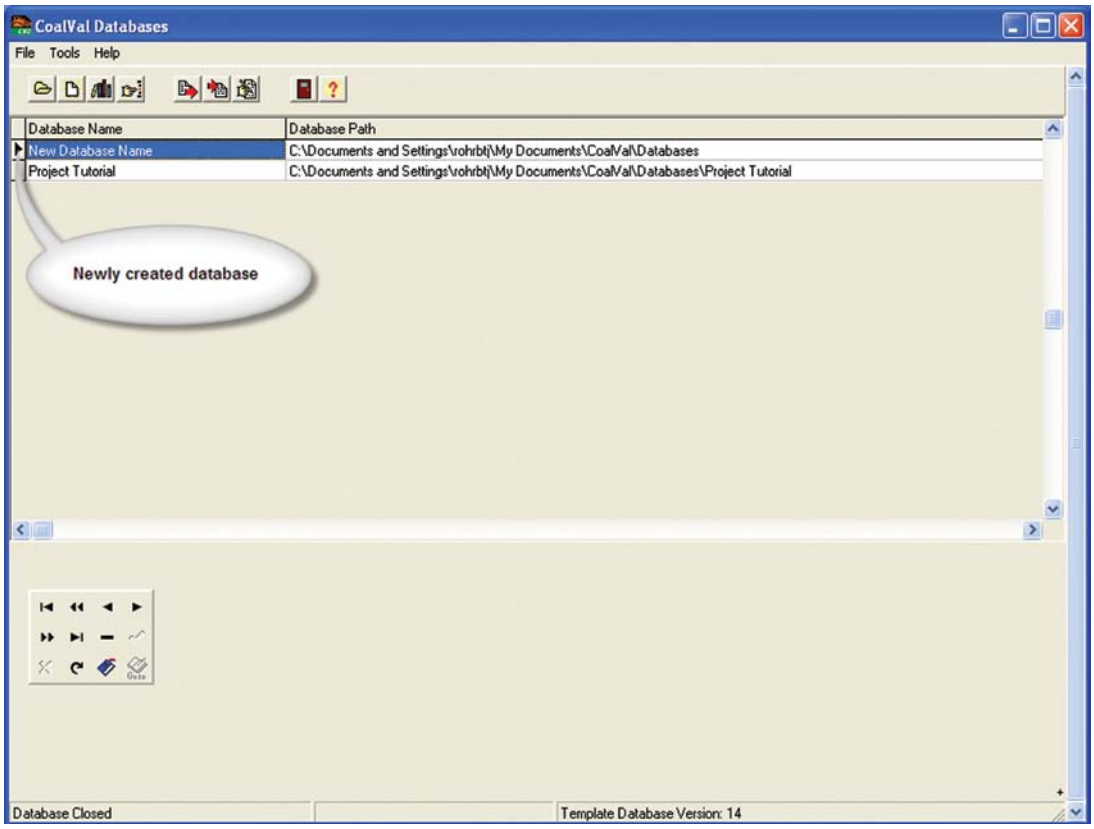


Figure C.13. CoalVal Database window showing a newly created database added to CoalVal's Database list.

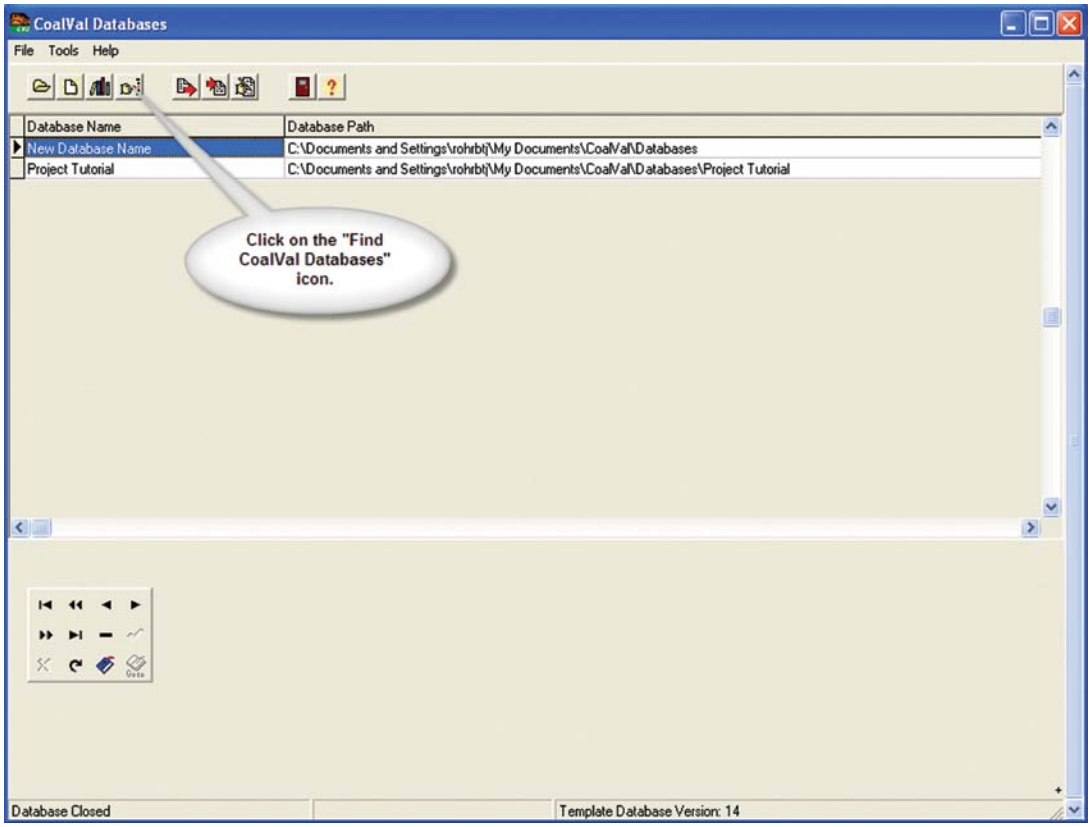


Figure C.14. CoalVal Databases dialog window showing the Find CoalVal Databases button.

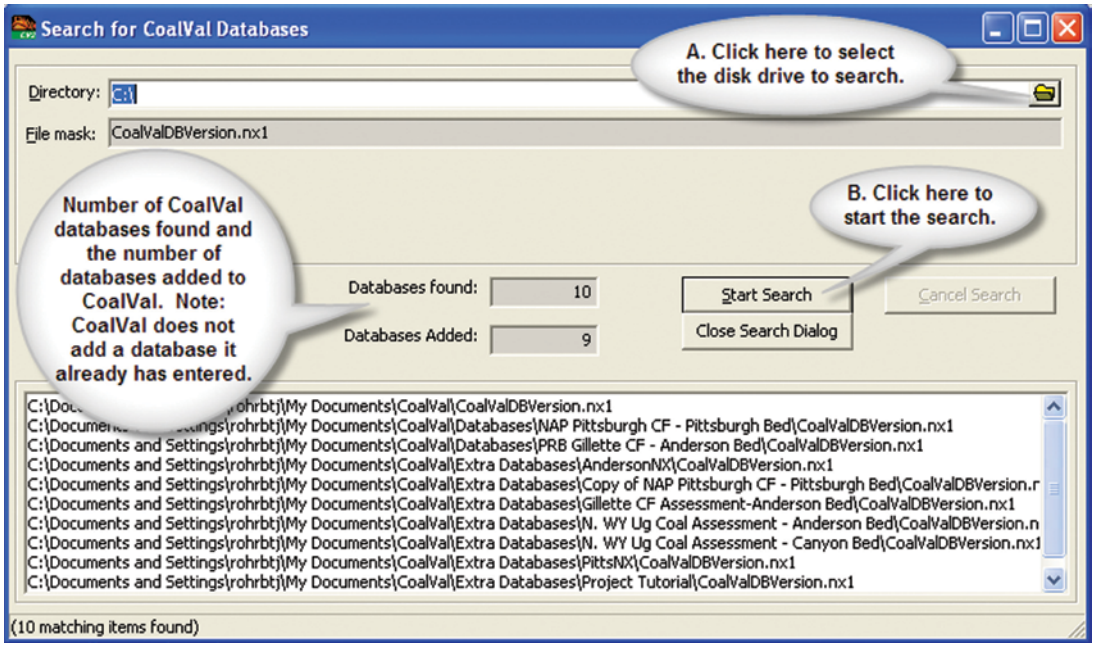


Figure C.15. CoalVal's Databases dialog window showing the dialog searching for existing databases.

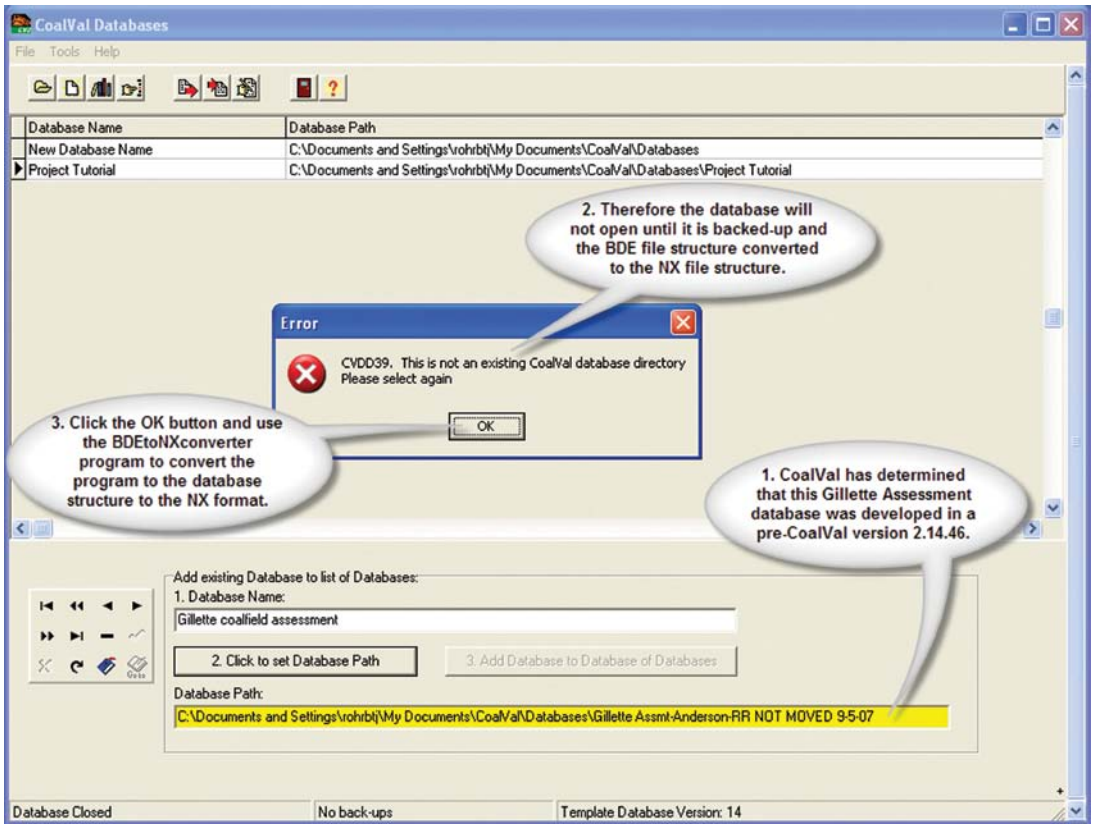


Figure C.16. Opening a database developed in an older version of CoalVal with an updated version of CoalVal.

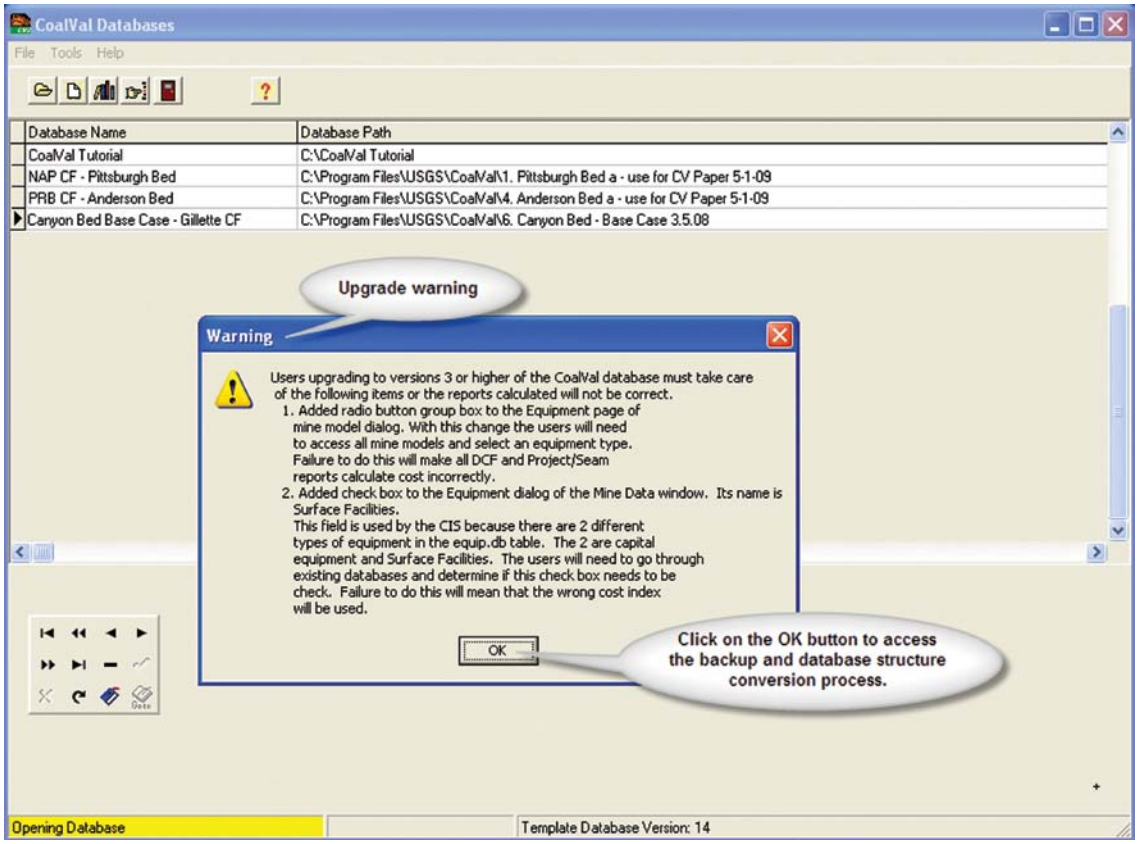


Figure C.17. Version upgrade warning.

dialog, the Copy Database Tables dialog will be shown (fig. C.18). The user must *browse to the "ReportBackup" folder in the* CoalVal program (fig. C.18), then *click on the "Back-up Data" button*. As soon as the database is backed-up and CoalVal begins the database structure update, a note in the lower left corner of the CoalVal **Databases** dialog will appear (fig. C.19). When the update is successful, the database will be opened (fig. C.20). If the update is not successful, then the CoalVal database will not open and the process must be repeated. Occasionally, an early database cannot be opened by the new version of CoalVal and the database has to be rebuilt.

The CoalVal version number is in the form of x.y.z (2.4.1). The "**x**" number is the major version number of the CoalVal programming code, the "**z**" number is the minor version of the CoalVal programming code, and the "**y**" number is the version of the database table structure. For example, if version 2.7.30 was being used and a new version of CoalVal was released with the version number of 2.7.31, then the CoalVal database currently used will not need to be updated. However, if the version number "**y**" changed to 2.8.31, then the database table structure has changed and all databases that worked with 2.7.30 will need to be updated. Also, a database with the new structure (2.8.**z**) will work with an earlier version of CoalVal (2.7.**z**).

In the 2.7.30 version as compared with the 2.8.31 version example above, the minor version number "**z**" of CoalVal changed also. The reason for the change might be that the database table structure changed and therefore the programming code would have to be modified to use the changes in the database table structure, so the minor version would also change. Also, note that the minor programming code version number will be reset to zero whenever the major version number is increased.

Repairing Corrupted Database Tables

If a database or data table becomes corrupted, the **Restructure/Update Database** routine can be used to repair the corrupted database. This routine is found by *clicking on the **Databases** icon on CoalVal's **Main Menu** (fig. C.21) to open the **CoalVal Databases** window (fig. C.22). Select the Database that needs to be repaired*, then *click on the **Tools** menu and the **Restructure/Update Database** tool will drop down (fig. C.22). Select the **Restructure/Update Database** tool* and the **Confirm File Replace** window dialog will be shown (fig. C.23). *Select the "Yes" button (fig. C.23)* and the repair routine will start. The dialog in the lower window will explain the results of restructuring the database's data tables.

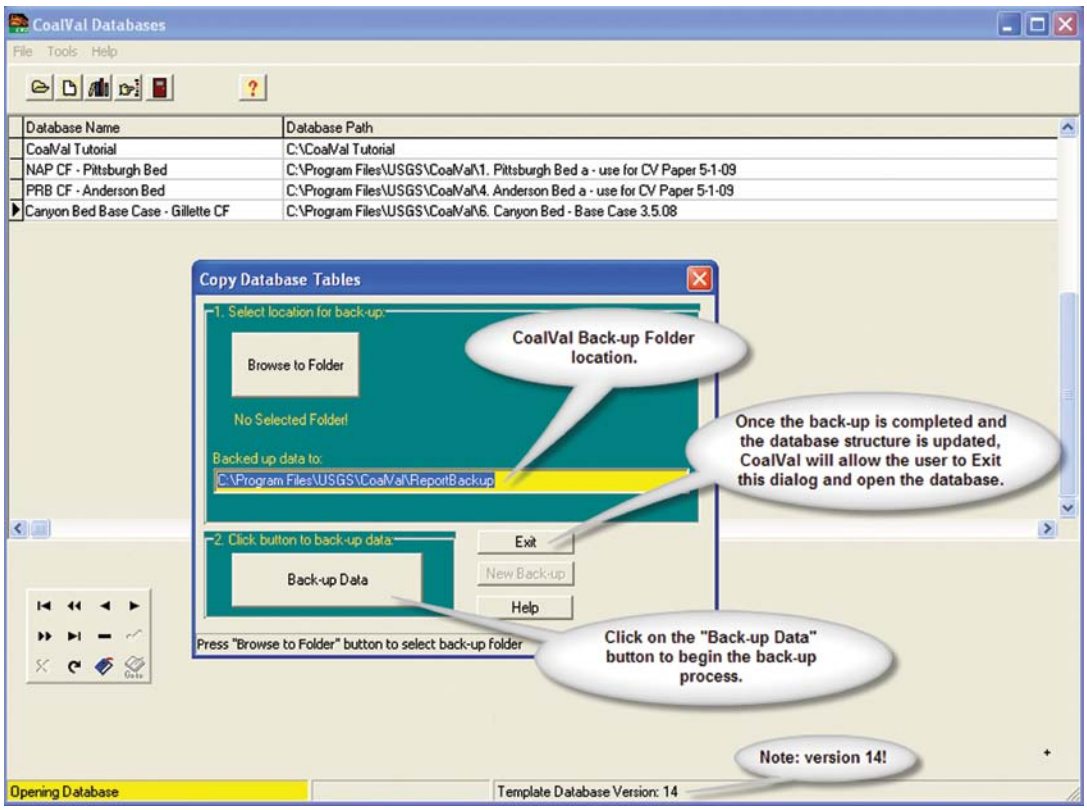


Figure C.18. Selecting the "Back-up Data" button to back-up the database and upgrade the database structure.

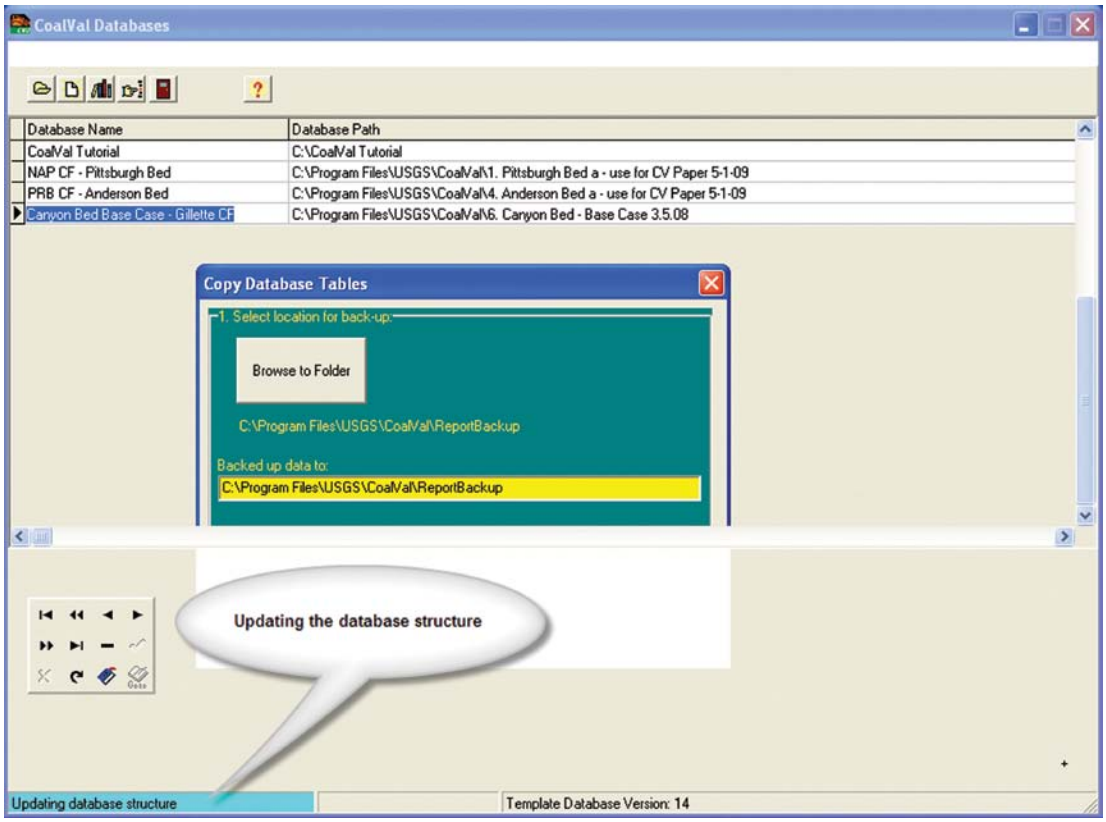


Figure C.19. Updating the database structure.

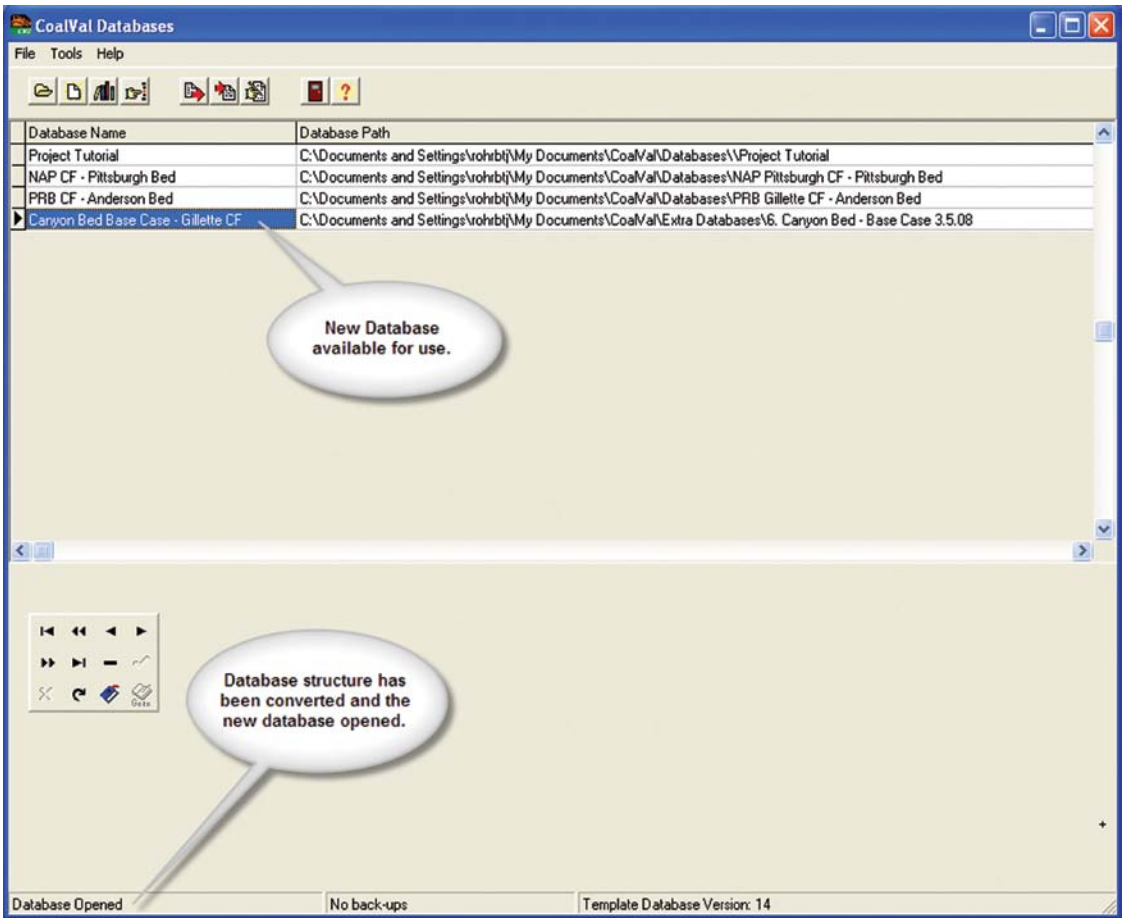


Figure C.20. The new database is now open and available for use.

Figure C.21. CoalVal's Main Menu.

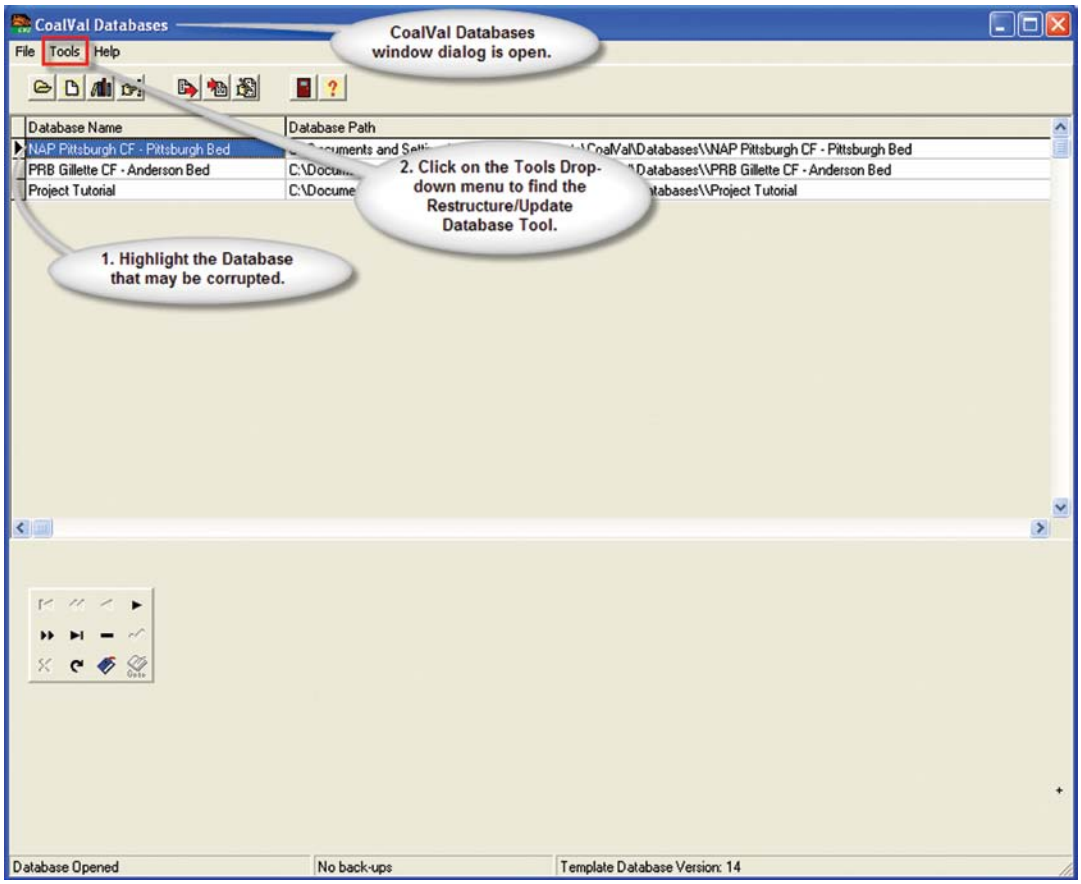


Figure C.22. CoalVal Databases window dialog with the Tools Menu.

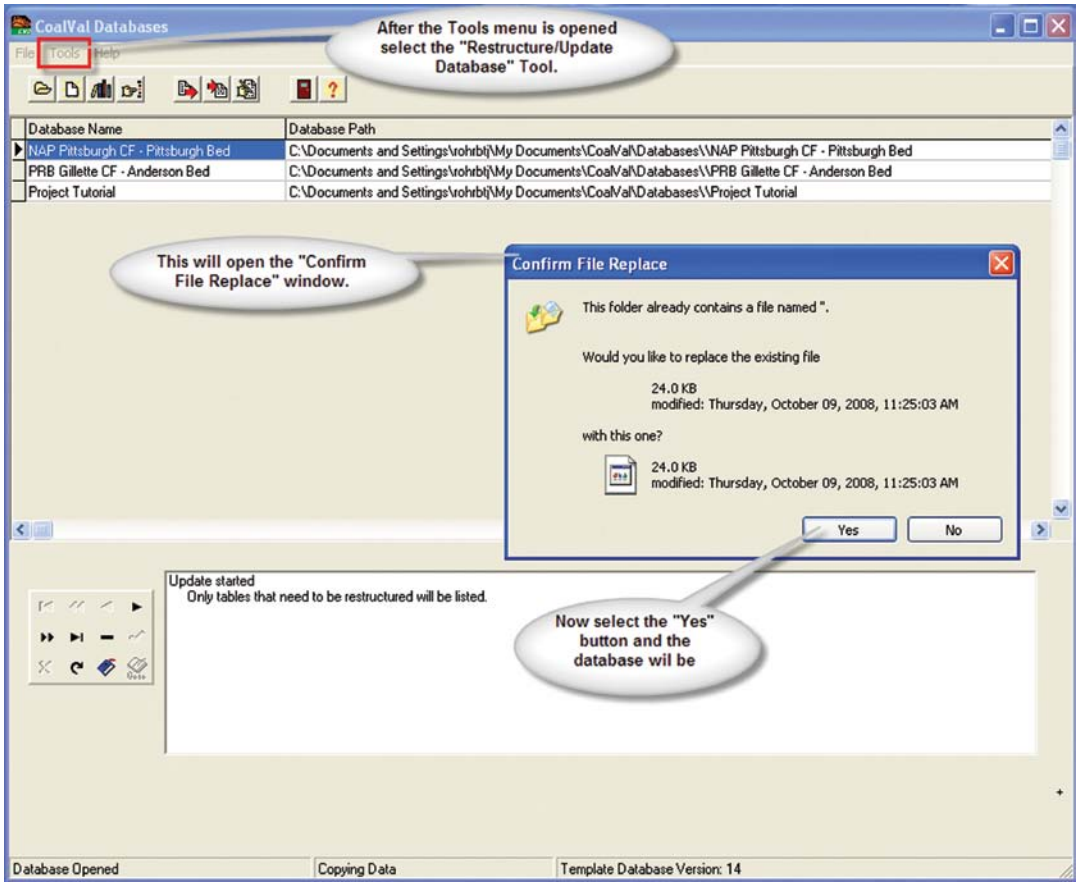


Figure C.23. Running the Restructure-Update Database Routine.

Navigation Bar

CoalVal uses a component called a Navigation Bar (fig. C.24). This bar allows inserting and editing within a data table, deleting database records, and moving the cursor from one record to another. The button's functions are shown below the button line and listed below.

1. First Record: Sets the current record to the first record in the data table, disables the First and Previous record buttons, and enables the Next and Last record buttons if they are disabled.
2. Previous Record: Sets the current record to the previous record and enables the Last and Next record Buttons if they are disabled.
3. Next Record: Sets the current record to the next record and enables the First and Previous record buttons if they are disabled.
4. Last Record: Sets the current record to the last record in the data table, disables the Next and Last record buttons, and enables First and Previous record buttons if they are disabled.
5. Insert Record: Inserts a new record at the end of the data table and changes the mode to Edit.
6. Delete Record: Deletes the current record and makes the next record the current record.
7. Edit Record: Causes the data table to be in edit mode so changes to the record can be made.
8. Post Changes: Writes any changes to the current record of the data table.
9. Cancel Changes: Cancels any modifications to a record and restores the record to its condition prior to editing. This will not undo a modification that has already been posted. It turns off the Edit mode.
10. Refresh Data: Redisplays the current record from the data table, updating the display of the current record on the screen. This button is used only when a change has been made but is not yet visible.

CoalVal Data Management

When CoalVal is started and a database is opened, all the data entered into that database is accessible. **Mine Model** data can be imported and exported to assist in updating the latest mine models. ArcView, DBF, or CSV data tables can be imported into a **Project Area**. Coal, parting, and dilution quality data can be imported into **Project Areas** from Excel workbooks by exporting the workbook in DBF or CSV format. It is recommended that CoalVal databases be backed-up to a folder or removable medium to eliminate potential data loss due to hardware problems or user mistakes.

Setup

Standard Report Setup

The opening window of the **Setup** dialog is the **Standard Report Setup** dialog window (fig. C.25). The report margins, font, and font size of the titles may be changed in this dialog.

Program

The **Program** window has three options. The first option determines the placement of the **Main Menu Bar** on top of or under all other windows. If it is desirable to leave the **Main Menu Bar** on the top of all other windows, check the box. The next option allows for backing-up a database before calculating a report. The third option allows the user to set a preparation plant base cost.

Coal Washing

CoalVal handles coal washing in two ways on the **Mine Model Assumptions** menu: (1) the default costs may be used, or (2) the user may input costs developed elsewhere. A preparation plant design and costing routine will be available in a later publication. Coal recovery rates, both from mining and from washing, are needed on the **Mine Model Assumptions** menu. If the coal is not washed, a wash recovery of 100 percent must be entered.

Cost Indexing System

To access CoalVal's **Cost Indexing System** (fig. C.26) *click on the **Tools** item from the **Main Menu** window**,** then click **Cost Indexing System** menu item*. The **Cost Indexing System** (CIS) allows the base prices that have been entered into the lookup tables (see Look-up Tables under the CoalVal Concepts section) to be indexed by the CIS giving an estimate of yearly price changes simply by entering Producer Price Indexes (PPI) from the Bureau of Labor Statistics (U.S. Department of Labor, Bureau of Labor Statistics, 2008 (*www.bls.gov/PPI*). This window has two tabs: (1) **Producer Price Index** and (2) **Calculated Cost Category Items**. To enter producer price indexes *select the **Producer Price Index** tab*. This dialog has two sections. The left section is a listing of the "CoalVal Cost Category Items" and the right section is where the "Producer Price Indexes" are entered. *First select a "CoalVal Cost Category Item"; then enter a "PPI Name**"** followed by "Beginning Year**"** (as a date), "Beginning (PPI) Value," "Ending Year" (as a date), "Ending (PPI) Value," and a "PPI*

Figure C.24. Details of CoalVal's Projects - Navigation Bar.

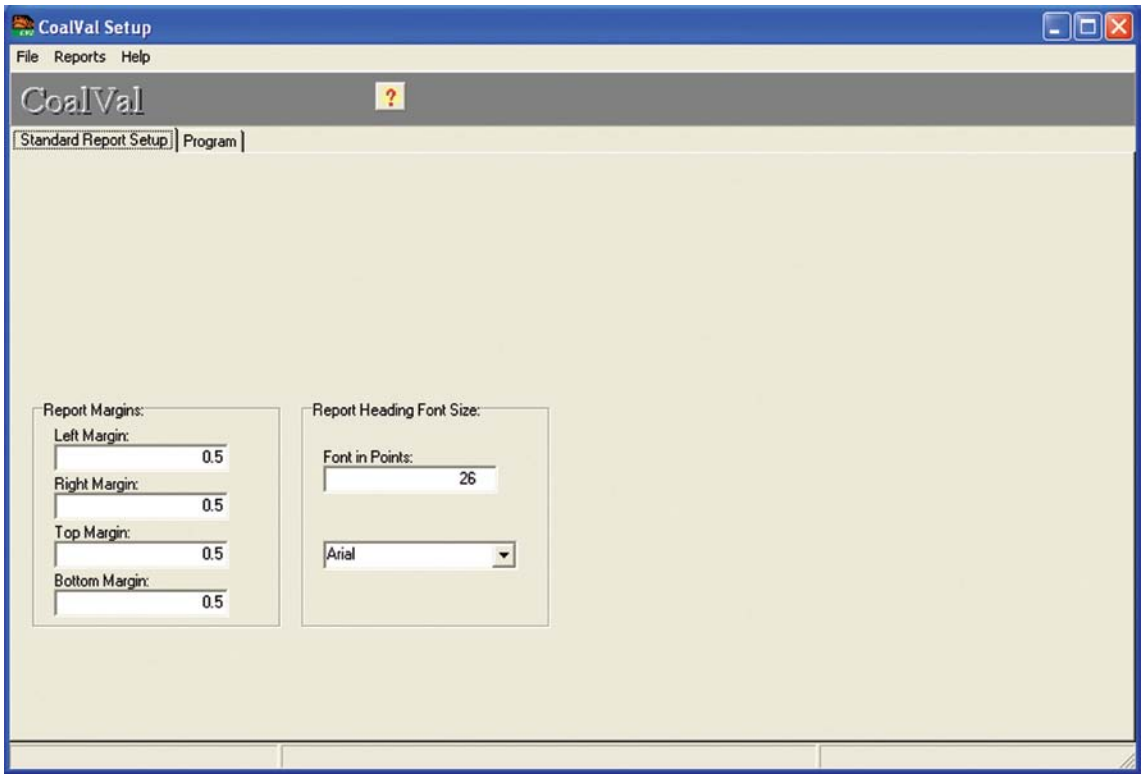


Figure C.25. CoalVal's Setup menu window showing the Standard Report Setup dialog.

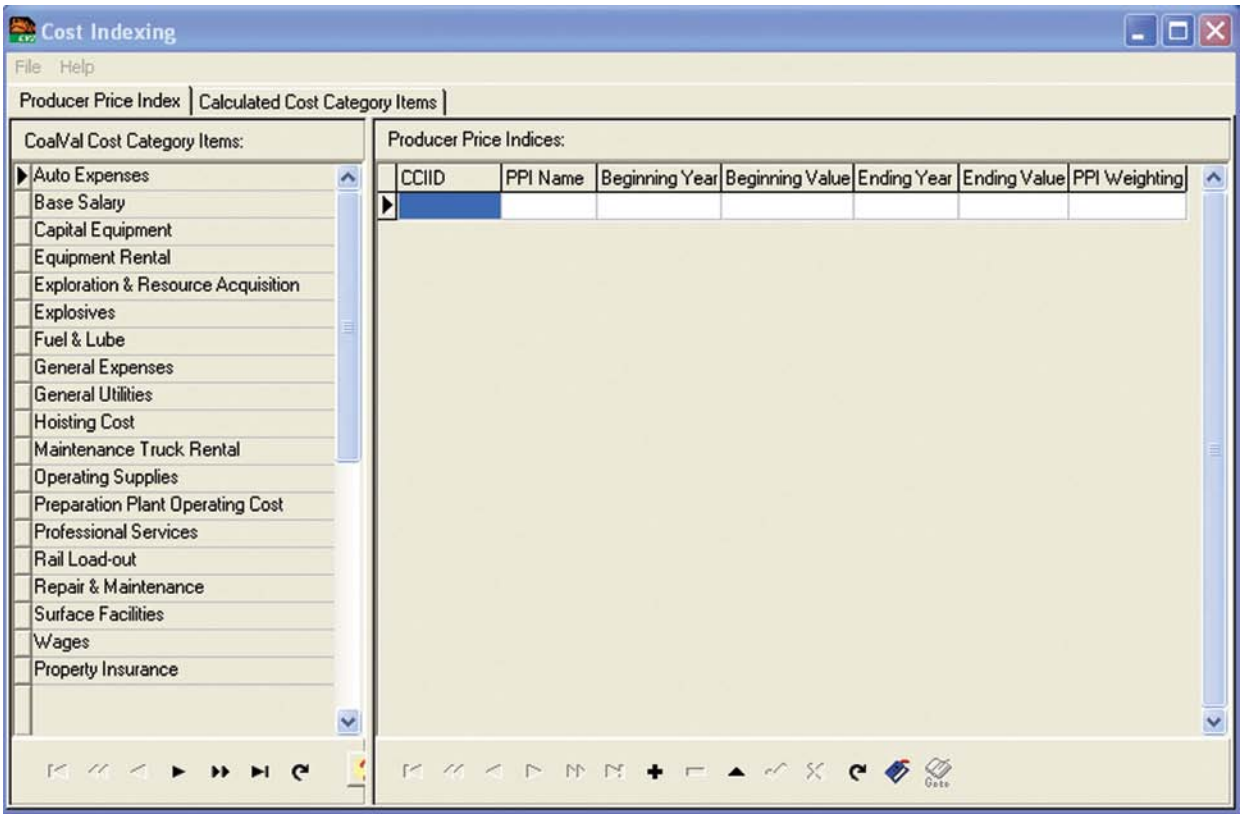


Figure C.26. CoalVal's Cost Indexing dialog window.

Weighting" factor. The "PPI Weighting" factor is necessary if more than one PPI for a "CoalVal Cost Category Item**"** is added. The "PPI Weighting**"** factor is a percentage value between 1 and 100. Generally, base prices can be indexed for about 2 to 4 years before the indexed costs are not a valid estimate of actual cost. Therefore, it is recommended that base prices be updated at least every 5 years.

The general approach for the CIS is to use a Base Cost Year ("Beginning Year") for each indexed component cost of a **Mine Model**. The cost of a particular piece of equipment can then be changed to the current price and the Base Cost Year will be set to the current price year. The CIS will then use that Base Cost Year to determine what the adjustment index would be. For an updated cost component, there would be no adjustment. For a cost component that has a Base Cost Year of 3 years ago, the adjustment index would be based on the PPI of 3 years ago compared to the PPI of the latest year.

When adding new PPIs into the CIS, it is necessary to *select a "Cost Category Item**"** from figure C.26 or from the "Cost Category Items**"** list. A Producer's Price Index name or description is entered, then the "Beginning Year**"** and the* PPI value ("*Beginning Value***"**) *for that year, and then the PPI value ("Ending Value**"**) for the ending year*. Each **Mine Model** cost component (**Mine Model Assumptions**, **Wage**s, **Salaries**, and **Equipment**) will have a Base Cost Year ("Beginning Year**"**) indicating the year of the cost of that component and cost for the component. More than one PPI may be entered for each cost category. If more than one PPI is entered for a "Cost Category Item," a weighted average PPI will be calculated for the cost category. The listing of "Cost Category Items**"** for the Producers Price Index (the terms are explained in Glossary of Terms, appendix E) follows:

1. Auto Expenses
2. Base Salary
3. Capital Equipment
4. Equipment Rental
5. Exploration and Resource Acquisition
6. Explosives
7. Fuel and Lube
8. General Expenses
9. General Utilities
10. Hoisting Costs
11. Maintenance Truck Rental
12. Operating Supplies
13. Preparation Plant Operating Supplies
14. Professional Services
15. Rail Loadout
16. Repair and Maintenance
17. Surface Facilities
18. Wages
19. Property Insurance

The **Equipment** dialog on the **Mine Model** window allows "Capital Equipment" or "Surface Facilities" to be selected for CIS. A check box on the **Equipment Entry** Data Table allows selection of "Surface Facilities.**"** If the check box is not selected, the equipment type will be assumed to be "Capital Equipment.**"** All **Mine Model** cost components

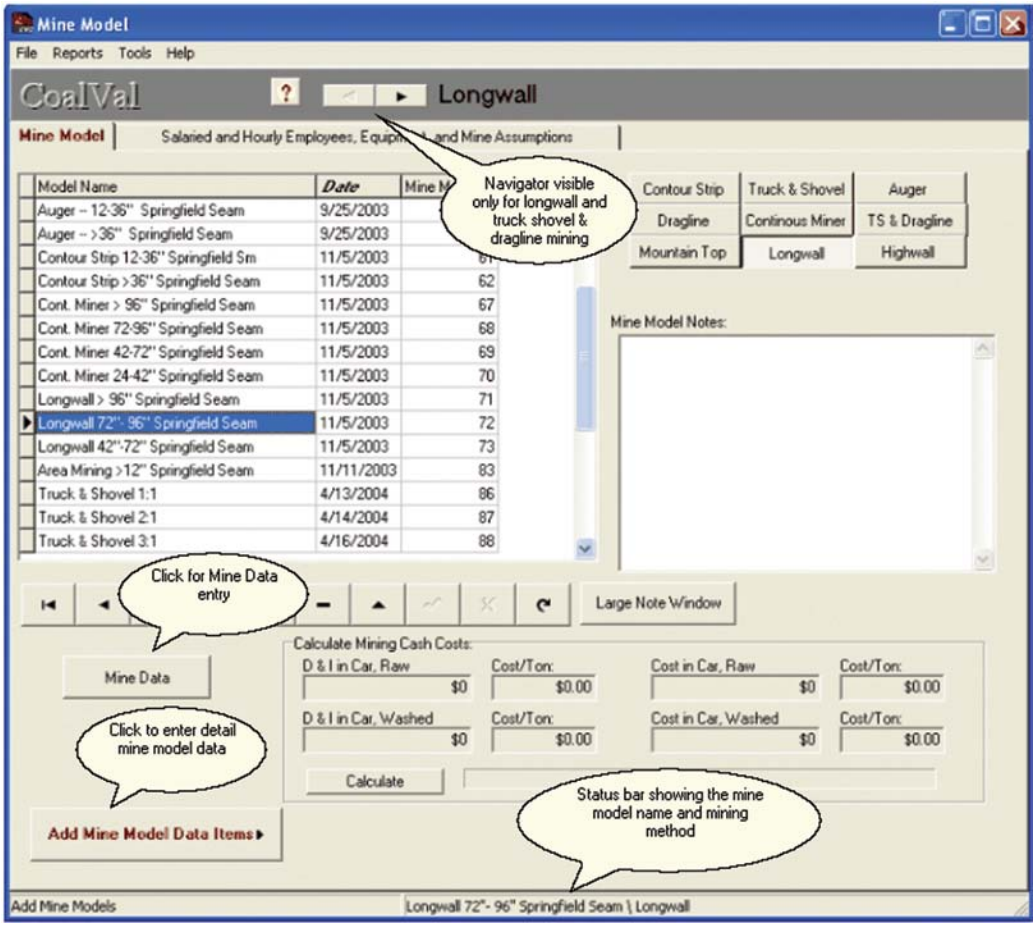


Figure C.27. CoalVal's Mine Model dialog window highlighting the Longwall Mine Model.

on the **Mine Data** window have a separate Base Cost Year for each component found in the **Mine Model Assumptions** listing. These cost components are on the **Equipment Entry Table**, **Wage Schedule Table**, and **Salaried Employees Table**.

All **Mine Model** cost components on the **Mine Assumptions** dialog of the **Mine Model** window will use one Base Cost Year. The reports for a **Mine Model** show only the adjusted cost, not the Base Cost Year cost. The following is a list of **Mine Model Assumptions** that can be indexed for cost adjustments:

1. Auto Expenses
2. Equipment Rental
3. Explosives for Coal
4. Explosives for Overburden
5. Exploration and Resource Acquisition
6. General Expenses
7. General Utilities
8. Hoisting Costs
9. Operating Supplies
10. Preparation Plant Cost
11. Property Insurance
12. Professional Services
13. Rail Loadout Cost
14. Maintenance Truck Rental

The area calculated fields on the **Equipment Entry Table**, **Wage Schedule Entry Table,** and **Salaried Employees Entry Table** allow the user to view the indexed cost. On the **Mine Assumptions** dialog window, a button allows the user to toggle between the indexed cost (CIS Costs) and the base year cost. Editing of base-year costs is possible but not the adjusted costs.

Mine Model

The **Mine Model** dialog window is used to create and edit mine models (fig. C.27). A mine model is an extraction plan for a given coal resource that uses one of nine default mining methods. The mining methods are contour strip, mountain top removal, highwall mining, auger, truck and shovel, dragline, dragline and truck-shovel, room and pillar (continuous miner), and longwall. Although a mine model must use one of the nine mining methods, the user can develop as many different mine models as desired. The user can use the mine models provided for reference to development of new or modified mine models. Prior to mine model construction, the user will need to develop the supporting mine

plans and accompanying equipment, employees, and mining assumptions needed for the new mine model.

Before a new **Mine Model** is created, the **Mine Data** dialog should be opened and **Equipment**, **Employees**, **Wages**, **Taxes**, or **Haul Costs** that are needed for the **Mine Model** should be developed. The **Mine Data** menu item is found on the **Mine Model** dialog window by clicking the **Tools** menu. If the data are in the look-up tables, then the user can proceed to the **Salaried and Hourly Employees, Equipment, and Mine Assumptions** pages. See below for more information on both of these activities.

A **Mine Model** consists of a mining method, **Groupings of Salaried and Hourly Employees**, **Groupings of Equipment**, and one set of **Mine Assumptions**. The groupings allow the user to plan the **Mine Model** with any amount of equipment and personnel necessary to produce a particular coal tonnage. **Hourly Employees** can be separated into "Production Employees" and "Auxiliary Employees" and a **Grouping of Salaried Employees** separated into "Overhead" and "Production" functions.

Previously, it was noted that a **Mine Model** can use one or more mining methods. Longwall mining is subdivided into two mining methods. Room and pillar methods employing continuous mining machines develop the access rooms and support pillars for longwall panel extraction. The longwall method uses a longwall shear and its related equipment for longwall production. Likewise, the dragline and truck-shovel mining model employs dragline and truck-shovel stripping methods that may be used together or independently with modeled coal production.

Figure C.27 shows a navigation button for the Longwall Mining Model at the top of the screen. This button is visible only for the Longwall Mining Method and the Truck-Shovel and Dragline Mining Methods. This navigation tool allows the user to have a set of employees, equipment, and mining assumptions for the longwall panel and one for the continuous miner development (longwall mining method) or a set of employees, equipment, and so forth, for coal production, truck-shovel stripping (benching), or dragline stripping (truck-shovel and dragline mining method).

From CoalVal's **Main Menu Bar**, *click on the **Mine Model** icon, then on the "Add Mine Model Data Items" button (lower left) to enter the detailed data for a mine model as shown in figure C.27*. A menu will appear that allows the selection of adding **Salaried Employees**, **Hourly Employees**, **Equipment**, and **Mine Model Assumptions**.

Salaried Employees

The **Salaried Employees**, **Hourly Employees**, **Equipment,** and **Mine Assumptions** menu windows each have two tabs as shown on the **Salaried Employee** window (fig. C.28). The tab on the left (in this example, the **Salaried Employee Groupings**) is for entering an employee group. Here the groupings for the employees or for equipment on the **Equipment** page are created. Each grouping can have one or more employees or pieces of equipment. If a **Salaried Group** is to use the overhead calculations, then *check the "This is an Overhead Group" check box* (fig. C.29). This group is used in the overhead calculations. The exact calculation can be seen in the Mine Model Formulas section**.**

The **Salaried Employee** window (fig. C.30) is slightly different than the **Hourly Employee** window. The two primary differences are the placement of the "Ordered/Edit" button and the addition of the "Auto Rental" check box. Every salaried employee with the "Auto Rental" box checked will add a monthly auto rental cost to the production expenses. The **Mine Assumptions** window has a cost per month assumption for "Auto Rental."

To review the number of salaried employees for a **Mine Model,** *click on the **Mine Operations Staff** or the **Mine Management Staff** tabs (fig. C.29)*. Salary assumption data can be reviewed by *clicking on the "goto" (**Salaried Employee Entry Table**) button located on the right hand side of the **Mine Model** dialog (fig. C.30)*.

Hourly Employees

The **Hourly Employees** dialog window (fig. C.31) has two tabs. The tab on the left, the **Hourly Employee Groupings** tab, is for entering a group. Here the user can create the groupings for wage employees needed in the mine model. Each grouping can have one or more employees. The tab on the right, **Hourly Employee Group-Development Production,** will change according to the Group Name selected. This tab is used to add wage employees by job classification to the **Mine Model**.

Figure C.32 shows the Continuous Miner model, production wage-worker classifications, number of employees, hours per shift, and navigation and ordering buttons. This page will allow employees to be entered into the **Mine Model** from the **Hourly Employees Entry** look-up tables. There are three ways this can be done. First, the pull-down selection menus in the employee listing table can be used (by left-clicking the mouse several times quickly in the selected field) for the **Employee Type.** The second way is to select an employee by using the **Employee ID** from the "Select Report: Default" values in the **Hourly Report** look-up table. The third way is with the **Drag and Drop** dialog box.

After all the employees and equipment have been added to the **Mine Model**, the report order can be changed by pressing the "Arrange Employee Order" or "Arrange Equipment Order" button (fig. C.32). The reordering of data can be done only when the "Ordered/Edit" button shows the "Ordered" message (figA field heading that uses an italic font in a grid as in figure C.32 (*Employee Type*) means that data entry is from a pull-down selection box. On the employee listing table in figure C.32, the user can either select an employee by "Employee Type" or by "Employee ID**"**; both have pull-down menus.

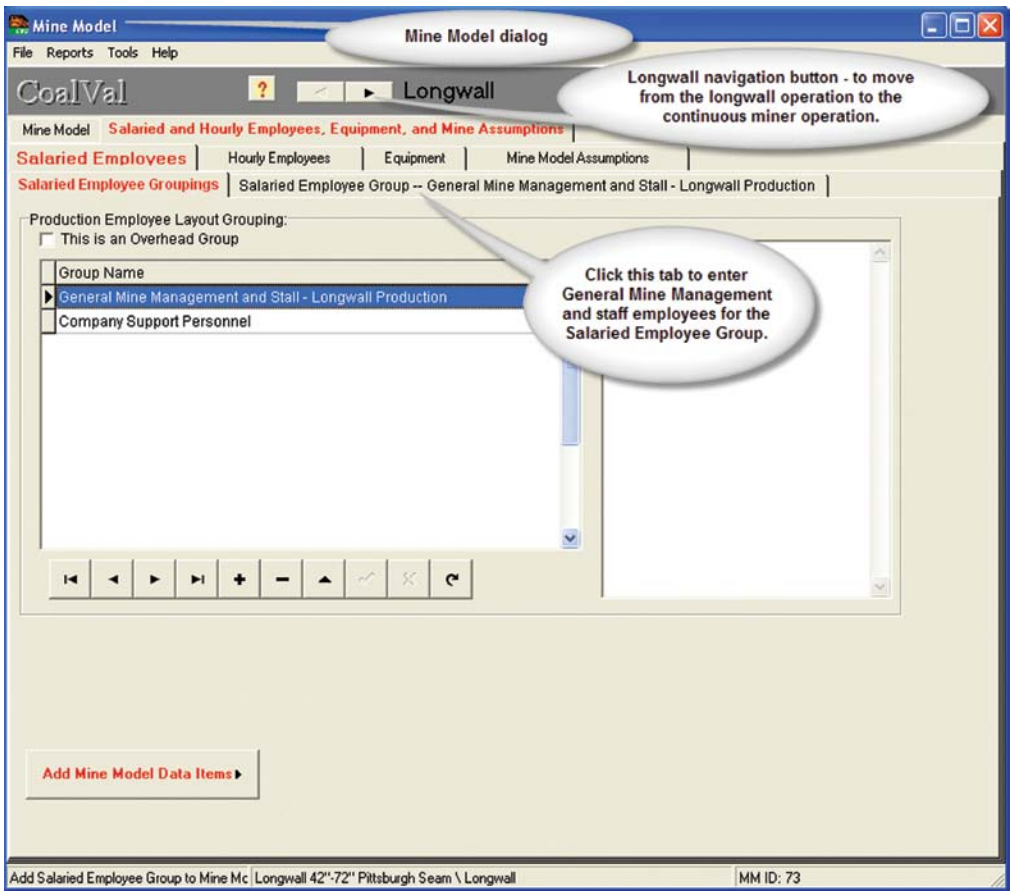


Figure C.28. CoalVal's Mine Model dialog window showing the Salaried Employees Grouping dialog.

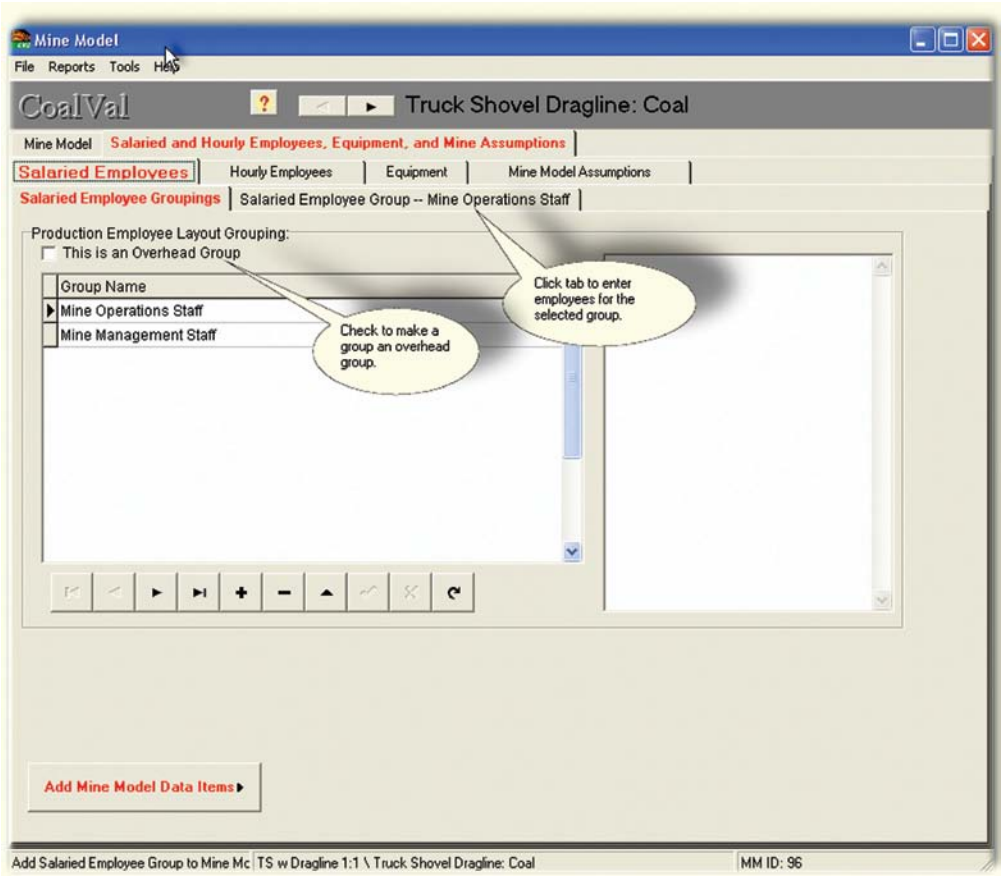


Figure C.29. CoalVal's Mine Model window showing a Salaried Production Employee Layout Grouping with "Overhead Group" notation box.

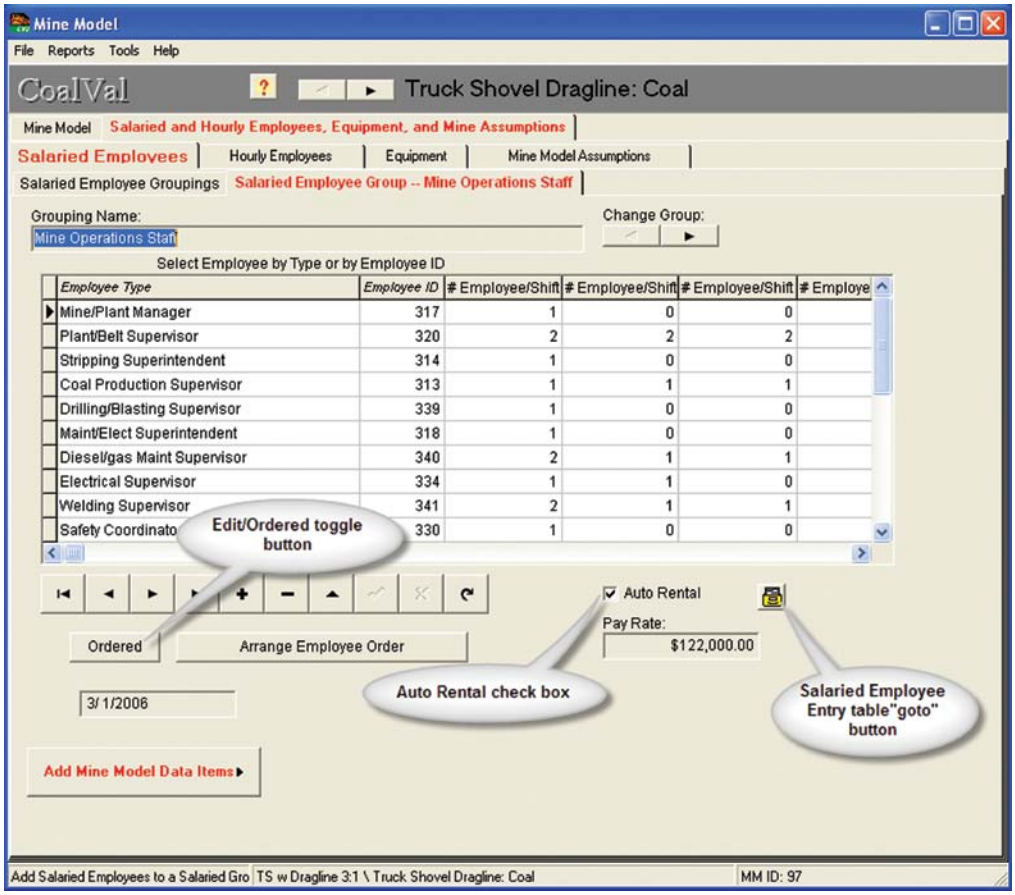


Figure C.30. CoalVal's Mine Model dialog showing the Salaried Employees Group – Mine Operations Staff window.

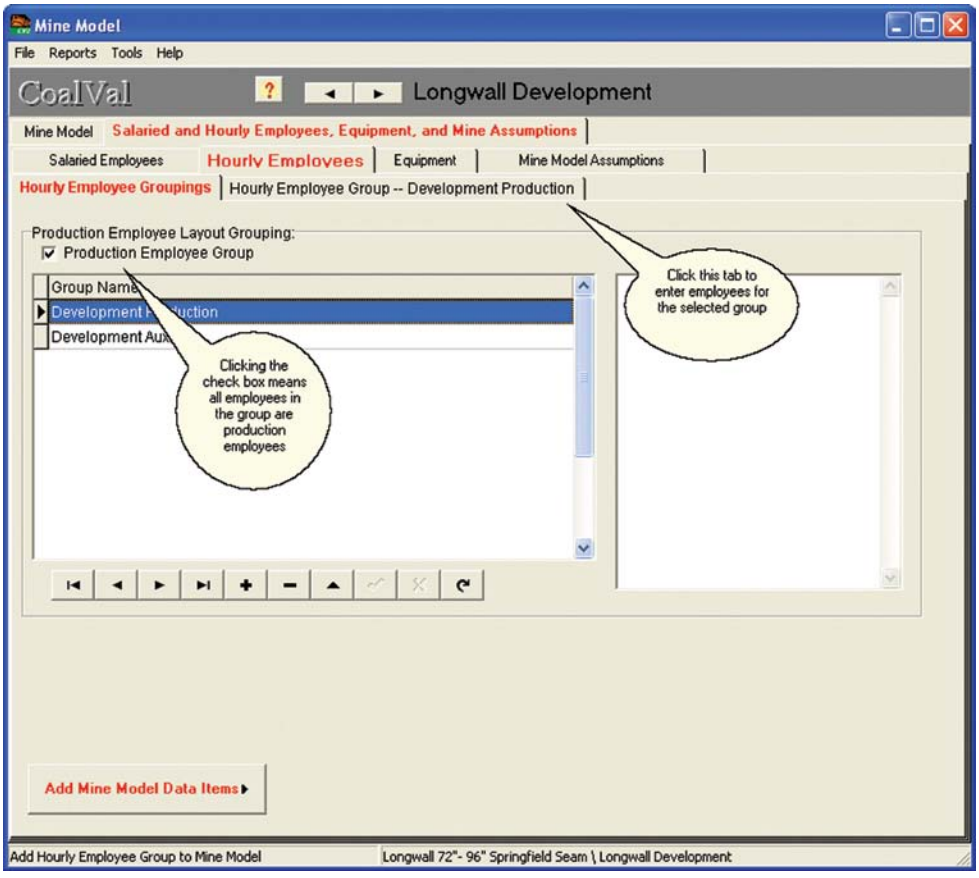


Figure C.31. CoalVal's Mine Model dialog showing production groups within the Wage (Hourly) Employee Grouping tab.

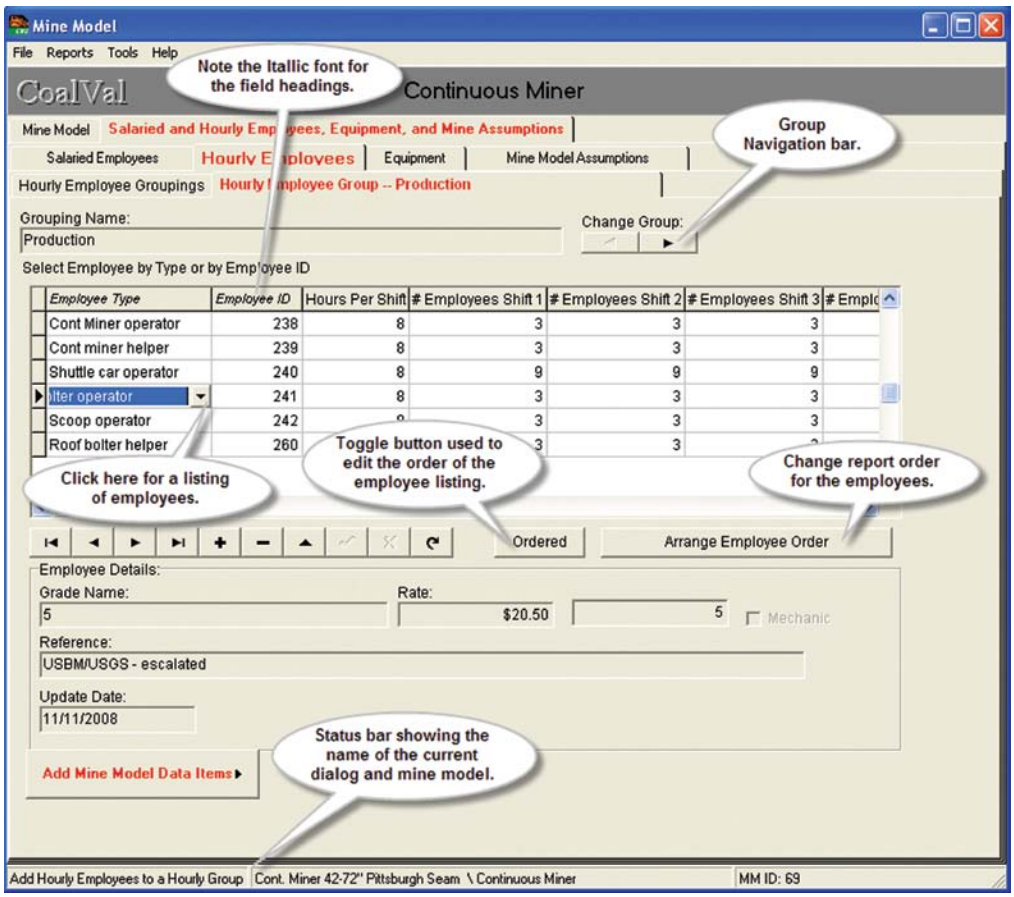


Figure C.32. CoalVal's Mine Model dialog showing the Hourly Employee Group—Production dialog.

Hourly Employee position assumptions are displayed in the lower portion of figure C.32.

Equipment

The **Equipment** menu dialog window has two tabs directly below highlighted **Equipment** (figs. C.33 and C.34). The tab on the left is for entering a group. Here, the groupings for equipment, such as "Production Equipment" (fig. C.34), "Auxiliary Equipment" (fig. C.35), and "Surface Support Facilities" (figures C.36 and C.37), can be developed. After the **Equipment Groupings** have been created for the mine model, the pieces of equipment can be entered into the groups. In the case of "Equipment Group-Production Equipment," figure C.38, equipment would be added by using the "Equipment" pull-down menu to select the equipment, or use the "Equipment ID" pull-down menu to select the equipment by ID number. Then the "Equipment Use**"** would be selected from the drop-down list (fig. C.38). Equipment use is defined as follows:

1. Production – Front line equipment used in the removal of coal and overburden (fig. C.34).

2. Auxiliary – Support equipment for the production equipment (fig. C.35).

3. Surface Support Facilities – This item refers to the infrastructure for the mine, such as buildings, roads, loadouts, and tipples (fig. C.36). When the equipment uses the "Other Equipment Use," the number of units and production employee's total hours worked per year will be used in the hourly depreciation formula (fig. C.37).

4. There are three "Property" types or classifications for taxation. They are as follows:

5. Tangible – Taxes are calculated on the current value of the piece of equipment (fig. C.34).

6. Real – Taxes are calculated on the value of the infrastructure (fig. C.36).

7. None – Used when amortization is calculated for the infrastructure (fig. C.37).

There can be four work shifts scheduled (fig. C.34): day shift, first shift; afternoon shift, second shift; night shift, third shift; and swing shifts which allows for a 24 hours per day, 7 days per week operation (weekend coverage). If the production schedule needs to operate only 5 days per week to meet production goals, only the first, second, and third shifts would be filled.

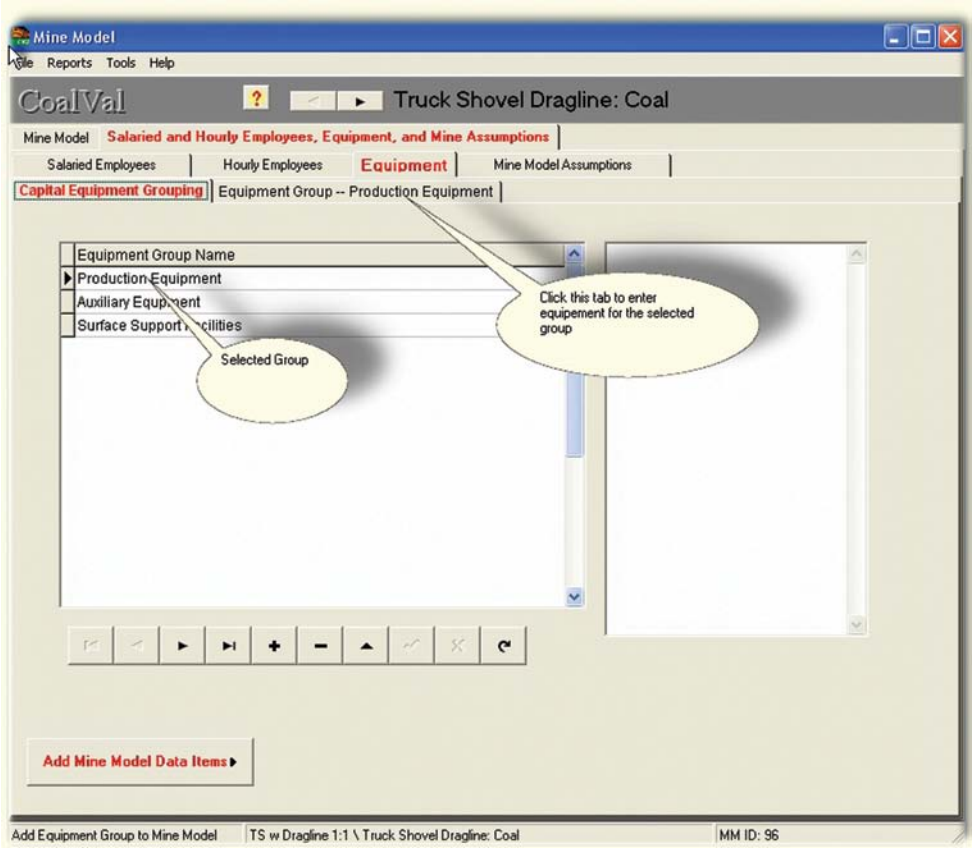


Figure C.33. CoalVal's Mine Model dialog showingCapital Equipment Grouping for Production Equipment, Auxiliary Equipment, and Surface Support Facilities.

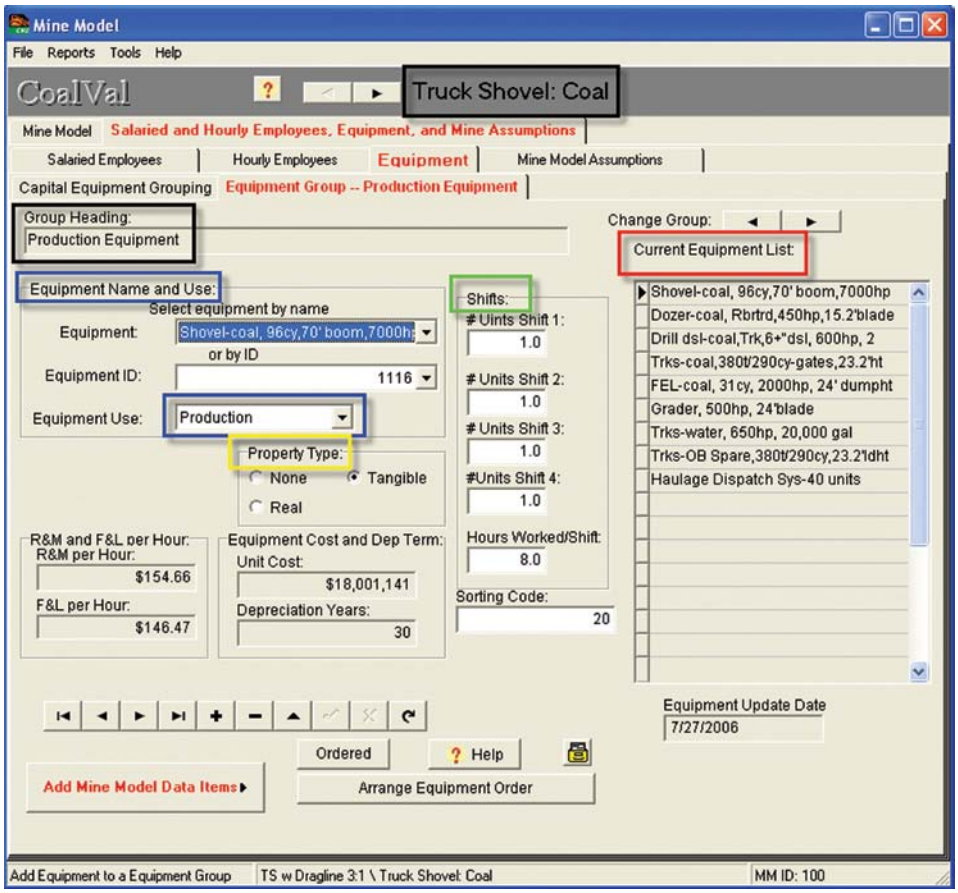


Figure C.34. CoalVal's Mine Model dialog showing the Production Equipment Group for the Truck-Shovel: Coal dialog.

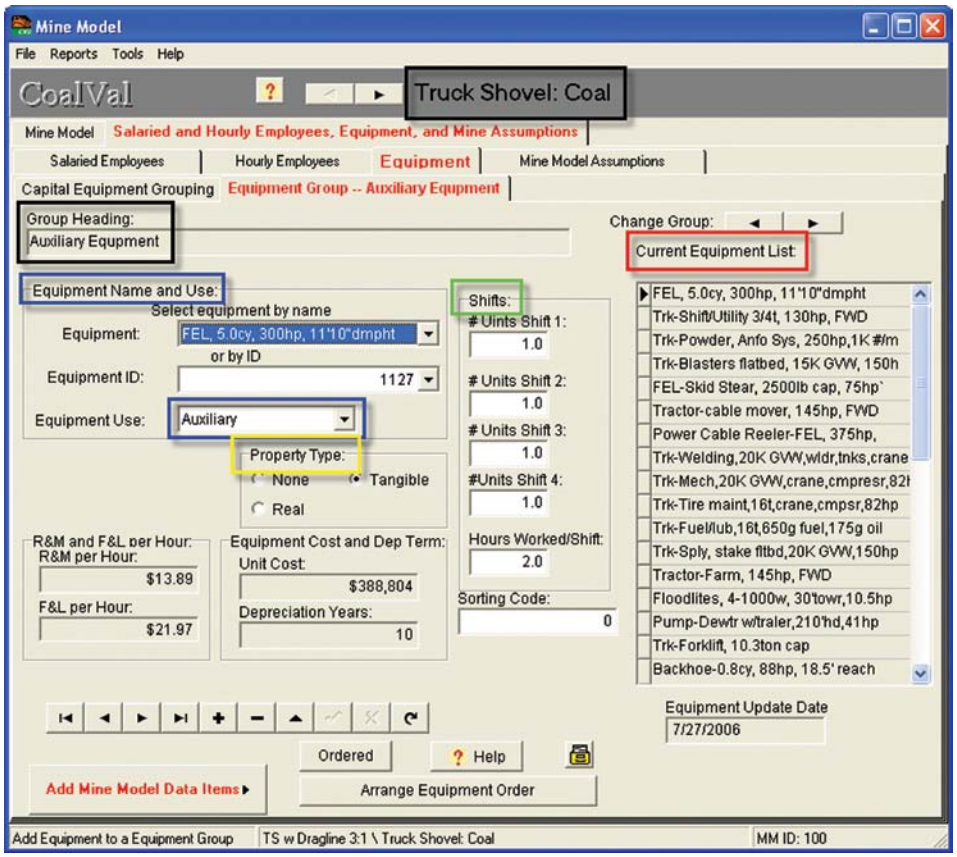


Figure C.35. CoalVal's Mine Model dialog window showing the Auxiliary Equipment Group—Equipment window for supporting production operations.

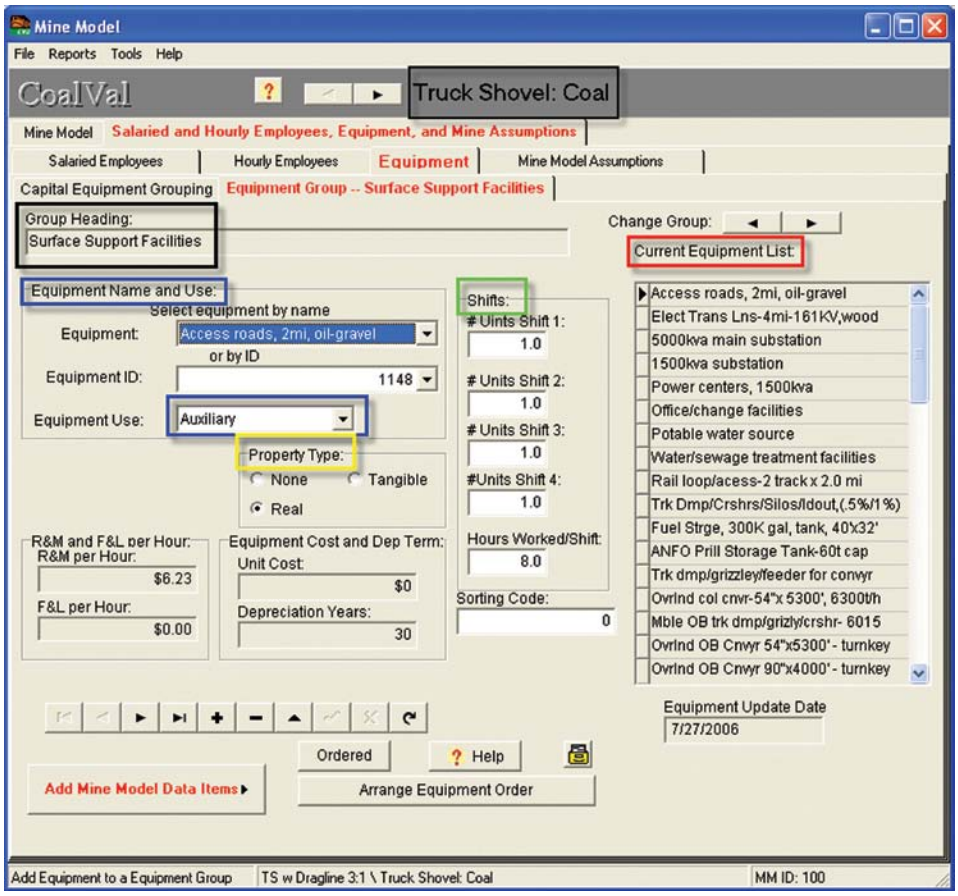


Figure C.36. CoalVal's Mine Model dialog showing the Surface Support Facilities Group for Infrastructure buildings and equipment.

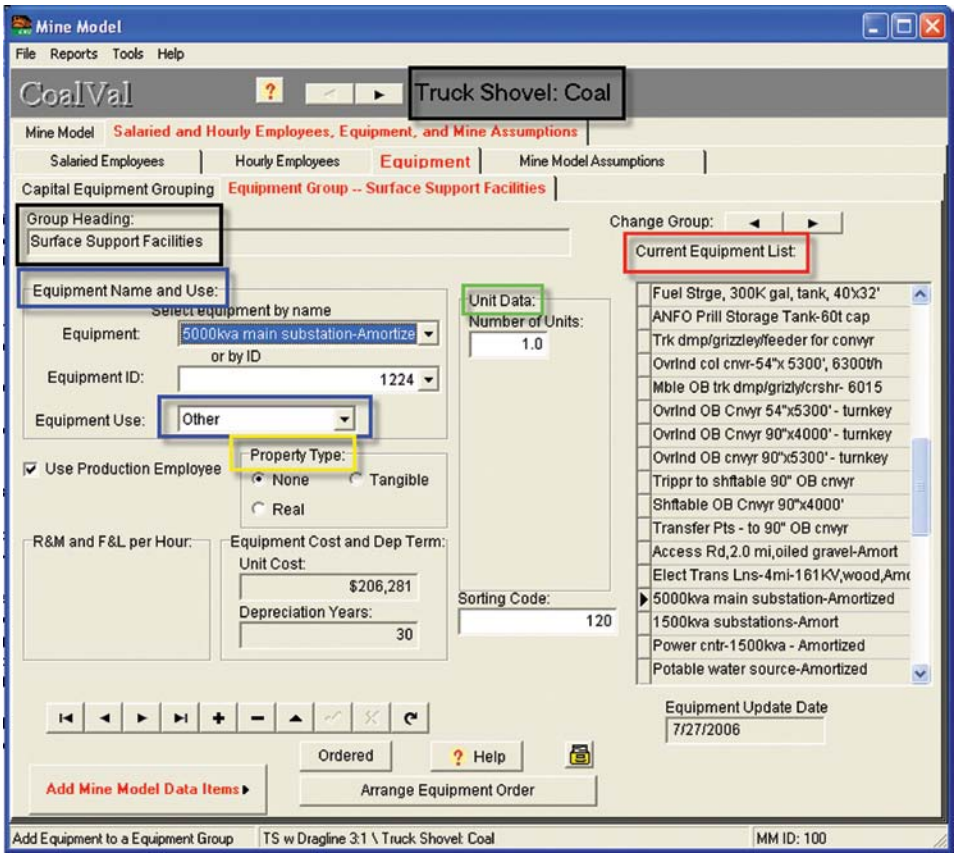


Figure C.37. CoalVal's Mine Model dialog showing the Surface Support Facilities Group—Other dialog window used in hourly depreciation calculations.

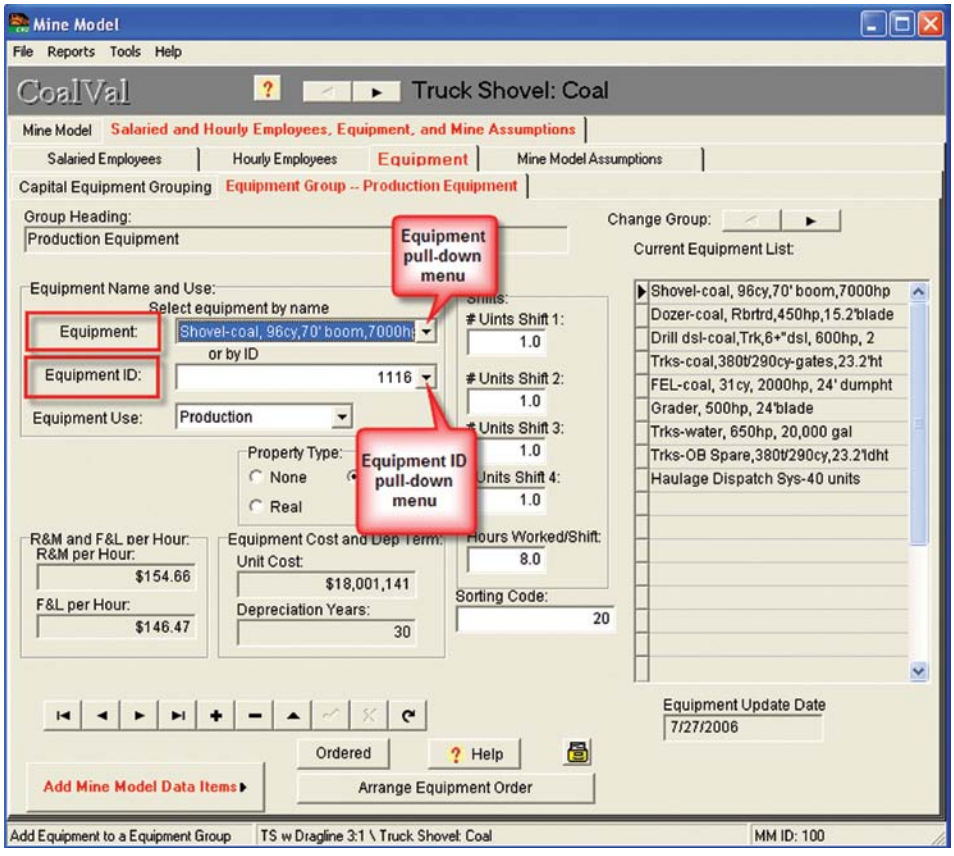


Figure C.38. CoalVal's Mine Model dialog showing the Production Equipment pull-down and ID menus.

Mine Model Assumptions

The **Mine Model Assumptions** window of the **Mine Model** dialog is shown in figure C.39. The fields seen in figure C.32 will differ based on the mining method selected for the **Mine Model**. *Enter the relative mining data, including **Tax** and **Haul Cost** data into the appropriate fields to complete the **Mine Model Assumptions** dialog*. If the tax and haul cost data are not available, *click on the **Tax** and (or) **Haul Cost** buttons* (see graphic below) *to access the **Mine Data** dialog so a **Tax** and (or) **Haul Cost Table** can be created*.

Two specific fields, the "Auto Rental" expense and "Truck Rental" expense fields (fig. C.43), have costs that are entered as a per month rate. The truck rental expense rate will be used by selecting the "Mechanic" check box on the **Hourly Employee Entry** dialog. The auto rental expense rate will be used if the **Salaried Employee Entry** dialog "Auto Rental" check box is checked. If the Longwall and Truck-Shovel and Dragline mining methods are being used, remember to enter all of the data relative to the entire longwall or Truck-Shovel and Dragline operation.

Looking at the details of the **Mine Model Assumptions** window shown in figure C.40 indicates the design layout for the page used in writing the CoalVal program. All the data fields shown in the figure C.40 are defined in the Glossary, appendix E. Please be aware that when the program is running, not all the fields will be shown on the same **Mine Model Assumptions** dialog page. The fields seen depend on the mining method selected.

The following CoalVal **Mine Model Assumptions** list shows the data entry fields for the **Mine Model Assumptions** dialog page (definitions are found in the Glossary, appendix E).

1. Ave. inches in-seam coal
2. Ave. inches in-seam parting
3. Ave. inches out of seam dilution
4. Auto rental expenses
5. Burden Rate
6. Coal Recovered
7. Days Week – production
8. Days Week – auxiliary
9. Days Year – auxiliary
10. Days Year – production
11. Equipment rental
12. Exploration and Resource acquisition
13. Explosive Cost (cost/ton)
14. Explosive Cost Overburden (cost/BCY)
15. Factor for Hourly Payroll
16. General Expenses:
17. General Utility
18. Hoisting Cost
19. Minable Resource Recovery
20. Number of spreads or units
21. Operational Supplies
22. Overburden Prod. Shift
23. Parting Recovered
24. Professional Services
25. Program Calculated Prep Plant Cost
26. Property Insurance/$100 of Capital Value
27. Rail loadout cost
28. Reclamation Provisions
29. Shifts/Day–Auxiliary
30. Shifts Day–Production
31. Shifts per day
32. Stripping Ratio
33. Tons Prod. Shift
34. Truck Rental Expenses
35. Use Prep Plant Program's Cost
36. Use user entered Prep Plant Cost

Arrange Employee Order or Arrange Equipment Order

Employee job descriptions or equipment may be arranged or reorganized for the mine model report as desired by the user. To reorganize the equipment order, *click on the **Equipment Group** tab (fig. C.41) on the **Mine Model** dialog window; then click on the "Arrange Equipment Order" button located at the bottom-center of the dialog window* (fig. C.42). The current equipment order (fig. C.43) will appear. To rearrange the equipment order, *click on the desired item and move it up or down using the directional buttons on the right side of the dialog box*. After the items are reordered *click on the "OK" button*. If no changes are desired, *click on the "Cancel" button*.

Adding Employees or Equipment to a Mine Model

Equipment or **Employees** can be added to a **Mine Model** in two different ways. The first way is to *open the **Mine Model** dialog window and tab to the appropriate **Equipment Group** (or **Employees Group**) dialog page (fig. C.44*). Then *open the **Tools** menu on the upper left menu bar and scroll down to the **Mine Data** menu. Click on **Mine Data** and another dialog page will open with the **Haul Cost**, **Taxes**, **Equipment**, **Employees**, and **Wages** databases listed on the left side of the dialog page* (fig. C.45). If the **Equipment** listing is needed, *click on the **Equipment** button and new buttons for two dialog pages will be shown.* One is the **Equipment Data Entry** (fig. C.45) where equipment information can be entered or modified and the second is the **Equipment Report** button (fig. C.45). This report is the current list of equipment in the Mine Model database. *Select the report at the top of the dialog page by clicking on the toggle button.* Then *click on the "Default" report and the equipment listing will be shown (fig. C.46). Select the equipment and equipment ID number needed and return to the **Equipment Group** that is being built or modified. Add equipment by using the "+" on the Navigation Bar in the lower left portion of the **Equipment Group** dialog page*.

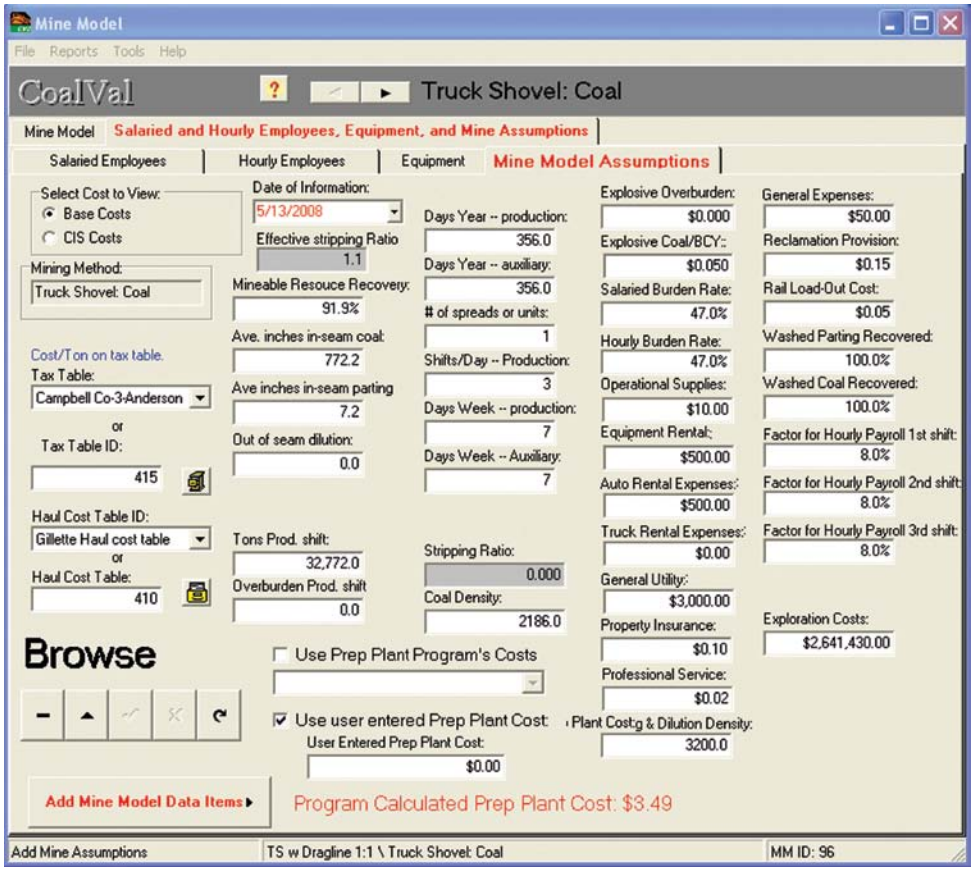


Figure C.39. CoalVal's Mine Model window showing the Mine Model Assumptions dialog.

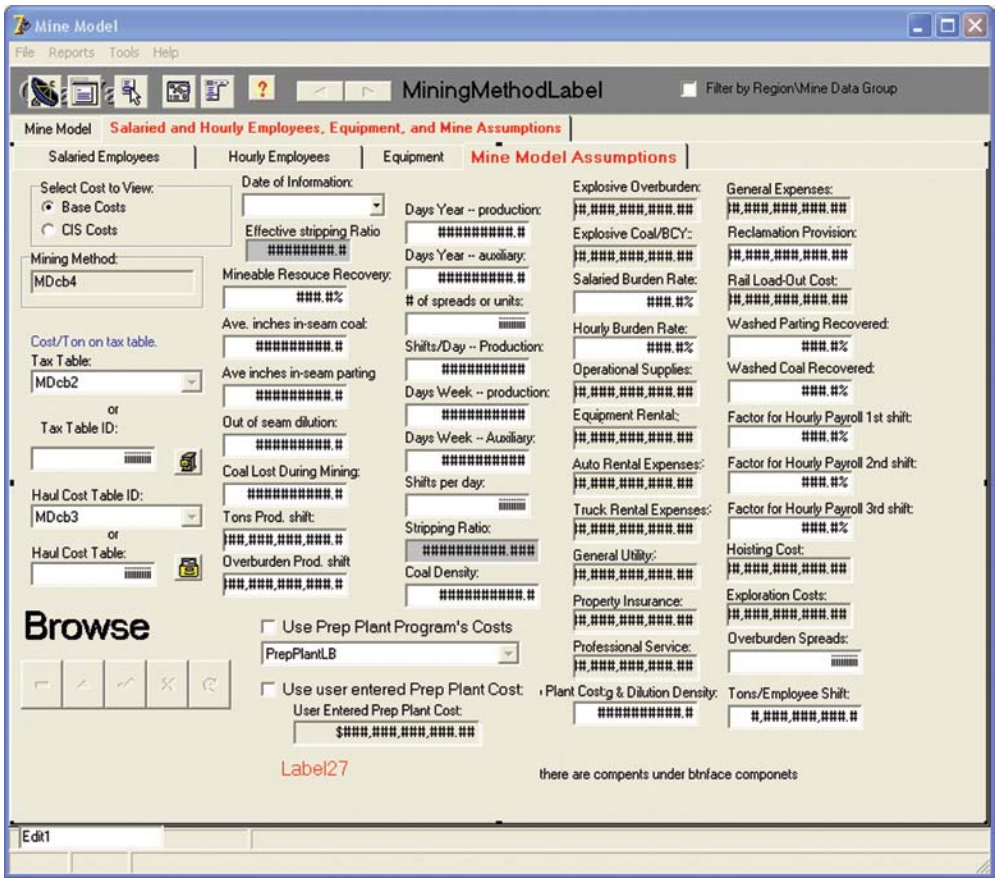


Figure C.40. CoalVal's Mine Model window showing the Mine Model Assumptions window data fields.

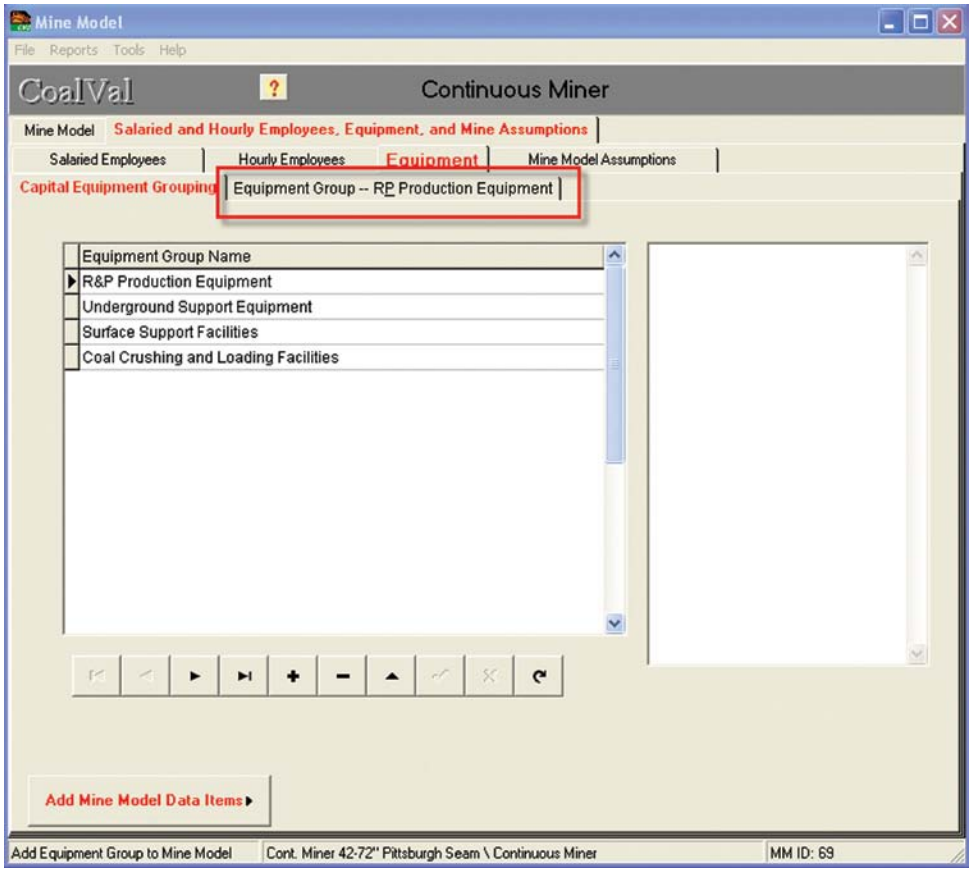


Figure C.41. CoalVal's Capital Equipment Grouping tab on the Mine Model dialog window will show the equipment group names. By selecting the R&P Production Equipment tab the user can navigate to the group equipment listing.

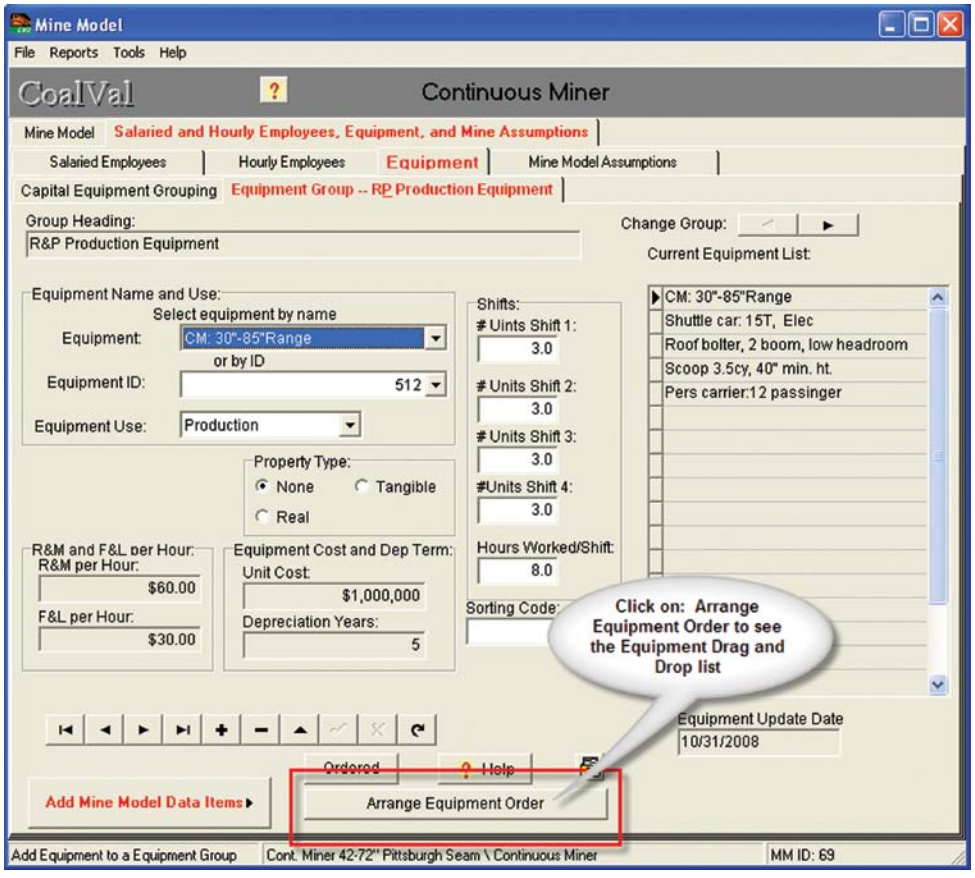


Figure C.42. CoalVal's Equipment Group—R & P Production Equipment dialog window showing the "Arrange Equipment Order" button for reorganizing the equipment order.

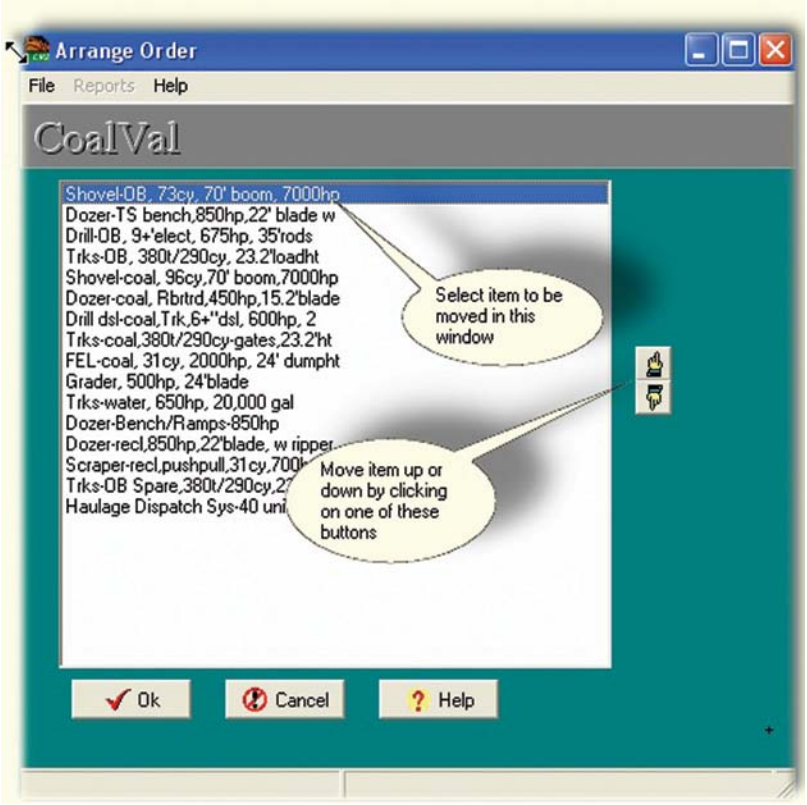


Figure C.43. CoalVal's "Arrange Order" dialog window for arranging lists of mining equipment for mining reports.

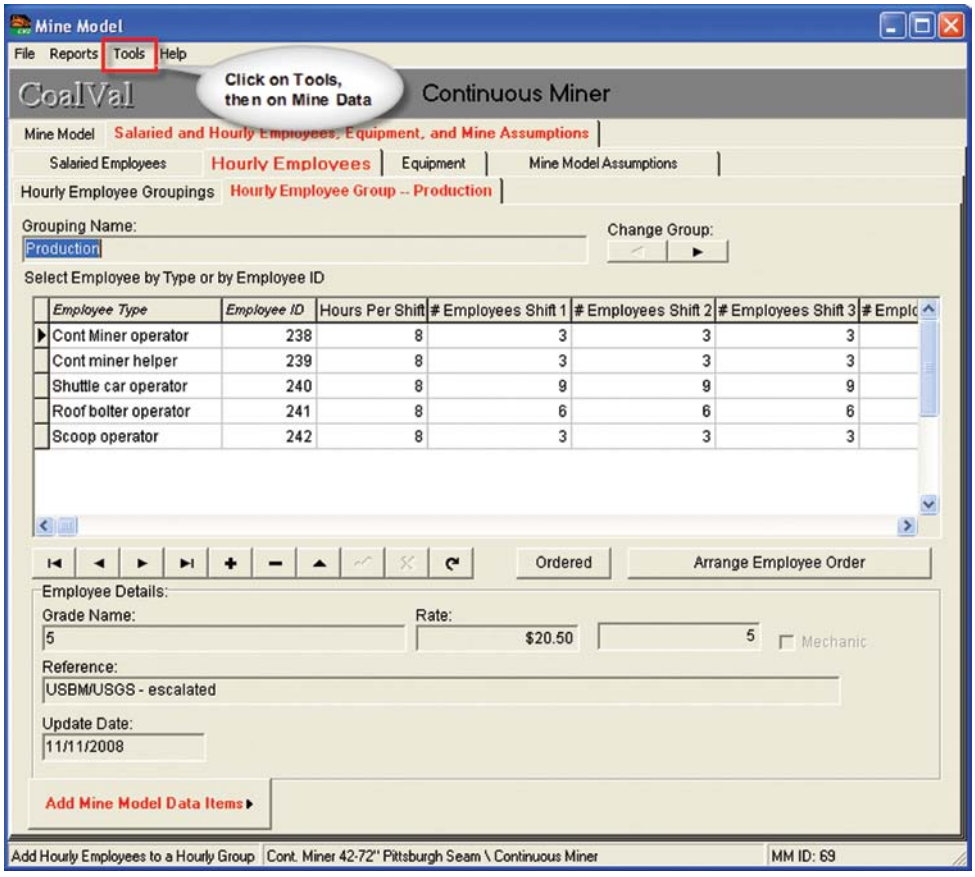


Figure C.44. Navigating to the Mine Data databases from CoalVal's Hourly Employee Group—Production tab under the Mine Model dialog window.

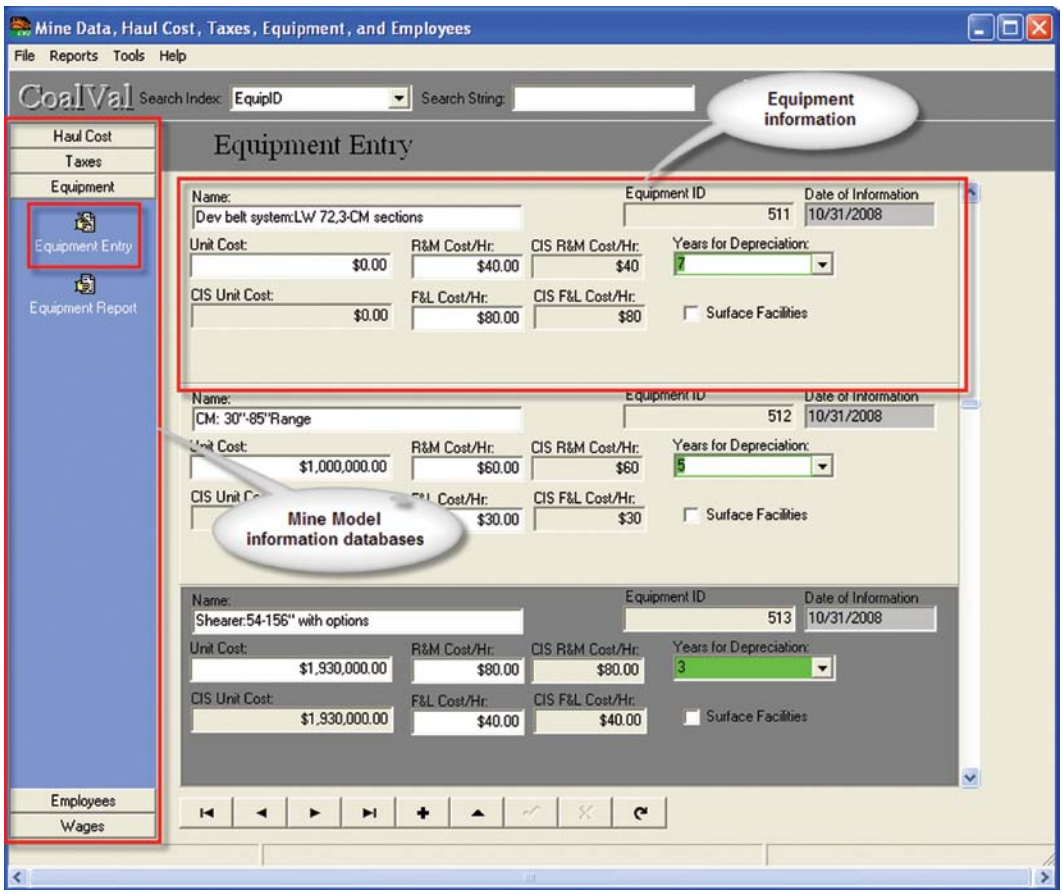


Figure C.45. CoalVal's Mine Model information databases (left side of figure) and the Equipment Entry input data table.

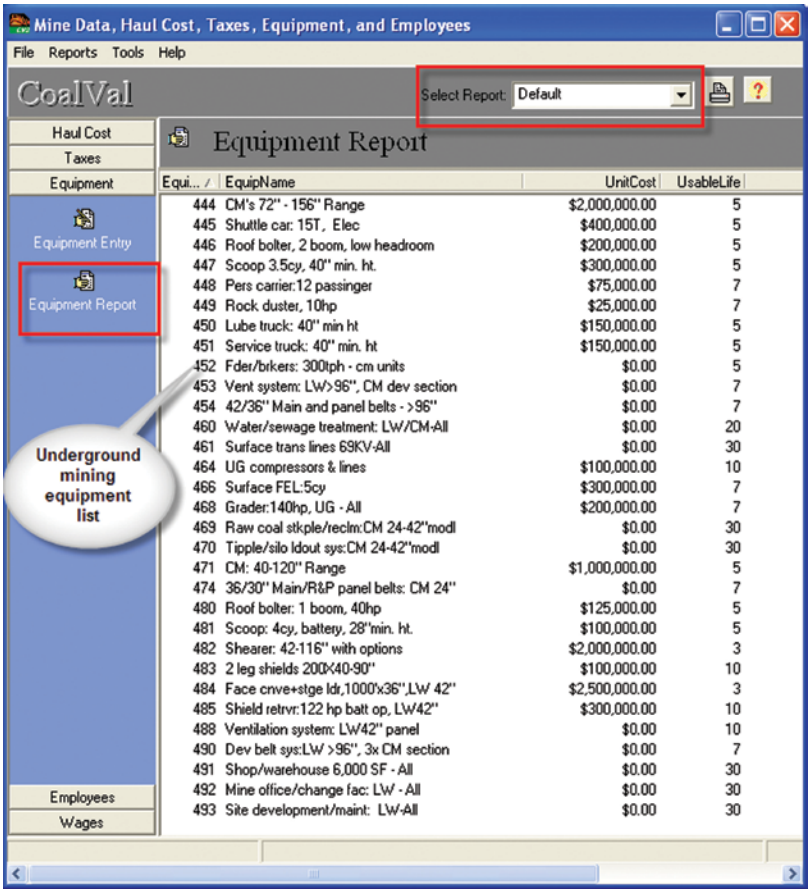


Figure C.46. CoalVal's underground mining equipment listing in the Equipment Default Report from the Tools drop-down menu under the Mine Models dialog window.

The second way is to *open the **Hourly Employee Group—Production** dialog page in the **Mine Model** dialog window as shown in figure C.47* (or the **Equipment Group** dialog page) *to add **Employees**. Click on the **Tools** menu (fig. C.47) on the upper left hand menu bar and the **Drag and Drop Employees or Equipment** item will appear in the drop-down list. Click on* "*Drag and Drop Hourly Employees" and the employees list will be shown (fig. C.48)*. Because the **Hourly Employee Group** dialog page is open, the Drag and Drop dialog page will display the hourly employees used in the current mine model. The user can now *left-click on a desired employee position, hold the mouse button down, and drag the cursor over to the **Employee Group** dialog page*. The cursor will change shape to indicate that the mouse button can be released. When *released, the item will be inserted into the **Mine Model***.

Export Mine Model Exchange File

Users of CoalVal can share a **Mine Model** by creating a **Mine Model Exchange** file. This can be done from the **File** menu of the **Main Menu Bar** or from the **File** menu of the **Mine Model** dialog window (fig. C.49). *Click on the **File** menu and then on the **Mine Model Data Exchange** item on the drop-down menu*. When the **Mine Model Data Exchange** dialog is opened, the **Import Mine Model Exchange File** tab will show. C*lick on the **Export Mine Model Exchange File** tab (fig. C.50)*. Then *Select a Mine Model to export. All mine models are listed, so single-click on one.* Second, *press the "Set Path" button to select a directory where the user wants the exchange file placed*. Third, *give the new exchange file a name*. When all this is done, *press the* "Export" *button*. The exchange file will be in the directory where the user directed it. The user can now e-mail the file or do whatever is needed with the exchange file.

Import Mine Model Exchange File

To import a **Mine Model Exchange** file, the user needs to access the **Mine Model Data Exchange** dialog window. This can be done from the **File** menu of the **Main Menu Bar** or from the **File** menu of the **Mine Model** dialog window (fig. C.49). When the dialog window is open, *click on the* **Import Mine Model Exchange File** *tab* (fig. C.51). First, *click on the* "*Select File" button and browse to the location of the exchange file and select it*. Second, *click on the* "*Import" button and the new mine model is imported*. The "Refresh" button on the **Mine Model** dialog window must be clicked to view the new model.

Copying a Model

Making a copy of a CoalVal **Mine Model** (fig. C.52), can be done by (1) *selecting the desired mine model*, (2) *selecting the **Make Copy of Selected Model** from the **File** menu of the **Mine Model** dialog window (fig. C.52)*, (3) then *clicking on the OK button* (this will complete copying the selected mine model), (4) *returning to the **Mine Model** dialog window and pressing the "Refresh" button on the Navigation Bar to see the new mine model at the bottom of the mine model list*. It is important to rename the copy at this time so that it is not confused with the original mine model of the same name. The newly copied **Mine Model** is now ready for modification. CoalVal stores **Mine Models** in a database. The database allows the **Mine Models** to have the same name and yet be separate **Mine Models**. It is up to the user to give each mine model a meaningful name.

Mine Data

The **Mine Data** dialog window is the location to enter data for the look-up tables that are used by both **Mine Models** and **Projects** and is found by clicking on the "Mine Data" button on the lower left side of the **Mine Model** dialog page. The six look-up tables found in the **Mine Data** dialog are **Haul Cost**, **Taxes**, **Equipment**, **Hourly Employees**, **Salaried Employees**, and **Wages** (fig. C.53). **Mine Models** use all six look-up tables, whereas **Projects** use only the **Tax** and **Haul Cost** look-up tables. Note that both **Hourly** and **Salaried Employees** are accessed through the **Employees** button.

A review of the CoalVal outline diagram, figure C.54, will show the relationship of the look-up tables (shaded in orange) to each other. Note that the **Wages** look-up table is also a look-up table for **Hourly Employees**. It is best to enter wages into the **Wages** look-up table before entering data into the **Hourly Employees** look-up table.

If the user desires to sort or search the items in a look-up table, the Search String box along the top of the **Mine Data** dialog window (fig. C.55) will help. There is a unique ID field for each item or record in a look-up table. This ID is also used for entry of look-up items into a **Mine Model**. In the previous **Mine Model** discussion, it was stated that a look-up item could be added in three different ways, one of which was the ID. An ID may be selected from the **Search Index** box and the **Search String** box. Once that ID is entered into a **Mine Model** the program will find and use the associated information.

Haul Cost Table

The **Haul Costs** are used for estimating contract truck haulage only. For example, if the mine is located in an area where rail access is not possible, then the coal may be transported from the mine to the preparation facility or rail loadout by means of highway-legal trucks. If a mine has its own loadout or has close access to a loadout, where contract trucking is not necessary, it is still necessary to have a **Haul Cost Table**. CoalVal must have coal resources, a **Mine Model**, a **Haul**

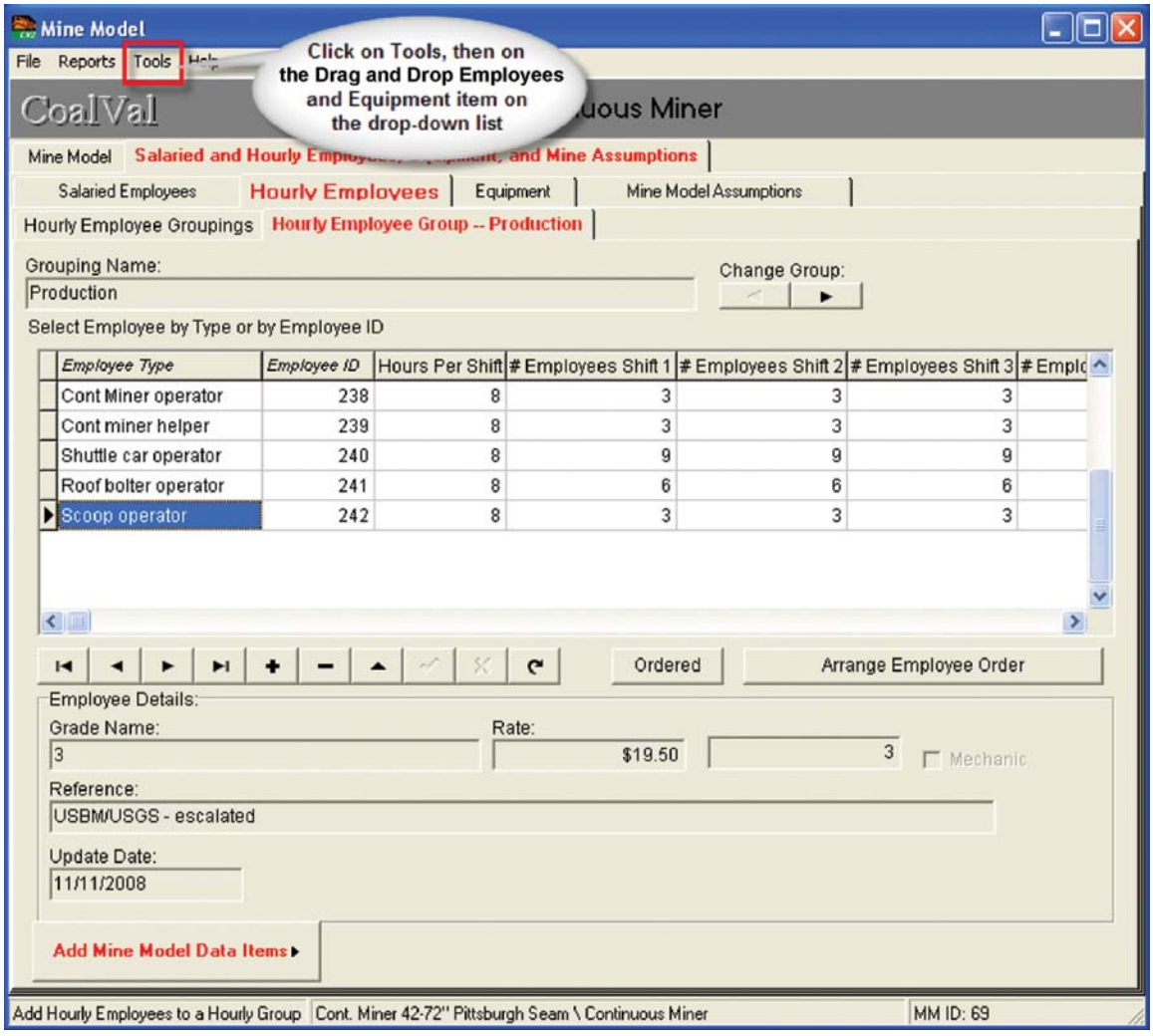


Figure C.47. Locating CoalVal's "Drag and Drop Employees or Equipment" option from the Tools drop-down menu of the Mine Model dialog window.

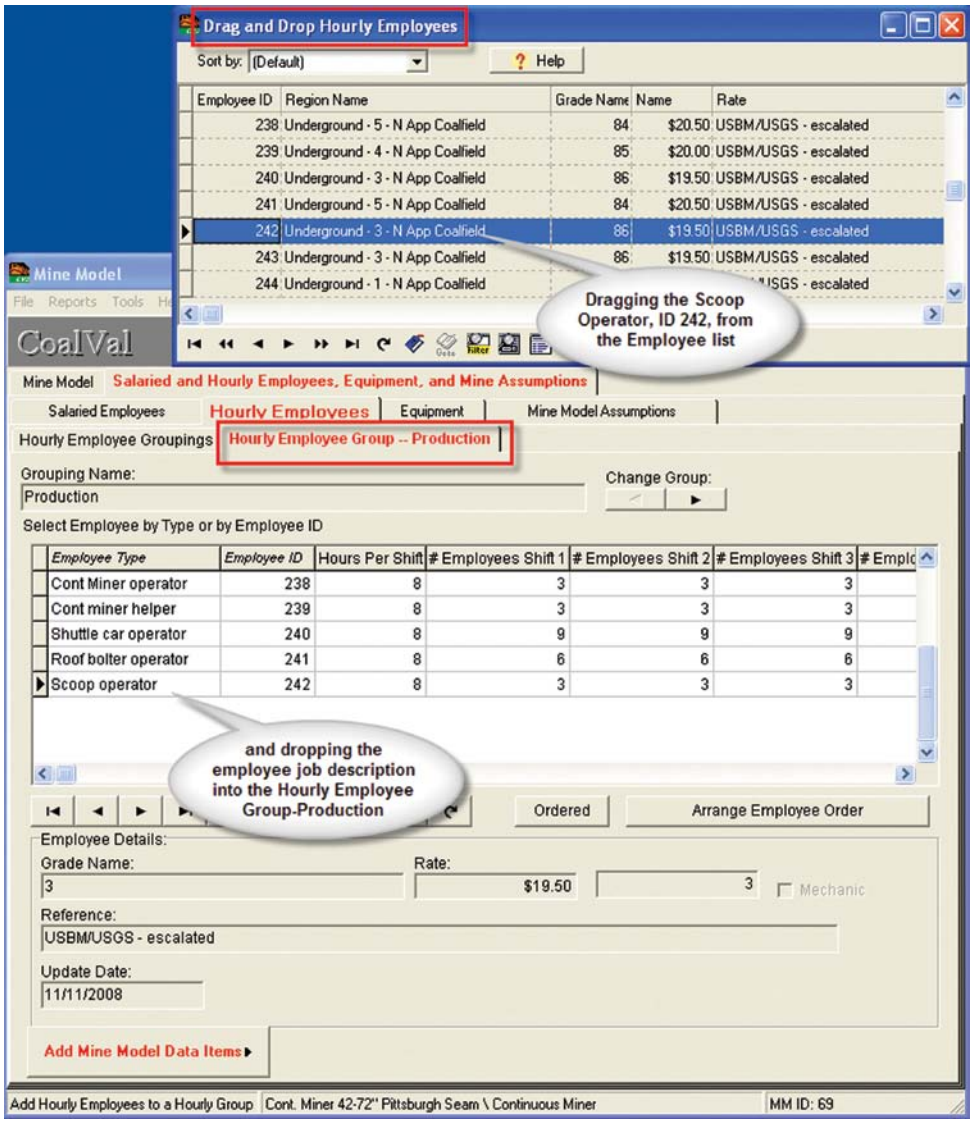


Figure C.48. Adding or modifying employee or equipment lists using a drag and drop dialog page accessed through CoalVal's Mine Model window.

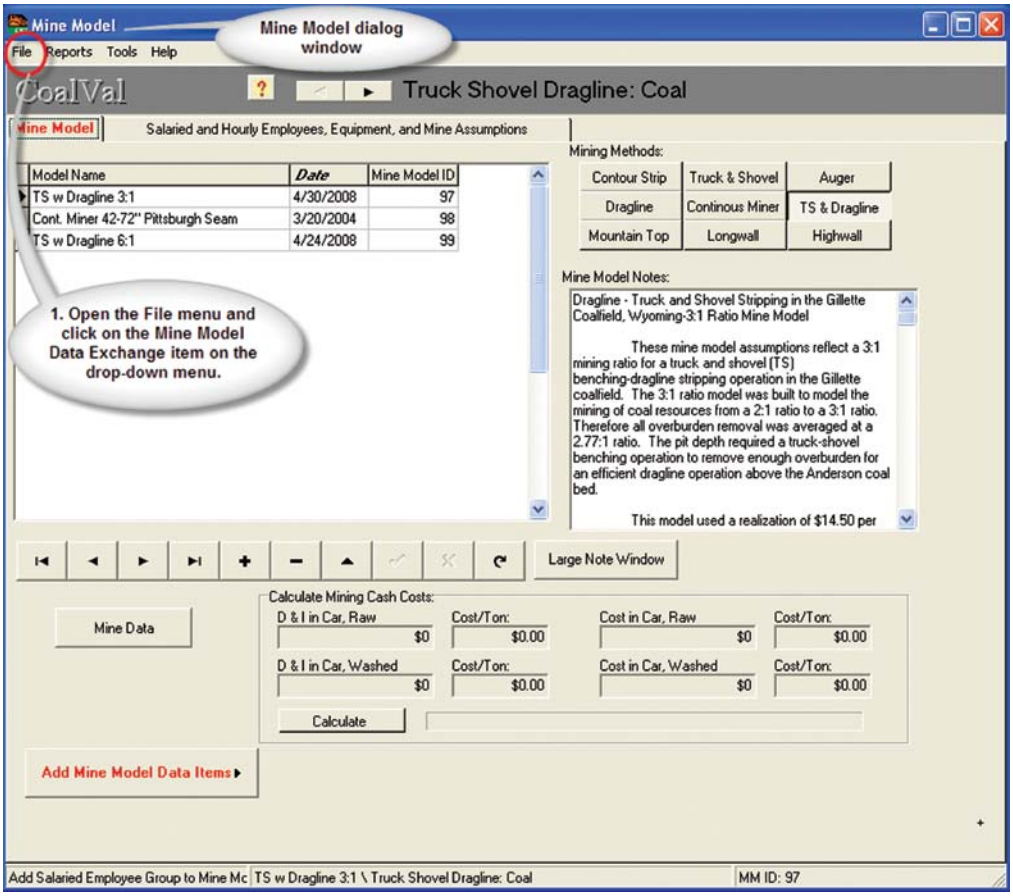


Figure C.49. Navigating to the Mine Model Data Exchange dialog from the Mine Model dialog window.

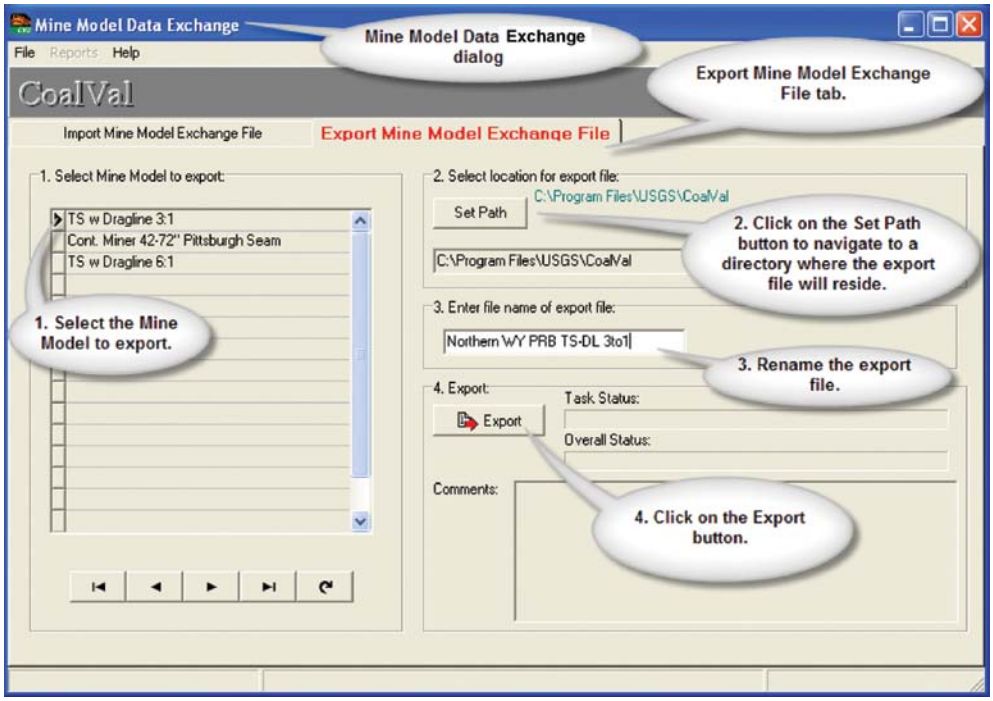


Figure C.50. CoalVal's Exporting Mine Models dialog window.

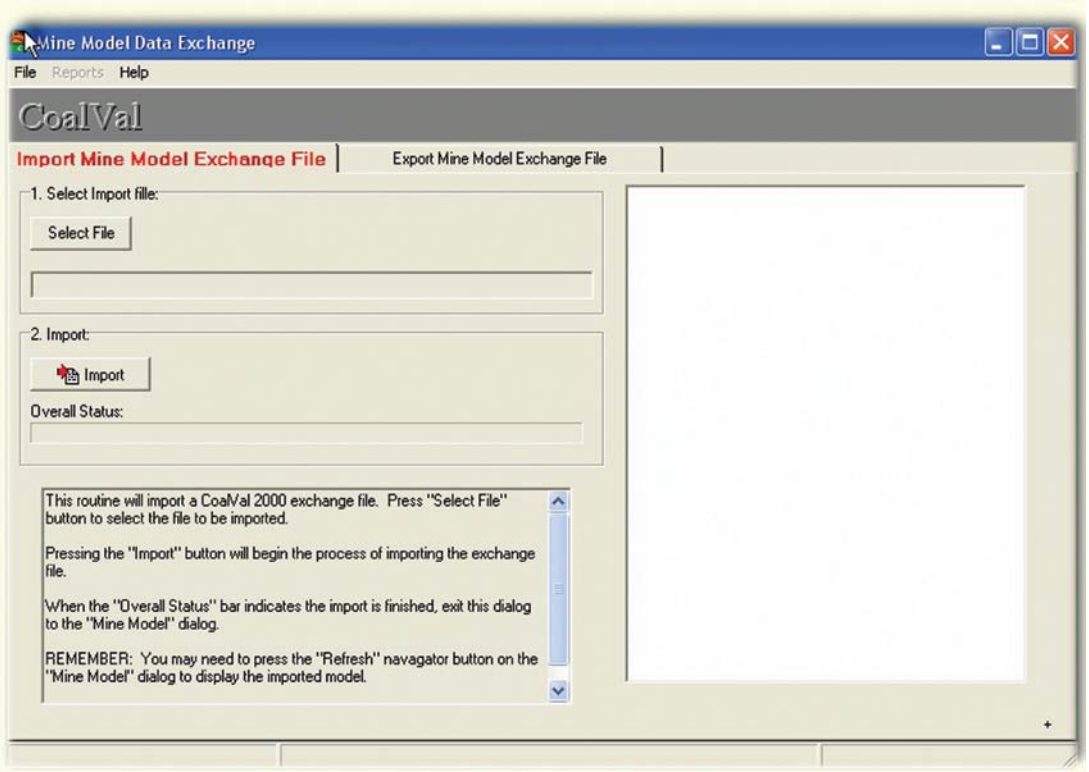


Figure C.51. CoalVal's Import Mine Model Exchange File tab located under the Mine Model Data Exchange dialog window.

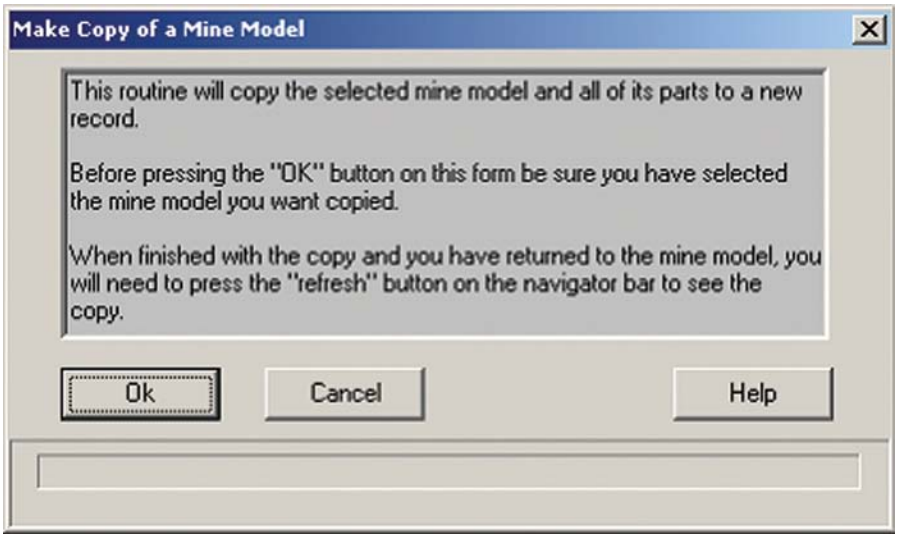


Figure C.52. CoalVal's Make Copy of a Mine Model dialog window.

Figure C.53. CoalVal's look-up tables dialog window.

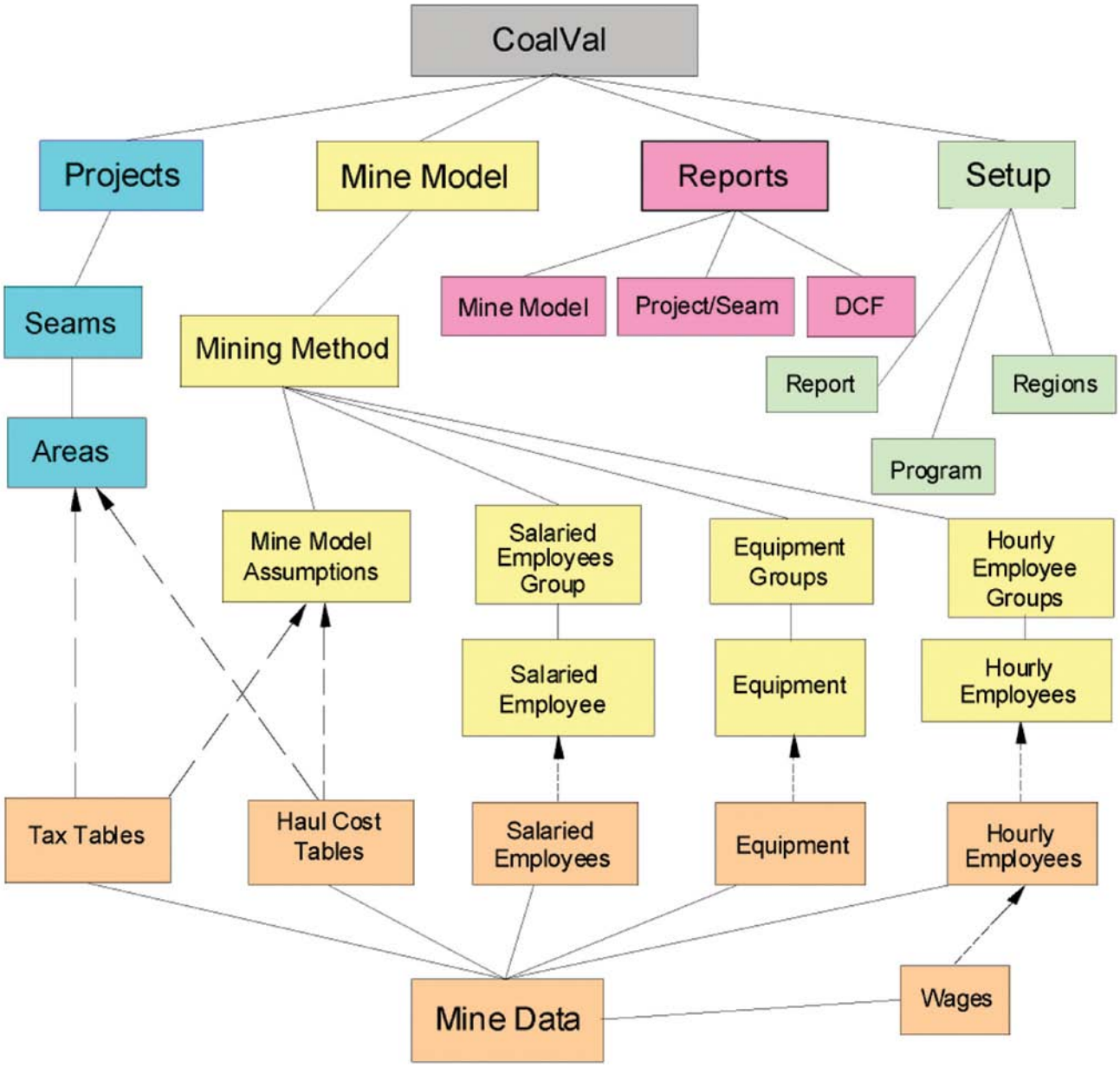


Figure C.54. CoalVal's program organization diagram showing the different connecting functions by color codes.

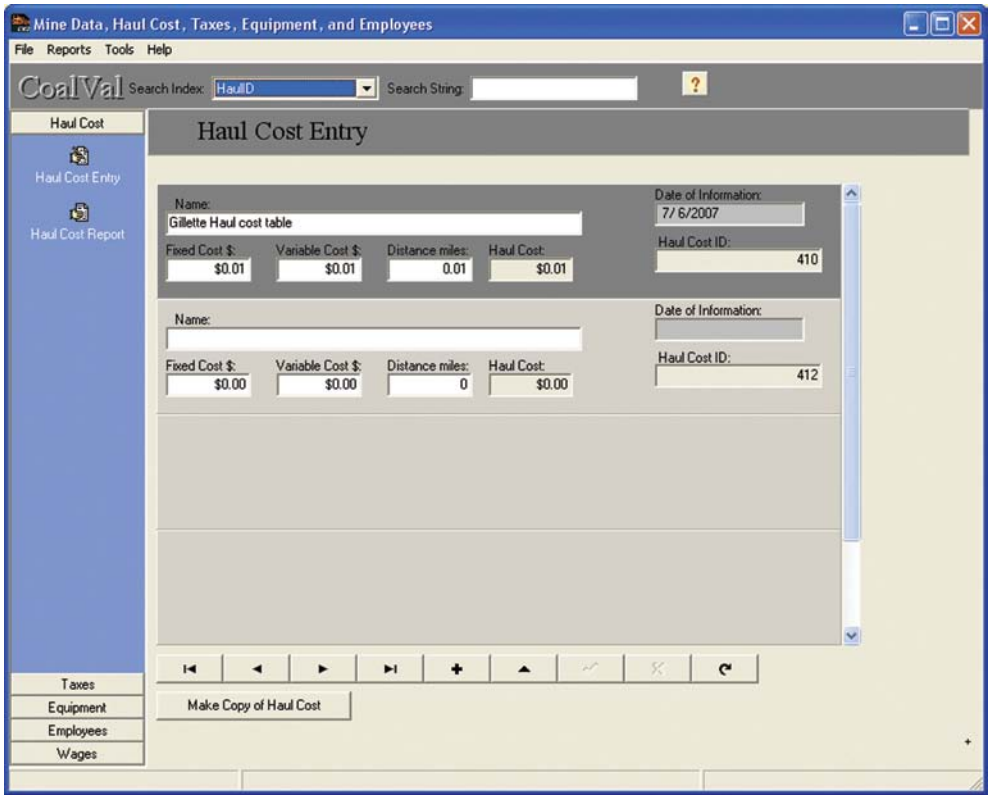


Figure C.55. CoalVal's Haul Cost Table dialog or data entry information menu for the Mine Model.

Cost Table, and a **Tax Table** for the program to perform its operations. If there is no contract **Haul Cost** (for example, mines in the Gillette coalfield), a table must be developed and very small values used for costs and distance (for example $0.01/ton and 0.01 miles). *Enter a name for the **Haul Cost Table** (fig. C.55), then enter the fixed and variable cost and the mileage*. The program will calculate the cost and place it in the **Haul Cost** field (fig. C.55). The following is a list of data input fields and their associated definitions for the **Haul Cost Data Entry Table**:

Data Field	Definition
1.Name:	The name for the **Haul Cost Data Entry Table**.
2. Fixed Cost:	The cost of loading the raw coal into the truck at the mine site.
3. Variable Cost:	The cost of hauling the coal on a dollar per ton-mile basis, from the mine to the wash plant or loadout.
4. Distance:	The distance from the mine to the crushing, washing, or loadout facilities.
5. Date of Information:	This optional field can be use to help the user to know when the data entry table was last updated.

Tax Table

The **Tax** look-up table is divided into five areas (fig. C.56). The first area includes the name of the **Tax Table**, market price of the coal, valuations and income taxes. The market price is used in the calculation of **Project Reports**. **Mine Models** do not use it. The other four areas are for Royalty Rates, State Sales Tax, Property Tax, and Environmental Taxes. Enter a value for the items needed in the **Mine Model** or **Project**. If the **Mine Model** does not need a tax rate or Royalty, then enter a zero for it.

The CoalVal **Tax** Table contains dollar values, tax rates, and valuation rates to be used for each coal taxation district and includes a cost for acquiring undeveloped coal. *Create and enter a "Name" for a "Tax Zone."* This name may indicate in which tax district it is and whether the mineral rights are owned by the mining company or are leased from the state or Federal Government. The "Contract per Ton" price is only used to calculate the Royalty Rates, Taxes, and Fees on the annual cash cost statement in the **Mine Model** and the **Project-Seam Reports**. The annual cash cost statement summarizes the cash cost of continued mining operations but does

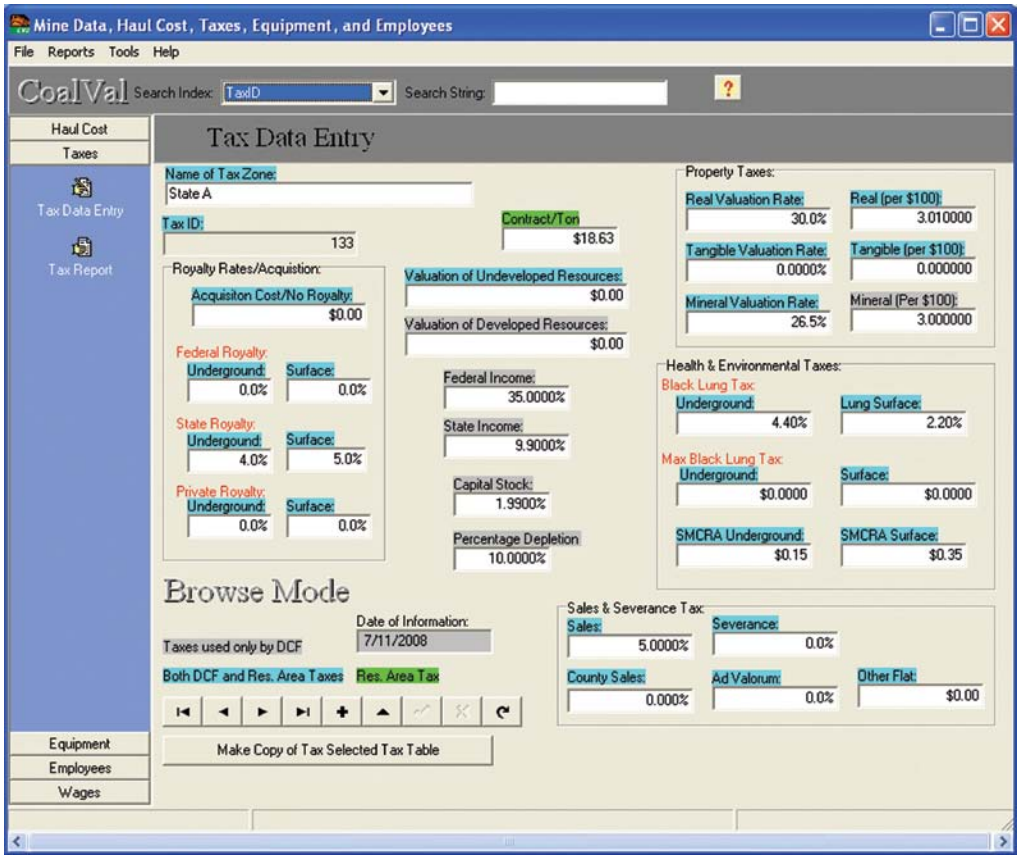


Figure C.56. CoalVal's Tax Data Entry Table dialog used for data entry.

not include sunken costs such as Capital Expenses, Property Acquisition, Property Exploration, and Development Costs.

The threshold price for individual coal **Resource Areas** is calculated in the Discounted Cash Flow Analysis part of the program. At the threshold price, the net present value (NPV) of after-tax income over the mine life equals the capital investment where price-based royalties and taxes are calculated on the threshold price independent of market pricing.

Typically, there is an acquisition cost for the mineral rights whether private, state, or Federally owned. CoalVal requires only one entry under the royalty portion of Royalty Rates and Acquisition costs; otherwise, multiple taxes and fees will be calculated. Acquisition Costs cover the cost of acquiring the in-place coal at undeveloped properties. The dollar per ton value entered will be multiplied by the amount of in-place coal in the ground. Royalty fees are paid annually as a percentage of the sales price on the coal sold that year. The CoalVal **Tax Data Entry Table** (fig. C.56) allows for the entry of royalty fees depending on ownership and whether the mining is surface or underground. Ownership can be either Federal, state, or private. Because the **Mine Models** are specified as either underground or surface, CoalVal will assign surface royalty or underground royalty depending on the **Mine Model** type.

The CoalVal **Tax Table** enables the user to assign common Royalty Rates to particular ownership categories that are summarized in a CoalVal report according to ownership. A separate **Tax Table** is necessary for each kind of Royalty Rate or acquisition cost calculation in order to calculate either an acquisition cost or a royalty fee based on surface or underground mining. CoalVal's **Tax Data Entry** fields are found in the following list and defined in detail in the Glossary (appendix E).

Tax Table Data Entry Fields:

1. Acquisition Costs
2. Ad Valorem Tax
3. Black Lung Tax Rate
4. Capital Stock Tax
5. Contract/Ton
6. County Sales Tax
7. Date of Information
8. Federal Income Tax
9. Maximum Black Lung Tax
10. Name of Tax Zone
11. Other Flat Taxes
12. Percentage Depletion
13. Property Taxes
14. Property Tax Rate (per $100)
15. Royalty Rates
16. Severance Tax
17. SMCRA
18. State Sales Tax
19. State Income Tax
20. Valuation of Developed Resources
21. Valuation of Undeveloped Resources
22. Valuation Rate

Equipment Table

The **Equipment** look-up table is where the mining equipment is entered for **Mine Models**. Each piece of **Equipment** has a name, unit price for the equipment, fuel and lube cost, repair and maintenance cost, and depreciation in hours (fig. C.57).

The **Equipment Entry Table** dialog page is shown in figure C.57. This page is not just used for equipment such as loaders, trucks, and shovels, it is also used for surface roads, buildings, rail loops, tipple facilities, dewatering, power centers, transmission line, sewage treatment, and site development. Required data for CoalVal's **Equipment Entry Table** for **Mine Models** is listed here and the detailed definitions are found in the Glossary (appendix E).

Data required to complete an **Equipment Entry Table**:

1. Date of Information
2. Equipment ID
3. F&L (fuel and lube) Cost/Hr
4. Name (of equipment)
5. R&M (repair and maintenance) Cost/Hr
6. Surface Facilities
7. Unit Cost
8. Years for Depreciation

Salaried Employee Table

Salaried Employees require a job name for the position, an annual salary, and the date of the information. CoalVal will assign the employee ID number automatically. Figure C.58 shows the data entry field for the **Salaried Employee Table**.

Hourly Employee Table

For the **Hourly Employees Table** dialog page the user needs to remember to make sure that the wages needed are entered before adding an employee to the table. Figure C.59 is an image of the **Hourly Employee Data Entry** dialog. By c*licking on the employee's "Grade," a data entry field will display a dialog box that lists all the positions entered into the* ***Wages Schedules Entry*** *dialog (fig. C.60)*. *Select the appropriate position and click the OK button*. CoalVal's hourly employee data entry fields are shown in the following list and defined in the Glossary, appendix E):

1. Date of Information
2. Employee Category
3. Grade/Classification
4. Mechanic box (contractor)

Wages Table

For the Wages look-up table (fig. C.61), *enter a name for the employee grade, and then enter a grade code, followed by the base hourly rate.* The **"**Reference" field is used to add reference information, such as databases and reports where the wage information originated. The following list contains the data entry fields for the **Wages Table**. Detailed definitions can be found in the Glossary, appendix E.

1. Base Rate
2. Date of Information
3. Grade Code
4. Grade Name
5. Reference
6. Wages ID

Baggage Collection

After CoalVal has been used for a while and data has been entered and deleted from a few mine models, there may be tax tables, haul cost tables, employees, and equipment that are no longer used in the look-up tables. If the user wants to remove these items from the database, the **Baggage Collection** dialog is used. The **Baggage Collection** can be accessed by navigating through the **Main Menu/Mine Models/Tools drop-down list/Mine Data** dialog pages to the **Tools** drop-down menu on the **Mine Data** dialog (fig. C.62). To view items that are not used by a mine model or project, press one of the six look-up table buttons in the lower left hand corner of the "Select Baggage Collection" tab (fig. C.63).

In the figure C.64, the "Equipment" tab on the Baggage Collection dialog was pressed. A report of the equipment that is not used by any mine models is seen. If all the unused items are to be deleted, *click on the "Select Baggage Collection" tab, then select the "Delete any extra stuff" radio button* (fig. C.65), and *click on the "Equipment" button*. All the unused equipment will be deleted.

Projects

The **Projects** dialog window is the place to create or edit the coal resource and **Discounted Cash Flow** (DCF) **Projects**. This dialog has two pages: (1) **Projects,** and (2) **Seams, Areas, and Discounted Cash Flows**. To edit a project, simply *select it by right-clicking with the mouse button.* To create a new project, *click on the "insert" (+) button of the* ***Project*** *page's Navigation Bar*, *enter a name for the project, a date, and comments*. After the **Project** page information has been entered, *click on the* ***Seams, Areas, and Discounted Cash Flows*** *tab to enter the seams to be evaluated*. Remember, each **Project** can have several **Seams**, but there must be at least one, and each **Seam** must have at least one **Area**.

The **Projects** dialog window (fig. C.66) is accessed from the **Main Menu**. *Click on the* **Projects** *icon or menu item and the page displayed should look similar to figure C.66*. The calendar shown on the figure C.66 is visible when the data field is opened by *clicking on the button located on the right side of the date field*. The "Less Than**"** field is the mining restriction where coal mining cannot continue because the seam height is less than the height of the mining equipment. This data can be entered manually by hand or imported using CoalVal's import functions. In the eastern coalfields of the United States, CoalVal mine models are planned to use a 12 in. minimum

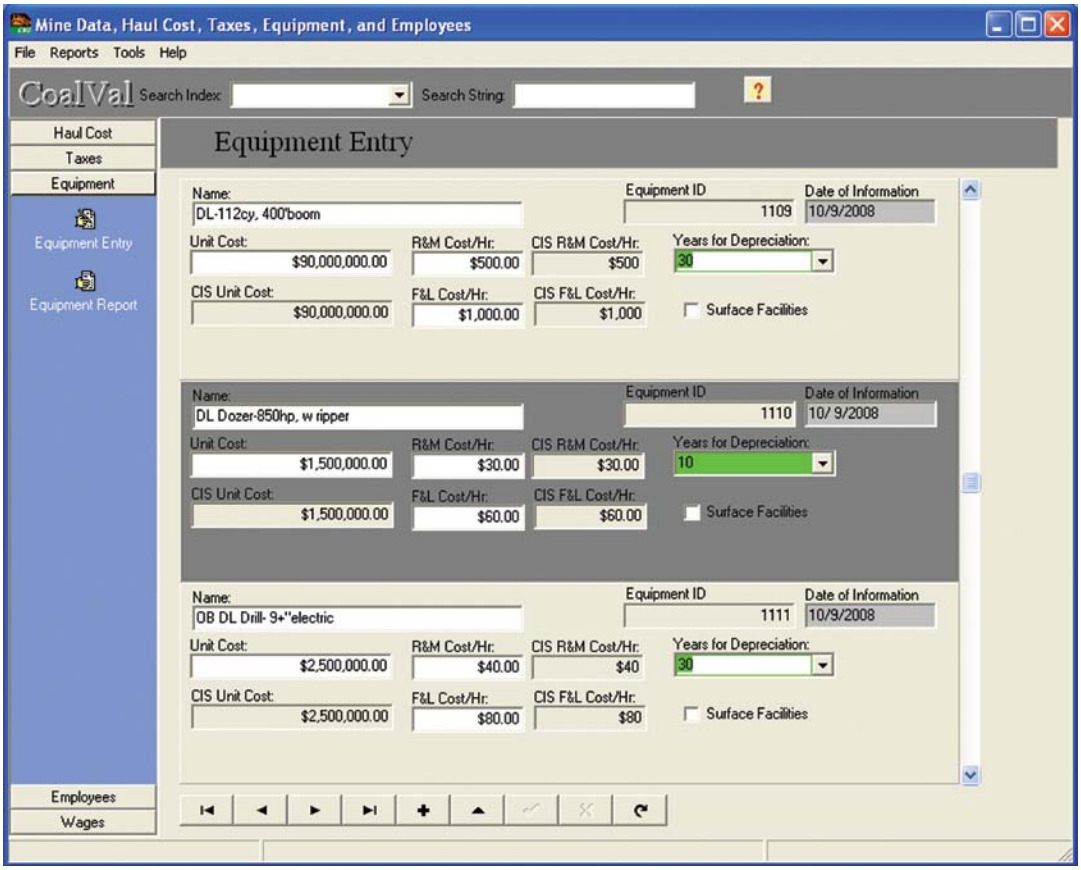


Figure C.57. CoalVal's Equipment Entry Table dialog used for equipment data entry.

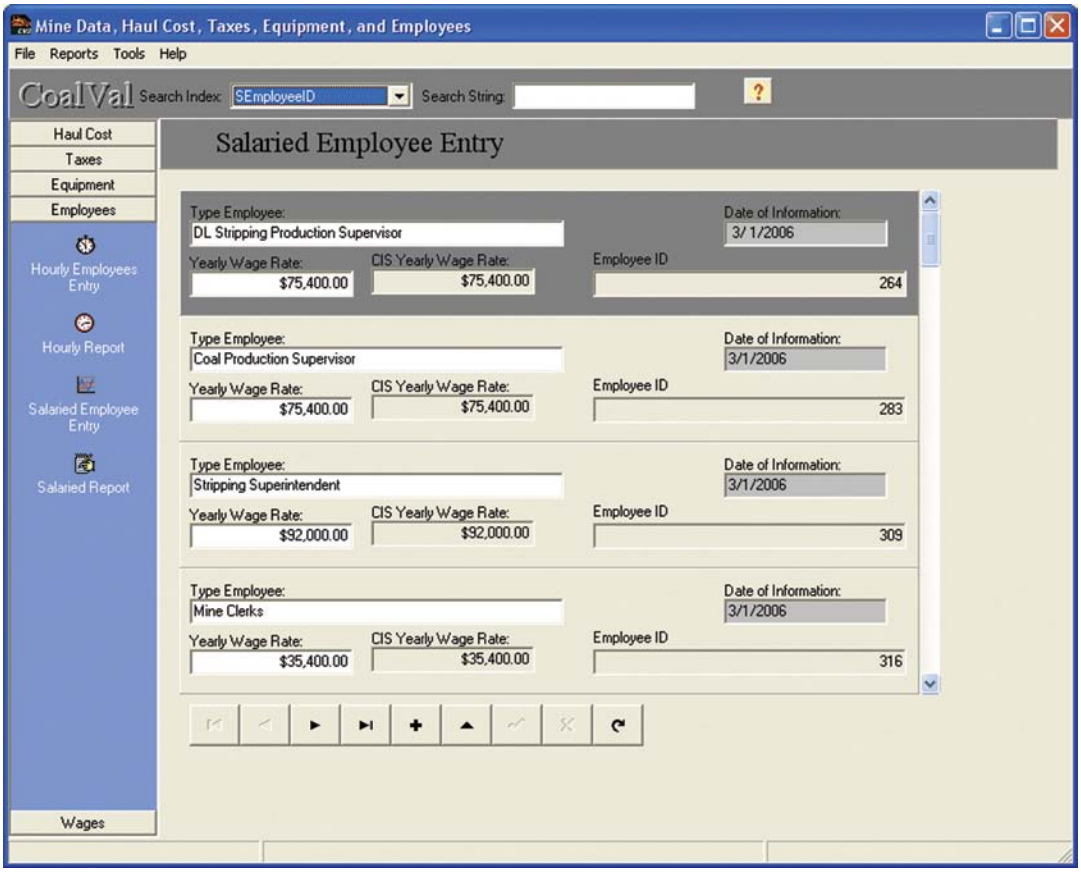


Figure C.58. CoalVal's Salaried Employee Entry pay information dialog page.

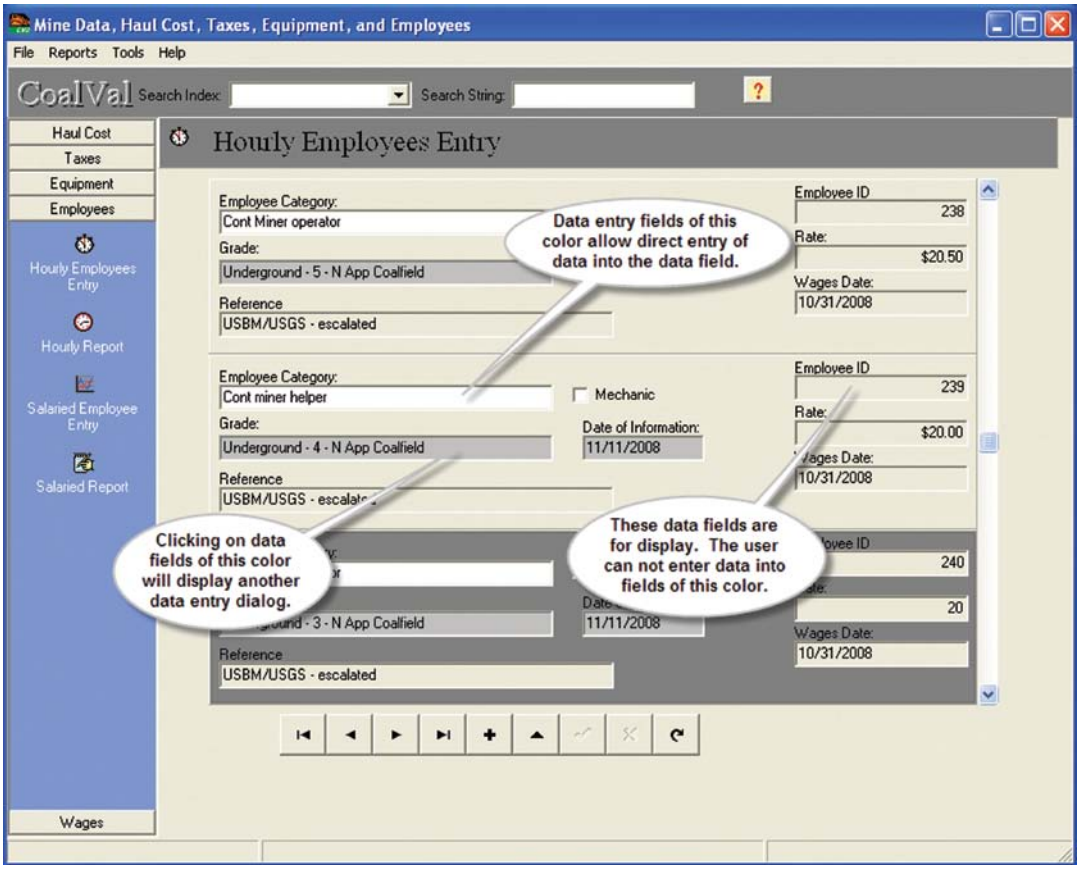


Figure C.59. CoalVal's Hourly Employee Entry dialog window.

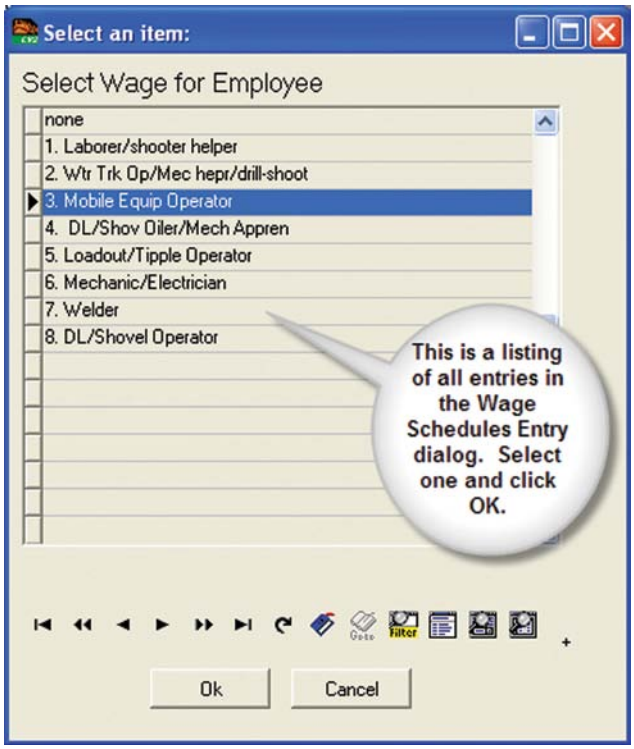


Figure C.60. CoalVal's Hourly Employee Wage information dialog page.

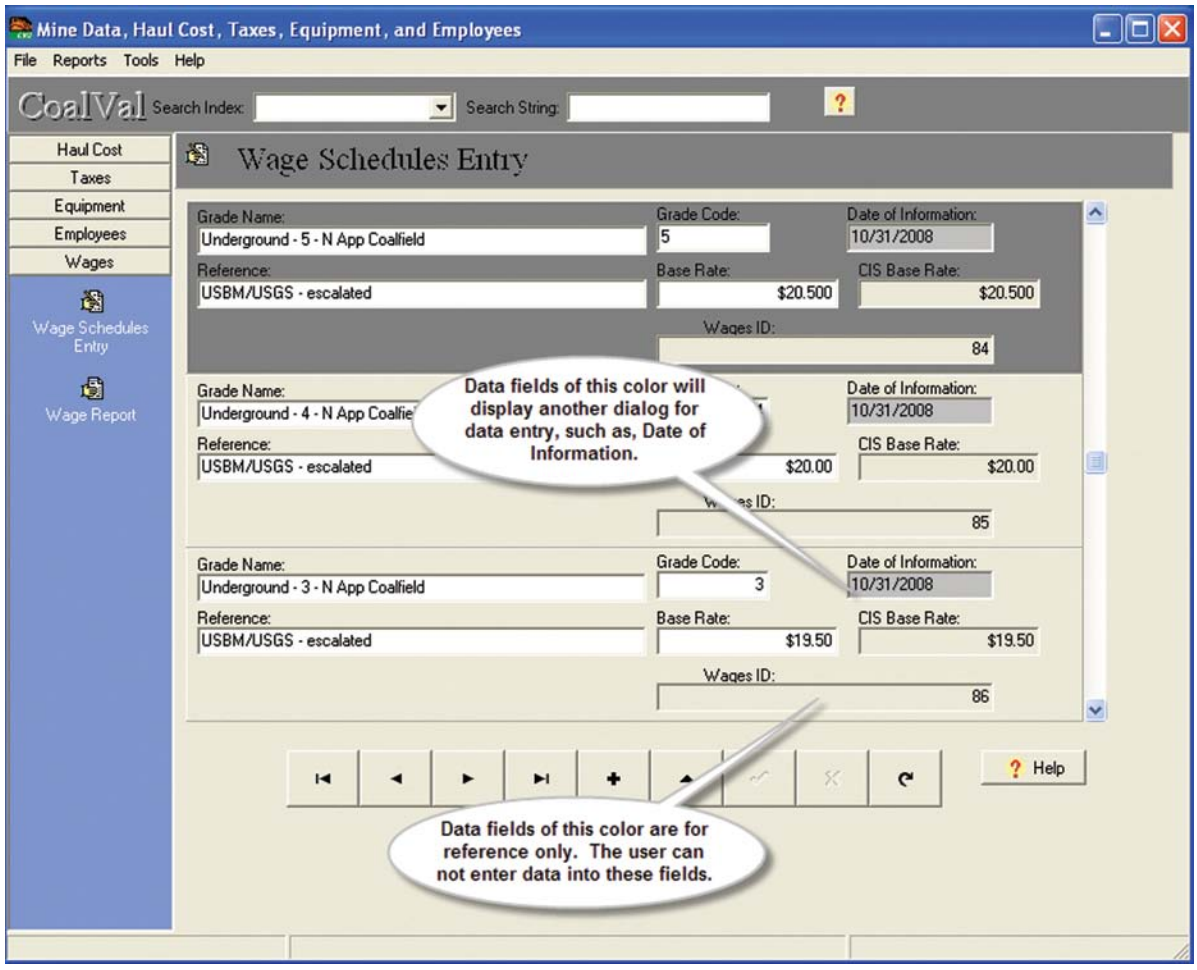


Figure C.61. CoalVal's (Hourly) Wage Schedules Entry by job definition dialog page for data entry into the Wages Table.

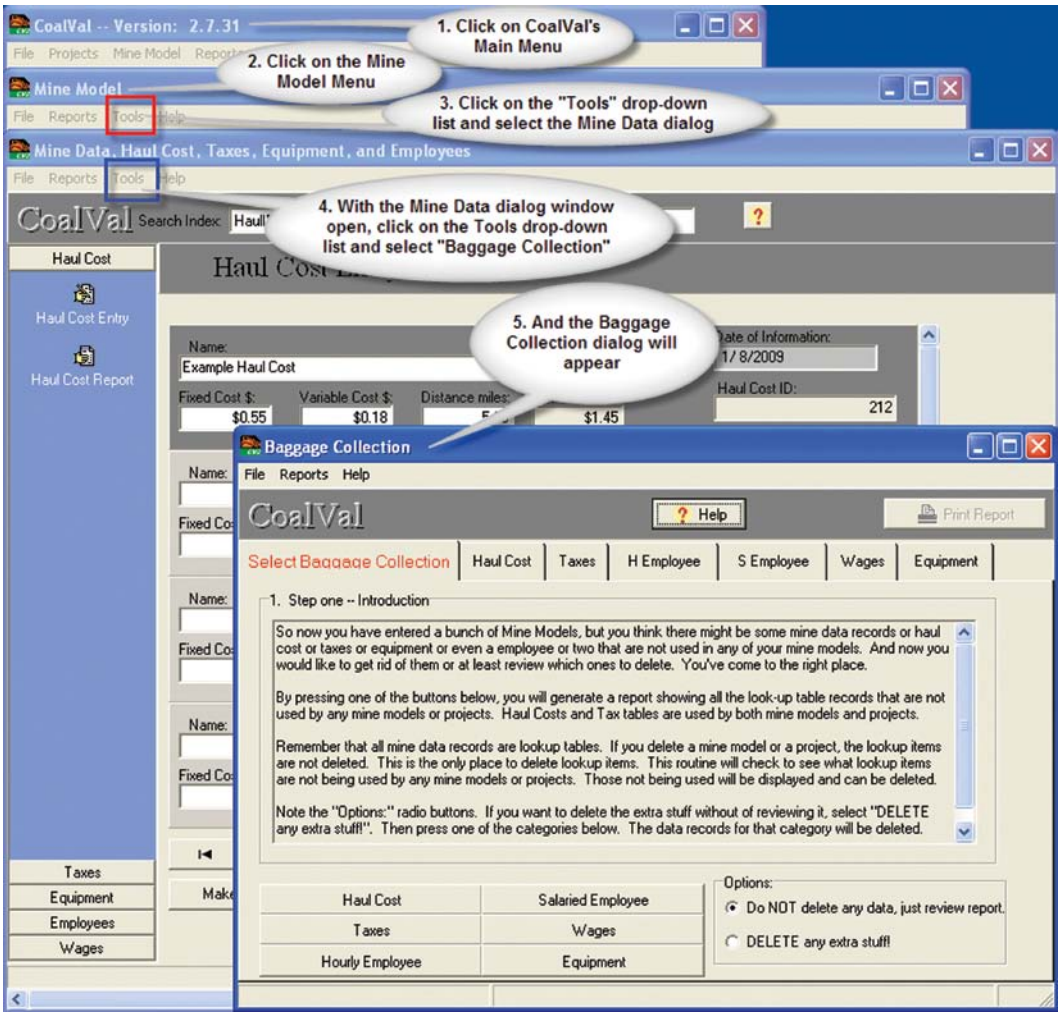


Figure C.62. Navigating to CoalVal's Baggage Collection dialog window.

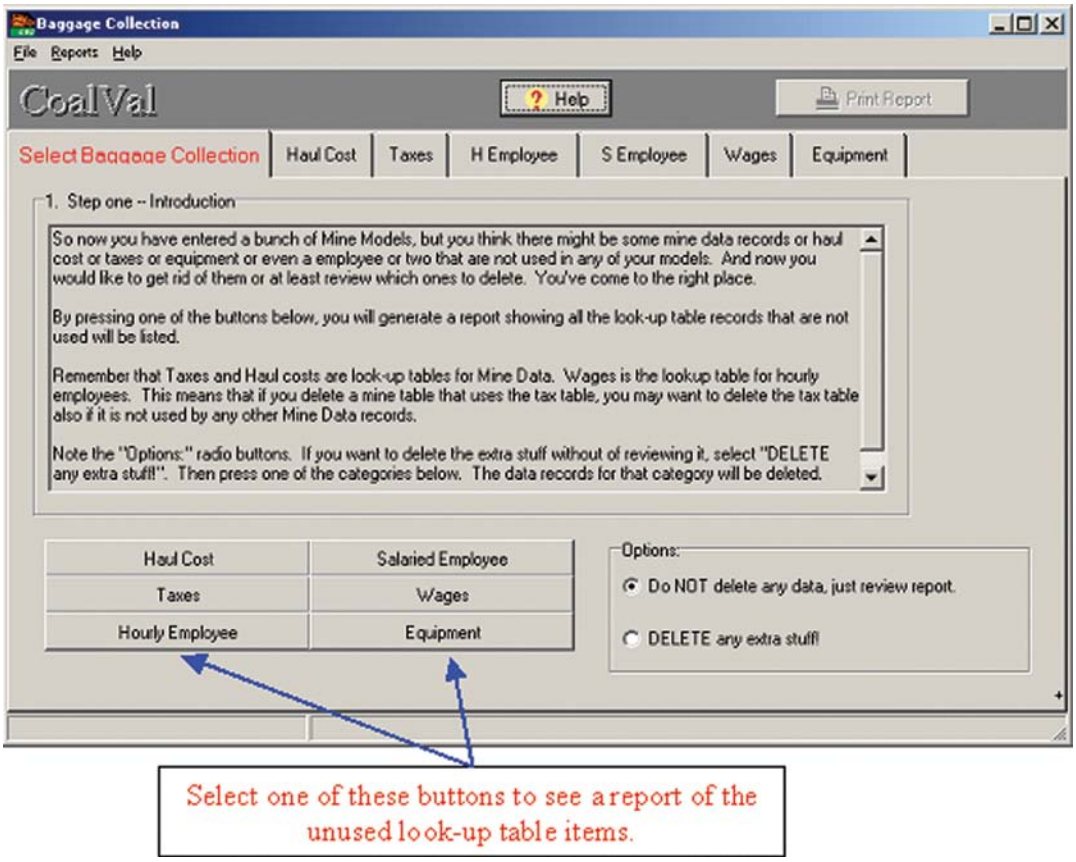


Figure C.63. CoalVal's review of Baggage Collection dialog page used to delete unused data records.

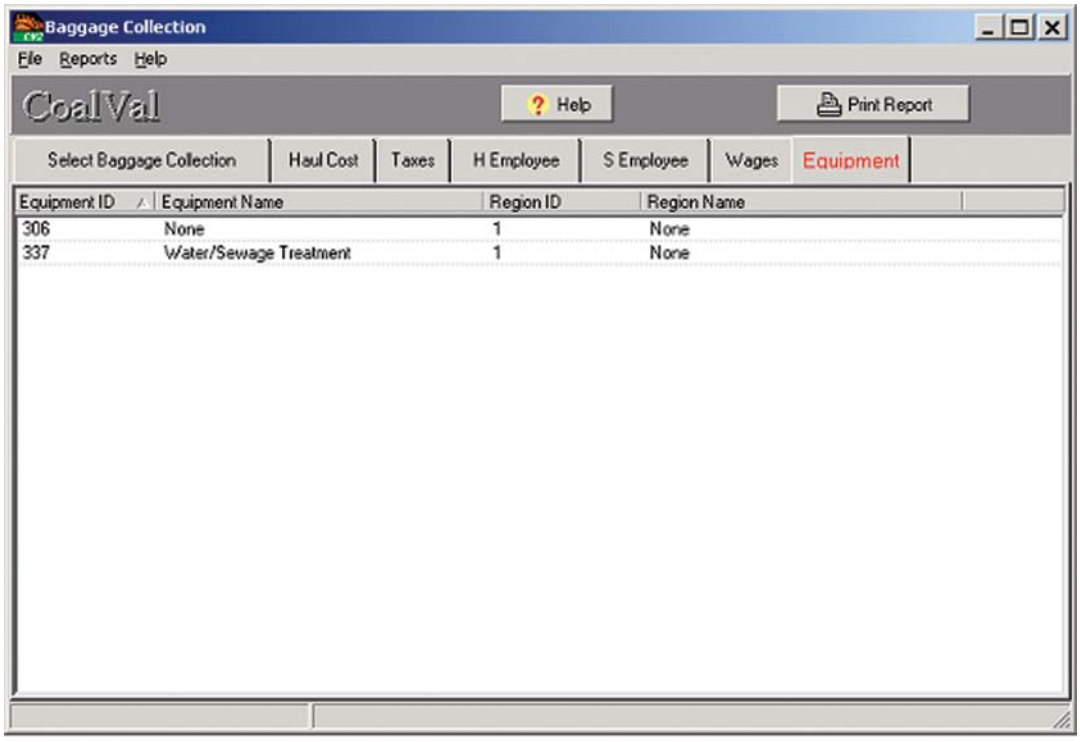


Figure C.64. CoalVal showing the Equipment look-up table's unused data using the Baggage Collection dialog page.

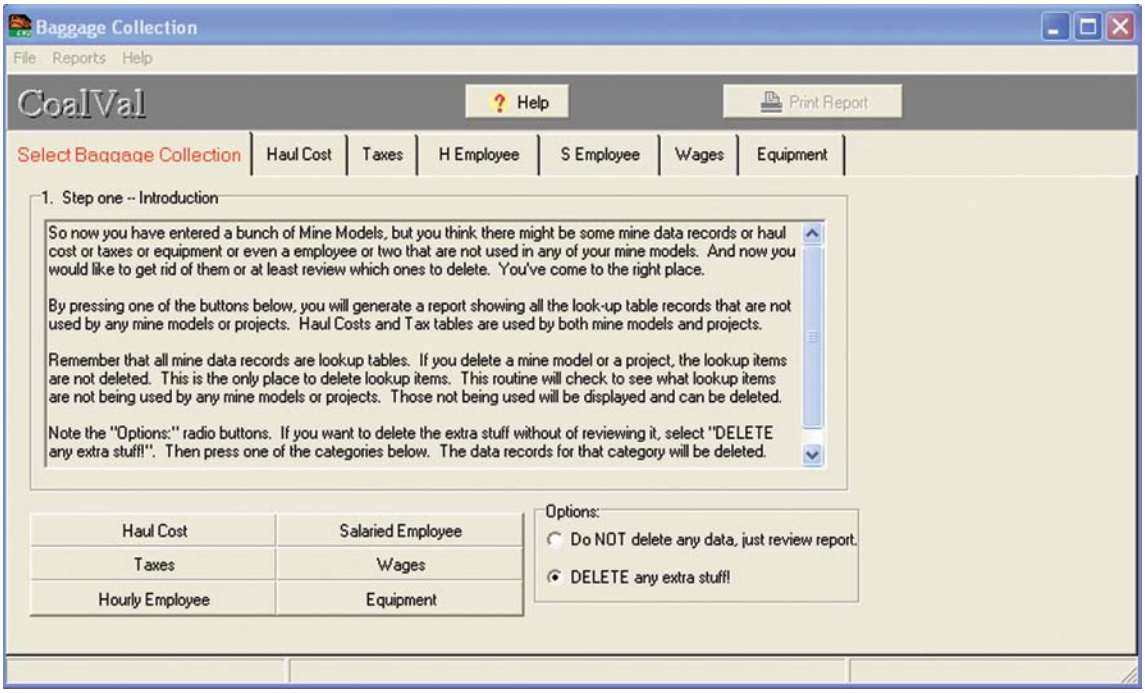


Figure C.65. Selecting the "DELETE any extra stuff" radio button to delete unused equipment files.

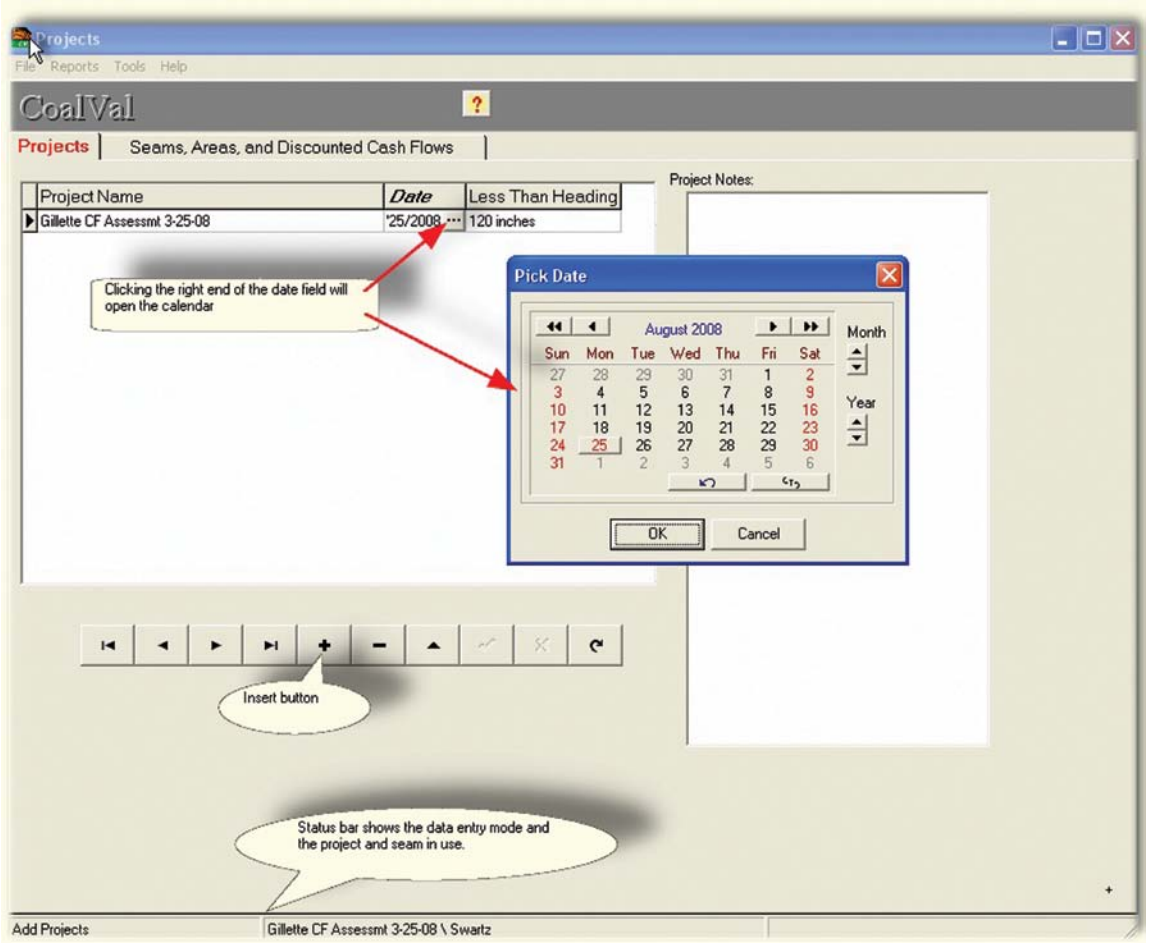


Figure C.66. The CoalVal Project dialog window.

thickness for coal beds to be surface mined or 24 in. thickness for underground mining. The amount of coal resources restricted by the minimum thickness should be entered on the **Seam** page.

Seam

The **Seams** tab is located on the **Seams, Areas, and Discounted Cash Flows** dialog tab (fig. C.67). There must be at least one **Seam** for each **Project**, but a **Project** can have as many **Seams** as needed. The memo field for "Seam Notes**"** is an area used to enter additional information concerning the seam. That information will be printed in the **Seam Report**.

It should be noted that the "Moist MMF Btu**"** (Moist Mineral Matter Free Btu) field and the "Total Tons to Market" are calculated fields. Values entered for "sulfur," "moisture," "ash," and "Btu" are used by CoalVal to calculate the "MMF Btu" value and place it in the "Moist MMF Btu" field. Table C.1 shows the coal resource and coal-quality data entry fields on the **Seam** dialog page.

Coal Resource and Discounted Cash Flow Areas

After entering the seam information, the **Areas** can be created. *Click on the **Coal Resource and Discounted Cash Flow Areas** tab to display the **Coal Resource and Discounted Cash Flow Areas dialog** page (fig. C.68)*. It should be noted that each seam can have an unlimited number of **Areas** and that when an area is entered, it is related to the seam selected on the **Seam** page. Therefore, it is important to make sure the correct seam is selected prior to entering area data.

To create an **Area**, *click on the "insert" (+) button on the Navigation Bar*, *and then enter the data*. The "Washed?" check box determines which cost per ton for coal preparation the **Project** and **Seam** reports will use. If the box is checked, then a cost per ton for washing the coal will be added to the operating costs; if it isn't checked, the raw coal cost per ton will be used. The **Tax** and **Haul Costs** are look-up tables (See **Mine Data**) that should already be entered. If they have not been developed, the tables can be accessed by *clicking on the **Edit/Add Tax Table** or **Edit/Add Haul Table** buttons.* Next, *select the **Mine Model** that is appropriate and has been developed for the new area*. The **Mine Model** is used to calculate the washed and raw coal cost per ton. The **Mine Model** can be printed for reference by running the **Mine Model Report** under the **Reports** menu. Whenever production assumption or cost data in the **Mine Model** is changed, the **Mine Model** costs will change. It is a good exercise to keep a log of changes and reference **Mine Model Reports** to keep track of the changes and their effects on coal recovery and mining costs. Table C.2 shows the data entry fields for the **Area** dialog. Table C.3 shows the calculated fields for Discounted Cash Flow analysis.

The Net Present Value (NPV) method of financial analysis uses the hurdle rate to calculate a market price where the NPV is zero. CoalVal calculates the market rate to the thousandth of a dollar ($0.001).

Area Review

The **Resource Area Data Review** dialog is found on the **Project** dialog window under the **Tools** drop-down list. When selected, the **Area Review** dialog will appear (fig. C.69). The **Area Review** dialog allows the user to review the tons of coal and partings for the different mining methods and export the data shown to an excel workbook. The button on the top left of the form allows the user to toggle between "View Coal Tons" and "View Parting Tons." The pull-down selection box allows the user to select the mining method. The close button will close the dialog and return the user to the **Project** window. The "Excel" button exports all the data in the **Area Table** in an Excel workbook.

Bulk Change Area Mine Model

The **Bulk Change Area Mine Model** dialog is found on the **Tools** drop-down list under the **Projects Menu**. When this item is selected, a dialog will appear (fig. C.70) that allows the user to *select a mine model from the* "*List of Mine Models Used by Areas" to be replaced by a mine model from the "List of all Mine Models."* When the OK button is clicked, all areas will be searched for the **Mine Model** in the first list, and when it is found, the **Mine Model** from the second list will replace the **Mine Model** in the first list.

Delete All Areas

The **Delete All Areas** item is found by *clicking on the **Tools** menu under the **Projects** dialog window and selecting **Delete All Areas** from the menu list*. The user can delete all **Areas** (fig. C.71) that have been entered for a coal seam by selecting the OK button on the Warning dialog.

Importing and Exporting Data Into Projects

There are five menu items in the **Tools** drop-down list under the **Projects** dialog window that can be used to import data into a **Project** or to export **Area** data.

- **Import From CSV file** – Imports mining data into either the **Seam Table** or the **Area Table** from a CSV file. The data imported are added as a new table record to the table.
- **Import From ArcView Table** (DBF Data Table) – Imports mining data into either the **Seam Table** or the **Area Table** from a DBF table. The data imported are added as a new table record to the table.

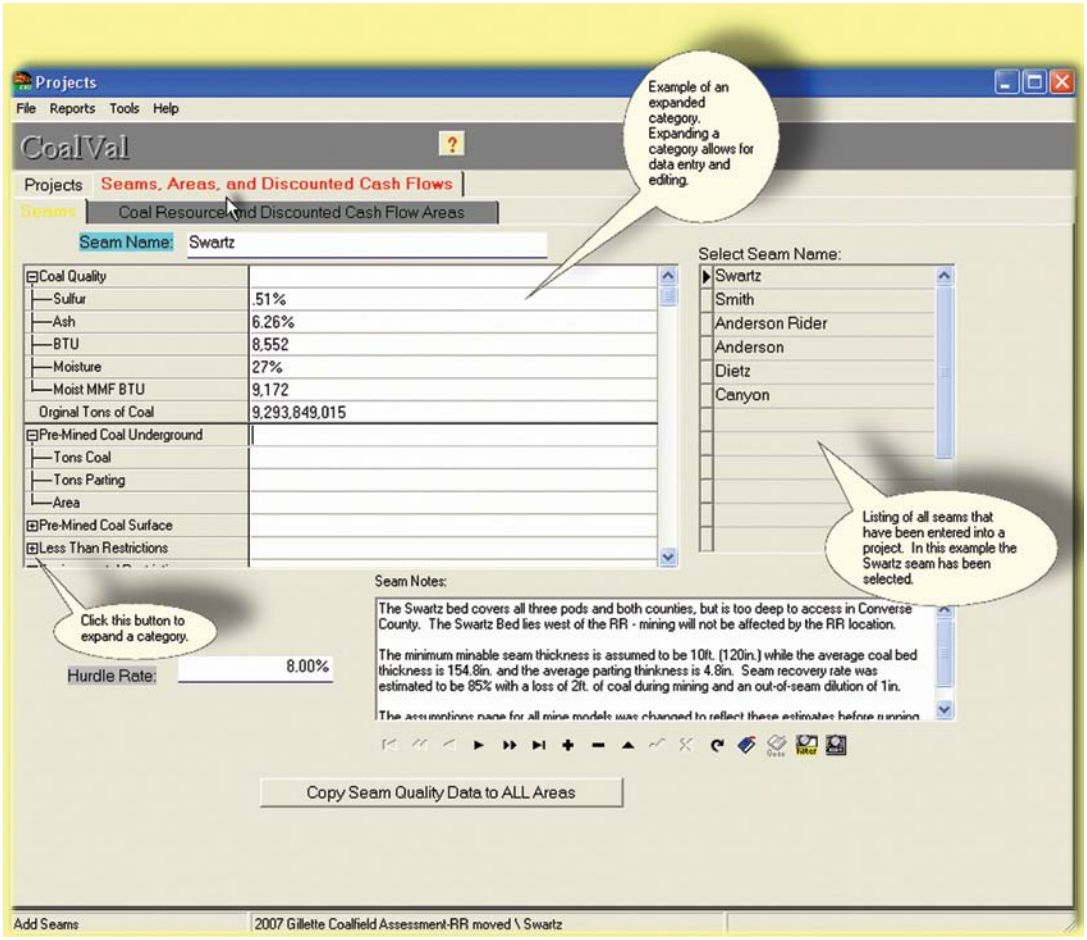


Figure C.67. CoalVal's Seams dialog window.

Table C.1. CoalVal's Seam dialog window data fields.

[Definitions in the Glossary, appendix E]

Coal Resource Fields	Coal-Quality Fields
Area	Btu
Barrier Restrictions	Coal Density
Environmental Restrictions	Copy Seam Quality Data to All Areas
Group on Mine Model	Dilution Density
Hurdle Rate	Moist MMF Btu
Less than Minable Thickness Restrictions	Parting Density
Logical Production Units	Percent (%) Ash
Original Tons of Coal	Percent (%) Moisture
Parting Barrier Restrictions	Percent (%) Sulfur
Parting - Environmental	Seam Name
Parting - Less than Minable Thickness	
Parting - Previously Mined - Surface	
Parting - Previously Mined - Underground	
Parting - Technical Restrictions	
Previously Mined Coal - Surface	
Previously Mined Coal - Underground	
Technical Restrictions	
Total Tons to Market for Calculated Resources	

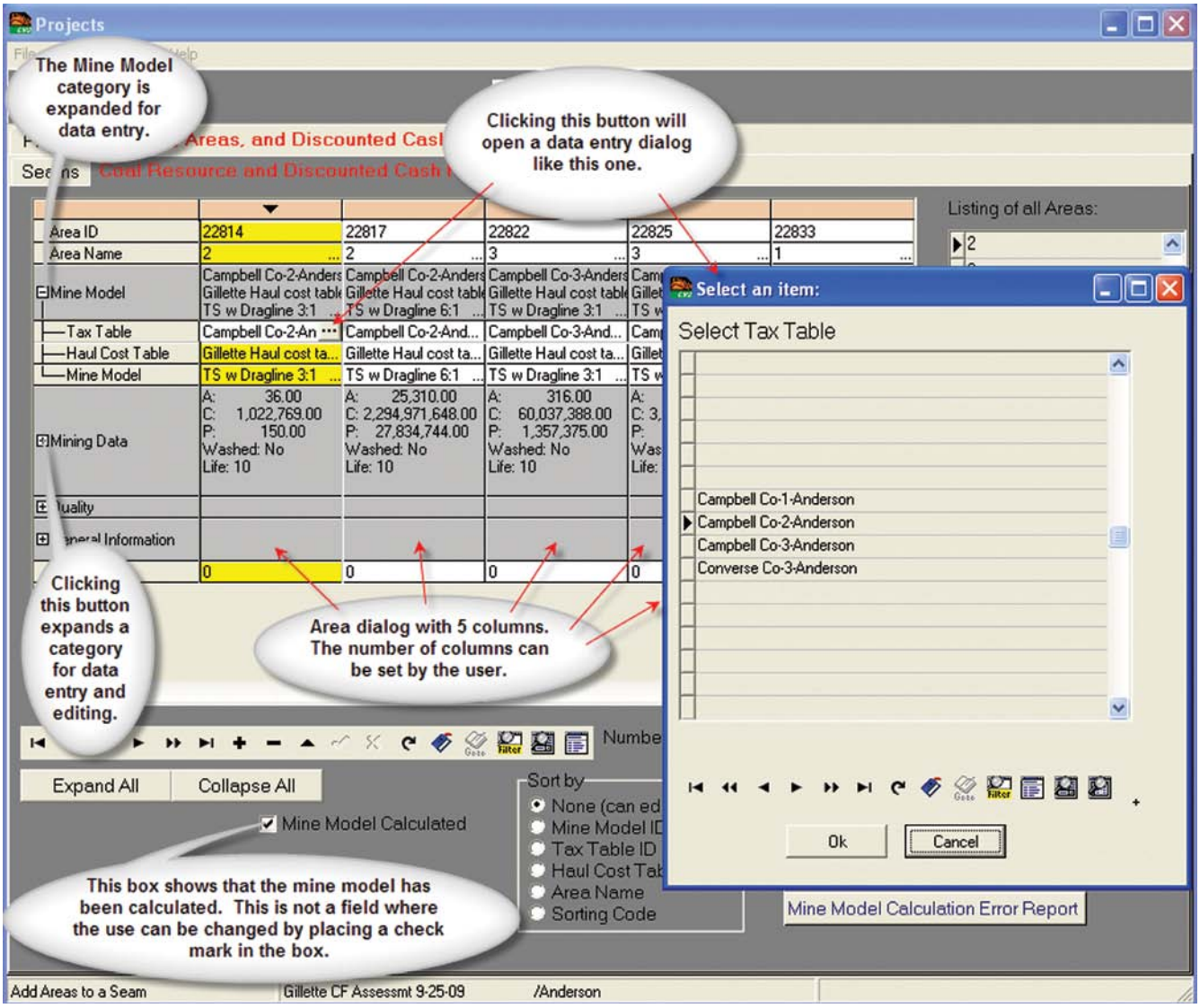


Figure C.68. CoalVal's Coal Resource and Discounted Cash Flow Areas dialog page with the Tax Table listing button activated. This results in the opening of "Select Tax Table" list.

Table C.2. CoalVal data entry fields for the Area dialog window.

[Definitions are found in the Glossary, appendix E]

Mining Fields	Other Fields
Area Acres	Coal Bed Name
Area Name	Mine life
Mine Model	Notes
Mine Model Calculated	Quality
Mined Partings Tons	Taxing District
Mined Tons of Coal	Tax Table
Washed?	

Table C.3. CoalVal calculated data fields for Discounted Cash Flow Analysis.

[Definitions are found in the Glossary, appendix E]

Mining Field	Economic Field
Dilution	After-Tax Rate of Return (time adjusted)
Logical Production Unit (LPU)	Discounted Cash Flow (DCF)
Partings	Free on Board (FOB)
	Hurdle Rate
	Net Present Value (NPV)
	NPV Method
	Threshold Sales Price

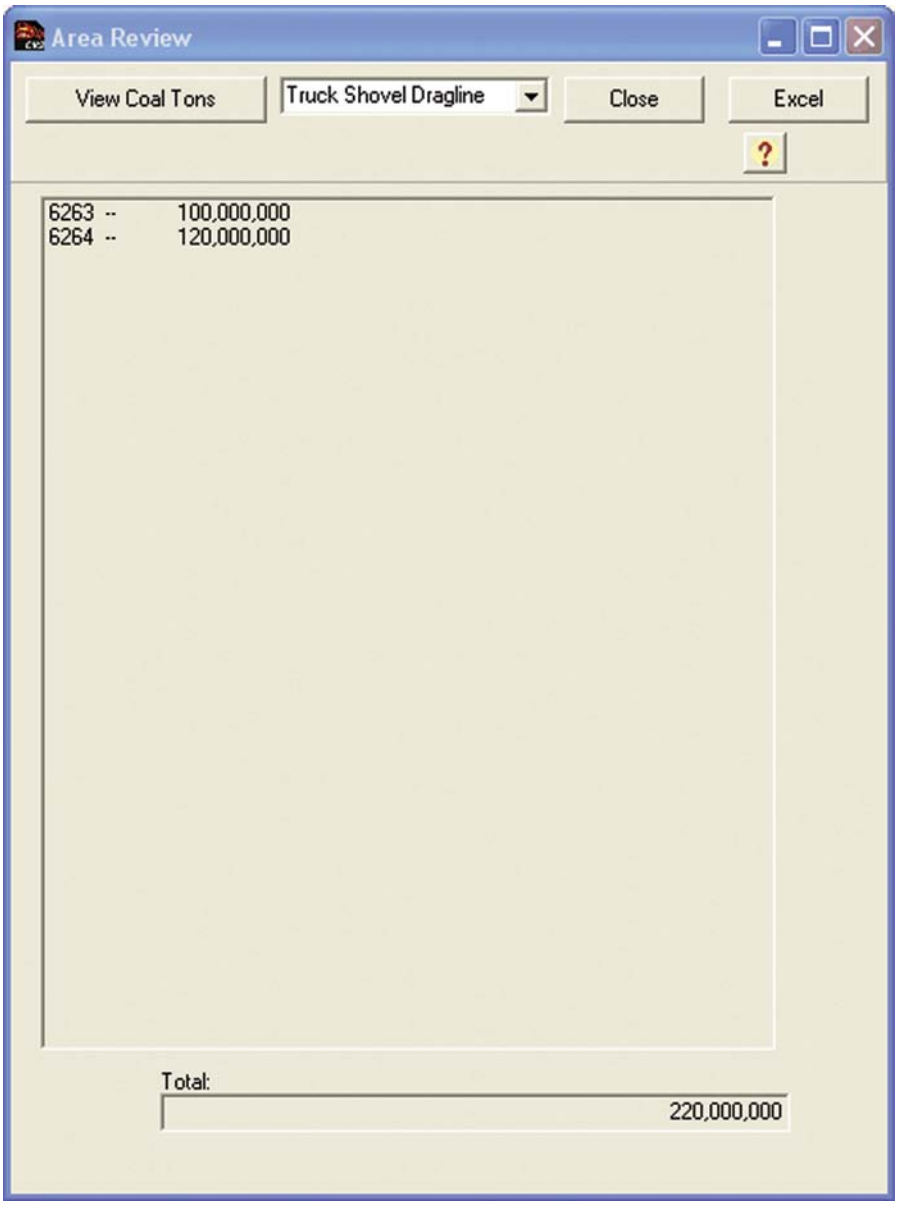


Figure C.69. CoalVal's Area Tonnage Review dialog window.

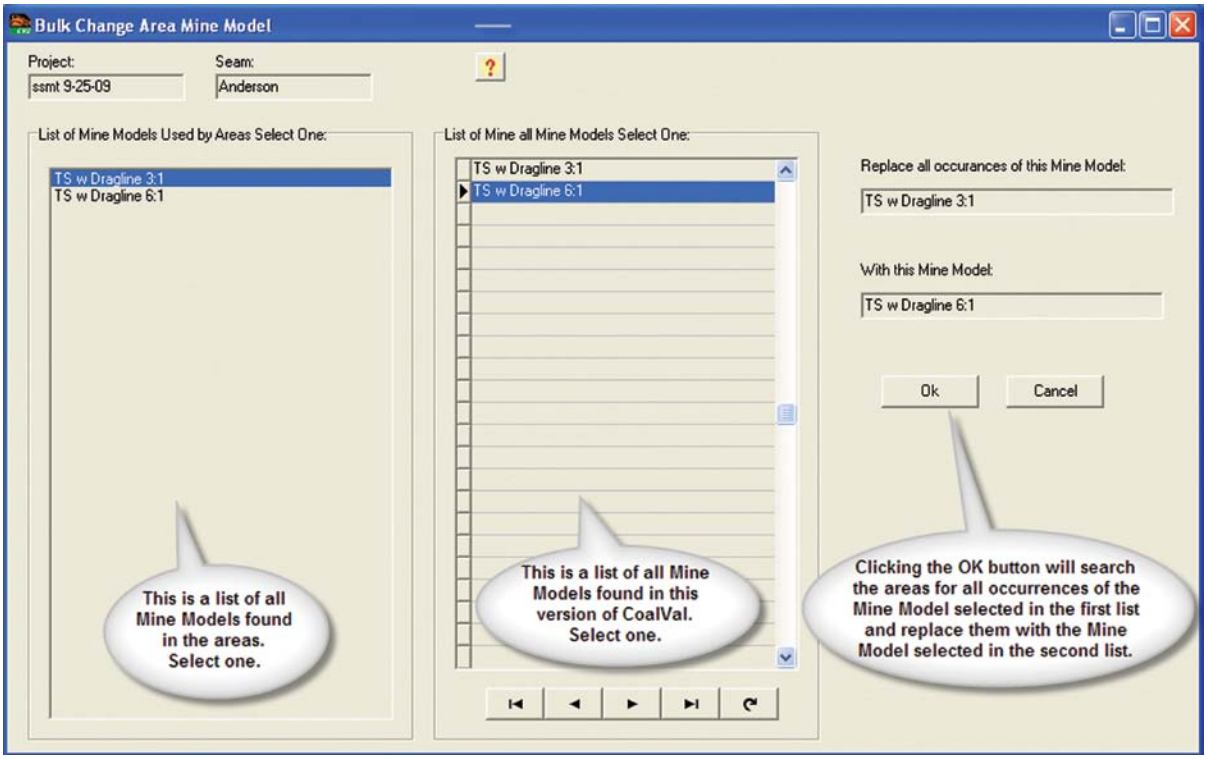


Figure C.70. CoalVal's Bulk Change Area Mine Model dialog page.

- **Import Quality Data From CSV file** – Imports data into the **Area Table** from a CSV file. The data are appended to the existing records in the tables.
- **Import Quality Data From DBF file** – Imports data into the **Area Table** from a DBF file. The data are appended to the existing records in the tables.
- **Export Area Table Data** – Exports data in the **Area Table** to a DBF, CSV, or Excel workbook.

Importing Mining Data From DBF/CSV Files—Developing a Schema

Clicking either the **Import From CSV File** or **Import From ArcView Table (DBF Data Table)** will display the **ArcView Import and Export** dialog. Before a whole table or file can be imported into CoalVal, the user needs to let CoalVal know how to relate the file to be imported to its database. This is done through the creation of a schema (fig. C.72). Once created, the schema can be used any time to import a file with the same data structure as the one used to create the schema.

To create a schema for the importing of data, *click on the **Create DBF or CSV Import Schema** tab*. Then *click the* "*Open ArcView Table*" *button*. *Find the table and open it.* Next *click the "Create DBF/CSV Schema**"** button and enter a name for the schema*.

Creating a schema involves selecting a field from the "DBF/CSV Fields:" pull-down menu, selecting a CoalVal field and clicking the "Accept Relationship" button. *Click on the down arrow of the "DBF/CSV Fields:" component and select a field name (fig. C.73)*. Next, *select the CoalVal field from the CoalVal field list shown in figure C.73* Then, *click the* "*Accept Relationship" button and finish adding all the relationships needed by repeating the last three steps*.

The CoalVal field, "Washed?" (fig. C.73), uses a value in the DBF or CSV import file of "0" to mean the coal is not washed. A value of "1" means the coal is washed. The Create Schema page can also be used to import data into a **Project's Seams Table**. Figure C.74 shows some of the **Seam Table** data fields that can be used to relate import fields to CoalVal **Seam** fields. It is important not to create a schema with both **Areas** and **Seam** import fields.

A Mine Model ID can be imported into the "Mine Model ID" field. This "Mine Model ID" corresponds to a mine model on the **Mine Model** dialog. Figure C.75 shows the **Mine Model** dialog with a **"**Mine Model ID" highlighted. If the DBF or CSV table has a data field with a "Mine Model ID" it can be imported into the **Area Table**. If the **"**Mine Model ID" imported is 100, that area would be using a "Truck-Shovel (TS) with Dragline 3:1" mine model (fig. C.75).

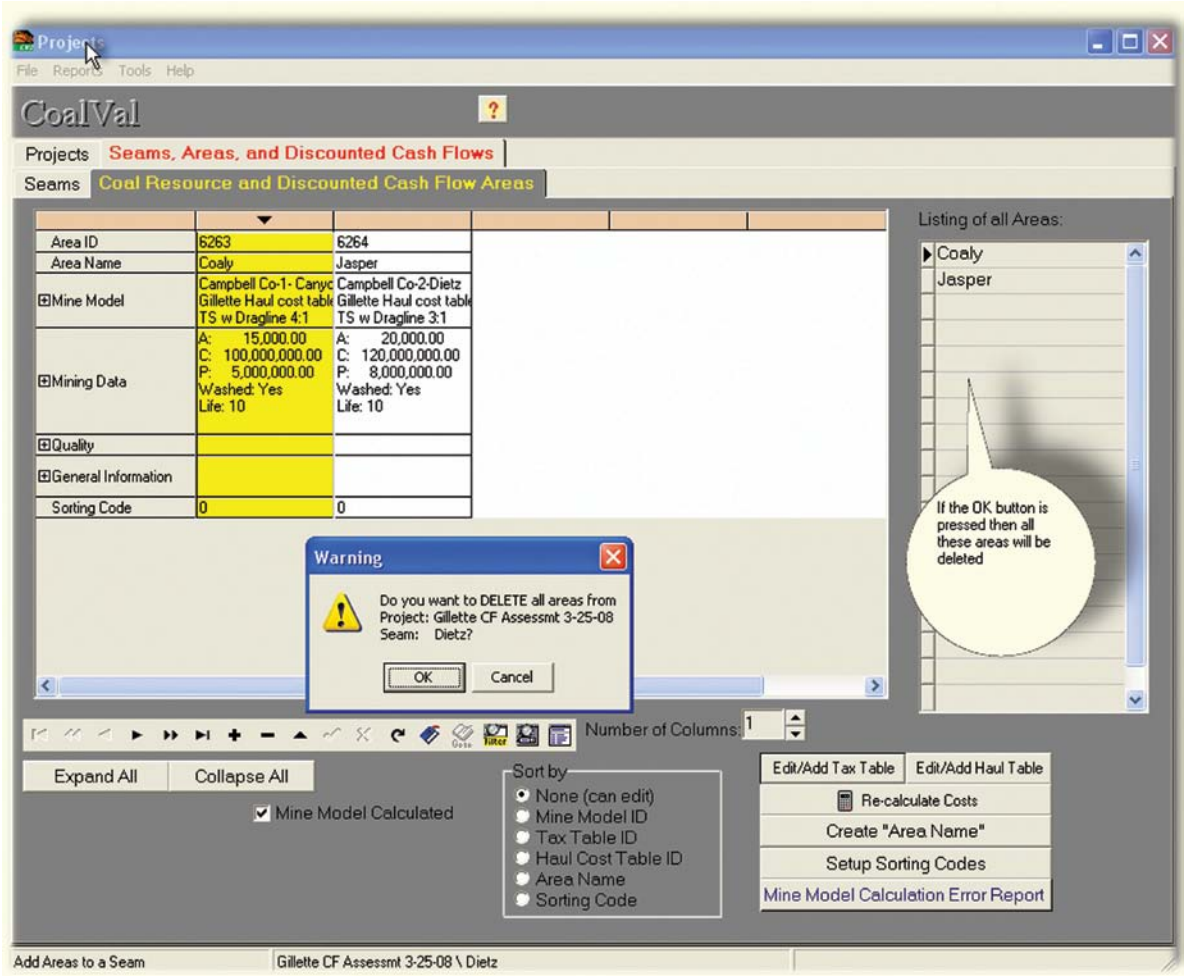


Figure C.71. CoalVal's deleting all bed data for an Area dialog window showing the associated "Warning" menu.

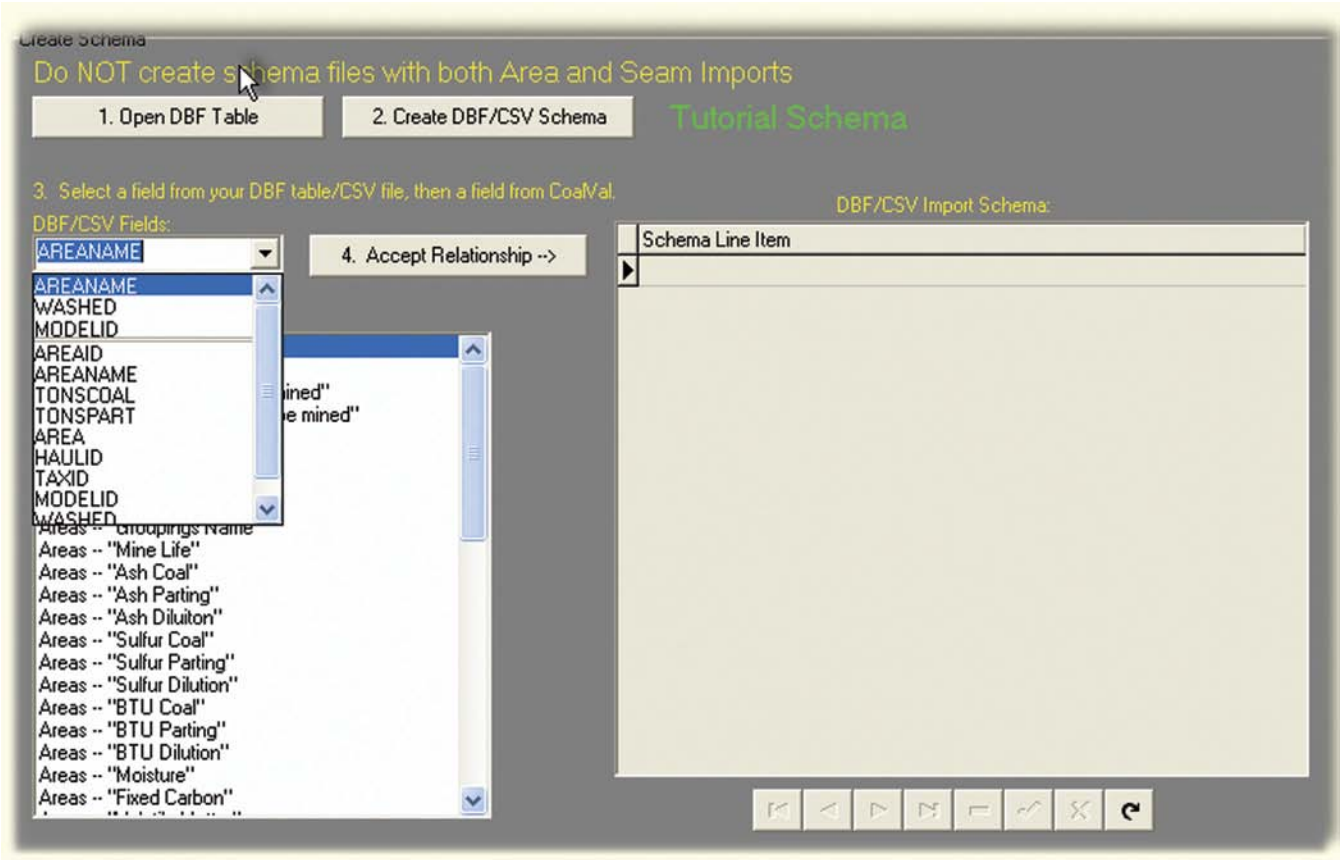


Figure C.72. CoalVal's Create Schema dialog for importing data from ArcView tables.

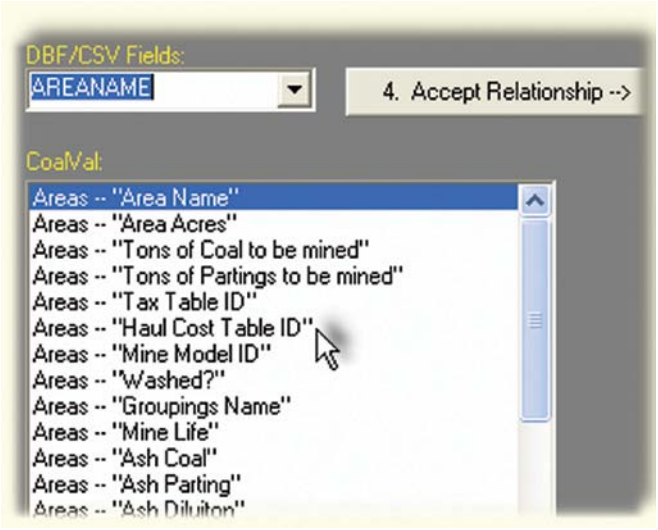


Figure C.73. Creating a relationship between an ArcView data table and CoalVal Areas table.

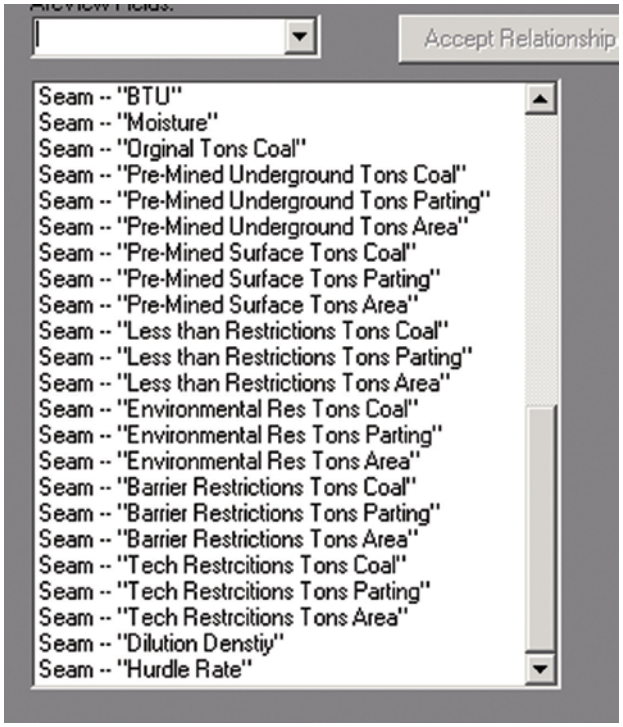


Figure C.74. Examples of Seam fields used for importing data into the CoalVal Areas Table.

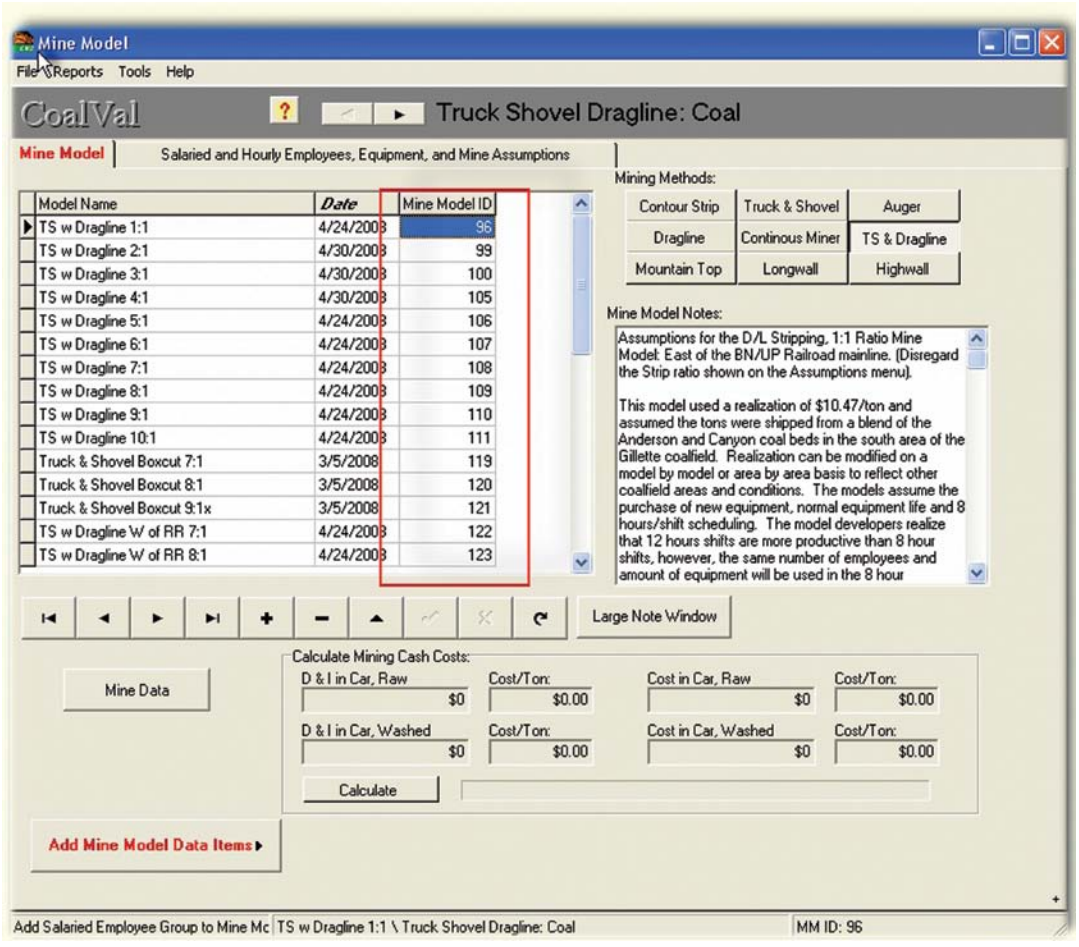


Figure C.75. CoalVal's Importing Mine Models dialog page showing the highlighted Mine Model ID field.

Also the "Tax ID" and "Haul Cost ID" can be imported from an ArcView table into an **Area**. The IDs for **Tax** and **Haul Cost Tables** can be found on the **Mine Data** dialog's **Tax Data Entry** page and **Haul Cost Entry** page.

After a schema has been created *it can be used to import data by clicking on the **Use Schema for import of ArcView File** dialog tab*. When the **Use Schema for Import of ArcView File** page is displayed, *select a schema from the "Select Schema" list*. Then *click on the "Open ArcView Table" button and select an ArcView table* (fig. C.76).

Figure C.77 is an image of the **Haul Cost Entry** dialog page in the **Mine Data** dialog. This dialog page allows the use of constant values for "Haul Cost ID," "Tax Table ID," and (or) "Mine Model ID." Figure C.78 shows the **Haul Cost Table** named "Example Haul Cost**"** and with a **"**Haul Cost ID" of 88. To import the data *click the "Import (DBF) Table" button*. For more help see the Tutorial Chapter in appendix C.

Advance Schemas are an additional method for importing **Mine Model**, **Haul Cost**, and **Tax Table** data into the **Area Table**. They work in conjunction with a standard schema, where the user can directly import data from a file into the **Area Table**. However, records in the **Area Table** also need **Haul Cost Tables**, **Tax Tables**, and **Mine Model** information. While standard schemas can import this information into the **Area Table**, the user must know CoalVal's IDs for the **Mine Model**, **Haul Cost**, or **Tax Table** and place these IDs into the import file before importing. With the advanced schema, the user can import a value into one of CoalVal's user-defined fields (found under the "General Information" field on the **Projects/Seams/Coal Resource, and Discounted Cash Flow Areas** dialogs) and relate it to one of CoalVal's **Tax Tables**, **Haul Cost Tables**, or **Mine Models**. The General Information fields are **Geo Location**, **Taxing District**, and **Coal Bed Name** (although these fields have names that seem to imply a use, the user can use them for anything). The value imported can be of the user's choice, but it should relate to the **Mine Model**, **Tax Table**, or **Haul Cost Table** that will be used for an **Area**. For example, assume there are going to be two **Haul Cost Tables** needed (one for each of two counties) for five areas that will be imported, but other evaluators are developing the **Haul Cost Tables** so their CoalVal IDs are not currently known. Table C.4 shows an example of an import file that has five areas that use two haul costs (the county field will be used to indicate which **Haul Cost Table** to use). From

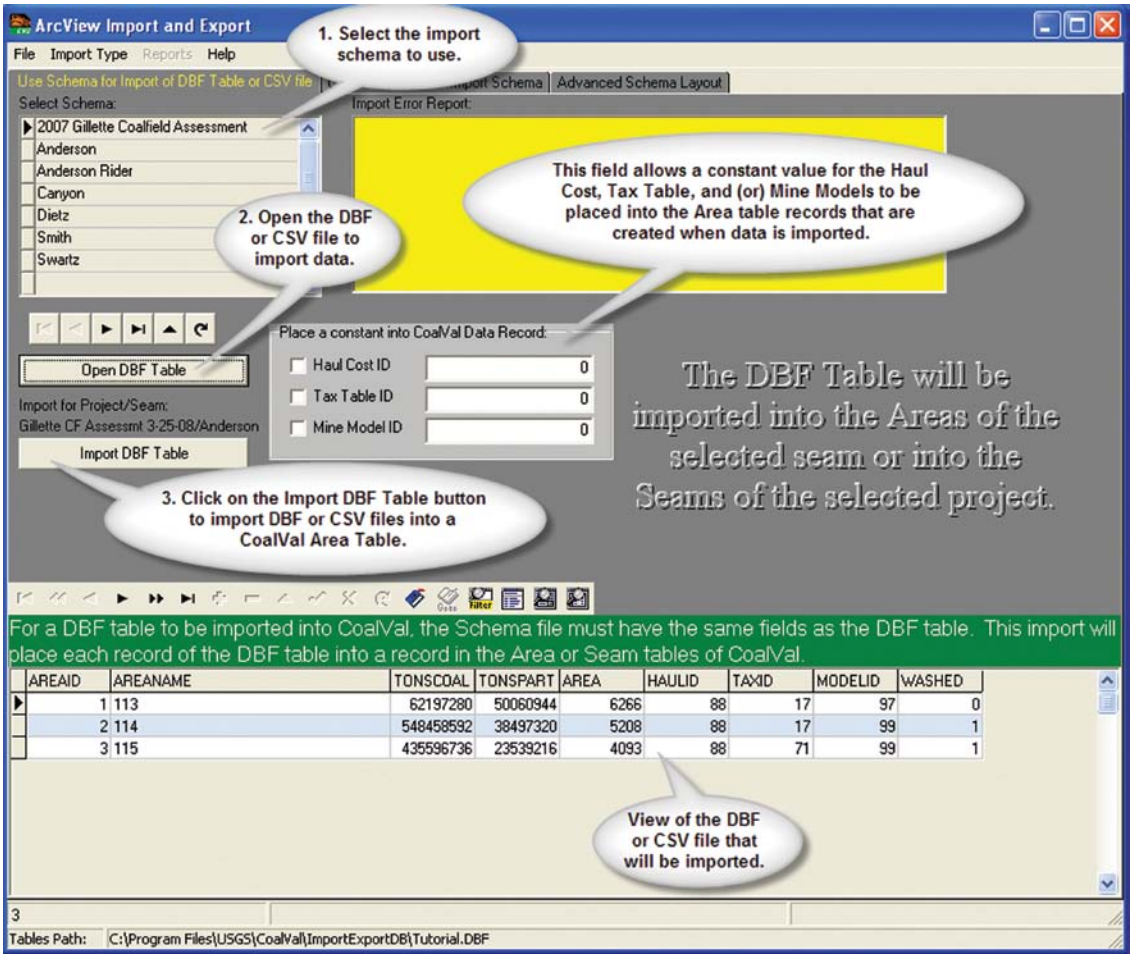


Figure C.76. CoalVal's Tax and Haul Cost Table imports dialog page.

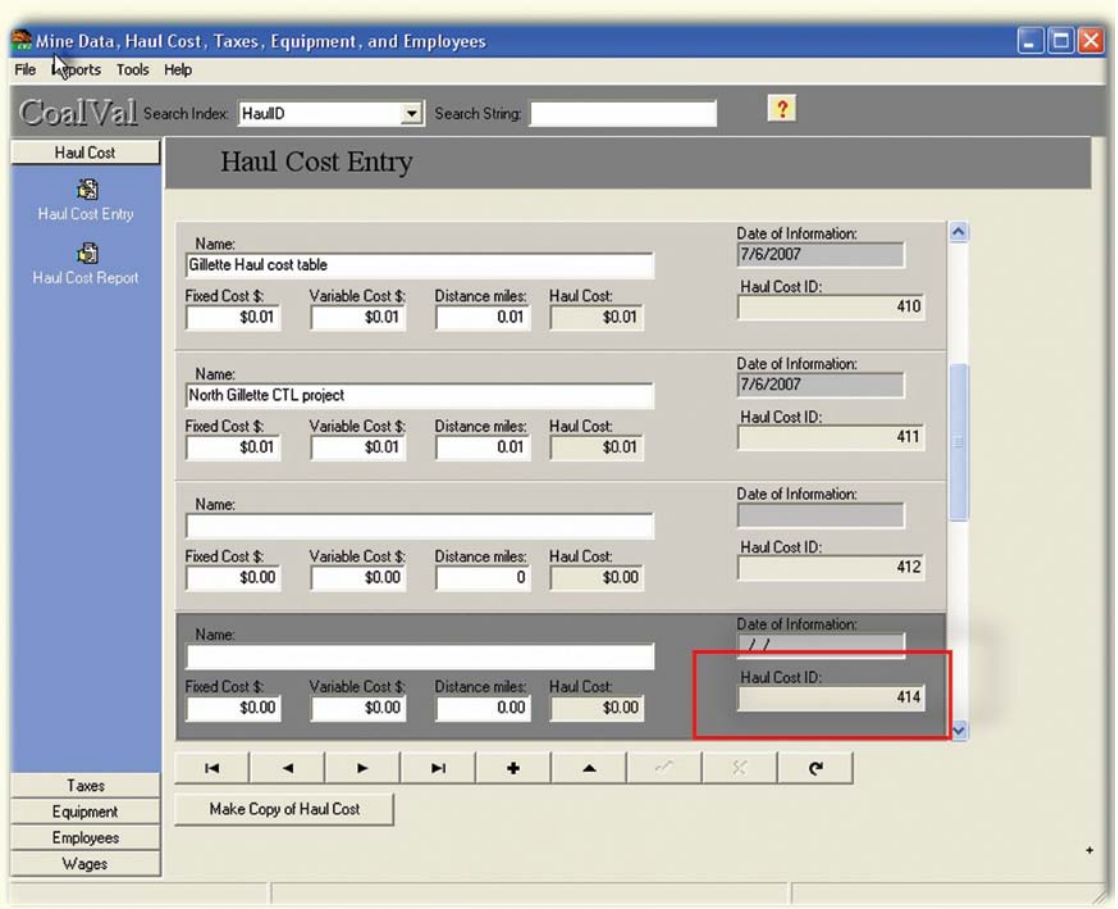


Figure C.77. Finding the Haulage Cost ID number (outlined in red) to add data to the import schema.

table C.4 it is apparent that areas 1, 2, and 4 will use haul costs found in Haul Cost Table 1 and areas 3 and 5 will use haul costs found in Haul Cost Table 2.

Haul Cost Tables, **Tax Tables**, and **Mine Models** are records in other CoalVal tables. They should be entered into CoalVal before importing or hand entering data into an **Area Table**. After the two **Haul Cost Tables** have been developed, figure C.79 shows that CoalVal's "Haul Cost ID" is 212 for Haul Cost Table 1 and 213 for Haul Cost Table 2. These are the values that could have been imported into the standard schema, if they had been available at the time of the development of the import file (see comment in preceding paragraph). The "Advance Schema" allows the user to relate the value in the import file's "County" field to one of CoalVal's "Haul Cost Table IDs." In other words, the value of "1" in the import files "County" field can be related to 212 and the value of "2" can be related to 213. When the import file is imported CoalVal will replace the "1" in the import file with 212 and it will replace the "2" in the import file's "Haul Cost Table" field with 213.

To use an "Advance Schema" *click on the **Advanced Schema Layout** tab of the **ArcView Import and Export** dialog (fig. C.80)*. A "Standard Schema" must first have been created to use the "Advance Schema." An **Advanced Schema Layout** is used to import data into the **Area Table**. No data can be imported into a **Seam Table**.

The first step in adding an "Advanced Schema" is to *select the "Standard Schema"* to which the advanced options will be added. The next step is to *create a series of "If" statements that constitute the "Advanced Schema."* The "If" statements are made up of DBF or CSV field names that are equal to a user-entered value. The user then *selects the appropriate **Mine Model**, **Tax Table**, or **Haul Cost Table***. After the selection of the type of table, the user *selects a value from that table.*

In figure C.81 the user has selected the field name "COUNTY" in the import file and "County" has a value of "2." Now the **Haul Cost Table** "North Gillette CTL project" will be placed into the **Area** being imported. For more help see the Tutorial Chapter in appendix B.

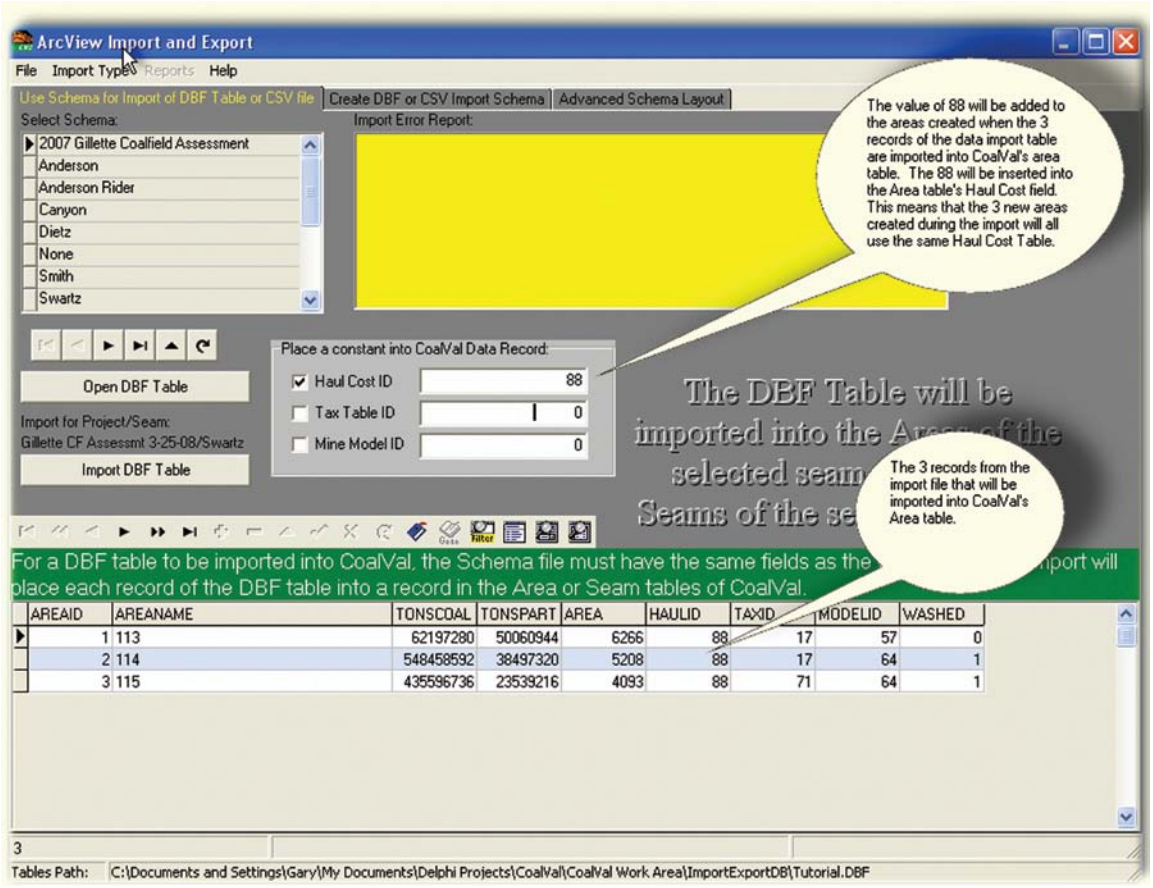


Figure C.78. Importing Haul Cost data through an Advanced Schema using the Haul Cost ID.

Table C.4. Import file showing "Area Names," "acres" in each Area, "tons of coal" in each Area, and the Haul Cost Table associated with each county studied.

Area name	Area (in acres)	Coal tons	County (haul cost table)
Area 1	12,000	1,000,000	1
Area 2	13,000	2,000,000	1
Area 3	11,000	3,000,000	2
Area 4	11,500	2,500,000	1
Area 5	100,000	1,100,000	2

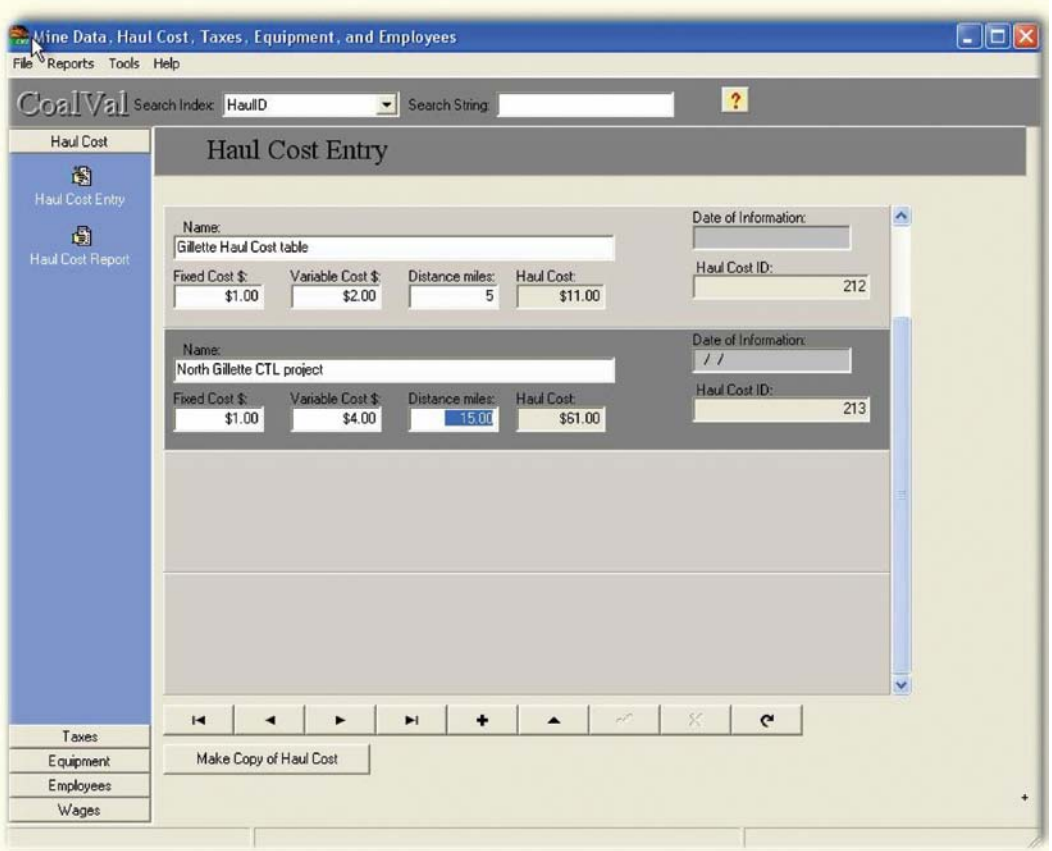


Figure C.79. Haul Cost Tables showing the Haul Cost ID's related to the County number in previous table.

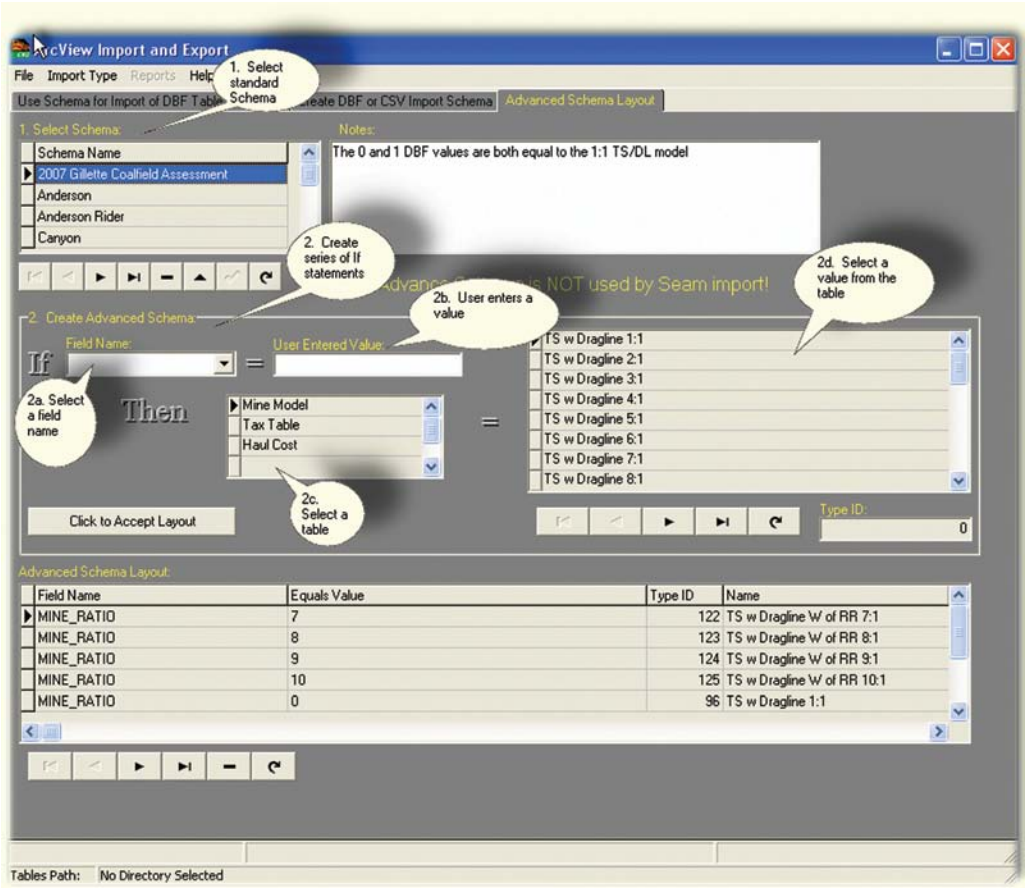


Figure C.80. Advanced schema layout using the ArcView Import and Export dialog window.

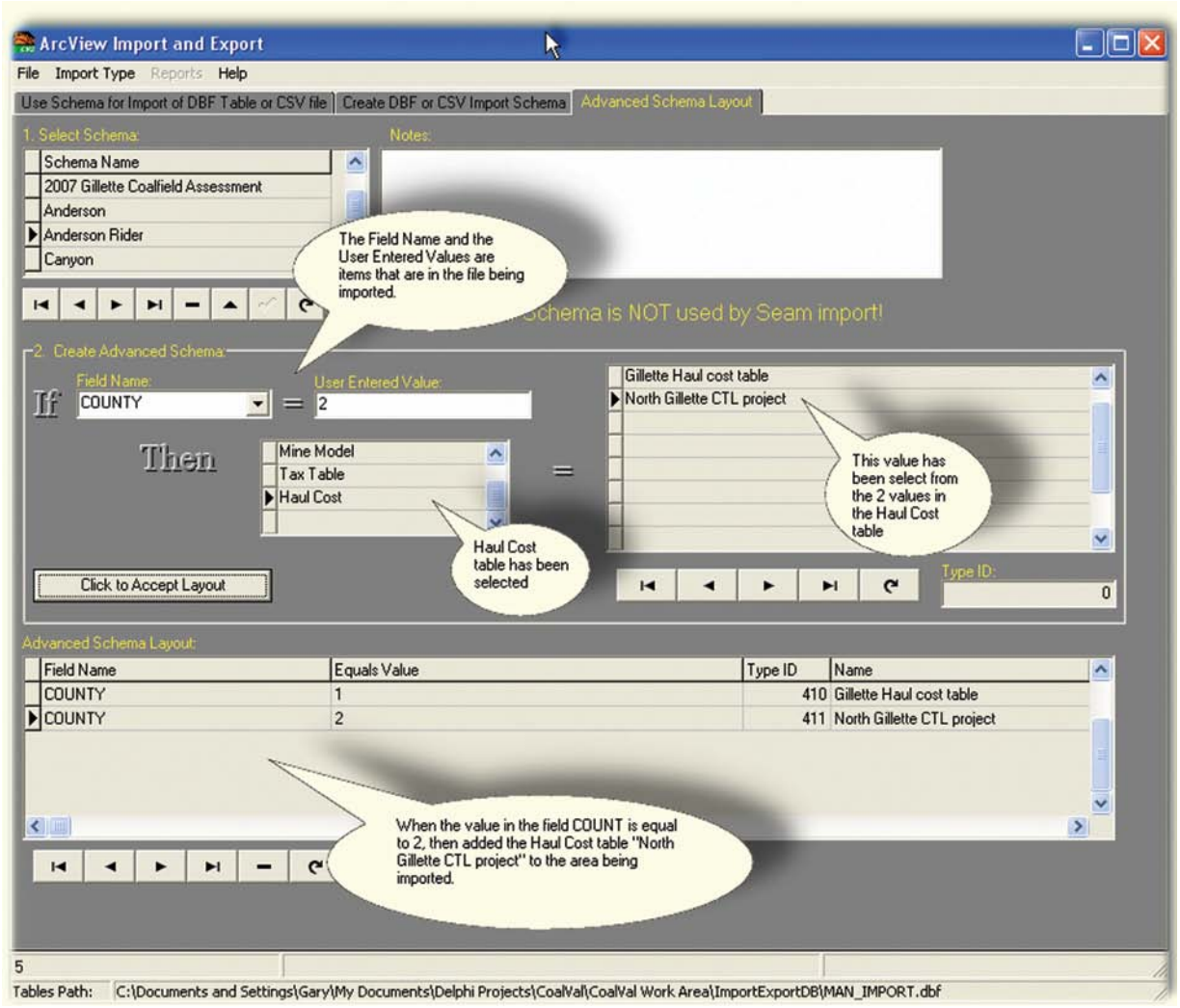


Figure C.81. Adding Haul Cost data using the Advanced Schema.

Import Coal-Quality Data

There are two menu items found under the **Tools** drop-down list under the **Projects** dialog window that allow the user to import quality data into existing records of the **Area Table** from DBF tables or CVS files. A DBF or CVS file can be created in Excel. To create DBF or a CSV file in Excel first *create a work sheet with field headings in the first row*. *Add data in the other rows starting with row 2*.

The coal-quality items that can be imported are listed as follows:

1. Ash coal
2. Ash parting
3. Ash dilution
4. Sulfur coal
5. Sulfur parting
6. Sulfur dilution
7. Btu coal
8. Btu parting
9. Btu dilution
10. Moisture
11. Fixed carbon
12. Volatile matter

The Excel worksheet should have one field that is the name of the row. This field will be used to relate records in the DBF or CSV file to records in CoalVal's **Area Table**. Put data under the headings and save the worksheet as a DBF version 3 or 4 file, or CSV file (Excel version 2007 does not export DBF files). Figure C.82 is an example of an Excel work sheet that can be saved as a DBF file or CSV file.

The first step in importing quality data into CoalVal, after the creation of the DBF Table or CSV file in Excel or some other program, is to *navigate from the **Projects** dialog window*, *through the **Tools** drop-down list, and select **Import Quality Data From DBF Table***. That will open the **Import Quality Data** dialog window and allow the user to *select an* "*Import Schema" from under the heading* "1. Select Quality Import Schema." The next step is to *open the import table*. Figure C.83 shows the **Import Quality Data** dialog with the import table open. The data displayed in the data grid at the bottom of the dialog are the same as the data in the Excel work sheet graphic above. The "Import" table was opened by *clicking on the button labeled* "*2. Open import DBF Table,***"** *then using the Open dialog to find the import table, selecting it and clicking the* "*Open" button* (fig. C.83).

The last step is to *click the* "*3. Import Quality Data" button*. For this step to work the following must be taken into account:

1. There must be an import schema listed in the list of schemas. If there are no schemas then one must be created.

2. The Import table must have the same fields as the import schema. One schema can be used on many import files, but the data-field names that each data field represents must be the same in the schema and the import file.

3. Each import schema must have two parts. The first part is the field relationships and the second part is the record relationships. The field relationships are how the data fields of the import table relate to the data fields in CoalVal's **Area Table**. The import table has a field named "ASHCOAL" (a field relationship). If this field is to be related to CoalVal's "Ash Coal" field (a record relationship), then CoalVal must know that a value in the field "ASHCOAL" is to be placed in CoalVal's "Ash Coal" field. The record relationship refers to what records in CoalVal's **Area Table** are to receive imported data from what record in the import table. An important concept is that one record in the import table can be used to import data into one or more records in CoalVal's **Area Table** or it may not be used at all.

Create Field Relationships

To create a schema the user first needs to create the "Field Relationships." To do this *click the **Create Import Schema** tab (fig. C.84)*, *then the **Create Field Relationships for a Schema** tab*. Figure C.84 shows the **Create Field Relationships for a Schema** dialog. The first step is to *open the "Import DBF Table" if it is not already open*. Figure C.84 shows that the

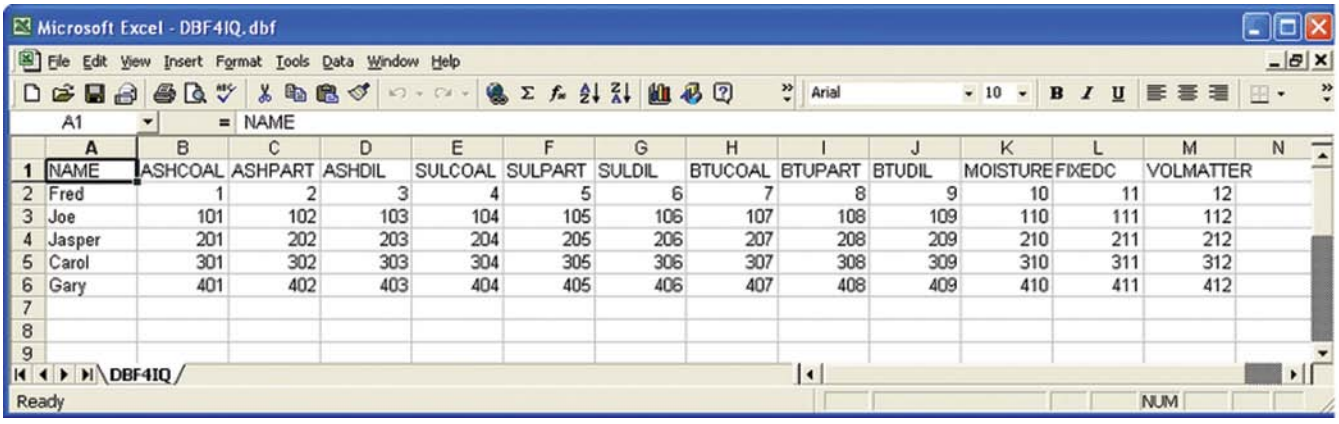


Figure C.82. Microsoft Excel spreadsheet showing data format for importing coal quality into CoalVal.

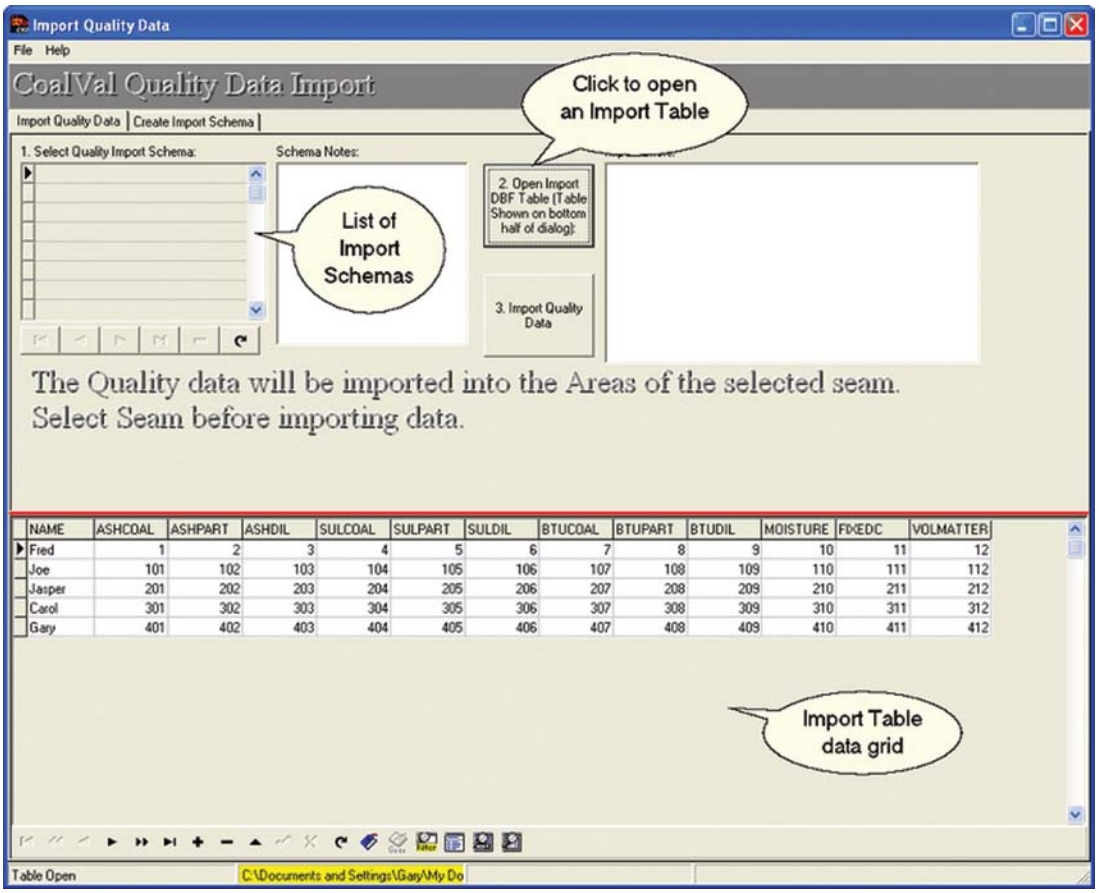


Figure C.83. CoalVal's Import Quality Data dialog window.

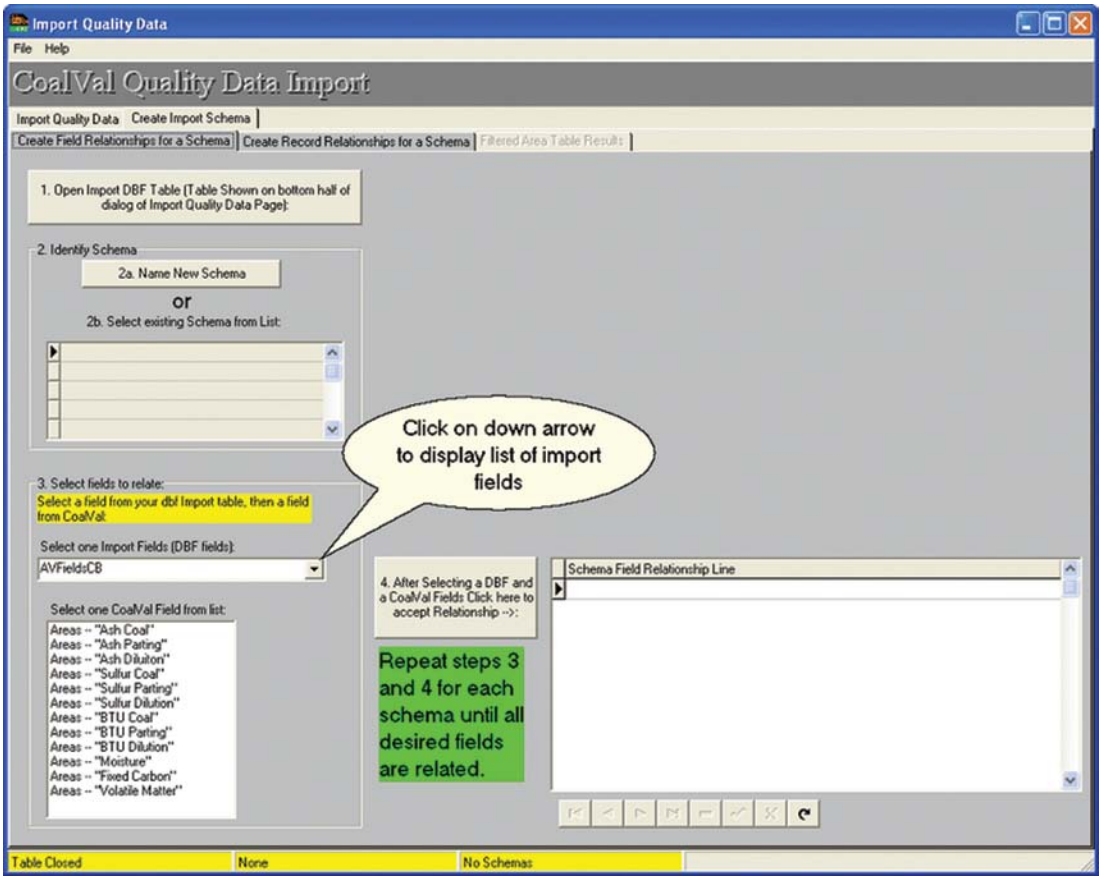


Figure C.84. Closing the Import table under the Create Field Relationships for a Schema tab on the Import Quality Data dialog.

dialog window displays "Table Closed" (lower left, yellow line). This is referring to the import table.

The steps below work for both a DBF file and CSV file. For a CSV file use the **Project**/**Tools** drop-down list and select **Import Quality Data From CSV File** and replace the "DBF" with "CSV" in the instruction below. The steps for creating a field relationship schema are as follows:

1. "Open an Import Table"—To open an Import table *click the button labeled "1. Open Import CSV Table."* When clicked, the "Open" dialog will be displayed. *Find, select, and then click the "Open" button to open an* ***Import*** *table*.

2. "Identify Schema"—In this step a currently defined schema can be selected from step 2, "2a. Name New Schema" (fig. C.84) and **"**2b. Select existing Schema from List," or a new schema can be named. To name a new schema *click on the button: "2a. Name a New Schema."* A dialog will be displayed allowing for the entry of a schema name. The name entered cannot be the name of an existing schema. To select an existing schema, *click on the schema name under item: 2b. Select existing Schema*"Select fields to relate" – *Use the pull-down arrow from step "3. Select field to relate" to select an import data field and use the list box* ("Select one CoalVal Field from list") *to select a CoalVal data field*.

3. "Accept Relationship"—*Click the button*: *"4. After Selecting a DBF and a CoalVal Fields click here to accept the Relationship" to select the field from "Step 3."*

4. "Repeat steps 3 and 4"—*Repeat steps 3 and 4 until all desired fields have been related.*

Create Record Relationships

"Field Relationships" are needed to create a schema and then "Record Relationships" must be created. "Record Relationships" are created by *clicking on the* **Create Import Schema** *dialog tab then the* ***Create Record Relationships for a Schema*** *dialog tab*. Figure C.85 shows the **Create Record Relationships for a Schema** dialog page.

The purpose of this dialog is to pick which quality values in the import table will be placed in the data fields found in the CoalVal **Area Table**. One record of the import table can be used by one or more records in the **Area Table**. This is done by *first selecting a field in the import table, step* "3a. Import Field to Relate." Next, *select a value in step* "*3b. Select import Record Value."* The values in step "3b. Select import Record Value" are from the field that was selected in step "3a. Import Field to Relate" (fig. C.86).

The next step is to set a filter for CoalVal's **Area Table**. Filtering is the process of separating desired data from an entire data set (or table). The next few steps lead the user through the filtering process for coal quality. *After clicking on the button in* step *"3c. Set Filter for Area Table" (fig. C.85)*, *the area table filter dialog will appear* (*fig. C.87)*. *Select a field name, such as* "Area Name," *from the "Fields" list box, then enter values for that field, and click OK*.

Click the button: "3d. Accept relationship" for the last step. Notice that the relationship entered has been placed in the list box. The relationship should look something like figure C.88. The first relationship shown in figure C.88 states that the import record where the "Name" field is equal to "Joe" will be used to import the quality data into the **Area Table** when the field "AreaName" in the **Area Table** is equal to "12." The second line in figure C.88 states that the record where the "Field Name" is equal to "Carol" will be used to import quality data into the CoalVal's **Area Table** when the "Area Table Filter," "AreaName" is equal to "12334**.**" A detailed discussion of Filtering follows the Exporting CoalVal Data section. For more information about importing quality data into CoalVal, see the Quality Data Import section in the Tutorial Chapter, appendix B.

Exporting CoalVal Data

CoalVal will export **Area** and DCF data to Excel workbooks and text files. To export CoalVal data select the **Export Area Data Table** list item from the **Tools** drop-down list on the **Projects** dialog window.

The **Export Area Data Table** (also called **ArcView Import and Export** dialog) has three tabs. The first tab, **Export Data to Excel Workbook** is for exporting data to an Excel Workbook. The second tab, **Export Text File**, exports to a text file, and the third tab, **Create Schema for Exporting Data**, creates an export schema. A single "Export Schema" file can be used for both exporting CoalVal data to Excel workbooks and text files. No "Export Schema" files come standard with CoalVal. The user will need to create the needed "Export Schema" files.

To create an "Export Schema" file *click on the* ***Create Schema for Exporting Data*** *tab*. A dialog like the one shown in figure C.89 will be displayed. The dialog has a list box of the items that can be exported. *Select one, and then type in a user-named DBF or Excel field name*. The "Field Name" is limited to a maximum of 10 characters that must be alpha characters or spaces (no numeric values). Any spaces entered will be changed to an underscore character. When ready to accept the relationship, *click on the* "*Accept Relationship" button*. After clicking this button, the relationship will be shown in the list box on the right hand side of the dialog.

The CoalVal fields list box can display the fields to be exported and the type of fields that will be created. The codes are as follows:

<N>—Numeric field.

<I>—Integer field.

<A35>—Alpha field of 35 characters. The number in this code is the length of the alpha field.

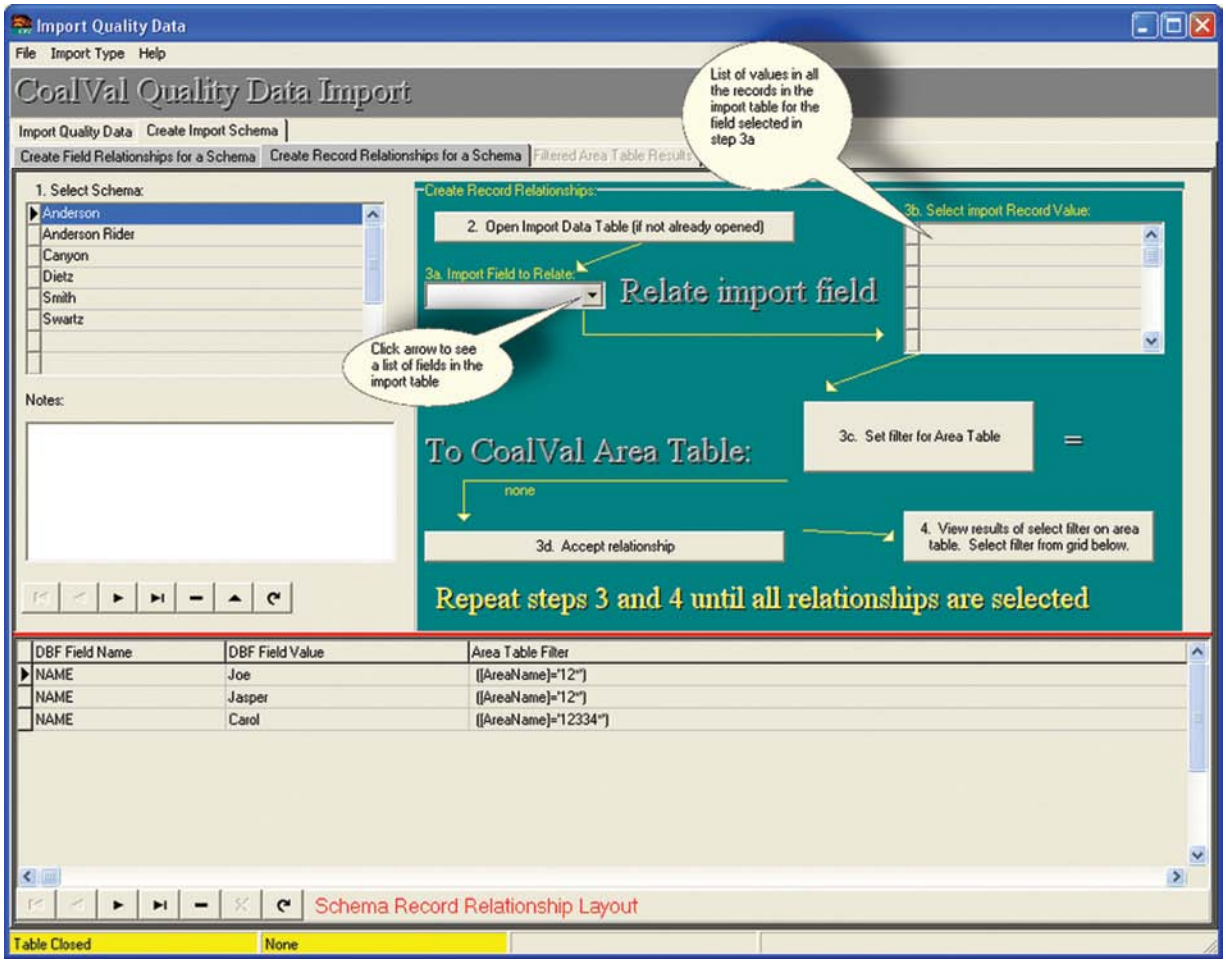


Figure C.85. Create Record Relationships for a Schema dialog page for the Create Import Schema dialog window.

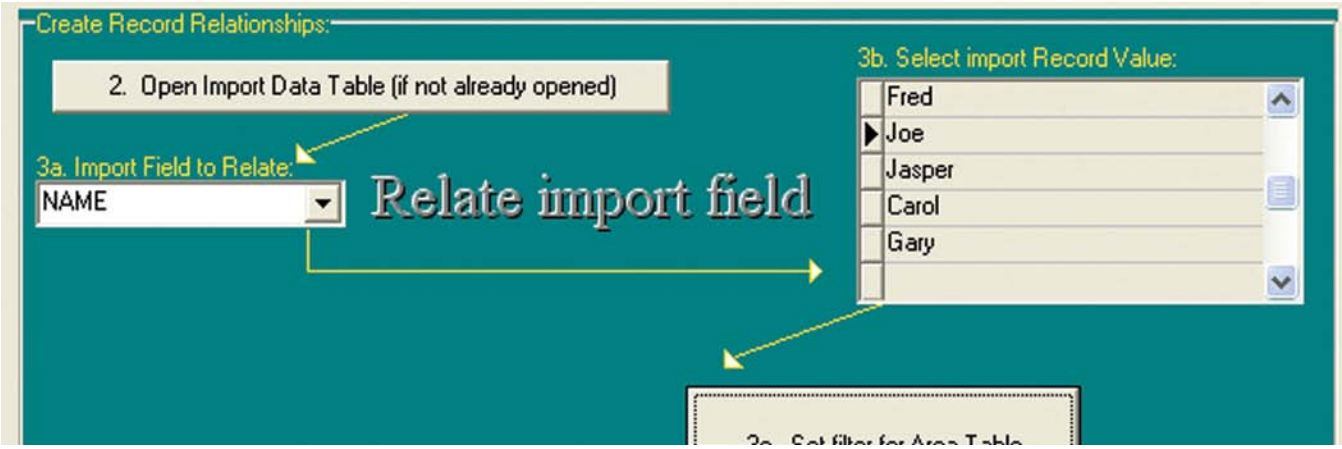


Figure C.86. Setting quality values from the import table to the CoalVal Area table.

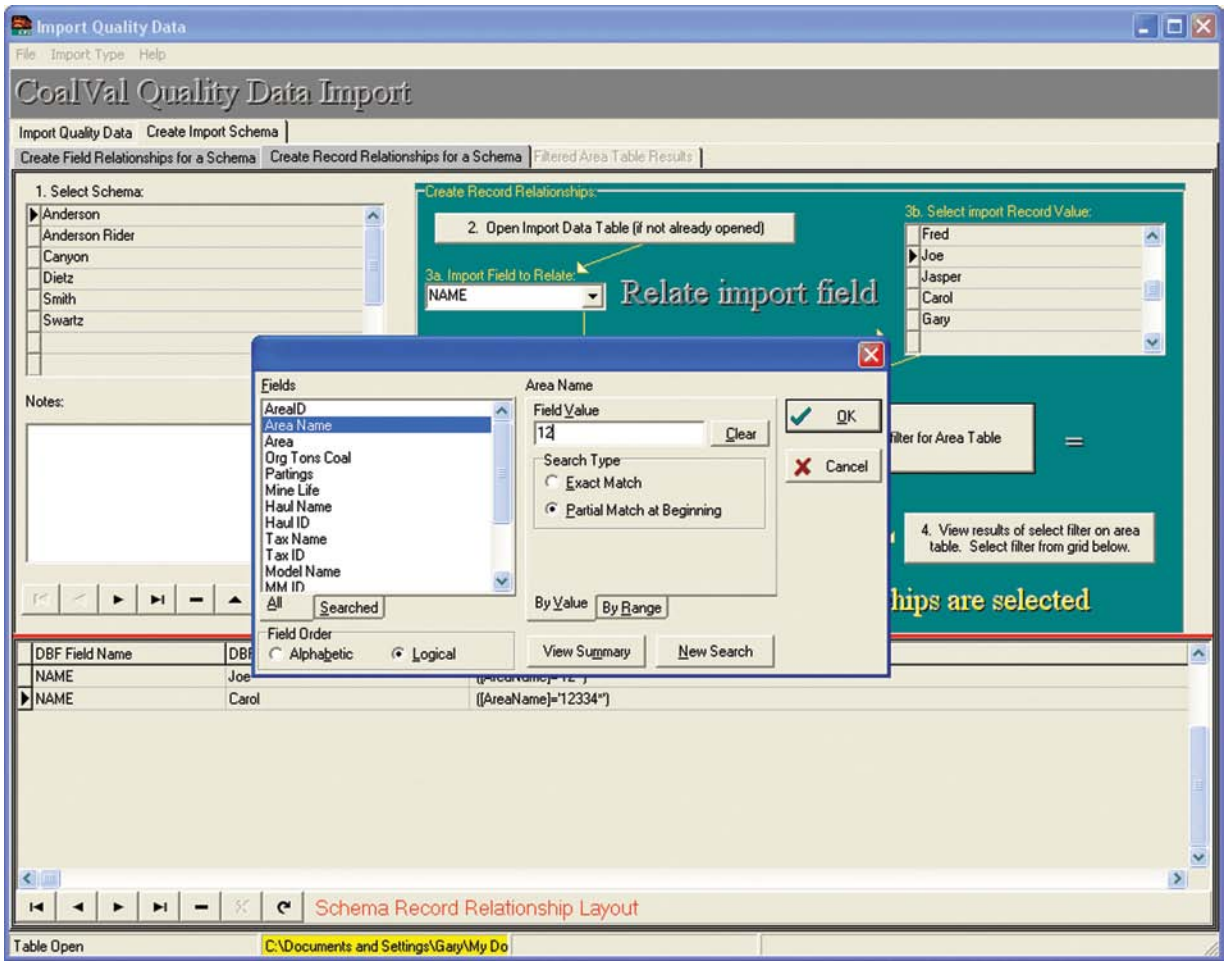


Figure C.87. CoalVal's Area Table Filter dialog window.

Figure C.88. Importing quality records into an Area table.

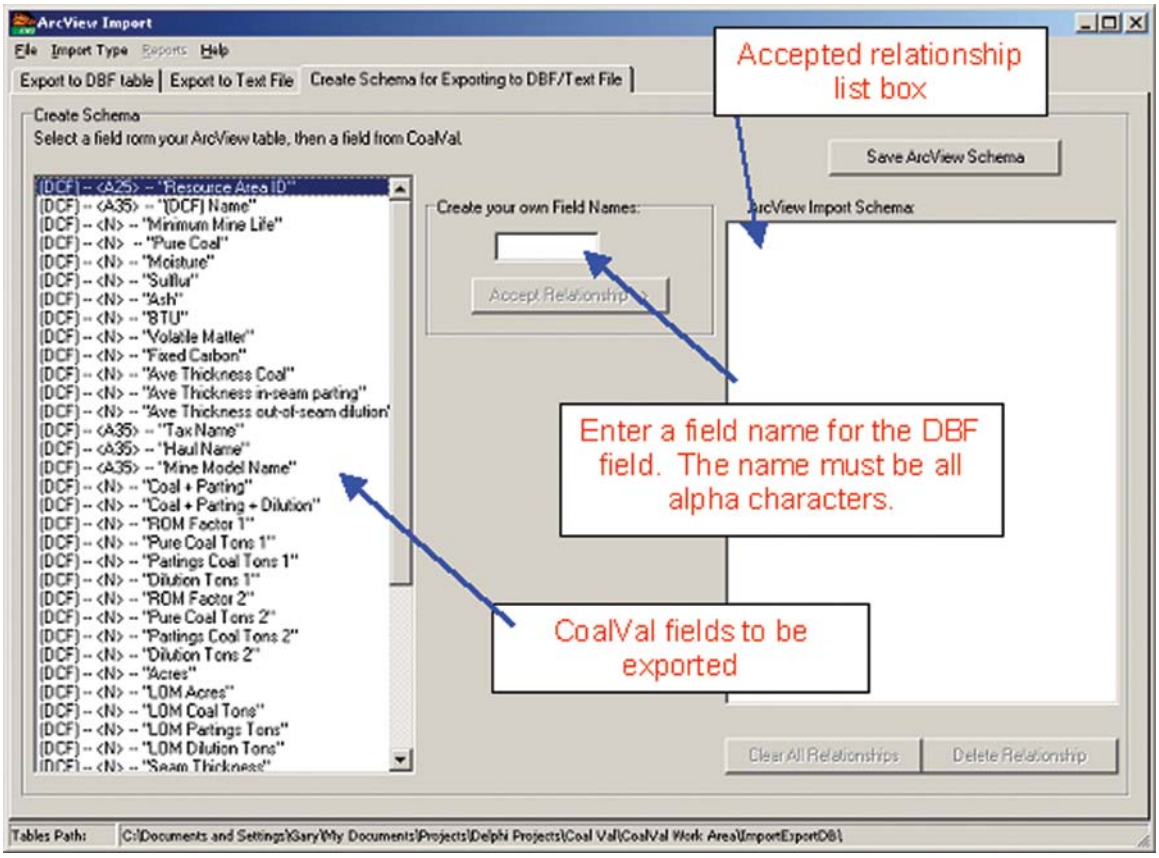


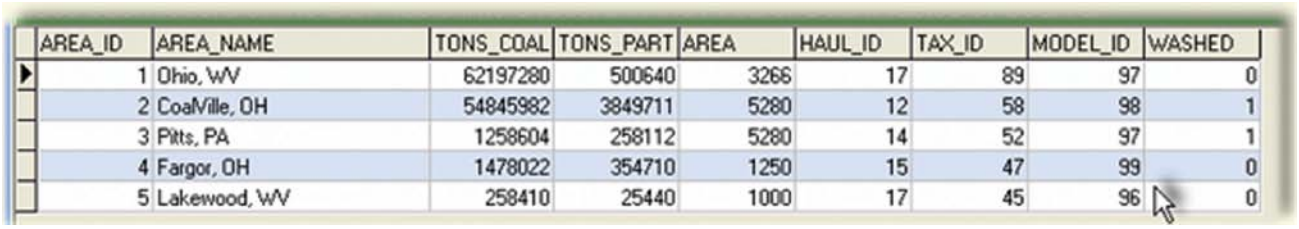
Figure C.89. CoalVal's Creating a Schema for Exporting to DBF/CSV Text File dialog page showing the steps to create an export schema.

When finished creating the schema relationships, *save the schema file by clicking on the "Save ArcView Schema" button*. To export data to an Excel workbook file format, *click the Export Area Data to Excel Workbook tab*. The first step is to *open an export schema file by clicking on the "Open Export Schema File" button. Select the schema file and press the "Open" button*. To export CoalVal data *click on the "Export to Excel Workbook" button*. A new table will be created. The data that will be exported will be from the **Project** and **Seam** selected by the user before the export dialog was opened. Exporting CoalVal data to a text file follows the same process needed to export data to an Excel workbook, except that the user needs to enter a path for the export and then *click on the* **Export to Text File** *tab*.

Data Filtering in CoalVal

A data table is a CoalVal representation of tabular data. It contains information about a specific subject (projects, mine models, seams, or areas). Each row or record of the table defines one member of the group the table represents. If a table contains areas to be mined, then each row or record would contain specific mining area information. For example, figure C.90 is a data table of areas to be mined with each row representing a specific mining area. Since there are five rows, there are five areas to be mined in this data table. Each column or field defines one characteristic of the record or row. In figure C.90 each column or field defines a characteristic about a specific area. For the record where the field AREA_NAME equals "Pitts, PA," there are 1,258,604 tons of coal to be mined and 258,112 tons of parting. The size of the area is 5280. The HAUL_ID is 14. It has a MODEL_ID of 97, a TAX_ID of 52, and the WASHED code equals 1. These are all properties of the third row or record shown in figure C.90.

In summary, the data table shown in figure C.90 is a group of areas to be mined. Each row or record in the data table is a specific area to be mined. Each column or field in a record is one property of the record or area to be mined. A field should never represent more than one record. For example a field should not contain coal quality and mining methods. As for coal quality, if sulfur, ash, moisture, and Btu are needed in a record, then each would be its own field. They cannot be combined into one master quality field. To understand this concept better, look figure C.90. How would area, tons of coal, and tons of parting be combined into one field? Between these three area fields, there are 3 values. Since a field can only



AREA_ID	AREA_NAME	TONS_COAL	TONS_PART	AREA	HAUL_ID	TAX_ID	MODEL_ID	WASHED
1	Ohio, WV	62197280	500640	3266	17	89	97	0
2	CoalVille, OH	54845982	3849711	5280	12	58	98	1
3	Pitts, PA	1258604	258112	5280	14	52	97	1
4	Fargor, OH	1478022	354710	1250	15	47	99	0
5	Lakewood, WV	258410	25440	1000	17	45	96	0

Figure C.90. Data table containing areas to be evaluated with coal resources and their associated Haul Table ID, Tax Table ID, Mine Model ID, and washing requirements.

contain 1 value, which one of the 3 values should be placed in the new field and how would the database know what that value represented?

Notice that units are not given in this table. An area of 5,280 could be acres, square miles, or other unit of area measurement. For this table to be useful there is a need to know the definition of each field. The way a data table is defined is called the data dictionary. The data dictionary for the table in figure C.90 follows:

This table represents areas to be mined. The table is intended to be imported into CoalVal's **Area** table. The table is made up of nine fields as defined below. The HAUL_ID, TAX_ID, and MODEL_ID fields represent records in CoalVal's **Haul Cost** table, **Tax Table**, and **Mine Model Table**.

- AREA_ID is a unique number for each record or row. This number is always an integer value.
- AREA_NAME is the geographical name of the area defined as a city or town followed by the state. Alphanumeric characters are valid for this field.
- TONS_COAL represents the tons of coal in the area to be mined. Only positive values are valid.
- TONS_PART represents the tons of parting in the area to be mined. Only positive values are valid.
- AREA is the acres of the area to be mined. Only positive values are valid.
- HAUL_ID is the **Haul** table ID number. CoalVal has **Haul** cost tables that have ID numbers, so this number will relate to a value in the **Haul** cost table ID field. This value is always an integer.
- TAX_ID is the **Tax** table ID number. CoalVal has a **Tax** table that contains user-developed tax information. Each record in CoalVal's **Tax** table has an ID number that represents the number of the **Tax** table associated with a particular area. This value is always an integer.
- MODEL_ID is the **Mine Model** ID number. CoalVal has a M**ine Model** table that contains user-developed mine models that will be used to represent the coal mining in each area. Each **Mine Model** has a unique ID number. This number represents the mine model that will be used to assess mining in this area. This value is always an integer.
- WASHED represents a value that indicates if the coal needs to be washed to make a saleable product or if the coal has a high enough quality as a run-of mine product to be sold without beneficiation. A "0" is false and means that the coal will not be washed and a "1" is true and means that the run-of-mine coal product must be washed to make a saleable product. Only the values of "0" or "1" are valid for this field.

Notice that the data dictionary for the table includes measurable units and limits for the field values.

The power of a database is the ability to use only the data in the table that are needed for a specific application while still retaining all records. In figure C.90 there are five records. But what if only the records with a value of "1" in the **WASHED** field are needed for a particular application? A filter can be set so that only those records that have a value of "1" in the field **WASHED** will be available for use. Figure C.91 is a dialog that allows for the setting of filters. Since the filter that is wanted is "WASHED=1," WASHED is selected from the Fields list. Then a "1" is entered into the Field Value edit box. In the Search Type radio button box "Exact Match" is selected. Selecting and clicking on the OK button will set the filter. The filtered data table will now look like figure C.92.

The only records in the table displayed are those where the washed field is equal to "1." Filters work on records in the table as shown in figure C.92 where all nine fields are still visible. In figure C.90 there were 5 records; now there are 2. The filters did not delete the data. CoalVal removed the records from current use if the records did not meet the filter requirements. When the filter is cleared, all records in the table become available for use again.

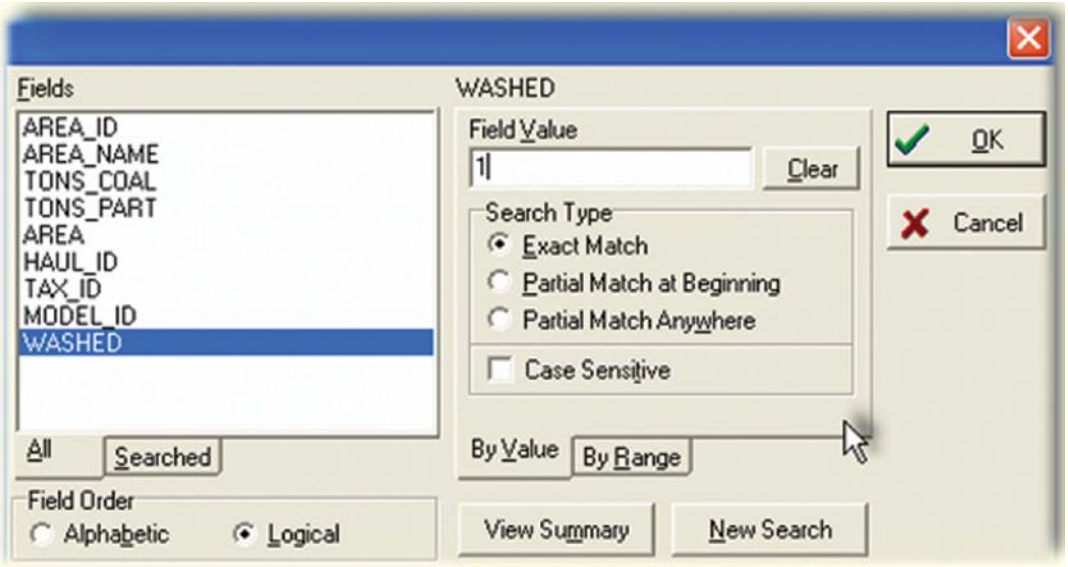


Figure C.91. CoalVal's Filter dialog showing the filtering of areas where washing of the coal resources is desired.

AREA_ID	AREA_NAME	TONS_COAL	TONS_PART	AREA	HAUL_ID	TAX_ID	MODEL_ID	WASHED
2	CoalVille, OH	54845982	3849711	5280	12	58	98	1
3	Pitts, PA	1258604	258112	5280	14	52	97	1

Figure C.92. Filtered data table showing only areas with coal resources requiring washing.

What if an application of the table called for records that were for the State of Ohio? Could those records be filtered? From the data dictionary of the table, it can be seen that the "AREA_NAME" field contains the state of each record, but it also contains a town or city name. Since the "AREA_NAME" has two pieces of information in it, a partial match in a filter will work. Figure C.93 shows the filter setting dialog for filtering for "OH" in the "AREA_NAME" field.

The "AREA_NAME" field has been selected in figure C.93. The value of "OH" has been placed in the "Field Value" edit box. And the "Partial Match Anywhere" radio button has been selected. When the OK button is clicked the resulting table will look like figure C.94. There are now 3 records, 2 for the State of "OH" and 1 for "WV." From figure C.94 it is evident that the AREA_NAME "Ohio, WV" also has an "Oh" in it. So there are three matches to the value of "OH." Since there are only two records related to the State of Ohio the question arises: How can a filter be set for this situation? There are two ways to set a filter to filter only the State of Ohio records. The first way shown in figure C.95 adds the selection of the Case Sensitive check box. This method works because only the states' abbreviations have both letters in upper case and the **Field Value** entered is "OH."

The second filter is shown in the filter dialog box in figure C.96. In this filter, the **Field Value** has been changed from "OH" to ",OH," with no space between the comma and "OH."

Notice that the filters that have been used as examples have been setting a field to a value that the user supplies. There are no filters when one field is set to equal another field. This makes no sense because each field is a property of the record. For 2 fields to be equal would imply that the same information is in the 2 different fields. Also, what would the filter mean where "AREA_NAME" is set to equal "TONS_COAL"? It would have no meaning. Tons of coal could never equal "Pitts, PA."

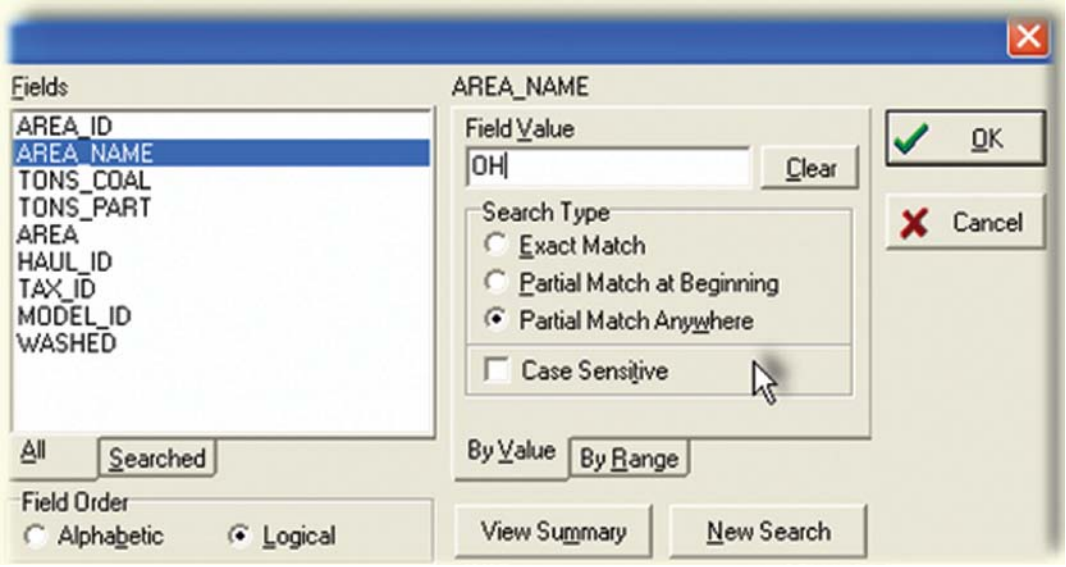


Figure C.93. CoalVal's Filter dialog showing filtering for "OH" in the Area Name field.

AREA_ID	AREA_NAME	TONS_COAL	TONS_PART	AREA	HAUL_ID	TAX_ID	MODEL_ID	WASHED
1	Ohio, WV	62197280	500640	3266	17	89	97	0
2	CoalVille, OH	54845982	3849711	5280	12	58	98	1
4	Fargor, OH	1478022	354710	1250	15	47	99	0

Figure C.94. Data table showing the results of filtering for "OH" in the Area Name field. Note that the "OH" filter did not recognize the difference between capital and small letters.

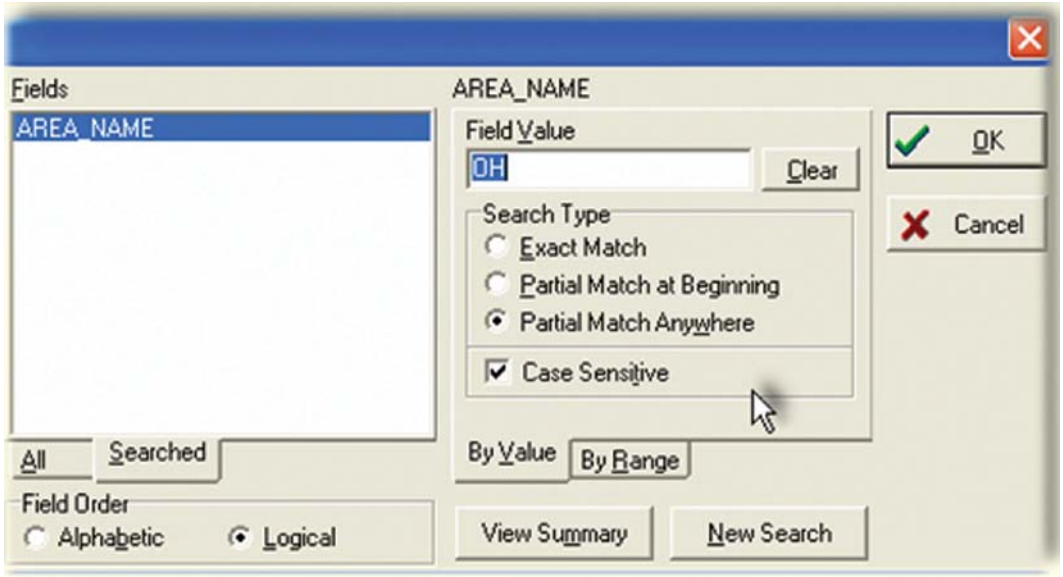


Figure C.95. CoalVal's Filter dialog showing the use of the Case Sensitive check box to filter only the capital letters "O" and "H" in "OH."

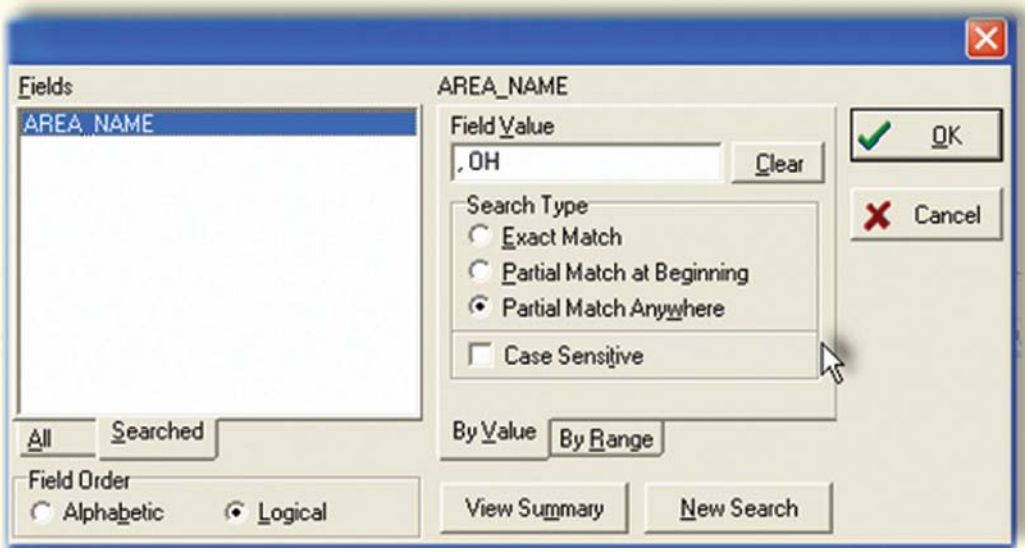


Figure C.96. CoalVal's Filtering dialog showing a second method to filter the Ohio Area Names by using available punctuation, as in ",OH."

Reports

Mine Model Report

When the **Reports** icon is selected from the **Main Menu** window, the **Report** dialog page will be displayed (fig. C.97). To calculate a **Mine Model Report**, (1) *select the desired* ***Mine Model*** *from the dialog page;* (2) *enter a title and subtitle for the report;* (3) *select whether the report should be calculated as cash or yearly cost; and* (4) *click the* ***Print/Review*** *button*. The ***Report Setup*** dialog window will then be displayed. This dialog allows the user to select the print report function, preview it on the computer screen, or both. The report can also be written to a text file. *Press the OK button and the report will be printed, previewed, or written to a file*.

Mining Assumptions Section of Mine Model Report

Running a **Mine Model Report** will print a narrative of all **Mine Assumptions** used in the chosen CoalVal **Mine Model**. The pages following the narrative contain the user-entered production assumptions and the calculated tons of produced, washed, and sold coal. The last line of this report page is a calculation of productivity calculated as raw tons produced per man-hour worked. This value allows the user to compare the **Mine Model** productivity rates to similar operations through data published by government monitoring agencies, such as the Mine Health and Safety Administration (Mine Safety & Health Administration, 2007).

The raw tons produced per man-hour is found by dividing the total number of hours worked at the mine by all personnel, including overtime hours, into the total number of tons produced in the mine prior to beneficiation of the run-of-mine product. CoalVal equations use the total scheduled days per year for each employee times the number of hours scheduled per shift, times the overtime factor (if applicable) for production and auxiliary wage staff plus the hours per year for salaried staff (supervision, technical, and direct management staff) to arrive at the total hours worked per year. The hours of work by contractors are not reported in the Mine Safety & Health Administration data report.

Cost Assumptions Section of Mine Model Report

Figure C.98 is an example of the Operation Statement section from a **Mine Model** report and will be used as a reference for the discussion of how its values were calculated. The actual formulas for each calculation can be viewed in appendix D, Mine Model Formulas. All **Mine Model Reports** will look like figure C.98, except for mine models that use the longwall mining or truck-shovel and dragline stripping methods. Reports for these methods will have more columns. The first column will show the cost for the longwall mine itself. The second column will show the cost for the longwall development work (using continuous miners), and the third column will show the cost for the combination of the longwall mine and the longwall development. A similar, multiple mining type model is included in the combination dragline and truck-shovel models where the primary model is coal production using a truck-shovel operation and overburden removal using a dragline operation or a truck-shovel operation, or a combination of dragline and truck-shovel operations. **Reports**

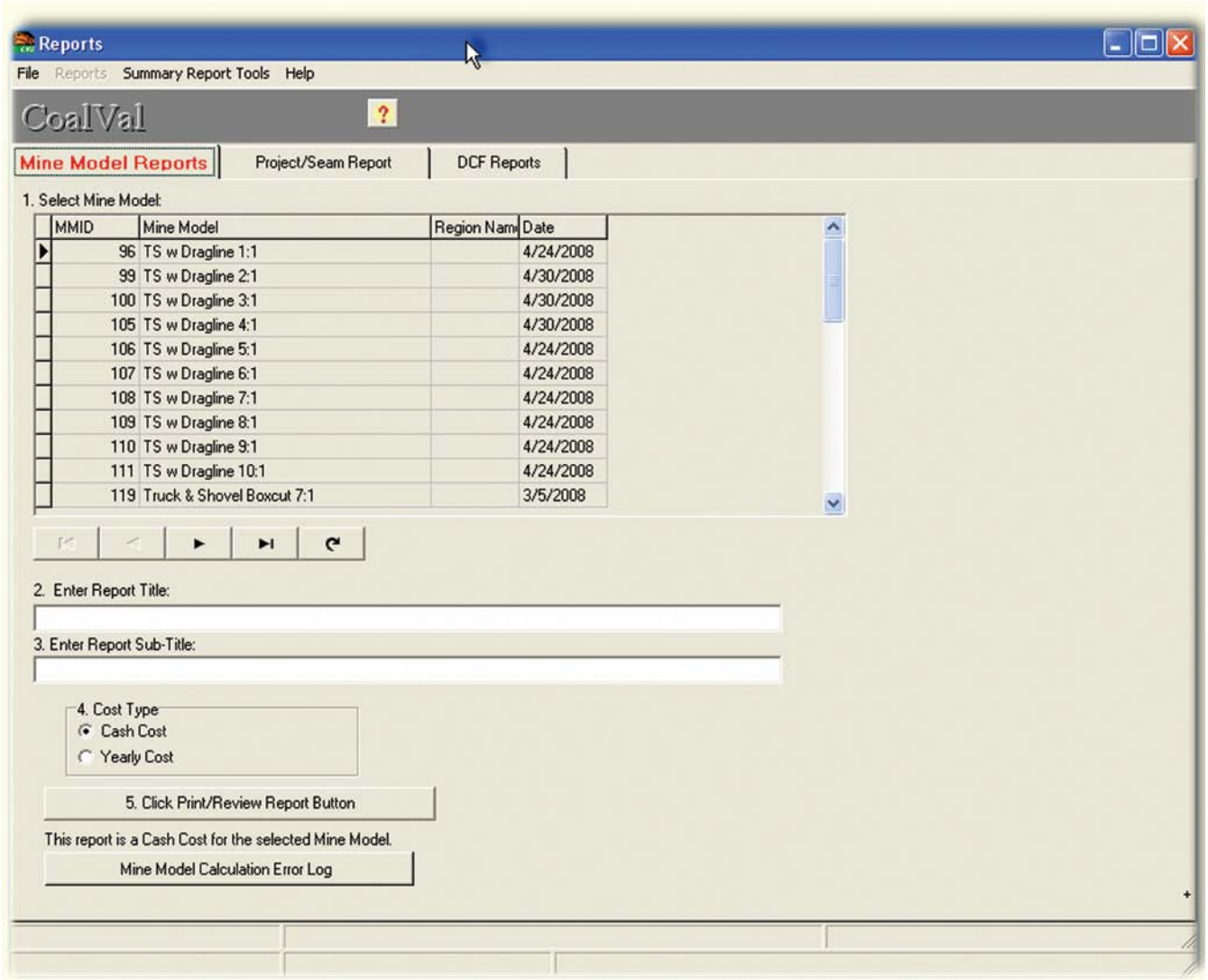
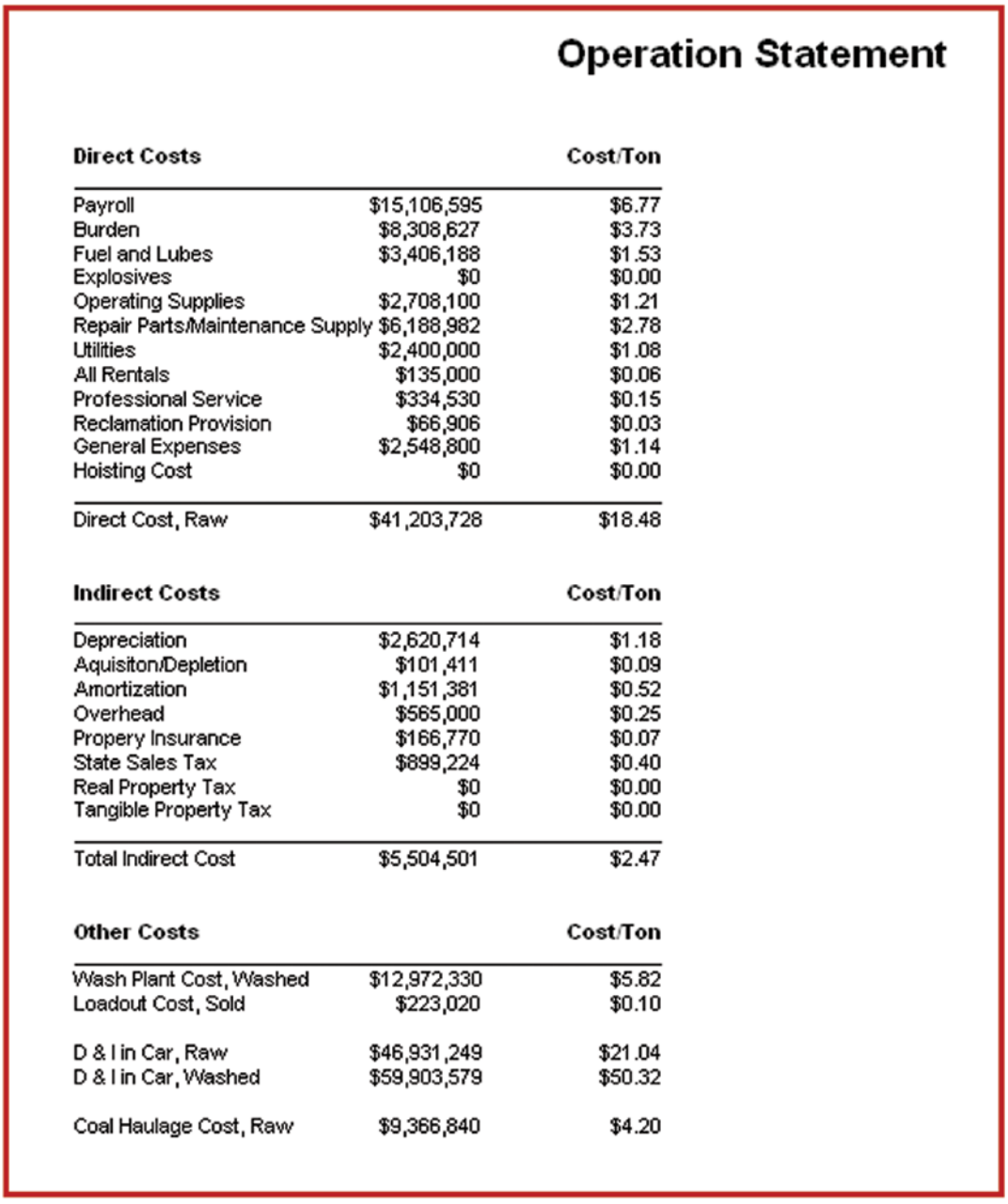


Figure C.97. CoalVal's Mine Model Report dialog page.



Operation Statement

Direct Costs		Cost/Ton
Payroll	$15,106,595	$6.77
Burden	$8,308,627	$3.73
Fuel and Lubes	$3,406,188	$1.53
Explosives	$0	$0.00
Operating Supplies	$2,708,100	$1.21
Repair Parts/Maintenance Supply	$6,188,982	$2.78
Utilities	$2,400,000	$1.08
All Rentals	$135,000	$0.06
Professional Service	$334,530	$0.15
Reclamation Provision	$66,906	$0.03
General Expenses	$2,548,800	$1.14
Hoisting Cost	$0	$0.00
Direct Cost, Raw	$41,203,728	$18.48

Indirect Costs		Cost/Ton
Depreciation	$2,620,714	$1.18
Aquisiton/Depletion	$101,411	$0.09
Amortization	$1,151,381	$0.52
Overhead	$565,000	$0.25
Propery Insurance	$166,770	$0.07
State Sales Tax	$899,224	$0.40
Real Property Tax	$0	$0.00
Tangible Property Tax	$0	$0.00
Total Indirect Cost	$5,504,501	$2.47

Other Costs		Cost/Ton
Wash Plant Cost, Washed	$12,972,330	$5.82
Loadout Cost, Sold	$223,020	$0.10
D & I in Car, Raw	$46,931,249	$21.04
D & I in Car, Washed	$59,903,579	$50.32
Coal Haulage Cost, Raw	$9,366,840	$4.20

Figure C.98. Mine Model Report showing direct, indirect, and other costs.

for the Dragline and truck-shovel **Mine Models** will have four columns. The first column will show the cost for mining the coal. The second column shows the cost of truck-shovel benching, the third column shows the cost of the dragline, and the fourth column is a total of all costs and a cost per ton by line item.

Table C.5 shows the different reporting categories for the Operating Statement Report and includes Direct Costs, Indirect Costs, Other Costs, and Royalty, Tax and Fee Costs associated with the mining, processing, and loading coal into unit trains. The cost per ton for Direct Costs is found by dividing the direct cost by the saleable or washed tons per year. The cost per ton for all Royalties, Taxes, and Fees is calculated by dividing the total category cost by washed (or sold) tons produced per year (fig. C.99). The tons of washed product produced per year are assumed to be sold tons per year.

Employee Cost Reports Section of the Mine Model Report

The following lists for CoalVal labor reports and figures C.100 and C.101 will be used as examples for the following discussion of the wage and salaried employee assumptions. See the Cost Assumptions section for additional explanation. The following list provides the categories included in the wage employee and pay rate report (the definitions are found in the Glossary, appendix E):

1. Adj 1st Shift
2. Adj 2nd Shift
3. Adj 3rd Shift
4. Adj 4th Shift
5. Base Rate
6. Grade
7. Hours per Shift
8. Number of Employees: 1st, 2nd, 3rd, 4th Shift
9. Payroll Rate/Day
10. Total Payroll

The salaried-labor report contains the following list of items (the definitions are found in the Glossary, appendix E).

1. Base Salary per Year
2. Total Annual Salary
3. Number of Employees 1st, 2nd, 3rd, and 4th Shift
4. Total Salary per Year
5. Total Annual Overhead

Equipment Cost Reports Section of Mine Model Report

The following equipment lists and figures C.102 and C.103 can be used as reference for equipment fields in the equipment cost reports. Underground mining equipment terms used for production and support equipment cost reports are found in the following list (the definitions are found in the Glossary, appendix E):

1. Depreciation per Hour
2. F&L (fuel and lube) per Hour
3. Hrs Worked per Shift
4. # Units 1st, 2nd, 3rd, 4th shifts
5. R&M (repair and maintenance) per Hour
6. Total Depreciation per Day
7. Total F&L (fuel and lube) per Day
8. Total R&M (repair and maintenance) per Day

Terms used for surface support equipment at an underground mine and infrastructure cost reports are found in the following list (the definitions are found in the Glossary, appendix E.).

1. Depreciation Term Hours
2. Development Amortization
6. Real Property
7. Straight Line Depreciation

Table C.5. Direct, Indirect, Other Costs, and Royalty, Tax and Fee cost-categories in the Operating Statement Report.

[Definitions are found in the Glossary, appendix E. SMCRA, Surface Mining Control and Reclamation Act]

Direct Costs	Indirect Costs	Other Costs	Royalty, Tax, & Fees
Payroll	Depreciation	Prep Plant Cost	Private , State, and Federal Acquisition
Burden	Acquisition/Depletion	Load out Cost, Sold	Royalty Federal Lands
Fuel and Lubes	Amortization		State Mineral Tax
Explosives	Overhead		Black Lung Tax
Operating Supplies	Property Insurance		Severance Tax
Repair Parts–Maintenance Supply	State Sales Tax	Coal Haulage Cost– Raw	Other Tax
Utilities	Real Property		SMCRA Tax
All Rentals	Tangible Property		
Professional Services			
Reclamation Provision			
General Expenses			Total Tax
Hoisting Cost			
		D&I in Car, Raw	Cost in Car, Raw
Direct Cost, Raw	Total Indirect Cost	D&I in Car, Washed	Cost in Car, Washed

Royalities, Taxes, and Fees		Cost/Ton
Private, State, Acquisition	$130,939	$0.11
Royalty Federal Lands	$11,452,608	$9.62
State Mineral Tax	$4,714	$0.00
Black Lung Tax	$1,309,393	$1.10
Servance Tax	$6,736,828	$5.66
Other Tax	$13,473,656	$11.32
SMRCA Tax	$178,554	$0.15
Total Tax	$33,286,691	$27.96
Cost in Car, Raw	$89,584,780	$53.21
Cost in Car, Washed	$102,557,110	$86.16

Figure C.99. Mine Model Report showing royalties, taxes, and fees costs.

Wage Labor

Production

Employee	# of Empls 1st Shift	# of Empls 2nd Shift	# of Empls 3rd Shift	# of Empls 4th Shift	Hours Per SHift	Payroll Rate/Day	Grade	Base Rate	Adj 1st Shift	Adj 2nd Shift	Adj 3rd Shift	Adj 4th Shift
Cont Miner operator	3	3	3	3	8	$2,076.96	5	$20.50	$21.46	$21.76	$21.86	$21.46
Cont miner helper	3	3	3	3	8	$2,027.04	4	$20.00	$20.94	$21.24	$21.34	$20.94
Shuttle car operator	9	9	9	9	8	$5,928.48	3	$19.50	$20.41	$20.71	$20.81	$20.41
Roof bolter operator	3	3	3	3	8	$2,076.96	5	$20.50	$21.46	$21.76	$21.86	$21.46
Scoop operator	3	3	3	3	8	$1,976.16	3	$19.50	$20.41	$20.71	$20.81	$20.41
Roof bolter helper	3	3	3	3	8	$1,976.16	3	$19.50	$20.41	$20.71	$20.81	$20.41

Total Daily 1st Shift:	**$3,981.84**
Total Daily 2nd Shift:	**$4,039.44**
Total Daily 3rd Shift:	**$4,058.64**
Total Daily 4th Shift (not included in daily wages):	**$3,981.84**
Total Daily Payroll:	**$16,061.76**
Total Daily With Over Time Pay:	**$17,667.94**

Auxiliary

Employee	# of Empls 1st Shift	# of Empls 2nd Shift	# of Empls 3rd Shift	# of Empls 4th Shift	Hours Per SHift	Payroll Rate/Day	Grade	Base Rate	Adj 1st Shift	Adj 2nd Shift	Adj 3rd Shift	Adj 4th Shift
Scoop operator	2	2	2	2	8	$1,317.44	3	$19.50	$20.41	$20.71	$20.81	$20.41
Pocketmen	3	3	3	3	8	$1,976.16	3	$19.50	$20.41	$20.71	$20.81	$20.41
Supplymen	2	1	1	2	8	$960.32	1	$19.00	$19.89	$20.19	$20.29	$19.89
Lampman/warehouse	3	3	3	3	8	$1,926.24	1	$19.00	$19.89	$20.19	$20.29	$19.89
Belt maint/cleanup	6	6	6	6	8	$3,852.48	1	$19.00	$19.89	$20.19	$20.29	$19.89
Mechanics	5	5	5	5	8	$3,461.60	5	$20.50	$21.46	$21.76	$21.86	$21.46
Electricians	3	3	3	3	8	$2,076.96	5	$20.50	$21.46	$21.76	$21.86	$21.46
Surf Utility operator	2	1	1	2	8	$985.28	3	$19.50	$20.41	$20.71	$20.81	$20.41
Tipple/loadout Operator	1	1	1	1	8	$642.08	3	$19.00	$19.89	$20.19	$20.29	$19.89
Hoist Operator	1	1	1	1	8	$642.08	1	$19.00	$19.89	$20.19	$20.29	$19.89

Total Daily 1st Shift:	**$4,584.96**
Total Daily 2nd Shift:	**$4,324.96**
Total Daily 3rd Shift:	**$4,345.76**
Total Daily 4th Shift (not included in daily wages):	**$4,584.96**
Total Daily Payroll:	**$17,840.64**
Total Daily With Over Time Pay:	**$19,624.70**
Total Annual Payroll (includes 4th Shift):	**$13,201,595**

Figure C.100. Mine Model Report showing annual wage labor manpower and costs report by position for a three unit, room and pillar mine using continuous miner mining machines.

Salaried Labor

General Mine Management and Staff

Employee	# of Empls 1st Shift	# of Empls 2nd Shift	# of Empls 3rd Shift	# of Empls 4th Shift	Base Salary Per Year	Total Salary Per Year
Superintendent ug/surf - N App CF	1	0	0	0	$105,000.00	$105,000.00
Production Foremen ug - N App CF	3	3	3	3	$65,000.00	$780,000.00
Maintance foremen ug - N App CF	2	2	2	2	$65,000.00	$520,000.00
Surface foremen ug - N App CF	1	1	0	1	$60,000.00	$180,000.00
Mine clerk ug - N App Coalfield	2	2	1	2	$30,000.00	$210,000.00
Safety Engineer ug -N App Coalfield	1	0	0	1	$55,000.00	$110,000.00

Company Support Personnel

Employee	# of Empls 1st Shift	# of Empls 2nd Shift	# of Empls 3rd Shift	# of Empls 4th Shift	Base Salary Per Year	Total Salary Per Year
General Mgr ug - N App Coalfield	1	0	0	0	$120,000.00	$120,000.00
Controller -ug/surf N App Coalfield	1	0	0	0	$85,000.00	$85,000.00
Secretary/Clerk ug - N App CF	2	0	0	0	$35,000.00	$70,000.00
Purchasing agent ug/surf - N App CF	1	0	0	0	$60,000.00	$60,000.00
Mine Engineers ug - N App Coalfield	2	0	0	0	$65,000.00	$130,000.00
Techs/Surv ug - N App Coalfield	2	0	0	0	$50,000.00	$100,000.00

Total Annual Salary: $1,905,000
Total Annual Overhead (includes Hourly and Salaried): $565,000

Figure C.101. Mine Model Report showing annual salaried labor manpower and costs report by position for a three unit, room and pillar mine using continuous miner mining machines.

Capital Equipment

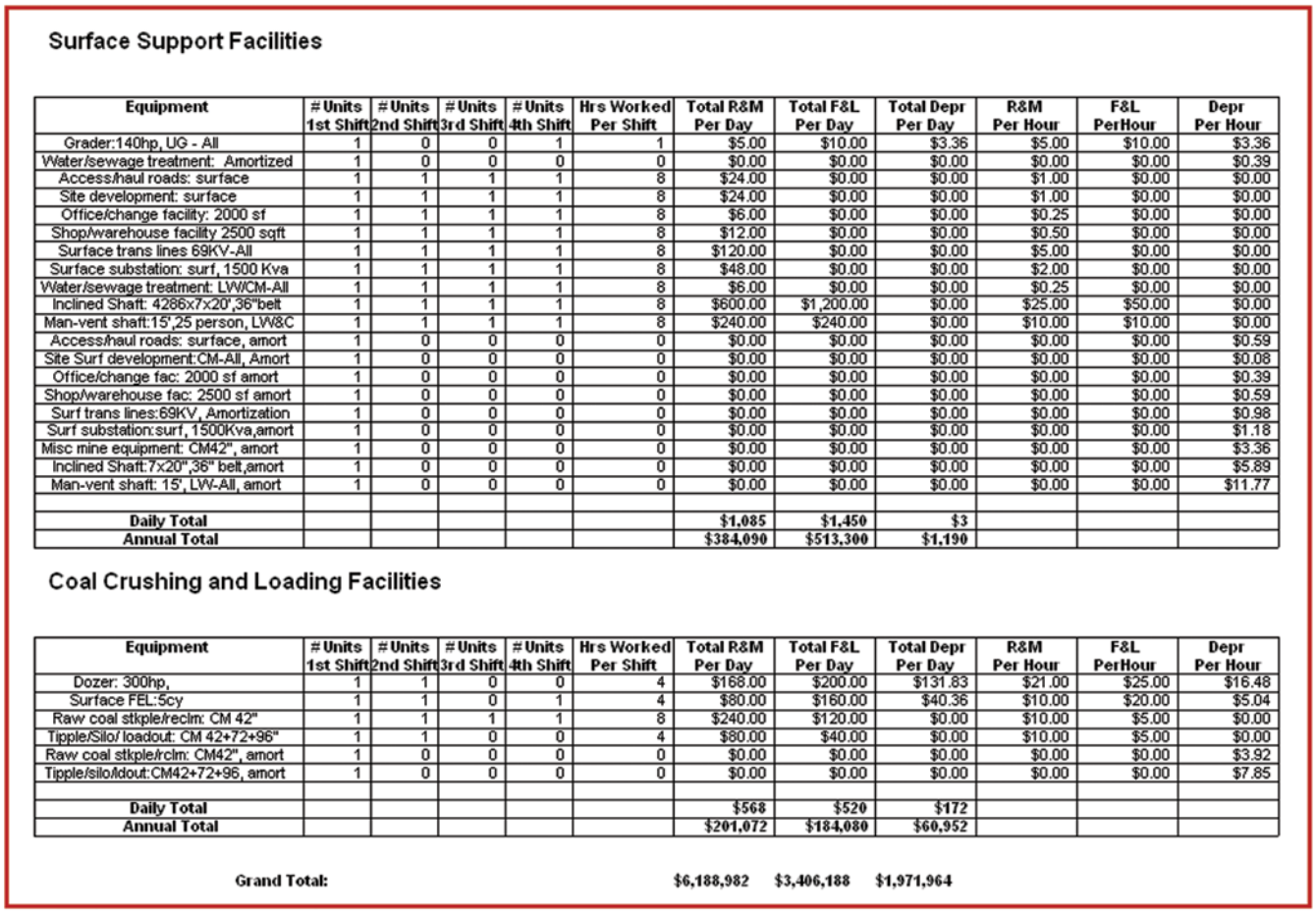
R&P Production Equipment

Equipment	# Units 1st Shift	# Units 2nd Shift	# Units 3rd Shift	# Units 4th Shift	Hrs Worked Per Shift	Total R&M Per Day	Total F&L Per Day	Total Depr Per Day	R&M Per Hour	F&L PerHour	Depr Per Hour
CM: 30"-85"Range	3	3	3	3	8	$4,320.00	$2,160.00	$1,694.92	$60.00	$30.00	$23.54
Shuttle car: 15T, Elec	9	9	9	9	8	$6,480.00	$1,080.00	$2,033.90	$30.00	$5.00	$9.42
Roof bolter, 2 boom, low headroom	3	3	3	3	8	$1,440.00	$720.00	$338.98	$20.00	$10.00	$4.71
Scoop 3.5cy, 40" min. ht.	3	3	3	3	8	$720.00	$720.00	$508.47	$10.00	$10.00	$7.06
Pers carrier:12 passinger	3	3	3	3	1	$18.00	$45.00	$11.35	$2.00	$5.00	$1.26
Daily Total						$12,978	$4,725	$4,588			
Annual Total						$4,594,212	$1,672,650	$1,624,018			

Underground Support Equipment

Equipment	# Units 1st Shift	# Units 2nd Shift	# Units 3rd Shift	# Units 4th Shift	Hrs Worked Per Shift	Total R&M Per Day	Total F&L Per Day	Total Depr Per Day	R&M Per Hour	F&L PerHour	Depr Per Hour
Service truck: 40" min. ht	2	2	2	2	8	$240.00	$240.00	$169.49	$5.00	$5.00	$3.53
UG compressors & lines	3	3	3	3	8	$144.00	$288.00	$84.75	$2.00	$4.00	$1.18
Scoop 3.5cy, 40" min. ht.	1	1	1	1	8	$240.00	$240.00	$169.49	$10.00	$10.00	$7.06
Lube truck: 40" min ht	2	2	2	2	8	$240.00	$240.00	$169.49	$5.00	$5.00	$3.53
Pers carrier:12 passinger	3	3	3	3	1	$18.00	$45.00	$11.35	$2.00	$5.00	$1.26
Rock duster, 10hp	1	1	0	1	4	$8.00	$8.00	$3.36	$1.00	$1.00	$0.42
Portable Power Cntr: 750 Kva	3	3	3	3	8	$72.00	$0.00	$0.00	$1.00	$0.00	$0.00
Fder/brkers: 300tph - cm units	3	3	3	3	8	$720.00	$360.00	$0.00	$10.00	$5.00	$0.00
36/30" Main & RP panel belts: 72"CM	1	1	1	1	8	$480.00	$960.00	$0.00	$20.00	$40.00	$0.00
Ventilation Sys: LW 42" CM sections	3	3	3	3	8	$360.00	$180.00	$0.00	$5.00	$2.50	$0.00
UG compressors & lines	3	3	3	3	8	$144.00	$288.00	$84.75	$2.00	$4.00	$1.18
Mine dewatering sys: CM 24+42"	3	3	3	3	8	$36.00	$18.00	$60.53	$0.50	$0.25	$0.84
CM: 30"-85"Range	1	0	0	1	1	$60.00	$30.00	$23.54	$60.00	$30.00	$23.54
Roof bolter, 2 boom, low headroom	1	0	0	1	1	$20.00	$10.00	$4.71	$20.00	$10.00	$4.71
Shuttle car: 15T, Elec	2	0	0	2	1	$60.00	$10.00	$18.83	$30.00	$5.00	$9.42
Scoop 3.5cy, 40" min. ht.	1	0	0	1	1	$10.00	$10.00	$7.06	$10.00	$10.00	$7.06
Pwr cntrs:750Kva,, amort	3	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.84
Frd/brkers: 300tph, CM units, amort	3	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$7.06
36/30"main&panel belts: CM72",amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$67.26
Vent sys: LW&CM 42", CM sec, amort	3	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$2.52
Daily Total						$2,852	$2,927	$807			
Annual Total						$1,009,608	$1,036,158	$285,804			

Figure C.102. CoalVal's Mine Model Report showing production and support, capital equipment costs.



Surface Support Facilities

Equipment	# Units 1st Shift	# Units 2nd Shift	# Units 3rd Shift	# Units 4th Shift	Hrs Worked Per Shift	Total R&M Per Day	Total F&L Per Day	Total Depr Per Day	R&M Per Hour	F&L PerHour	Depr Per Hour
Grader:140hp, UG - All	1	0	0	1	1	$5.00	$10.00	$3.36	$5.00	$10.00	$3.36
Water/sewage treatment: Amortized	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.39
Access/haul roads: surface	1	1	1	1	8	$24.00	$0.00	$0.00	$1.00	$0.00	$0.00
Site development: surface	1	1	1	1	8	$24.00	$0.00	$0.00	$1.00	$0.00	$0.00
Office/change facility: 2000 sf	1	1	1	1	8	$6.00	$0.00	$0.00	$0.25	$0.00	$0.00
Shop/warehouse facility 2500 sqft	1	1	1	1	8	$12.00	$0.00	$0.00	$0.50	$0.00	$0.00
Surface trans lines 69KV-All	1	1	1	1	8	$120.00	$0.00	$0.00	$5.00	$0.00	$0.00
Surface substation: surf, 1500 Kva	1	1	1	1	8	$48.00	$0.00	$0.00	$2.00	$0.00	$0.00
Water/sewage treatment: LW/CM-All	1	1	1	1	8	$6.00	$0.00	$0.00	$0.25	$0.00	$0.00
Inclined Shaft: 4286x7x20',36"belt	1	1	1	1	8	$600.00	$1,200.00	$0.00	$25.00	$50.00	$0.00
Man-vent shaft:15',25 person, LW&C	1	1	1	1	8	$240.00	$240.00	$0.00	$10.00	$10.00	$0.00
Access/haul roads: surface, amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.59
Site Surf development:CM-All, Amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.08
Office/change fac: 2000 sf amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.39
Shop/warehouse fac: 2500 sf amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.59
Surf trans lines:69KV, Amortization	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$0.98
Surf substation:surf, 1500Kva,amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$1.18
Misc mine equipment: CM42", amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$3.36
Inclined Shaft:7x20",36" belt,amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$5.89
Man-vent shaft: 15', LW-All, amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$11.77
Daily Total						**$1,085**	**$1,450**	**$3**			
Annual Total						**$384,090**	**$513,300**	**$1,190**			

Coal Crushing and Loading Facilities

Equipment	# Units 1st Shift	# Units 2nd Shift	# Units 3rd Shift	# Units 4th Shift	Hrs Worked Per Shift	Total R&M Per Day	Total F&L Per Day	Total Depr Per Day	R&M Per Hour	F&L PerHour	Depr Per Hour
Dozer: 300hp,	1	1	0	0	4	$168.00	$200.00	$131.83	$21.00	$25.00	$16.48
Surface FEL:5cy	1	1	0	1	4	$80.00	$160.00	$40.36	$10.00	$20.00	$5.04
Raw coal stkple/reclm: CM 42"	1	1	1	1	8	$240.00	$120.00	$0.00	$10.00	$5.00	$0.00
Tipple/Silo/ loadout: CM 42+72+96"	1	1	0	0	4	$80.00	$40.00	$0.00	$10.00	$5.00	$0.00
Raw coal stkple/rclm: CM42", amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$3.92
Tipple/silo/ldout:CM42+72+96, amort	1	0	0	0	0	$0.00	$0.00	$0.00	$0.00	$0.00	$7.85
Daily Total						**$568**	**$520**	**$172**			
Annual Total						**$201,072**	**$184,080**	**$60,952**			

Grand Total: **$6,188,982** **$3,406,188** **$1,971,964**

Figure C.103. CoalVal's Mine Model Report showing the capital costs for surface facilities at an underground room and pillar mine.

3. Hourly Depreciation
4. Equipment Cost
5. Number Units
8. Total Hrs per Day
9. Unit Cost
10. Usable Life Years

Project Report

The second set of **Reports** is the **Project–Seam** report. There are four types of **Project Reports**: the **Seam Report**, the **Summary Project Report**, the **Recoverable Tons Cost Summary** and the **Recoverable Tons Sold at or above Price** range reports. Figure C.104 shows the **Seam Report** dialog page in the **Reports** window.

Selecting the Reports

Figure C.104 shows the **Reports** window with the **Project–Seam Report** dialog page, *select the project desired*. If a **Project Summary Report** of all **Seams** is desired, *select the Project under* "1. Project Name," but *do not check either the* "5. Calculate Seam Report" *or the* "7. Recalculate Mine Model Boxes" and the Project Report will be prepared. If a specific **Seam Report** is needed, *select that* ***Seam*** *under* "2. Select Seam" *and enter a main title and a subtitle or comments for the report.* If the "5. Calculate Seam Report" box is checked, a **Seam Report** will be prepared. If one of the **Recoverable** reports is needed: *select a summary format in step "6. For Recoverable Tons Cost Summary Report" (fig. C.105)*. A summary format is a set of price ranges (see **Summary Report Tools** drop-down menu on the **Reports** dialog for more information about summary report format.

The **Reports** dialog window has an area on the right side of the bottom line that will have a yellow highlighted message: "Calculating: Preparing Report" while the report is being calculated. On occasion the CoalVal Report Output Options window may get stuck in the back of the **Reports** dialog window. If, after you wait for a few minutes for the report calculation but the Output Options window does not appear, the status may be checked *by selecting* "Ctrl-Alt-Delete" on the keyboard. This selection will allow the Task Manager to check to see if the program is responding. *Click on the Task Master button* and if CoalVal is running, *exit from the window*, and the

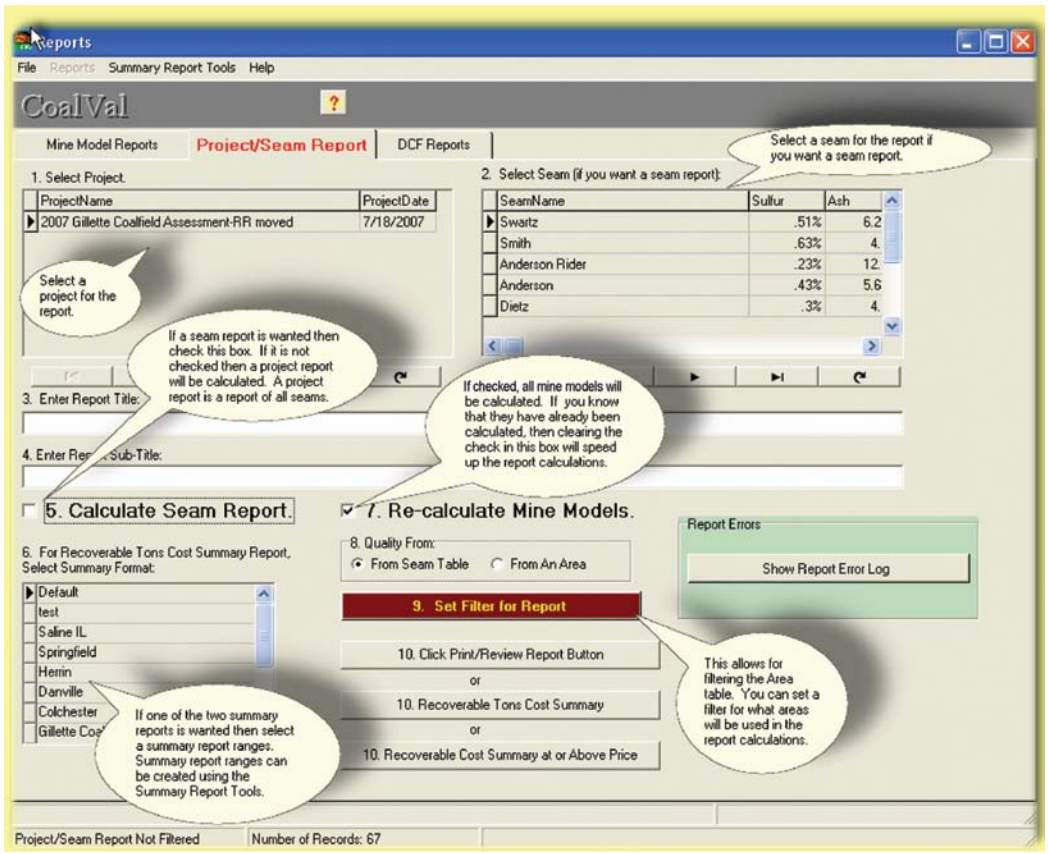


Figure C.104. CoalVal's Seam Report dialog page on the Reports window.

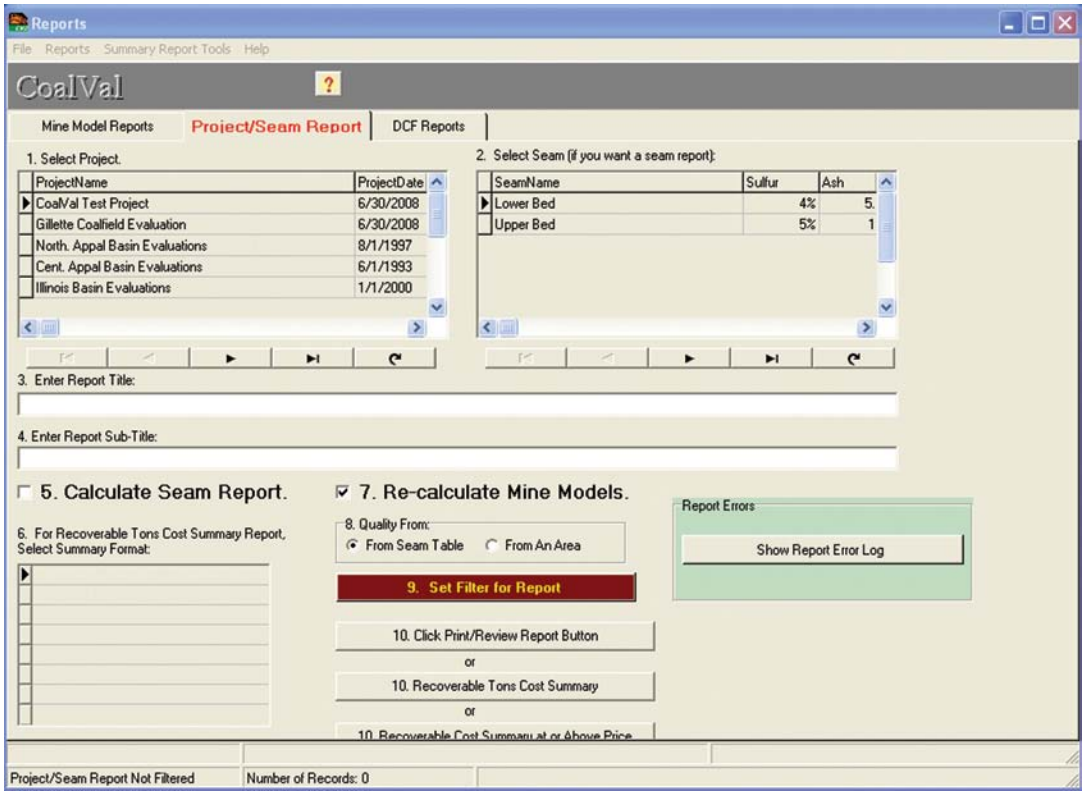


Figure C.105. Re-calculation of CoalVal's cost-per-ton for mining in the Mine Models.

Output Options window will appear. If the Report Manager shows that CoalVal is not running, *exit from CoalVal, reopen CoalVal, check the input data, and rerun the Project Report*.

The recalculation section of the **Project–Seam Report** dialog page of the cost-per-ton from the **Mine Models** is shown in figure C.98. The mining costs calculated from the **Mine Models** are stored in the **Coal Resource and Discounted Cash Flow Areas** calculations page of a **Project**. If the **Mine Models** have not changed, the step "7. Recalculate Mine Models" box does not need to be marked. If however, the **Mine Model** was modified, the **Mine Model** costs will be changed and the cost of mining needs to be recalculated. The **Reports** will take longer to create if the **Mine Models** are recalculated.

Choosing Coal Quality from an **Area** or from a **Seam** and Selecting the Desired **Summary Reports**

The user can pick between using the coal-quality data from the **Seam Table** or one from a selected **Area** (fig. C.106) in the **Coal Resource and Discounted Cash Flow Areas Table**. If **From An Area** is selected, the quality data will come from the highlighted **Area** in the **Coal Resource and Discounted Cash Flow Areas Table**. If "From Seam Table" is selected the coal-quality data will come from the **Seam Table** in the **Projects** menu. Once the coal-quality data source is selected, the user will need to select the desired **Report**. *Click on the step "10. Click Print/Review Report" button for the standard **Resource Area Report**, or the step "10 Recoverable Tons Cost Survey" or "Recoverable Cost Summary at or Above Price" buttons for the cost of **Recoverable Resource Reports***.

Discounted Cash Flow Report

The third report is found on the **DCF Reports** tab on the main **Reports Menu** (fig. C.107). In the preceding section the **Project Reports** summarized the resources by operating cost for a group of **Areas**; in this section the **DCF Reports** summarize the costs on an **Area** by **Area** basis with a **DCF Report** for every **Area** and a summary for all **Areas** combined. If there are 100 **Areas** in a **Seam** then there will be 100 **DCF Reports**. To review the **Reports** available under the **DCF Reports** tab, *select step "1. Select Project" and then select step "2. Select Seam" for the report*. If a **Recoverable Tons Cost Summary Report** is needed (see the **Summary Report Tools** drop-down menu on the **Reports** dialog page

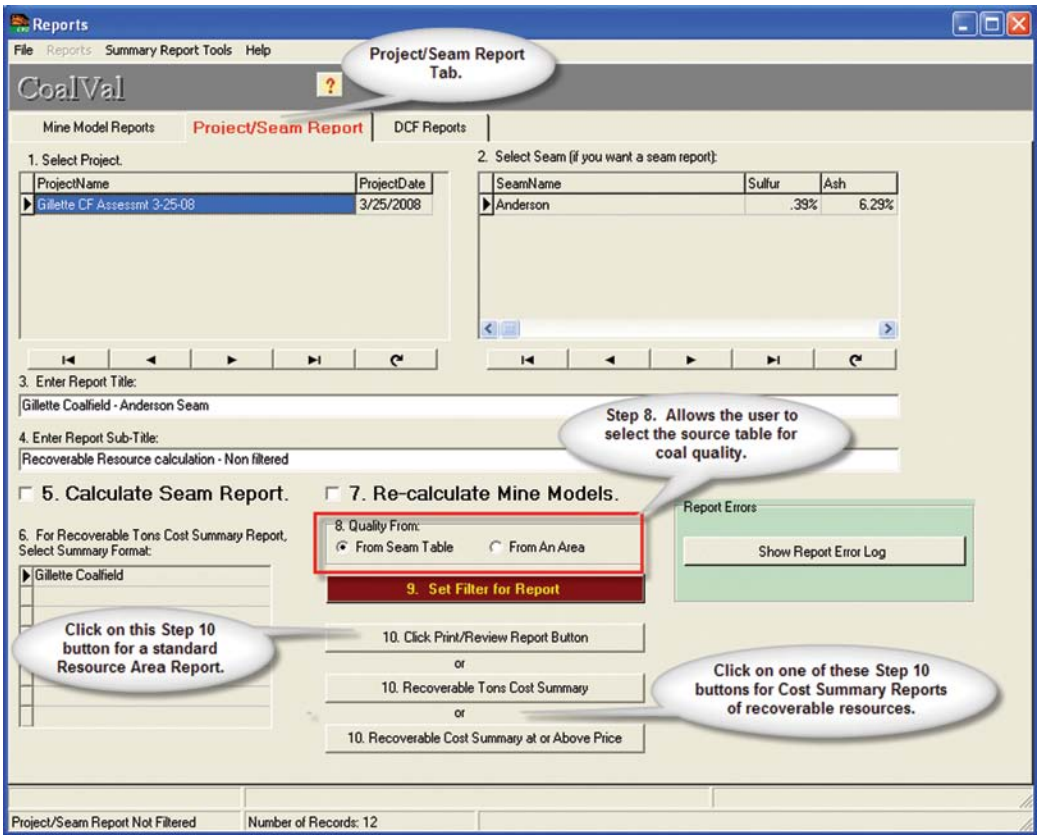


Figure C.106. CoalVal's Reports window showing the selected coal-quality data box (item 8) where the user can select the source table for coal quality and Project/Seam Summary Reports (item 10).

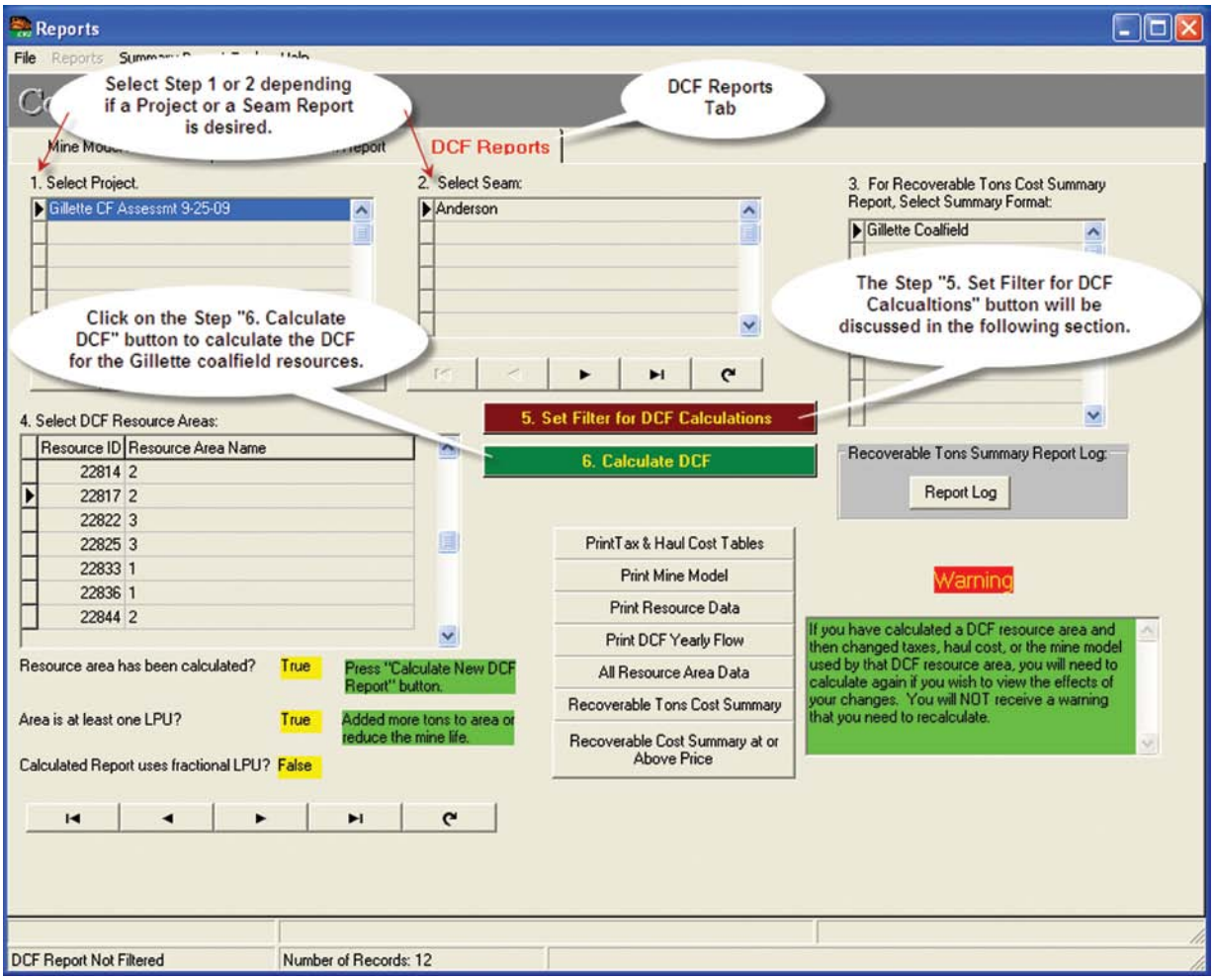


Figure C.107. CoalVal's DCF Reports dialog window showing the six steps to calculating the Discounted Cash Flow for an Area.

for more information about summary report formats), *select step "3. For Recoverable Tons Cost Summary Report" on the* ***DCF Reports*** *dialog window*. Next, *select the* ***DCF Resource Area*** (step "4"; the **Area** will be highlighted in blue). *Clicking on the: "5. Set Filter for DCF Calculations" button is needed only if the DCF calculations that are used in the* ***Recoverable Report*** *need to be filtered.*

The filter for the **DCF Reports** is used to limit the **Areas** that the user wishes to have calculated. To use, *click on "5. Set Filter for DCF Calculations" button (fig. C.108) and select the field for filtering from the "Fields"* list. In figure C.108 the field, "Area Name" has been selected, a field value of Ohio (county), WV has been entered, and the "Search Type: Partial Match Anywhere**"** has been selected. Through this filtering of the **Area Table** only records that have Ohio (county), WV somewhere in the field, "Area Name" will be calculated (fig. C.109). For a more detailed explanation of filtering, see the appendix C, Program Description, Data Filtering in CoalVal Section.

The **Print Tax & Haul Cost Tables** and **Print Mine Model Reports** shown in figure C.107 will print the **Tax Table**, **Haul Cost Table**, and **Mine Models Reports** used for the **Discounted Cash Flow (DCF) Resource Area Reports** selected by the user. The **Print Resource Data** will print all the resources by **Area** for the **Seam** that the user has selected and the **Print DCF Yearly Flow** button will allow printing of the actual cash flow analysis for each **DCF Resource Area** with a summary page showing the hurdle rate, coal quality and logical production units (LPUs) in the resource area. This report is an excellent summary of mining costs by area. The **Tax, Haul Cost,** and **Mine Model Report** buttons on this dialog (fig. C.108) are not DCF reports. They are references for the **Mine Models, Haul Costs,** and **Tax Tables** for the selected **Areas**. If the **Tax** and **Haul Cost Tables** used by a DCF **Area** are deleted, the associated **Tax** and **Haul Cost Reports** will not be calculated correctly. Calculation of the DCF will be described in the next section. Some of the reports on this dialog will display all the DCF **Areas** for a **Seam**

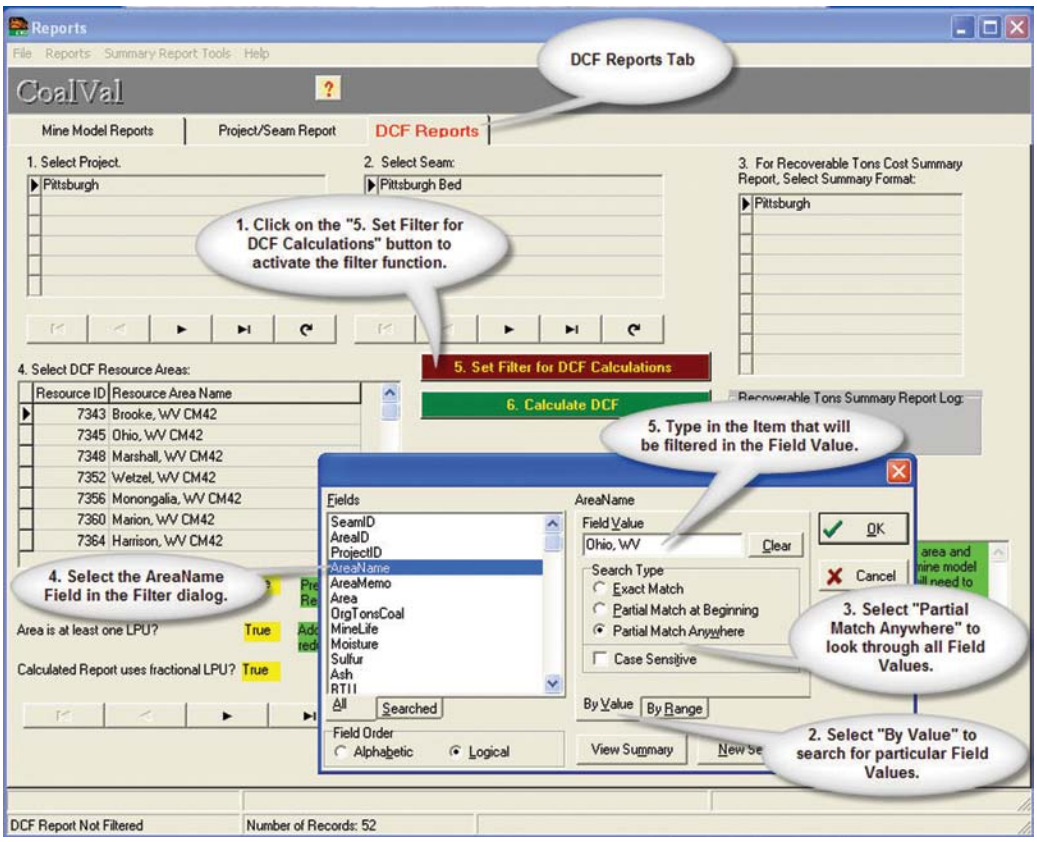


Figure C.108. Setting a filter for the DCF calculations.

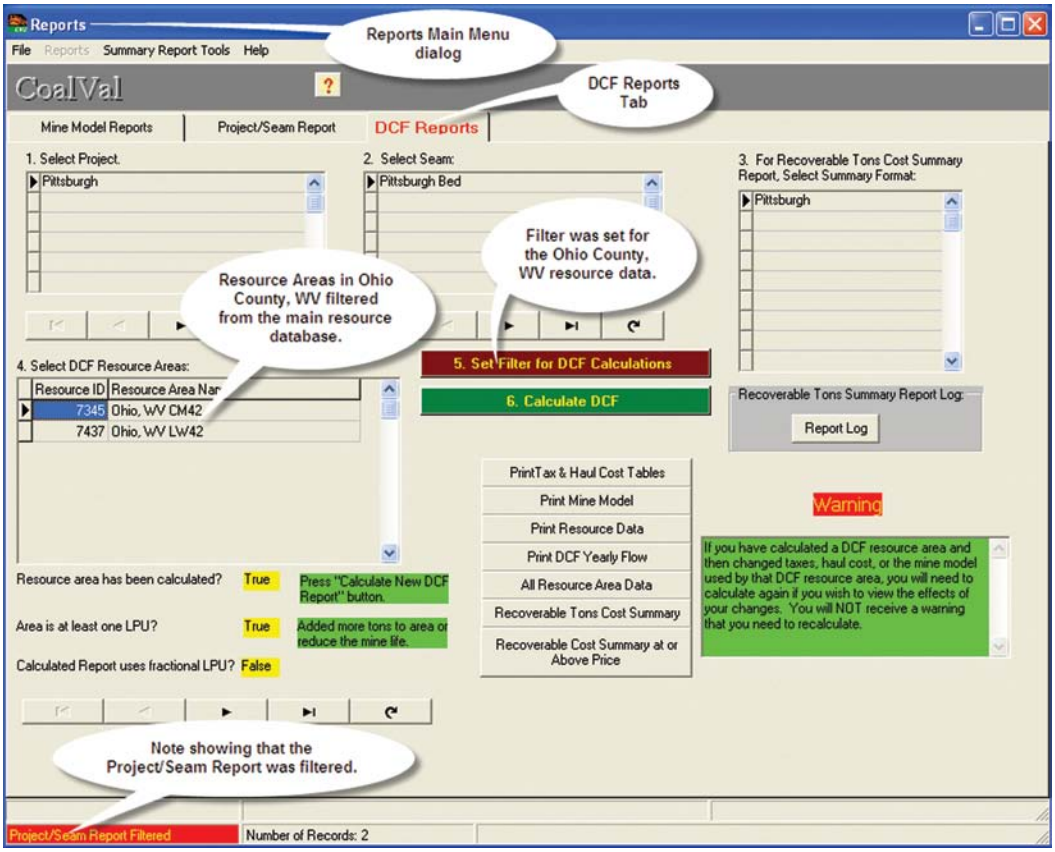


Figure C.109. Ohio County, WV, resource data filtered out from the main Pittsburgh database.

and some will display only data from the single DCF **Area** selected.

Discounted Cash Flow Calculations

The **Discounted Cash Flow** (DCF) **Report** calculations assume that coal is being produced by all mining processes in the **Mine Model**. With the inclusion of **Mine Models** that have more than one mining process, such as truck-shovel stripping plus dragline stripping plus truck-shovel coal production, any process that does not produce coal production will use the Direct Cost, Raw + Overhead + Property Insurance "Yearly Cost" for the O&M ROM (Operating and Maintenance costs for run-of-mine coal) value without dividing by the raw tons of coal produced per year. CoalVal uses the Net Present Value (NPV) method for the DCF calculations, thus the DCF Report Timings must be set correctly for **Mine Models** that have more than one mining process. The **DCF Calculator** dialog (fig. C.110) is accessed from the **DCF Reports** tab dialog window by *clicking on* "*6. Calculate DCF*" *(fig. C.110)*. All of the calculation buttons for **Calculate New Standard LPU DCF Reports, Calculate New Fractional LPU DCF Reports**, and **Calculate All Areas, LPU DCF Reports** are found on the **DCF Calculator** dialog window (fig. C.110). An LPU is a Logical Production Unit and represents the minimum coal resources necessary for one life-of-mine of that **Mine Model** (see the Glossary, appendix E).

Discounted Cash Flow Error Messages

There are three errors that can occur when creating a **DCF Report**. The first one is a "Cannot Calculate NPV" error message. This error means that the routine to calculate the internal rate of return could not complete the calculations. The second error is due to coal mine costs exceeding $1,012 per ton for the price per ton of coal. When this limit is reached an error message will appear and the mining assumptions and tonnages will need to be reassessed.

The third error message concerns the number of Logical Production Units (LPU) used in the DCF area. If the number is less than 0.1 LPUs, an error message will occur. Reassess the mine life, the tonnages for the mine life, and the **Mine Model** chosen. This reassessment can be done on the **Coal Resource and Discounted Cash Flow Areas** dialog page. The review should insure that there is sufficient coal in each "Resource Area" to sustain at least one logical production unit (LPU) of the particular **Mine Model** that was chosen. If the coal volume associated with a "Resource Area" cannot support the minimum LPU size, then the resource area should be assigned to an alternative **Mine Model** (requiring a smaller resource volume) to determine if it could be mined with a less capital-intensive technology. For example, room and pillar mining with continuous miner technology could be substituted for longwall mining.

Fractional Logical Production Units

If the "Resource Area" still cannot support an alternative mining technology, then the data should be reviewed to determine whether the "Resource Area" representing a fractional Logical Production Unit (LPU) can be combined with another "Resource Area" or with another partial (fractional) "Resource Area" in order to have sufficient coal to support a logical production unit for its mine life. The fractional LPUs will be calculated to 0.01 of a full LPU. Less than 0.01 of an LPU results in an error listing that will show in the "Reports Log" on the **DCF Reports** tab or in the "Reports Log" on the **DCF Calculator** dialog window.

To calculate an area with less than one LPU or one LPU plus any fractional part of an LPU, *click on the* ***Calculate New Fractional LPU DCF Report*** *button*. However, if the **Calculate All Areas, LPU DCF Reports** button is selected, all full and fractional LPUs for all areas will be calculated (fig. C.110). After the DCF calculation has been completed but prior to exiting the dialog window, the user should *click on the* ***Mine Model Calculation Report Log*** *button*. This will list all of the **Areas** that contain too few resources to calculate even fractional LPUs. If there are **Areas** with less than 0.01 LPU they will be listed in the **Small Areas Report** on the **DCF Calculator** dialog (fig. C.110). *Clicking on the* ***Small Areas Reports*** *button will provide the user two options (fig. C.111)*: (1) to look at the **Areas** with less than 0.01 LPU **By Mine Model Small Area Report** or (2) to look at small **Areas By Geo Location Small Area Report**. *Clicking on one of these buttons will present the* ***Small Area Report*** *shown in figure C.111*. Comparing this listing with the **Areas** shown in the **Coal Resource and Discounted Cash Flow Areas Table** and the **Areas** too small to evaluate in the DBF table will allow the user to account for all of the unevaluated resource tons. Next, *select the "Exit" button in the upper left-hand corner of the* ***DCF Calculator*** *dialog window and exit to the* ***DCF Reports*** *dialog window*.

Salvage Value Calculations

It should be noted that the DCF report calculates salvage cost differently for **Mine Models** that have more the one mining process, such as longwall and truck-shovel and dragline. The formula is changed only for the first process. The formula is as follows:

```
if MultiProcess then
   SalvageArray[1,1] :=
   (Trunc((3 - (DCFMineLife + YearsToStart1 - i)) -
      PercentLastYear1 + 1) /3) * MMCalDeprec
        Array[dr3,makMineModel]
else
SalvageArray[1,1] :=
   (Trunc((3 - (DCFMineLife + YearsToStart1 - i)) -
   PercentLastYear1) /3) * MMCalDeprecArray
     [dr3,makMineModel];
```

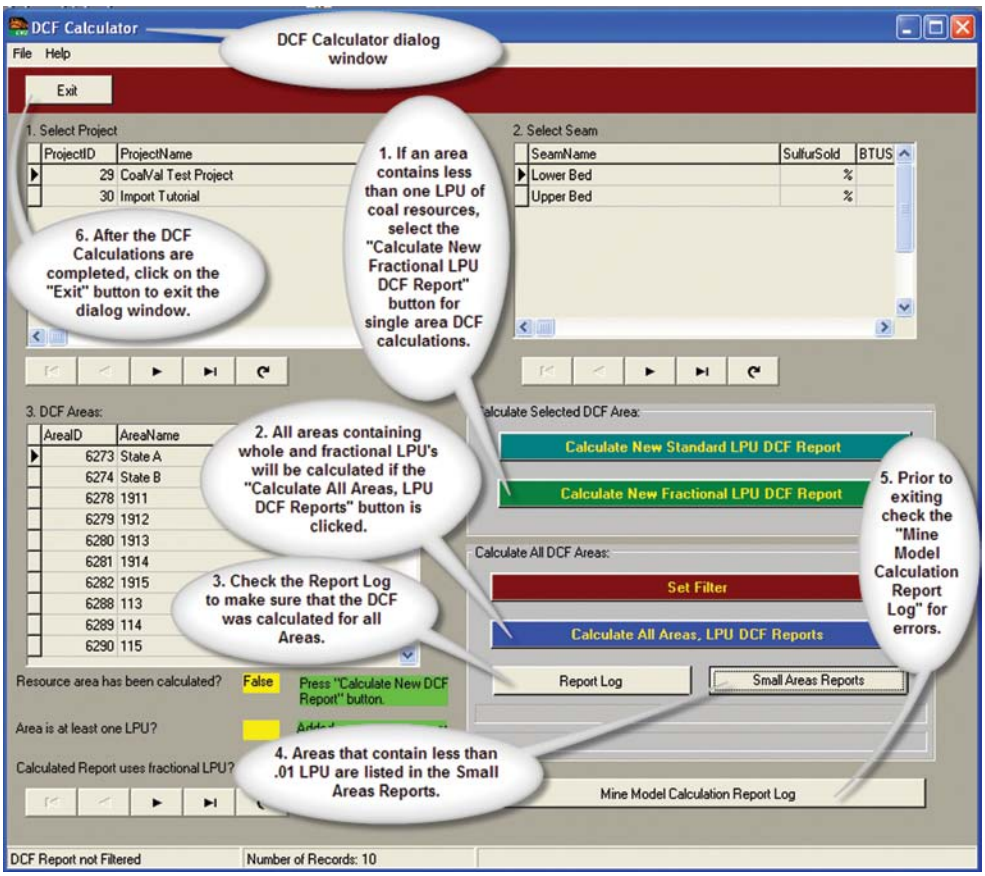


Figure C.110. CoalVal's DCF (Discounted Cash Flow) Calculator dialog window showing the steps for calculating the DCF of a resource and follow-up through the "Report Log" and "Small Areas Reports."

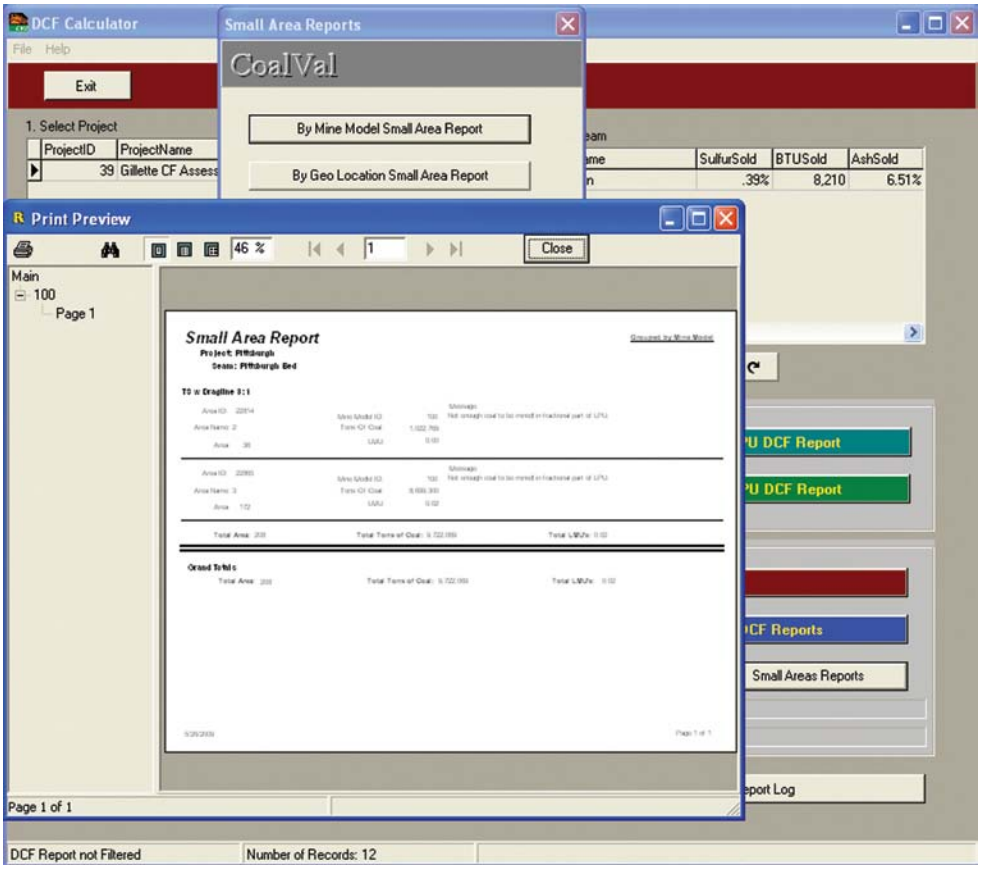


Figure C.111. CoalVal's "Small Area Report" showing resource areas less than 0.01 LPU.

The bold letters shows the differences in the way a multiprocess **Mine Model** salvage is calculated.

The **DCF** (Discounted Cash Flow) **Reports** are different from the other reports in CoalVal in that they are stored in a database. Once these reports have been calculated there is no need to recalculate them again unless input data have changed.

The Report Builder Function

Some of the reports generated by CoalVal are created by a program called **Report Builder,** a product of Digital Metaphors Corporation (*www.digital-metaphors.com*). This program allows for the enhancement and modification of CoalVal reports by the user. A public domain tutorial for learning **Report Builder** can be downloaded from the Digita-Metaphors website. An example of **Report Builder** can be seen through CoalVal's **DCF Reports** by *selecting the **Print DCF Yearly Flow Report** button (fig. C.112)*. The **Report Builder** function develops the **DCF Report** and produces a **Material Flow Tracking Summary Report** (fig. C.113).

The CoalVal user can modify or create new reports through the use of the **Report Builder** routine. The following text describes the steps to modify one of CoalVal's Summary Reports using **Report Builder**.

Step 1. With the **DCF Reports** tab dialog open, *click on the **Summary Report Tools** drop-down menu shown in figure C.114, and*

Step 2. *Select the **End User Reports** option.* This option will provide an **End User Report** dialog window as shown in figure C.115.

Step 3. *Click on the **Run Report Explorer** button in the lower left corner of the dialog window and the **Report Explorer** dialog will appear (fig. C.115).*

Step 4. *Select the **New Report** icon in the upper left corner of the dialog window (fig. C.116) and the **ReportBuilder: New Report** dialog will be displayed (fig.C.117).*

Step 5. *Click on the drop-down **File** menu in the upper left corner of the **ReportBuilder: New Report** dialog (fig. C.117) to navigate to the **Summary Report*** that will be modified. *Select the "Load From File" option from the submenu and navigate through the CoalVal program folder (fig. C.118) to the RBReports folder*.

Step 6. *Double click on the RBReports folder, select the TonsCostSummary.rtm file, and click on the "Open" button* (fig. C.119).

Figure C.120 shows the **Report Builder** dialog with the CoalVal **Summary Report** layout that can now be edited to the user's needs. For example, the headings and data fields for Mountain Top stripping could be removed if the data does not include any Mountain Top data, or the report title could be modified.

New reports from the **Report Builder** function can be created by the user by accessing the Report Builder: **New Report** dialog as shown in figure C.119.

Additional information about using **Report Builder** can be found on the Digital Metaphor website: *www.digital-metaphors.com/learnrb/learnrb.exe.* Learning ReportBuilder, an end-user guide, is a comprehensive interactive learning system designed to teach end-users how to work with ReportBuilder applications. It comes with a 150 page PDF, a standalone application complete with a database, and a help file.

Report Tools

Summary Report Tools Chart Setup

The **Summary Report Tools** consist of a dialog to create range formats and charts for the recoverable reports used by the **Project/Seam Reports** and the **DCF Reports** (fig. C.121). When the **Setup Summary Ranges** menu is selected from the **Summary Report Tools** drop-down list (fig. C.121), the **Recoverable Tons Coal Summary Setup** dialog will be displayed (fig. C.122). This dialog allows the user to create price ranges for the recoverable reports. The first step is to create a summary name. This step is done by *clicking the insert button (+) on the Navigation Bar and typing in a name (fig. C.122)*. Next, *determine the range of costs that will encompass the evaluated coal resources (fig. C.122)*. Any size range or incremental units may be set; however, it is a good idea to review the lowest mining costs and the sales price to get an idea of the lower cost limit and the size of the steps in the range. If the report comments indicate a large resource tonnage discrepancy that cannot be explained, check the report error messages. If a resource area tonnage is less than 0.1 of an LPU or if the resource is restricted from mining, the mining costs will not be calculated and a residual tonnage will develop.

The second tool in the **Summary Report Tools** drop-down menu is a charting tool for creating charts of the recoverable reports. The **Chart** menu item is found on the **Summary Report Tools** drop-down menu (fig. C.123). The two-dimensional chart of the data will look like figure C.124 and the three-dimensional chart will look like figure C.125. For a chart to be displayed, a tabular report must have been calculated using any of the "Recoverable Report" buttons on the **Project/Seam Reports** or **DCF Reports** dialog window tabs. After the tabular report has been created, selecting the Chart menu will display a graphic of the tabular report. The chart can't be printed directly from CoalVal, but it can be saved as a Windows® Meta File (.wmf) graphic and imported

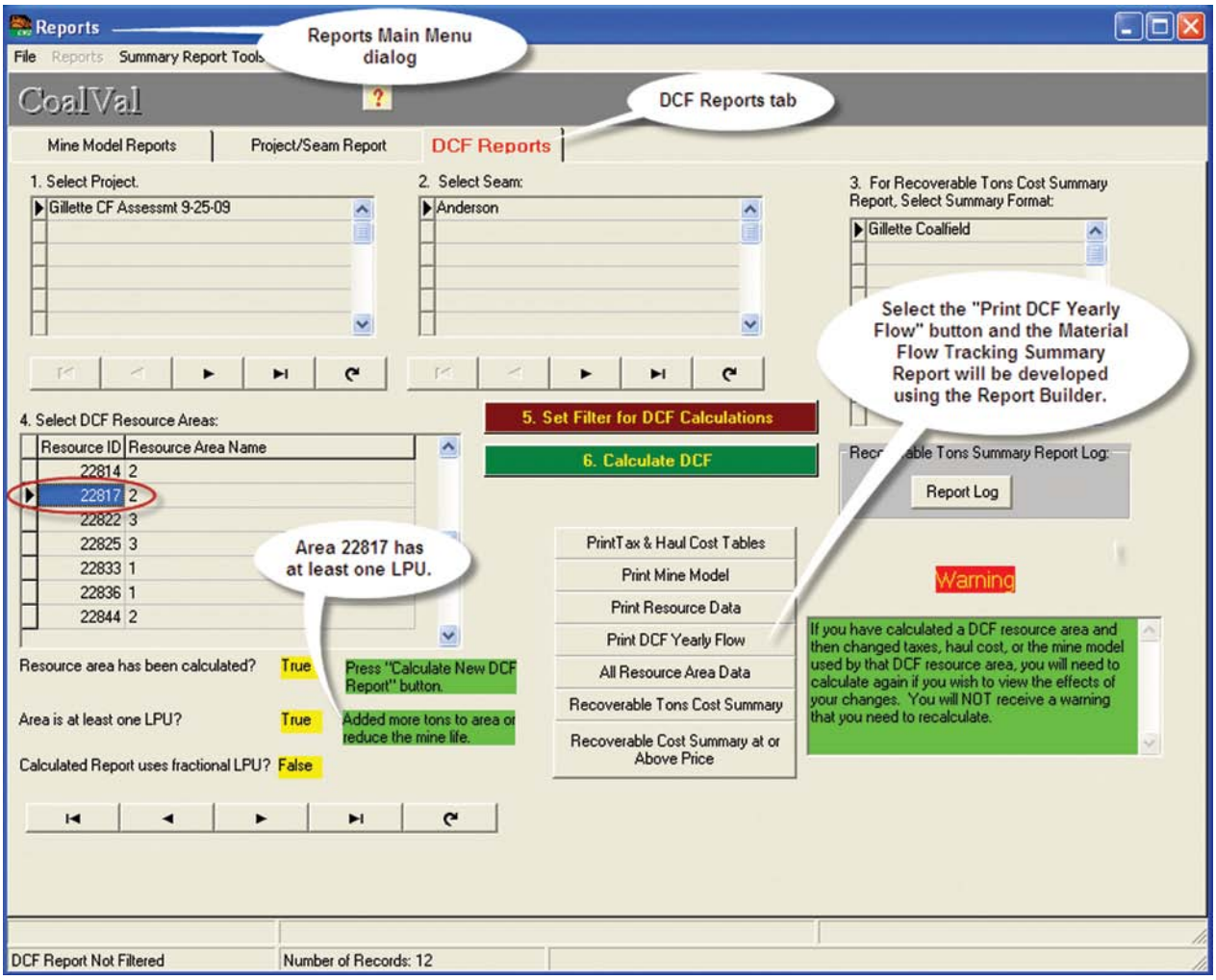


Figure C.112. CoalVal's DCF Reports dialog with the "Print DCF Yearly Flow" button highlighted to calculate the "Material Flow Tracking Summary Report" generated by the Report Builder routine.

Material Flow Tracking Summary

Resource ID	Mine Life	Coal FOB to Market	HurdleRate	Threshold Price
2	10	0	8.00 %	$14.58

	Coal	Parting	Dilution	Total
In Place Tonnage				
In Place Total	0	0	0	0
from Whole LPUs	2,251,399,706	27,306,278	0	2,278,705,985
from Carry Over	43,571,942	528,466	0	44,100,407
Annual In Place Tonnage per LPU				
Coal Part of LMU	37,523,328	455,105	0	37,978,433
Benching Part of LM	0	0	0	0
DragLine Part of LM	0	0	0	0
Totals	37.523.328	455.105	0	37.978.433
Annual Run of Mine Tonnage per LPU				
Coal Part of LMU	34.483.939	418.241	0	34.902.180
Benching Part of LMU	0	0	0	0
Dragline Part of LMU	0	0	0	0
Totals	34.483.939	418.241	0	34.902.180
In Place Tonnage Carry Over (CO)				
Coal Part of CO	43.571.942	528.466	0	44.100.407
Benching part of CO	0	0	0	0
Dragline part of CO	0	0	0	0
Recovered Carry Over				
Coal Part of CO	40,042,614	485,660	0	40,528,274
Benching Part of CO	0	0	0	0
Dragline Part of CO	0	0	0	0
Out of Wash Plant Carry Over				
Wash Plant Recovery Rate	100%	100%	100%	
Coal Part of CO	40,042,614	485,660	0	40,528,274
Benching Part of CO	0	0	0	0
Dragline Part of CO	0	0	0	0
Total	40.042.614	485.660	0	40.528.274
Out of Wash Plant to Market				
from whole LPU's	2.069.036.330	25.094.470	0	2.094.130.800
from Carry Over	40.042.614	485.660	0	40.528.274
Total	0	0	0	0

Fractional Report ☐

Number LPU's Based on User Entered Mine Life
6.12

Number LPU's Based on Calculated Mine Life
6.12

Calculated Mine Life
10

Mineable Resource Recover Rate (from mine model)

92%

92%

Mine Model Name:
TS w Dragline 6:1

Quality

	In-Place	Sold
BTU	8,203	8,210
Sulfur	0.39 %	0 %
Ash	6.29 %	7 %

1 8/13/2009 4:48:29 PM

Figure C.113. CoalVal's "Material Flow Tracking Summary Report" produced by the Report Builder routine.

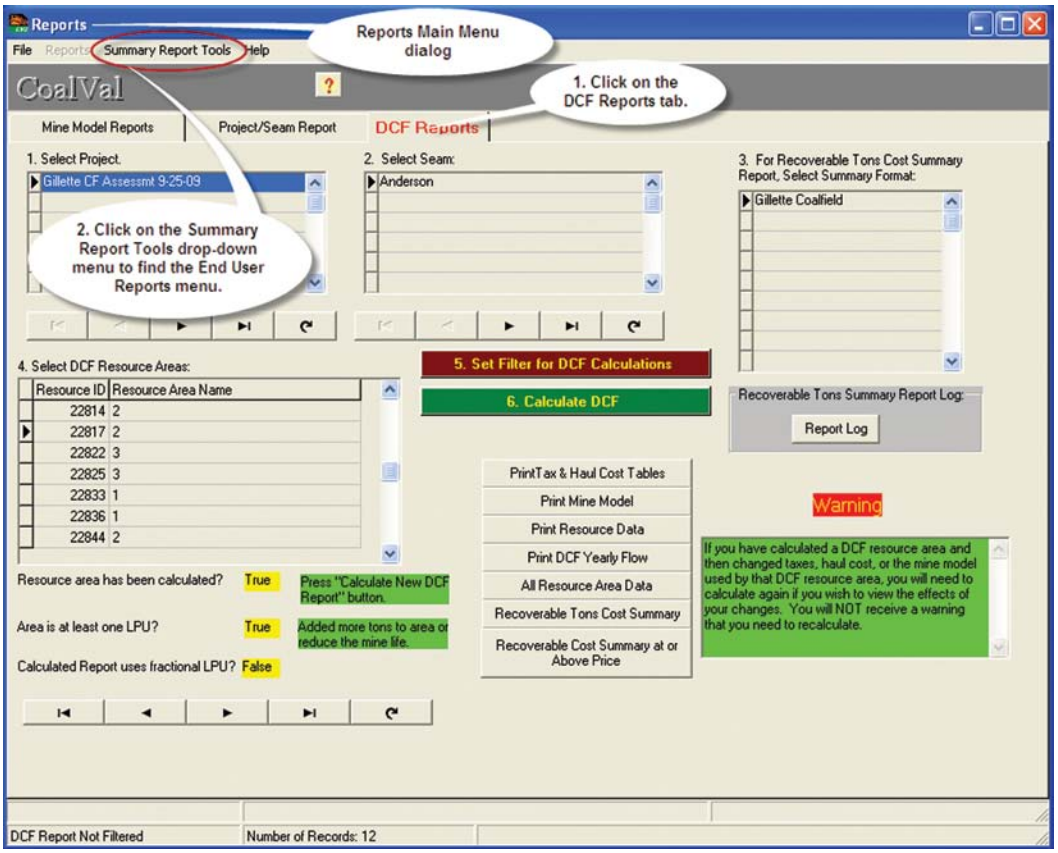


Figure C.114. Navigating to the End User Report dialog via the DCF Reports tab and Summary Report Tools drop-down menu on CoalVal's Reports Main Menu.

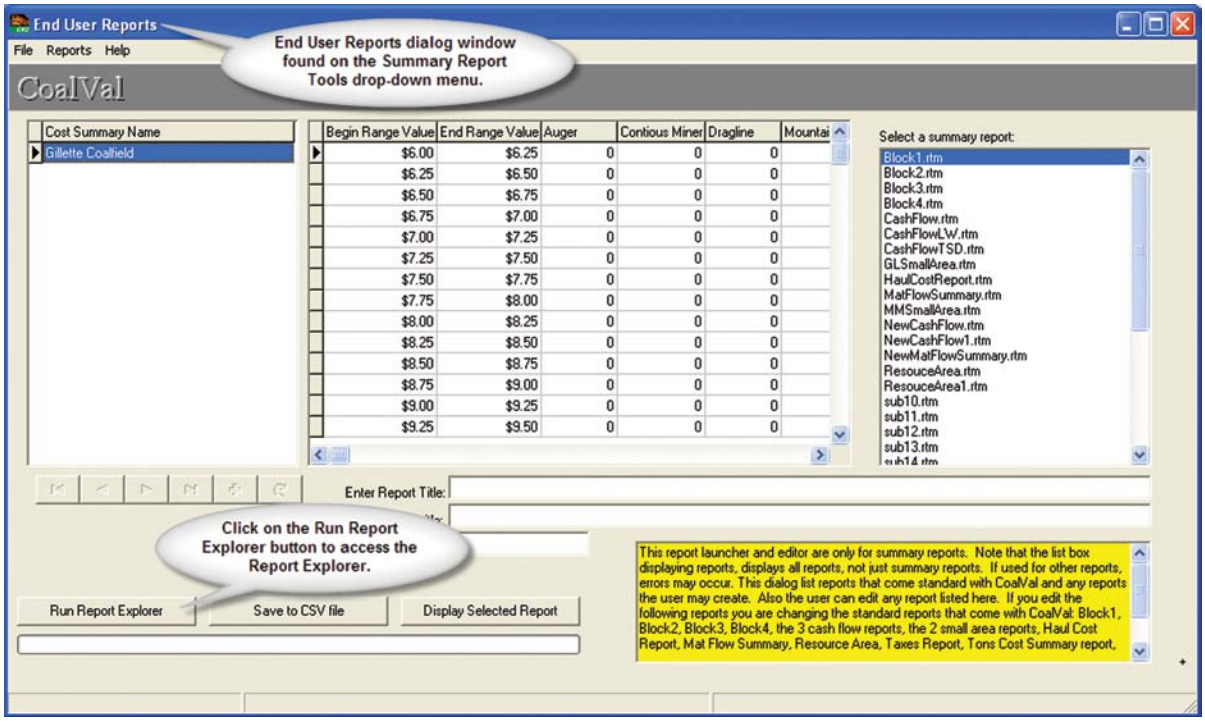


Figure C.115. Using the End-User Reports dialog to access the Report Explorer dialog.

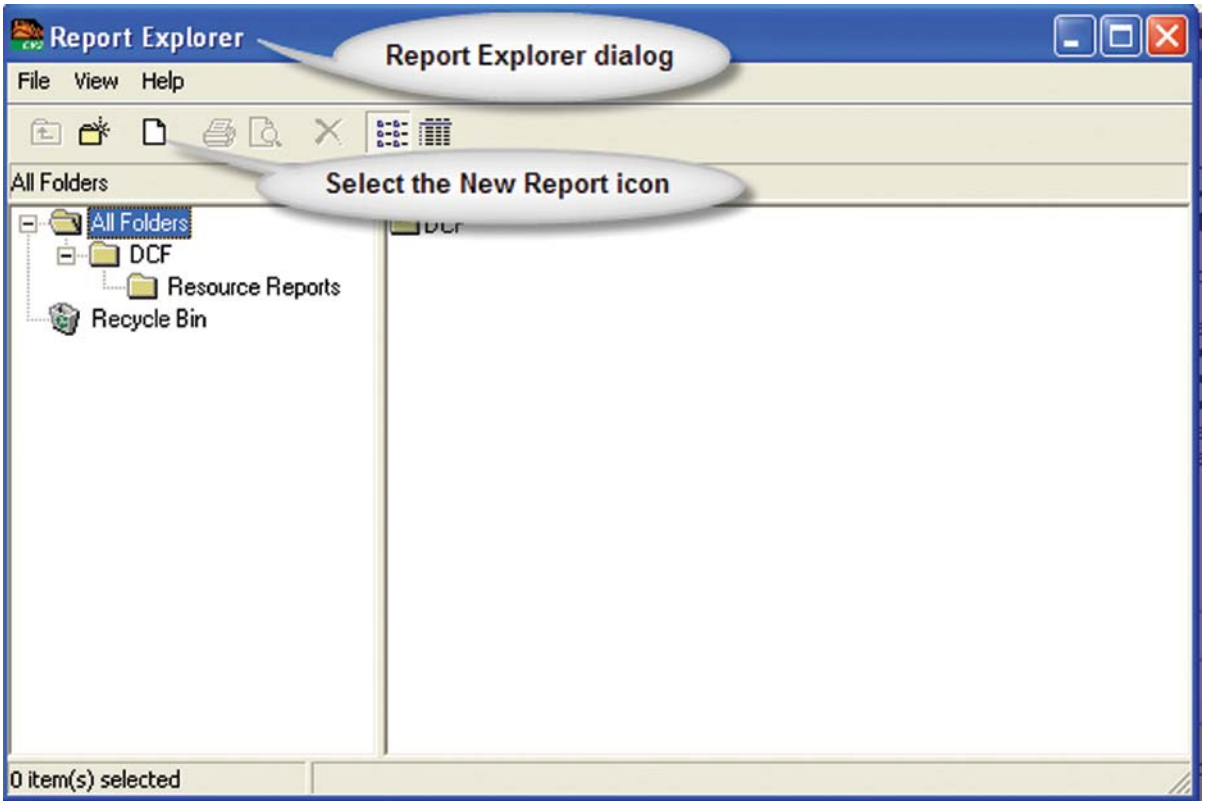


Figure C.116. Selecting the "New Report" icon on the Report Explorer dialog window.

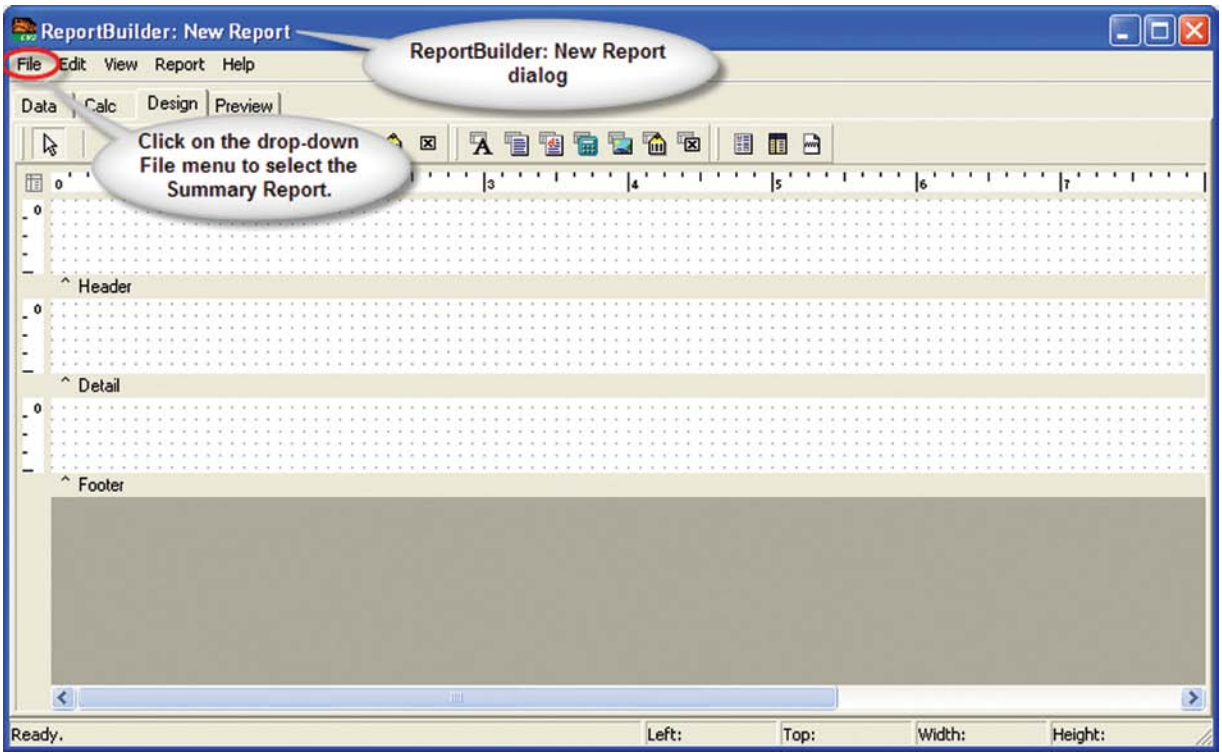


Figure C.117. Navigating to the "Summary Report" through "ReportBuilder: New Report" on the File drop-down menu.

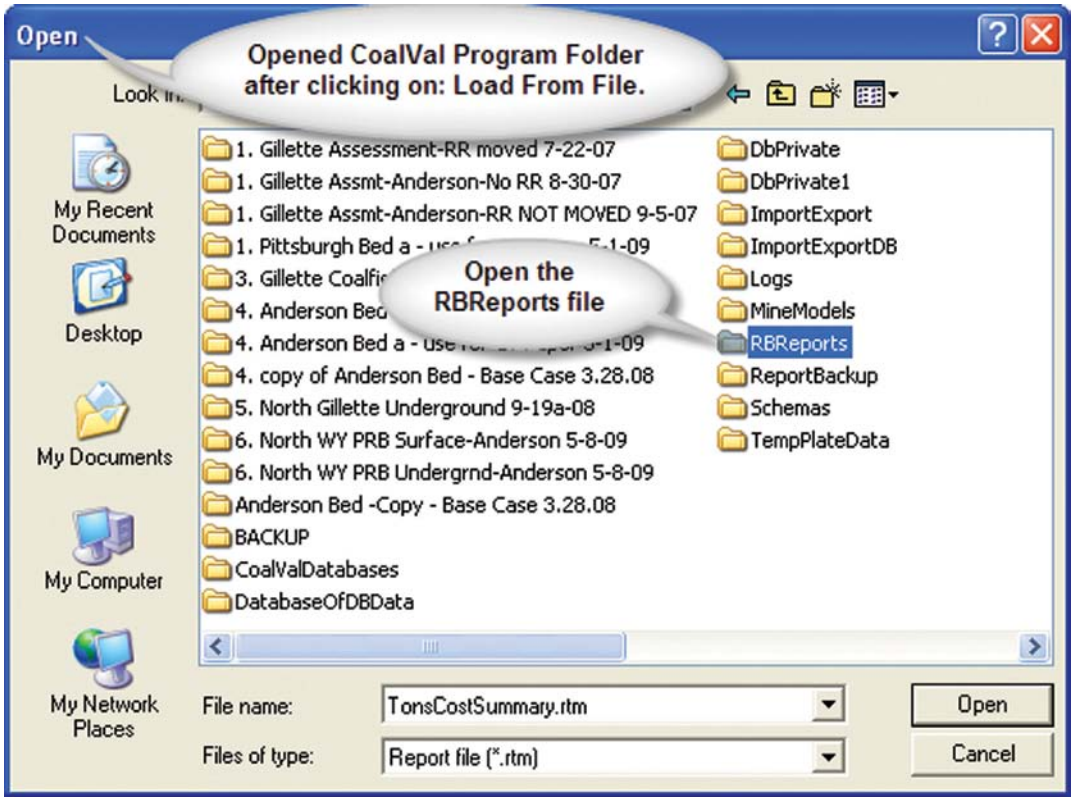


Figure C.118. Navigating to the "RBReports" folder in the CoalVal program directory.

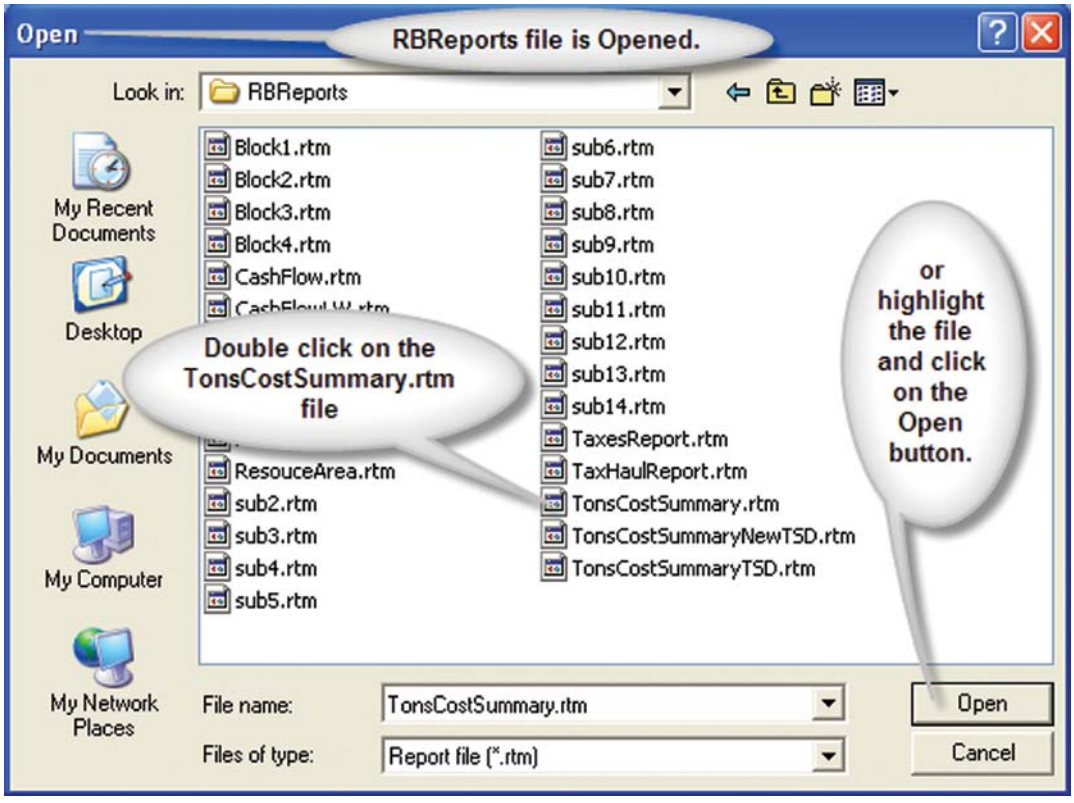


Figure C.119. Opening the "TonsCostSummary" file in the "RBReports" folder.

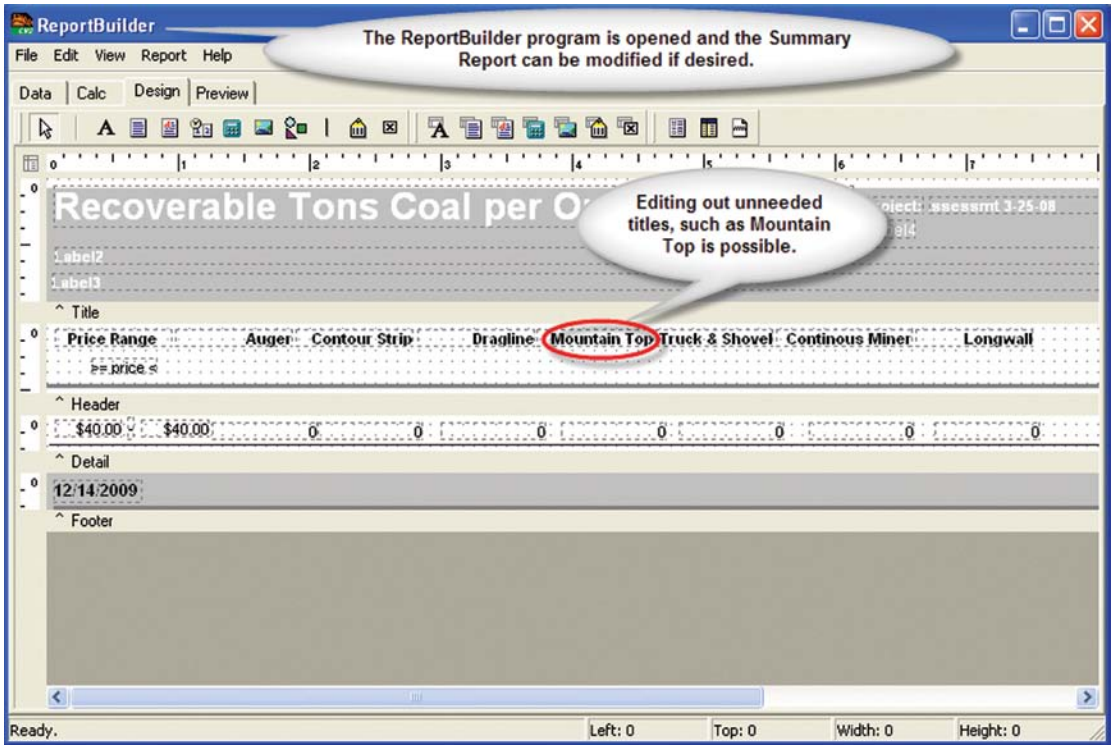


Figure C.120. Editing CoalVal's "Summary Report" through Report Builder to fit the user's needs.

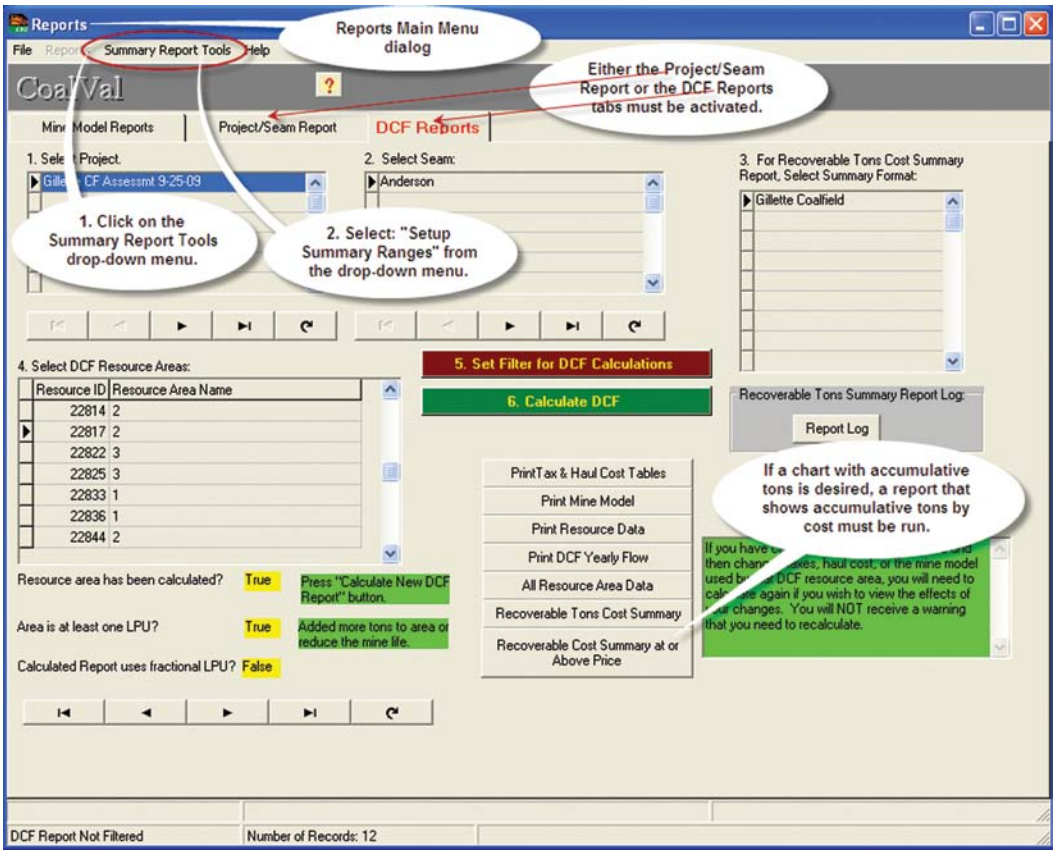


Figure C.121. Selecting the Setup Summary Ranges from the Summary Report Tools drop-down menu on the DCF Reports tab dialog.

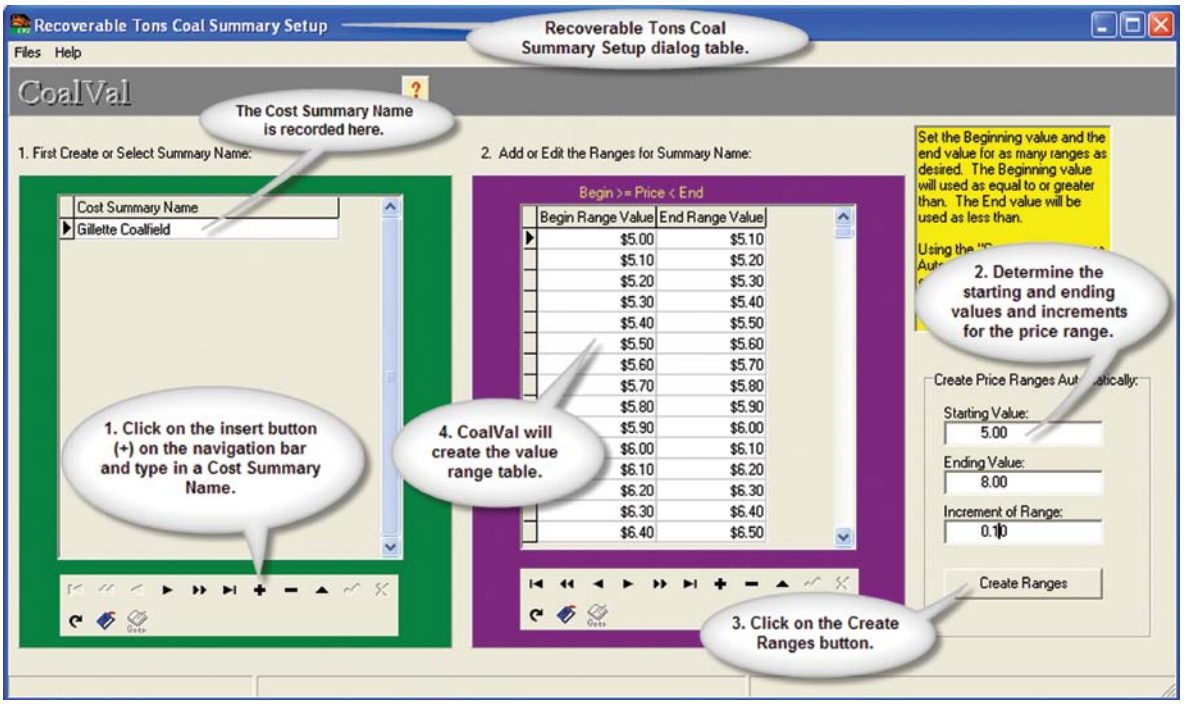


Figure C.122. CoalVal's Recoverable Tons Coal Summary Setup dialog table.

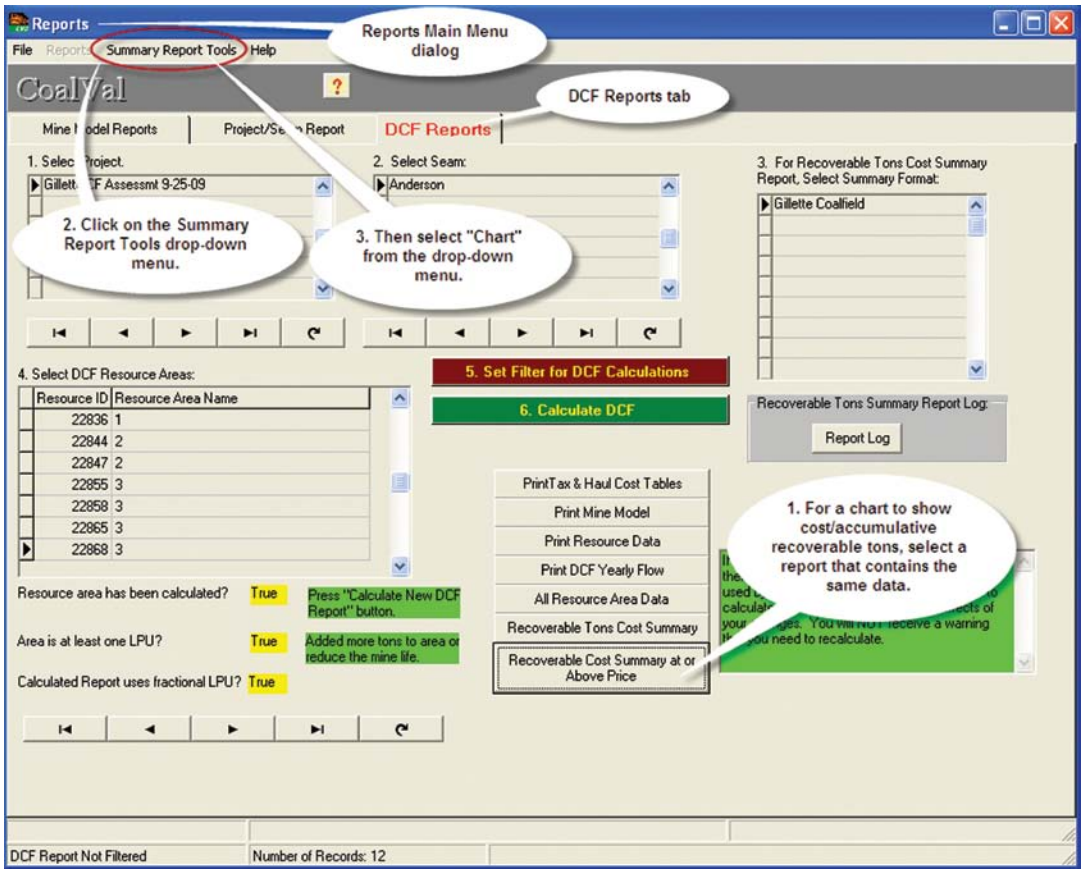


Figure C.123. Selecting the Chart dialog page from the Summary Report Tools drop-down menu on the DCF Reports tab dialog.

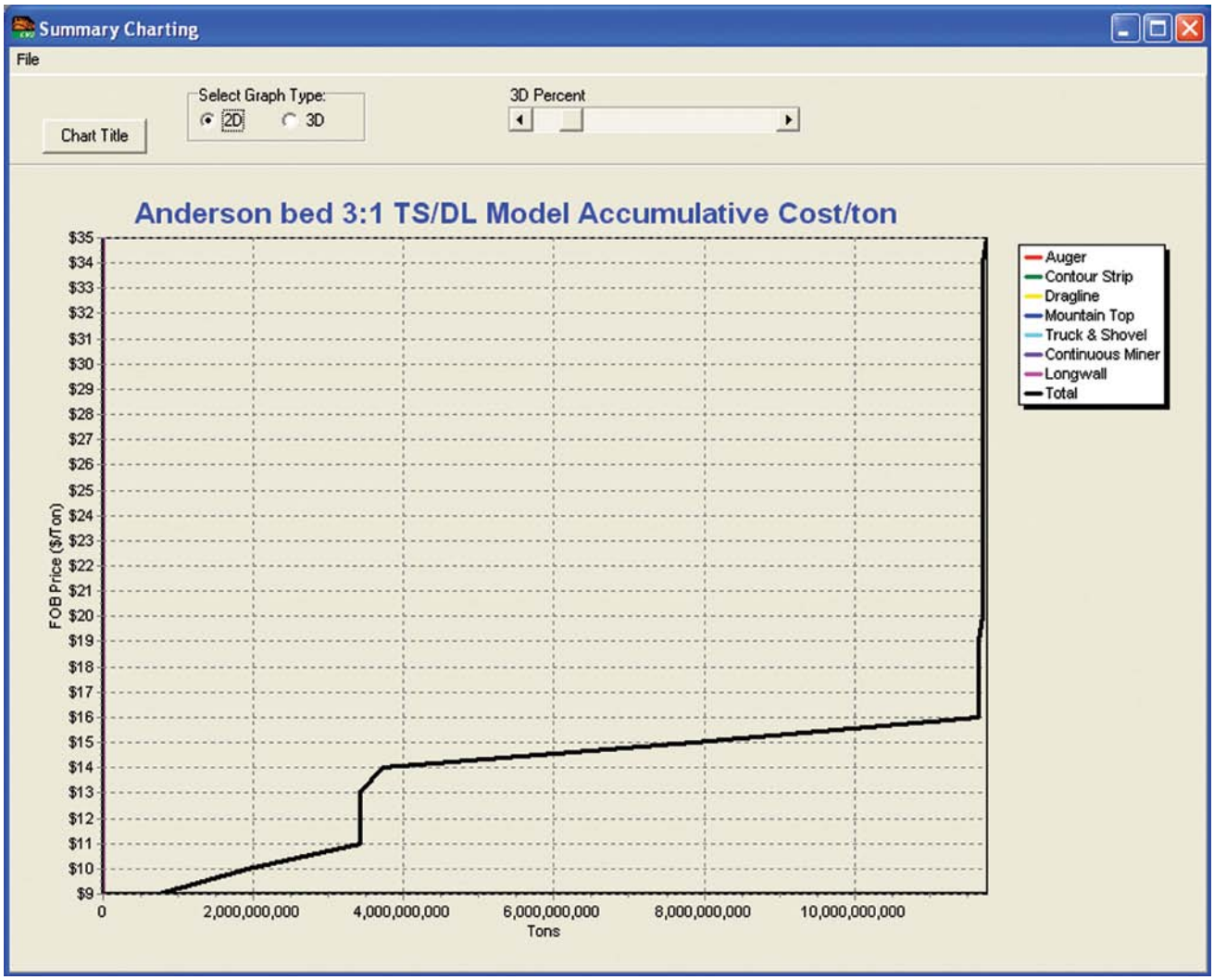


Figure C.124. Two dimensional chart for the Anderson bed, 3 to 1 Ratio, Truck-Shovel and Dragline Mine Model accumulative cost per ton.

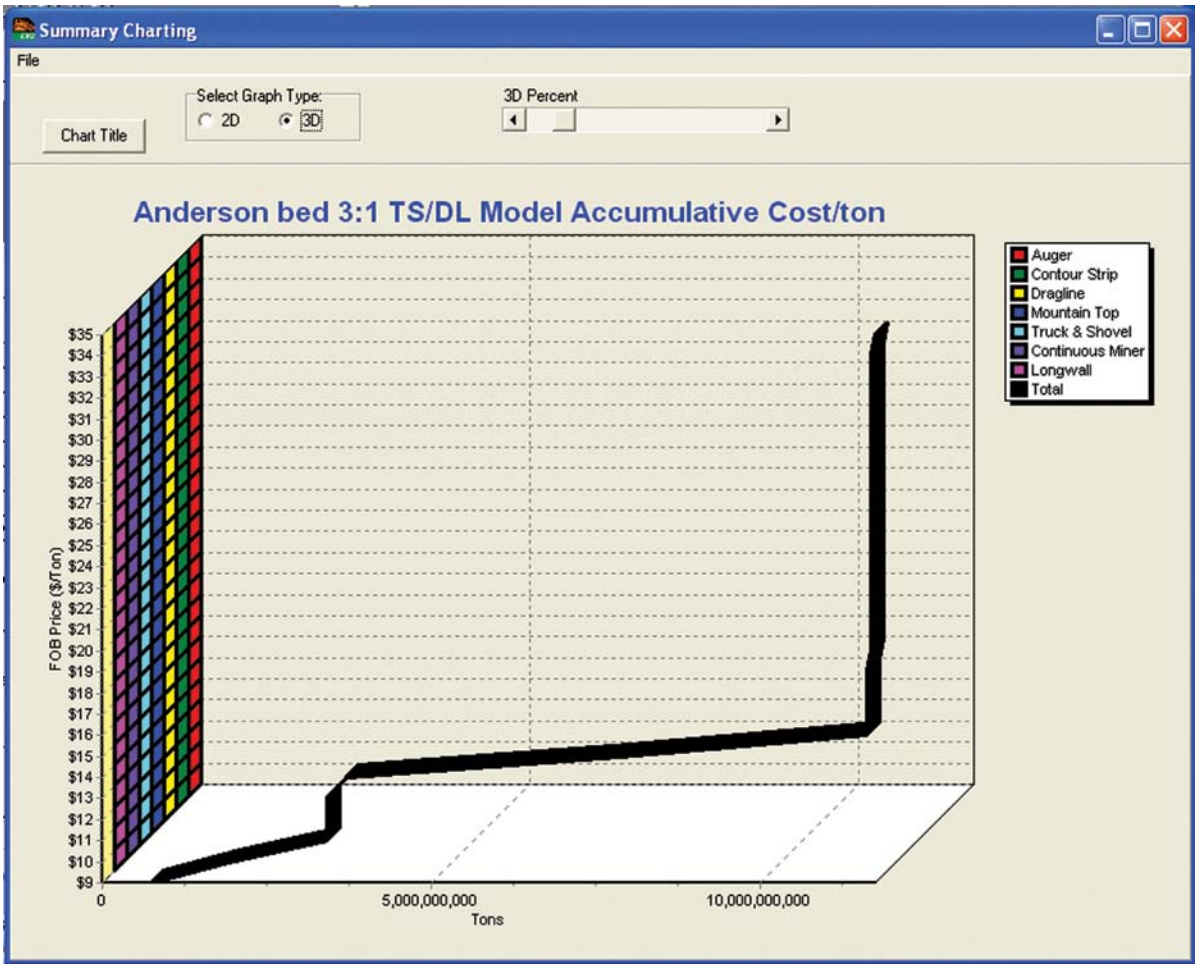


Figure C.125. Three dimensional chart for the Anderson bed, 3 to 1 Ratio, Truck-Shovel and Dragline Mine Model accumulative cost per ton.

into Word or any other program that can import Windows® Meta Files.

Modifications to the Timing of Expenses for Discounted Cash Flow Calculations and Reports

The settings for starting a Discounted Cash Flow calculation for a mine model's first major production and the percentage of the first year's production that will be affected by the start-up delays can be modified in CoalVal. This dialog page can be accessed from the **Reports** dialog window under the **Summary Report Tools** drop-down list (fig. C.126). *Select the **DCF Mine Type Production Preferences** item from the drop-down list* (fig. C.127). The current default mine models are Contour Strip, Dragline, Mountain Top, Truck Shovel, Continuous Miner (room and pillar), Longwall, Auger, and Dragline and Truck-Shovel. There are two mine models that contain more than one process. The longwall mine model contains two mining operations, the "Longwall Development" using continuous miners and "Longwall Production." The Dragline and Truck-Shovel mine model has three mining operations: the "Truck-Shovel Dragline: Coal," "Benching" and "Dragline" operations. All numbers entered into this dialog should be integers.

In figure C.127 the "Longwall" has a "2" for the "Years to Start of Production" column and 50 percent for "First Year Production Percent" column. These columns mean that mine development with continuous miners will take 2 years to prepare the first longwall panels for production. The "longwall" mining operations will start 2 years after the mine opens and will have 50 percent of the production scheduled in that year and 50 percent scheduled production in the last year of operations (fig. C.127). Likewise, the same reasoning is relevant for the Dragline striping operation in figure 123, where construction and development was scheduled for 2 years and the first year of production produced 50 percent of a normal year's production. If the results for the DCF Reports do not look correct, one of the first places to check for mistakes is in the timing for mine expenditures; then check the production assumptions and costs.

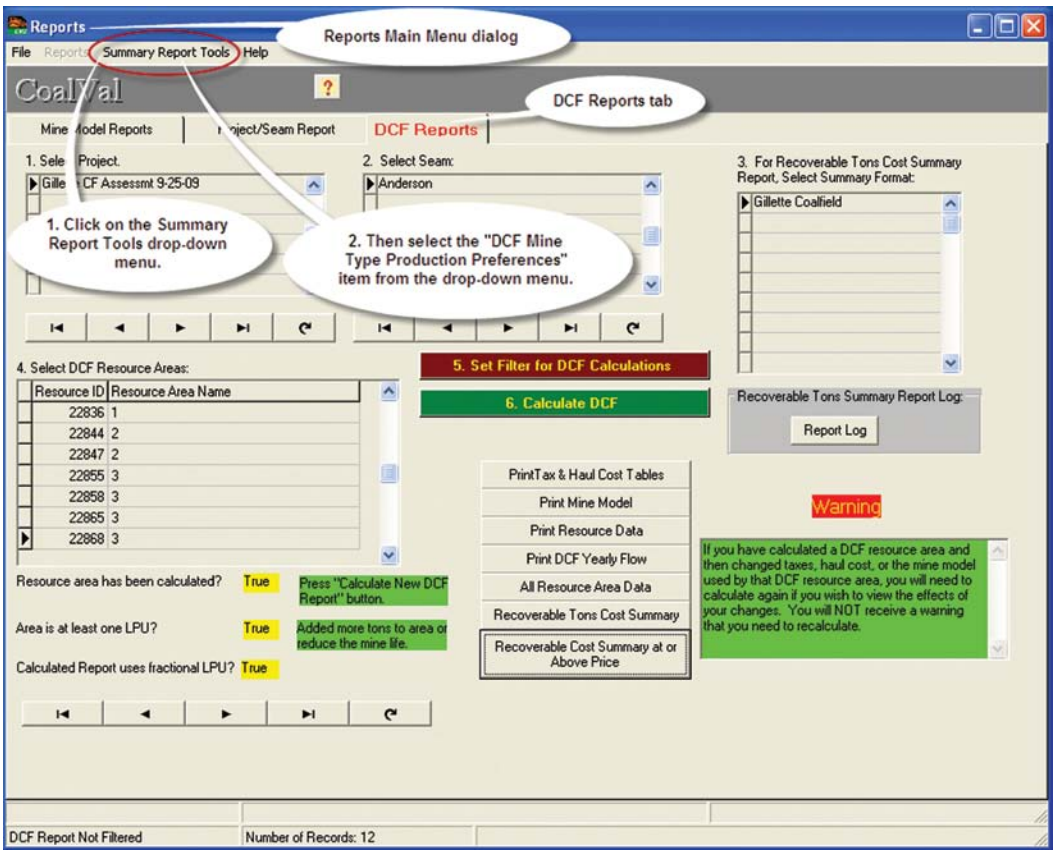


Figure C.126. Navigating to CoalVal's DCF MineType Production Preferences dialog from the DCF Reports tab dialog and the Summary Report Tools drop-down menu.

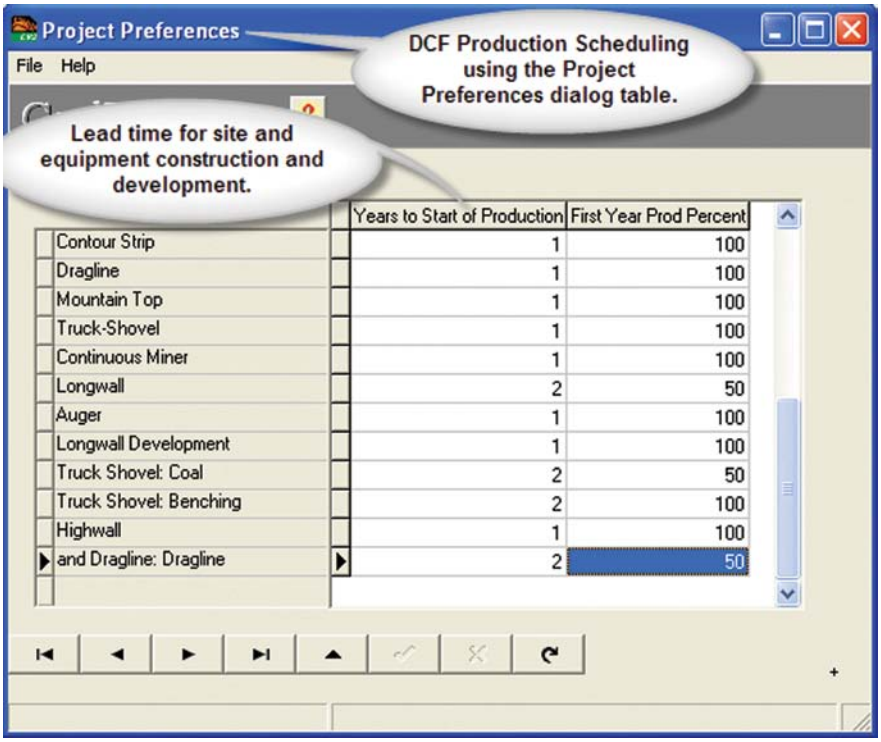


Figure C.127. CoalVal's scheduling of expenses for Discounted Cash Flow calculations on the Project Preferences dialog.

Appendix D

Contents

Figure

Mine Model and Discounted Cash Flow Formulas

Introduction

Mine model and discounted cash flow (DCF) formulas are used in calculating mining costs involved for a particular mine model. Before the formulas can be understood it is necessary to understand what is contained in a mine model. A mine model contains costs and production values for equipment, salaried and hourly employees, and mine assumptions acquired from published references and field data. Some values are entered by the user and other values are the result of calculations from several entered values (fig. D.1).

A review of all results for mining assumption formulas is stored in an array of values. The first formula listed in the Mining Assumptions Formulas section follows:

MineAssumpt[maMineableRR] := Entered by user; // resource recovery

In this example, the array of values for Mine Assumptions is abbreviated: "MineAssumpt." Each value in the array is indexed by a phrase that defines what a specific array location contains. The first value in the array "MineAssumpt" is indexed by "maMineableRR." The "ma" stands for "Mining Assumptions" and the rest stands for "minable resource recovery." The formula contains the phrase "Entered by user." The user enters this value into the array on the Mine Assumptions page of the **Mine Model** dialog.

The fifth formula in the list states:

MineAssumpt[maAveMineHeight] := MineAssumpt[maAveInSeamC] + MineAssumpt[maAveInSeamP] + MineAssumpt[maOutSeamD]

This formula calculates a value in the "MineAssumpt" array by using other values in the "MineAssumpt" array. So to calculate average mine height, the computer adds the average inches of coal (maAveInSeamC) and the average inches of parting (maAveInSeamP) and the inches of out-of-seam dilution (maAveOutSeamD).

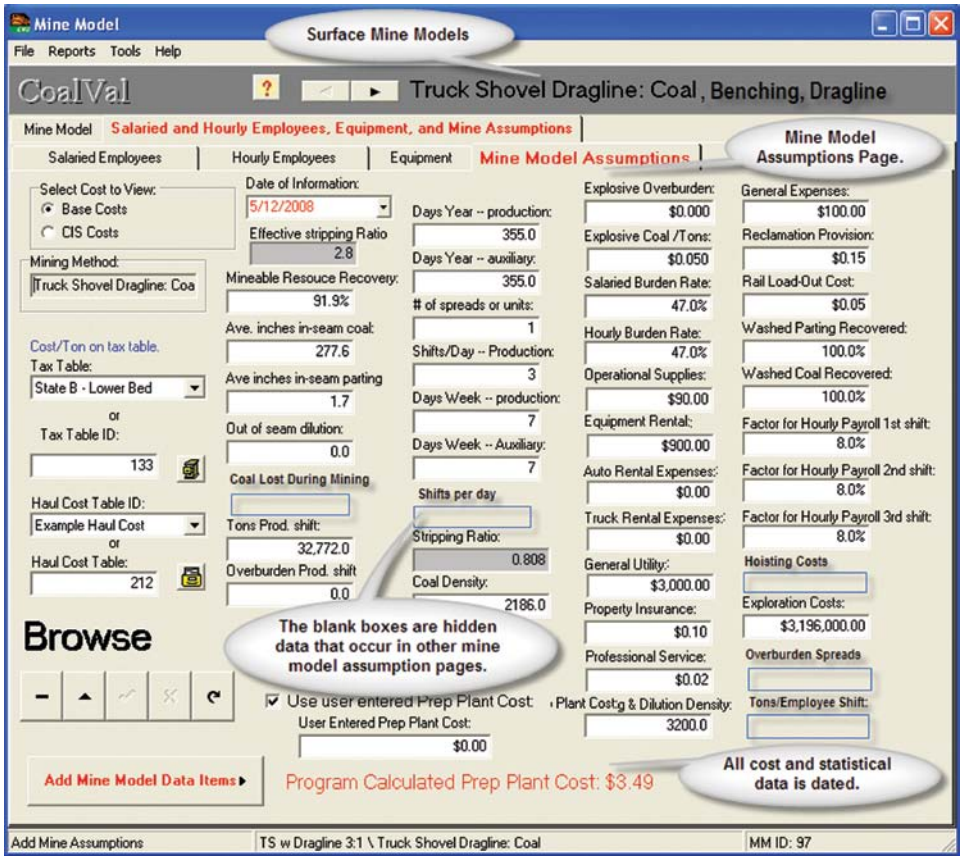


Figure D.1. CoalVal's Mine Assumptions dialog page showing all data entry fields.

Next, review the Direct Cost Formulas, Indirect Cost Formulas, Royalties, Tax, Fee, and Grand Cost Formulas sections that follow this section. Each set of formulas calculates three items: Name, TotalCost, and CostPerTon. One of the formula sets is as follows:

DirectCost[1].Name := 'Payroll';

DirectCost[1].TotalCost := TotalAnnualSalary + TotalAnnualPayroll;

DirectCost[1].CostPerTon := DirectCost[1].TotalCost / MineAssumptResults[smaRawTonsPY];

The first formula line contains the name "Payroll," which indicates the **Item** name which is being calculated in this set of formulas. The second formula line calculates the total cost of the **Item** in the first line, which, in this example, is the payroll. The payroll is derived by adding the total annual salary of the salaried employees plus the total annual pay of the hourly employees. The third formula in the set calculates the cost per ton of coal in relationship to the **Item** in the first formula of the set. To get this value, the total cost (DirectCost[1].TotalCost) is divided by raw tons of coal [smaRawTonsPY] produced per year. The raw tons produced per year are calculated in the "MineAssupmtResults" array (section 2). In this example, the total payroll cost is divided by the tons of coal produced per year to derive the cost per ton in terms of payroll cost. This same procedure calculates the cost per ton in terms of several other expense categories (see formulas below for Explosives, Utilities, and other categories). When these costs are totaled by the computer, the complete cost of mining is derived for each mine model.

The mine model report has three columns labeled "Name," which represents the name of the item calculated; "Total Cost," which represents the value of the item; and "Cost per Ton." These calculations represent the Total Cost or Cost per Ton for the resource examined at the point in time used for the cost assumptions. For example, January 1, 2008, is the reference time for the costs used in the tutorial. The values in these columns are derived from the set of formulas just examined.

The **Mine Model Formulas** section is the location to see the difference between the mining methods. Review Section 8, "Raw Tons Dilution per Year Formulas" for an example. Two sets of formulas are observed: one set for truck & shovel, dragline, contour strip, and mountain top removal; and another for continuous miner, auger, and longwall. This section shows that different mining methods use different formulas to calculate the same **Item.**

The sections containing the **Mine Assumptions Formulas; Mine Assumptions Result Formulas; Direct Cost Formulas**; **Indirect Cost Formulas**; and **Royalties, Tax, Fee, and Grand Cost Formulas** are listed in the order that they appear on a mine model report. All the formulas after the **Royalties, Tax, Fee, and Grand Cost Formula** sections are basic formulas used by other formulas and are not directly displayed on a report.

Section 1. Mining Assumptions Formulas List

```
MineAssumpt[maMineableRR] = Entered by user; //
  resource recovery;
MineAssumpt[maAveInSeamC] = Entered by user; // coal;
MineAssumpt[maAveInSeamP] = Entered by user; //
  Parting;
MineAssumpt[maOutSeamD] = Entered by user; //
  dilution;
MineAssumpt[maAveMineHeight]
  = MineAssumpt[maAveInSeamC]
  + MineAssumpt[maAveInSeamP] +
MineAssumpt[maOutSeamD];
MineAssumpt[maPSpreadShift] = Entered by user;
  //coal produced per spread;
MineAssumpt[maOSpreadShift] = Entered by user;
  // overburden produced per spread;
MineAssumpt[maDWYP] = Entered by user;
  // Days worked per year Production;
MineAssumpt[maDWYA] = Entered by user;
  // Days worked per year Auxiliary;
MineAssumpt[maNumSpreadsUnits] = Entered by user;
  // number spreads or units;
MineAssumpt[maShiftsDayProcduc] = Entered by user;
  // shifts per day production;
MineAssumpt[maDWWP] = Entered by user;
  // Days/week production employees;
MineAssumpt[maDWWA] = Entered by user;
  // Days/week auxiliary employees;
MineAssumpt[maStripRatio] = Entered by user;
  // stripping ratio;
MineAssumpt[maExplosivesi] = Entered by user;
  // Explosives used for coal;
MineAssumpt[maExplosivesOver] = Entered by user;
  // Explosives for overburden;
MineAssumpt[maBurdenRate] = Entered by user;
  // burden rate for salaried;
MineAssumpt[maHourlyBurdenRate] = Entered by
  user; // burden rate for hourly;
MineAssumpt[maEquipRentSY] = Entered by user;
  // equipment rental per unit-month;
MineAssumpt[maGenUtilMonth] = Entered by user;
   // general utilities per month;
MineAssumpt[maAutoRent] = Entered by user;
  // Auto rental for salaried employees;
MineAssumpt[maTruckRent] = Entered by user;
  // Truck rental for mechanics;
MineAssumpt[maPropInsurance] = Entered by user;
  // Property insurance;
MineAssumpt[maProfessService] = Entered by user;
  // Professional services;
MineAssumpt[maGenExpensesSpread] = Entered by
  user; // General expenses;
```

MineAssumpt[maTonsRoyalRate] = CalRoyalityRate;
// see CalRoyalityRate.;
MineAssumpt[maTonsRecTax] = CalSMCRARate;
// See CalSMCRARate;
MineAssumpt[maTonsDepletion] = Calculated//
(MineAssumpt[maExploreResCost] ÷
MineAssumptResults[smaRawTonsPY]) ÷ 10;
// if longwall mine, then split the overhead
between the development and the production flows;
MineAssumpt[maOverheadRate] =
TotalAnnualOverHead[i]; // From Salaried employees;
MineAssumpt[maReclamationPro] = Entered by user;
// reclamation provision;
MineAssumpt[maHaulCost] = From haul cost table
selected by user;
MineAssumpt[maRailLoadOutCost] = Entered by user;
MineAssumpt[maCoalRecoverWash] = Entered by user;
// Percent coal recovered from wash plant;
MineAssumpt[maPartRecoverWash] = Entered by user;
// Percent parting recovered from wash plant;
MineAssumpt[maROMRecoverWash] = ROMReco
WashPlant; //see: ROMRecovWashPlant;
MineAssumpt[maPrepPlantCost] =
(MineAssumpt[maROMRecoverWash] × 3.49) ÷ 100;
MineAssumpt[maFHP] = Entered by user; // Percent
overtime for hourly payroll first shift;
MineAssumpt[maFHP2nd] = Entered by user;
// Percent overtime for hourly payroll second shift;
MineAssumpt[maFHP3rd] = Entered by user;
// Percent overtime for hourly payroll third shift;
MineAssumpt[maHoistCostHour] = Entered by user;
MineAssumpt[maExploreResCost] = Entered by user;
MineAssumpt[maCoalDensity] = Entered by user;
MineAssumpt[maPartDensity] = Entered by user;
MineAssumpt[maAllowUserWashPlan = Entered by user;

Section 2. Mine Assumption Results Formulas

MineAssumptResults[smaRTCPY] = RawTonsCoalYr;
MineAssumptResults[smaRTPPY] = RawTonsPartYr;
MineAssumptResults[smaRTDPY] = RawTonsDiluYr;
MineAssumptResults[smaROMTotal] =
MineAssumptResults[smaRTCPY] +
MineAssumptResults[smaRTPPY] +
MineAssumptResults[smaRTDPY];
MineAssumptResults[smaCTCPY] =
(MineAssumptResults[smaRTCPY] ×Mine
Assumpt[maCoalRecoverWash]) ÷ 100;
MineAssumptResults[smaCTPPY] =
(MineAssumptResults[smaRTPPY] ×
MineAssumpt[maPartRecoverWash]) ÷ 100;
MineAssumptResults[smaWashTotal] =
MineAssumptResults[smaCTCPY] +
MineAssumptResults[smaCTPPY] +
MineAssumptResults[smaCTDPY];
MineAssumptResults[smaRawTonsPY] = Mine
AssumptResults[smaROMTotal];
MineAssumptResults[smaWSTPY] = MineAssumpt
Results[smaWashTotal];

Section 3. Direct Cost Formulas

DirectCost[1].Name = ‘Payroll’;
DirectCost[1].TotalCost = TotalAnnualSalary +
TotalAnnualPayroll;
DirectCost[1].CostPerTon = DirectCost[1].TotalCost ÷
MineAssumptResults[smaRawTonsPY];

DirectCost[2].Name = ‘Burden’;
DirectCost[2].TotalCost = (DirectCost[1].TotalCost ×
MineAssumpt[maBurdenRate]) ÷ 100;
DirectCost[2].CostPerTon = DirectCost[2].TotalCost ÷
MineAssumptResults[smaRawTonsPY];

DirectCost[3].Name = ‘Fuel and Lubes’;
DirectCost[3].TotalCost = AFLT; // total fuel and
lubes from equipment list; MineAssumptResults
[smaRawTonsPY];

DirectCost[4].Name = ‘Explosives’;

For truck and shovel use:
DirectCost[4].TotalCost =
(MineAssumptResults[smaRTCPY] ×
MineAssumpt[maExplosives]) + (BCYPerYear ×
MineAssumpt[maExplosivesOver]);

For all others use:
DirectCost[4].TotalCost = BCYPerYear ×
MineAssumpt[maExplosives];
DirectCost[4].CostPerTon = DirectCost[4].TotalCost ÷
MineAssumptResults[smaRawTonsPY];

DirectCost[5].Name = ‘Operating Supplies’;
DirectCost[5].TotalCost = (MineAssumpt[maDWYA] ×
MineAssumpt[maNumSpreadsUnits]) × (Mine
Assumpt[maShiftsDayProcduc] ×
MineAssumpt[maOpSUpplies]);
DirectCost[5].CostPerTon = DirectCost[5].TotalCost ÷
MineAssumptResults[smaRawTonsPY];

DirectCost[6].Name = ‘Repair Parts/Maintenance Supply’;
DirectCost[6].TotalCost = ARMT; // total repair and
maintenance from equipment list; MineAssumpt
Results[smaRawTonsPY];

DirectCost[7].Name = ‘Utilities’;

```
DirectCost[7].TotalCost =
   MineAssumpt[maGenUtilMonth] × 12;
DirectCost[7].CostPerTon = DirectCost[7].TotalCost ÷
   MineAssumptResults[smaRawTonsPY];

DirectCost[8].Name = 'All Rentals';
DirectCost[8].TotalCost =
   (MineAssumpt[maNumSpreadsUnits] ×
   MineAssumpt[maEquipRentSY] × 12) +
   (TotalAutoRental × 12 × MineAssumpt[maAutoRent])
   + (NumMechanics × 12 ×
   MineAssumpt[maTruckRent]);
DirectCost[8].CostPerTon = DirectCost[8].TotalCost ÷
   MineAssumptResults[smaRawTonsPY];

DirectCost[9].Name = 'Professional Service';
DirectCost[9].TotalCost =
   MineAssumpt[maProfessService] × MineAssumpt
   Results[smaRawTonsPY];
DirectCost[9].CostPerTon = DirectCost[9].TotalCost ÷
   MineAssumptResults[smaRawTonsPY];

DirectCost[10].Name = 'Reclamation Provision';
DirectCost[10].TotalCost =
   MineAssumpt[maReclamationPro] × MineAssumpt
   Results[smaRawTonsPY];
DirectCost[10].CostPerTon = DirectCost[10].TotalCost
   ÷ MineAssumptResults[smaRawTonsPY];

DirectCost[11].Name = 'General Expenses';
DirectCost[11].TotalCost = MineAssumpt[maDWYP]
   × MineAssumpt[maNumSpreadsUnits] ×
   MineAssumpt[maShiftsDayProcduc] × Mine
   Assumpt[maGenExpensesSpread];
DirectCost[11].CostPerTon = DirectCost[11].TotalCost
   ÷ MineAssumptResults[smaRawTonsPY];

DirectCost[12].Name := 'Hoisting Cost';
DirectCost[12].TotalCost := (MineAssumpt[maDWYP]
   × MineAssumpt[maShiftsDayProcduc]) ×
   MineAssumpt[maHoistCostHour];
DirectCost[12].CostPerTon = DirectCost[12,k].Total
   Cost ÷ MineAssumptResults[smaRawTonsPY];

DirectCost[13].Name := 'Direct Cost, Raw';
DirectCost[13].TotalCost := DirectCost[1].TotalCost
   + DirectCost[2].TotalCost + DirectCost[3].TotalCost
   + DirectCost[4].TotalCost + DirectCost[5].TotalCost
   + DirectCost[6].TotalCost + DirectCost[7].TotalCost +
   DirectCost[8].TotalCost + DirectCost[9].TotalCost +
   DirectCost[10].TotalCost + DirectCost[11].TotalCost +
   DirectCost[12].TotalCost;
DirectCost[13].CostPerTon = DirectCost[13,.TotalCost ÷
   MineAssumptResults[smaRawTonsPY];
```

Section 4. Indirect Costs Formulas

```
IndirectCost[1].Name = 'Depreciation';
IndirectCost[1].TotalCost = AStLineDepT;
IndirectCost[1].CostPerTon = IndirectCost[1].TotalCost
   ÷ MineAssumptResults[smaRawTonsPY];

IndirectCost[2].Name = 'Acquisition/Depletion';
IndirectCost[2].TotalCost =
   MineAssumpt[maTonsDepletion] × MineAssumpt
   Results[smaRawTonsPY];
IndirectCost[2,.CostPerTon = IndirectCost[2].TotalCost
   ÷ MineAssumptResults[smaRawTonsPY];

IndirectCost[3].Name = 'Amortization';
IndirectCost[3].TotalCost = ADevlAmort;
IndirectCost[3].CostPerTon = IndirectCost[3].TotalCost
   ÷ MineAssumptResults[smaRawTonsPY];

IndirectCost[4].Name = 'Overhead';
IndirectCost[4].TotalCost =
   MineAssumpt[maOverheadRate];
IndirectCost[4].CostPerTon = IndirectCost[4].TotalCost
   ÷ MineAssumptResults[smaRawTonsPY];

IndirectCost[5].Name = 'Properly Insurance';
IndirectCost[5].TotalCost =MineAssumpt[maProp
   Insurance,k] AequipCostT ÷ 100;
IndirectCost[5].CostPerTon = IndirectCost[5].TotalCost
   ÷ MineAssumptResults[smaRawTonsPY];

IndirectCost[6].Name = 'State Sales Tax';
IndirectCost[6].TotalCost = (DirectCost[3].TotalCost +
   DirectCost[4].TotalCost + DirectCost[5].TotalCost +
   DirectCost[6].TotalCost + DirectCost[8].TotalCost +
   DirectCost[11].TotalCost) × CoalValDataForm.Taxes
   StateSales.AsFloat) ÷ 100;
IndirectCost[6].CostPerTon = IndirectCost[6].TotalCost
   ÷ MineAssumptResults[smaRawTonsPY];

IndirectCost[7].Name = 'Real Property';
IndirectCost[7].TotalCost = (ARealPropT ÷ 1000) ×
   (CoalValDataForm.TaxesTStateReal.AsFloat ÷ 100) ×
   CoalValDataForm.TaxesTPropReal.AsFloat;
IndirectCost[7].CostPerTon = IndirectCost[7].TotalCost
   ÷ MineAssumptResults[smaRawTonsPY];

IndirectCost[8].Name = 'Tangible Property';
IndirectCost[8].TotalCost = (AequipCostT ÷ 1000) ×
   (CoalValDataForm.TaxesTStateReal.AsFloat × 100) ÷
   CoalValDataForm.TaxesTPropTan.AsFloat;
IndirectCost[8].CostPerTon = IndirectCost[8].TotalCost
   ÷ MineAssumptResults[smaRawTonsPY];

IndirectCost[9].Name = 'Total Indirect Cost';
```

```
IndirectCost[9].TotalCost = IndirectCost[1].TotalCost
  + IndirectCost[2].TotalCost + IndirectCost[3].TotalCost
  + IndirectCost[4].TotalCost + IndirectCost[5].TotalCost
  + IndirectCost[6].TotalCost + IndirectCost[7].TotalCost
  + IndirectCost[8].TotalCost;
IndirectCost[9].CostPerTon = IndirectCost[9].TotalCost
  ÷ MineAssumptResults[smaRawTonsPY];
```

Section 5. Other Cost Formulas

```
OtherCost[1].Name = 'Prep Plant Cost, Washed';
OtherCost[1].TotalCost = MineAssumpt[maPrepPlant
  Cost] × MineAssumptResults[smaWSTPY];
OtherCost[1].CostPerTon = OtherCost[1].TotalCost ÷
  MineAssumptResults[smaWSTPY];

OtherCost[2].Name = 'Loadout Cost, Sold';
OtherCost[2].TotalCost =
  MineAssumpt[maRailLoadOutCost] ×
  MineAssumptResults[smaWSTPY];
OtherCost[2].CostPerTon = OtherCost[2].TotalCost ÷
  MineAssumptResults[smaWSTPY];

OtherCost[3].Name = 'D & I in Car, Raw';
OtherCost[3].TotalCost = IndirectCost[9].TotalCost +
  DirectCost[13].TotalCost + OtherCost[2].TotalCost;
OtherCost[3].CostPerTon = IndirectCost[9].CostPerTon
  + DirectCost[13].CostPerTon + OtherCost[2]
  CostPerTon;


OtherCost[4].TotalCost = OtherCost[3].TotalCost + Othe
  Cost[1].TotalCost;
OtherCost[4].CostPerTon = OtherCost[3].CostPerTon +
  OtherCost[1].CostPerTon;

OtherCost[5].Name := 'Coal Haulage Cost, Raw';
OtherCost[5].TotalCost = MineAssumpt[maHaulCost] ×
  MineAssumptResults[smaRawTonsPY];
OtherCost[5].CostPerTon = OtherCost[5].TotalCost ÷
  MineAssumptResults[smaRawTonsPY];
```

Section 6. Royalties, Tax, Fee, and Grand Cost Formulas

```
RoyTaxFeesGrandTotalsCost[1].Name = 'Royalty Private
  Lands';
RoyTaxFeesGrandTotalsCost[1].Total
  Cost = MineAssumpt[maTonsRoyalRate] ×
  MineAssumptResults[smaWSTPY];
RoyTaxFeesGrandTotalsCost[1].CostPe
  Ton = RoyTaxFeesGrandTotalsCost[1].TotalCost ÷
  MineAssumptResults[smaWSTPY];

RoyTaxFeesGrandTotalsCost[2].Name = 'Royalty Federal
  Lands';
RoyTaxFeesGrandTotalsCost[2].TotalCost = FedRoyalit
  Rate × MineAssumptResults[smaWSTPY];
RoyTaxFeesGrandTotalsCost[2].CostPe
  Ton = RoyTaxFeesGrandTotalsCost[2].TotalCost ÷
  MineAssumptResults[smaWSTPY];

RoyTaxFeesGrandTotalsCost[3].Name = 'State Mineral
  Tax';
RoyTaxFeesGrandTotalsCost[3].TotalCost =
  (MineAssumptResults[smaWSTPY] ÷ 1000) ×
  (TaxesTStateMineral.AsFloat ÷100) × (TaxesTTaxU
  mined.AsFloat × TaxesTPropReal.AsFloat);
RoyTaxFeesGrandTotalsCost[3].CostPerTon =
  MineAssumptResults[smaWSTPY];

RoyTaxFeesGrandTotalsCost[4].Name = 'Black Lung
  Tax';
RoyTaxFeesGrandTotalsCost[4].TotalCost = BlackLun
  Tax × MineAssumptResults[smaWSTPY];
RoyTaxFeesGrandTotalsCost[4].CostPe
  Ton = RoyTaxFeesGrandTotalsCost[4].TotalCost ÷
  MineAssumptResults[smaWSTPY];

RoyTaxFeesGrandTotalsCost[5].Name = 'Severance Tax';
RoyTaxFeesGrandTotalsCost[5].TotalCost = (TaxesT
  StateServance.AsFloat ÷ 100) × (TaxesTMarketTon
  AsFloat × MineAssumptResults[smaWSTPY]);
RoyTaxFeesGrandTotalsCost[5].CostPe
  Ton = RoyTaxFeesGrandTotalsCost[5].TotalCost ÷
  MineAssumptResults[smaWSTPY];

RoyTaxFeesGrandTotalsCost[6].Name = 'Other Tax';
RoyTaxFeesGrandTotalsCost[6].TotalCost = OtherTax(k);
RoyTaxFeesGrandTotalsCost[6].CostPe
  Ton = RoyTaxFeesGrandTotalsCost[6].TotalCost ÷
  MineAssumptResults[smaWSTPY];

RoyTaxFeesGrandTotalsCost[7].Name = 'SMCRA Tax';
RoyTaxFeesGrandTotalsCost[7].TotalCost = SMCRA Tax
  × MineAssumptResults[smaWSTPY];
RoyTaxFeesGrandTotalsCost[7].CostPe
  Ton = RoyTaxFeesGrandTotalsCost[7].TotalCost ÷
  MineAssumptResults[smaWSTPY];

RoyTaxFeesGrandTotalsCost[8].Name = 'Total Tax';
RoyTaxFeesGrandTotalsCost[8].TotalCost = Ro
  TaxFeesGrandTotalsCost[1].TotalCost + RoyTaxFee
  GrandTotalsCost[2].TotalCost + RoyTaxFeesGran
  TotalsCost[3].TotalCost + RoyTaxFeesGrandTotal
  Cost[4].TotalCost + RoyTaxFeesGrandTotalsCost[5]
```

TotalCost + RoyTaxFeesGrandTotalsCost[6].TotalCost + RoyTaxFeesGrandTotalsCost[7].TotalCost;
RoyTaxFeesGrandTotalsCost[8].CostPe Ton = RoyTaxFeesGrandTotalsCost[8].TotalCost ÷ MineAssumptResults[smaWSTPY];

RoyTaxFeesGrandTotalsCost[9].Name = 'Cost in Car, Raw';
RoyTaxFeesGrandTotalsCost[9].TotalCost = RoyTaxFee GrandTotalsCost[8].TotalCost + OtherCost[3].Total Cost + OtherCost[5].TotalCost;
RoyTaxFeesGrandTotalsCost[9].CostPerTon = Ro TaxFeesGrandTotalsCost[8].CostPerTon + Othe Cost[3].CostPerTon + OtherCost[5].CostPerTon;

OtherCost[4].Name = 'D & I in Car, Washed';

RoyTaxFeesGrandTotalsCost[10].Name = 'Cost in Car, Washed';
RoyTaxFeesGrandTotalsCost[10].TotalCost = Ro TaxFeesGrandTotalsCost[9].TotalCost + OtherCost[1] TotalCost;
RoyTaxFeesGrandTotalsCost[10].CostPe Ton = RoyTaxFeesGrandTotalsCost[10].TotalCost ÷ MineAssumptResults[smaWSTPY];

Section 7. Run of Mine Coal Recovery Wash Plant Formulas

Result = ((MineAssumpt[maAveInSeamC × MineAssumpt[maCoalRecoverWash] × 1800) + (MineAssumpt[maAveInSeamP] + MineAssumpt[maOutSeamD]) × MineAssumpt[maPartRecoverWash] × 2400) ÷ ((MineAssumpt[maAveInSeamC] × 1800) + (MineAssumpt[maAveInSeamP] + MineAssumpt[maOutSeamD]) × 2400);

Section 8. Raw Tons Dilution per Year Formulas

If Truck and shovel, dragline, contour strip, or mountain top removal use:
E = MineAssumpt[maPSpreadShift] ÷ MineAssumpt[maStripRatio] × MineAssumpt[maDWYP] × MineAssumpt[maNumSpreadsUnits] × Mine Assumpt[maShiftsDayProcduc];

If auger, longwall, continuous mine use:
E = MineAssumpt[maPSpreadShift] × MineAssumpt[maDWYP] × MineAssumpt[maNumSpreadsUnits] × Mine Assumpt[maShiftsDayProcduc];

For all other mine models use:
E = MineAssumpt[maPSpreadShift,i] × MineAssumpt[maDWYP,i] × MineAssumpt[maNum SpreadsUnits,i] × MineAssumpt[maShiftsDay Procduc ,i];

Then all mine models continue with:
D = ((MineAssumpt[maAveInSeamC,i] ÷ 12) × MineAssumpt[maCoalDensity,i]) + ((MineAssumpt[maAveInSeamP,i] ÷ 12) × MineAssumpt[maPartDensity,i]) + ((MineAssumpt[maOutSeamD,i] ÷ 12) × MineAssumpt[maPartDensity,i]);

Result = (1-(((MineAssumpt[maAveInSe mC,i] ÷ 12) × MineAssumpt[maCoalDensity,i]) + ((MineAssumpt[maAveInSeamP,i] ÷ 12) × MineAssumpt[maPartDensity,i])) ÷ d) × E;

Section 9. Raw Tons Parting per Year Formulas

If Truck and shovel, dragline, contour strip, or mountain top use:
E = MineAssumpt[maPSpreadShift] ÷ MineAssumpt[maStripRatio] × MineAssumpt[maDWYP] × MineAssumpt[maNumSpreadsUnits] × MineAssumpt [maShiftsDayProcduc];

If auger, longwall, continuous mine use:
E = MineAssumpt[maPSpreadShift] × MineAssumpt[maDWYP] × MineAssumpt[maNumSpreadsUnits] × MineAssumpt [maShiftsDayProcduc];

All other mine models use:
E = MineAssumpt[maPSpreadShift,i] × MineAssumpt[maDWYP,i] × MineAssumpt[maNum SpreadsUnits,i] × MineAssumpt[maShiftsDay Procduc ,i];

Then all mine models continue with:
d = (((MineAssumpt[maAveInSeamC,i]) ÷ 12) × MineAssumpt[maCoalDensity,i]) + ((MineAssumpt[maAveInSeamP,i] ÷ 12) × MineAssumpt[maPartDensity,i]) + ((MineAssumpt[maOutSeamD,i] ÷ 12) × MineAssumpt[maPartDensity,i]);

Result = (1- (((MineAssumpt[maAveInSeamC,i] ÷ 12) × MineAssumpt[maCoalDensity,i]) + ((MineAssumpt[maOutSeamD,i] ÷ 12) × MineAssumpt[maPartDensity,i])) × d) × E;

Section 10. Raw Tons Coal per Year Formulas

If truck and shovel, dragline, contour strip, or mountain top removal, then use:
E = MineAssumpt[maPSpreadShift] ÷ MineAssumpt[maStripRatio] × MineAssumpt[maDWYP] × MineAssumpt[maNumSpreadsUnits] × MineAssumpt[maShiftsDayProcduc]
If auger, longwall, or continuous mine, then use:
E = MineAssumpt[maPSpreadShift] × MineAssumpt[maDWYP] × MineAssumpt[maNumSpreadsUnits] × MineAssumpt [maShiftsDayProcduc];

All other mine models use:
E = MineAssumpt[maPSpreadShift,i] × MineAssumpt[maDWYP,i] × MineAssumpt[maNum SpreadsUnits,i] × MineAssumpt[maShiftsDay Procduc ,i];

Then all mine models continue with:
D = ((MineAssumpt[maAveInSeamC,i] ÷ 12) × MineAssumpt[maCoalDensity,i]) + ((MineAssumpt[maAveInSeamP,i] × 12) × MineAssumpt[maPartDensity,i]) + ((MineAssumpt[maOutSeamD,i] × 12) × MineAssumpt[maPartDensity,i]);

Result = (1 - (((MineAssumpt[maAveInSeamP,i] ÷ 12) × MineAssumpt[maPartDensity,i]) + ((MineAssumpt[maOutSeamD,i] ÷ 12) × MineAssumpt[maPartDensity,i])) ÷ d) × E;

Section 11. Bank Cubic Yards per Year Formulas

For truck and shovel use:
Result = MineAssumpt[maOSpread Shift] × MineAssumpt[maDWYP] × MineAssumpt[maNumSpreadsUnits] × MineAssumpt [maShiftsDayProcduc];

For all others use:
Result = MineAssumpt[maPSpreadShift] × MineAssumpt[maDWYP] × MineAssumpt[maNumSpreadsUnits] × MineAssumpt [maShiftsDayProcduc];

Section 12. Royalty Rate Formulas

Surface Mines Use:
If, MineAssumpt[maAveMineHeight] < 37 then,
Result = (TaxesTRoyalS36.AsFloat × TaxesTMarketTon AsFloat) ÷ 100 //from the user selected tax table;

Otherwise,
Result = (TaxesTRoyalS37.AsFloat × TaxesTMarketTon AsFloat) ÷ 100; // from the user selected tax table;

Underground Mines use:
If, MineAssumpt[maAveMineHeight] < 42 then,
Result = (TaxesTRoyalU24.AsFloat × TaxesTMarketTon AsFloat) ÷ 100; // from the user selected tax table;
If, (MineAssumpt[maAveMineHeight] > or = 42) and (MineAssumpt[maAveMineHeight] <72) then,
Result = TaxesTRoyalU42.AsFloat × TaxesTMarketTon AsFloat ÷ 100; // from the user selected tax table;

If, (MineAssumpt[maAveMineHeight > or = 72) and, (MineAssumpt[maAveMineHeight] <96) then,
Result = TaxesTRoyalU72.AsFloat × TaxesTMarketTon AsFloat ÷ 100; // from the user selected tax table;

If, MineAssumpt[maAveMineHeight] > or = 96 then,
Result = TaxesTRoyalU96.AsFloat × TaxesTMarketTon AsFloat ÷ 100; // from the user selected tax table;

Section 13. Tax Formulas

Surface Mining Control and Reclamation Act Rate Formulas

Surface Mines Use:
Result = TaxesTSMCRAS.AsFloat;

Underground Mines Use:
Result = TaxesTSMCRAU.AsFloat;

Federal Royalty Rate Formulas

Surface Mines Use:
Result = (TaxesTFedRoyalS.AsFloat ÷ 100) × TaxesT MarketTon.AsFloat;

Underground Mines Use:

```
Result = (TaxesTFedRoyalU.AsFloat ÷ 100) × Taxes
  TMarketTon.AsFloat;
```

Black Lung Tax Formulas

Surface Mines Use:

```
Result = (TaxesTBlackLungS.AsFloat × TaxesT
  MarketTon.AsFloat) ÷ 100;
```

Underground Mines Use:

```
Result = (TaxesTBlackLungU.AsFloat × TaxesT
  MarketTon.AsFloat) ÷ 100;
```

Other Tax Formulas

Surface Mines Use:

```
Result = (TaxesTMarketTon.AsFloat ×
  MineAssumptResults[smaWSTPY] × ((TaxesTState
  AdVel.AsFloat ÷ 100) + TaxesTStateFlat.AsFloat +
  (TaxesTStateRoyalS.AsFloat ÷ 100))) + (TaxesT
  CountySales.AsFloat × (DirectCost[3,i].TotalCost
  + DirectCost[4,i].TotalCost + DirectCost[5,i].Total
  Cost + DirectCost[6,i].TotalCost + DirectCost[8,i]
  TotalCost + DirectCost[11,i].TotalCost));
```

Underground Mines Use:

```
Result = (TaxesTMarketTon.AsFloat ×
  MineAssumptResults[smaWSTPY] × ((TaxesTState
  AdVel.AsFloat ÷ 100) + TaxesTStateFlat.AsFloat +
  (TaxesTStateRoyalU.AsFloat/100))) + (TaxesTCount
  Sales.AsFloat × (DirectCost[3,i].TotalCost +
  DirectCost[4,i].TotalCost + DirectCost[5,i].TotalCost
  + DirectCost[6,i].TotalCost + DirectCost[8,i].TotalCost
  + DirectCost[11,i].TotalCost));
```

Surface Mining Control and Reclamation Act Tax Formulas

Surface Mines Use:

```
Result = TaxesTSMCRAS.AsFloat; // from the taxes
  look-up table;
```

Underground Mines Use:

```
Result = TaxesTSMCRAU.AsFloat; // from the taxes
  look-up table;
```

Appendix E—Glossary of Terms

The present study includes determinations of original, available, recoverable, and economically recoverable (reserves) resources. This terminology has been used in many USGS and USBM coal studies (see Carter and Gardner, 1989; Eggleston and others, 1990; Molnia and others, 1999; Osmonson and others, 2000, Luppens and others, 2008).

The following definitions were applied in this document.

Acquisition The purchase of coal resources may include the mineral (subsurface) or surface estate or both entities with the cost depending on many factors, such as coal quality, thickness, mineability, proximity to the market, and environmental and societal consideration.

Acquisition Costs Dollar per ton cost to purchase in-place coal (in the ground) resources.

Adj(usted) 1st Shift The United Mine Workers of America (2007) contract stipulates that base hourly pay be applied to the first 7.25 hours of an 8-hour shift, with the remaining 0.75 hours paid at the base rate multiplied by 1.5

Adj(usted) 2nd Shift The second shift hourly employees are paid at a rate equal to that of the first shift plus $0.30 per hour with the same contract stipulation as in the first shift.

Adj(usted) 3rd Shift The third shift hourly employees are paid at a rate equal to that of the first shift plus $0.40 with the same contract stipulation as in the first shift.

Adj(usted) 4th Shift The fourth shift is paid the same as the first shift and has the same contract stipulations.

Ad Valorem Tax An additional tax for education or public infrastructure based on a percentage applied to the sales price of the coal. This tax may be calculated differently from state to state. For example, in Wyoming the ad valorem tax is based on a percentage applied to the sold tons times their realization, then subtracting pit mining costs.

After-Tax Rate of Return (ROR) The time-adjusted discount rate that equates the present value of cash investment with the after-tax net cash inflows over the life of the project.

Amortization Capital costs associated with mine development, acquisition, and exploration that are amortized before production begins cannot be totally tax expensed in the year they take place. The residual amount is amortized or straight-line deducted generally over a 5-year period.

Area The area is a particular extent of a geographical surface measured in acres and may or may not contain coal-bearing resources.

Area Acres The geographical surface of the area is measured in acres (1 acre = 43,560 square feet).

Area Name The field name or Area Name is used to identify each area in a project. The user can enter any descriptive name desired.

Auto rental expenses The monthly cost used to provide management personnel with company-owned transportation or reimbursement for use of personal vehicles. It is a line item cost found on the **Mine Assumptions** dialog of the **Mine Model** window. The user of CoalVal selects the employees that have rental cars.

Auto Expenses This cost will index the Auto Expenses.

Available Resource The amount of the original resource that is accessible for mine development under current regulatory and land-use constraints. This resource is the original coal minus previously mined coal and coal that cannot be mined owing to land use and technical restrictions.

Ave. inches in-seam coal The average thickness of in-place coal. CoalVal uses this value to calculate the tons of coal produced. Only partings less than 3/8 of an inch thick are included as part of the coal bed.

Ave. inches in-seam parting The average thickness of the parting found in the coal seam that is being mined. CoalVal uses this value to calculate the tons of parting produced.

Ave. inches out of seam dilution The average thickness of the rock above and below the coal seam that is removed during the mining process. CoalVal uses this value to calculate the tons of dilution produced.

Barrier Restrictions Amount of coal, parting, and dilution tonnage resources for the required barriers between two different underground mines or between underground and surface mines for safety reasons.

Base Salary This cost will index the Salaried Employees cost found on the **Salaried Employees** dialog of the **Mine Data** window.

Base Salary per Year The amount the user entered for the employee category on the mine data table.

Base Rate The hourly rate paid to every employee entered into the wage table.

Black Lung Tax Rate A percentage tax times the sales price times the sold tons, depending on surface or underground mining, and cannot exceed a certain cost per ton. For underground mining, the current rate is 4.4 percent not to exceed the maximum tax of $1.10 per ton. For surface mining, the current rate is 2.2 percent not to exceed the maximum tax of $0.55 per ton. There is no black lung tax on lignite. These tax rates are entered in CoalVal's Tax Tables.

Box Cut The initial pit developed when opening a surface coal mine.

Btu The amount of energy in the coal measured in British Thermal Units (see ASTM International, 2008, Standard D1826-94).

Burden (payroll) The Payroll multiplied by the burden rate that the user set on the Mine Assumptions page of the mine model.

Burden Rate The rate at which the total payroll cost is multiplied in order to account for the medical, retirement, and other benefits.

Burden (weight) The consolidated or unconsolidated rock material that overlies an underground mineable coal bed.

Capital Equipment This cost will index the Capital Equipment cost found on the **Equipment** dialog of the Mine Data window.

Capital Stock Tax If applicable, the Capital Stock Tax percentage rate is a state property tax on the net worth of the business entity operating in the state. For coal mining operations, the net worth of the business entity is based on valuation of the remaining coal reserves, capital equipment, and average of the taxable income from five previous years.

CD ROM A prepressed compact disc with read-only memory that contains data accessible to, but not writable by, a computer. CD ROMs are used to store and distribute computer data and software.

Coal Bed The term bed is defined as the geologically smallest distinctive division of a stratified series, marked by a more or less well-defined surface or plane from other lithologies above and below. When one refers to a coal bed, the bed is all the coal minus partings thicker than 1 in. that lie between the roof and the floor of the mine. In CoalVal, the term coal bed is used strictly in the geological sense referring to the coal and parting material lying between the top and bottom of the bed, and not as a mining term.

Coal Contract Costs per Ton Market price (in dollars per ton) is not needed for mining reports, but it is used to calculate the royalties, taxes, and fees on the annual cash cost statement in the mine model report and the seam report. The annual cash cost statement summarizes the cash cost of continued mining operations but does not include sunken costs such as capital expenses and acquisition costs. The threshold price for individual coal Resource Areas is calculated in the Discounted Cash Flow (DCF) Analysis. At the threshold price, the net present value of after-tax income over the mine life equals the capital investment where price-based royalties and taxes are calculated on the threshold price independent of market pricing.

Coal Density The density of the coal is measured in grams per cubic centimeters. Density is used to calculate the tonnage in a volume of coal resource or to back-calculate the average area thickness of the coal in an Area's Mine Model if only the tonnage and the surface area are known.

Coal Haulage Cost, Raw The haul cost from the haul cost table multiplied by the raw tons produced per year.

Coal Recovered The percentage of coal recovered from the washing process, if the coal is washed. If the coal is not washed, the Coal Recovered from the mine is the run-of-mine production.

Coal Seam A stratum or bed of coal, generally applied to large coal deposits. In CoalVal the term coal seam is a mining term that refers to the coal, parting, and floor and roof dilution (sandstone, siltstone, or shale) produced during the extraction of the coal material. CoalVal was originally written using mining terminology where coal seams identified the entire mining column from floor to roof. For example, in some geographic areas of the Pittsburgh coal bed, the Pittsburgh bed is 48 in. to 60 in. thick and includes about 25 percent parting and 75 percent coal. However, the immediate roof is not stable. To obtain a stable roof horizon, 12 in. of shale, a 12 in. coal bed rider, and occasionally another 24 in. of shale must be mined. This consideration (a stable roof) can result in a mined product of less than 50 percent coal and greater than 50 percent parting material by volume.

Coal Seam Name This data-field name is the name used to identify the mineable coal seam (in and around the geological coal bed).

Copy Seam Quality Data to All Areas If the user does not have coal-quality data for all areas in a seam, entering the quality data on the seam page and then pressing the "Copy Seam Quality Data to All Areas" button will copy data from the **Seam** dialog to all the areas. Be sure to enter quality data into all areas before clicking this button.

Cost curve A graph of the costs of production as a function of total quantity produced. Discrete quantities are ordered from lowest to highest cost.

County Sales Tax These taxes are based on percentages applied to the sale of all consumables. In some cases, fuels are exempted or taxed at a lower rate, if they are used in the mining operation. Data are normally gathered from the County Assessor's office at the county seat.

Days per Week Production Total number of days worked per week by the production employees. Production employees are considered to be those that operate production-related equipment such as continuous miners, roof bolters, and shuttle cars. This value is not used in any calculations in CoalVal. It serves only as information for the user to make sure the model is using the correct "Factor for Hourly Payroll." Hourly employees get a different "Factor for Hourly Payroll," based on the number of days they work per week.

Days per Week Auxiliary work Total number of days worked per week by the auxiliary employees. Auxiliary employees are considered to be mechanics and those that operate nonproduction equipment such as rock dusters, belt movers, suppliers. This value is not used in any calculations in CoalVal. It serves only as information for the user to make sure the model is using the correct "Factor for Hourly Payroll." Hourly employees get a different "Factor for Hourly Payroll, " based on the number of days they work per week.

Days per Year for Production Total number of days worked per year by the production employees. Production employees are considered to be those that operate production-related equipment such as continuous miners, roof bolters, and shuttle cars.

Days per Year for Auxiliary Work Total number of days worked per year by the auxiliary employees. Auxiliary employees are considered to be mechanics and those that operate nonproduction equipment such as rock dusters, belt movers, suppliers.

Days per Year Scheduled per Employee The days scheduled or planned for each employee to work on a straight-time basis were calculated using the norms for the Gillette coalfield. These may change from coal field to coal field but should be within 1 percent of the actual observed days. The calculation is as follows: 365 days per year, minus 104 weekend days per year, minus 10 paid holidays per year equals 251 scheduled working days per year per employee assuming 8-hours per shift per scheduled day. This number is used to calculate the estimated **Mine Model** productivity and to compare with the industry-reported statistics to Mine Safety & Health Administration.

Date of Information This optional field can be use to help the user to know when the data record was last updated.

DBF File An abbreviation for dBase IV (.dbf) files used to import ArcView data into CoalVal using the Microsoft Windows® Excel® program. The dBase IV program is owned by dataBased Intelligence, Inc.

Depletion The equivalent to depreciation for coal reserves. It represents the declining value of the reserve that taxing authorities permit a company to claim as a valid deduction from taxable profits. Depletion is normally calculated as a rate percent times the value of the reserve mined out during a year.

Depreciation The allowance for wearing out equipment. Usually depreciation is undertaken by using the straight-line deduction method (that is, the capital cost is written off in equal increments over the designated life of the equipment).

Depreciation per Hour This value is calculated from the depreciation entered at the time data was entered for this equipment.

Depreciation Term (in hours) The depreciation term is the period of time in hours over which the equipment will be depreciated using the straight-line method. The user enters this value when adding equipment to CoalVal.

Development Amortization Capital costs associated with mine development are amortized on a straight-line basis. This value is used to calculate the real property tax.

Direct Cost, Raw The sum of all the direct costs to produce run-of-mine (ROM) coal. The cost per ton for direct costs is calculated by dividing the direct cost by the raw tons produced per year.

Direct and Indirect Costs (D &I Costs) in Car, Raw The total cost per ton to produce raw, run-of-mine (ROM) coal. This total cost is calculated by adding together all the ROM direct and indirect costs.

Direct and Indirect Costs (D&I Costs) in Car, Washed The total cost for producing washed coal and including prep plant costs for washing the coal plus the total direct and indirect costs. The cost per ton for this item is the total D&I in Car, Washed divided by the washed tons produced per year. If the coal is not washed, this cost will be identical to the total cost to produce run-of-mine coal.

Dilution (also called out-of-seam dilution) The material that contaminates mined coal with barren rock from the roof and floor of the excavation, subsequently lowering the ideal mineable coal bed quality.

Dilution Density The density of the dilution material in tons per acre feet to be used by all restrictions, premined areas, and mine modeled areas to calculate the annual tons of dilution produced during the mining operation

Discounted Cash Flow (DCF) The stream of the net after-tax cash flows where the cash outlays include all operating costs, taxes, and investment costs, and where revenues include cash payments of product sales.

Effective Ratio The total volume of waste material (overburden, interburden, rehandled waste, and mined parting material) moved during mining divided by the total tons of coal recovered during mining. This is the most accurate stripping ratio definition to define the mining operation.

Employee Category The user-assigned name given to a job description in the mine model, such as “FEL Operator-Coal.”

Environmental Restrictions The tons of coal, parting, and dilution estimated to be legally unavailable for mining owing to their proximity to sites such as cities, roads, power lines, pipelines, gas wells, flood plains, and rights-of-way.

Equipment Cost The purchase price of the equipment. The user enters this value.

Equipment ID Data-field name given a unique value by CoalVal. The user cannot change this value.

(Equipment) Name Description of capital equipment, generally by equipment type, size, and horse-power. Equipment names used in this manual are not to be considered a recommendation.

Equipment Rental The rental cost of any equipment for temporary replacement of mine equipment while being repaired other than cars, pickups or mechanics’ trucks for mine operations.

Exploration and Resource Acquisition The total cost of exploration and acquisition of the mine property. This cost will index the Exploration & Resource Acquisition cost found in the **Mine Assumptions** dialog of the **Mine Model** window.

Explosives Cost per Bank Cubic Yard (BCY) The annual cost of explosives per bank cubic yard (BCY) used to shoot the total volume of overburden, interburden, and parting material. The Explosives Costs are found on the **Mine Assumptions** dialog of the **Mine Model** window.

Explosive Cost per Ton The cost of explosives per ton of coal used to shoot the coal before loading into trucks. The cost is based on the total annual tons of coal recovered in the mining operation.

Explosive Overburden Cost of explosives for mining overburden per bank cubic yard (BCY). This cost is used in Contour Stripping, Area Mining, Truck-Shovel, and Dragline mining methods.

Factor for Hourly Payroll The total hourly payroll cost figures calculated in the model are multiplied by this factor in order to provide an estimate of the additional payroll cost incurred when hourly employees work overtime.

Federal Income Tax United States Corporate Income Tax rate is currently 35 percent on taxable income. Federal taxable income is net revenue minus deductible expenses, depletion allowance, and state and local taxes.

Front End Loader (FEL) A tracked or rubber-tired tractor with a digging bucket attached to the front end and capable of loading trucks or moving material from one location to another.

File This pull-down menu allows you to access the **Backup Database** and **Mine Model Data Exchange** dialog windows. Backup Database is useful if you would like to guard against data loss. Mine Model Data Exchange is where you go to import a new mine model or export a mine model for someone else to use. But most important, this menu item allows you to create, add, or open a CoalVal database. A database must be opened before most Menu Icons and Menu Items will be active. Until the database is opened, these menu items and icons will be grayed out.

Filtering In CoalVal, a process that removes unneeded data from a calculation to allow the report to address a specific area or bed.

Free on Board (FOB) The free-on-board mine price of coal loaded into a rail car. This amount is the price paid for the coal at the mining operation site. It excludes freight or shipping and insurance.

Fuel and Lube (F&L) The total annual cost of fuel and lubrication of the equipment selected for a mine model. The Fuel & Lube costs are entered on the **Equipment** dialog of the **Mine Data** window.

Fuel and Lube (F&L) Cost per Hour The cost for fuel and lubricant per hour to run the equipment. This field would not be used for equipment such as buildings, roads, and power centers.

General Expenses Catch-all costs, miscellaneous expenses not covered under operating supplies. This cost will index the General Expenses cost found on the **Mine Assumptions** dialog of the **Mine Model** window.

General Utilities The monthly electrical cost to operate the mine. The General Utilities cost is found on the **Mine Assumptions** dialog of the **Mine Model** window.

Grade This item is a pull-down menu that displays all the wages and wage codes entered on the Wages page.

Grade Code Any integer the user wants to enter. This code was taken from the United Mine Workers of America (2007) contract and modified as needed for CoalVal mine models.

Group on Mine Model This option allows for the grouping of coal tonnage by mine model for the Coal Resource Area report. For example, if more than one area uses the same mine model, then the report can group all those areas into one coal tonnage report.

Help The Help Menu links subjects to definitions and instructions. The software used to do this is called Help and Manual, version 5.0.3 by EC Software (ComponentSource Corporation, 2006).

Haul Cost Table The Haul Cost table contains specific haulage costs used with a **Mine Model** for a specific area.

Hoisting Cost Used only for underground mines. This item is the cost of hoisting the coal or manpower and supplies from the working area of the mine to the surface. This cost is calculated by multiplying the days worked per year by production employees times the number of shifts per day for production employees times the hoisting cost per hour, as entered on the **Mine Assumptions** page.

Hourly Depreciation The hourly depreciation based on the depreciation terms the user entered in the equipment tables of CoalVal.

Hours per Shift Scheduled time in one shift

Hrs Worked per Shift CoalVal will handle shifts with any number of hours. Normally the user will use 8, 10 or 12 hours per shift.

Hurdle Rate The rate of return (ROR) required for the mining company to mine the coal resource at a profit.

Interburden Noncoal material that lies between two coal beds.

Less than Restrictions The tons of coal resource that have less than a mineable thickness as determined by the user. The heading that will be printed on the reports is the "Less Than Heading" data field found on the Project page. Generally this thickness is a coal thickness that is not mineable by any method in today's industry.

Loadout Cost, Sold The cost of the rail loadout multiplied by the washed tons of coal produced per year.

Logical Production Unit (LPU) The minimum amount of coal resources needed to support a specific CoalVal Model Mine over the specified mine life. The LPU has a minimum producing unit life, generally tied to the life of major equipment and infrastructure.

Maintenance Truck Rental This cost indexes the Maintenance Truck Rental Cost found on the **Mine Assumptions** dialog of the **Mine Model** window (used only if the field mechanics are independent contract operators).

Mechanic If an employee is considered to be an independently contracted "Mechanic" and is used in the mine model, the number of employees in this category will be multiplied by the "Truck Rental Expenses" on the **Mine Assumptions** page of the **Mine Model**, to calculate the total truck rental costs.

Mineable Resource Recovery The percent of the mineable resource that is recovered during the mining operation. This value is used for the calculation of the sold coal produced by a CoalVal project. The assumptions for this data field can be found in tables 1 and 2.

Mined Tons of Coal The coal tonnage that will be mined from a Project Area.

Mined Partings Tons The tons of mined parting material from a coal bed in the project area.

Mine Model This pull-down menu allows you to select the Mine Model to be used for a selected Project Area.

Mine Life Specified length of time period during which coal is produced from the CoalVal Mine Model applied in the Logical Production Unit (LPU). The specified mine life is associated with a production period sufficiently long to recover capital costs.

Mine Model The **Mine Model** dialog page is where the mine models are created and edited. **Mine Models** can be used as part of the user's project or can stand alone. CoalVal comes with a group of default mine models for the user.

Mine Model Calculated This indicates if the Mine Model associated with the Area has been calculated. Each Area must have a tax table, haul cost table, mine model, Area acres, and mined tons of coal before the Mine Model can be calculated. If the Mine Model is not calculated, no reports can be created for that Area.

Mineral property (tax) The right to mine coal resource; in some states the coal resources are taxed as a property. The taxes and valuations vary from state to state and are more common in the eastern United States' coalfields.

Mining Face The work area where current production is taking place. In coal mining this could refer to the coal production face or to an overburden removal face.

Moist MMF Btu The Moist Mineral Matter Free (MMF) Btu data field name is calculated from other coal-quality data fields located on the Seams page in the Seams, Areas, and Discounted Cash Flows window. The ASTM International (2008) calculation methodology was used to calculate the Moist MMF Btu.

Name of Tax Zone Reference name for tax table to be used elsewhere in CoalVal. Unique name indicates which tax district it is and whether the mineral rights are owned by the mining company or are leased from the state or Federal Government.

Net Present Value (NPV) The sum of the discounted net after-tax cash flows (including all costs, taxes, and investment cash outlays) over the life of the project.

Notes A memo data field where users can enter any information they want—such as about the area or mine model.

NPV Method In CoalVal, the Net Present Value (NPV) Method is the determination of the free on board (FOB) sales price given a hurdle rate.

Number of Employees 1st, 2nd, 3rd, and 4th Shifts The number of hourly employees for each employee category the user has added to the **Mine Model**.

Number of Units 1st, 2nd, 3rd, 4th Shifts This number is intended to be used in mines where similar groups of equipment and man-power are working independently of each other but each group has equal numbers. When our mine models became more detailed these units became place holders.

Number of Spreads or Units of Production Equipment The equipment spreads that are mining at the same time. A spread or unit includes equipment and employees.

NX NX is the abbreviation for NexusDB, which is a commercial database engine for the Delphi, C++ Builder, and .NET programming languages created by Nexus Database Systems Pty. Ltd. It was created as a successor to the FlashFiler system from the Turbo Pascal days. The database engine supports the SQL:2003 standard alongside Core SQL functionality.

O&M (Operating and Maintenance) Costs Costs of operating and maintaining equipment, including fuel and lube costs, electricity (if applicable), tires and tracks, parts, supplies, repair, and rebuild. In CoalVal the O&M costs do not include labor costs.

Operational Supplies Represents the cost of daily supplies to all functions of the mining operation. The cost is found on the **Mine Assumptions** dialog of the **Mine Model** window, and the calculation is the number of spreads or mining units times the "shifts per day production" times the cost entered on the **Mine Assumptions** page of the **Mine Model**.

Operational Supplies Supplies such as tools, bits, rags, and bottled water.

Original Resource The total amount of a coal resource in the ground prior to mining.

Original Tons of Coal The coal tonnage that existed in the seam throughout a given area prior to any mining activity.

Other Flat Taxes Additional taxes calculated as dollars per ton.

Other Tax The annual cost of washed coal in tons, produced per year times a tax made up of the state ad valorem, state flat, and county sales tax all multiplied by the total of fuel and lubes, explosives, operating supplies, repair, rentals, and general expenses. The taxes are user entered on the tax table. The exact formula can be seen in the other taxes in the Mine Model Formulas section.

Overburden Noncoal material that overlies the uppermost mineable coal bed.

Overburden Prod(uced per) Shift The tons of overburden and interburden produced per shift. This item is used only for the truck-shovel and dragline surface mining methods.

Overhead The total annual overhead of the salaried employees. The user selects a group of salaried employees to be overhead. This value includes salary and auto expenses.

Parting Layers of noncoal material within a coal bed. Typically, parting material contains higher ash and lower carbonaceous material than the surrounding coal.

Parting Density The estimated density for the parting material reported in tons per acre-feet. This value is used to calculate tons of parting within a Project Area and the average thickness of the parting, given the total tons of parting and the surface area extent of parting for use in an Area's Mine Model.

Parting Barrier Rest Parting material in tons associated with Barrier Restrictions.

Parting Environmental Parting material in tons associated with Environmental Restrictions.

Parting Less Than Parting material in tons associated with Less Than (minimum mineable thickness) Restrictions.

Parting Previous Surface Parting material in tons associated with any previously surface mined coal.

Parting Previous (Mined by Underground Methods) UG Parting material in tons associated with any previously underground mined coal.

Parting Recovered The percentage of parting material recovered along with the coal in the washing process. That is, the percentage of parting material that cannot be separated from the coal.

Parting Tech Rest (Parting Technical Restrictions) Parting material in tons associated with Technical Restrictions.

Payroll The total annual cost for the hourly employees plus the total annual cost for salaried employees.

Payroll Rate per Day Total hourly employees wage cost for one shift per day.

Percent (%) Ash The amount of ash content in the coal or parting material (see ASTM International (2008) - Standard D3174-00).

Percentage Depletion Permitted deductible expense under the Federal Tax code to compensate the mine operator for exploration and acquisition expenses associated with a specific mine property. Federal law allows coal property depletion to be recovered using percentage depletion method or unit if production depletion. For coal properties, the mine operator almost always chooses the percentage depletion method and this method is modeled in CoalVal. While the computation of the percentage depletion deduction starts with the application of the percentage depletion rate to gross mine revenue, the permitted deductible depletion is reduced by means of a series of subsequent calculations based on remaining reserves and net income of the operation. Rate set by law at 10 percent.

Percent (%) Moisture The amount of moisture content in a coal or parting material sample (see ASTM International (2008) - Standard D3173-00).

Percent (%) Sulfur The amount of sulfur content in the coal or parting material (see ASTM International (2008) - Standard D3177-89, 2002).

Preparation Plant Operating Cost This cost will index the Preparation Plant Operating cost found on the **Mine Assumptions** dialog of the **Mine Model** window.

Prep Plant Cost The cost calculated by dividing the preparation plant cost that the user entered on the Mine Assumptions page by the washed tons produced per year.

Prep Plant Program's Cost This check box allows the user to select a Preparation Plant Calculator model for use as the Prep Plant Cost for the Mine Model. After this box is checked, the user can use the pull-down box below the check box to select a Prep Plant Calculator model. When this check box is checked, the user-entered Prep Plant Cost check box and the data entry field below it will be disabled and CoalVal will use the selected prep plant model for prep plant costs.

Prefeasibility Study or Preliminary Feasibility Study is a comprehensive study of the viability of a mineral (coal) project that has advanced to a stage where the mining method, in the case of underground mining, or pit configuration, in the case of an open pit, has been established, and an effective method of mineral (coal) processing has been determined. The study includes a financial analysis based on reasonable assumptions of technical, engineering, legal, operating, economic, social, and environmental factors and the evaluation of other relevant factors which are sufficient for a qualified person, acting reasonably, to determine if all or part of the mineral (coal) resource may be classified as a mineral (coal) reserve.

Previously Mined Coal Coal that has already been extracted.

Previously Mined Coal Underground The amount of coal in the coal seam previously mined by underground mining activity.

Previously Mined Coal Surface The amount of coal in the coal seam previously mined by surface mining activity.

Private, State, and Acquisition The annual cost of washed tons produced per year multiplied by private lands royalty, State, and Acquisition entered on the tax table dialog page.

Productivity A statistic that compares the amount of coal produced in a unit of time, as in: tons per shift (shown on the **Mine Assumptions** dialog page); or a statistic that compares the coal produced by one person in a unit of time, as in: tons per man-hour (reported in CoalVal's Mine Model Report). In this study, tons per man-hour productivity is arrived at by dividing the total number of accumulating hours worked per year by all mine employees into the total mine production. In CoalVal the productivity is calculated by multiplying the days scheduled per year per employee, times the total number of employees at the mine, times the overtime factor to yield the total hours worked. This number is divided into the total produced coal per year for a measure of productivity. A comparison of the CoalVal modeled productivity to the actual productivity reported by the Mine Safety & Health Administration for similar operations in the coalfield allows for a high confidence level in the estimated mine staffing in CoalVal.

Professional Services Contracted engineering, environmental, and other technical services. The Professional Services cost is found on the **Mine Assumptions** dialog of the **Mine Model** window.

Program Calculated Prep Plant Cost The prep plant cost that CoalVal calculates. It cannot be modified by the user.

Projects Accesses the **Projects** dialog page. A project is where you create a coal resource evaluation.

Property Insurance per $100 of Capital Value The number of mils per $100 of equipment and infrastructure value used to calculate property insurance. The property insurance is a cost entered by the user on the **Mine Assumptions** dialog page and developed by multiplying the insurance rate by the total capital cost (equipment plus infrastructure).

Property Taxes Annually assessed tax (in percent of value) depending upon whether the property is real, tangible, or mineral. Real property includes physical assets such as buildings and land without the mineral rights. Tangible property includes physical assets such as business equipment. Mineral property includes the mineral rights to mine the coal.

Property Tax Rate This tax is a percentage of the dollar amount assessed on every $100 of the valuation. For example, the real property tax on a building worth $100,000, where the real property valuation rate is 30 percent and the real property tax rate is $3.01 per $100, would amount to $3.01 for every hundred dollars of the assessed valuation of $30,000, or $903.

Quality The coal and parting-material quality is derived from analysis of each Area. There are quality data fields for ash, sulfur, Btu, moisture, fixed carbon, and volatile matter. In addition, ash, sulfur, and Btu can be reported for coal, partings, and dilution.

Rail Loadout This will index the Rail Loadout costs found on the **Mine Assumptions** dialog page of the **Mine Model** window.

Rail Loadout Cost The cost per ton for loading the produced coal into unit trains.

Real Property Physical assets such as buildings and land without the mineral rights. This value is located in the Tax Tables and is used in the calculation of real property tax for indirect costs.

Real Property Tax The total of the real property entered by the user multiplied by real property tax rate from the tax table multiplied by real property assessment.

Reclamation Provisions A fund that will cover cost of removing surface facilities, reclaiming roads and ponds, site maintenance, and seeding and mulching. It is based on an estimated cost per ton and is found on the **Mine Assumptions** dialog of the **Mine Model** window.

Recoverable Resource The amount of the available resource that is left after mining losses and cleaning losses are subtracted. The economics of extraction and coal cleaning are not considered in the recoverable resource determination.

Reference (to wage rates) Information about the wage rate. This screen is where the user might want to enter the union contract or other reference that relates to this wage.

Reliability Categories Statistical references based on the distance from points of measurement or based on sampling. The measured, indicated, inferred, and hypothetical resource categories, as defined, indicate the relative reliability of tonnage estimates as related to distance from points of thickness control of particular parts of a coal deposit (Wood and others, 1983).

Measured Tonnage estimates computed by projection of thicknesses of coal for a radius of ¼ mile (0.4 km) from a point of measurement.

Indicated Tonnage estimates computed by projection of thicknesses of coal for a radius of ¼ to ¾ mile (0.4 to 1.2 km) from a point of measurement.

Inferred Tonnage estimates computed by projection of thicknesses of coal for a radius of ¾ to 3.0 miles (1.2 to 4.8 km) from a point of measurement.

Hypothetical Tonnage estimates computed by projection of thicknesses of coal for a radius beyond 3.0 miles (4.8 km) from a point of measurement.

Remaining Resource The amount of coal resource left after subtracting mined-out coal resources from the original coal resource total.

Repair & Maintenance (R&M) Item This cost will index the Repair & Maintenance cost found on the Equipment dialog of the Mine Data window.

Repair and Maintenance (R&M) Cost/Hour The cost for repair and maintenance per hour for the piece of equipment.

This field is not be used for equipment such as buildings, roads, and power centers.

Repair Parts/Maintenance Supply The annual cost of parts and maintenance for the equipment in the Mine Model.

Reports When you are finished with your project or mine model and want to know the results, this menu item will create a report and allow you to print it or review the report on the screen.

Reserve The amount of the recoverable resource that can be mined at a profit at the time of the economic evaluation. Reserves are affected by the mine location, coal bed characteristics, coal quality, mining methods, and cleaning of the coal.

Resource (coal) A naturally occurring concentration or deposit of coal in the Earth's crust, in forms and amounts such that economic extraction is currently or potentially feasible.

Restrictions to Mining Restricted land, technically limited, and legally unsuitable areas that would preclude mining operations.

Land Use Restrictions Constraints placed upon mining by societal policies to protect those surface features or entities that could be affected by mining. Since laws and regulations can be modified or repealed, the restrictions, including industrial and environmental restrictions, may change. Land use typically is restricted near railroads, cities and towns, airports, and interstate highways.

Technical Restrictions Constraints, relating to economics and safety, placed upon mining by the state of technology or prescribed by law. These restrictions can change with advances in science or modifications in the law. Geological factors, such as coal less than 5.0 ft thick, and clinker areas are included as technical restrictions for surface mining the Powder River Basin. Underground coal resources are considered to be technically restricted in coal seams less than 24 in. thick in Cretaceous or older coal and 60 in. thick or less in Tertiary coal. In addition, they are restricted if coal resources are greater in thickness than a single pass from a longwall mining machine (typically greater than 13 to 14 ft. thick).

Legal Unsuitability Criteria Constraints used to determine if an area can be mined by surface mining methods. These include, but are not limited to, Federal land systems, dwellings, and alluvial valley floors.

Run-of-Mine (ROM) Produced tonnage from the mine face that includes coal, parting material, and dilution. Mine production prior to any beneficiation of the product.

Royalty Federal Lands The annual cost of washed coal in tons produced per year multiplied by Federal royalty entered on the tax table. Notice that there are two Federal rates, one for surface and one for underground mining. CoalVal will use the rate based on the mining type the user selected for the mine model.

Royalty Rates Percentage of the sales price (in percent) of the delivered coal. Royalty fees paid to the owner of the mineral rights. Common royalty rates exist for underground or surface mines depending upon whether the rights are Federal, state, or private, but different rates can be negotiated.

Schema The schema of a database is its structure described in a formal language supported by the database management system. In a relational database, the schema defines the tables, the fields in each table, and the relationships between fields and tables. In CoalVal the schema ties the information in an outside database to a CoalVal database and allows the import of outside data into CoalVal databases and reports.

Setup The Setup dialog will allow you to set filters for viewing only the look-up information you want. You can also set report parameters such as margins and logo location. The program options allow you to set whether the Main Menu Bar remains on top of all dialogs and whether you want to use the tabbed version of the Mine Model and Project dialogs.

Severance Tax This tax is calculated by multiplying the tax rate (as a percentage) times the total tons sold outside the state of origin, multiplied by the price per ton received for the coal. This information is gathered from the State Auditor's office or County Assessor's office. In regional coal evaluations it is normally assumed that all coal is sold out of state.

Shifts per Day, Production The number of shifts per day that the production employees work.

Shifts per Day, Auxiliary The number of shifts per day that the auxiliary employees work.

Shifts per Day The number of shifts per day for production and auxiliary employees.

Spread (of Equipment) The type and amount of equipment necessary to do one or more operations in a mine. For example, the production equipment necessary to move coal from the working face of a surface mine to the crushing and conveying system could be called a "coal production spread." If the mine had two distinct producing areas it might need two "coal production spreads" to meet planned production.

State Sales Tax The state sales tax from the tax table multiplied by the total of fuel and lubes, explosives, operating cost, repair and maintenance, and rentals.

State Income Tax The state tax rate on taxable income as a percentage. State taxable income is typically the Federal taxable income with the state income tax deduction added back in.

State Mineral Tax The annual cost of washed tons produced per year multiplied by state mineral tax entered on the tax table multiplied by the unmined tax, multiplied by the real property tax.

Surface Mining Control and Reclamation Act (SMCRA) A reclamation tax (in dollars per ton) used to reclaim abandoned mines. The amount is dependent on surface or underground mining and set by the Surface Mining Control and Reclamation Act of 1977 and its Amendments. The rate in 2009 is $0.15 per ton for underground and $0.32 per ton for surface mining. The surface rates decreased by 10 percent in 2005 (from $0.35 per ton to $0.32 per ton) and are scheduled to decrease by 10 percent in 2012. The SMCRA tax is recorded in CoalVal's Tax Table.

Straight Line Depreciation The annual depreciation of the equipment.

Stripping (Mining) Ratio The most influential economic factor in the evaluation and planning of open pit coal mines. Several different stripping ratio definitions exist.

Virgin Ratio The amount of overburden and interburden that must be removed to gain access to a unit amount of coal (rehandle is not considered).

Mining Ratio The ratio of the volume of overburden and interburden (waste) plus rehandle that must be moved to gain access to a unit amount of coal.

Effective Ratio The total volume of waste material (overburden, interburden, rehandled waste, and mined parting material) moved during mining divided by the total tons of coal recovered during mining. This ratio is the most accurate stripping ratio definition to define the mining operation.

Surface Facilities Used by the cost indexing system (CIS) to tell CoalVal if the equipment is Capital or surface facilities. Failure to check this check box for surface facilities will mean that the wrong cost index will be used. This index is found in the Surface Supplies & Facilities cost on the Equipment dialog of the Mine Data window.

Tangible Property The acquisition cost or current value of equipment entered in the mine model multiplied by the state's real property tax, normally a percentage times the tax in mils. The tax and mils data are accessed from the County Assessor's office and change from county to county and state to state.

Taxing District This data field name allows the user to enter information about the taxing district.

Tax Table The tax table developed for use in the Mine Model.

Technical Restrictions The tonnage of coal that is unavailable for mining because of technical reasons such as subjacent or superjacent seams that are too close together to mine both or where the coal seam is too thick to mine (the coal out of the mining height would be technically restricted). Other technical restrictions could be areas where the roof is not stable, where faulting is too dense, or where the beds are too steeply dipping.

Threshold Sales Price The minimum free-on-board (FOB) sales price required to recover all mine and beneficiation operating costs, investment expenditures, and meet a specified after-tax rate of return to investment.

Tons Prod(uced per) Shift Total run-of-mine tons of coal produced per shift.

Tools The Tools pull-down menus allow the user to reset the CoalVal database, access the Mine Data dialog page, and access the Cost Indexing System. The user can also run the Prep Plant Calculator from the menu and select whether values from the Prep Plant Calculator can be used on the Mine Assumptions page of the Mine Model dialog.

Total Annual Overhead The total number of salaried employees that the user has placed in the overhead salaried employee group. For mine models using the longwall mining method, the overhead is split between the longwall mine and the development mine.

Total Annual Salary The total of annual salary of all salaried employees.

Total Fuel and Lube (F&L) per Day The fuel and lube (F&L) costs are calculated from the F&L cost per hour recorded in the Equipment Data Entry tables.

Total Depreciation per Day The daily depreciation calculated from the total amount of equipment, hours worked per day, and the hourly depreciation.

Total Hrs per Day Total hours per day are scheduled for employees, equipment, and infrastructure. The calculations are generally hours per shift times shifts per day times the number of employees or equipment.

Total Indirect Cost The total of all indirect costs. The indirect cost per ton is calculated by dividing the indirect cost by the raw tons produced per year.

Total Repair and Maintenance (R&M) per Day The total repair and maintenance (R&M) calculated from the R&M per hour cost recorded in the Equipment Data Entry tables.

Total Payroll The total annual payroll for wage or hourly employees as calculated by adding the daily payroll costs and multiplying by the days worked per year by employee group. This value is placed in the payroll field of the direct cost. See Cost Assumptions.

Total Salary per Year The total number of salaried employees multiplied by the base salary per year.

Total Tax The annual total of all the royalties and taxes calculated for the Operating Report. For all Royalties, Taxes, and Fees, the cost per ton is calculated by dividing the rate by saleable tons of coal (run-of-mine or washed) produced per year.

Total Tons to Market for all Calculated LPU"s The total of summing the marketable coal from all the logical production units contained in all resource areas.

Truck Rental Expenses The monthly rental of mechanics' trucks and tools when outside mechanic services are used.

Unit Cost The purchase price of each piece of capital equipment. The value entered by the user for the cost of the equipment, including transportation and erection costs.

Usable Life Years Calculated data field from the user-entered depreciation.

User entered Prep Plant Cost If the user desires to use his or her own prep plant costs, this check box must be checked and the user must enter a cost per ton for prep plant costs into the data entry field below the box. If the user desires to use CoalVal's prep plant cost, then the check box should be left unchecked.

Utilities The annual cost for utilities to operate the mine. This cost does not include electrically driven equipment such as shovels, draglines, conveyor belts, and similar equipment that has an electric operating cost component in the equipment operating costs.

Valuation of Developed Resources The value of coal in dollars per ton that is within the current permit area, where facilities are in place and the coal is expected to be mined in the near term.

Valuation of Undeveloped Resources The value of in situ coal in dollars per ton that will not be mined in the near term. Typically, it is the same value per ton as the acquisition cost.

Valuation Rate The percentage rate of the full assessment value at which property taxes are applied. If property taxes are to be applied to the full assessment value, then the valuation rate is 100 percent. It is not uncommon to have the property tax rate applied to a fraction of the full assessment rate.

Wages This item indexes the Wages cost found on the Wages dialog of the Mine Data window.

Wages ID A unique value that CoalVal assigns to each wage category.

Washed (coal) This cost is used by the Area Resource Calculation report. If the coal is washed, then the associated costs will be used in the report. However, if the coal is not washed and the run-of-mine product is saleable, then no wash costs will be added to the total production costs.

Years for Depreciation A data field used for selecting the number of years to depreciate a piece of equipment. Note: Discounted Cash Flow (DCF) analysis does not use the data field for real property. The DCF analysis depreciates real property over the life of the mine. This data field is used for all mine models except truck and shovel and dragline.

Publishing support provided by:
Denver Publishing Service Center

For more information concerning this publication, contact:
Center Director, USGS Central Energy Resources Science Center
Box 25046, Mail Stop 939
Denver, CO 80225
(303) 236-1647

Or visit the Central Energy Resources Science Center Web site at:
http://energy.cr.usgs.gov/