Demo Quick Start Guide for MAGIS eXpress

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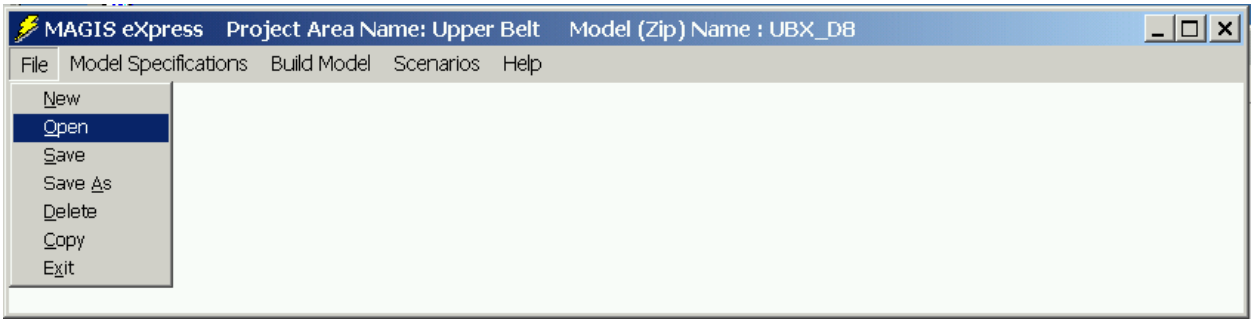
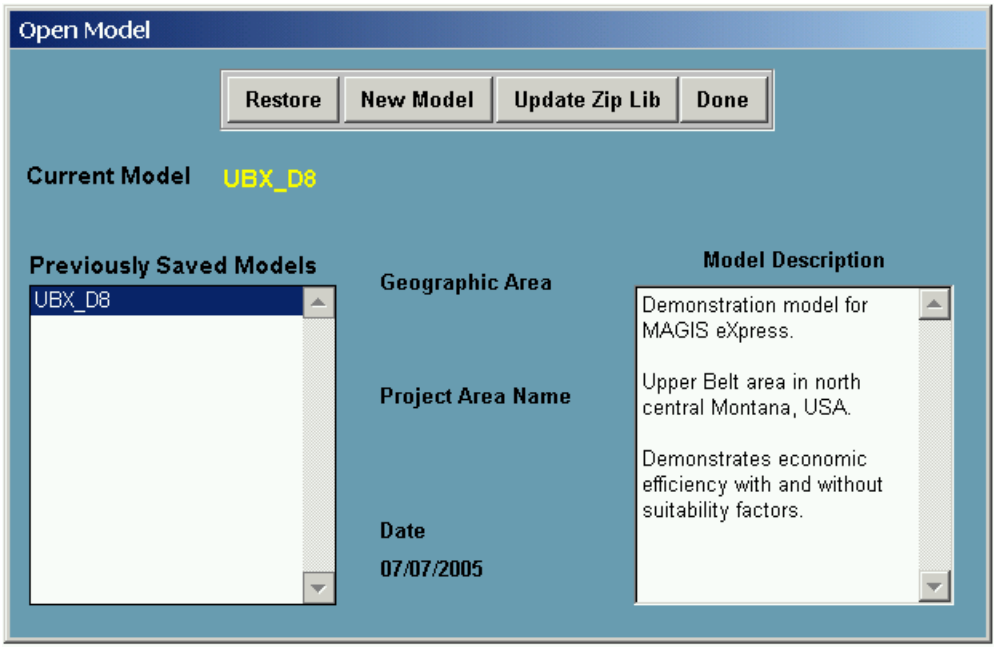
The horizontal menu bar contains five items: File, Model Specifications, Build Model, Scenarios, and Help.

File menu: This pull-down menu contains seven items: New, File, Save, Save As, Delete, Copy, and Exit.



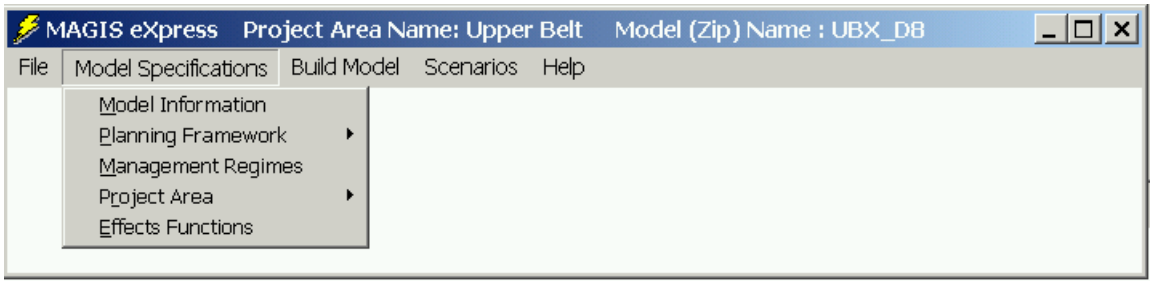
1. Select **Open** and the following form will appear:



2. Click the **Restore** button to open the demonstration model.

3. Follow through the menu system as described below. Then, several alternative scenarios will be compared in item 4.

Model Specifications menu: This pull-down menu contains five items: Model Information, Planning Framework, Management Regimes, Project Area, and Effects Functions.

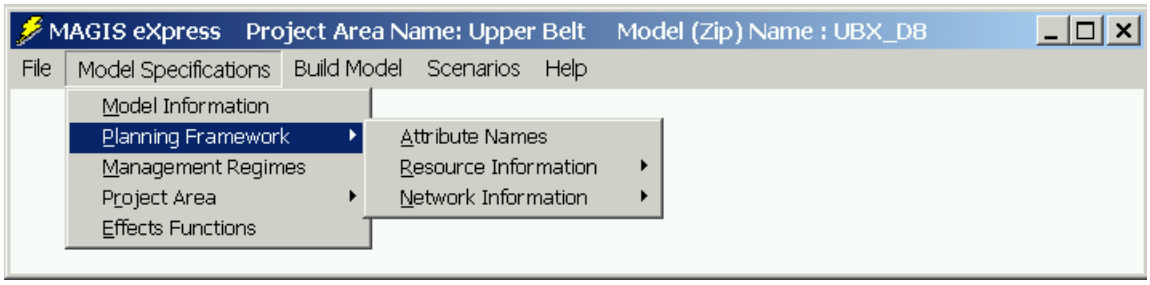


Model Information submenu

Selecting this submenu item brings up a form where the following general information is entered: Planning Framework Area Name, Planning Framework Description, Discount Rate, Time Unit Length (years), Base Year, Standing Volume Unit of Measure, Capacity Unit of Measure, Area Units (Acres v. Hectares), Project Area Name, Project Area Description, Project Area Location, Zip Model Name (not editable), Roads Coverage path name (not editable), Treatment Unit Coverage path name (not editable), and Planning Horizon Time Periods.

Planning Framework submenu

Selecting this submenu item yields three other submenu items as follows: Attribute Names, Resource Information, and Network Information.

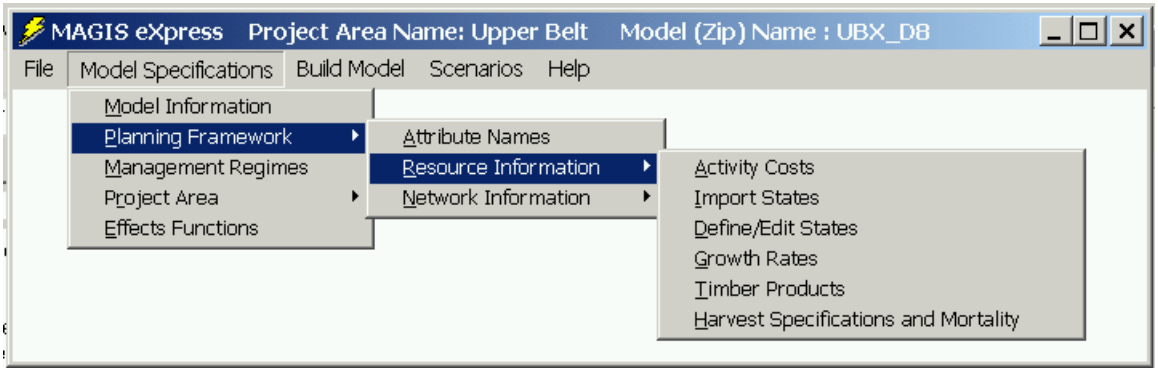


Attribute Names

Selecting this submenu item results in a form where attributes, either discrete or continuous are defined. They form the building block of any future constructed planning model.

Resource Information

Selecting this submenu item yields **six** other submenu items as follows: Activity Costs, Import States, Define/Edit States, Growth Rates, Timber Products, and Harvest Specifications and Mortality.



1) Activity Costs submenu:
What you need to know: activities can be combined into management regimes. Each activity has a cost associated with it that can be expressed as a cost per acre or cost per unit of output (timber), a specific cost that is attributed to a polygon, or as a lookup table of costs based on unit attributes. Note: make costs as 'lumpy' as possible.

2) Import States/ Define/Edit States submenus:
What you need to know: IF SIMPPLLE has been used to define vegetation pathways, they can be exported to a text file which may then be converted to a MAGIS import file. This is a somewhat involved process. Just bring your SIMPPLLE model with you!

3) Growth Rates submenu:
What you need to know: The method by which timber is grown in MAGIS is optional. You can start with standing volume (as an attribute) of each treatment unit (you would only need to have this available for potential harvest units). If you want to grow these stands, you set up an annual growth rate (percent increase) for each relevant vegetation state. The residual volume after harvest continues to grow by this method.
Alternatively, you can set up an estimated volume table based on the vegetation state characteristics. MAGIS will lookup the appropriate amount and use that as the standing volume, apply the activity and harvest specifications (see below) to determine the harvest volume. The post-treatment vegetation state and subsequent states (succession) determine the future standing volume.

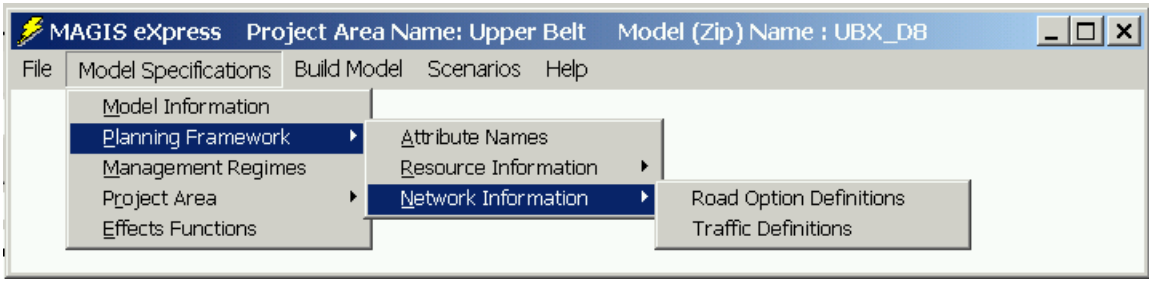
4) Timber Products submenu:
What you need to know: On this form the names of products, method of valuation (straight $ per CCF, or a TE (transaction evidence) equation are defined. If you want a detailed accounting, will need the local TE model, plus important attributes assigned to each treatment unit (only need it for polygons that might be harvested). Examples for Region 1 include average diameter, percent defect, logging method (we will handle that with a file of logging methods and loading nodes), volume per acre, and total sale volume (we can't attribute that quantity to each treatment unit, so we just need a general estimate).

5) Harvest Specifications (required) and Mortality (optional) submenu:
What you need to know: For each harvesting activity, you need to define the percent of the standing volume that will be harvested. This can be an average percent, or you can set up harvest percents by 'state groups'. State groups are categories of vegetation 'states' to which activities will be applied. For example, you might want to define a commercial thin as removing 20% of the standing volume for vegetation states that are large multistory size classes, but only 10% of the volume for large single-story stands.

- On the harvest specifications tab page, select an activity for a state group, then enter % harvest and product name.
- On the mortality page, the user indicates expected mortality for each state group for certain management activities.

Network Information

Selecting this submenu item yields **two** other submenu items as follows: Road Option Definitions and Traffic Definitions.



1) Road Option Definitions submenu:
What you need to know: With this form road activities are defined as one of **three** classes: "Classified" (permanent) road, "Temporary" road, and "Decommissioning" (permanent removal of road from network).

2) Traffic Definitions submenu:
What you need to know: With this form traffic is defined by quantity of product loaded onto the road network at user-specified locations and the cost associated with transporting the material to a destination.

Management Regimes submenu

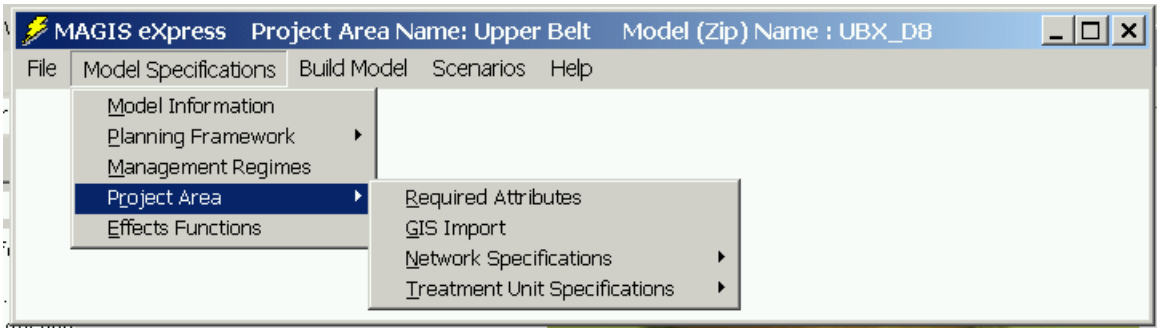
1) Define Regimes by creating an activity (cost) schedule:
Activities can be repeated, or can be re-used in different management regimes.

2) Setup Resource Project Generator rules
a. State Group Definitions
The user creates groups of states for which the management regime might be appropriate: for example, you would only want to apply commercial thinning to a

forested state that is a 'medium' size class or larger and has a density class 3 or 4 (if you use SIMPPLLE density classes).
b. State Group Assignments
Once the state-groups are created, they are assigned to a management regime definition.

Project Area submenu

Selecting this submenu item yields **four** other submenu items as follows: Required Attributes, GIS Import, Network Specifications, and Treatment Unit Specifications.



1) Required Attributes: Hbty_grp, dom_sp, sz_class, density, and time_inc.
Conditionally required attributes: Stnd_vol if you select Standing volume by attribute, Cost Table or Cost Amounts and ADBH and ADEF if specify TEA model.

2) GIS Import (**embedded GIS**):
This process brings external GIS data into the MAGIS environment. It is an automated process and the user only needs to verify that it was successful.

Required GIS data:

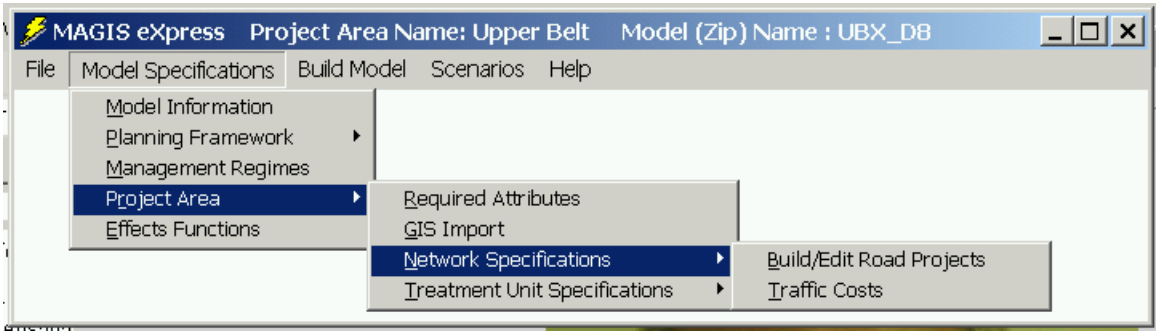
a. ARCGIS road coverage:
This map layer must contain NO loops, NO from-to/to-from duplicates, NO gaps (all intersections snapped to a node). All this implies connectivity. All intersections must be marked with a node. This map layer must be cleaned, built, and projected.
This map layer has the following 5 attributes: user-defined From_Node ID, To_Node ID, Cur_status (E = existing, C = proposed (new Construction), Horz_len (actual length in miles), and Rd_option (for existing roads only, for new roads, leave blank)

b. ARCGIS coverage for treatment units (and stands). This map layer must be cleaned, built, and projected.
This map layer has the following 12 attributes: user-defined polygon ID, HBTY_GRP, DOM_SP, SZ_CLASS, DENSITY, TIME_INC, STARTVOL, YR_SIN_ACT, PAS_ACT_ID, Lookup Table costs or Total costs (dependent on how costs are defined by user), and Zone attributes associated with management regimes and/or effects functions.

In addition there are three Auxiliary tables named RD_OPTIONS.DBF, TRAFFIC_COST.DBF and Loading Nodes File (any name). The first database

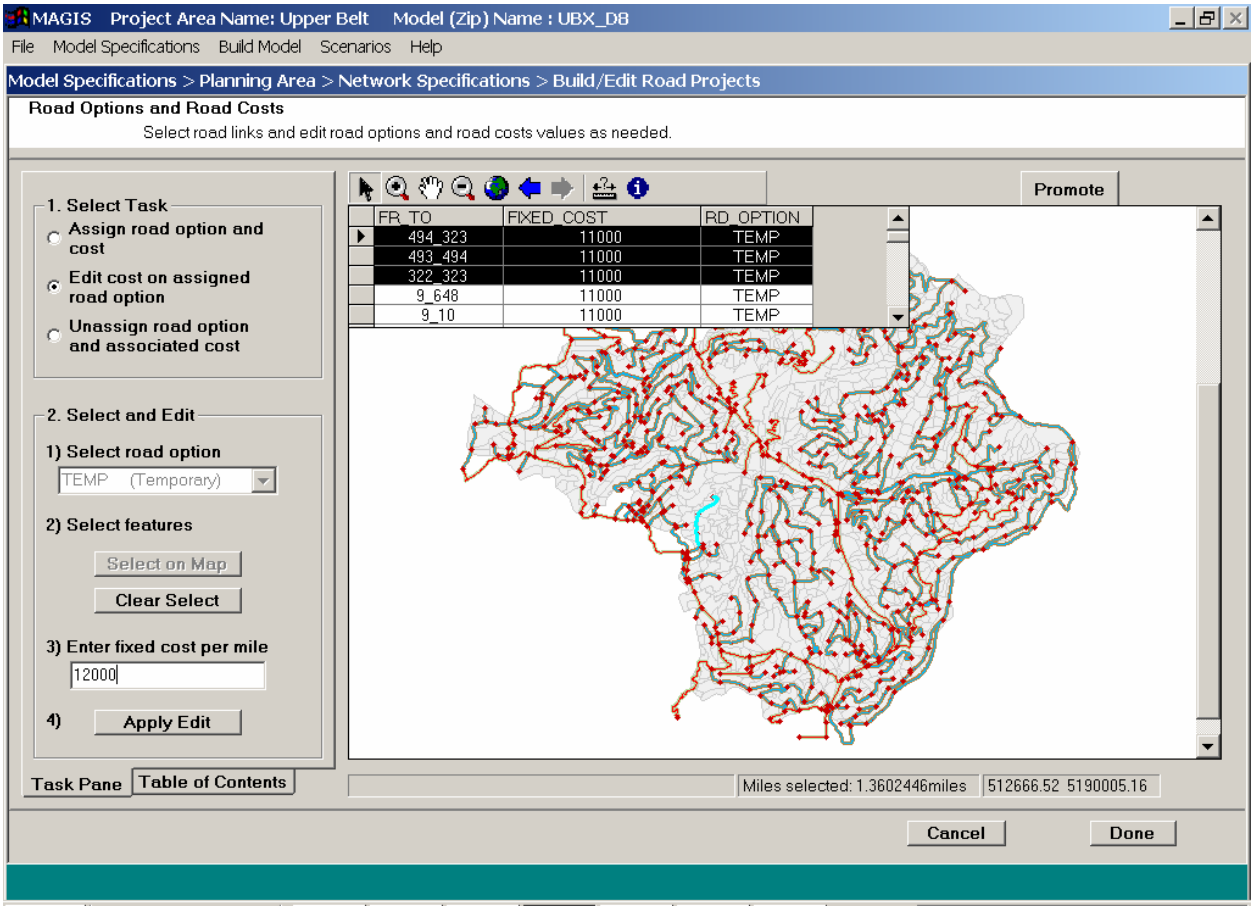
contains 5 attributes: FR_TO, FROM_NODE, TO_NODE, RD_OPTION and FIXED_COST. The second database contains 6 attributes: FR_TO, FROM_NODE, TO_NODE, RD_OPTION, TRAF_TYPE, and VAR_COST. The third database contains 4 attributes: CUT_UN_ID, LOG_METH, NODE, and VALUE.

3) Network Specifications submenu:
Selecting this submenu item yields **two** other submenu items as follows: Build/Edit Road Projects and Traffic Costs.

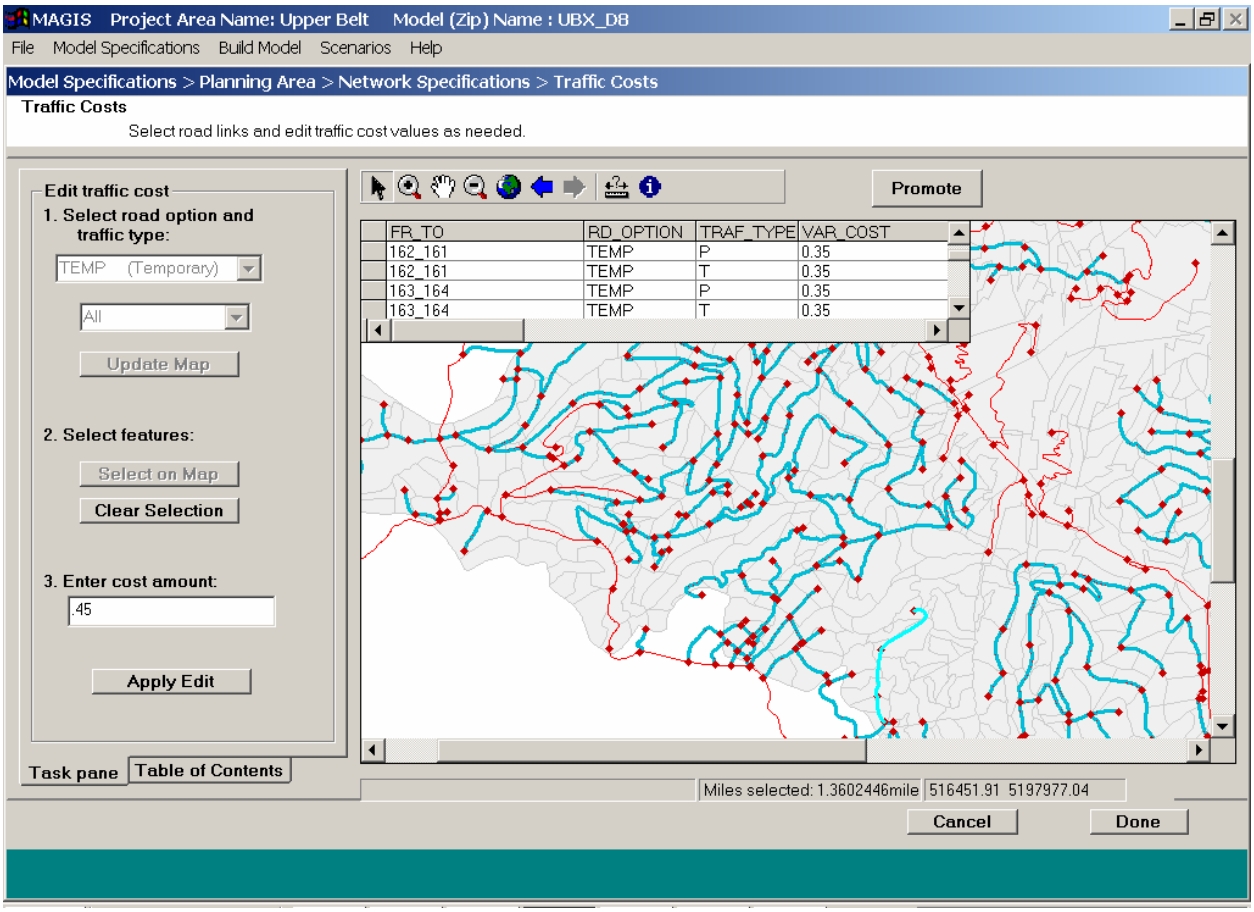


a. Build/Edit Road Projects (**embedded GIS**)

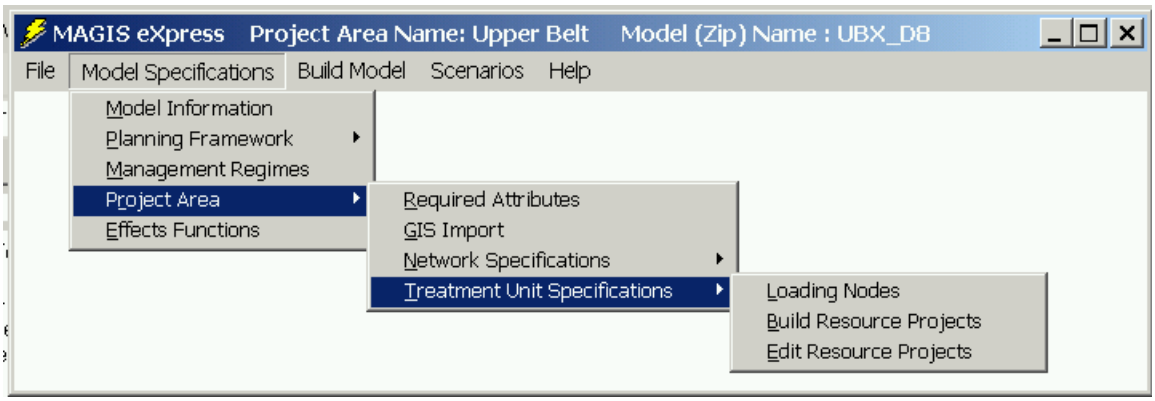
This custom graphical interface aids the user in adding information about proposed roads and their costs.



b. Traffic Costs (**embedded GIS**)
This custom graphical user interface facilitates building the information about the cost of hauling timber product PLUS any specific maintenance costs.



4) Treatment Unit Specifications submenu:
Selecting this submenu item yields **three** other submenu items as follows: Loading Nodes, Build Resource Projects and Edit Resource Projects.



a. Loading Nodes submenu:

There should be a file or a map ready to create the loading nodes defaults table. This information connects harvest-able treatment unit polygons to the road network and builds a table of default loading-node/logging method (yarding methods) to be used by the resource project generator.

b. Build Resource Projects submenu:

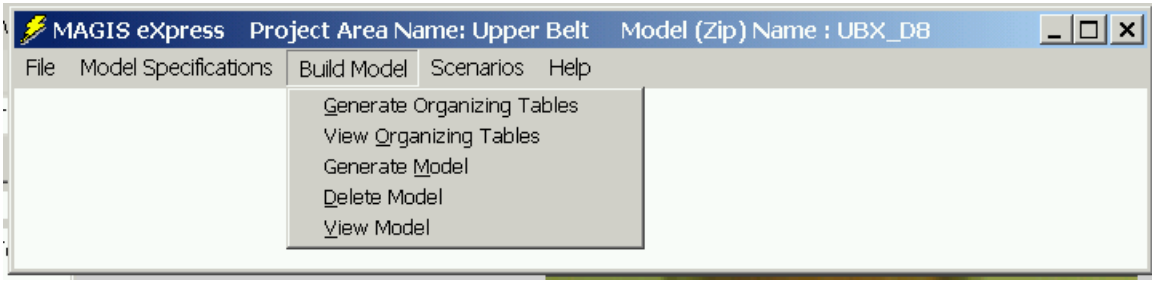
This process builds the options for treatment units. It applies the rules defined with management regimes to the vegetation states and management compartments associated with treatment units.

c. Edit Resource Projects submenu:

Effects Functions submenu

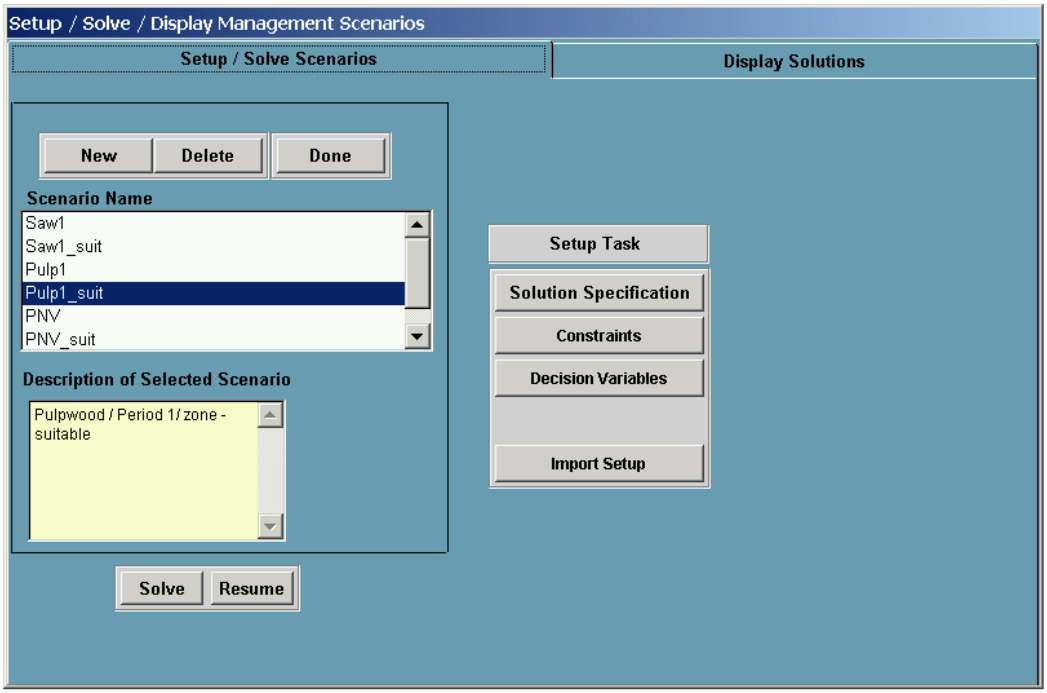
The user needs to think about /decide what quantities are important, and which ones are used to control the planning model solution. Generally you want to build net revenue and total cost functions, any specific costs (like Rx burning) that might be used for budget control, as well as functions that track the harvest amounts and any outputs that are built into the planning model. Other controlling functions might include acres or costs of specific activities -- to make target burning acres for example. Any functions can be accounted for by management areas that are already built into the GIS (watersheds, compartments, ownership or management areas and so on.)

Build Model menu: This pull-down menu contains five items: Generate Organizing Tables, View Organizing Tables, Generate Model, Delete Model, and View Model.



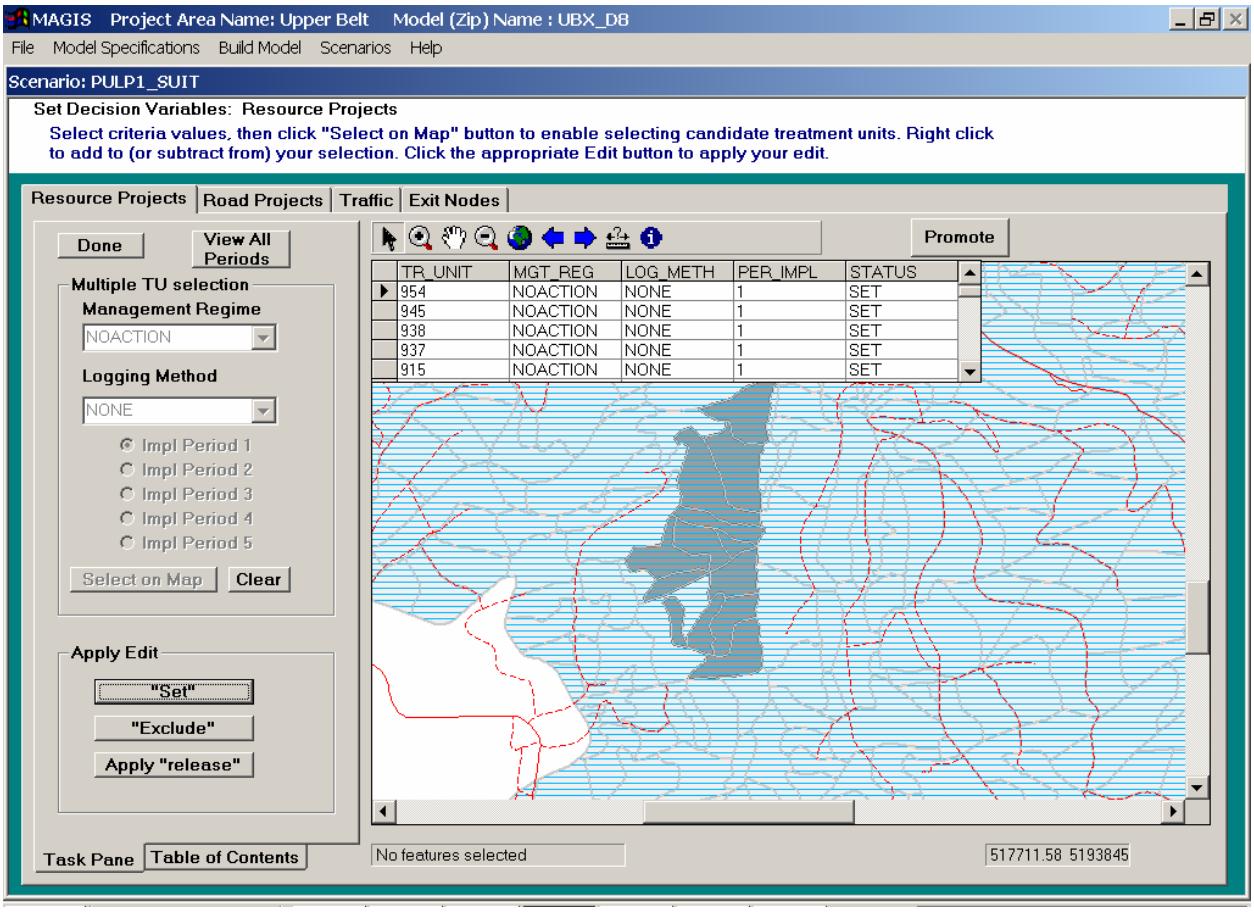
Scenarios Menu: Selecting this pull-down menu results in the display of a tabbed form where management scenarios are setup, solved, and how resultant solutions are to be displayed.

Setup/Solve Scenarios tab:



Setup: Several tasks need to be performed before the planning model can be solved. A new Scenario Name can be created, the type of solution (in Solution Specifications) must be specified (LP vs MIP), Management Constraints may be specified (optional), Decision Variables may be specified (optional - **embedded GIS**) or a setup can be imported (optional).

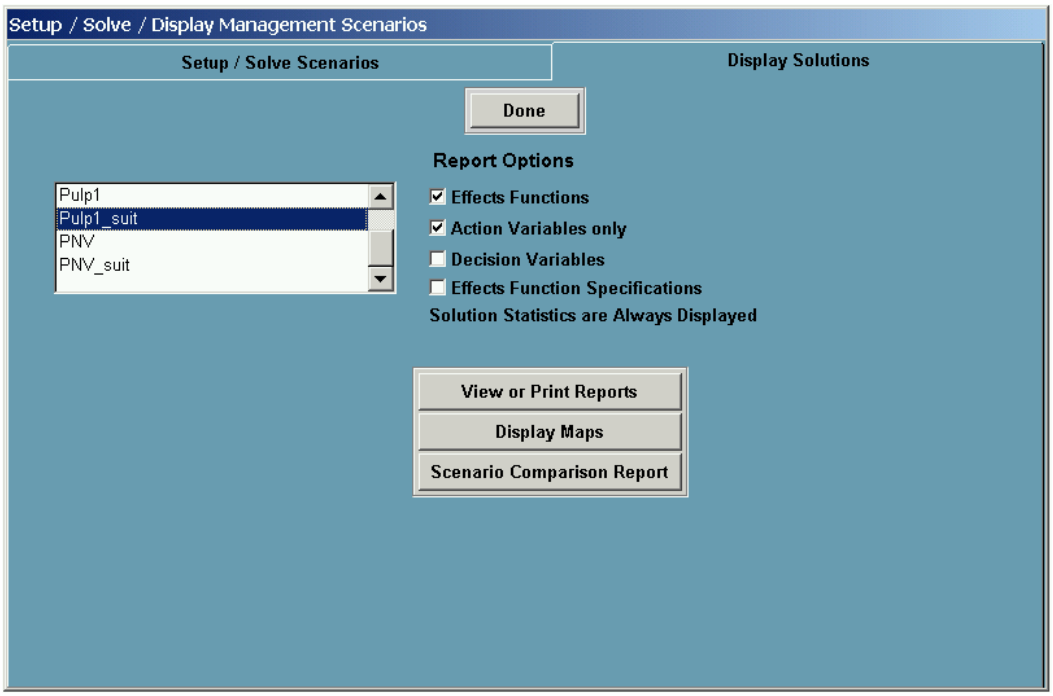
The graphic below shows an example of pre-setting treatment unit polygons to a particular management choice. Here, the “NoAction” management regime for period 1, that is, no treatment is to be applied in period 1. See the interface in action for the complete list of choices which may be preset.



Solve:

Solve – Click this button to start the solution process. (Note: The solver is not enabled for the applications fair demo installation.) The solver seeks the most efficient set of management actions to meet the objective specified by the user.
Resume – Click this button to resume/refine iterations for the solution process (MIP only)

Display Solutions (**embedded GIS**) tab:



Solution results are presented both in tabular and map form.

The report form provides all the information presented in the maps and also the objective function value and shadow prices for effects functions for those who understand mathematical optimization concepts. Additionally, one may make custom reports to compare results of two to six scenarios (see item 4 below).

The map displays enable visual interpretation of complex information. Three option buttons on the task pane (toggle between task pane and TOC) allow choosing views displaying treatment units effects functions and vegetation attributes, road effects functions, and

schedules (treatment schedules, road management action implementation schedules, and traffic volumes.
Special features of the map display interface include:

- Display results by time period.
- For schedules, also display results for all time periods
- The schedules map displays include additional information in status bars. Move the mouse cursor over treatment unit and road link features to see values in the status bar message panels.
- The schedules map displays include a custom identification tool for treatment unit polygons; the popup attribute window shows the management regimes for each period.

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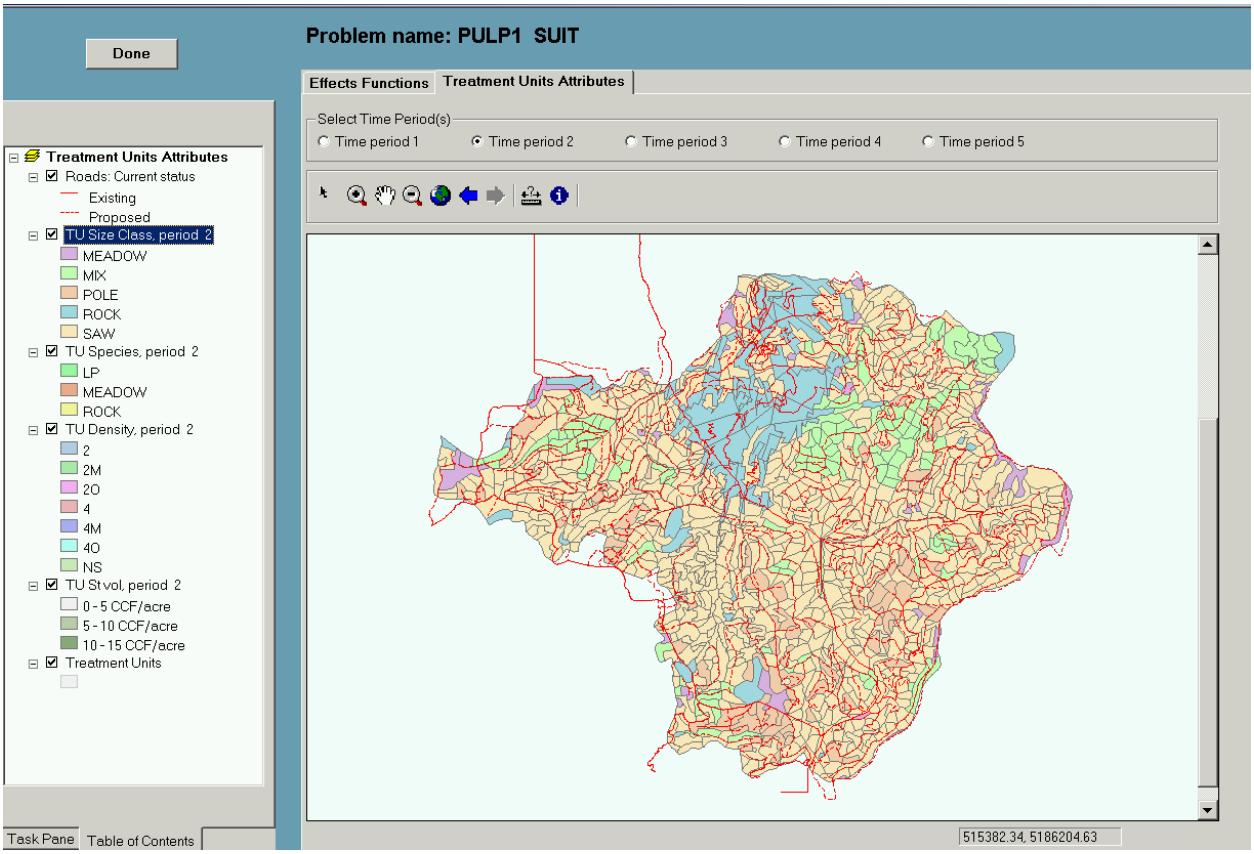
The map displayed in the figure below depicts user-defined size class categories for time period 2 for a scenario which removes hazardous fuels, from areas suitable for harvest (specified earlier in the modeling process by the user), which are to be used as wood pulp.



4. Compare Scenarios

1) **Modeling present net value and costs into the future.**

We here analyze a minimizing cost problem over 5 time periods (10 years/period) as a baseline cost scenario. The graphic below shows a table (generated via the Scenario Comparison Report dialogue on the Display Solutions tab) comparing selected Effects Functions for five alternative scenarios in this analysis. These depict typical tradeoffs to be considered when planning forest management operations. The left-most column lists the names of Effects Functions whose values are displayed for each scenario being compared. For example, PNV is the present net value of management actions for each scenario. Scenario names are displayed in the field headers. Z5PNV is the alias name of a scenario which aims to maximize the Effects Function PNV (problem ID "5", problem name "PNV"). Note that, of all five scenarios, this scenario has the highest value for the Effects Function PNV.

When we schedule timber harvest we have to deal with the tradeoff question of whether to harvest in period 1 or to let the treatment unit increase its volume of wood and harvest a greater amount in a later period (but discounting the amount of revenue in the Present Net Value). If it is harvested later, road construction may be required; thus, road cost will vary between the scenarios. If we build a road and harvest a treatment unit in period 1, it may be possible to harvest an adjoining unit in a later period and use the same road (and therefore save road construction costs in some cases). Another tradeoff we make is between road construction (and the costs) verses helicopter logging (no road construction costs but higher harvesting costs).

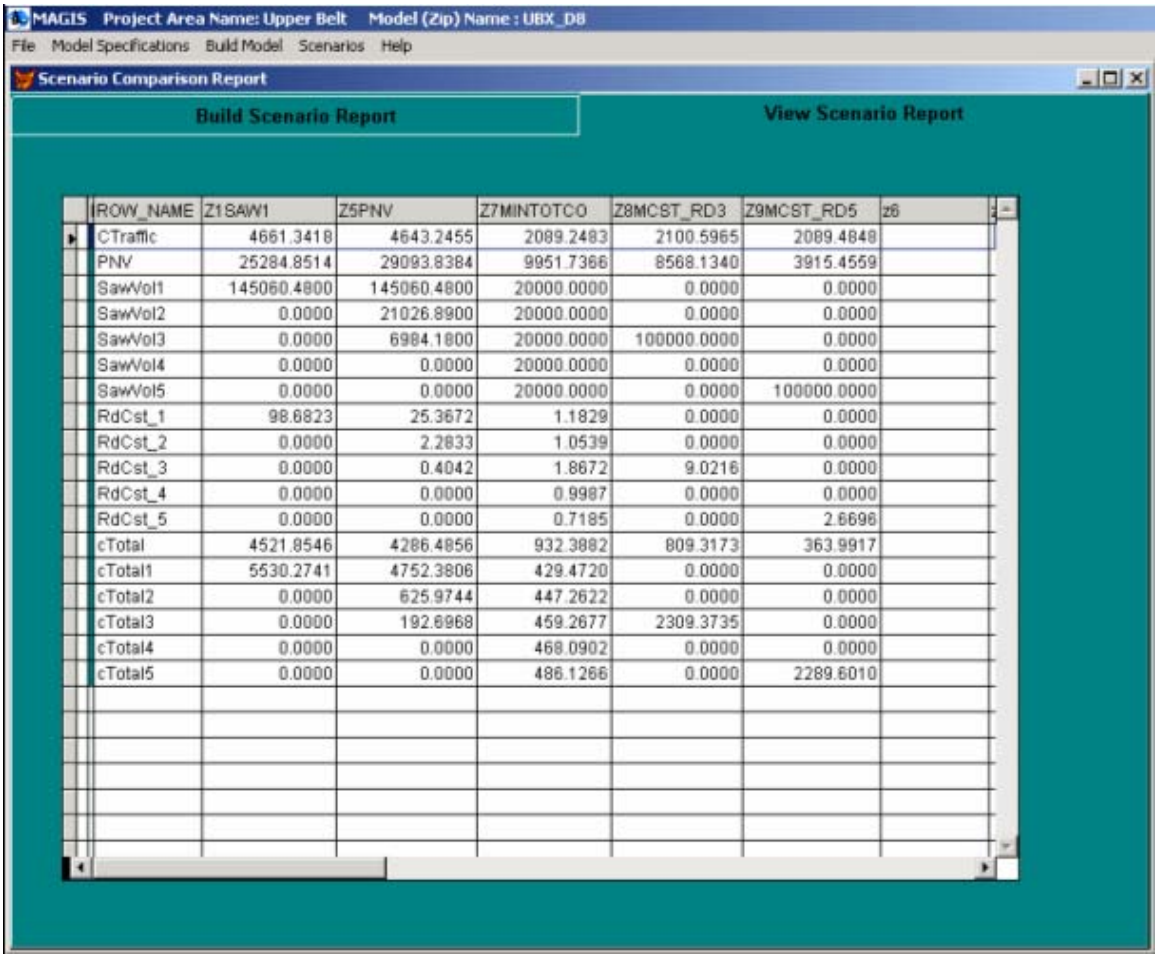
To gain a sense of the upper limit of the current vegetation harvest spectrum, we specify a scenario to maximize saw log volume (harvest) in period one (objective function - SawVol1). We find that if we harvest everything in period 1 we get 145060 cff. We could use this as a guide to set harvest limits (upper or lower) when optimizing other objectives (minimize cost for example). Harvest limits could be for healthy forests, fuel treatments, or supplying the local sawmill with raw material. If the revenues from a harvest don't return to your local unit, you may wish to only consider the effect on your budget. The question then becomes how should we schedule this harvest at a minimum cost. So we will run three scenarios: (1) the harvest spread out equally between the five periods (20,000 ccf/period) (2) 100,000 ccf harvested in Period 3 and (3) 100,000 ccf harvested in Period 5. With time period and amount already set in the scenarios setup dialogue, the solver need only choose the optimum locations based on vegetation state in a time period, logging method cost, and road and traffic costs. The solver does not select harvesting in any period other than that specified in setup because costs are being minimized subject to the specified harvest amount for each of the three scenarios.

Looking now at the Effects Functions values for the three minimum-cost comparison scenarios (specified in Setup), note that the discount rate is 4% for the Effects Function cTotal which is the total cost of management actions over all five periods. The individual time

period Effects Functions for cost (cTotal1, cTotal2, cTotal3, cTotal4 and cTotal5) are NOT discounted. This would be the case for any scenario but is easily discernable in the results listed for scenario Z7MINTOTCO.

We see that, by comparing the three scenarios, each minimizing the cTotal (total cost over all five periods) function for the harvest specs for that scenario, we obtain the smallest cTotal (in discounted dollars) in scenario Z9MCST_RDS5. That is, waiting until period 5 to harvest requires the least cost but we also (because of discount revenue) would have the smallest PNV. Timber growth close to existing roads enabled harvest with minimal road construction.

To decide which of these scenarios is most appropriate, consider demand for timber, fire risk, timing of operational budget, or include additional Effects Functions to look at the tradeoffs involved for other management objectives.
If, however, maximizing PNV (scenario Z5PNV in table) over all five time periods is the primary objective, we see the same amount of harvest in Period 1 and that growth in subsequent periods (in treatment units other than those harvested in period 1) allows harvest volumes in Period 2 and Period 3 as well.



ROW_NAME	Z1SAW1	Z5PNV	Z7MINTOTCO	Z8MCST_RD3	Z9MCST_RD5	z6
CTraffic	4661.3418	4643.2455	2089.2483	2100.5965	2089.4848	
PNV	25284.8514	29093.8384	9951.7366	8568.1340	3915.4559	
SawVol1	145060.4800	145060.4800	20000.0000	0.0000	0.0000	
SawVol2	0.0000	21026.8900	20000.0000	0.0000	0.0000	
SawVol3	0.0000	6984.1800	20000.0000	100000.0000	0.0000	
SawVol4	0.0000	0.0000	20000.0000	0.0000	0.0000	
SawVol5	0.0000	0.0000	20000.0000	0.0000	100000.0000	
RdCst_1	98.6823	25.3672	1.1829	0.0000	0.0000	
RdCst_2	0.0000	2.2833	1.0539	0.0000	0.0000	
RdCst_3	0.0000	0.4042	1.8672	9.0216	0.0000	
RdCst_4	0.0000	0.0000	0.9987	0.0000	0.0000	
RdCst_5	0.0000	0.0000	0.7185	0.0000	2.6696	
cTotal	4521.8546	4286.4856	932.3882	809.3173	363.9917	
cTotal1	5530.2741	4752.3806	429.4720	0.0000	0.0000	
cTotal2	0.0000	625.9744	447.2622	0.0000	0.0000	
cTotal3	0.0000	192.6968	459.2677	2309.3735	0.0000	
cTotal4	0.0000	0.0000	468.0902	0.0000	0.0000	
cTotal5	0.0000	0.0000	486.1266	0.0000	2289.6010	

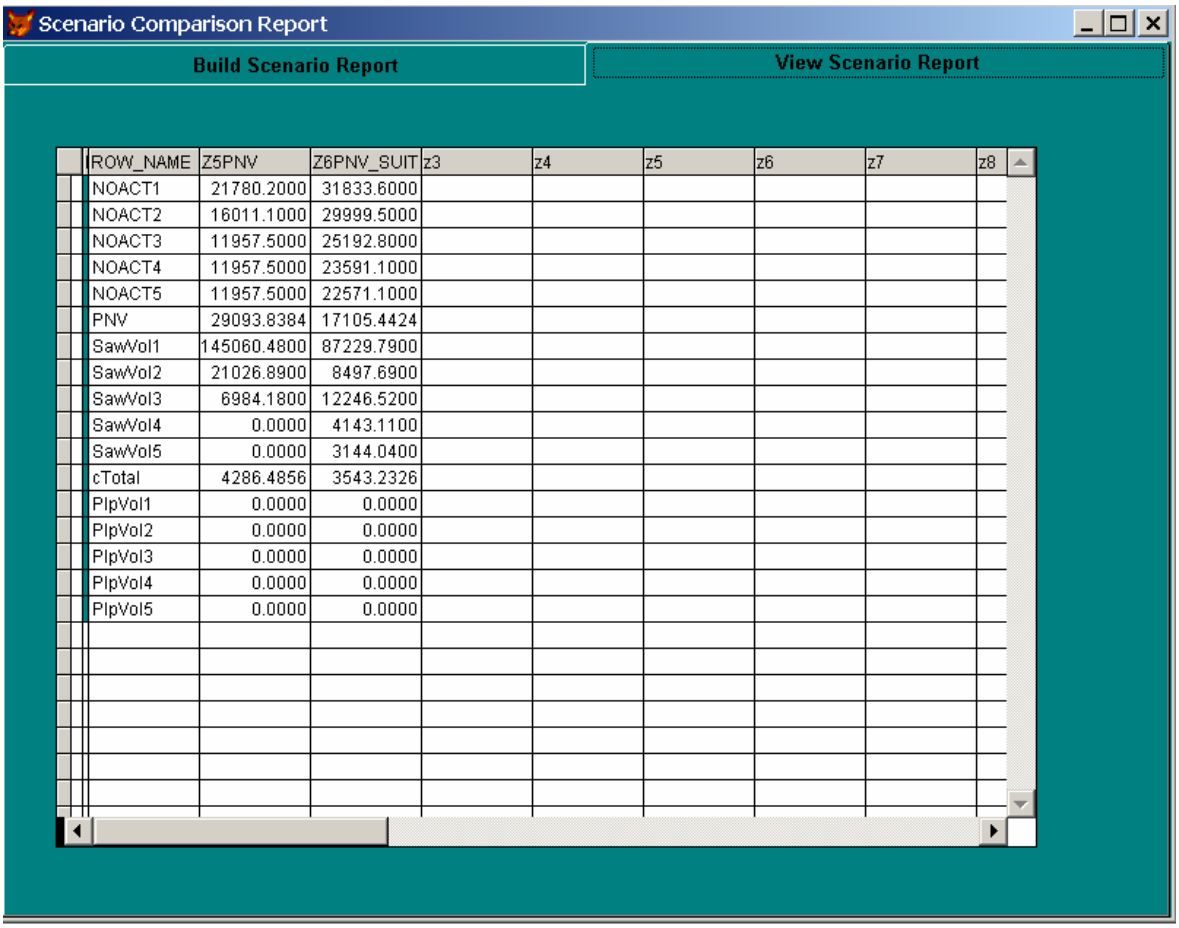
2) **Interaction of suitability factor (zone) with other objectives.**

Forest managers may define an attribute for treatment units to indicate suitability for harvest. This may be based on a range of ecological or other issues. For example, an area considered unsuitable for harvest would be wetlands are areas close to streams. This demonstration model includes a hypothetical suitability zone. The figure below displays a comparison for the scenarios PNV vs. PNV constrained by suitability. The Effects Functions listed for this comparison follow.

1) PNV - total present net value for management actions over all five time periods
2) NOACT1, …, NOACT5 – number of acres in a time period having no management action
3) SawVol1, …, SawVol5 - volume of saw timber extracted in each time period
4) PlpVol1, …, PlpVol5 - volume of pulp extracted in each period (none)
5) cTotal - total cost over all five time periods

Where constrainted by suitability (Z6PNV_SUIT), the effects functions for SAWVOLx and PNV have lower values than for the scenario Z5PNV. The NOACTx Effects functions however values have higher values in Z6PNV_SUIT, that is, the number of acres where no management action occurs is higher.

Note that saw timber is more valuable in this particular model and contributes more to the PNV than does wood pulp. A MAGIS model may alternatively specify harvest ratios for saw timber and pulp in treatment units in the Planning Framework submenu. This model defines management regimes (also in Planning Framework) to harvest both pulp and saw timber, or only one at a time for a treatment unit. The solver selected saw timber because it contributes more to the PNV. This varies with wood product prices and harvest costs (entered by the user in the Planning Framework submenu).



ROW_NAME	Z5PNV	Z6PNV_SUIT	z3	z4	z5	z6	z7	z8
NOACT1	21780.2000	31833.6000						
NOACT2	16011.1000	29999.5000						
NOACT3	11957.5000	25192.8000						
NOACT4	11957.5000	23591.1000						
NOACT5	11957.5000	22571.1000						
PNV	29093.8384	17105.4424						
SawVol1	145060.4800	87229.7900						
SawVol2	21026.8900	8497.6900						
SawVol3	6984.1800	12246.5200						
SawVol4	0.0000	4143.1100						
SawVol5	0.0000	3144.0400						
cTotal	4286.4856	3543.2326						
PlpVol1	0.0000	0.0000						
PlpVol2	0.0000	0.0000						
PlpVol3	0.0000	0.0000						
PlpVol4	0.0000	0.0000						
PlpVol5	0.0000	0.0000						

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