VDDT- Path Modeling Rollup Tutorial

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Introduction

This document specifies the steps needed to create a Path database from an individual VDDT model database and integrating these models with the spatial data relevant to the geographic modeling region. This entire process is referred to as "data rollup" or "rollup" in this document. The modeling packages used for this were created by the Integrated Landscape Assessment Project at the Oregon State University-Portland State University's Institute for Natural Resources (ILAP: http://oregonstate.edu/inr/ilap). There is no warranty or support available for these models, spatial data or the use of this document.

Data and software used in ILAP State-and-Transition modeling

External software:

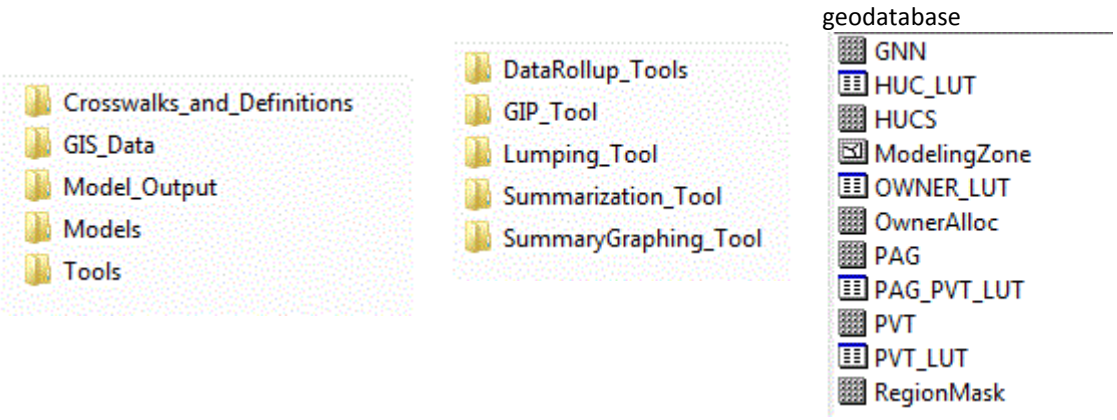
- VDDT 6.0.25 (http://essa.com/)
- Path 3.0 to Path 3.1 (ESSA technologies, at: http://www.apexrms.com/path)
- ArcGIS 9.3 with spatial analyst extension (ESRI: http://www.esri.com/)
- R-language and free software (http://www.r-project.org/)

ILAP models, data and tools (on FTP site: ftp://131.252.97.79/):

- Pre-Rollup Modeling Package
    - VDDT and Path model databases (without spatial information)
        - Multiplier files used by models
            - Transition multipliers
            - MCM multipliers (temporal multipliers)
    - Template folders
    - Documentation
- Tools Package
    - Data rollup tools
        - Data Rollup and Query Tool (DRQT v3.2)
        - GIS tool v.3.0.1
        - Template rollup database
        - DRQT and GIS Tool Documentation
        - GIS temporary output folder
    - Lumping tool (R-code: LumpStrata_0.10.zip)
    - GIP tool
    - Summarization tool (R-code package: SumPath_0.10.zip)
    - Summarization graphing tool
- GIS data (Individual model region's file geodatabase)

Figure: Files to download from the ILAP FTP site

Pre-Rollup Modeling Package Tools Package Contents of a GIS file



Directory structure for rollup and modeling on your computer

The **folder and pathways names must not contain spaces**. For example, the typical Microsoft's "My Documents" location is not acceptable to some of the tools used in the rollup process. There also appears to be a limitation in the length of characters in the full path to your modeling directory. This is most likely related to the length of the pathway to the ArcInfo directory that is created as part of the rollup process by the GIS tool. To avoid problems, the modeling folder name should be short and placed close to the root directory of your hard drive so that the **number of characters should not exceed 65 for the entire pathway, including the name of your modeling folder** (e.g. "D:\ILAP\Modeling\WNE_Forest_Modeling" is OK but "D:\ILAP\Modeling\Folder1\Folder2\Folder3\Folder4\WNE_Forest_Modeling" may be too long). Whatever your choice, you will want to organize your directories in such a way that you can find files easily and track all the steps in the modeling and rollup processes. The steps in this document refer to the folder, file and field names that are shown above and it is recommended that you maintain these names and directory structure until you are more familiar with the rollup process. The Northeast Washington modeling region (WNE) for forest models and the Southeast Oregon (OSE) for arid models are provided as tutorial packages on the FTP site. In this document, I use the WNE models and the date convention,"YYYYMMDD", as examples in these steps.

Copy data from ILAP FTP site

1. Use your web browser to navigate to the ILAP FTP site: ftp://131.252.97.79/ and download the following:
    a. Download a regional, pre-rollup modeling package for your project area (ILAP/Modeling/PreRollupModelingPackages/) and unzip to a location on your computer.

b. Download the corresponding region's GIS data (ILAP/GIS/Rollup_GDBs/), unzip and install to the GIS_Data folder in the modeling package
c. Download the tools package (ILAP/Modeling/Tools/), unzip and install to the Tools folder in the modeling package

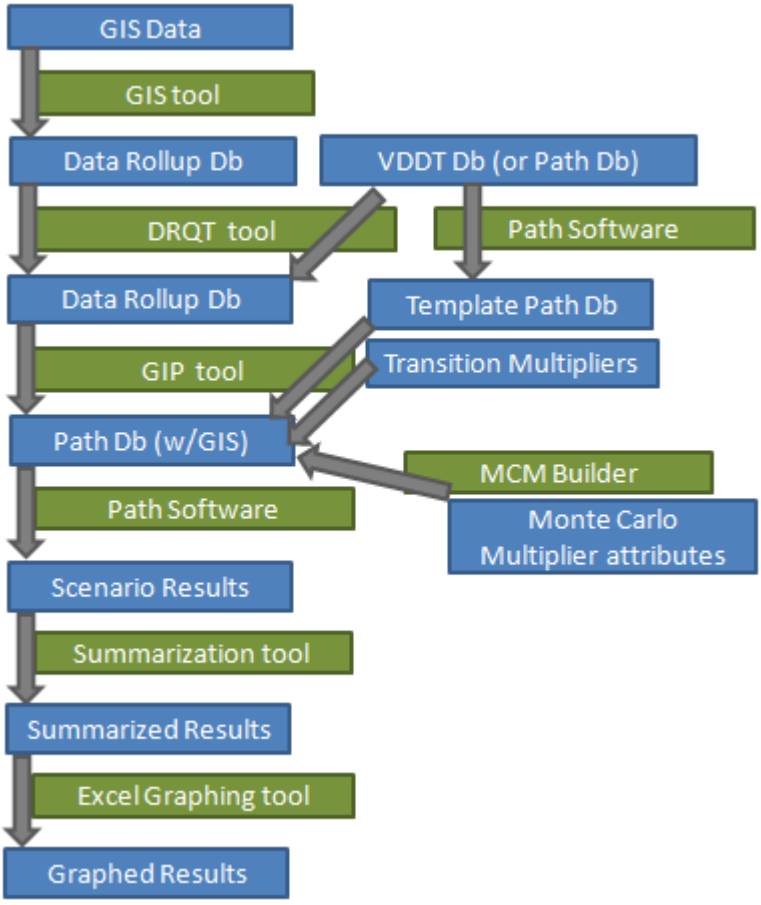
2. **For tutorial only:** Instead of step 1, download one of the two tutorial packages ILAP/Modeling/Pre-RollupModelingPackages/Tutorial_WNE_Forest_Modeling.zip or Tutorial_OSE_Arid_modeling.zip), which contains all 3 packages in one folder. This tutorial data limits the data to just wo watersheds for WNE forests or one watershed for OSE arid models. By using the tutorial package, the processing time for each step is reduced considerably. This package also contains sample results (databases and models) that have been created after the completion of different stages of the tutorial.

Model databases in the pre-rollup modeling packages

These databases only contain the VDDT and Path versions of regional ILAP models. Neither of these databases contain the spatial information necessary for running these models for an actual landscape. If users desire to use the landscape-populated databases used by ILAP to create results, they should refer to the rollout packages that are also found on the FTP site. Otherwise, the user should proceed with building spatially-populated Path databases by following the steps in this document.

Tutorial assumptions and modeling rollup schematic

This tutorial begins with the assumption that the user must build a landscape-ready, Path database from a VDDT database and GIS data. The term "Db" will be used throughout this document to refer to a database. An advanced tutorial (not part of this document but will be downloadable from the same location) will provide instructions on creating a landscape-ready Path database from an existing Path Db. This advanced tutorial will also discuss the development of a "relative area" Path database to facilitate testing and modifications of Path models' states, transitions and multipliers. A schematic of the rollup instructions provided in this document (i.e. assuming you are starting from VDDT) is shown below.



Compare PVT spatial data with models in VDDT

The models in the database must match the PVT spatial data. Compare and modify by:

1. In MS Access, open the VDDT model database (Models folder), then open the 'Project' table.
2. Open ArcMap, add the PVT data, open its table and compare against the model table:
    a. The same PVT data is used by both Forest and Arid models, so you need to set the mask values to match your model database. Change the values in the mask field to "1" for all models that you want to rollup into Path. The number of PVTs that have a "1" should be the same number as (or less than) the number of models in your VDDT Db.
    b. The 7-digit PVT codes (e.g. "WNE_fpd") must match the model names in the model database.

Optional: Import models or modify an existing VDDT database

Models and GIS databases for the ILAP project are divided into geographic modeling regions. If your region crosses over ILAP modeling regions, you will need to import new models into your Db and also

modify your existing spatial data. It is beyond the scope of this document to instruct the user on all the possible alterations to an existing ILAP model database but some limited instructions are below:

1. Import additional models into the region's already existing VDDT Db
    a. Populate this Db with models from another VDDT Db: Open Db in VDDT, then choose File->Import->Project->mdb
2. Modify existing models in VDDT
    a. Replace the 3-digit prefix in each of the models with any prefix that meaningfully matches your region or project name and matches the PVT codes in your GIS data. For example, you could change "WNE_fpd" (ILAP's Washington Northeast model region's dry pine model) to "CNF_fpd" for a dry pine model for the Colville National Forest.
    b. Although there are many changes that can be made to the models (new states, transitions, probabilities, etc), these changes are beyond the scope of this document. Users should refer to the ESSA website for detailed instructions on model modifications (http://essa.com/tools/VDDT/).

Optional: Modify GIS data to suit your project needs

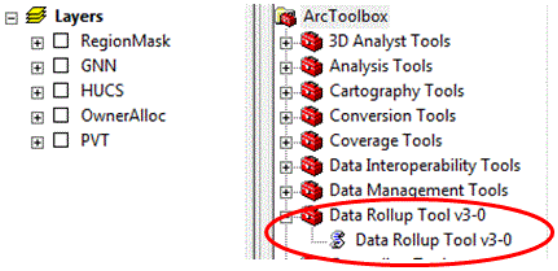
The PVT layer specifies which models are available in an ILAP model region and the geographic extent and area of each model. Modify the GIS data to suit your project needs. It is beyond the scope of this document to instruct the user on all the possible alterations to the existing ILAP model region data. Any new data must have the same resolution, snap, extent and coordinate system as the existing data. Some possible alterations might be:

1. Ignore watershed boundaries: reclassify all raster values in the existing HUC layer as 999 (any 3 digits) and name this new layer as "HUCS_NoData"
2. Use different ownership group: Reclassify a copy of the existing OwnerAlloc layer or add a new ownership layer to the file geodatabase. This new layer should follow the same field naming and data type conventions to avoid errors in the rollup process. For example, you should use the field name "Owner_Id", with a String/text data type, and populate with codes that are only 2 characters in length (letters or numbers are OK). You can create an additional field or a separate lookup table to keep track of what each code means and how they match your particular ownership-management groups.
3. Mask layer: The existing mask allows the rollup process to ignore areas identified by the GAP coverage as wetlands, barren, water, urban, agricultural, etc. If some of these land use/ land cover types are needed, then you will need to create and use a new mask layer.

Import GIS data into the data rollup database

This step will populate tables in the data rollup database with information from the GIS data.

1. Copy and rename the data rollup database (Tools/DataRollup_Tools/DataRollup_Database/) into the same folder and rename with a region prefix and a date suffix (e.g. "WNE_DataRollup_ YYYYMMDD.mdb"). Because this tool overwrites tables in the rollup database, copying and renaming the database with a date suffix will help to keep track of multiple rollup iterations.
2. Using the GIS tool to populate the rollup database:
    a. Open ArcMap and add the required GIS layers from your file geodatabase (ModelinPackage/GIS_Data/): PVT (potential vegetation),HUC (watersheds),Ownership-Allocation, GNN (Current vegetation), RegionMask
    b. If the Spatial Analyst extension is not already active, from the menu, select Tools>Extensions>Spatial Analyst (in ArcGis 10, this is Customize>Extensions>Spatial Analyst)
    c. Add the Data Rollup Toolbox (Data_RollupTools/GIS_RollupTool/) to ArcMap's ArcToolBox
    d. Open the script (with the same name) inside this toolbox (figure below)

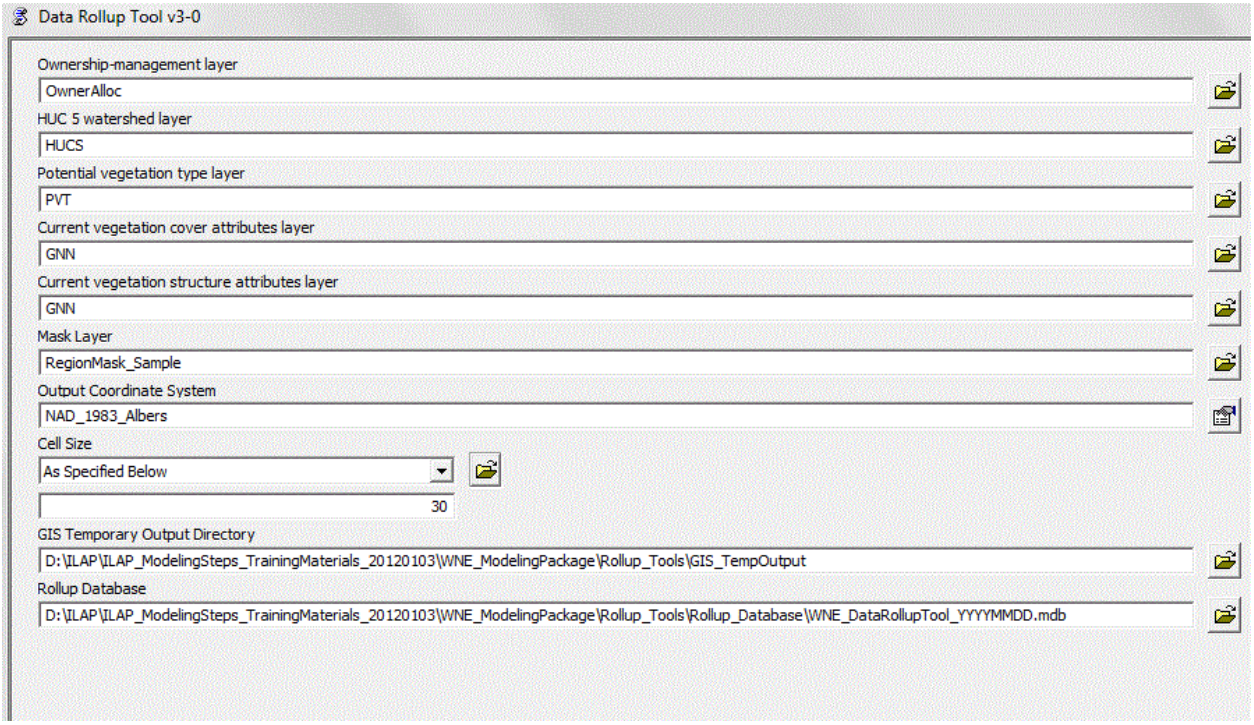


    e. Populate the tool's form with the GIS data (figure below)
        i. Drag-and-drop the GIS layers into the corresponding boxes in the tool form (or browse to each layer in the file geodatabase using the open-folder icon)
        ii. For Coordinate System, import from any one of these GIS layers
        iii. For the temporary GIS output directory, browse for and select the Tools\DataRollup_Tools\GIS_TempOutput folder (optionally, you can create a new folder in any location with a name of your choosing , such as "GISRollupOutput_YYYYMMDD". This would be helpful if you need to track multiple versions of the rollup and don't want to overwrite data in the default folder.)
            1. An ArcInfo workspace will automatically be created in this folder during the rollup process
        iv. For the Rollup Database, browse to the database renamed in step 1 above.
        v. Run the Tool and once the GIS rollup process has completed successfully,close ArcMap (optionally, save the mxd file to your GIS_Data folder). Depending on your data, this tool may take several minutes to more than hour. For the tutorial data, this should be less than 10 minutes.

vi. You may confirm that this tool was successful by opening the data rollup database. There will now be values from your GIS data in the tables: rollup_final; ownerall_final; pvt_final; huc_5_final; cover_final and structure_final tables.

vii. For future rollups, you may also re-use an existing, populated rollup database (rather than the Template_Rollup provided in these packages). The values in the tables from previous rollups will simply be overwritten.

Figure: The GIS Data Rollup Tool with example inputs



Create a Cover Type crosswalk (Region 6 forests only)

A crosswalk has already been built for each model region, which matches the current vegetation cover types ((GNN layer, ForTypeIV field) that are found within each PVT with the cover types for each VDDT model (CoverAbbr in the crosswalk). If no changes are made to the models or the spatial data (e.g. adding new cover types or new models), then add the existing crosswalk to the rollup Db:

1. Open the data rollup Db (Tools/DataDataRollup_Tools/DataRollup_Database/)
2. Import the Excel file (ModelingPackage/Documents/)
3. Confirm that 3 field names are exactly specified as “PVT”, “ForTypeIV” and “CoverAbbr” (figure below

Figure: PVT-ForTypIV-Cover Crosswalk example

PVT	FORTYPIV	CoverAbbr
OSW_fcw	TSME/ABPRSH	RF
OSW_fcw	TSME/PIAL	RF
OSW_fcw	TSME/PIBR	RF
OSW_fcw	TSME/PICO	RF
OSW_fcw	TSME/PIMO3	RF
OSW_fcw	TSME/PSME	RF
OSW_fcw	ABAM	RFWF
OSW_fcw	ABAM/ABPRSH	RFWF
OSW_fcw	ABAM/CHNO	RFWF
OSW_fcw	ABAM/PSME	RFWF
OSW_fcw	ABAM/THPL	RFWF

Otherwise, use the auxillary tool found within the DRQT tool to create a new crosswalk.

1. Open the data rollup tool, "DRQT" (Tools/DataDataRollup_Tools/DRQT/)
2. Select the "File" menu option at the top of the tool, then select 'Create ForTypIV to Cover table' (figure below)
3. For the 1st box, browse for and select the data rollup Db (Tools/DataDataRollup_Tools/DataRollup_Database/)
4. From the dropdown list, select PVT code
5. Specify a meaningful name for this table. For example, "WNE_CurrentCoverType_to_ModelCoverType_Crosswalk"
6. Select continue to create a template table, which is added to the data rollup Db
7. Close the auxillary tool and DRQT
8. Open the data rollup tool Db, then open the table you just created
9. For each PVT, assign a model cover type that most closely matches the current veg cover types (ForTypIV)

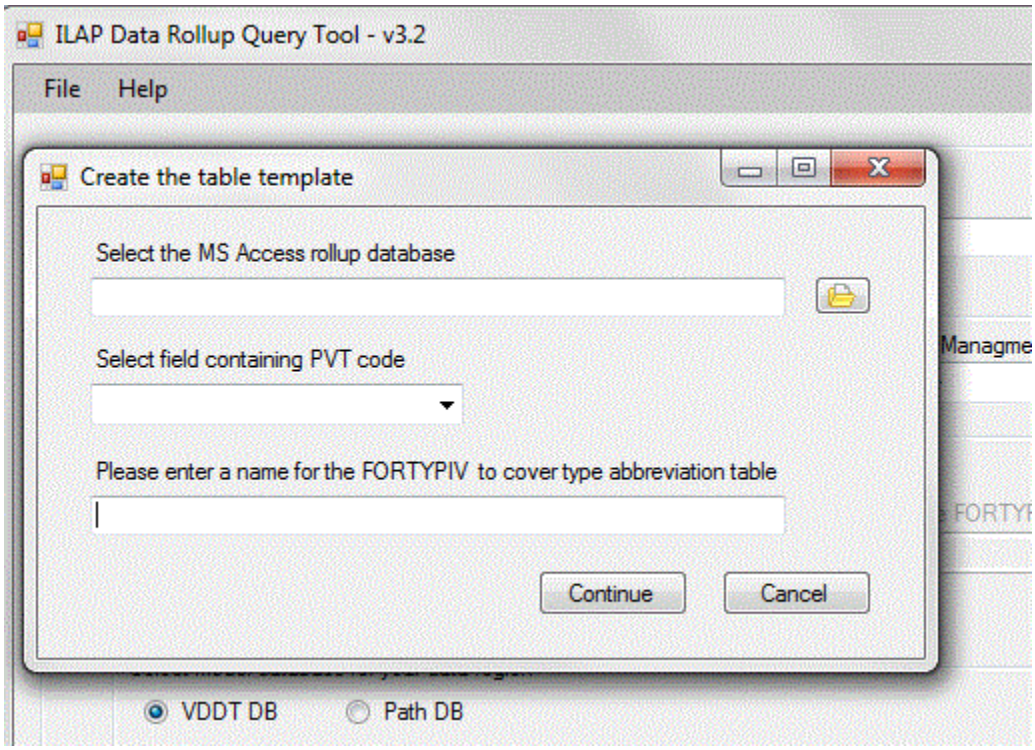
Additional notes on building this new crosswalk:

a. It may be easier to copy this table to Excel, filling it out and then copying back to the data rollup Db
b. "REMNANT" (<10% tree cover) and blank records (1 of each for each PVT) should be reclassified into the early-successional cover type.

Note: The assumption here is that the reproducing species is the dominant one in these cells, rather than the species that might be standing and forming the sparse canopy cover. For example, in the mountain hemlock model (OEC_fmh), one could assume that a remnant has been created by a wildfire disturbance and that the standing trees are those that are most resistant to wildfire, in this case, mountain hemlock. Also, maturing and mature lodgepole pine (the early successional species) would have been killed during the fire that produced the remnant. However, given the rule of thumb, the

correct cover type call is lodgepole pine because we would expect it to be regenerating in the site more successfully than the late seral species, mtn. hemlock.

Figure: Auxillary tool for creating a template crosswalk



Lumping Strata (optional)

ILAP uses the unique combination of 3 data layers (PVT, Ownership-Allocation and Watersheds) to create modeling strata. This may create many strata which are regarded as "too small". ILAP uses a threshold of <1,000 acres for distinguishing these small strata. Problems with modeling these small strata are:

- The precision of these strata is greater than the spatial accuracy of the underlying data layers, particularly the current and potential vegetation data.
- Low probability transitions may not occur, so states that would normally be represented on the landscape will not be modeled. ILAP refers to this as "unstable results"
- Path modeling software (versions 3.0 and 3.1) has an internal default minimum area ("total number of simulation cells" >1). If a modeled stratum is less than this, the software will still model the stratum but it will default to 100 cells. If the user chooses not to aggregate strata with our lumping tool then they should be aware that some of their area results will be simulated rather than actual.

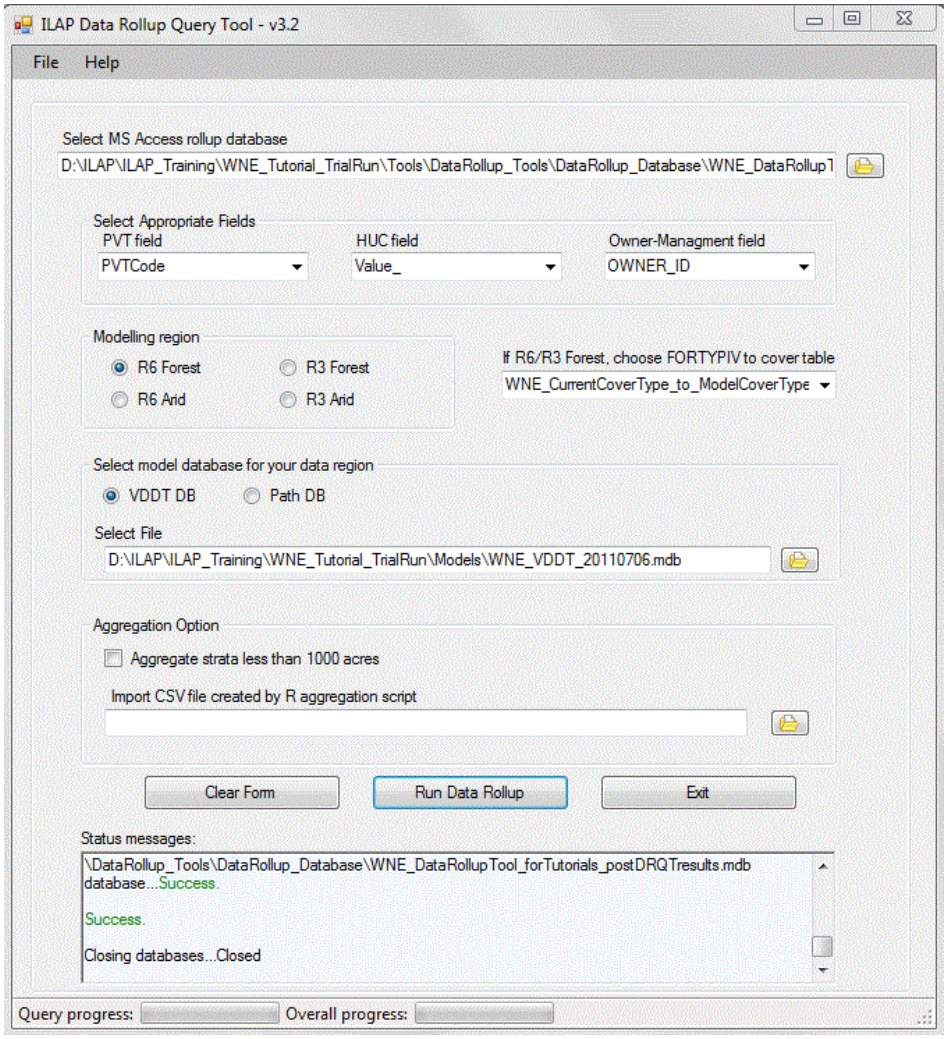
ILAP uses a tool that reassigns pixels from a small stratum (<1,000 acres) to a larger, similar stratum within the same HUC. This reassignment is based on similarities in PVT (using elevation, moisture regimes, species composition and ownership-allocation). When there is no reasonable reassignment, any remaining, small strata are excluded from the rollup into the Path Db. For instructions on lumping, see the Appendix-Advanced section at the end of this document.

Run the DRQT tool

The Data Rollup Query Tool (DRQT) performs several operations on the data generated from the GIS tool and contained in the rollup database. First it ensures that the set of PVTs in the GIS data contain a match in the VDDT model database. Next, DRQT joins all of the GIS attribute data so that all pixels have all input layer attributes. It then applies cover and structure crosswalks to the current vegetation classes (defined in the current vegetation (GNN) layer). The newly classified state classes are compared to those that exist in the VDDT model database. For Oregon and Washington (Region 6) forests, if no such state class exists, structural attributes are subjected to an iterative reclassification scheme until all pixels are assigned to a state class that exists in the VDDT model database. Pixels are then summarized by modeling strata and VDDT state class.

1. Open the data rollup tool, "DRQT" (Tools/DataDataRollup_Tools/DRQT_Tool/)
2. In the 1st box, browse for and select your data rollup tool DB (Tools/DataDataRollup_Tools/DataRollup_Database/)
3. From the dropdown lists under "Select Appropriate Fields", select the PVT field ("PVTCode"), the HUC field ("Value_") and the Owner field ("Owner_ID"). Note: these could be named something else. PVT field should be 7 characters, HUC should be 3 digit number, owner-Management should be 2 characters
4. For the Modeling Region radio buttons, select your model region (and if R6 forest, select the CurrentCover-to-ModelCover crosswalk that should now be in your data rollup Db)
5. Under the "Select model database for your data region option", 'VDDT DB' should be checked by default. If you are interested in rolling up data from a Path DB, refer to the Path DB rollup section in the advanced tutorial .
6. Under "Select File", browse for and select your VDDT Db (ModelingPackage/Models/)
7. Do not check the "aggregation" box unless you have lumped your strata (Instructions for this lumping process are in the appendix at the end of this document)
8. Select "Run Data Rollup". If there are errors, see the Troubleshooting section at the end of this document in the Appendix.
9. Confirm that the tool was successful by opening the rollup Db and making sure the following tables are populated with information from the models you are running: CoverType, StateClass, StructuralStage, tmp_importedICs, ztbl_initialConditionsRasterTable, ztbl_RawData, ztbl_reclassifiedSCs (and ztbl_StrataAggregation if you used the lumping process and checked the aggregation option in DRQT)
10. Close DRQT

Figure: The Data Rollup Query Tool (DRQT)



Create a Transitions Multipliers table

Transition multipliers can be used to adjust the probability of a transition occurring, ranging from deactivating the transition completely (multiplier of zero) to decreasing or increasing a transition rate by using a number between zero and one or greater than one, respectively. For the ILAP default “No Management” scenario, all management transitions were deactivated using a multiplier of zero. However, for many management situations, numbers between zero and to greater than one should be used to adjust the transition probability of a management event. The value of “1” should be used to simply “turn on” a transition with the same probability that is specified in the model. A transition multipliers table has been created for each model region package, follow the steps below to include this in your rollup database. If the Transition Multipliers is missing follow the steps in the Appendix to create a new table.

1. Open the data rollup Db in Microsoft Access (Tools/DataDataRollup_Tools/DataRollup_Database/<Your rollup database name>)
2. Import the Transition Multipliers Excel table (Models/Multipliers). The Transition Multipliers table must have the following structure:
    a. ID – a series of numbers from 1 to n+1 which span the entire list of transitions by PVT. (if not already existing, this can be added when you import the table from Excel back into the rollup Db by allowing Access to add a primary key)
    b. PVT – The PVT name. Each PVT name will be repeated in the table based on the number of probabilistic transitions in the model. Example: There are seven transitions in the oak-pine model in the CWLA (Y301op). Y301op will therefore be listed seven times.
    c. Transition Type – the name of each transition found in every PVT in the modeling region. Each transition type is unique within a PVT. This field name must have a **space between the words "Transition" and "Type"**.
    d. Management Codes – The remaining columns will contain two character codes for every ownership/allocation found within the modeling region **pre-lumping**. The names and number of columns (i.e. # of codes) should correspond to the owner-management codes in the "owner_all" table in the Rollup Tool database.
    e. Name the table TransitionMultipliers, or any other name that does not contain spaces

If the mask or spatial extent of your region is not the same as the ILAP region's GIS data, you will need to make sure the ownership-allocation fields exactly match the name and number of categories in the GIS data (as imported into the data rollup Db from the GIS tool).

1. Compare the "TransitionMultipliers" table with the ownall_final table (in the rollup database)
2. If an ownership type does not exist in ownall_final table , then delete extra ownership field from the TransitionMultipliers table
3. If an ownership type exists in ownall_final table and is not in the TransitionMultipliers table, then add this type as a new field
    f. Populate the new field with values (1s and 0s or other numbers)

Figure. Example of the TransitionsMultiplier Table

TransitionMultipliers

ID	PVT	Transition Type	b1	b3	b4	b5
1	OSW_ftd	HRDev	0	0	0	
2	OSW_fdm	RegHar	0	0	0	
3	OSW_fdm	Salv	0	0	0	
4	OSW_fdm	PCT	0	0	0	
5	OSW_fdm	PH.sm.hd	0	0	0	
6	OSW_fdm	PH.lg.hd	0	0	0	
7	OSW_fdm	PH.salv	0	0	0	
8	OSW_fdm	Plant	0	0	0	
9	OSW_fdm	PFNL	0	0	0	
10	OSW_fdm	PFSR	0	0	0	
11	OSW_fdm	USDev	1	1	1	
12	OSW_fdm	AltSucc	1	1	1	
13	OSW_fdm	GroCan	1	1	1	

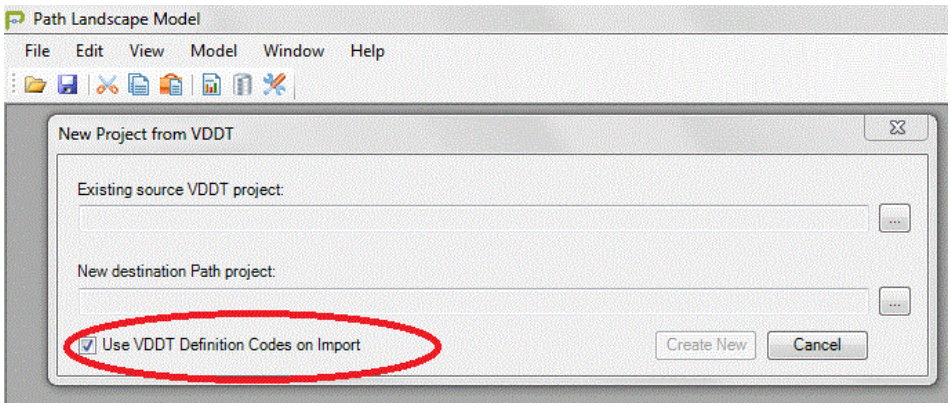
Monte Carlo Multipliers (MCM) file

VDDT and Path provide the capacity to incorporate stochasticity in model runs, such as yearly variation in the amount of area burned or onset and duration of insect outbreaks. To incorporate year-to-year variation, we created a stream of randomly generated sequences of multipliers that are applied to individual model simulations and select transition types. These sequences are called Monte Carlo multipliers and are generated using the MCM builder tool in VDDT for the desired number of model simulations. An MCM file has been created for each model region package (Models/Multipliers). You will be specifying the location of this file inside the Path Db in the next section of this document. If you intend to run models longer than 300 years (or 150yrs for arid models) or want to change the variation of the transitions in this file or want to add new transitions to this file, you will need to use the MCM Builder (Models/Multipliers /Build_MCM.exe) and the auxillary MCM files also found in this folder. Users should refer to VDDT documentation for more details on constructing a new MCM file.

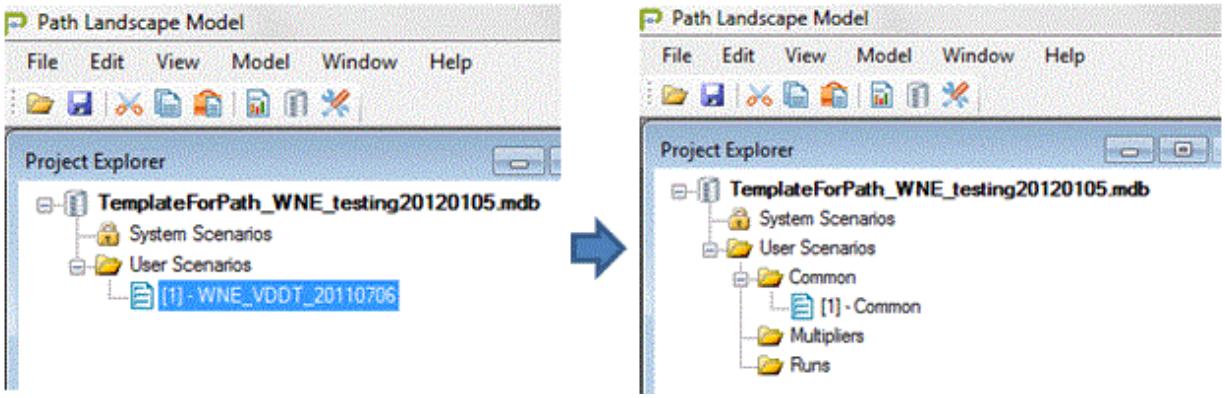
Template Path database

The template Path Db contains the models, imported from VDDT, folders used by the ILAP modeling process, and parameters specified in the Common scenario. Such a database has already been created for each region's modeling package and is available in the Model folder with a prefix of "TemplateForPath_". This database is then used to create a new Path database with multiple modeling strata and spatial information for each state within each stratum. If this template database is available, you may skip to the next section titled "Get into Path: The GIP Tool". If this template Db is not available or your models have been modified (i.e. new models added or new states added to a model) you will need to create a new template by following the steps below. For questions about how to create new folders and navigate in Path, refer to the Path help file.

1. Open Path software
2. Import VDDT models:
    a. Select "File"->"New"->"Project from VDDT"
    b. Browse for and select your VDDT Db
    c. Save a new Path Db with a "TemplateForPath" prefix (e.g. "TemplateForPath_WNE_Path_Forest_YYYYMMDD") into your Model folder. This will be used to create another Path DB in the GIP tool.
    d. Check the box, "**Use VDDT definition Codes on Import"**
    e. Select "Create New" to create this template Db



3. A scenario will be added to the project explorer with the name of your imported VDDT model database. Rename this scenario to “Common”. (Figures below)
4. Add the following sub-folders to the “User Scenarios” folder:
    a. Common
    b. Multipliers
    c. Runs
5. Drag the default scenario (which will be automatically created when you create a Path database from VDDT, and will be named as the VDDT database by default. You may rename it “Common” or keep the original name) into the ‘Common’ subfolder.



*note that the WNE_VDDT_20110706 scenario shown in the left window of the above figure is the same scenario as the one renamed Common in the right window. This scenario contains the models.

6. Double click on the ‘Common’ scenario and specify model parameters with the following information:
    a. Summary tab – leave this as is, unless you want to write notes in the author or description field
    b. General tab (figure below)
        i. Timesteps: ILAP forests=300 years, ILAP arid=150yrs

1. Note: regardless of length, the MCM file (discussed later) must be at least this long or greater or the MCM multipliers will not be applied for the full simulation length

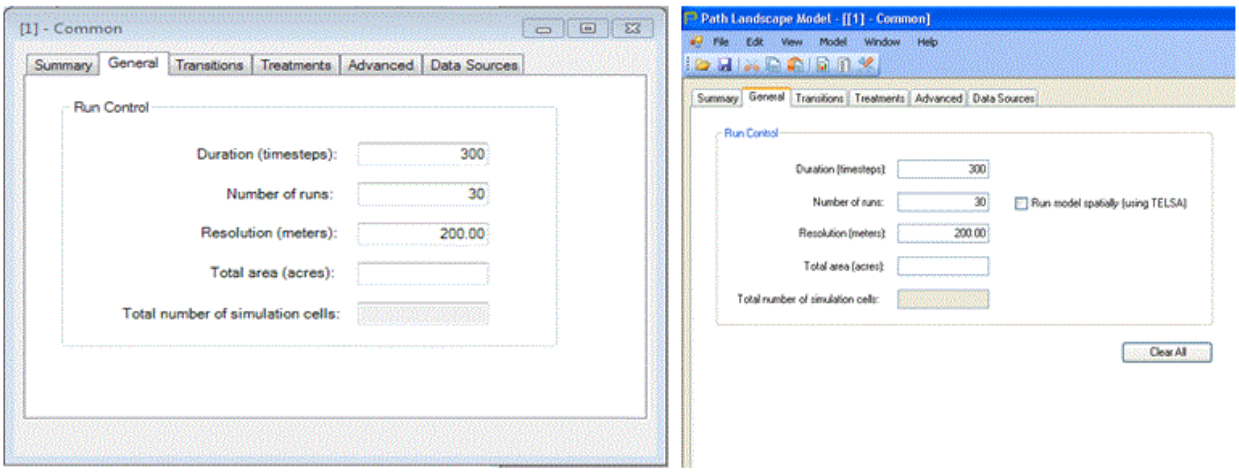
ii. Number runs (simulations):ILAP=30

iii. Resolution: ILAP=200 (approximately 10 acres)

iv. Remove any information from the "total area" field

v. **For tutorial data only:** *Change the # simulations in the Common scenario from 30 to 3 and duration to 100 years. Along with the tutorial's selection of just two watersheds within the WNE model region (created from the tutorial spatial data layer's "RegionMask_ForTutorial"), this will change processing time from 24+ hrs to approximately 30 minutes.*

Figure: Common-Scenario's, general parameters used by ILAP (v3.0 left, 3.1 right)



c. Transitions tab – This holds all the models; leave as is

d. Treatments tab – Make sure this is blank. Right click in the Treatment Details window to delete all, if necessary

e. Time Since Transition Groups – leave anything in this tab as is

f. Advanced tab

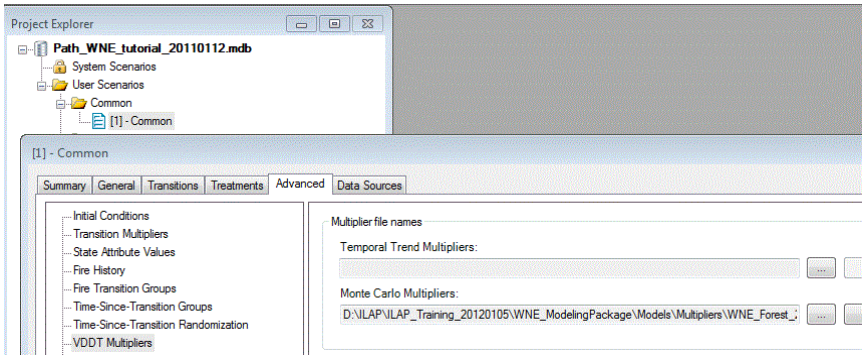
i. Make sure nothing is in Initial Conditions tab. Right click to delete all if necessary. If there are values, it is OK because the values within the individual modeling strata will take precedence over the values in the common file, when dependencies are created with the GIP tool (next section).

ii. Make sure nothing is in Transition Multipliers tab. Right click to delete all if necessary.

iii. We do not use state attribute values, but if something is listed here you can keep it or delete it

iv. We do not use fire history – right click to delete all, if necessary.

v. Fire transition groups are only used with fire history – right click to delete all, if necessary.
vi. If there is anything in the Time Since Transition Randomization, you can keep it or delete it.
vii. VDDT Multipliers (figure below)
    1. Add the Monte Carlo Multipliers (MCM) file to the VDDT Settings->VDDT Multipliers options window.



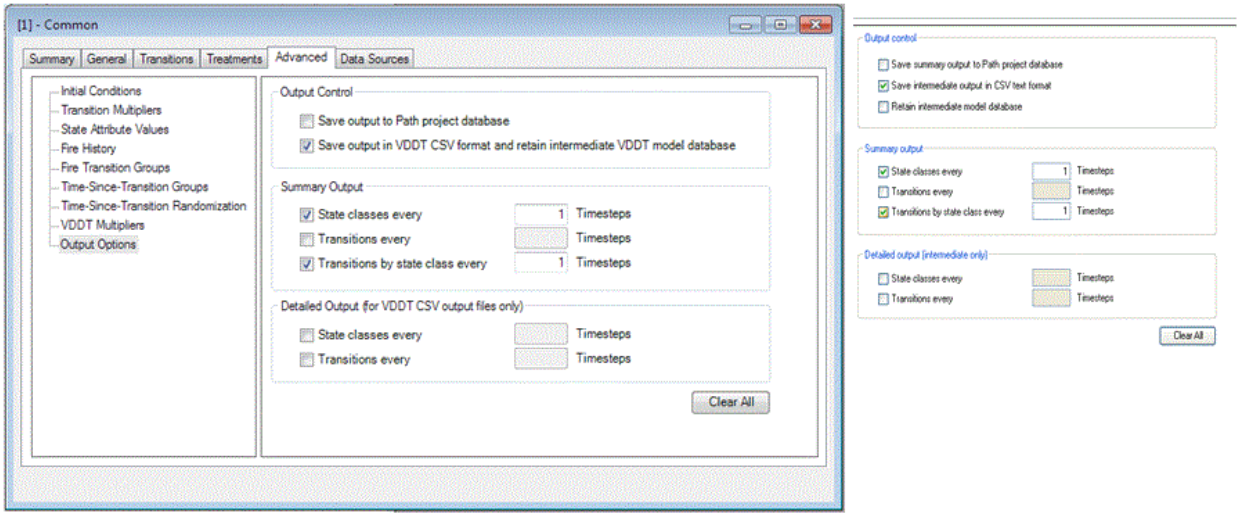
viii. Set the VDDT Outputs under **Output Options** (figure below)
    1. Output Control
        a. Save output in VDDT CSV format and retain intermediate VDDT model database (v3.1:"Save intermediate output in csv format")
    2. Summary Output
        a. 'State classes every' → Have Path write to file every 1 Timesteps
        b. 'Transitions by state class every' → Have Path write to file every 1 Timesteps

g. Data Sources tab
    i. This can be used to double check which parameters are in each scenario. Nothing needs to be changed here unless you catch an error

7. Set the output directory for output .csv files in the main window of Path under File-Preferences-VDDT-Folder for VDDT Model Output. Specify the Path_Output/Output_Date folder in the rollup file structure.

8. Save the Path database and close Path.

Figure: Common-Scenario's, Advanced-Output used by ILAP (v3.0 left, 3.1 right)

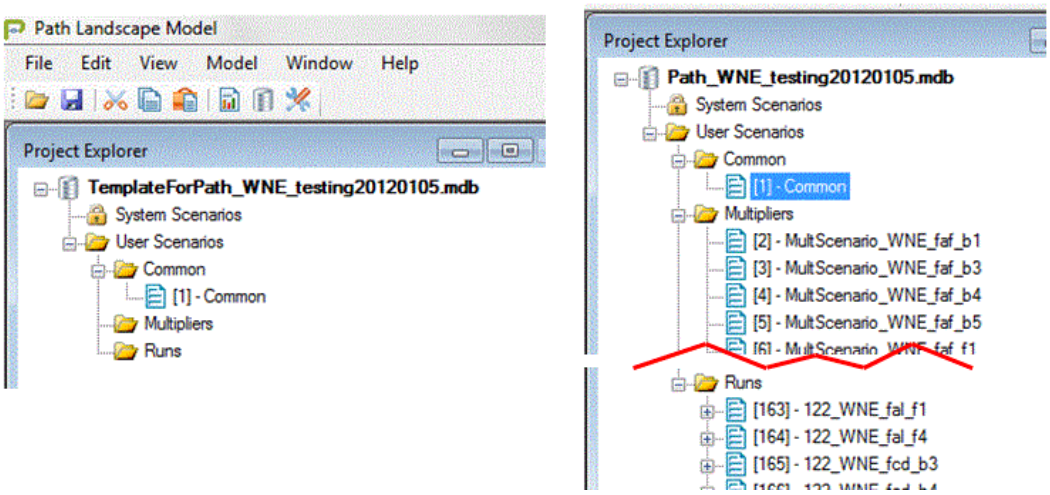


Get Into Path: The GIP tool

The next step in the modeling process is to use the Get Into Path (GiP) tool to populate the Path database that you will use to run the models (Figure below). This tool automatically uploads the strata (unique combinations of Watershed-PVT-Ownership) found in each modeling region (and which should now be in your rollup database) and their associated transition multipliers into Path. This creates in a Path Db:

- Individual Path Multipliers-scenarios
- Individual Path Runs-scenarios
- The dependencies between the Common-scenario, the Multipliers-scenarios and the Run-scenarios.

Figure: “TemplateForPath” Path Db vs. the post-GIP Path Db



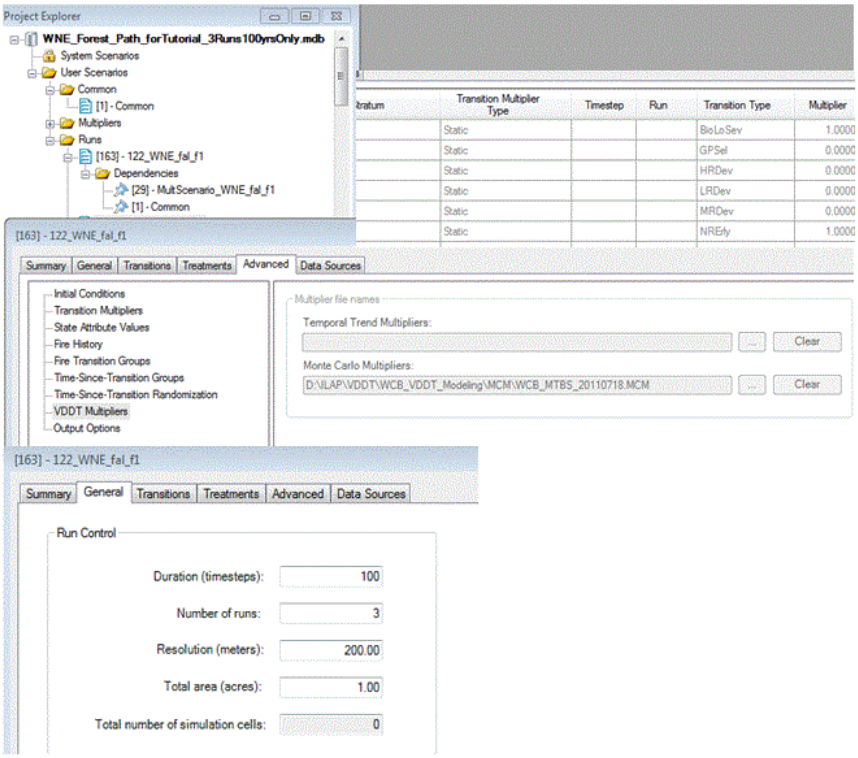
1. Open the GIP tool (Tools/GIP_Tool)
   a. Browse for and select the rollup database (Tools/DataDataRollup_Tools/DataRollup_Database/)
   b. Set the spatial resolution. ILAP data uses a resolution of 30 meters. This resolution requires the same resolution that was used in the Rollup GIS tool and should be the same as the resolution as your GIS data. It is extremely important to get the correct resolution, otherwise final acreages will be wrong.
   c. Select the management code field ("owner_id").
   d. Select the multiplier table (the newly-created, "TransitionMultipliers" in the Data Rollup Tool database).
   e. Select the file name and location of the existing or newly-created, Path template DB (e.g. Models/TemplateForPath_WNE_Path_Forest_YYYYMMDD).
   f. Select a name and location for your Path DB that will be created by the GIP tool. (e.g. Models/ "WNE_Path_Forest_YYYYMMDD")

Click 'Create Path Database'Figure: Get Into Path (GIP) tool

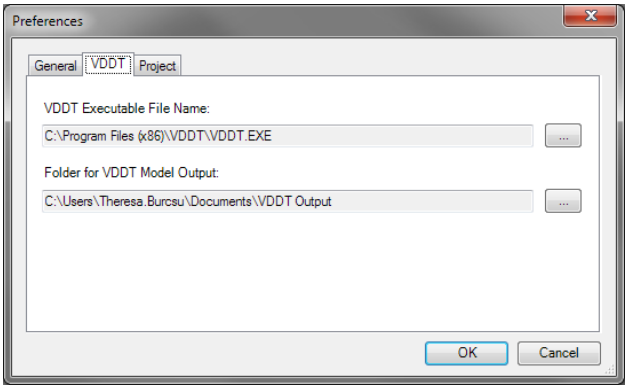
9. The GIP tool will have updated the rollup database by populating the tables, “tbl_InitCondScenarios” and “tbl_MultiplierScenarios” and have added that information to your new Path Db.
10. Close GIP and open the newly created Path Db (in the Path software)
11. Confirm that the GIP tool was successful by verifying the following:
    a. The MCM file and Output options have been set in the Common Scenario (and update if information is still missing).
    b. Transition multipliers exist in the Multipliers folder
    c. Modeling strata have been added to the Runs folder
    d. Dependencies for the Common file and the Multipliers have been added to the individual modeling strata. If you open an individual modeling strata in the Runs folder, you will notice that any values that are provided by dependencies are greyed out (figure below). This indicates that you can’t change these options within the modeling strata but must change the dependent files themselves: either the Common scenario or the strata-related Multiplier scenario. Also note that the general parameters of #runs, #simulations and resolution are not greyed out. This indicates that these values are not part of the Common scenario’s dependency and if you desire to make changes to those values, you must either rerun the GIP tool or change those values in every individual modeling strata. This also means that

changing the values in the Common scenario after the post-GIP PathDb has been created will not change the values in the individual modeling strata at runtime!

Figure: Path modeling strata with MCM location and multiplier values greyed out because they are part of a dependency (top). The general parameters are set within each modeling strata (indicated by black lettering).



12. Under File->Preferences, choose a new folder location for your scenario runs (e.g. Path_Output\Output_YYYYMMDD). Save your Path DB and close the software.
13. Make a backup copy of your newly-created Path DB (e.g. “Path_...._backup.mdb”). This is so that if there are errors in running Path scenarios, the user can discard this “polluted” Db and recopy the from the backup Db.

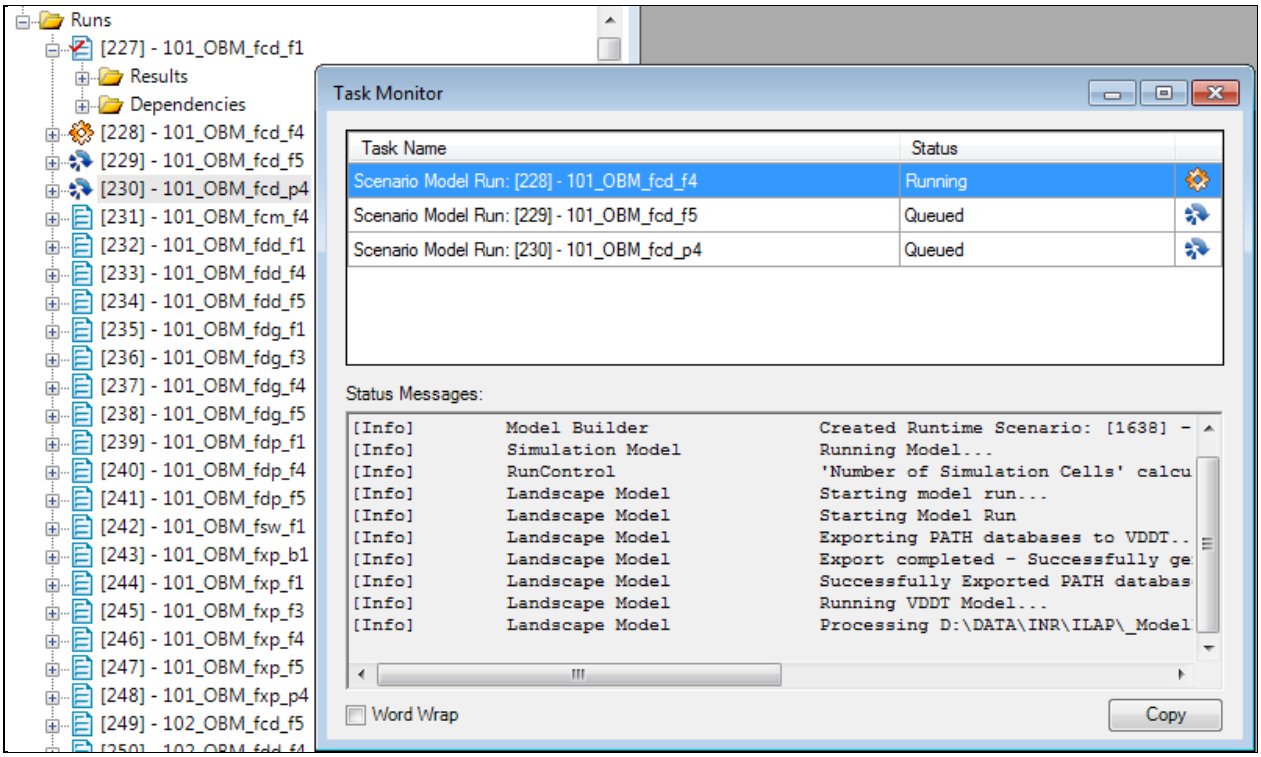


Running models in Path

Your Path Db should now be ready for running simulations. Because of the size of ILAP model regions and the number of strata that need to be run this process will likely take several days. The results are written to hundreds of individual output folders which will need to be merged together before viewing the results for the entire region. If you are OK with running the full set of strata in your Path Db, then follow the steps below. In Path 3.x there is a memory leak which will cause Path to crash during a model run if the steps below are not exactly followed. It is unknown whether this issue was resolved for Path 4.x

1. Reboot your computer.
2. Open Path.
3. If you haven't done so already, make a backup of your Path Db, set the output directory, the location of the MCM file and save the Path Db.
4. From the Runs folder, select up to 300 run scenarios at a time that you want to run, right click and select "Run". In the example, 3 scenarios have been selected. One scenario [227] was run already and has a check mark by it.

   Figure: The Path Explorer and Task Monitor showing scenarios being run.



5. Save your database after these 300 scenarios have been run and close the software. Shutdown your computer, restart (cold-boot) and re-open Path.

6. Select the next 300 scenarios and run. Repeat these steps 5&6 until all scenarios have been run.

7. If there was an interruption at any point in the scenario runs, you need to be aware that Path may try to run several scenarios before stopping. Check the previous output files and delete the Results file from the Results folder for theaborted runs. These aborted run files should also have an “exclamation” icon next to their file names in Path. Make sure these aborted scenarios are also deleted in your file system (the output folders containing the .csv output within Windows Explorer). Otherwise, the summarization tool (next section) will not work.

8. After running models in Path, the database size will expand dramatically. This is occurs even if you do not save results inside Path. After a complete run, you should always open the Path Db and choose Manage>Compact and Repair. This will de-fragment your Db and reduce the size. For example, the tutorial Db went from 300MB to 40MB after compacting. You can optionally change a setting in Access to automatically “compact and repair” every time a Db is closed.

Summarize outputs in R

Output from the Path model runs is saved outside of the Path interface as comma separated variable (csv) files. There is both a transitions summary and a states summary csv file created as output for each of the Run-scenarios, which means there could be hundreds to a thousand-plus files that a user must manage and view the results for. This step combines the output from each of the run-scenarios into a single csv file.

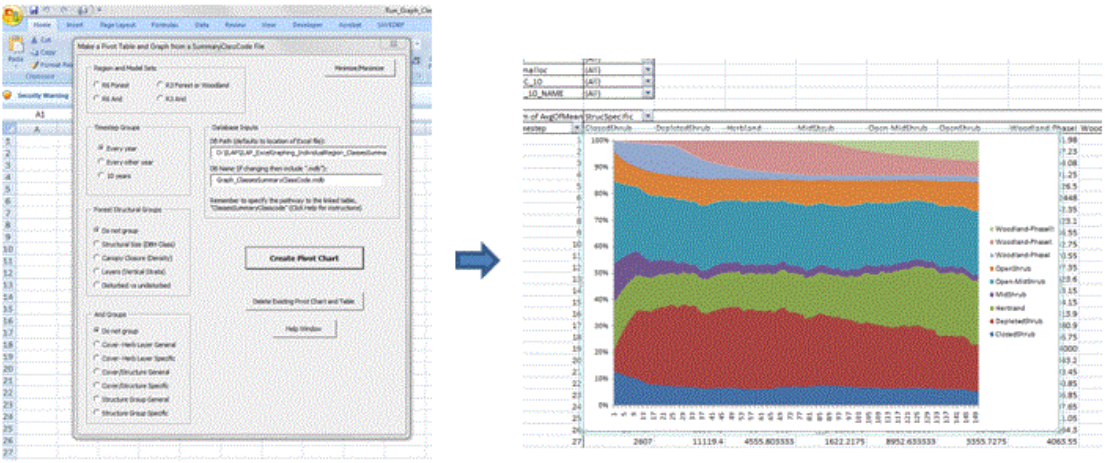
1. Close the Path project.
2. Launch the R program
3. Install the package in R from the menu item: Packages > Install from local zipped file. Navigate to the Tools\Summarization_Tool\RCode folder and select the SumPath_0.10.zip file.
4. Copy the following lines of code into Notepad (or any text editor) and change the two pathways to match the directory and file names on your computer. Make sure to change any single backslashe (from Windows file system) to two backslashes or one forward slashes in the paths you just inserted. The example below uses two backslashes. Keep the quotes around the pathname for the output folders and Path database.

```
library(SumPath)
setwd("D:\\DIRECTORY_PATH_CONTAINING_YOUR_PATH_OUTPUT_FOLDERS")
scenariolist<-GetLinks("D:\\FULL_PATH_TO_YOUR_PATH_DATABASE")

SummarizeScenarios(scenariolist, tablename = "ClassesSummary.csv",
sumcols = "ClassCode", replace.existing = F, quiet = F, return.to.r =
F)


SummarizeScenarios(scenariolist,tablename =
"TransitionsByClassesSummary.csv", sumcols = c("TransTypeCode"),
replace.existing = F, quiet = F)
```

5. Select all (ctrl+A) and copy (crtl+C)
6. At the R command line, paste this code (Ctrl+V) and enter to run
7. The code will pause almost immediately and normally you should just press <enter> to proceed. This code automatically deletes data from previous summarizations so it pauses to allow you to change your mind and either change your pathways or save this previously summarized data somewhere else.
8. A summarized output file for both transitions ("TransitionsByClassesSummaryTransTypeCode.csv") and states ("ClassesSummaryClassCode.csv") will be created in your Model_Output/ Output_YYYYMMDD folder. This process may take a couple hours for an entire model region. For the tutorial results, this will take approximately 10 minutes.
9. To see help on the SumPath package, type `help(SumPath)` at the R prompt

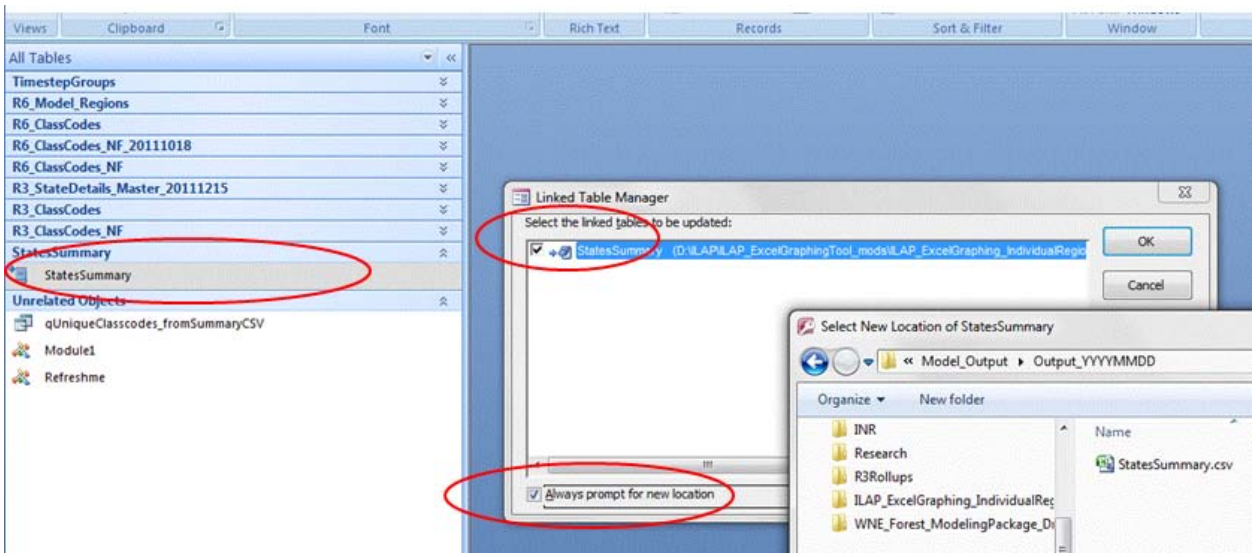
Graph the Classes Summary file in Excel

Path allows the scenario results for state classes to be written to an individual csv file. However, once these individual csv files are summarized into a single csv file, they may be too large to open in Excel. Also, only the most basic information is supplied in the summarized csv file. There are no descriptive fields or fields that allow a user to group the summary results for more meaningful interpretations. This Excel-based graphing tool allows the user to graph the results (or grouped results) of the summarized csv file in Excel.

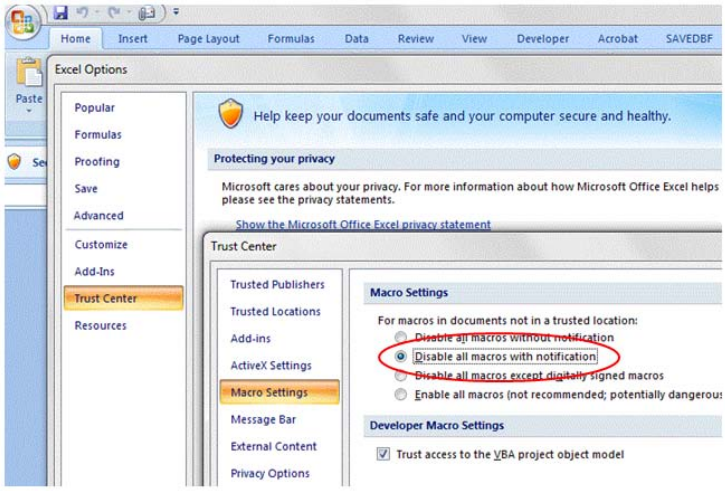


Follow the steps below or the powerpoint readme file for instructions on using this tool.

1. Rename your summarized class code file from Model_Output/ Output_YYYYMMDD/ “ClassesSummaryClassCode.csv” to “StatesSummary.csv”. Alternatively, you can also make a copy of the summary file and move to any location on your computer before renaming to “StateSummary.csv”.
2. Open the graphing tool database (Tools/SummaryGraphing_Tool/). This Db contains the summarized csv file, tables that link summary codes with descriptive names and the pre-built queries, which Excel runs to create the pivot table.
3. Reset the location of the linked summary table to the newly-generated, summarized csv file in your Path_Output folder
    a. Right click on the StateSummary file and choose Linked Table Manager
    b. Check both boxes in the LTManager window (figure below) and browse and navigate to your new file.

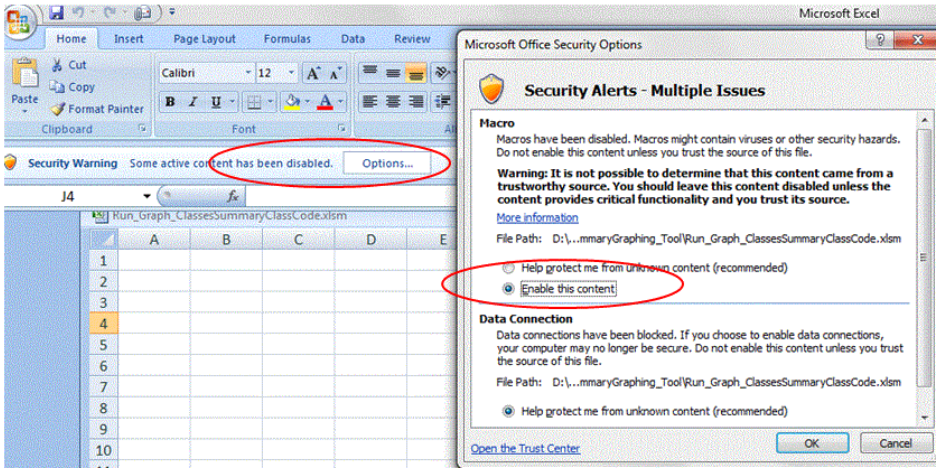


4. Open the Excel graphing tool (Tools/SummaryGraphing_Tool/Run_Graph_ClassesSummaryClassCode.xlsm)
5. When this tool is first opened, a form provides the user chooses such as region of interest, timestep intervals and the type of grouping. However, if this form does not automatically open, security settings need to be changed in Excel:
    a. Excel OfficeButton(top left)>Excel options>Trust Center> Trust Center Settings>Macro Settings>Change to disable macros with notification (Figure below)("Enable all macros" would be preferable so you won't have to keep re-doing step 6 every time you need to run the tool. However, there may be a slight risk of exposure to malicious macros if a user was to download an Excel file from an unknown source.)

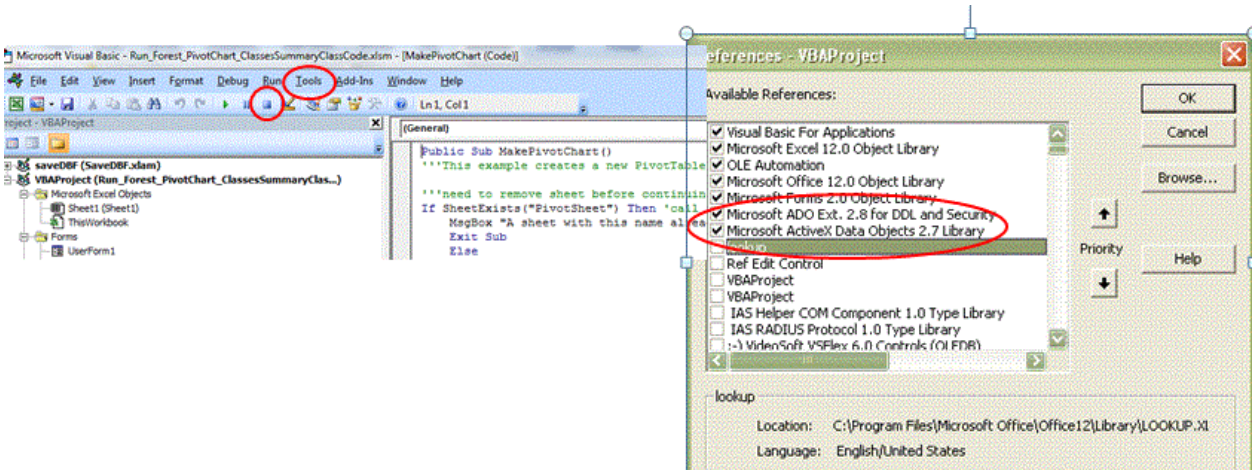


6. Save the Excel file, close and re-open. If the form still does not open:
    a. Select "Options" from the security ribbon

b. Select “Enable this content” and OK. The form should now pop-up automatically (but you will probably need to re-do this step every time you open this Excel file).



7. Select the options for this tool and choose “Create Pivot Chart” to run. If there are errors, then it is likely that some “references” need to be loaded in Excel (figure below)(this will be a one-time update to the Excel software (not the specific file) on your computer):
   a. In the VBA module, Select Tools->References
   b. If there are references at the top of the dialog box that are checked but begin with “MISSING…”, then uncheck them before proceeding.
   c. Browse for and check the following to references
   d. Microsft ADO ext. 2.8 for DDL and Security (or highest version)
   e. Microsoft ActiveX Data Objects 2.7 Library (or highest version)
   f. Click OK
   g. Then Save and close Excel , then re-open and rerun the form



8. Once the tool is run, a pivot table is built in Excel and a graph is automatically generated based on this table. This pre-built graph can be changed to suit the user’s needs based on any of the

information available in the pivot table. For example, results can be filtered by watershed or PVT. Also, a new chart of a different type can be built from the pivot table.

9. Save this pivot table and chart as a new sheet in the graphing tool or as a new Excel file. The next time the tool is run, it will ask you to delete the previously-created pivot sheet.

Additional graphing notes

Confirm that all your results are being reported by examining the summarized area (far right column in the pivot table beneath the chart) across all timesteps. If the area changes (by more than a few acres) then it is possible that the master codes crosswalk (r6_classcodes, r6_classcodes_nf, r3_classcodes or r3_classcodes_nf) inside the graphing database (e.g., Tools/SummaryGraphing_Tool/ Graph_ClassesSummaryClassCode.mdb) does not contain the entire list of states used by your models. Add new records to the crosswalk to rectify this error. This will only occur if you or someone else has added new states to the ILAP models (that were completed at the end of 2011).

If you want to use different groups from what is currently available in the "ClassCodes" tables, then replace the values in one of the grouping fields with your own. Do not change the name of the field. The grouping fields are at the end of each master codes table.

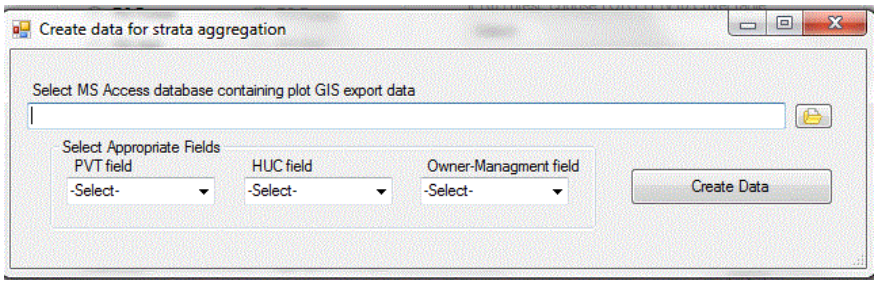
Appendix-Advanced Section

Lumping Strata (optional)

Our state-and-transition models do not yield stable results when the number of pixels in a modeling stratum (run-scenario) is too small. Wherever possible, we reassign pixels from a small stratum (<1,000 acres) to a larger, similar stratum within the same HUC. This reassignment is based on similarities in PVT (using elevation, moisture regimes, species composition and ownership-allocation). When there is no reasonable reassignment, any remaining, small strata are excluded from the rollup into the Path Db.

Create a template strata aggregation table

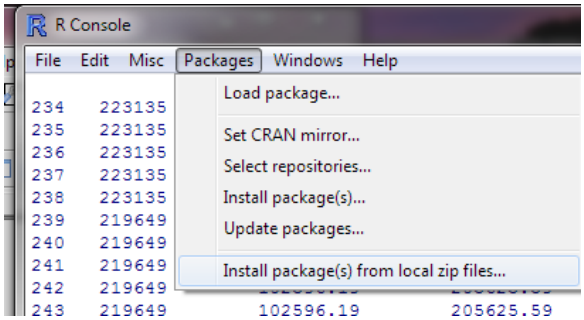
1. Run the auxillary tool within DRQT to generate a strata table for aggregation (lumping). In this new dialogue box (File > Build strata table for aggregation…):
    a. Select the rollup database (e.g., DataRollup_WNE_YYYYMMDD.mdb)
    b. Select the PVT field ("PVTCode" in R6), the HUC field ("Value_") and the Owner field ("Owner_ID")
    c. Select "Create Data"
    d. This creates a table,"tbl_rollupStrata" that is later referenced in the R-code, "LumpStrata".



To lump fragments we have two methods. One method is used for the Pacific Northwest only at the writing of this document, and the other is used only for the southwest Region 3. Both methods create a "strata aggregation table".

Region 3 Lumping: Lumping with the LumpStrata library in R

1. Install the LumpStrata package in R using the Packages menu > Install package(s) from local zip files…



2. Access the LumpStrata functions by loading the library

   > library(LumpStrata)

   > help(LumpStrata)

3. Set your working directory

   ```
   > setwd("D:/WORK/ACP/Lumping")
   ```

4. Load the R3 data included in the package for the `pvtindset` and `mgtindset`

   ```
   > data(mgtindset.forest)
   ```

   or

   ```
   > data(mgtindset.woodland)
   ```

   or

   ```
   > data(mgtindset.arid)
   ```

   and

   ```
   > data(pvtindset)
   ```

5. Import the strata table to R from the rollup database to the object "StrataTable". Make sure that you include the path to <u>your</u> rollup database.

   ```
   > StrataTable<-
   GetStrataTable("D:/temp/NRM_Forest_dataRollupTool_v3061711.mdb") #
   ```

```
change the directory to match your directory structure and the name
of your DataRollup database
```

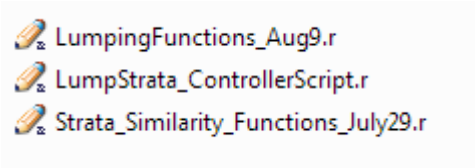
6. To see what the R3 index sets look like, use the `PrintSimMat` function

```
> PrintSimMat(mgtindset.forest) or
> PrintSimMat(mgtindset.woodland) or
> PrintSimMat(mgtindset.arid)

> PrintSimMat(pvtindset[grepl("AMT",pvtindset[,1]) & grepl("AMT",
pvtindset[,2]),])[[2]]  # customize for your region by replacing
"AMT" with your modeling region code.
```

7. Finally, execute the lumping function, LumpStrata. The only thing that you may wish to change at this step is the output .CSV file name.

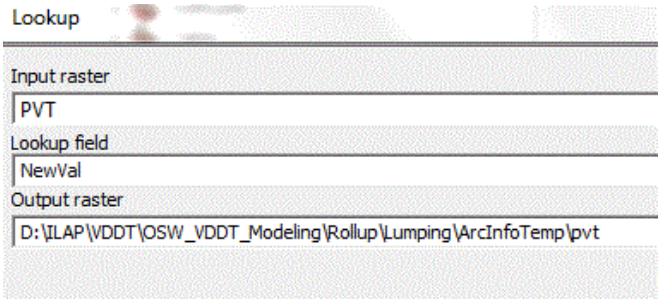
```
> LumpStrata(StrataTable,pvtindset,mgtindset.xxxx, outfilename =
"temp.csv") # use the mgtindset that matches your model type (arid,
forest, woodland)
```

Region 6 Lumping: Lumping with the Lumping functions in R



1. **Lumping**: lumping using Emilie's lumping codes that will require you to navigate to ArcInfo and ArcGIS world. This produces the *strata aggregation table* referenced in the VDDT Data Rollup Tool Step 3.
    a. GIS Directory and Files
        i. Create an ArcInfo workspace (directory) for ArcGIS Grid files (e.g. Rollup\Lumping\ArcInfoTemp)
        ii. In ArcMap, add the PVT grid from your rollup DB
            1. add a new field (e.g. "newVal" and copy the ObjectId values to this new field (so that the new field has consecutive #'s from 1 to the # of PVTs)
            2. if there are PVT codes that are "na" (or otherwise not used in VDDT), recode these values to zero.
            3. Open the table for the grid and export this as a dbf, "pvt_lut.dbf" to the "lumping" folder
            4. use the Lookup tool (Spatial analyst tool>Reclass>Lookup) to create a new grid based on this new value field, saving the ouput raster as, "pvt"

to your ArcInfo workspace in the “lumping” folder



iii. Export a DEM (does not need to be clipped to model region) to a Grid into this workspace as, “dem”

iv. Add the GNN Basal Area attributes table (Rollup\Databases\R6_GNN_BasalArea.mdb) and join to the fGDB’s GNN layer

Note: If you are using the full GNN table (GNN_attributes.dbf) to the GNN grid, you will need to remove the duplicate field, “Imap_Layer_1” and copy and overwrite previous GNN grid. It’s also possible that you’ll have to remove other fields if the list is too long. In this case, keep the *_BA fields. You can use the ArcTool Data Management Tools > Fields > Delete Field to drop multiple fields.

v. Export this joined GNN layer to a Grid into this workspace as, “gnn”

vi. Add the AML files, pvt_gnn.aml and cleanupdir.aml to this workspace if you haven’t already.

b. Create the Species Matrix (“pvt_gnn.csv”)

Note: The R code uses the basal area (*BA) fields in the GNN table to create the species matrix.

Purpose: The species matrix supplies information on the kinds of vegetation that are found in each PVT and uses this information to help identify similarities in the lumping process.

i. Add the pvt_gnn.aml and cleanupdir.aml AML files to the Rollup Strata folder (see image below)

ii. Create a csv file based on the “pvt_lut.dbf”
   a. Open the dbf and delete all fields except the PVTCode and your newly created, new value field
   b. Delete the records with zero values (i.e. “na” PVTs)
   c. Save this as a csv in the same folder (e.g. “pvt_lut.csv”)

iii. Navigate to this new, ArcInfo directory within an ArcInfo command prompt and then run the first aml by typing, “&r pvt_gnn.aml [pvtgrid] [gnngrid] [#ofPVTs in your region]” (e.g. “&r pvt_gnn.aml pvt gnn 4”) (see document, “readme-pvt_gnn.aml” for detailed instructions)…this creates a species matrix for each PVT as the first of 3 parts for determining similarity between PVTs

c. Create an Environmental Similarity matrix (“pvt_attributes.csv”)

Purpose: The ES matrix helps identify similar PVTs in the lumping process using the elevation range extremes determined through zonal statistics analysis in GRID. This matrix contains information that is used in developing an index of similarity among all of the PVT's present in a given modeling region. The file 'pvt_attributes.csv' contains information that is used in developing an index of similarity among all of the PVT's present in a given modeling region.

i. Store the ES matrix in a file called 'pvt_attributes.csv' (see "readme-pvt_attributes.txt" for the detailed instructions).
ii. Copy and paste the "template_pvt_attributes.csv" (e.g. pvt_attributes_WNE_YYYYMMDD .csv) and the pvtcode value from your region's pvt_lut.csv into the first field. Generate and export the elevation min and max for each pvt in the PVT grid in ArcWorkstation, using the ArcInfo commands below:

```
a. > w YOURWORKINGDIRECTORY
b. > Grid
c. > summary1.dat = zonalstats(pvt,dem)
d. > quit
e. > infodbase summary1.dat summary1.dbf
```

iii. Use the summary1.dbf to fill in the "ElevMin" and "ElevMax" values in your region's "PVT_attribute.csv" file (or estimated by the user if either PVT map, or elevation map is missing) **Important Note**: The summary1.dbf gives output related to the PVT Grid values whereas the ID's from the VDDT DB are automatically assigned to the PVT's as they are imported into the DB. You must find the PVT_code that corresponds to the Grid values (presented in the Summary.dbf) and match those to the PVT_code-to-VDDTId shown in the pvt_attribute.csv.
iv. Classify each PVT into a moisture class (dry, intermediate, mesic, or wet) and fill in the Moisture field in the PVT_attribute.csv file
v. Have this table reviewed by Miles Hemstrom or someone familiar with the PVTs.

d. Identify the management treatments in the "management_attributes.csv" table as the third part of the lumping process by placing a 0 (does not occur) or a 1 (occurs) under the treatment.
    i. Copy and paste template_mgt_attributes.csv (e.g. mgt_attributes_WNE_YYYYMMDD.csv). Identify the management treatments in this new table as the third part of the lumping process by placing a 0 (does not occur) or a 1 (occurs) under the treatment field.
e. Lump your strata based on the files just created
    i. open the R-code named "LumpStrata_ControllerScript.r" and change file and folder names before running:

1. main.wd<-"AddPathHere/Lumping"
2. pvt.wd<-paste(main.wd,"/AddArcInfoWorkspaceHere"
3. ch1<-odbcConnectAccess("AddPathHere/Rollup/Databases/AddInitCond-DRT.mdbHere ")
4. StrataTable<-sqlFetch(ch1,"tbl_rollupStrata")(this is the table created by DRQT)
5. pvtlut<-read.csv("ChangeNameHereForpvt_lut.csv")
6. outfilename<-"ChangeNameHereForStrataTable.csv"
7. pvt.attributes<-read.csv("ChangeNameHereForpvt_attributes.csv")
8. mgt.attributes<-read.csv("ChangeNameHereFormgt_attributes.csv")

ii. This will create a new file (e.g. "StrataTable_WNE_YYYYMMDD.csv") that will be used in the Access rollup process. This is the strata aggregation table.

iii. Repeat this step 3-4 times (adding an iteration number to the file name) and make sure the number of records is the same across runs If record number is the same across files then you can delete the extra file iterations, if not refer the problem to Emilie Henderson.

Create a new multipliers table

To create a new Transition Multiplier table, follow the steps below:

1. Create a new table ("tempTransitionMultipliers ") from a query in your VDDT database. Set the query to View SQL and enter the following statement. This creates a 3-field table consisting of the PVT, transitions, and multipliers:

```
SELECT Project.Name AS PVT, ProbabilisticTransitionType.Name AS [Transition Type],
ProbabilisticTransitionMultipliers.Multiplier INTO tempTransitionMultipliers FROM (Project INNER JOIN
ProbabilisticTransitionType ON Project.ProjectID = ProbabilisticTransitionType.ProjectID) INNER JOIN
ProbabilisticTransitionMultipliers ON ProbabilisticTransitionType.ProbabilisticTransitionTypeID =
ProbabilisticTransitionMultipliers.ProbabilisticTransitionTypeID;
```

2. In this temporary multiplier table, convert any fractional multipliers to 1, using an update query: (R3 forest, woodland and arid lands use multipliers other than 1. If you change these without knowing what you're doing, you could accidentally change the models a lot. Multipliers should only be changed to 1 if R6 models included these fractions into the probabilities for that transition. The purpose for doing this in R6 is so that R6 models will only have 1s and 0s in the multipliers field as this is used to turn on and off management multipliers rather than being used to adjust base probabilities.)

```
UPDATE tempTransitionMultipliers SET tempTransitionMultipliers.Multiplier = 1 WHERE
(((tempTransitionMultipliers.Multiplier)>0));
```

3. Export the resulting table to Excel format, saving it in your GiP folder, and open the table in Excel.
4. Open the DRT database and open the "ownall_final" table.

5. Copy the field of owner codes from the database and paste them into your newly exported table of PVTs, transitions, and multipliers in Excel.
6. Re-copy the list of owner codes (in Excel) and use Paste Special to transpose the list as column headings in your open spreadsheet, as is pictured in the table below.
7. Copy the multiplier values across all rows for all ownership fields
8. Delete original, multiplier field

Import this table into the DRT DB (as a table, "TransitionMultipliers") and **allow Access to add primary key field called, "ID"** (see field descrips and image below)

Troubleshooting

Resolving Errors in DRQT

Two errors may occur at this point. First, the structural codes in the VDDT DB may not match the structural codes in the rollup DB. Second, after lumping your ForTypIV-Cover crosswalk may not match.

- Error#1: Structural codes not matching. You'll need to update the DRT database to match your VDDT database and the **R6_codes** master database of codes
  - Import the MasterStructureCode table from the R6_Codes DB (in Lumping/Databases)into your VDDT DB
  - Create the query shown below to identify the missing records in the Initial Conditions DB
  - Add these values to the rollup DB

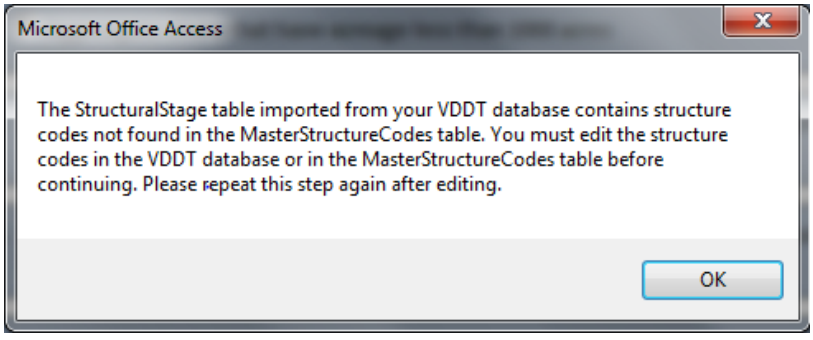
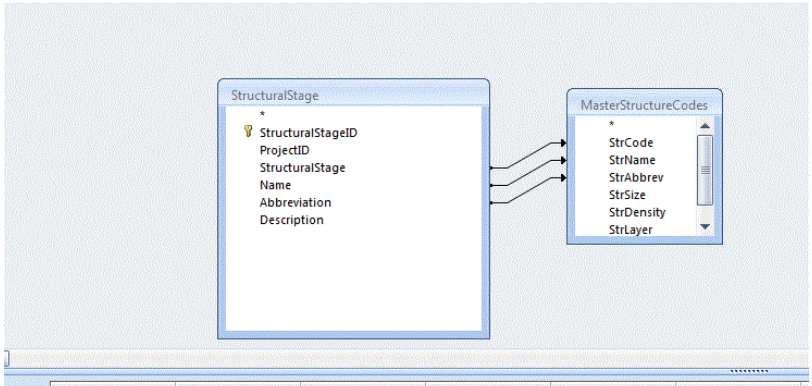
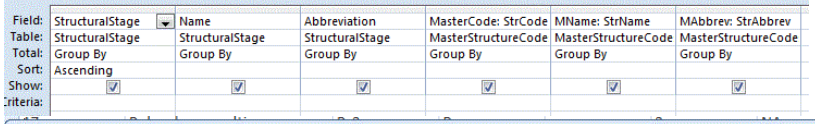


Figure 6. Error message that will appear if your DRT database does not have all of the structure codes found in your VDDT models.





Field:	StructuralStage	Name	Abbreviation	MasterCode: StrCode	MName: StrName	MAbbrev: StrAbbrev
Table:	StructuralStage	StructuralStage	StructuralStage	MasterStructureCode	MasterStructureCode	MasterStructureCode
Total:	Group By	Group By	Group By	Group By	Group By	Group By
Sort:	Ascending					
Show:	☑	☑	☑	☑	☑	☑
Criteria:						

Figure 7. Used this query to identify missing structure codes in the DRT MasterStructureCodes table

FindMissingMasterStructureCodes

StructuralSt	Name	Abbreviatio	MasterCode	MName	MAbbrev
15	Pole_multi_PostDist	P2p			
16	Pole_med_multi	Pm2			
17	Pole_close_multi	Pc2			
23	Smtree_multi_PostDist	S2p			
49	Meadow	Me			
5	Shrubs_PostD	SHp			
51	Moderate residential development	MDV			
8	SSap_med	Ym			
1	Barren	B	1	Barren	B
10	Pole_open_single	Po1	10	Pole_open_sin	Po1
11	Pole_single_PostDist	P1p	11	Pole_single_Pc	P1p
12	Pole_med_single	Pm1	12	Pole_med_sing	Pm1
13	Pole_close_single	Pc1	13	Pole_close_sin	Pc1

Figure 8. Example of missing structure codes

- Error#2: Missing entries in ForTypIV-Cover crosswalk (Forests only).
    - After lumping, this crosswalk may have new conditions that were not found in the initial crosswalk. The current workaround is to add these manually, each time DRQT throws an error:
        - Run DRQT to get an error message that states the missing ForType-Cover record found within a specific PVT
        - Copy the original crosswalk (in the data rollup DB) and rename this as a backup file (e.g. "…Crosswalk_PreLumping")
        - In your crosswalk table, create a new record with the PVT code and ForTypIV value from the error message. Add a cover value from your options for that PVT.
        - Rerun DRQT and repeat these steps until you stop getting error messages (for southwest OR, there were 25 new records that needed to be created after lumping)