Exercise 8 – A Simple Model - Last modified on 03/18/2014

Within this document, the term NHDPlus is used when referring to NHDPlus Version 2.1 (unless otherwise noted).

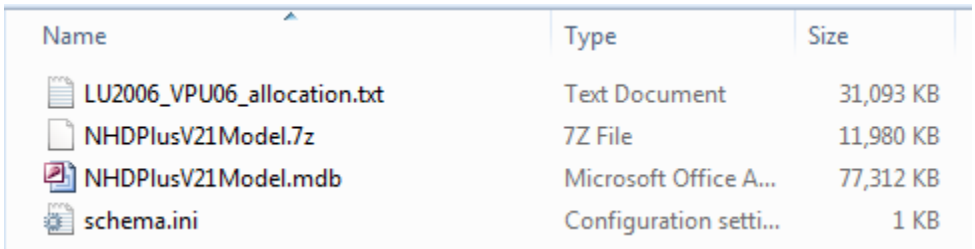
Installing the Model:

This exercise requires Microsoft Access. It has been tested with Access Versions 2003, 2007, 2010 and 2013. It has also been tested over a local network. Running the model does not require a working knowledge of Access; the model is totally menu-driven. At this time, Exercise 8 can only be run on VPU 06, primarily because the model requires the allocation of the 2006 land use data, which has been done expressly for this exercise.

Notes for Access 2013: Access 2013 does not support Dbase files (.dbf). The NHDPlus data tables are .dbf files, which means that loading and exporting as .dbf files is not possible. Step 1, "Loading the Data", cannot be run in Access 2013.To enable this exercise to be run in Access 2013 the NHDPlus data comes pre-loaded. Note that all users of this exercise can skip Step 1. Step 7, "Export Model Results" has options for exporting to a .dbf file or to a .txt file. Access 2013 users must export the results to a .txt file and all other users should export to a .dbf file. The model results in.txt format perform very poorly in ArcMAP. Therefore, Access 2013 users should first load the .txt file into ArcMAP, export it as a .dbf file, and then load and use this .dbf file in ArcMAP.

Follow Exercise 6 to download and install NHDPlusV21 VPU 06. NHDPlusAttributes and EROMExtension need to be installed. NHDSnapsot is needed to display the model results in ArcGIS.

Create a directory for the model, e.g., "C:\NHDPlusV21Model". Download the model into that directory. Download the model from the NHDPlusV2 documentation page http://www.horizon-systems.com/NHDPlus/NHDPlusV2_documentation.php. Save the model into the NHDPlusV21Model directory. Unzip the model into the NHDPlusV21 model directory. The directory should look like this:



Model Description:

NHDPlus is, among its many other attributes, an excellent **integrated** system for the development of water quality and hydrologic models. This exercise shows how easy it is to build a basic modeling system. It takes advantage of the Value Added Attributes, in particular the HYDROSEQNO, FROMNODE and TONODE, as well as the fact that the catchments, Flowlines, etc. are all connected by common identifiers, especially Comid..

The “Simple Model” is a demonstration of how to use NHDPlus in modeling applications. The Model uses Microsoft Access as the platform. Users do not need to know Access to run and use the Model. Users who are familiar with Access can use it as a framework for other models as well as performing other tasks, such as generating profile plots of model results along a river’s mainstem.

The Simple Model is a basic nonpoint source “export coefficient” model. The export coefficients are in units of kg/sq km/yr by NLCD 2006 land cover type. A table of default coefficients is provided and users can edit these values, for instance, for running scenarios or using their own coefficients to reflect loadings for the pollutant of their choice. **The default coefficients do not apply to any particular pollutant and are provided for example purposes only.**

The modeling system does not take into account modeling from an upstream area. For instance, in modeling the Colorado River Basin, the results from VPU 14 are not automatically transferred for modeling in the downstream VPU 15. The upstream boundary loadings from VPU 14 can be manually transferred for modeling VPU 15 in Step 4. At this time the NLCD 2006 data is available only for VPU 06.

The modeling process assigns annual loadings (kg/yr) for each catchment and then performs routing, dilution and pollutant decay on each Flowline. The upstream boundary condition loadings for a downstream Flowline are based on the sum of the model results from the immediate upstream Flowlines. The EROM flows and velocities, EROM_MA0001.Q0001E and EROM_MA.V0001E, respectively, are used. The “divergence routed” methodology is used for routing and modeling. See the NHDPlusV2 User Guide for more information on this routing technique.

The decay is a simple first-order process with the user-defined decay coefficient. A decay coefficient of zero represents a conservative substance. The decay is computed as:

$L_1 = L_0 * \text{Exp}(-K * \text{ToT})$, where

L_1 = Load at the bottom of the Flowline (kg/yr),

L_0 = Catchment Loading + upstream boundary condition load (kg/yr)

K = Decay coefficient (/day), and

ToT = Time of travel (days) down the Flowline defined by the Flowline length / EROM_MA.V0001E

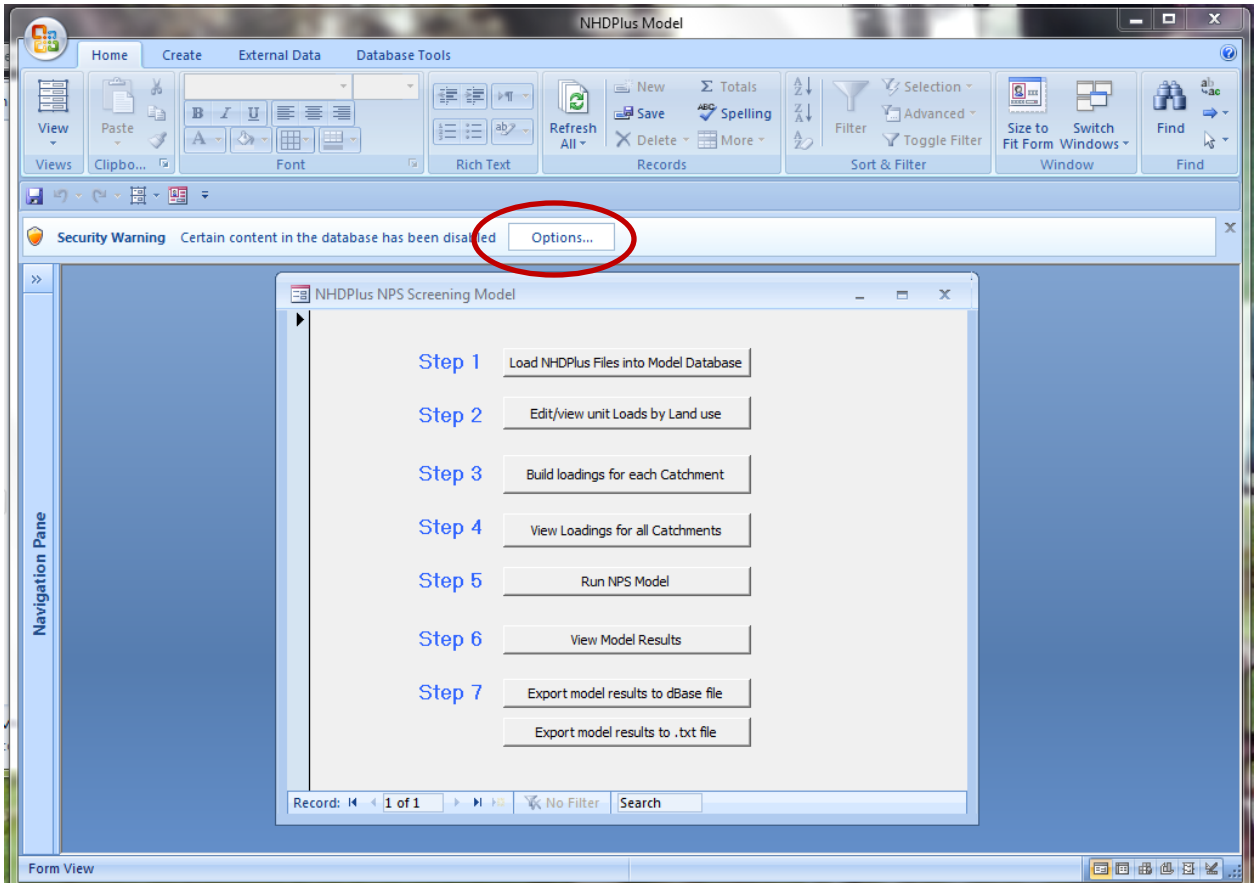
All unit conversions are done within the modeling code. Concentrations in mg/l on each Flowline are also computed and provided using the L_1 / EROM_MA.Q0001E relationship.

The Modeling Results are saved to an internal Access table named “MDLRSLT” and when exported are saved to “MDLRSLT.DBF”. When working with multiple scenarios, rename or copy the MDLRSLT.DBF file. For example, rename MDLRSLT.DBF to a file named “MDLRSLT_base.DBF” or “MDLRSLT_scen1.DBF”.

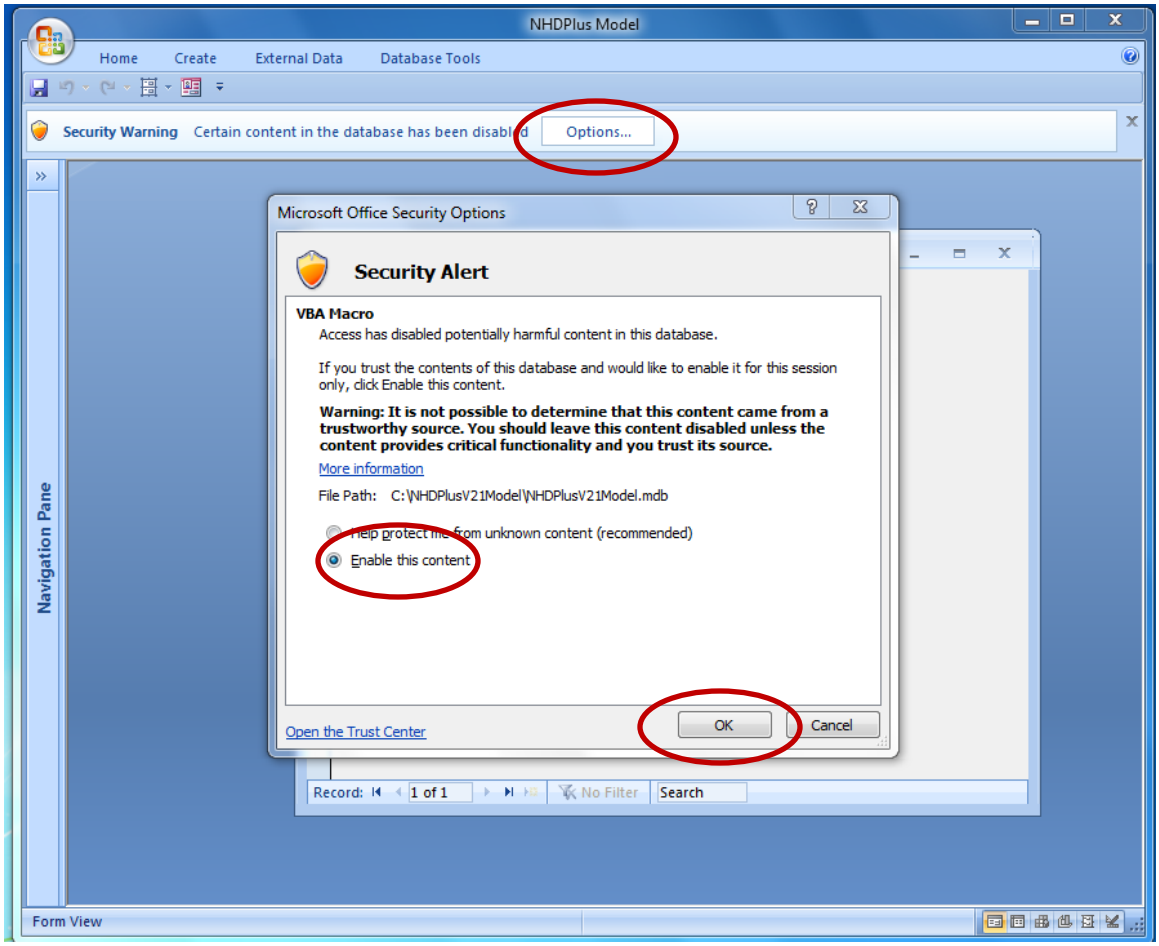
For users familiar with Access VBA, the modeling code is in “Basic Routing” under Modules.

Running the Model:

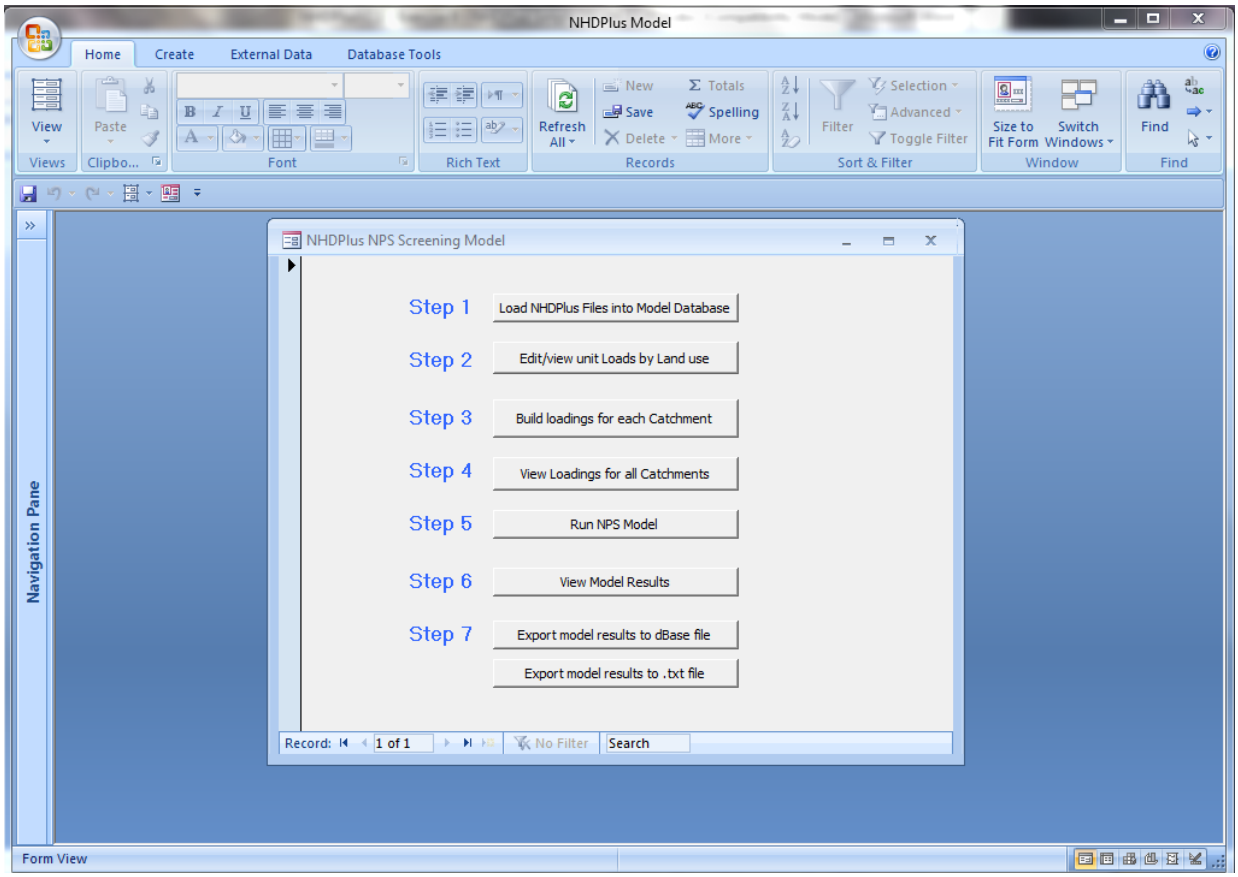
Dbl-click on NHDPlusV21Model.mdb. The menu will be displayed. Depending on your Access version and settings, a Security Warning message may come up. The screen will look like this:



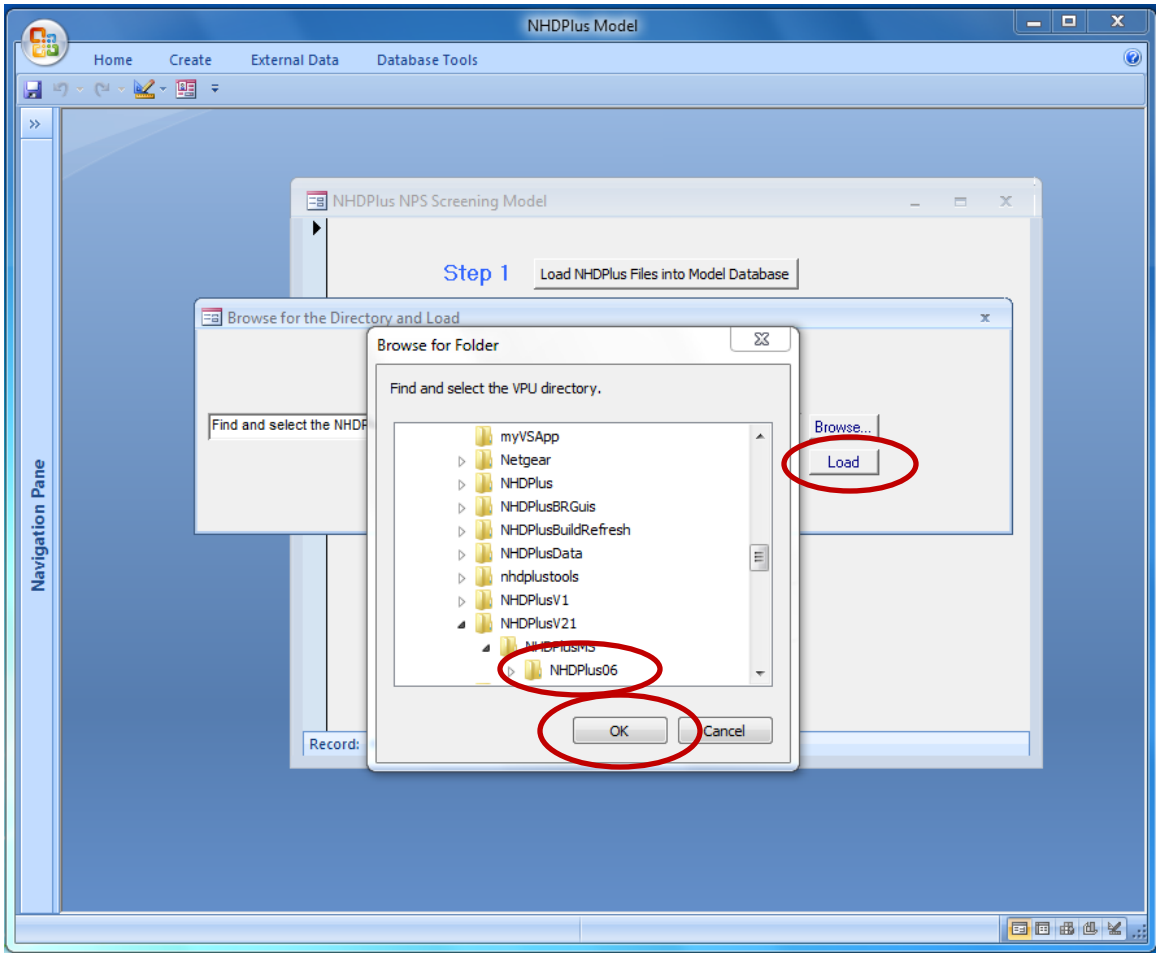
Select Options|Enable this content|OK:



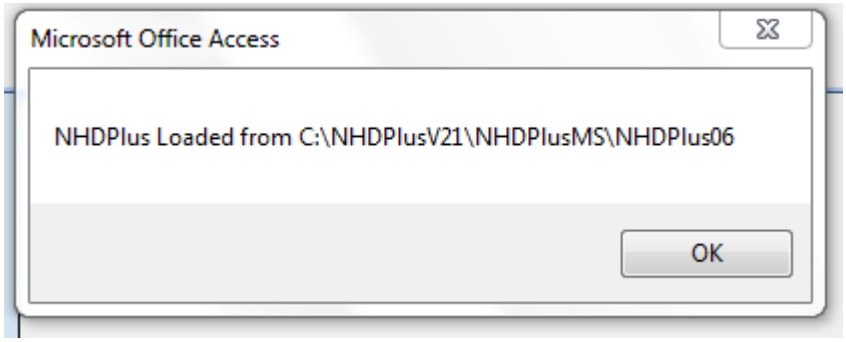
The main menu will be displayed:



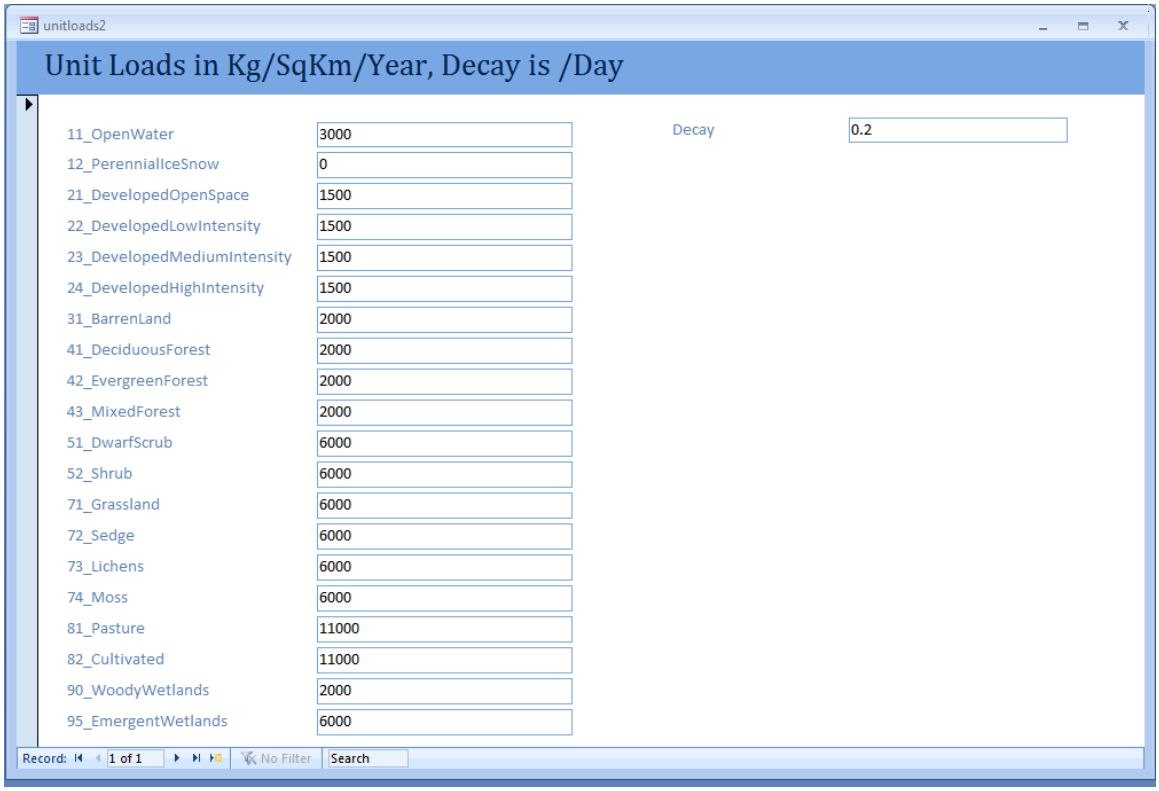
The model has seven steps. They should be run in sequence. Step 1 can be skipped because of the issues in using Access 2013. For any other steps (except Steps 1 and 2), an error message will come up if the prior steps have not been run. Step 1 loads the NHDPlusV21 data. When Step 1 is selected, a menu will come up to browse and then load data. Navigate to the VPU 06 directory and click OK:



After selecting the directory, select OK, and then click Load. It will take a few seconds to load the NHDPlus data. There will be an error message if it is not a valid VPU directory. If the load is successful the following message will come up, click OK:

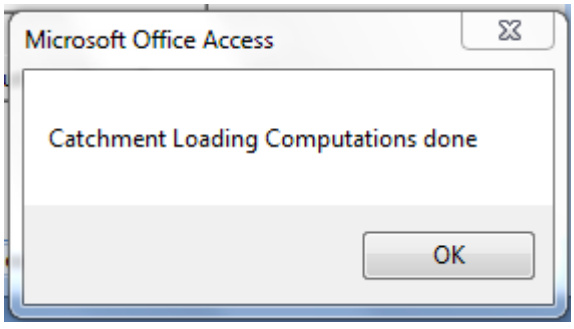


Now select Step 2. The pollutant unit loadings and decay coefficient form will come up:

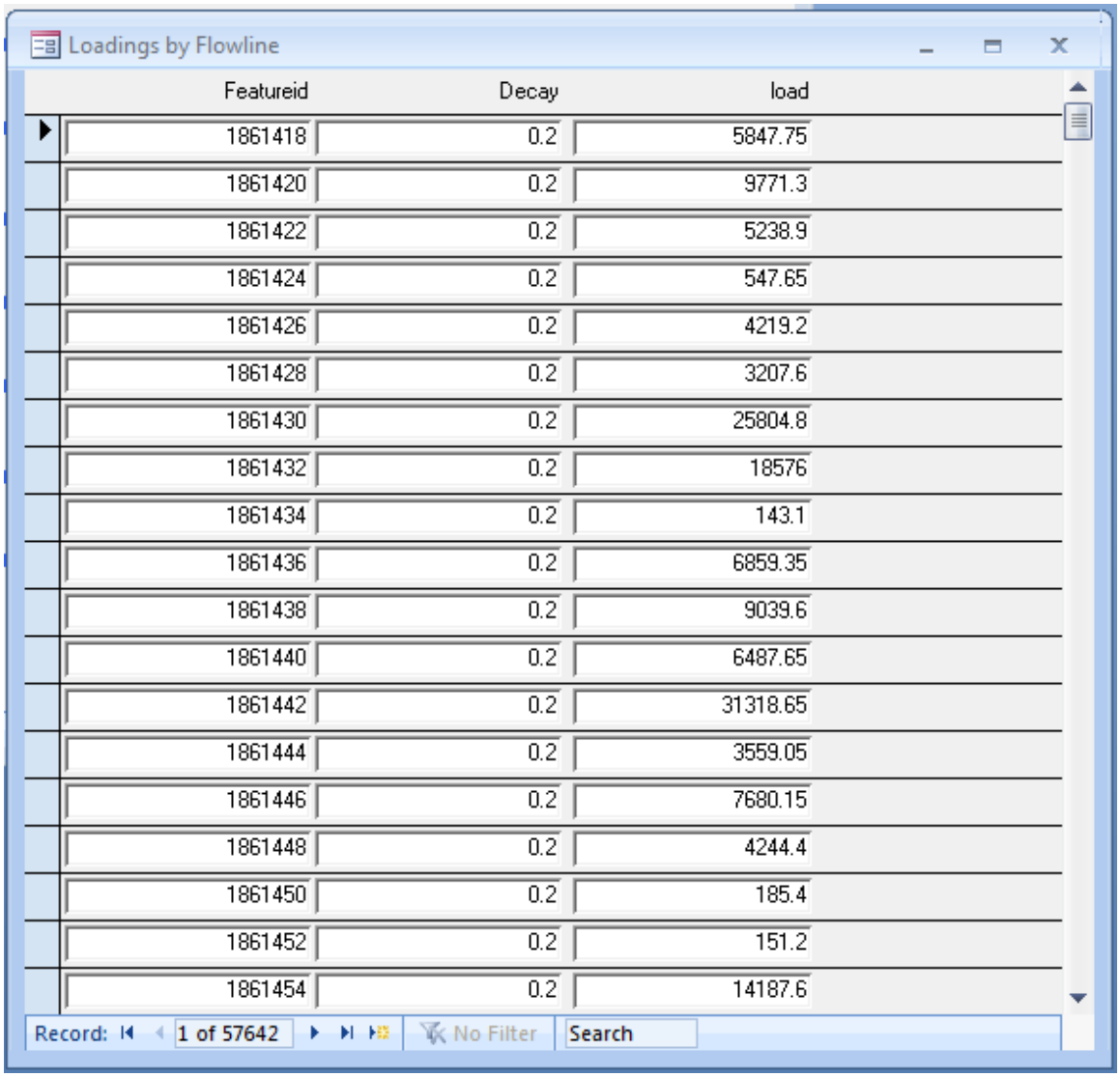


The NLCD 2006 land use categories will be on the left with the unit loads to the right. The decay coefficient will be in the upper right corner. Various scenarios can be generated using this form. For instance, to examine only the effects of agriculture, zero out all of the loadings except 81_Pasture and 82_cultivated. Click the “X” to close the form.

Click Step 3. This will calculate loadings by catchment by apportioning the unit loads by area. It should take a couple of seconds to run. If it is successful, the following message will be displayed:

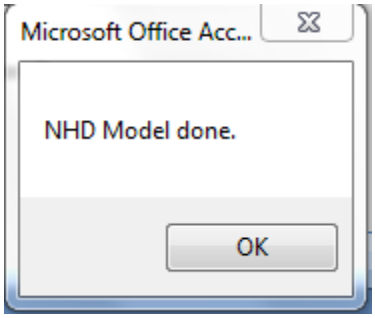


Step 4 will display the loadings for each catchment:



The Featureid is the catchment identifier, which links to Comid for routing and modeling. Note that the Decay coefficient is included in each record; this provides (future) options to vary the decay by other factors, such as stream flow. The loading is in Kg/Yr.

Step 5 runs the model. For VPU 06, it will take approximately 2 minutes on a local machine (possibly longer over a network). The following message will appear after the model runs:



Click OK.

Step 6 will display the model results:

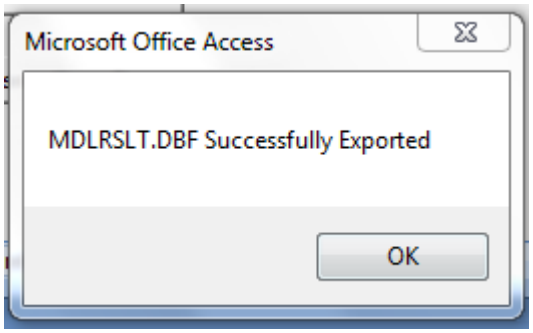
Model results

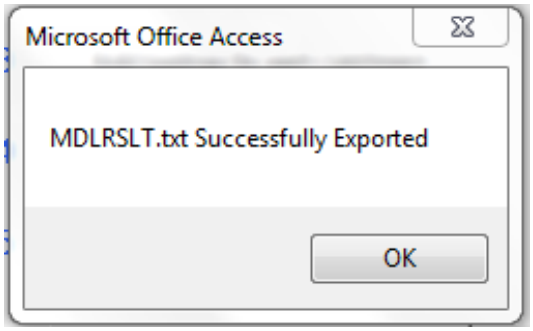
comid	darea	cumarea	maflow	mavel	load	cumload	conc
1861418	1.4814	1.4814	0.669	0.70492	5847.75	5728.462	9.588714
1861420	2.0322	2.0322	0.913	0.73041	9771.3	9581.751	11.75229
1861422	1.1601	1.1601	0.519	0.70789	5238.9	5147.917	11.1074
1861424	0.1008	3.6144	1.633	0.79104	547.65	15814.08	10.84441
1861426	1.287	1.287	0.575	0.6889	4219.2	4148.266	8.078806
1861428	1.0359	1.0359	0.462	0.69373	3207.6	3161.859	7.663884
1861430	3.0447	3.0447	1.355	0.75635	25804.8	25119.4	20.75957
1861432	2.3103	2.3103	1.028	0.74079	18576	18149.99	19.77115
1861434	0.0351	10.1709	4.606	0.85368	143.1	54178.9	13.17209
1861436	1.3347	3.6576	1.639	0.76865	6859.35	13896.21	9.494361
1861438	1.4283	1.4283	0.646	0.67892	9039.6	8866.644	15.37005
1861440	1.0944	14.9229	6.758	0.83495	6487.65	73884.94	12.24295
1861442	5.5395	5.5395	2.491	0.83185	31318.65	30234.18	13.59167
1861444	2.0916	2.0916	0.933	0.6809	3559.05	3515.533	4.219471
1861446	1.2834	1.4382	0.642	0.70335	7680.15	8818.127	15.38118
1861448	1.2042	21.6666	9.82	0.82427	4244.4	106348.7	12.12744
1861450	0.0846	23.3037	10.576	0.55121	185.4	114000.6	12.07075
1861452	0.0396	24.7815	11.248	1.08847	151.2	122813	12.22694
1861454	8.3304	12.132	5.373	0.82941	14187.6	20010.02	4.170413
1861456	5.2659	5.2659	2.41	0.80602	23798.25	22801.05	10.59464
1861458	7.9335	7.9335	3.66	0.84635	41098.5	39237.18	12.00508
1861460	1.5525	1.5525	0.706	0.64438	8426.7	8197.671	13.00272
1861462	1.71	1.71	0.76	0.67174	2942.1	2919.238	4.301346
1861464	5.5575	5.5575	2.491	0.7419	40152.15	39104.39	17.57925
1861466	1.782	1.782	0.795	0.72391	8307.45	8141.704	11.46824
1861468	4.2282	9.5832	4.287	0.82847	29054.25	70675.3	18.46132
1861472	0.5256	13.725	6.328	0.76401	2284.2	63905.63	11.30892
1861474	2.5578	2.5578	1.154	0.66013	12937.5	12854.42	12.47369
1861476	0.0882	15.7158	7.257	0.94539	441	77413.63	11.94562
1861478	0.1422	12.2832	5.517	0.84937	666	83727.27	16.99466
1861480	1.9026	1.9026	0.876	0.69478	13754.25	13270	16.96349

Record: 1 of 58834 No Filter Search

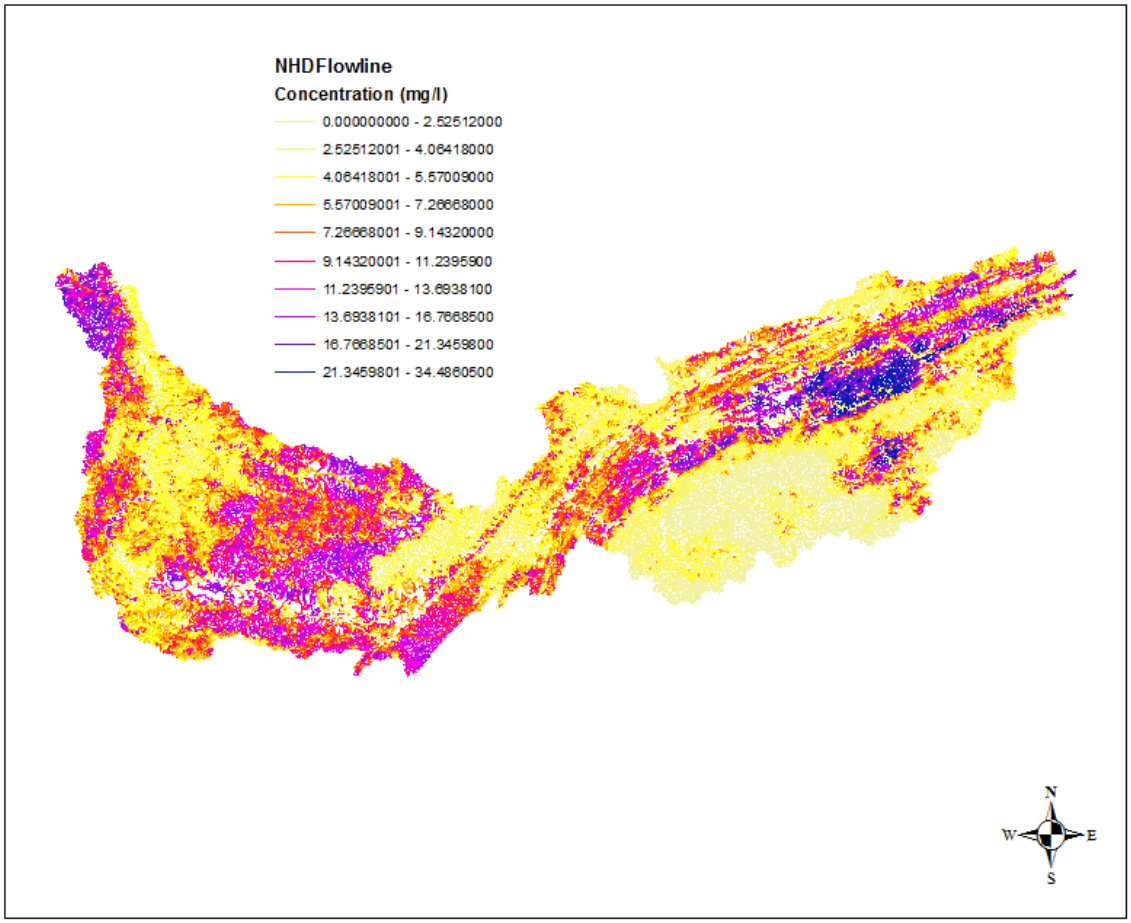
For each Comid, the pollutant concentration is in the far right column.

For Step 7, select either Export to a dBase file or Export to a .txt File. The model results will be saved to either MDLRSLT.DBF (Access 2003, 2007, or 2010 users) or MDLRSLT.txt (Access 2013 users) into the NHDPlusModel directory. Click OK:





The MDLRSLT.DBF or MDLRSLT.txt table can be imported into ArcMAP for further analyses and mapping. Access 2013 users should first load the .txt file into ArcMAP, export it as a .dbf file, and then load and use this .dbf file in ArcMAP. A basic map of the concentrations is shown below:


NHDFlowline
Concentration (mg/l)
0.000000000 - 2.52512000
2.52512001 - 4.06418000
4.06418001 - 5.57009000
5.57009001 - 7.26668000
7.26668001 - 9.14320000
9.14320001 - 11.2395900
11.2395901 - 13.6938100
13.6938101 - 16.7668500
16.7668501 - 21.3459800
21.3459801 - 34.4860500
N
W
E
S