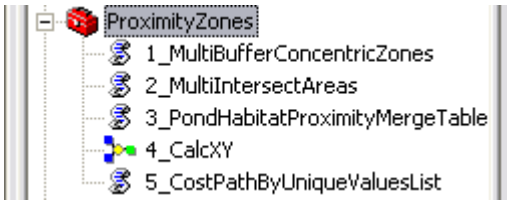
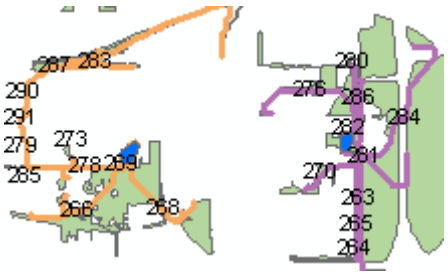
Calculating Edge to Edge Distances



These instructions enable you to calculate distances between polygons – from each polygon in one layer to multiple polygons within a specified search radius – using ArcGIS 9.3.
An ARCINFO LICENSE IS REQUIRED for the custom toolbox. For more information refer to: http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?id=1350&pid=1347&topicname=Generate_Near_Table_(Analysis)

The analytical scenario for this tool is to calculate the distances between an originating habitat polygon to available habitat polygons surrounding the origin, but keeping within a certain "buffer." This essentially means that optimal habitat patches within the specified distance are selected first before calculating near parameters to each originating polygon. There are two outputs that may be used for mapping and further analyses between the originating polygon and each available habitat polygon:



1. A table that provides the straight-line distances
2. A set of lines that provide the shortest/least-cost path distances (this attribute table may be exported)

The tool is meant to be fairly generic for any type of ecological landscape analysis. Please note that the instructions here use a wetland ecology application whereby distances from pond edge are calculated between all optimal habitat patches within 1000 meters.

See the APPENDIX for tips/considerations on creating **optimal habitat patches** and **cost/friction** layers.

ORIGINAL DATA

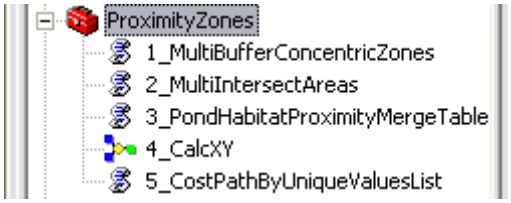
ponds.shp	originating polygons
optimal.shp	all available habitat patches (can be created by reclassifying landcover based on your particular criteria and dissolving by the reclass field in to single part polygons)
friction5	cost raster (or friction surface) grid file where each cell represents the cost of passing through

CREATED DATA

pond_NEAR.dbf	dBase table resulting from the custom tool calling on the GENERATE NEAR TABLE tool
pond_NEAR_Paths.shp	merged polylines resulting from calculating the shortest paths (least cost paths) between all edge-to-edge combinations for each originating polygons to selected available habitat polygons

Set up the ArcMap document with the custom toolbox:

1. Start ArcMap with a new empty map document
2. Click the SHOW ARCTOOLBOX WINDOW button (if ArcToolbox is currently hidden)
3. Right-click on ArcToolbox and choose ADD TOOLBOX
4. Navigate to the directory that contains the **ProximityZones.tbx** file, select it and click OPEN
5. Click the "+" beside **ProximityZones** to expand the toolbox and view all the tools it contains

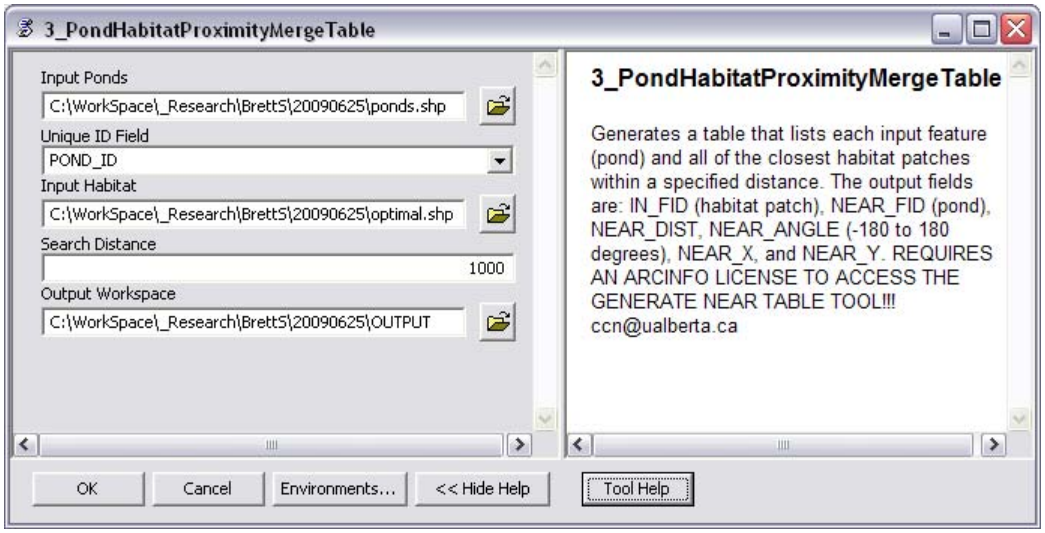


6. Click the ADD DATA button and add the following layers:
   - optimal.shp
   - ponds.shp

See APPENDIX for tips on creating optimal.shp.

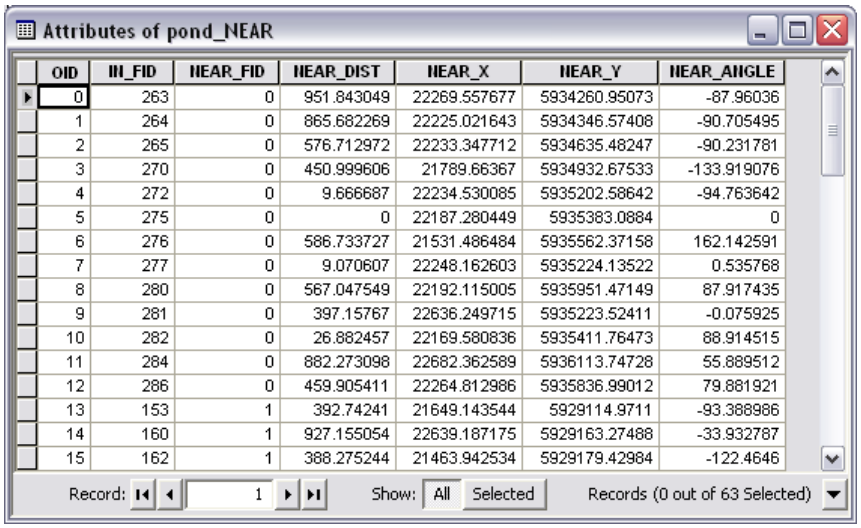
Run the 3_PondHabitatProximityMergeTable tool:

7. In ArcToolbox, double-click on 3_PondHabitatProximityMergeTable tool to open
8. Click SHOW HELP button to view information about the tool
9. As you click on each of the parameters, the help sidebar provides information about that parameter
10. Click the TOOL HELP button to open the help file
11. Specify the following parameters:
    - Input Ponds: **ponds.shp**
    - Unique ID Field: POND_ID
    - Input Habitat: **optimal.shp**
    - Search Distance: 1000
    - Output Workspace: C:\yourworkingdirectory\OUTPUT

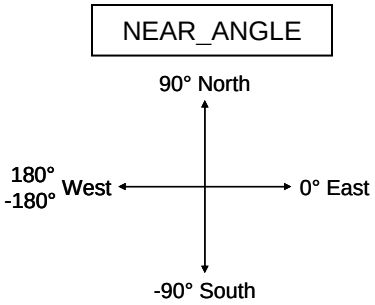


12. Click OK, wait a short while… then dismiss the status dialog when completed
13. Click ADD DATA and add the **pond_NEAR.dbf** table to the map document

14. In the SOURCE TAB, right-click on the table name to OPEN TABLE – notice the field headings:
    - IN_FID – the optimal habitat patch
    - NEAR_FID – the original pond
    - NEAR_DIST – the distance between features in map units
    - NEAR_X – the X coordinate at habitat edge
    - NEAR_Y – the Y coordinate at habitat edge
    - NEAR_ANGLE – the angle between features (see graphic below)
15. CLOSE the attribute table when finished



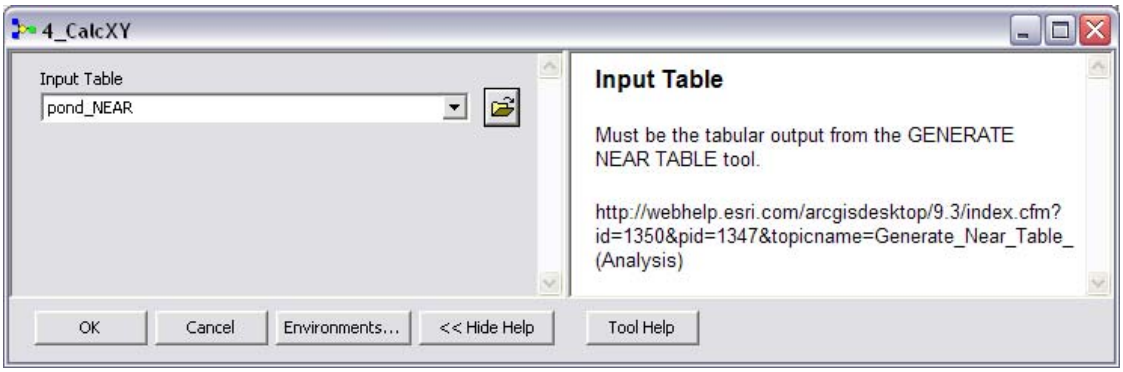
OID	IN_FID	NEAR_FID	NEAR_DIST	NEAR_X	NEAR_Y	NEAR_ANGLE
0	263	0	951.843049	22269.557677	5934260.95073	-87.96036
1	264	0	865.682269	22225.021643	5934346.57408	-90.705495
2	265	0	576.712972	22233.347712	5934635.48247	-90.231781
3	270	0	450.999606	21789.66367	5934932.67533	-133.919076
4	272	0	9.666687	22234.530085	5935202.58642	-94.763642
5	275	0	0	22187.280449	5935383.0884	0
6	276	0	586.733727	21531.486484	5935562.37158	162.142591
7	277	0	9.070607	22248.162603	5935224.13522	0.535768
8	280	0	567.047549	22192.115005	5935951.47149	87.917435
9	281	0	397.15767	22636.249715	5935223.52411	-0.075925
10	282	0	26.882457	22169.580836	5935411.76473	88.914515
11	284	0	882.273098	22682.362589	5936113.74728	55.889512
12	286	0	459.905411	22264.812986	5935836.99012	79.881921
13	153	1	392.74241	21649.143544	5929114.9711	-93.388986
14	160	1	927.155054	22639.187175	5929163.27488	-33.932787
15	162	1	388.275244	21463.942534	5929179.42984	-122.4646



Note: The table provides only FIDs, which you will want to join back to the original attribute tables later to get at the original information of each polygon.

Run the 4_CalcXY tool:

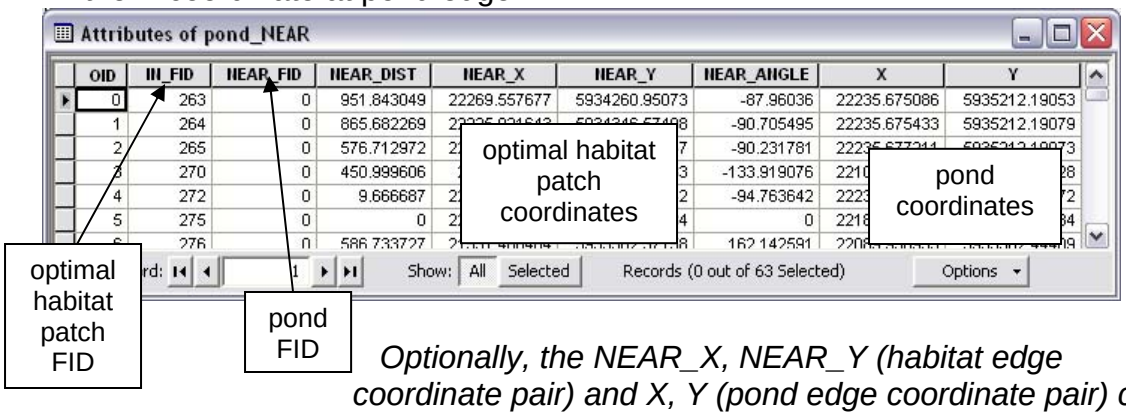
16. In ArcToolbox, double-click on 4_CalcXY tool to open
17. Optionally, click the TOOL HELP button to open the help file and learn more about the equations behind the calculations
18. Specify the following parameters:
    - Input Table: **pond_NEAR.dbf**



The input MUST be the output from tool #3 or ArcGIS' GENERATE NEAR TABLE.

19. Click OK, wait a short while… then dismiss the status dialog when completed

20. In the SOURCE TAB, right-click on the table name to OPEN TABLE – notice the two new field headings:
21. X – the X coordinate at pond edge
22. Y - the Y coordinate at pond edge

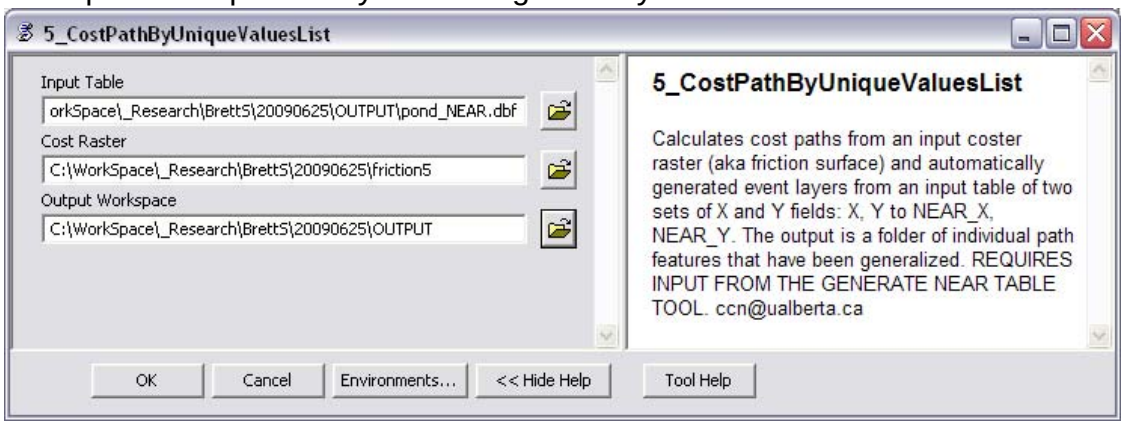


Optionally, the NEAR_X, NEAR_Y (habitat edge coordinate pair) and X, Y (pond edge coordinate pair) can be added as an XY event layer, if you wish to visualize these locations prior to the next step. Both these coordinate pairs are necessary for the next step (tool #5).

23. CLOSE the attribute table when finished

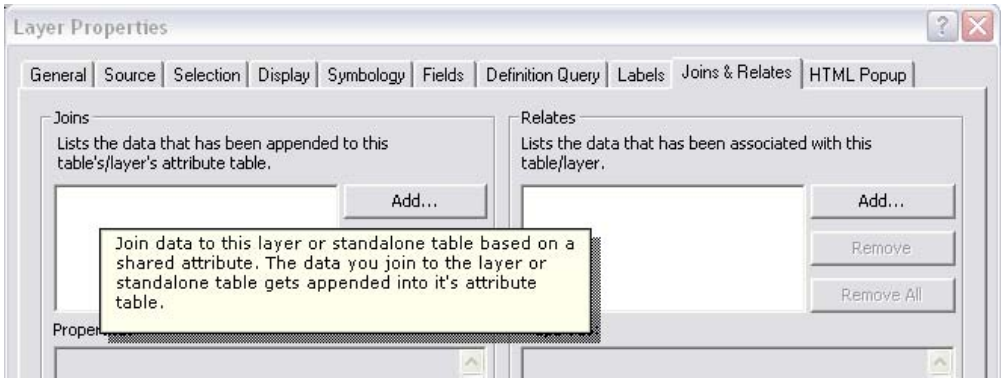
Run the 5_CostPathByUniqueValuesList tool:

24. In ArcToolbox, double-click on 4_CalcXY tool to open
25. Optionally, click the TOOL HELP button to open the help file and learn more about the equations behind the calculations
26. Specify the following parameters:
27. Input Table: **pond_NEAR.dbf** – *after running the 4_CalcXY tool on the table!*
28. Cost Raster: **friction5** – *see APPENDIX for tips on creating this layer*
29. Output Workspace: C:\yourworkingdirectory\OUTPUT

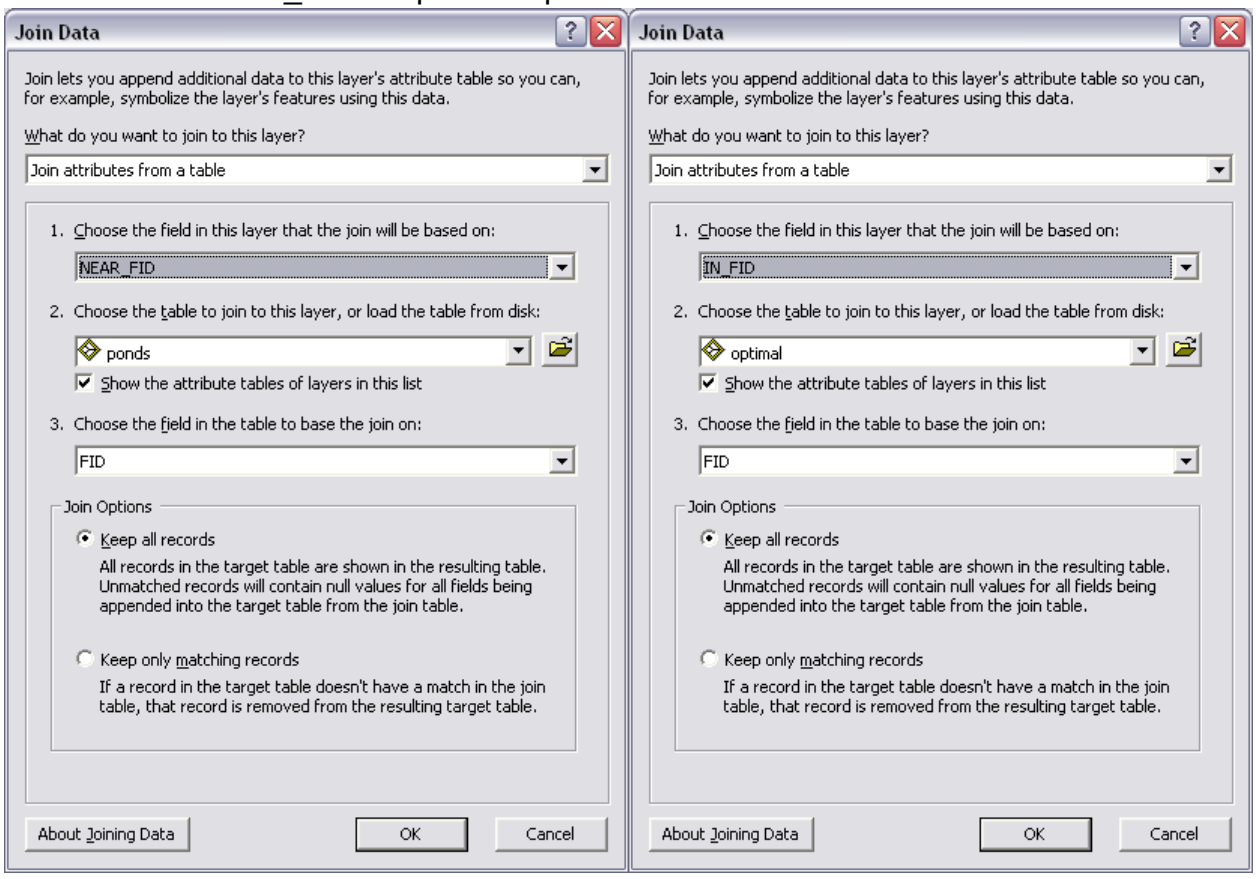


30. Click OK, wait a very long while…perhaps set it up to run overnight…
31. Click ADD DATA and add the **pond_NEAR_Paths.shp** file to the map document
32. In the SOURCE TAB, right-click on the layer name to OPEN ATTRIBUTE TABLE to view the fields – *remember the previous note indicating that you can join the NEAR_FID and IN_FID back to the ponds.shp and optimal.shp attribute tables FID fields respectively, to get the original polygon information*

33. In the table of contents, double-click on the _Paths.shp file name to access its layer properties



34. In the JOINS AND RELATES tab, click the JOIN button and specify the following two joins:
    - Join 1: NEAR_FID to ponds.shp FID
    - Join 2: IN_FID to optimal.shp FID



35. Click OK
36. If table appears blank, click OPTIONS >>> RELOAD CACHE
37. Click OPTIONS >>> EXPORT to a dbf or txt file for external use
38. CLOSE the attribute table when finished

IMPORTANT NOTE: The pond_NEAR.dbf table may have more records in it than the pond_NEAR_Paths.shp attribute table. This is because the cost path calculation does not include 0 distance values that the pond_NEAR.dbf NEAR_DIST field may contain – you can assume 0 distance values where no polyline paths were created!

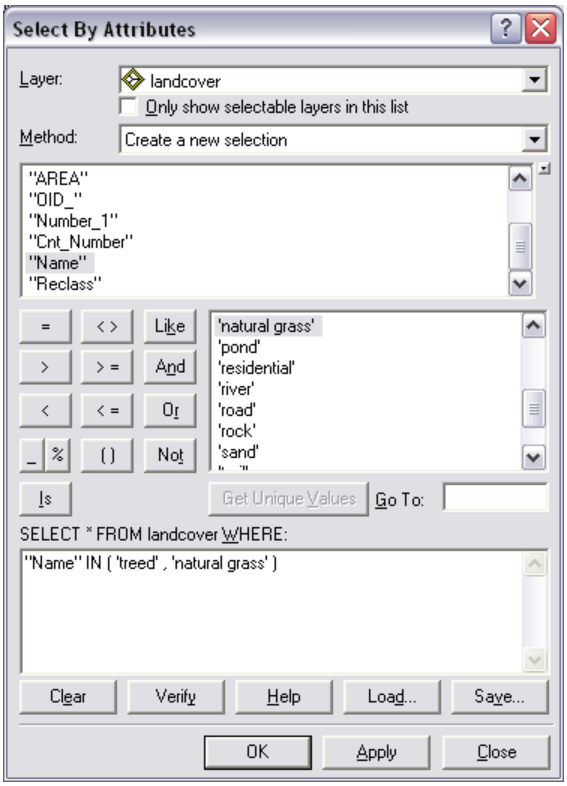
APPENDIX

A) Suggestions for creating the **optimal habitat patches** layer

a. You must first define what optimal habitat means for your research: Is it for breeding, dispersal, hibernation, predator avoidance, etc.? What landcover classes constitute this? This example defines optimal terrestrial amphibian habitat as forest and/or native grass.

b. Next, create a data selection using SELECT BY ATTRIBUTES and the appropriate SQL; e.g. "Class" IN ('Forest', 'Nonforest Native')

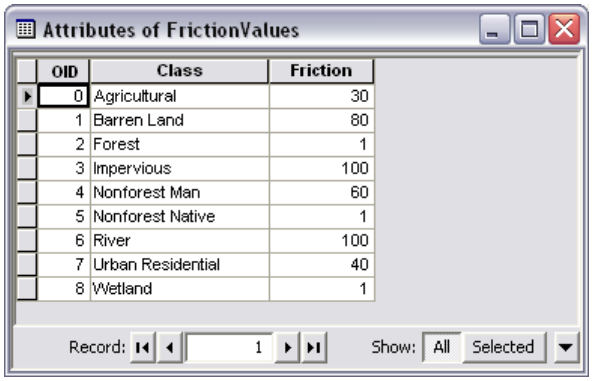
c. Use the DISSOLVE tool to create a new polygon patch layer named **optimal.shp** (or whatever you wish), do NOT check any Dissolve Fields (this means the shape field is used), and make sure to UNcheck the multipart option!



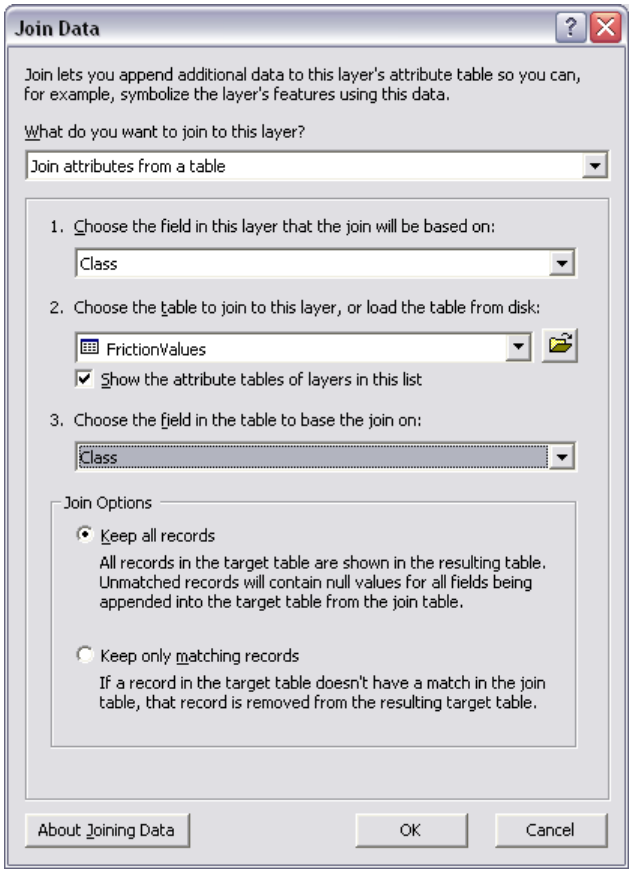
d. Optionally, add an AREA (double) field and right-click the attribute table heading to CALCULATE GEOMETRY

B) Suggestions for creating the **cost raster/friction surface** layer
This instruction set does NOT provide details on cost distance analyses. For the full explanations, please see: http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=Understanding_cost_distance_analysis. However, here are some general instructions on how to create your cost raster (i.e. the friction surface that identifies the cost of traveling through each cell) by assigning cost values to each landcover class:

a. Examine the scientific literature for guidance and use your knowledge of the species to rank your landcover classification according to your purpose. Decide on a scale: this example uses 1 to 100.
b. Higher cost classes should be given higher values.
c. Good habitat classes should be assigned no less than a 1 (you may get weird results from cost surfaces that have 0 values).
d. It is helpful to create a table of unique landcover Class values in one column, and Friction integer values in a second column. Complete the table with the friction values based on your scale.



e. Join to the landcover.shp file using the corresponding Class fields.



f. Convert to raster on the joined Friction field using an appropriate CELL SIZE.

g. If a particular landcover class is deemed to be an absolute barrier, then assign those cells with NoData in the input cost raster. Use the RECLASSIFY tool or the CON tool or map algebra function. You may need to flag this class with a value of 999 prior to conversion.