



# Rapid Land Cover Mapper Training Exercise

**An exercise on developing a Rapid Land  
Cover Mapper dataset**

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

# Learning Objectives

- After completing this exercise, participants should be able to create a land cover classification dataset using the USGS Rapid Land Cover Mapper (RLCM) tool.

## Techniques Covered:

- Building an Image Library
- Defining Time Periods
- Importing LCCS Classification Legend into the RLCM tool
- Defining the Study Area
- Using the Classification Attributer
- Using the Local Registration tool

# Module Data Requirement

- To fully benefit from this presentation, use of ESRI's ArcGIS software and RLCM exercise data is necessary.
- Software requirements:  
**ESRI ArcGIS version 9.1 (ArcView License)**
- Data Requirements:  
**RLCM exercise dataset distribution file `rlcm_training_data.zip`**

**NOTE:** Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

# RLCM Overview

- The RLCM tool is a vector/raster hybrid approach to land use land cover (LULC) mapping. It lends itself to both multiple-resolution and time series mapping of LULC and many other geographic themes.
- Conceptually, it is based on the traditional dot grid method for calculating areas that has long been employed by foresters and other users of aerial photography.

# RLCM Overview

- The RLCM tool generates a digital dot grid matrix for a given study area. Next, it overlays that dot grid matrix on an image within ESRI's ArcMap GIS software. Using standard photo interpretation techniques, an analyst identifies the discrete LULC class for each dot. The RLCM tool facilitates both the selection and attribution of the dots within a common LULC class. It also facilitates the management of multiple time period classifications for the study area.

# RLCM Overview

An example of a dot grid matrix created by RLCM.



# RLCM Overview

Here is an illustration of the same dot grid that was built on three time periods.

2002 Dot grid

1960 Dot grid

1920 Dot grid

# Exercise Outline

- **Access the RLCM Web site**
- **Planning**
  - Define the study area and spatial resolution.
  - Choose a classification system.
  - Determine time periods for classification.
- **Preparation**
  - Create study area folders.
  - Collect and prepare images used for classification.
  - Install RLCM.
  - Build an Image Library.
  - Define Time Periods.
  - Import the LCCS legend file (optional).
  - Define the Study Area.

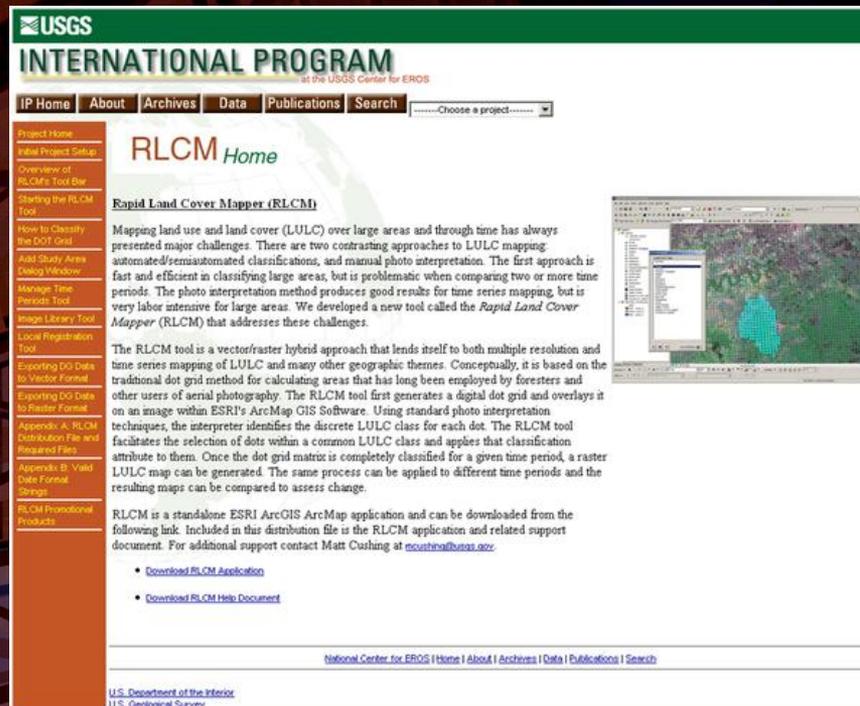
*(Continued on next slide)*

# Exercise Outline

- **Product Development**
  - Begin Classification.
  - Use the Local Registration tool to correct misregistered images.
  - Export to vector format.
  - Export to raster format.

# Access the RLCM Web site

- RLCM web site provides access to the current RLCM application, documentation, and promotional information.
- URL: <http://edcintl.cr.usgs.gov/rlcm/>



The screenshot shows the RLCM Home web page. At the top, there is a green header with the USGS logo and the text "INTERNATIONAL PROGRAM at the USGS Center for EROS". Below the header is a navigation menu with links for "IP Home", "About", "Archives", "Data", "Publications", and "Search". A search box is also present. The main content area features the title "RLCM Home" and a sub-heading "Rapid Land Cover Mapper (RLCM)". The text describes the challenges of mapping land use and land cover (LULC) over large areas and through time, and introduces the RLCM tool as a vector/raster hybrid approach. It explains that the tool generates a digital dot grid and overlays it on an image within ESRI's ArcMap GIS Software. The text also mentions that the tool facilitates the selection of dots within a common LULC class and applies that classification attribute to them. A small screenshot of the RLCM application interface is shown on the right. At the bottom, there are links to "Download RLCM Application" and "Download RLCM Help Document". The footer includes the text "National Center for EROS | Home | About | Address | Data | Publications | Search" and "U.S. Department of the Interior U.S. Geological Survey".

# Access the RLCM Web site

The screenshot shows the RLCM Home web page. On the left is a navigation menu with items like 'Project Home', 'Initial Project Setup', 'Overview of RLCM's Tool Bar', 'Starting the RLCM Tool', 'How to Classify the DOT Grid', 'Add Study Area Dialog Window', 'Manage Time Periods Tool', 'Image Library Tool', 'Local Registration Tool', 'Exporting DG Data to Vector Format', 'Exporting DG Data to Raster Format', 'Appendix A: RLCM Distribution File and Required Files', 'Appendix B: Valid Date Format Strings', and 'RLCM Promotional Products'. The main content area is titled 'RLCM Home' and features a sub-header 'Rapid Land Cover Mapper (RLCM)'. Below this is a paragraph describing the tool's purpose in mapping land use and land cover (LULC) over large areas and through time, comparing automated/semiautomated classifications with manual photo interpretation. A second paragraph explains the tool's vector/raster hybrid approach and its use within ESRI's ArcMap GIS Software. A third paragraph states that RLCM is a standalone ESRI ArcGIS ArcMap application and provides a link to download it, along with a link to the RLCM help document. Three callout boxes are overlaid on the page: one pointing to the 'RLCM Home' title with the text 'Links to RLCM help topics.', one pointing to the 'RLCM Promotional Products' menu item with the text 'Link to RLCM promotional materials.', and one pointing to the 'Download RLCM Application' link with the text 'Download for RLCM ArcGIS application.'. A fourth callout box points to the 'Download RLCM Help Document' link with the text 'Download for RLCM documentation.'.

**Links to RLCM help topics.**

**Link to RLCM promotional materials.**

**Download for RLCM ArcGIS application.**

**Download for RLCM documentation.**

**RLCM**

**PLANNING**



# Planning: Define the Study Area

- Before building a land cover classification dataset using RLCM, several questions need to be asked:
  - What level and type of land cover characteristics need to be retained?
  - Is the study area small or a larger region?
  - Is a change analysis required?
  - Are there multiple study areas needing assessment?
  - What are the available resources?
- Answering these questions will help define the optimum data set for your RLCM project.



# Planning: Define the Study Area

For the sample area in this exercise, several additional questions have been posed and answered:

- How much detail (spatial resolution) is required of the classification? (*As much as possible*)
- Is the study area going to cover multiple time periods? (*Yes*)
- Does the study area have potential to expand? What would the maximum extent be? (*No*)
- What are the time constraints? (*One training session*)



# Planning: Define Study Area

- Dot grid resolution considerations:

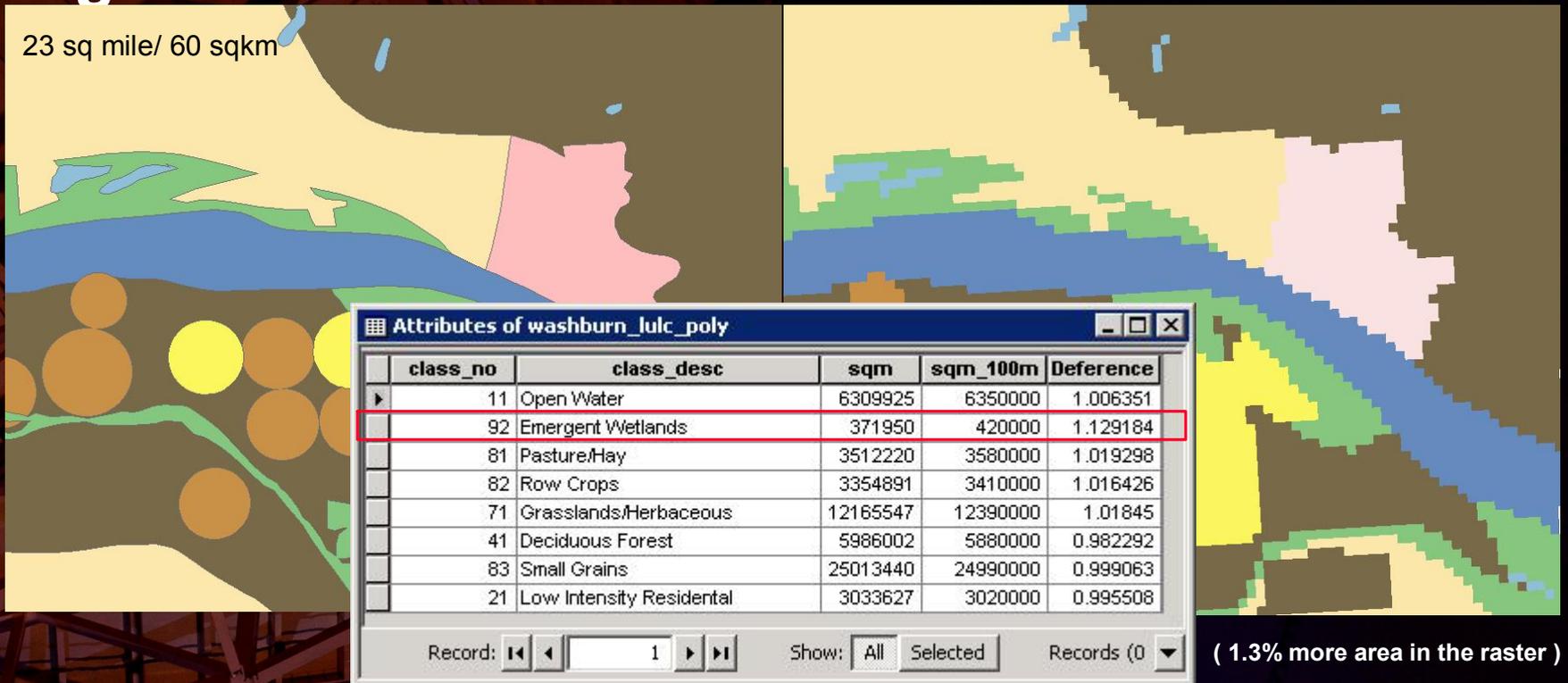
The dot grid resolution is the distance of separation between each dot in the matrix on the X and Y axis.

- What resolution is needed to retain the required land cover characteristics?
  - What resources are available to fulfill the requirements?
  - What are the time constraints? The higher the resolution the greater the level of effort.
- The objective at this stage of defining the study area is to determine the optimum resolution based on the requirements and available resources.
  - The following three sides illustrates the effects resolution has on characterizing a landscape.

# Planning: Define the Study Area

Digitized

100m Resolution

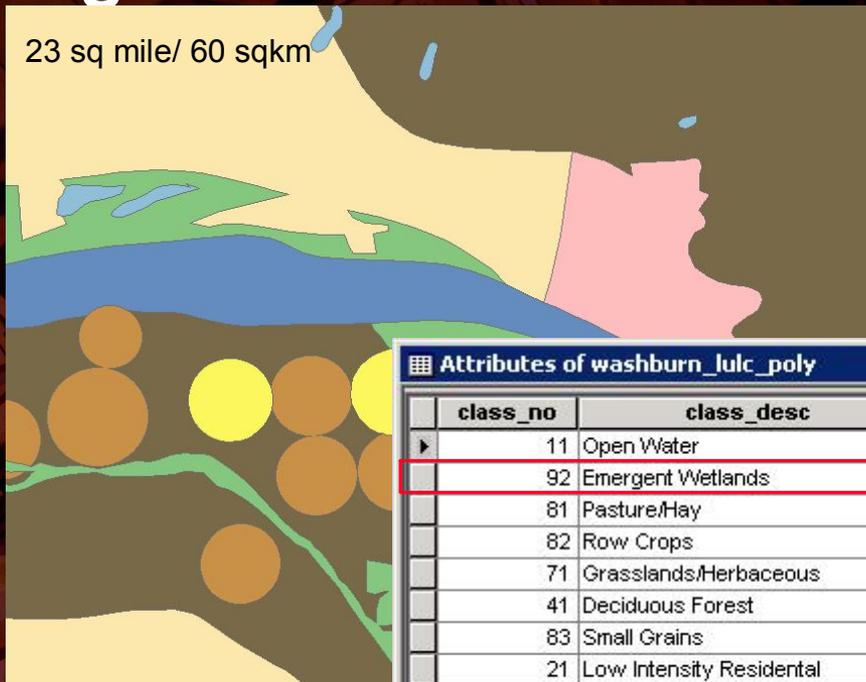


Characterizing the landscape at 100m resolution was easier than digitizing and the necessary information was still retained.

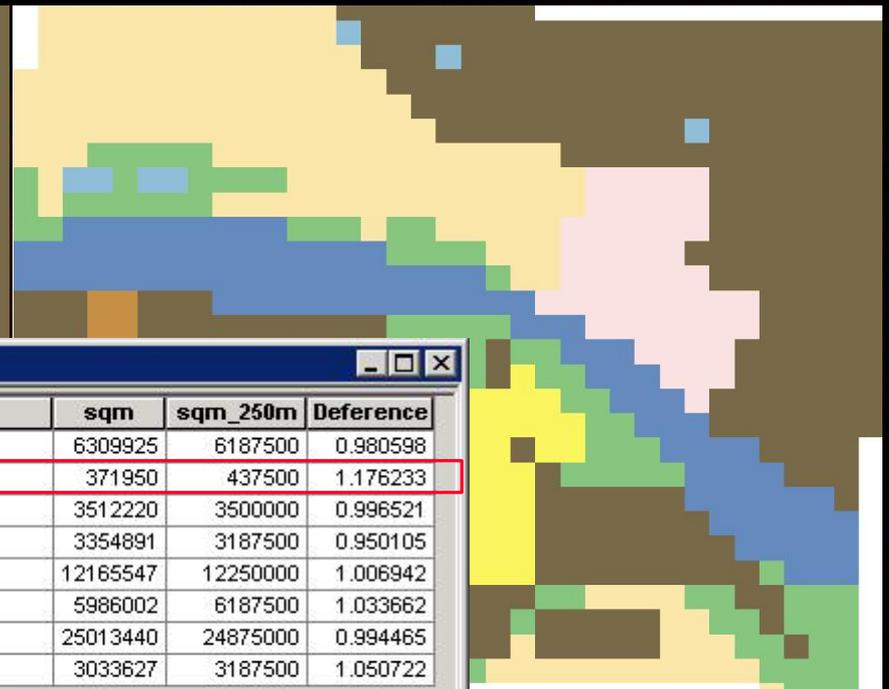
# Planning: Define the Study Area

## Digitized

23 sq mile/ 60 sqkm



## 250m Resolution



Attributes of washburn\_lulc\_poly

class_no	class_desc	sqm	sqm_250m	Deference
11	Open Water	6309925	6187500	0.980598
92	Emergent Wetlands	371950	437500	1.176233
81	Pasture/Hay	3512220	3500000	0.996521
82	Row Crops	3354891	3187500	0.950105
71	Grasslands/Herbaceous	12165547	12250000	1.006942
41	Deciduous Forest	5986002	6187500	1.033662
83	Small Grains	25013440	24875000	0.994465
21	Low Intensity Residential	3033627	3187500	1.050722

Record: 1 Show: All Selected Records (0)

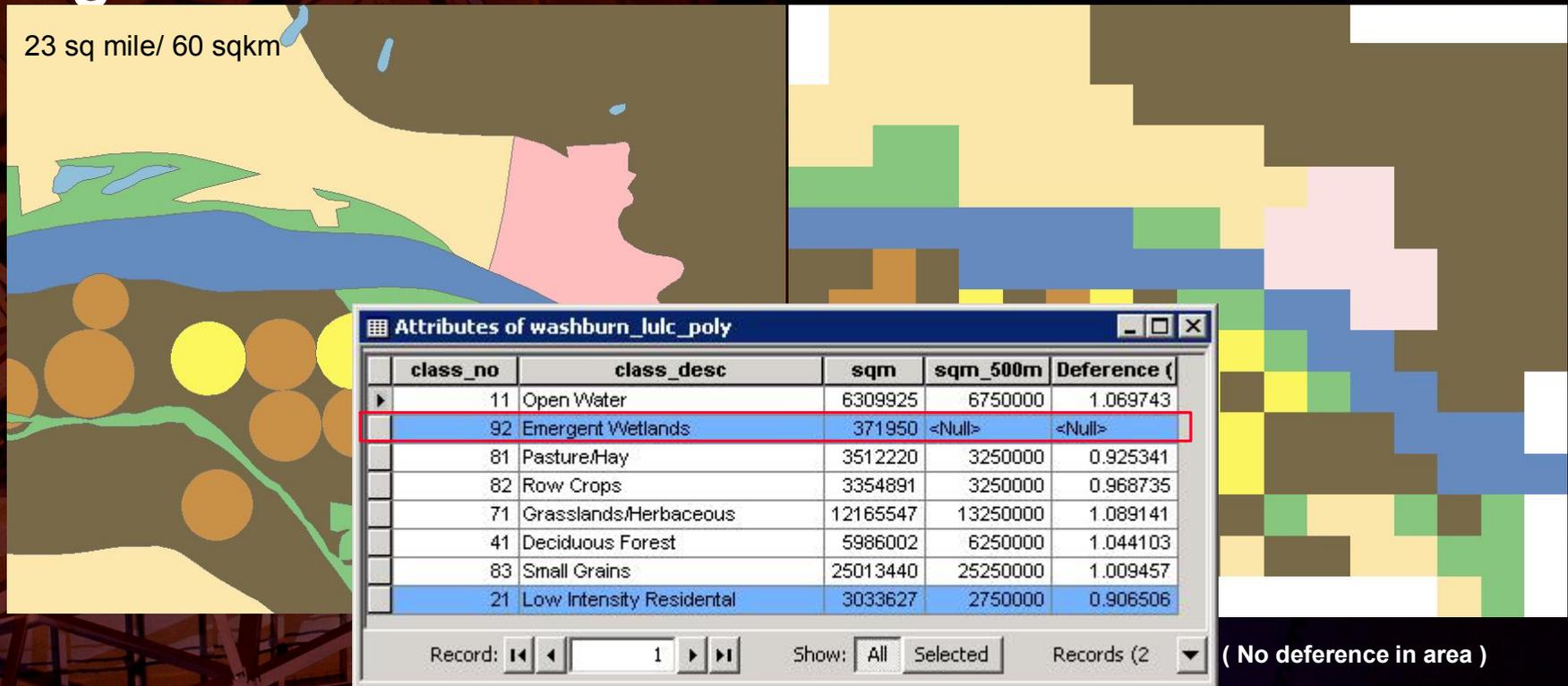
( 2.1% more area in raster )

Characterizing the landscape at 250m resolution was much easier than digitizing and most of the necessary information was still retained.

# Planning: Define the Study Area

Digitized

500m Resolution



Characterizing the landscape at 500m resolution was far easier than digitizing, but information has been lost (note the emergent wetlands class).

# Planning: Define the Study Area

- **Example of a realistic objective:**

- General crop/non-crop assessment of a region in northern Zimbabwe at 1km resolution for two time periods
- Resources: 1 month, 1 part-time staff  
*156,348 dot grids (records) to classify*

- **Example of an unrealistic objective:**

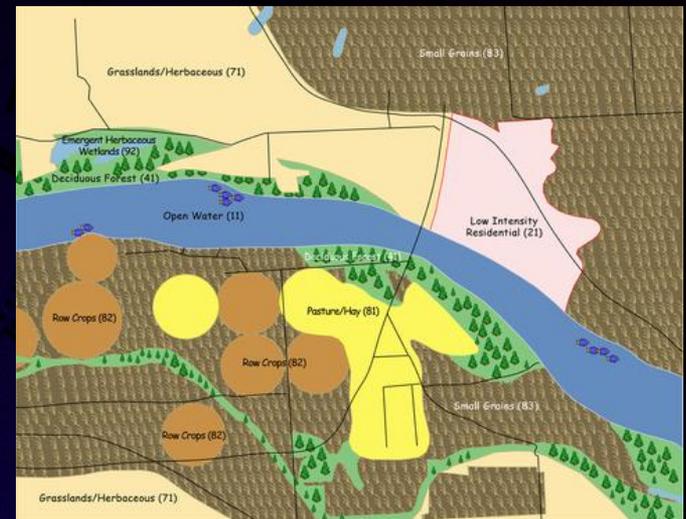
- General land cover/land use of Brazil at 250 m resolution for one time period.
- Resources: 12 months, 1 full-time staff.  
*~130 million dot grids (records) to classify*

# Planning: Define the Study Area

For this exercise we will be working on an area covering Washburn, ND. The extent of the area is defined by an ESRI Shapefile and uses a resolution of 250m.

**Important:** In order to ensure dot grid nesting and consistency of data RLCM allows only 50m, 100 m, 250 m, 500 m, 1,000 m, 2000 m, and 4000 m resolutions to be used.

**NOTE:** This exercise will use a graphical representation of the land cover for the selected study area.

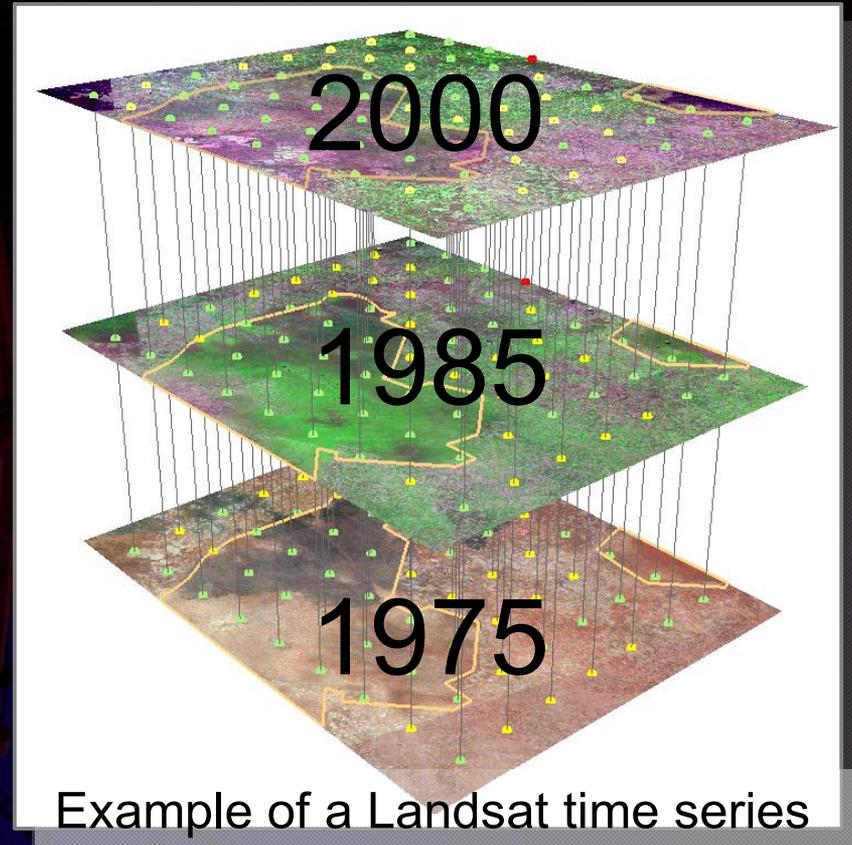


# Planning: Choose a Classification System

- RLCM currently is packaged with five land cover classification systems.
  - Sahel-West Africa land use/land cover
  - Anderson land use and land cover (Level II)
  - United States National Land Cover Data (NLCD92)
  - Global Land Cover 2000 (GLC2000)
  - Crop/Non-Crop
- RLCM does allow you to import a Land Cover Classification System (LCCS) legend in an xml format.
  - An LCCS legend is a method of applying an abstract LCCS classification to the study area at a defined scale and dataset (Gregorio, 2000). If you have an LCCS legend developed using LCCS's software, you can export that legend to a format for import into RLCM.
  - LCCS is a comprehensive hierarchical classification system developed by the Food and Agriculture Organization of the United Nations. For more information on the this system visit the [GLCN-LCTC](http://www.glcn-lccs.org/index.php) Web site (<http://www.glcn-lccs.org/index.php>).

# Planning: Determine Time Periods

- Time periods are defined as a range of dates for which an LULC classification is being interpreted.
- RLCM has no restrictions on the number of time periods applied to a study area.
- Typically, the dates defining the range of each time period are minimum and maximum acquisition dates of the available imagery.



**RLCM**

# **PREPARATION**

# Preparation: Create a Folder

With an area near Washburn, ND, defined as our study area, we first need to create a folder (directory) to contain all the required RLCM application files and data.

- Create a new folder under the “`...\rlcm_exercise`” folder named “`nd_washburn.`”

# Preparation: Collect and Prepare Imagery

- The only requirements for imagery in RLCM are that images have a spatial reference, a known acquisition date, and be in a file format supported by ESRI.
- It is a good, but not required, practice to collect all imagery used for an interpretation and put them in a single folder with sub-folders in which images of a common time period are grouped. This organizational practice will make managing the project much simpler.

# Preparation: Collect and Prepare Imagery

- Preparing imagery for RLCM's image library
  - During the process of building the image library with RLCM, several attributes are pulled from the imagery and stored in its database. These attributes include filename, path, acquisition date, number of bands, and projection information.
  - Of these attributes, four are required for an image to be used by RLCM. These are:
    - valid filename and path
    - projection parameters
    - acquisition date.
  - All are straightforward for RLCM to extract except the acquisition date. For the acquisition date to be extracted it must be embedded in the filename. If a file does not have the date embedded, it is entered into the library, but it will be unavailable to use until a valid acquisition date is entered.

# Preparation: Collect and Prepare Imagery

- Below is a list of the valid date strings that RLCM can extract from a filename. The date string does not need to be at a specific position in the filename, but it does need to be in one of the following formats:

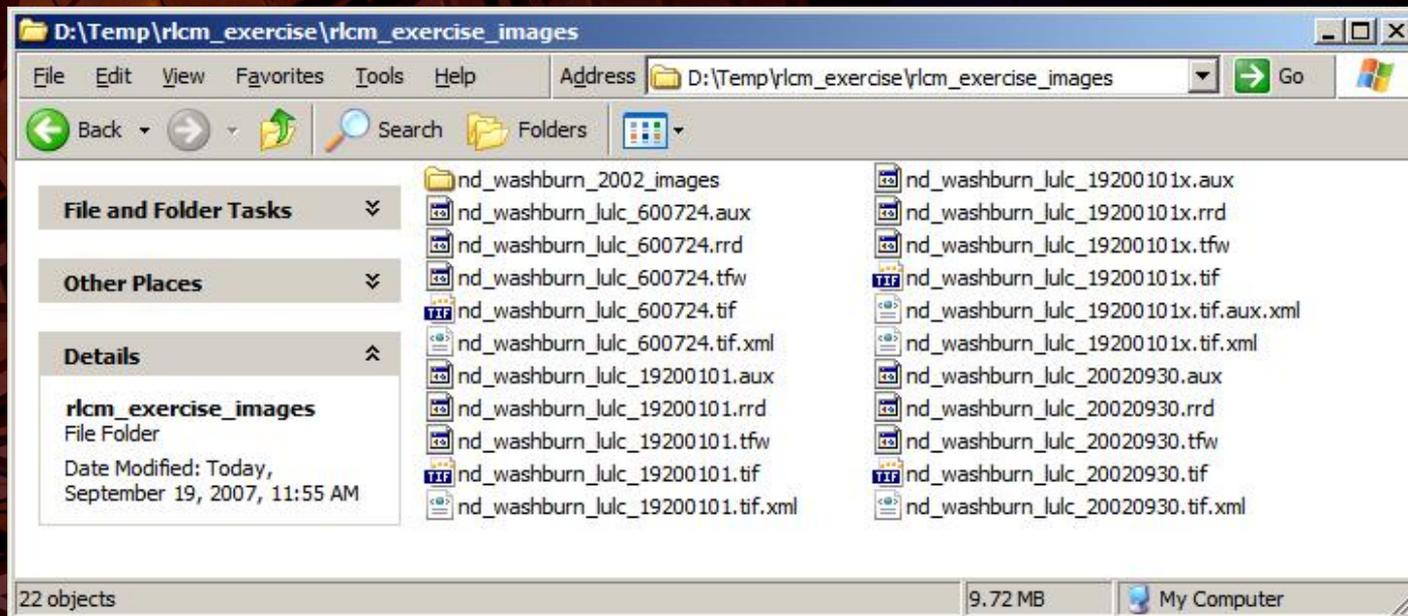
<u>MASK</u>	<u>Date String</u>	<u>Common Format (non-US)</u>
YYYY-MM-DD	1998-08-01	August 1, 1998 (1 August 1998)
YYYYMMDD	19750619	June 19, 1975 (19 June 1975)
DDMMYYYY	10021972	February 10, 1972 (10 Feb 1972)
DDMMMYYYY	01JAN2001	January 1, 2001 (1 Jan 2001)
MMDDYYYY	09302002	September 30, 2002 (30 Sept 2002)
YYYYJUL	2005205	July 24, 2005 (24 July 2005)

- Example: nd\_washburn\_lulc\_19750619.tif

**NOTE:** For information on date formatting see the RLCM Help documents appendix B or on-line at [http://edcintl.cr.usgs.gov/rlcm/appendix\\_b.php](http://edcintl.cr.usgs.gov/rlcm/appendix_b.php)

# Preparation: Collect and Prepare Imagery

- Review the image filenames in the “...\\data\\rlcm\_exercise\_images” folder and identify any problems. What problems do you see?

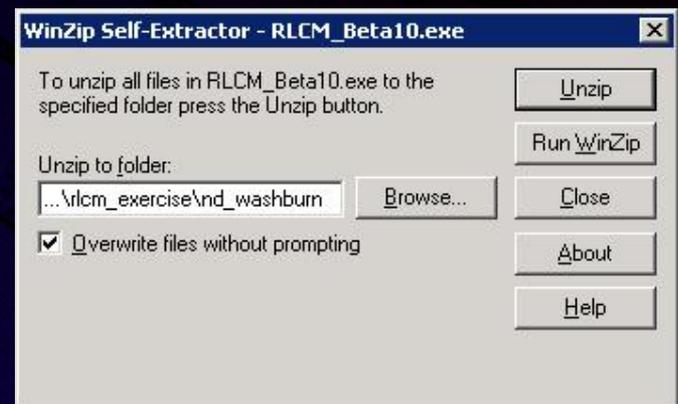


# Preparation: Collect and Prepare Imagery

- Open a Web browser, navigate to the RLCM Web site, and download the distribution file.

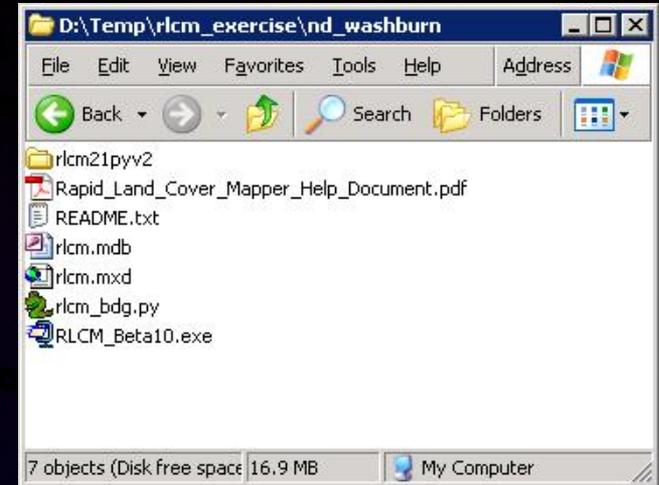
URL: <http://edcintl.cr.usgs.gov/rlcm/>

- Once downloaded, open the distribution file “RLCM\_Beta11.exe” and unpack (decompress) the contents to the “nd\_washburn” folder you created.



# Preparation: Installing RLCM

- Once unpacked in the “nd\_washburn” folder, the contents should be similar to those in the graphic shown to the right.

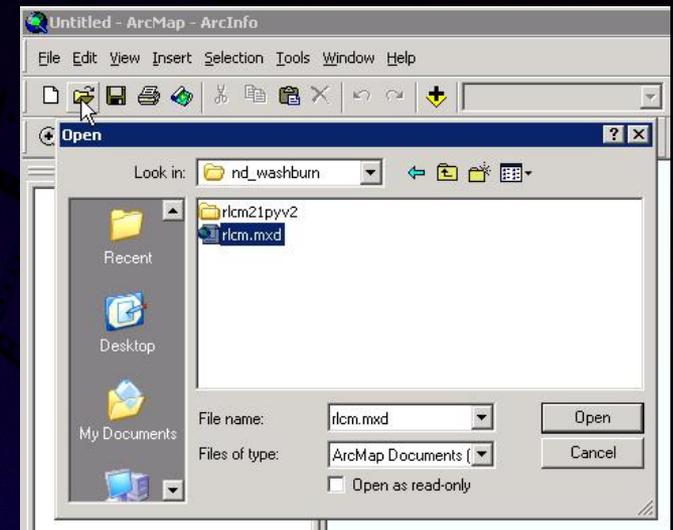


NOTE...

Because of the way the RLCM application is designed, do not rename any of the files in this folder.

# Preparation: Loading the Application

- To open the RLCM application, first open ESRI's ArcMap application.
- Once ArcMap is started, open the "rlcm.mxd" project file. Press the "Open" icon or "File | Open" on the menu bar.
- Navigate into the "nd\_washburn" folder and select the "rlcm.mxd" file.
- Press "Open."



# Preparation: Check the Toolbar



Once the RLCM tool is loaded into ArcMap, you should see a new toolbar within the ArcMap. The toolbar should look similar to the graphic shown above.

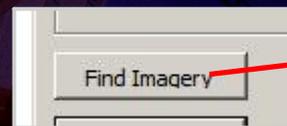
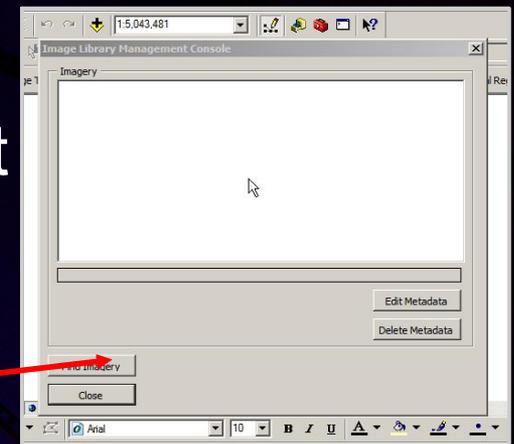
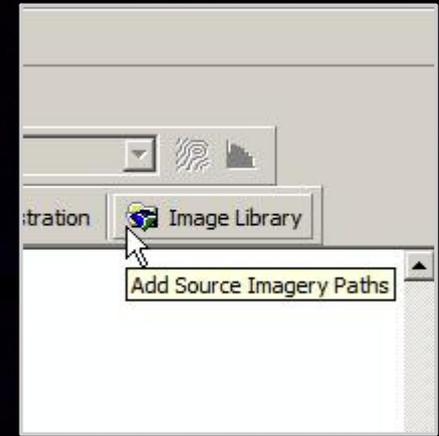
# Preparation : Toolbar



1. Add Study Area tool
2. Load Dot Grid feature class tool
3. Store Dot Grid feature class symbology button
4. Manage Time Periods button
5. Select Time Period dropdown
6. Dot Grid Attributer button
7. Exclusive Dot Grid Selection tool
8. Inclusive Dot Grid Selection tool
9. Clear Select button
10. Local Registration tool
11. Image Library tool
12. Import LCCS Legend file

# Preparation: Build the Image Library

- To build the initial image library, click the “Image Library” tool as shown in the graphic to the right.
- This will open the Image Library Management Console (ILMC). Initially there are no images in the library. To add imagery, click the “Find Imagery” button in the lower left of the ILMC.

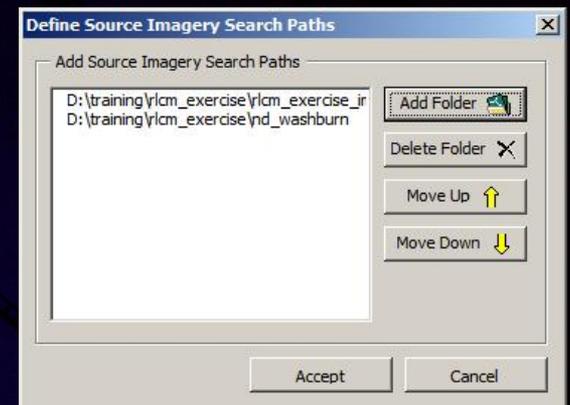
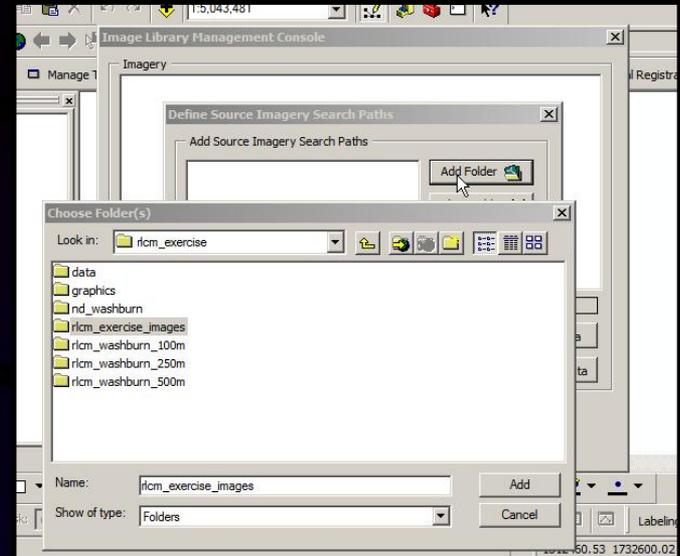


# Preparation: Build the Image Library

- A new window will open in which you will define the folders for RLCM to look for images. To add a folder click the “Add Folder” button.
- This will open a window in which you can navigate to the folder containing the imagery to be used for interpretation.
  - You can choose multiple folders. It is not required that all of your imagery be contained in a single folder or drive.

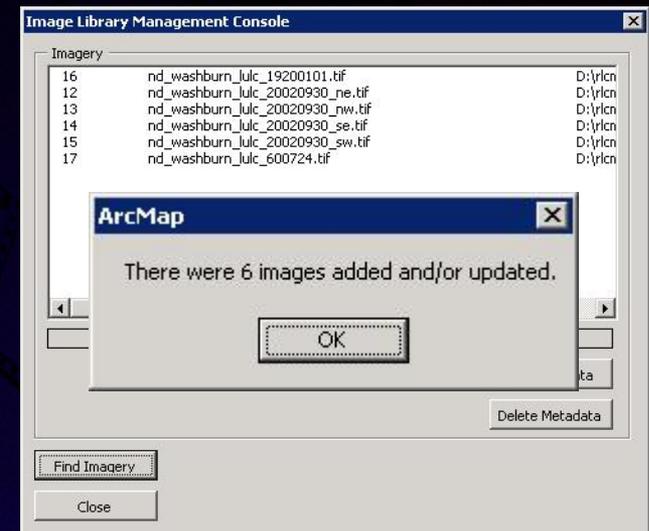
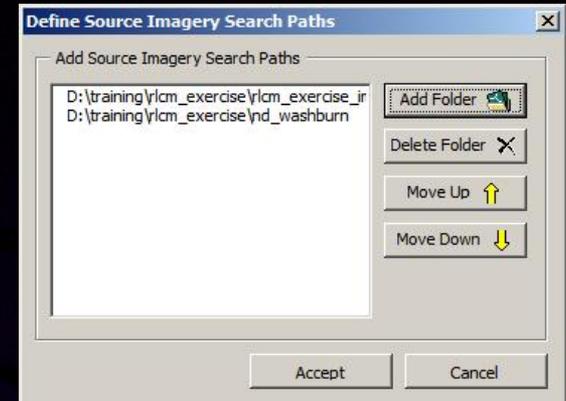
**NOTE:** *It is not necessary to include sub-folders of an already selected folder. RLCM searches them recursively.*

- Navigate into “...\rlcm\_exercise\data\” folder and select the “rlcm\_exercise\_images” and click the “Add” button.



# Preparation: Build the Image Library

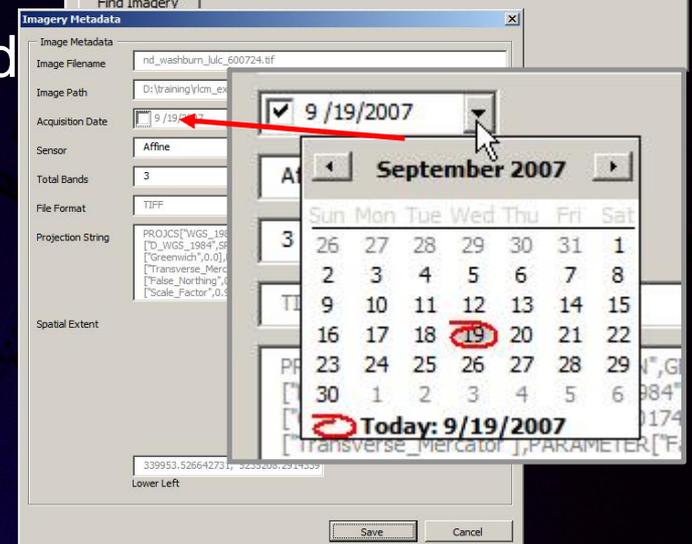
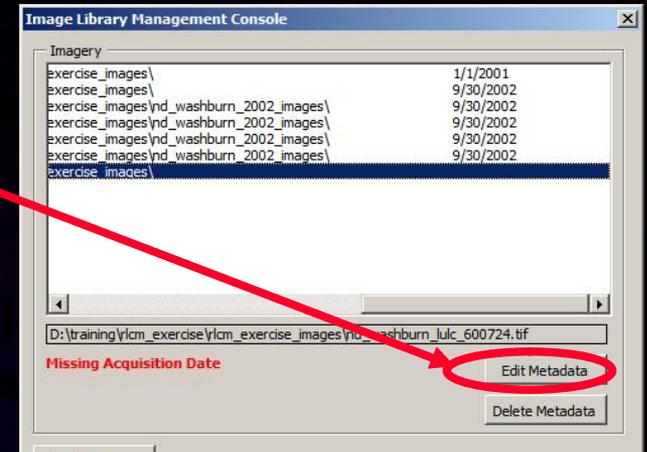
- When all the folders that contain the images are listed in the dialog box, click the “Accept” button.
- RLCM will now search all the folders listed and any subsequent ones for supported image file formats and add them to the library.
- In this exercise, a dialog box should appear indicating that six images were added to the library.





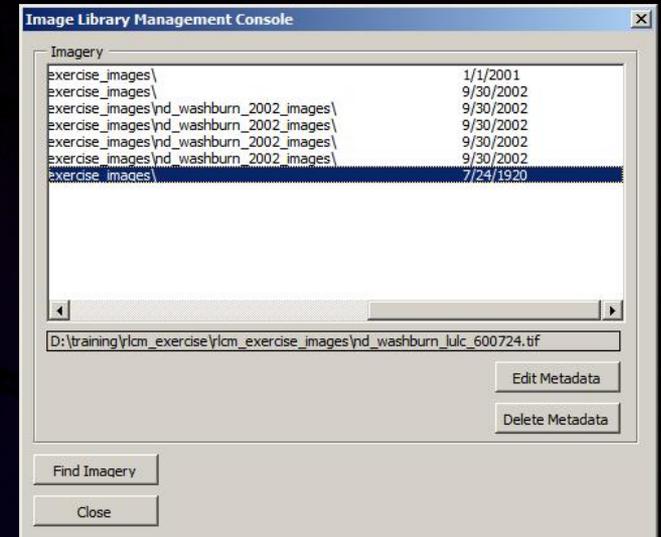
# Preparation: Build the Image Library

- To correct the missing date, click the “Edit Metadata” button. This will open a window showing all the metadata that was extracted when the library was built.
- To modify the acquisition date, click the pull-down list on the date field and select the correct date or manually enter the date. Enter the date indicated in the filename.
- Once the date has been corrected, click the “Save” button.



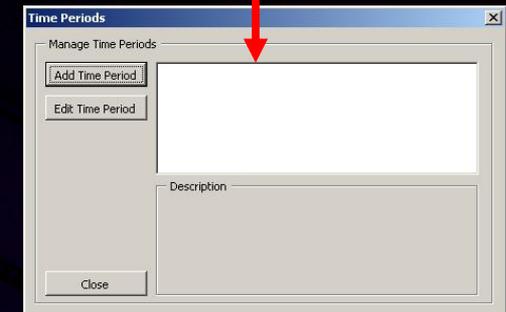
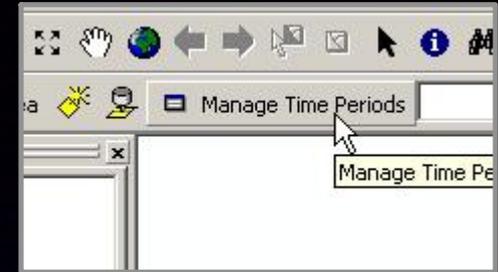
# Preparation: Build the Image Library

- In the ILMC, find the image you just corrected. It should now display an acquisition date of July 7, 1920.
- Close the ILMC.



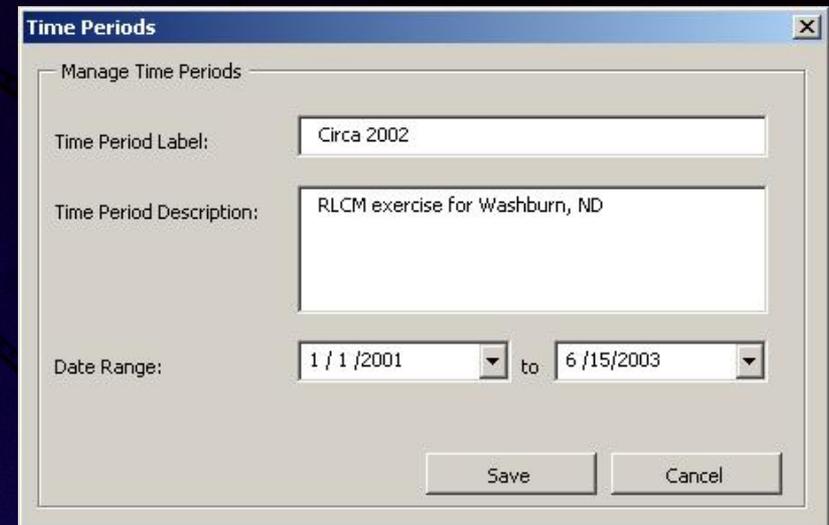
# Preparation: Define Time Periods

- To define a time period, click on the “Manage Time Periods” tool.
- The Time Periods dialog box will open, allowing you to add and edit time periods.
- Click the “Add Time Period” button on the dialog box.
- A new dialog box will open in which you can define the time periods.



# Preparation: Define Time Periods

- Three parameters are needed to define a time period: a name or label, a description, and a date range.
- Enter the following for the initial time period:
  - **Label:** Circa 2002
  - **Description:** RLCM exercise for Washburn, ND
  - **Date range:** 1/1/2001 through 6/15/2003
  - Click “**Save**”



Time Periods

Manage Time Periods

Time Period Label: Circa 2002

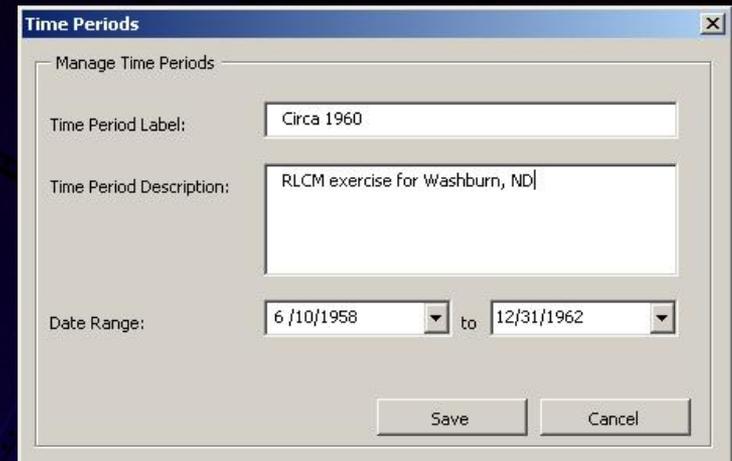
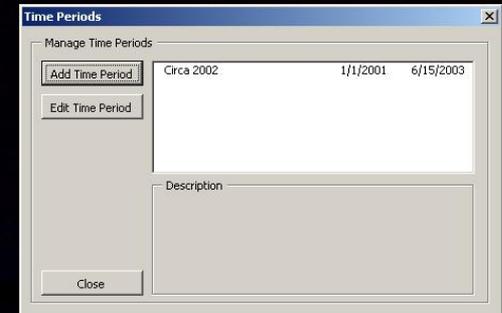
Time Period Description: RLCM exercise for Washburn, ND

Date Range: 1 / 1 /2001 to 6 /15/2003

Save Cancel

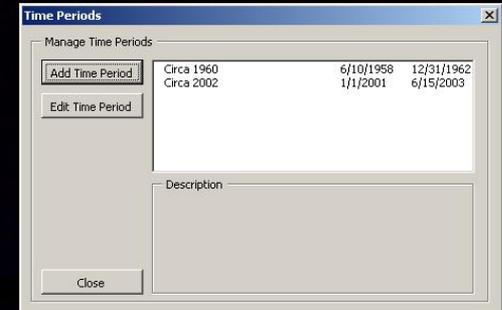
# Preparation: Define Time Periods

- The time period appears in the Manage Time Periods list.
- Click **“Add Time Period”** again to add the next period.
  - **Label:** Circa 1960
  - **Description:** RLCM exercise for Washburn, ND
  - **Date range:** 6/10/1958 through 12/31/1962
  - Click **“Save”**



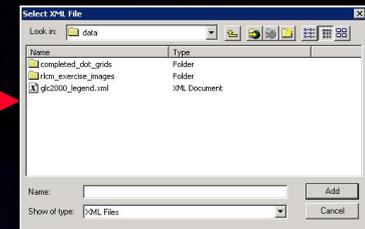
# Preparation: Define Time Periods

- Now there are two time periods that can be classified.
- The time periods can be modified at any time in the process, but if a classification has been applied to a period, its date range is restricted. It cannot have a range less than the minimum and maximum dates identified in the classification attributes.
- Click “Close” on the Time Periods dialog box to finish adding time periods.



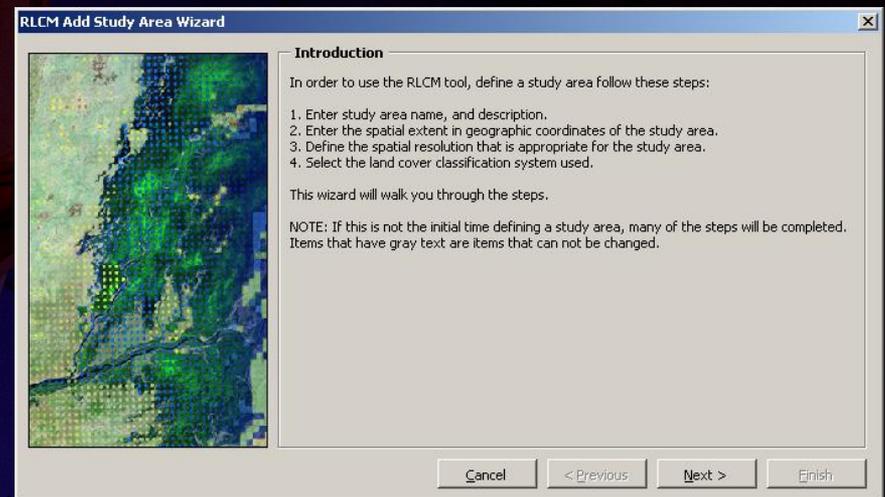
# Preparation: Importing the LCCS Legend File (optional)

- To load an LCCS XML legend file, click “Add LCCS Legend.”
- When the “Import LCCS Legend” dialog box opens, click on “Open Legend File.”
- Navigate to “...\rlcm\_exercise\data” and select the “glc2000\_legend.xml” LCCS legend file, click on “Add.”
- Enter the name of the classification system being imported and a brief description in the respective fields. By default the filename of the legend file is entered, but it can be changed. When you are finished entering the description, click the “Create Legend” button to import the table.
- Once the table has successfully been imported, this classification system will be available when building the study area.



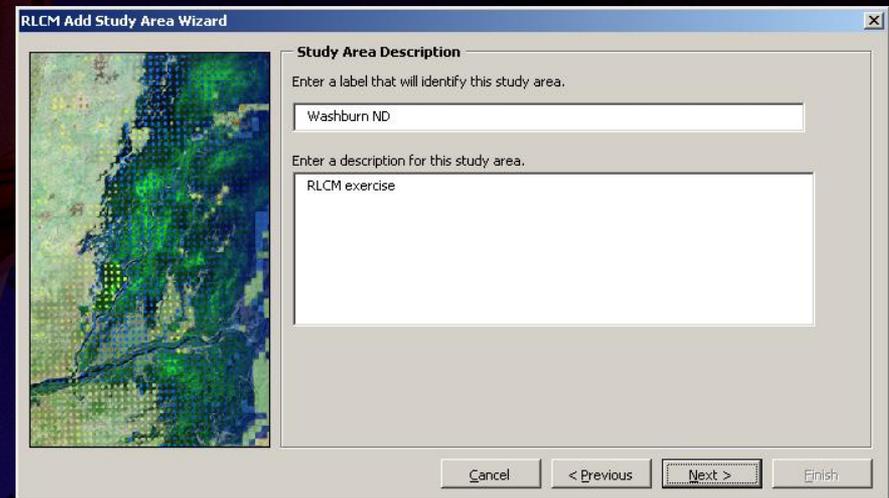
# Preparation: Define the Study Area

- To define a study area, click on the “Add Study Area” button. This will open the “RLCM Study Area Wizard,” which is a series of dialog boxes that will walk you through the study area definition process.
- The initial screen describes the steps involved in setting up a study area.



# Preparation: Define the Study Area

- The first step requires you to enter a study area name and an optional description.
- For the study area name, enter “Washburn ND.”  
NOTE: Don’t use commas or special characters in the name.
- For the description, enter “RLCM exercise.” Although this is optional, it is highly recommended.



RLCM Add Study Area Wizard

**Study Area Description**

Enter a label that will identify this study area.

Washburn ND

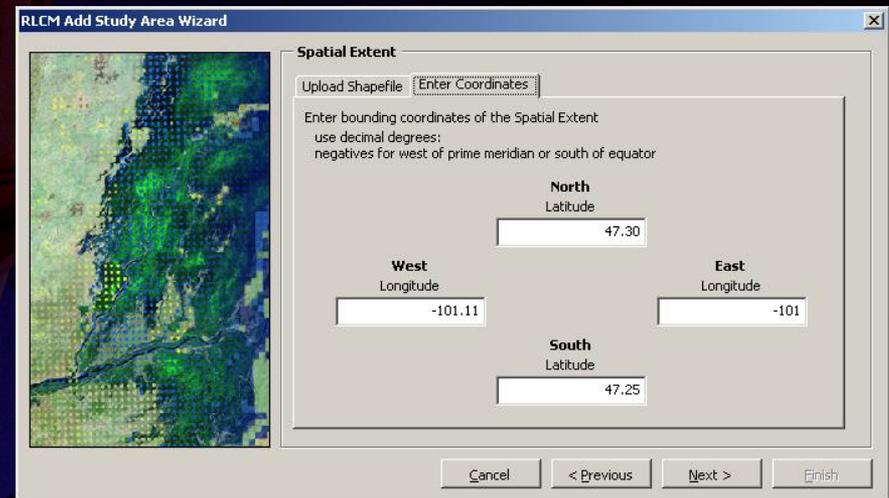
Enter a description for this study area.

RLCM exercise

Cancel < Previous Next > Finish

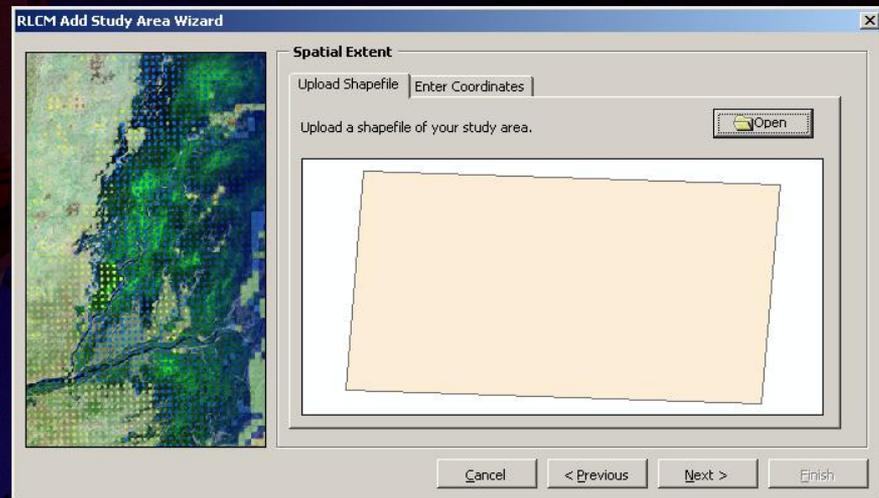
# Preparation: Define the Study Area

- Next, define the extent of the study area. This can be done by a) entering the bounding coordinates, or b) uploading an ESRI shapefile.
- To enter the bounding coordinates, click the “Enter Coordinates” tab and enter the coordinates in their respective fields.



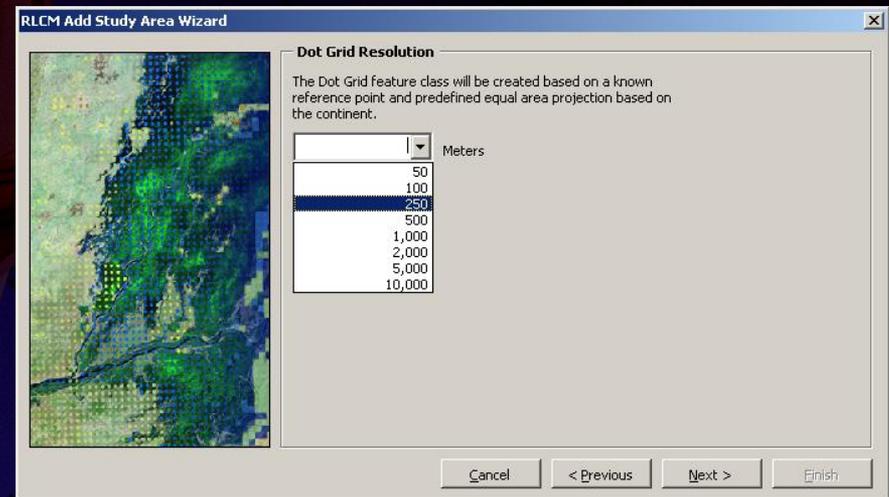
# Preparation: Define the Study Area

- Next, upload a shapefile. Select the “Upload Shapefile” tab and then click the “Open” button.
- In the file dialog box, navigate to the “...\\rlcm\_exercise\\rlcm\_exercise\\data” folder and select “washburn\_extent.shp” shapefile.
- Once uploaded, click “Next.”



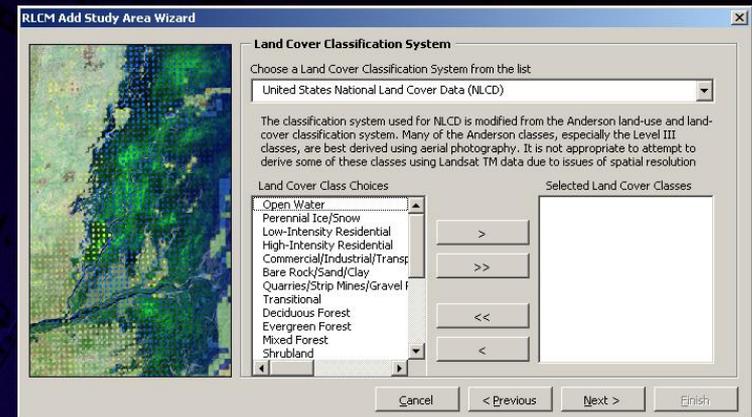
# Preparation: Define the Study Area

- The next step is to define the resolution of the land cover classification. To ensure dot grid nesting and consistency of data, RLCM allows only a specific resolution to be chosen.
- Click the resolution field and select **250** from the drop-down menu.
- Click “Next.”



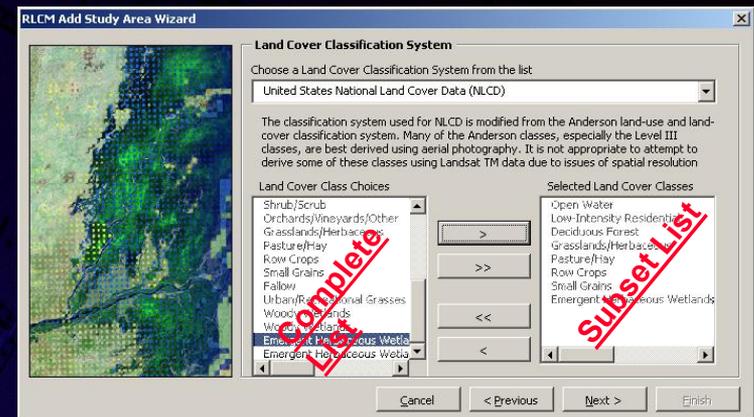
# Preparation: Define the Study Area

- Now you will select the land cover classification system and define which classes you wish to have displayed in the land cover attribute tool.
- From the top drop-down menu, select the United States National Land Cover Data (NLCD).
- Notice that once a system is selected, the lower left box is populated with all the classes in that system.



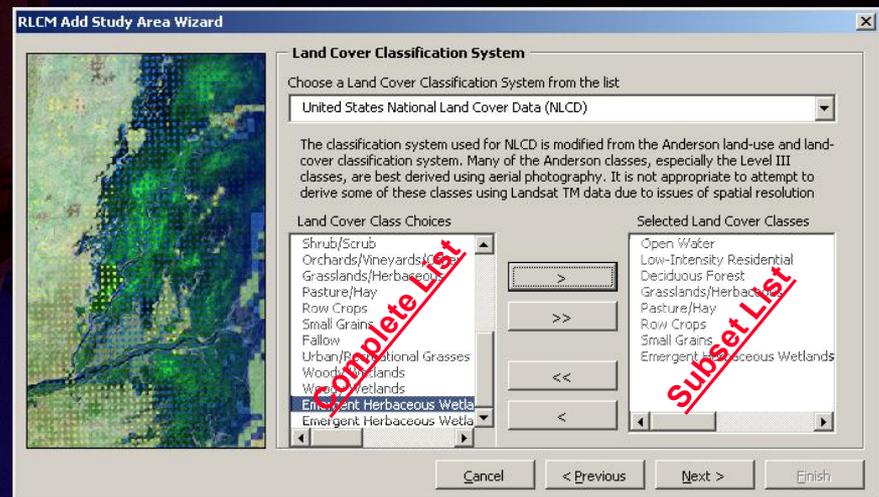
# Preparation: Define the Study Area

- Next, select the classes which are common in your study area. Classification systems often have more classes than are necessary for a given area. So to make selecting easier, RLCM has you define a subset of classes that you expect to identify in the study area. This subset will be listed in RLCM's classification attributer, simplifying the task of selecting and applying classification attributes.
- If you find that additional classes are needed, step back through the wizard and add them at any time in the classification process.
- If you wish to add all the classes select the ">>" button.



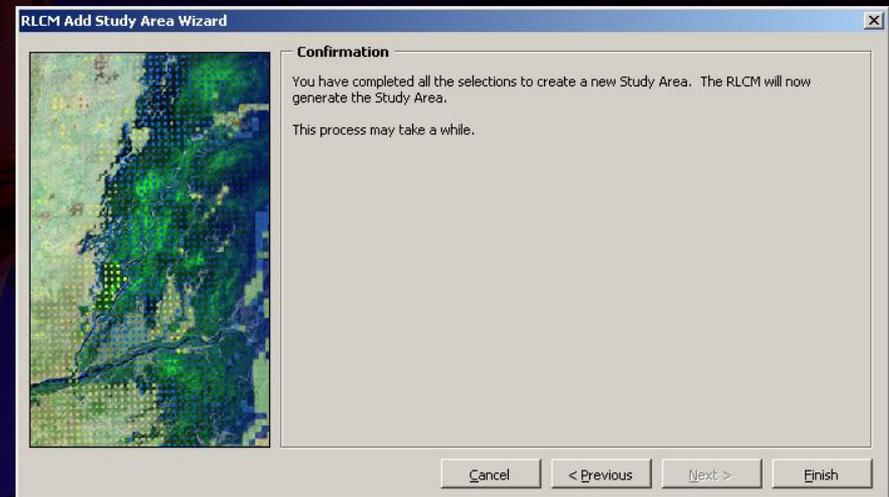
# Preparation: Define the Study Area

- To move a class to the subset list, select it from the class choices list and click the “>.” To remove a class from the subset list select it in the subset list and click “<.” To remove all from the right, press “<<.”
- For this exercise, add the following classes to the subset list.
  - Open Water
  - Low-Intensity Residential
  - Deciduous Forest
  - Grasslands/Herbaceous
  - Pasture/Hay
  - Row Crops
  - Small Grains
  - Emergent Herb. Wetlands



# Preparation: Define the Study Area

- The final step is to build the dot grid dataset. This process can take up to an hour, depending on the size of the area and the preferred resolution. Therefore, it is recommended that the dot grids be kept under about 200,000 records.



# Preparation: Define the Study Area

- If the desired study area is quite large, consider dividing it into smaller areas and merging them when classification is complete. Because all study areas are built on a common projection and reference point in RLCM, they will merge together seamlessly.
- To change any aspect of the study area definition, select the “Previous” button to step back through the wizard and make changes. Once the “Finish” button is pressed and the dot grid is built, few items can be changed.
- Click the “Finish” button to build the “Washburn, ND” study area. This should take only a few minutes.



# Preparation: Define the Study Area

- Once building the study area is complete, you will see the dot grids added to the table of contents (TOC) in ArcMap.





**RLCM**

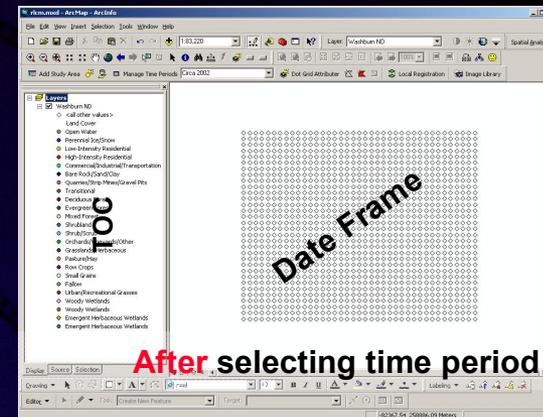
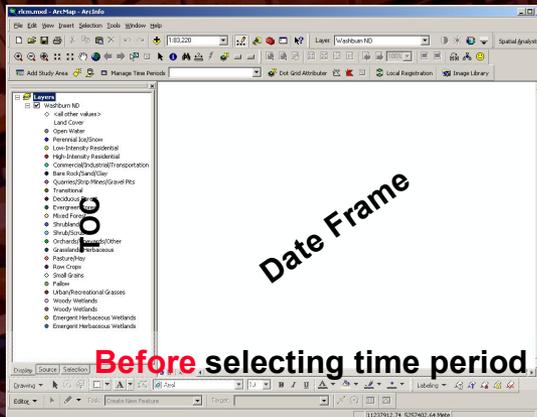
# **PRODUCT DEVELOPMENT**

# Product Development: Begin Classification

- Three components must be in place in RLCM before any land cover classifying can begin.
  - A defined study area must be loaded and visible in an ArcMap data frame.
  - A time period must be selected.
  - One or more images must be loaded in the data frame, be recorded in the image library, and fall within the selected time period.

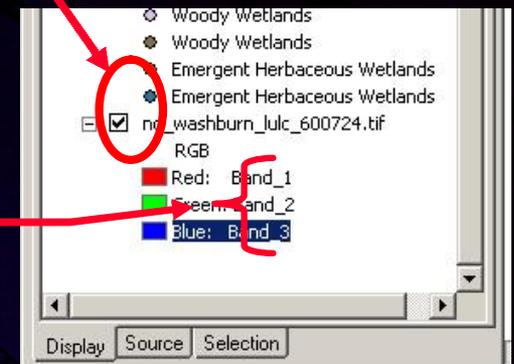
# Product Development: Begin Classification (Select Time Period)

- To begin classifying, a time period needs to be selected.
- From the “Select Time Period” drop-down menu, select “Circa 1960.”
- The dot grids should be displayed in the data frame.



# Product Development: Begin Classification (Load Images)

- Next, an image must be loaded into the data frame.
- In ArcMap, click the “Add Data” button  and navigate to “...\rlcm\_exercise\data\rlcm\_exercise\_images” and select the appropriate image file(s).
- If the image is not visible, click the check box next to the image name in the TOC (see red circle).
- To view the image in the correct color scheme, verify that the band combination reads 1, 2, 3. See graphics to the right.



# Product Development: Begin Classification (Selection Tools)



- RLCM has two methods and two modes for selecting dot grids.

- Methods:

- **Regular** polygon selection – initiated by a left click and drag.
- **Irregular** polygon selection – initiated by a right mouse click and by applying subsequent left clicks to define the path of a polygon and a final left double-click to close the polygon.

- Modes



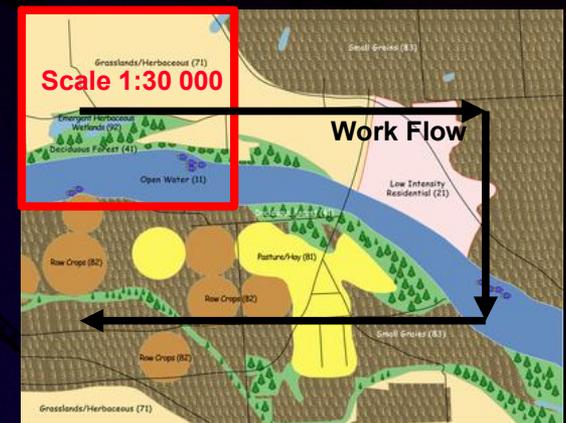
- **Exclusive** mode allows the selection of dot grids using either method, but any current selections will be removed once a new selection method is initiated.



- **Inclusive** mode allows the selection of dot grids using either method and will maintain previous selections.

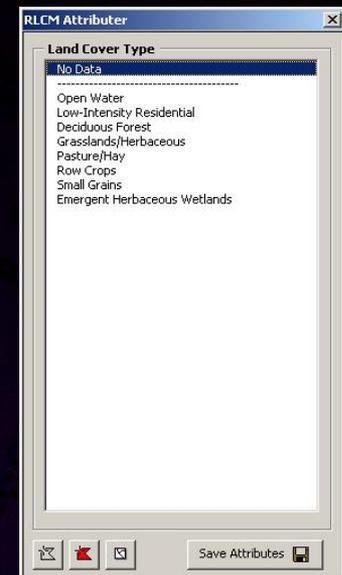
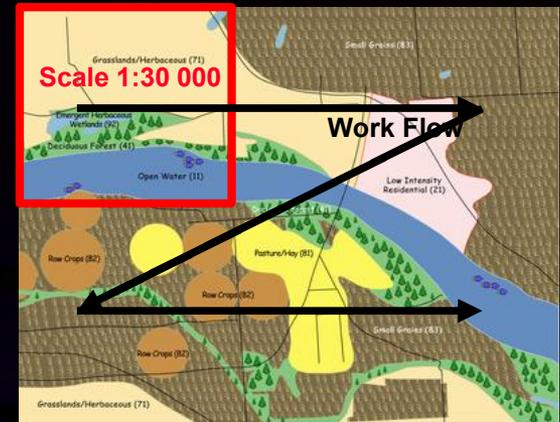
# Product Development: Begin Classification (Preparation)

- Before classifying any dot grids, a systematic approach of moving through the study area should be determined.
  - What is the appropriate scale for making interpretations?
  - Where is the best place to start?
  - Is there a priority area?
  - What is the best direction and flow?



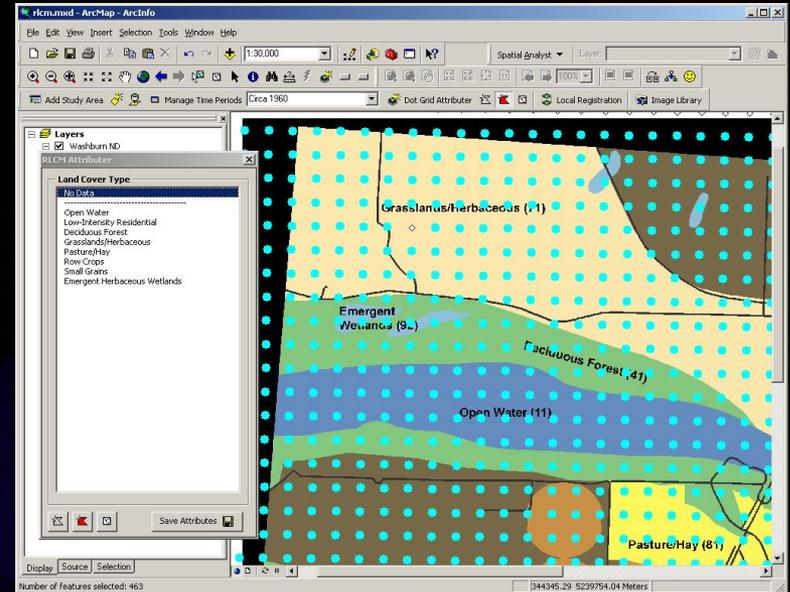
# Product Development: Open Attributer

- In this exercise, you will use a scale of 1:30,000 and start in the NW corner of the study area and move west to east.
- In ArcMap, move to the NW corner of the study area.
- Set the scale to 1:30,000.
- Open the Attributer by selecting the “Dot Grid Attributer” tool.
- The Attributer tool will show the subset of classes selected earlier in the Study Area Wizard.



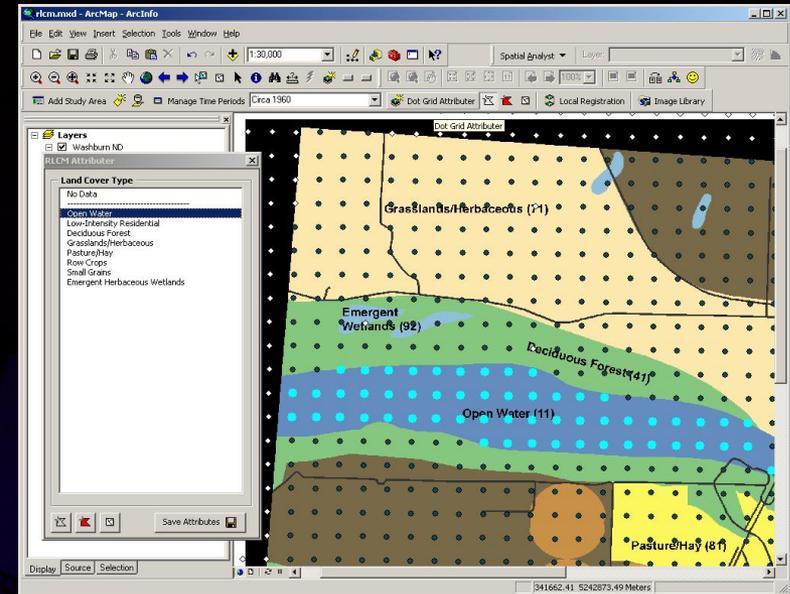
# Product Development: Begin Classification (1960s Dot Grids)

- Before starting to classify dot grids, look at the image and determine the dominant class.
- Select all the dot grids in the viewable area using the regular polygon select method.
- Assign the dominant class to the selected dot grids. This is called the “*Dominant class strategy*.”
- To assign a class to the selected dot grids, choose the dominant class from the list in the attributer and click the “Save Attribute” button or double-click the dominant class.
- Notice that the selected dot grids are not cleared. To clear the selected dot grids, click “Clear Selection”  on either the Attributer window or the RLCM toolbar.



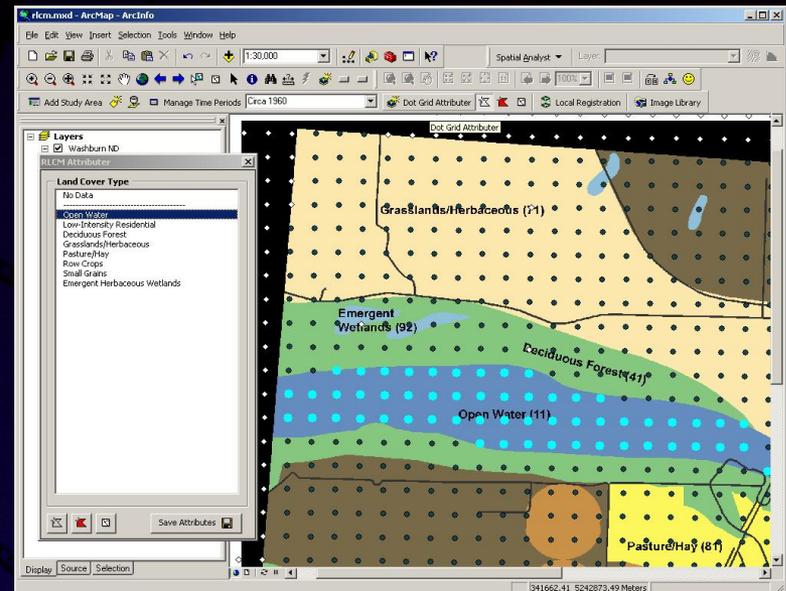
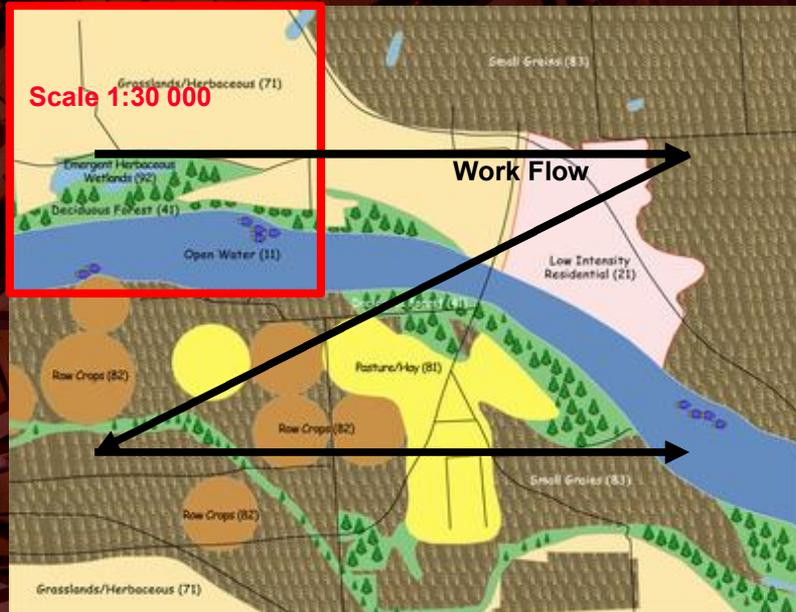
# Product Development: Begin Classification (1960s Dot Grids)

- Next, select each minor class within the viewable area using the most efficient method and mode and assign the appropriate class.
- Attributes are saved to the RLCM database each time a class is assigned. So in the event that ArcMap crashes, the attributes applied won't be lost.



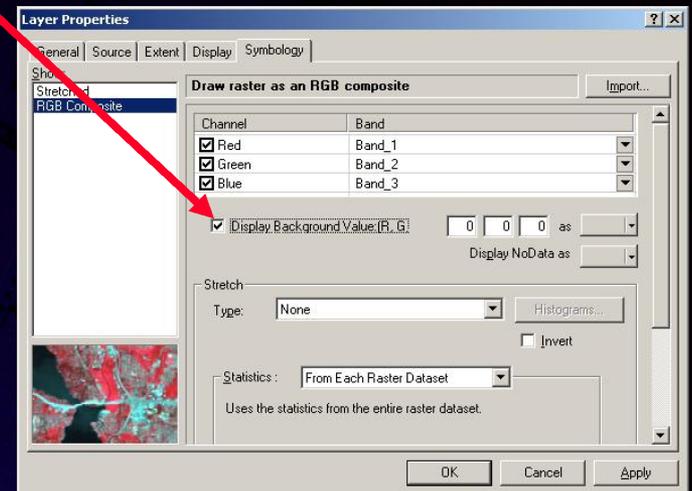
# Product Development: Begin Classification (1960s Dot Grids)

- Pan through the entire study area applying the “*Dominant class strategy*” to the 1960s time period.



# Product Development: Begin Classification (2002 Dot Grids)

- Once the 1960s dot grids are completed, load two of the four 2002 images.
- If necessary, correct any band combination issues.
- In the image properties, set the background color of the image to transparent.
- Zoom to the appropriate starting location and scale, and begin classifying the dot grids.
- Verify that the correct images are visible.

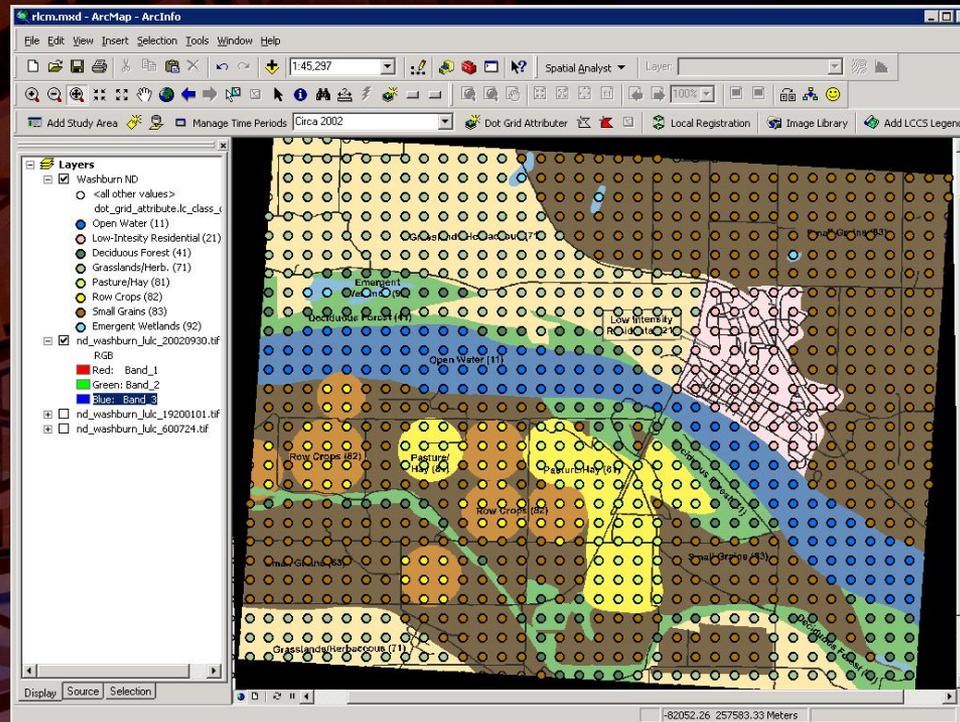


# Product Development: Begin Classification (2002 Dot Grids)

- Did everything work?
- If not, you may have forgotten to change the time period to “Circa 2002,” which would prevent you from classifying any points on the 2002 images.
- RLCM identifies each point being classified and verifies that the underlying image falls within the selected time period. This ensures that only images falling within the time period can be interpreted. This is also why only images listed in the Image Library with declared acquisition dates are used.

# Product Development: Begin Classification (2002 Dot Grids)

- Change the time period to “Circa 2002,” load the remaining 2002 images, and complete the classification.



# Product Development: Begin Classification (1920s Dot Grids)

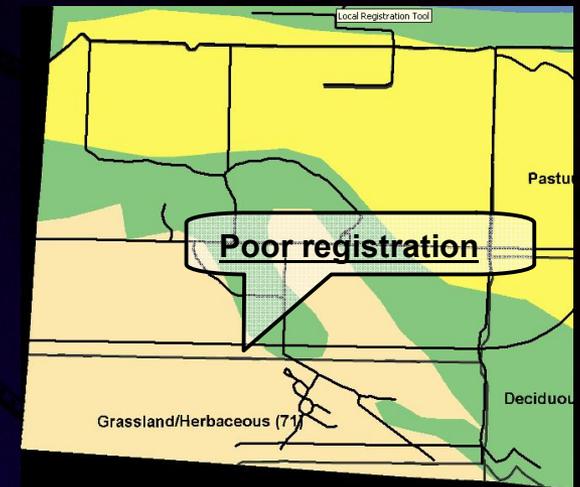
- Load the 1920 image “nd\_washburn\_lulc\_19200101.tif” located in the “...\rlcm\_exercise\data\rlcm\_exercise\_images” folder.
- Now change the time period to “Circa 1920.”
- Problem?
- Open the “Manage Time Period” window and add the “Circa 1920” time period.
- Define the period based on the date of the 1920 images available (Hint: there is only one).

# Product Development: Use the Local Registration Tool

- Using the “Add Data” button, load the vector BTS roads shapefile “washburn\_roads.shp” from the “...\rlcm\_exercise\data\rlcm\_exercise\_data” folder.
- Position roads layer above the 1920s images in the TOC and make those two layers the only ones visible.
- Compare the roads on the image and the vector data, keeping in mind that the BTS roads has the superior spatial accuracy.
- What is wrong?

# RLCM: Using Local Registration Tool

- Using the 1920 image “as is,” would the land cover classification be accurate? What would happen in a time series comparison?
- What should you do to correct this problem?
  - Apply a new spatial correction to the image?
  - Acquire a better image?
  - Throw out that time period?
  - Use image “as is”?



# Product Development: Use the Local Registration Tool

- RLCM's Local Registration Tool" helps you deal with minor georegistration issues such as this.
- The tool provides a simple method for adjusting poorly registered imagery at the appropriate interpretation scale or local area.
- The tool allows you to shift the image to the correct location at the local area. This is a temporary shift and does not affect the stored georeferencing information.

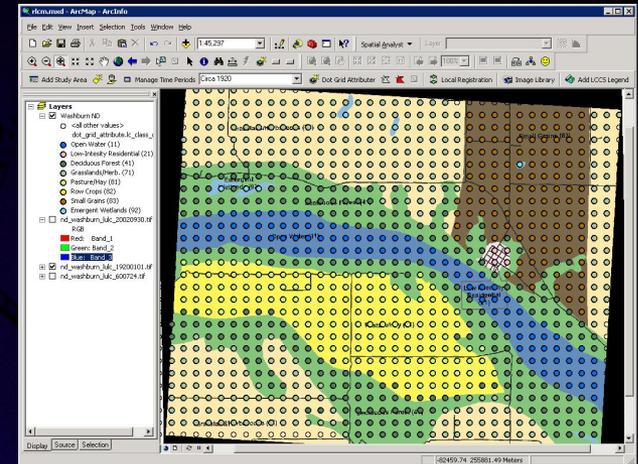
# Product Development: Use the Local Registration Tool

- With only the accurately spatially referenced layer and the 1920s mis-register image visible, zoom to an area where there is poor registration (hint: SW corner) and set the scale to 1:30,000.
- In the visible area, identify a common point between the two sources. Here, road intersections are the most appropriate.
- Once a common point is identified, select the 1920 image layer in the TOC (This is important).
- Select the “Local Registration” tool.
- Click the identified point on the 1920s image or “from location.”
- Click the identified point on the BTS road layer or “to location.”
- The 1920s image should shift to the “to location” and you should see a better registration at the “local area.”



# Product Development: Use the Local Registration Tool

- You may need to repeat these steps several times to reach the desired accuracy. You will also need to repeat these steps again when you move outside an area when the classification has been completed.
- Move through the remaining 1920 images and complete the classification while also correcting any local georegistration problems.

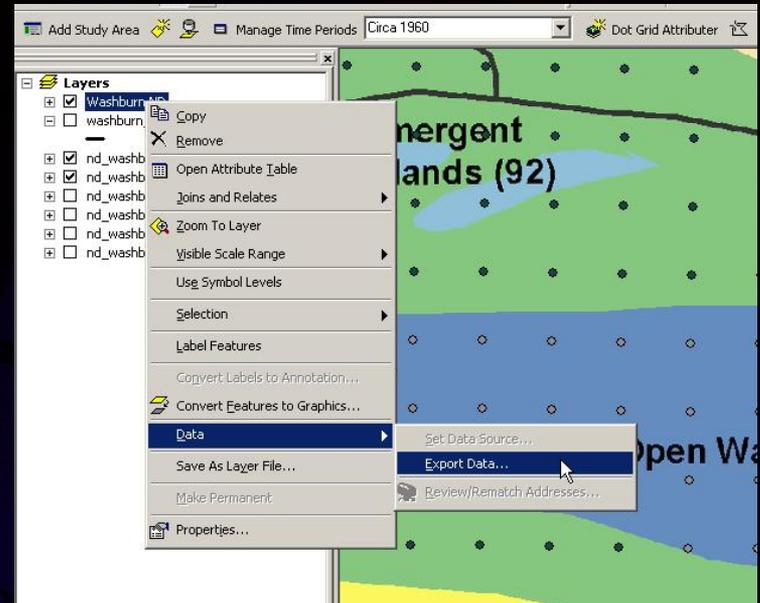


# Product Development: Export to Vector Format

- Once the classifications are completed, how do you get the data out of RLCM?
- Because the dot grid layer is not a simple ArcGIS feature class but is made up of several database relationships, it is not as simple as going into the ArcCatalog and exporting the dot grid feature class.
- Rather, the best way to export the dot grid for a selected time period is to select the dot grid feature class in the RLCM application and use ArcMap's export tool. By using this method, you don't need to re-create the relationship yourself.

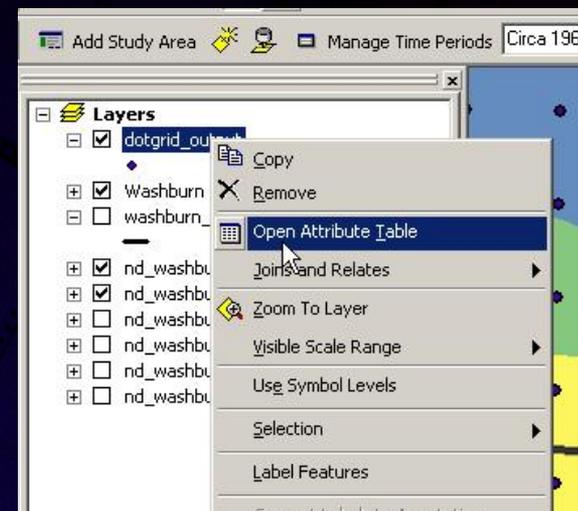
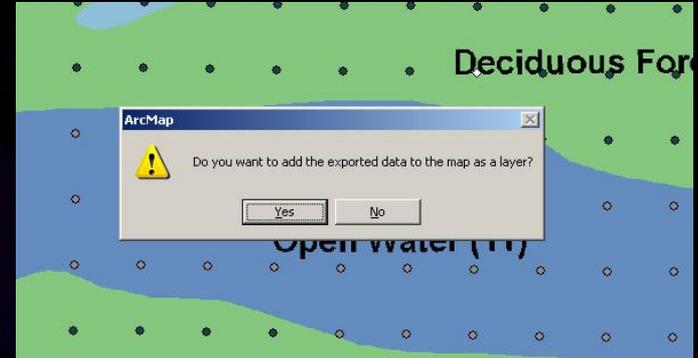
# Product Development: Export to Vector Format

- Select the time period you wish to export.
- Identify the dot grid layer (Washburn ND) in the ArcMap TOC.
- Right click on that layer and select “Export Data” under the “Data” option on the menu.
- Select the desired option in the “Export Data” dialog and click “OK.”



# Product Development: Export to Vector Format

- Click “Yes” when asked if you want to add the layer to the map.
- Right click on the layer just added and select the “Open Attribute Table” option.



# Product Development: Explore the Dot Grid Attribute Table

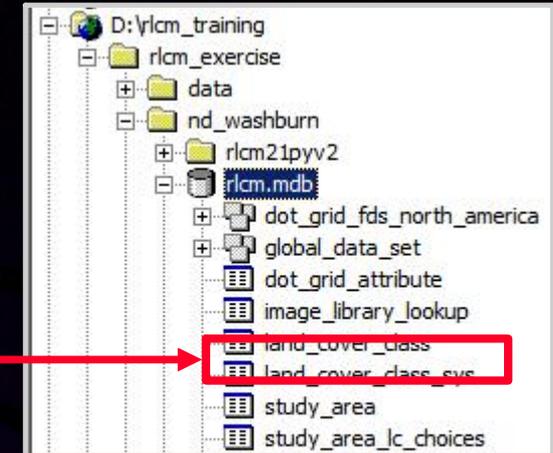
<b>xyp</b>	defines the relationship between the dot grid attribute table and the dot grid feature class
<b>period_id</b>	identifies the time period that is related to the classification
<b>study_area_id</b>	identifies what study area is being interpreted
<b>lc_class_code</b>	land cover class code assigned to dot grid
<b>lc_class_sys_id</b>	identifies the land cover class system used
<b>image_id</b>	identifies the image used to make interpretation
<b>date_interpreted</b>	date the interpretation was made

Selected Attributes of Washburn ND

dot_grid_fc.Washburn_ND.xyp	dot_grid_attribute.period_id	dot_grid_attribute.study_area_id	dot_grid_attribute.lc_class_code	dot_grid_attribute.lc_class_sys_id	dot_grid_attribute.image_id	dot_grid_a
-80250_256500	2	1 71		3	6	9/21/2007
-80000_256500	2	1 71		3	6	9/21/2007
-79750_256500	2	1 71		3	6	9/21/2007
-79500_256500	2	1 71		3	6	9/21/2007
-79250_256500	2	1 71		3	6	9/21/2007
-79000_256500	2	1 71		3	6	9/20/2007
-78750_256500	2	1 71		3	6	9/21/2007
-80250_256750	2	1 71		3	6	9/21/2007

# Product Development: Export to Vector Format

- With the exception of “lc\_class\_code” and “date\_interpreted” fields, all the rest store integer values that relate back to other tables.
- In the graphic, follow the path of the “lc\_class\_sys\_id” in the dot grid attribute table to the “land\_cover\_class\_sys” table. Notice that “OBJECTID” is the same value as the “...lc\_class\_sys” value.



OBJECTID*	label	description
1	Sahel-West Africa land use/land cover	Default Classification System
2	Anderson land-use and land cover (Level II)	This classification framework is
3	United States National Land Cover Data (NLCD)	The classification system used
4	Global Land Cover 2000 (GLC2000)	The global land cover 2000 (GL
5	Crop/Non-Crop	Used to do simple crop non-cro

Record: 1 Show: All Selected Records: (1 out of 5 Selected.)

dot_grid_fc.Washburn_ND.xyp	dot_grid_attribute.period_id	dot_grid_attribute.study_area_id	dot_grid_attribute.lc_class_code	dot_grid_attribute.lc_class_sys_id	dot_grid_attribute.image_id	dot_grid_a
-80250_256500	2	1 71		3	6	9/21/2007
-80000_256500	2	1 71		3	6	9/21/2007
-79750_256500	2	1 71		3	6	9/21/2007
-79500_256500	2	1 71		3	6	9/21/2007
-79250_256500	2	1 71		3	6	9/21/2007
-79000_256500	2	1 71		3	6	9/20/2007
-78750_256500	2	1 71		3	6	9/21/2007
-80250_256750	2	1 71		3	6	9/21/2007

# Product Development: Export to Vector Format

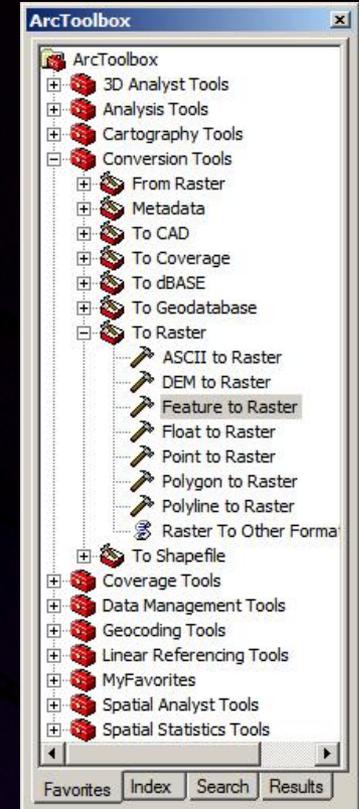
- When a dot grid feature class is exported to a shapefile, the attribute fields are truncated to 10 characters. The data in string field values are truncated to 255 characters.

Shape <sup>a</sup>	xyp	period_id	study_area	date_inter	lc_class_c	lc_class_s	image_id
Point	-84000_255000	2	1	9/20/2007	71	3	6
Point	-83750_255000	2	1	9/20/2007	71		6
Point	-83500_255000	2	1	9/20/2007	71		6
Point	-83250_255000	2	1	9/20/2007	71		6
Point	-83000_255000	2	1	9/20/2007	71		6
Point	-82750_255000	2	1	9/20/2007	71		6
Point	-82500_255000	2	1	9/20/2007	71		6
Point	-82250_255000	2	1	9/20/2007	71		6
Point	-82000_255000	2	1	9/20/2007	11		6
Point	-81750_255000	2	1	9/20/2007	11		6
Point	-81500_255000	2	1	9/20/2007	11		6

Graphic of table is truncated

# Product Development: Export to Raster Format

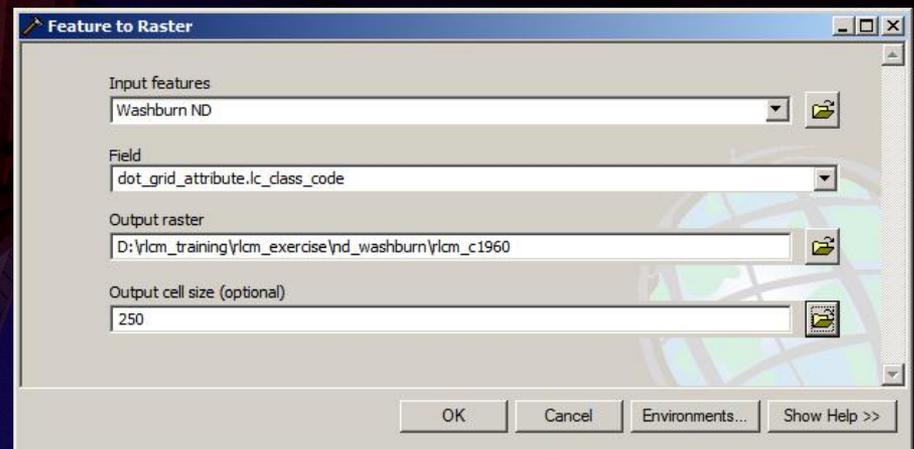
- To export a dot grid to a raster format for a selected time period, use the ArcGIS “Feature to Raster” tool.
- Open the ArcGIS toolbox window by clicking the Toolbox icon. 
- In the Toolbox window, navigate to the “Feature to Raster” tool.  
*Path: ArcToolbox | Conversion Tools | To Raster | Feature to Raster*
- Open the tool.



# Product Development: Export to Raster Format

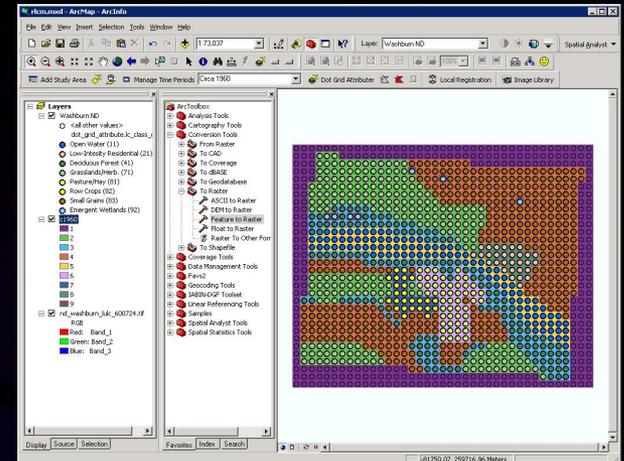
- In the “Features to Raster” tool, select “Washburn ND” as the Input feature.
- Select “dot\_grid\_attribute.lc\_class\_code” for the Field value.
- Set “...\\rlcm\_exercise\\nd\_washburn\\rlcm\_1960” as the Output raster.
- Set 250 as the output cell size.
- Click OK.

**NOTE:** If raster output pixels are not centered on the dot grid points, verify that the “Extent setting” in the Toolbox’s Environmental setting | General Settings is set to “Default.”



# Product Development: Export to Raster Format

- When the conversion is completed, the raster layer should load into ArcMap's TOC.
- Make the newly converted raster layer visible, if it isn't already.
- Open the raster layer's attribute table.
- Notice that the numbers in the "Value" field do not coincide with the NLCD code you assigned during classification. These values are stored in the "Lc\_class\_code." Depending on the use of the output raster it may be necessary to reclassify the values to represent the values in the "Lc\_class\_code" field.



ObjectID	Value	Count	Lc_class_code
0	1	290	
1	2	236	71
2	3	147	41
3	4	362	83
4	5	100	11
5	6	51	81
6	7	25	82
7	8	30	21
8	9	7	92

# Q & A

Questions?

# References

- Gregorio A. D., Jansen L. J., 2000, Land Cover Classification System – LCCS – Classification Concepts and User Manual. Rome, Food and Agriculture Organization of the United Nations. p 41.

**NOTE:** Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.