

## Surfacing Land Measurements

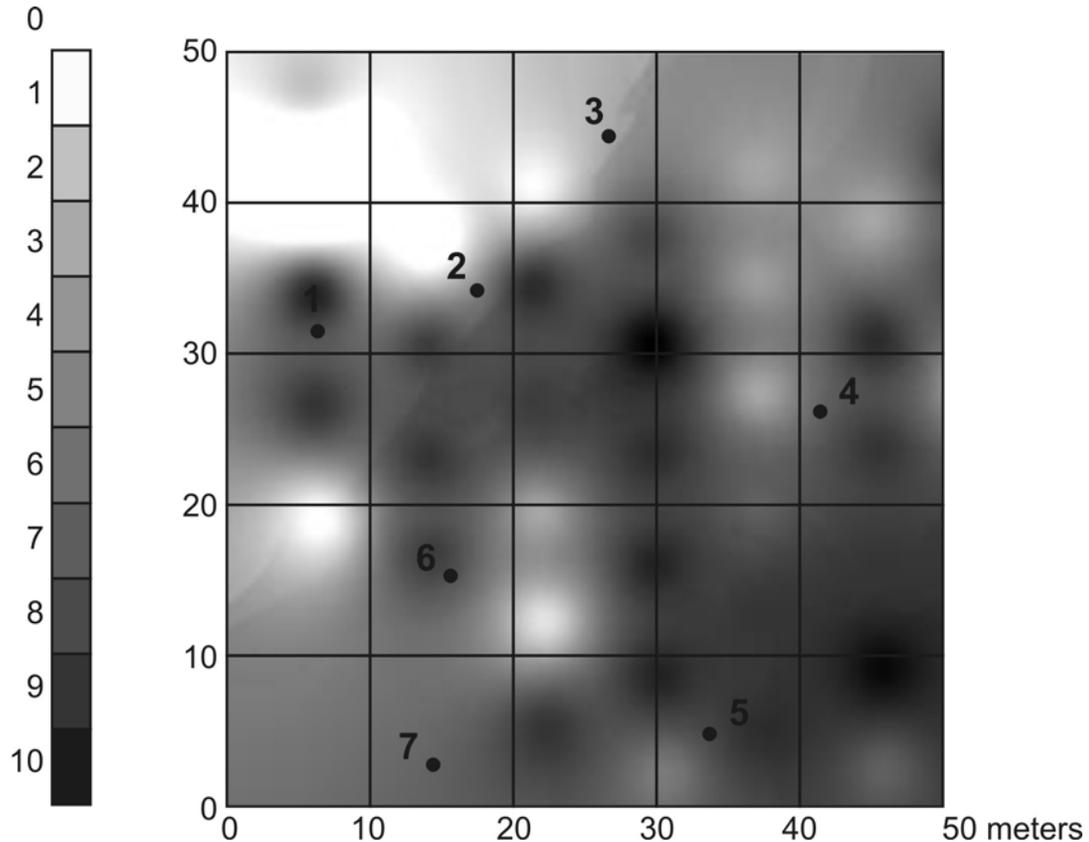
Ground based sensors play a key role in Agriculture. Light reflectance sensors could be used to monitor the canopy color, which is an indicator of nitrogen supply. If nitrogen or other nutrients are low, crops may express differences in leaf color. Plants usually become yellow and stunted, with smaller than average flowers and fruits. In this activity a ground based robot with light sensor is used to track the light reflectance in different spots in an exercise area.

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### Explorer's Guide

#### Before You Start

In the picture below, fill the X, Y, Z (color) values in the table below using the example for point1. Use the color chart to find the Z values.



Example →

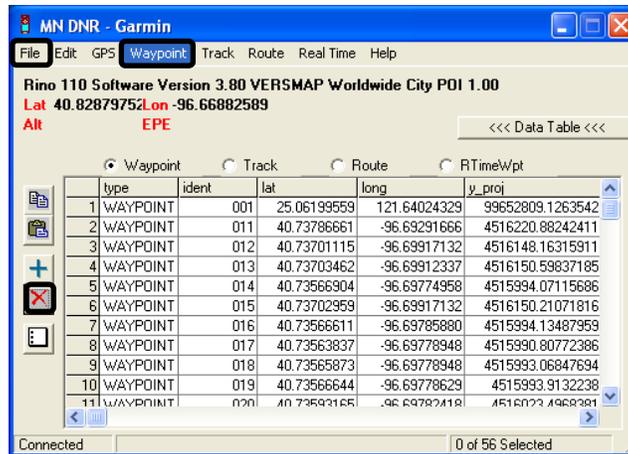
	<b>X</b>	<b>Y</b>	<b>Z (Color)</b>
1	8	32	3.5
2			
3			
4			
5			
6			
7			

### Learning by Doing

1. While out in the exercise area, plan how to take at least 7 on the spot measurements spread around the field.
2. Go to point # 1 as identified by the instructor and record your waypoint using GPS receiver.
3. Once the waypoint is recorded take on the spot light reflectance using the robot light sensor.
4. After taking on the spot measurement in point # 1, move to point # 2 and take the measurements there. Move on to the next point when done. For every point, keep in mind to record the location as a waypoint using GPS receiver and also take on the spot light reflectance using the robot.
5. Using DNR Garmin and ArcGIS software, download GPS coordinates and enter corresponding light reflectance measurements using either provided data (step 15) or actual exercise area measurements.
6. To Download GPS Coordinates using DNR Garmin and ArcGIS software follow the steps given below.
  - a. Connect your GPS receiver to the using proper connecting cable.
  - b. Turn on the GPS unit and assure proper interface setting (GARMIN).
  - c. Start *ArcMap* and *DNR Garmin* software. Click *GPS > Open Port* to connect to the GPS receiver (make sure the receiver is connected to the proper port).

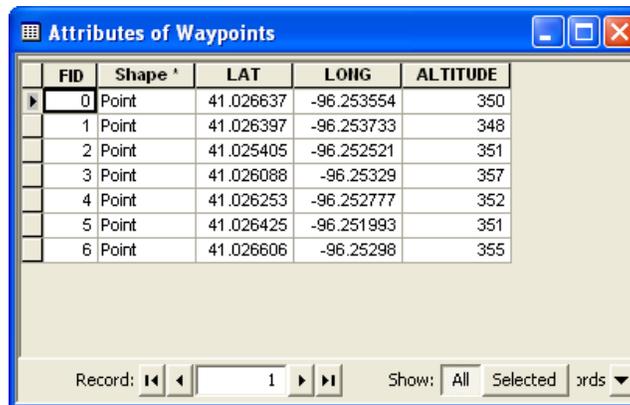


- d. In MN DNR - Garmin use *Waypoint > Download* to access all the waypoints collected. Use delete button to delete unnecessary waypoints after selecting them. You could edit your waypoints in DNR software or later using ArcGIS software which is given in the next step.

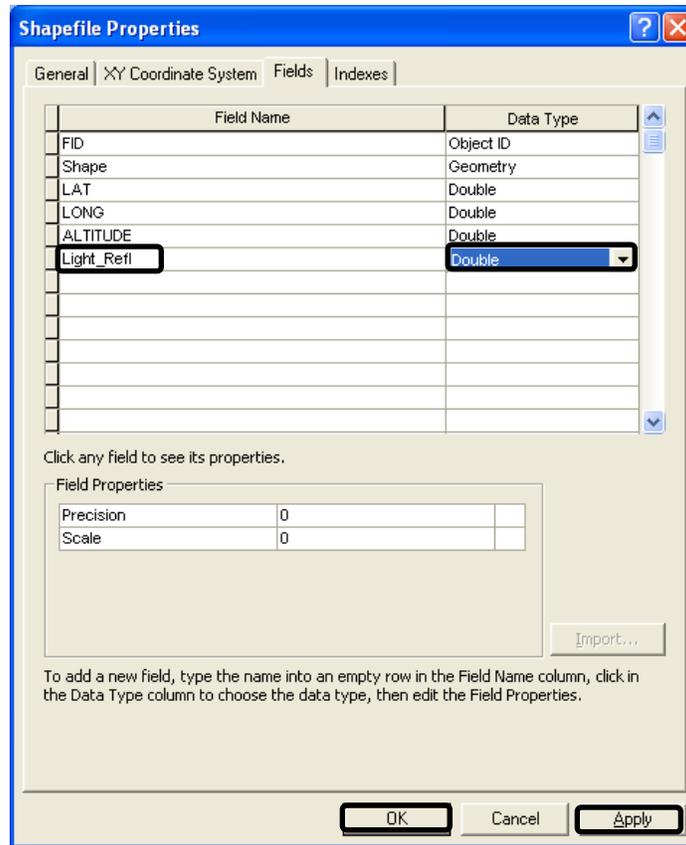


e. Save waypoints as an ArcView shapefile. Close *DNRGarmin* software.

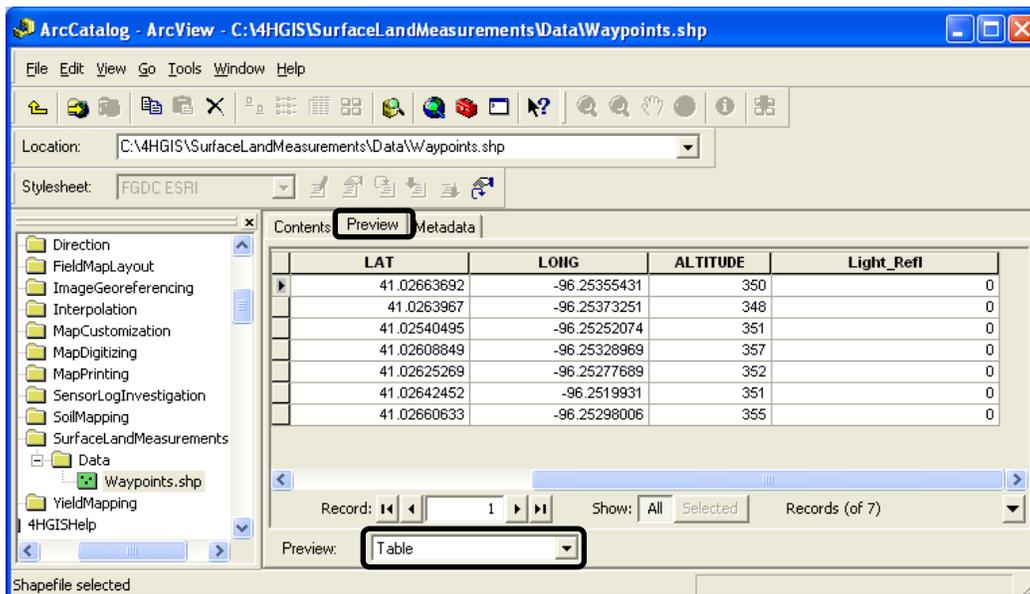
7. Open the downloaded shapefile (Waypoints.shp) in ArcMap. Right click Waypoints.shp and open the attribute table.
8. It is time to do some attribute editing. If using example data skip this step as the data is already edited for you. With the attribute table open as indicated in the previous step click Editor > Start Editing. Delete any unwanted rows or columns. To do this select the row and right click to delete it. You can also freeze the columns by right clicking the unwanted columns. Your table should be as shown below.



9. Now you can enter the light reflectance values given in step 15 in the table. For this open ArcCatalog and right click waypoints.shp to get the shapefile properties. You will not be able to do this if the file is open in ArcMap. Click the Field tab to add a new column named Light\_Refl. Note that there should be no space while naming fields. Choose the data type as shown below. Click Apply and Ok.



10. Preview the table in ArcCatalog.



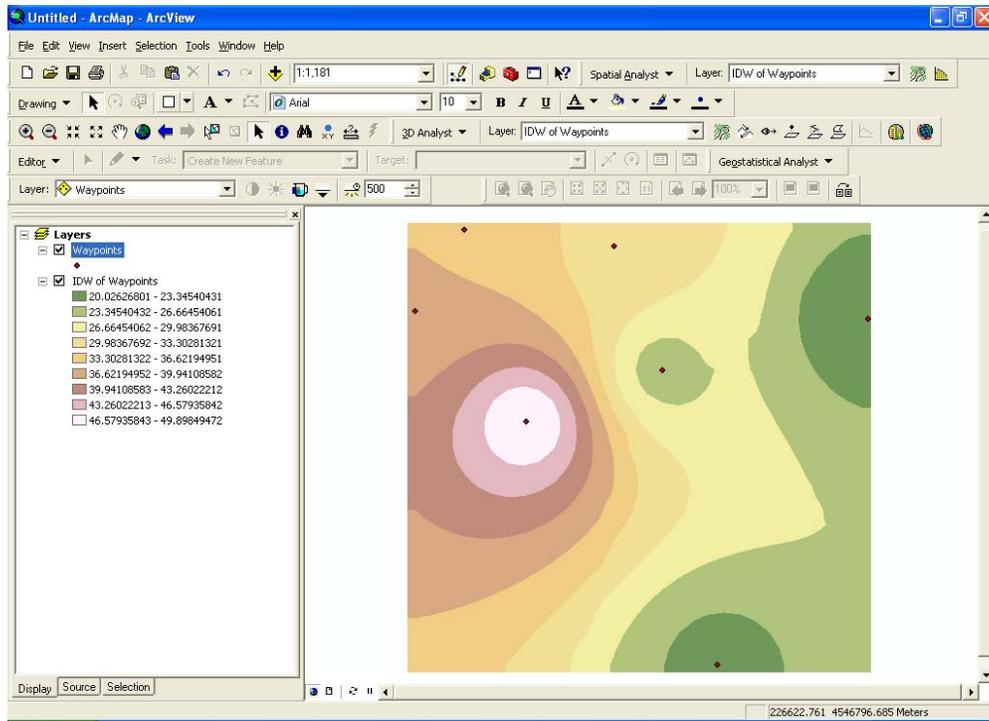
11. Close ArcCatalog and Open ArcMap to enter the values in Light\_Ref1 field using the Editor toolbar. Start editing and double click to enter the light reflectance values.

FID	Shape	LAT	LONG	ALTITUDE	Light_Refl
0	Point	41.026637	-96.253554	350	35
1	Point	41.026397	-96.253733	348	39
2	Point	41.025405	-96.252521	351	0
3	Point	41.026088	-96.25329	357	0
4	Point	41.026253	-96.252777	352	0
5	Point	41.026425	-96.251993	351	0
6	Point	41.026606	-96.25298	355	0

12. Remember to save your edits.

FID	Shape	LAT	LONG	ALTITUDE	Light_Refl
0	Point	41.026637	-96.253554	350	35
1	Point	41.026397	-96.253733	348	39
2	Point	41.025405	-96.252521	351	22
3	Point	41.026088	-96.25329	357	50
4	Point	41.026253	-96.252777	352	25
5	Point	41.026425	-96.251993	351	20
6	Point	41.026606	-96.25298	355	32

13. Now interpolate the light reflectance data using the interpolation technique (Step 15) as discussed in activity 28. An example of the interpolated map is given below.



14. In case of inclement weather use the example data for doing this activity. An example data is given in a file named waypoints.shp. Write down the corresponding light reflectance value in your dataset for each point as given below.

	Light Reflectance
1	35
2	39
3	22
4	50
5	25
6	20
7	32

### How Does It Work

It is hard to go out to the field and take measurements in every location. So measurements are taken only in few locations within the field. It is important that these locations should be spread around the field. Interpolation technique is then applied to get the measurement values through out the field.

Interpolation is performed in many areas. Example the weather data in mid US region is obtained from 9 weather stations located in that region. The weather data is then interpolated to get a weather map of the entire mid US region.

Optical sensor measurement has a great potential in crop production. For example, nitrogen management was made possible initially by the chlorophyll meter. However, a chlorophyll meter is time consuming to use correctly and it is difficult to accurately scout large acreages. More recently research has focused on the use of either passive or active vehicle mounted sensors for real time nitrogen management. Passive sensors rely on canopy reflectance from the sun, while

active sensors use their own light source. Passive sensors must be used during daylight hours and factors influencing canopy reflectance from the sun such as clouds and solar angle may influence spectral data. Active sensors are designed to cancel out solar influences, relying solely on reflectance from the internal light source, and thus can be used anytime, day or night, regardless of cloud cover. Active sensors use vegetation indices to determine canopy chlorophyll status and thus nitrogen status. It is recommended to compare at least 3 years of yield map to study the varying nitrogen rate within fields.

### **Additional Challenge**

Use the robot to measure the height of grass in a designated lawn. Use a stick to assure constant distance between ultrasonic sensor and ground. In every location, subtract the distance measured from the known length of the stick to obtain the height of grass.

### **Vocabulary**

**Waypoint** is a recorded set of coordinates (longitude latitude and sometimes elevation) associated with a given name and a symbol that relates to a specific location around the world.

**Nitrogen** is a chemical element that has the symbol **N**. Crops grown with inadequate nitrogen produces a poor yield.

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Last updated: March 18, 2009*