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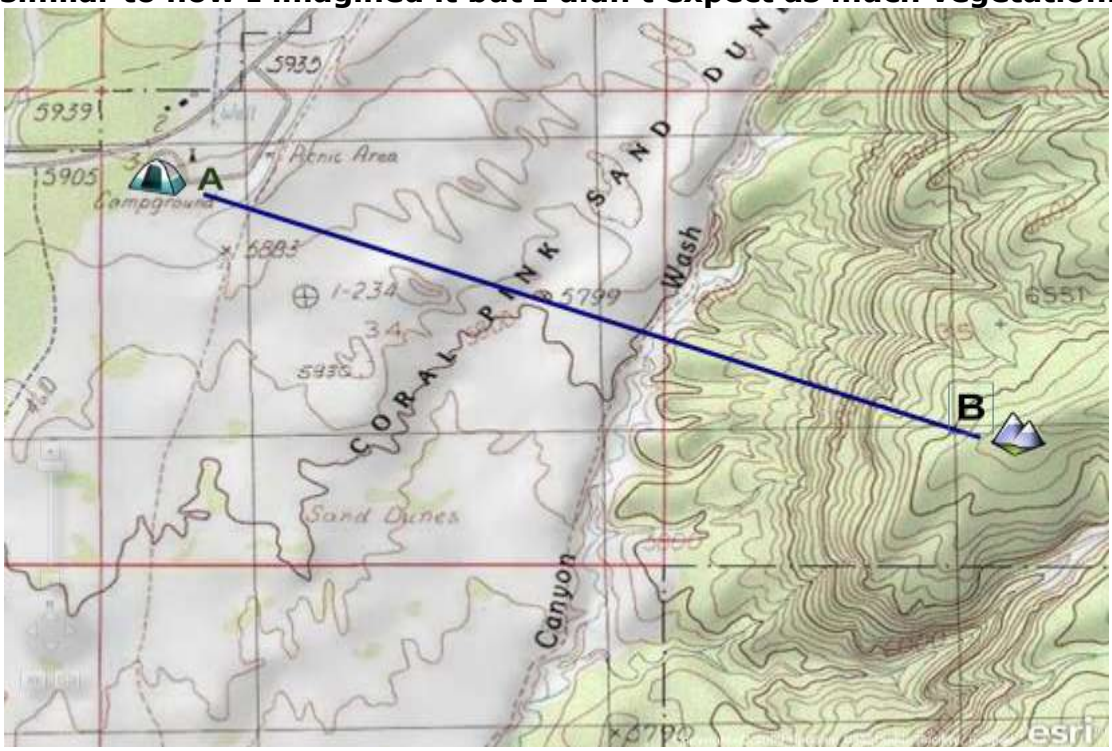
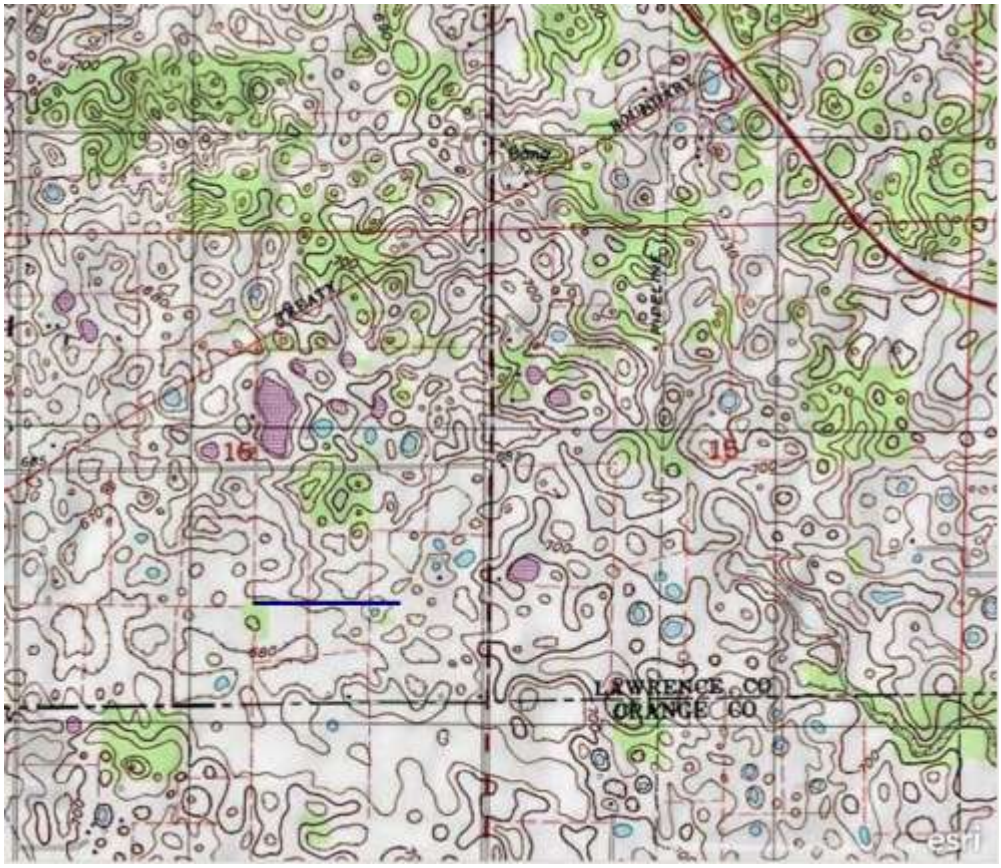
Summary: In this lesson, you will use *ArcGIS Explorer Online* to investigate 10 topographic map features and their surrounding landscapes.
Objectives: Work with topographic maps, including features, elevation, measurement, and other aspects of these maps to understand physical and cultural processes and the results of those processes.

Landscape 1: Sand Dunes
Examine the landscape below in southern Utah.
1) If the distance from C to D is one mile, estimate the length of the line that runs from A to B, to the nearest tenth of a mile: **2.3 Miles**.
2) Are the sand dunes lower or higher than the green area to the east? **Lower**
If you hiked from the campground to Point B, which would be steeper: The first half of your hike, or the last half? **The Last Half**
3) Estimate the percent grade on your hike from Canyon Wash to Point B. **75%.**
4) If green represents vegetation, is there any vegetation on the sand dunes? ___
Why or why not? **Not much, if any. There are just a few small patches that are visible on this map.**
5) If you stood at the campground at Point A and looked toward Point B, sketch what you would see below:
Compare your sketch against the photograph of Coral Pink Sand Dunes on the next page
How accurate was your portrayal of the landscape in your sketch? **It is pretty similar to how I imagined it but I didn't expect as much vegetation.**



Landscape 2: Karst
Examine the landscape below near Orleans, in south-central Indiana

1) This is a karst landscape. Do some research on karst. Describe what karst is: **Karst is a region that is characterized by sinkholes that are formed from the dissolution of soluble rocks. Usually involves caves and sinking streams.**
2) Name two things that you can find on the topographic map that give evidence that this is a karst landscape: **There are so many changes in elevation all over the map and a lot of boundaries everywhere.**
3) Describe what it would be like to go for a walk straight north up the road that runs from the Lawrence-Orange County line to the north end of the map: **It would be exhausting. There are lots of hills and changes in elevation. Probably would involve a lot of climbing.**
4) Why do you suppose that there no rivers that run across this landscape? **Possibly because there are so many sinkholes and elevation changes that a river would not be able to run through this type of landscape unless it was deep in the ground.**
5) The blue line running east west is 500 meters long. Use it to estimate the average size of the depressions this map, in meters: **My estimate is somewhere around 100 meters for an average.**



Landscape 3: Eskers
Examine the landscape below at Merden Lake in central Minnesota. A long but narrow esker runs from the southwest corner of this map toward the northeast, evident by the narrow cluster of contour lines indicating higher elevation

Read about the glacial history of Stearns County on:
http://www.ajur.uni.edu/v3n2/Davis&Hirsch.pdf . Examine the photograph of the esker. Do some additional research on eskers.
1) What is an esker? **An esker is a long winding ridge of post glacial gravel and other sediment. It is usually deposited by a stream flowing in or under a decaying glacial ice sheet.**
2) Describe how this esker ended up here in central Minnesota: **It was thought to have been deposited by a subglacial stream associated with the Laurentide ice sheet.**
3) If the distance from A to B is one mile, how long is the esker across this map? **Around 2 miles**
On average, how wide is this esker? Indicate the units that you are using: **Usually between 100-300 meters**
4) If the elevation on the road just south of the "25" in the center of the map is 1167 feet above sea level, and the contour interval is 10 feet, how tall is the esker as measured from its base at the 1167 marker to the contour behind the "25"? **1197 feet above sea level**
5) This is typical glaciated terrain. Describe three distinctive features that you notice about glaciated terrain: **There are lots of small lakes and streams. There are also changes in elevation with small scattered areas of vegetation.**

Landscape 4: Swamps

Examine the landscape of southern Florida, below. This is a section of Everglades National Park

1) Do some research on Everglades National Park. Why was the Everglades set aside as a national park? In other words, what makes it such a special place? **It has a very unique ecosystem and is the home to many endangered plant and animal species.**

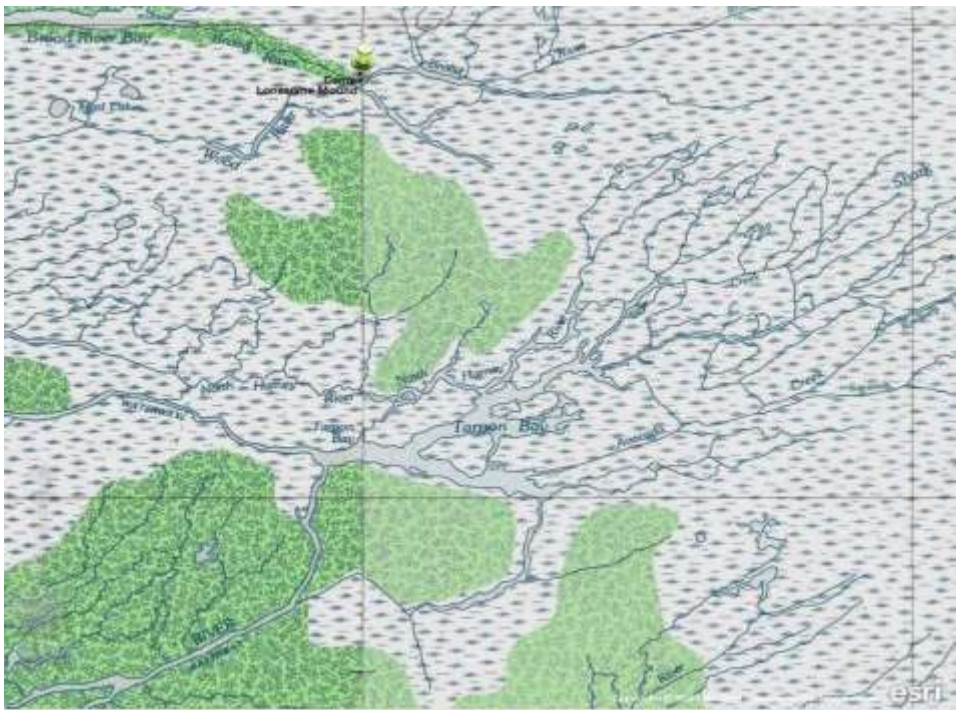
2) Sketch below what you think this area would look like if you were standing on Camp Lonesome Mound in the northwest corner of this map, looking toward Tarpon Bay: **It would probably look very green and swampy with lots of plants and water.**

3) What would be the best means of transportation to use in this area? **A fan boat** Why? **Because the ground is so swampy and wet. Anything with wheels would probably get stuck and sink into the mud.**

4) There are no elevations shown on this map. What do you think the elevation is in this area? **It is very flat. I read that the highest point is around 8 feet.** There are also no contour lines shown on this map. Why do you think that contour lines are absent from this map? **Because there are very few changes in elevation. The land is flat.**

5) How susceptible is this area to potential sea level rise? Why? **It is very susceptible to sea level rise because it is on the very Southern tip of Florida, which is right at sea level. It could easily go under water if the sea level were to rise.**

How susceptible is this area to damage from hurricanes? Why? **Very susceptible, as is all of Florida because of the converging air masses from the Atlantic and Gulf of Mexico. The ocean current is warm because it is coming from the equator.**



Landscape 5: Glaciers

Examine the landscape below just west of Seward, Alaska. The Harding Ice Field is visible on the west side of the map.

1) Define a glacier: **A glacier is a huge mass of ice that is flowing slowly over a land mass.**

2) What direction is the glacier that lies between the cloud symbol and the campground symbol flowing? Why? **It is flowing toward the campground symbol, west to east. The contour lines show the elevation change.**

What direction do you think Resurrection River (in the northeast corner of the map) is flowing? From **north** to **south**. Why? **Because of the shape of the river and the elevation would force it to flow in that direction. Plus I think the only river that flows south to north is the Nile.**

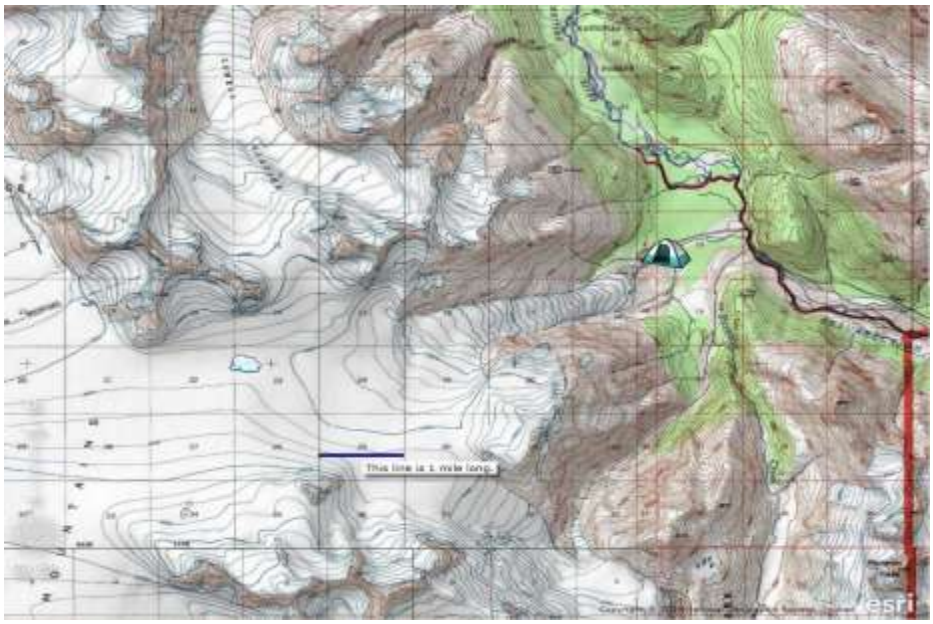
3) If you were sitting in front of your tent at the campground symbol and looking toward the cloud symbol, sketch what the landscape would look like: **It would have a steep decreasing slope and would probably be a really beautiful view of a glacier.**

4) If you were camping in December here, what would the climate be like? **It would be very cold. I would not be camping here because I would probably freeze to death.**

If you were camping in June here, what would the climate be like? **It would be nicer because the vegetation and it wouldn't be nearly as cold as the winter.**

5) Note the blue line that indicates that the distance between each of the north-south and east-west surveyed "section lines" on the map is 1 mile. If this is the case, how much area is contained in each of the square "sections", in square miles? **Each square would be 1 square mile,**

If you hiked from the campground to the Harding Ice Field at the cloud symbol, what would the average gradient be? Show your work: **It would be would most likely be extremely steep for the first mile because of the many contour lines. The second mile would be a more gradual slope.**



Landscape 6: Rivers

Examine the landscape below along the lower part of the Mississippi River, north of Baton Rouge, in Louisiana.

As rivers flow, the water in them not only moves downstream, but the rivers themselves migrate across the landscape, particularly in flat landscapes. Here in southern Louisiana, the Mississippi River has had a history of moving back and forth, much like trickles of water moving down a windowpane or windshield of a car.

1) Can you determine which direction the Mississippi River is flowing in this area? How? **Yes because of the turns in the river and the effect it has on the land around it.**

In which direction is the river flowing? **From west to east and then south**

2) Why do you think the feature in the middle of the map (at the boat symbol) is named "False River"? **Because it looks like a river, but it isn't**

What landform feature is False River? **It is an oxbow lake**

Do some research on oxbow lakes.

3) Do you think "False River" is an oxbow lake? **Yes** Why or why not? **Because I can see that it used to be part of the Mississippi. Also I can see the False Bayou that connects it to the Mississippi.**

4) How do you think False River formed? **The bend in the river was too sharp so the flow gradually worked its way through the land to redirect it in a more straight direction.**

5) Do some research on the "seigneurial system" that was used in French colonies such as Quebec and Louisiana. What evidence can you find in this map that this centuries-old system left its imprint on the landscape today? Cite specific locations in your answer: **All of the settlements that are built near the river are in long narrow strips. The property lines don't go all the way to the river to allow room for roads to be built.**

Landscape 7: Railroad-Influenced Towns

Examine the street pattern of Grand Island, Nebraska. Grand Island, like many towns built on the Great Plains and in the West during the latter part of the 19th Century, was heavily influenced by the railroads. Oftentimes, their location and survival depended on the existence of the railroad, and their street pattern to the present day is influenced by the original "platting", or laying out, of the community's streets and lots by the railroad companies and original town planners. The first streets in town were often laid out parallel to and perpendicular to the original railroad line running through town.

1) Why did the railroads have such an influence on towns in the late 19th Century? **Because the railroads were most likely the main purpose of the existence of the towns at that time. The railroads were their primary source of trade.**

2) Describe the direction that the two railroads run that intersect in the town of Grand Island: **One runs north to south and the other runs northeast to southwest.**

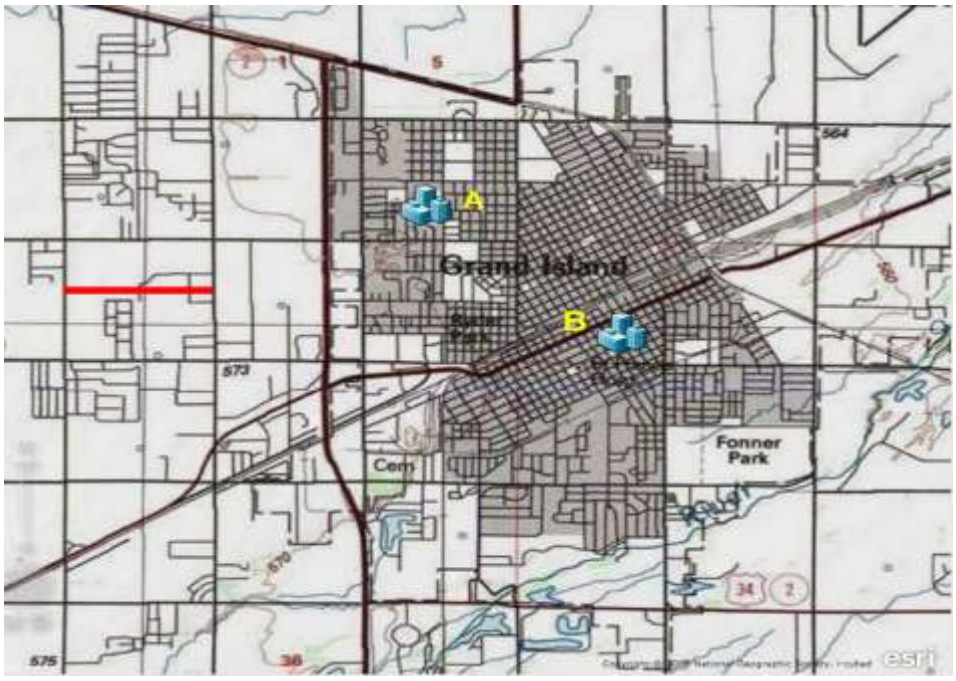
3) Which of the two railroads influenced the future street pattern of Grand Island the most? **The east to west line** Why? **Because the majority of roads run parallel to this line.**

4) Which section of town did the railroads influence the most? **B**

Which section of town do you therefore believe is the older of the two sections? **A**

5) Notice the straight north-south and east-west roads that are on the outskirts of Grand Island on all sides. These roads follow the Public Land Survey System, which was used to survey how land was to be subdivided and sold throughout much of the United States. Do some research on the Public Land Survey System (PLSS). The thick red line in the western portion of the map is 1 mile long. What are the squares on the map called that are part of the PLSS? **Township**

What is the primary influence on the present-day pattern of new streets in Grand Island? Circle your answer: **The PLSS**



Landscape 8: Modified Coastlines

Humans have lived along coasts for thousands of years, for a variety of reasons, and they continue to do so today. Ocean City, Maryland, on the Atlantic Ocean, is a community that grew large because of and exists largely for beach-loving tourists. Examine the landscape of Ocean City, below.

1) Would you describe Ocean City as being on an island or being on the mainland? **I think it is an Island**
2) Why? **Because it is doesn't show it being connected to land other than by roads.**

What side of Ocean City do you think that the best beaches are? On the west side, or the east side? **The East side** Why? **Because the west side is covered with buildings and the East side has a pier and space for a beach.**

Do some research on the history and physical geography of Ocean City, using the USGS booklet *Coasts in Crisis,* particularly the section beginning with: http://pubs.usgs.gov/circ/c1075/conflicts.html#fig1.

3) Now you know that Ocean City is built on Fenwick Island, and the Ocean City Inlet separates Fenwick Island from Assateague Island to the south. What kind of islands are these two islands? **Barrier Islands**
4) Why are these types of islands so vulnerable to hurricanes? **Because they border the edge of continents and are usually less than 3 meters above sea level.**

The thick blue line on the map indicates the position of both Fenwick and Assateague Island 150 years ago. The short green line indicates a distance of 200 meters. Use this as your scale and measuring device for the next question.

3) Measure the distance that Assateague Island has moved relative to the blue line. How much has it moved? **300 meters** Next, calculate how much the island is moving each year. Show your work: **150/300= .5 meters per year**

What direction is Assateague Island moving? From **east** to **west**.

Why is Assateague Island moving? **The rising sea level is pushing it**

4) What do you think this landscape will look like 150 years from now if present conditions continue? **It will possibly not be an Island anymore.** Why? **It will continue to move west until it meets up with the land.**

5) Discuss the pros and cons of developing these types of landscapes for tourism: **They probably have great beaches and views of the mainland and ocean. People like to be on Islands and exclusive locations. They are not safe in the long run because they can easily go under water in the event of a hurricane and the sea level rising.**

Landscape 9: Volcanoes

Some landscapes have been modified in the past and at the present time from volcanic activity—both explosive and quiet eruptions of volcanoes, and subsequent lava flows. Examine the landscape of a famous volcanic landscape, Craters of the Moon National Monument, Idaho, below.

1) Notice the BM 5808 elevation just east of the national monument headquarters. A "Bench Mark" is located here—a brass disk in the ground indicated a surveyed elevation. This is the elevation of most of the North Crater lava flow, shown in the tinted color in the northern part of the map. Now note the elevation of Paisley Cone. How high above the North Crater lava flow is Paisley Cone? **299 ft**

2) Paisley Cone and North Crater are two volcanoes in the area. How far apart are their summits? Be sure to indicate the units of measure that you are using: **551 ft**

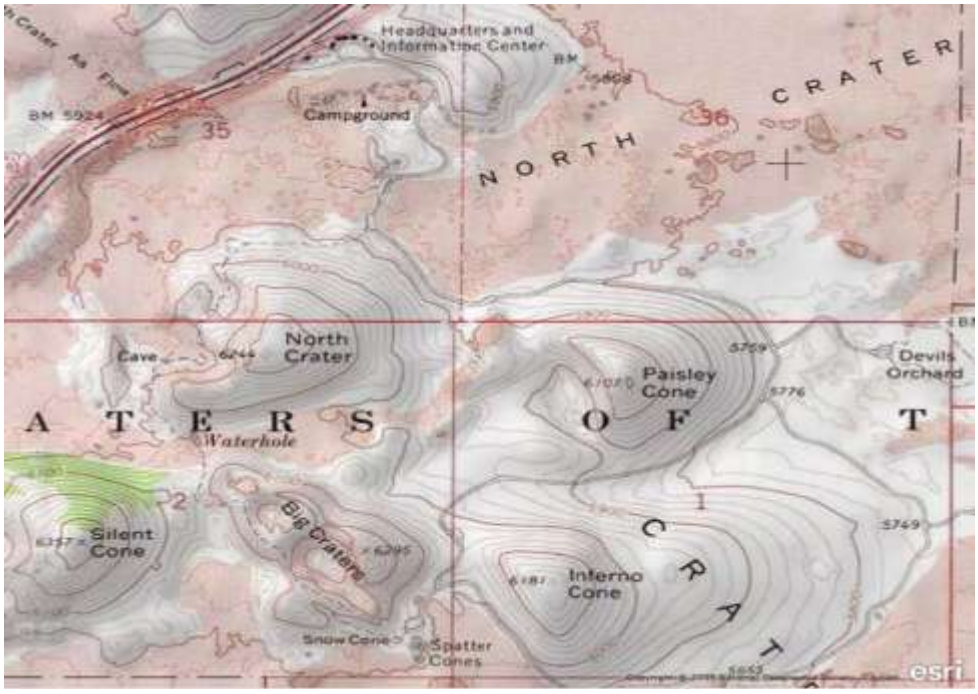
3) How much higher is North Crater than Paisley Cone? **137 ft**

4) Vegetation is shown in green on topographic maps. Why do you think there is so little vegetation in this area? **The surface is very hot and isn't very deep because of the mantle and volcanic activity.**

5) Based on your observations of the vegetation and of this map, do you think that this area is geologically young or geologically old? **Old** Explain your answer: **Volcanoes can take millions of years to form. This area is similar to Yellowstone and used to be over the same hot spot.**

Read the story of the Apollo astronauts visiting this national monument: http://www.nationalparkstraveler.com/2010/01/apollo-astronauts-visited-craters-moon5252

Why do you think the Apollo astronauts trained here before they went to the moon? **Because it has similar terrain to the moon in that it has volcanic landforms and rocks that are similar to the lunar surface. It was a good place for them to practice photographing, analyzing, and gathering volcanic rocks.**



Landscape 10: Protected Areas

Some landscapes are so special that they have been protected from development. One such place is the Waihe'e Refuge, protected by the Maui Coastal Land Trust. Examine the landscape at the Waihe'e Refuge, below. The elevations on this map are in feet above sea level

Read about the refuge on: http://www.mauicoastallandtrust.org/waihee.php. The refuge occupies the yellow area on the map. 1) Based on your reading, name at least 3 reasons why this area was deemed so special that it had to be protected: **It protects the archaeological and cultural resources and also is the home to several endangered plants, insects, and other animals. It is native Hawaii.**

Examine the map above.

5) What direction are the rivers running in this area? From **north** to **south**
6) Look at the oblique aerial photograph on the above website. What feature is traced by the thick blue line on the west side of the yellow area in the map above? **Wetland**

How long is this feature? Indicate the units you are using: **around 5000 ft**

How high above sea level is this feature? Indicate the units you are using: **40 ft**

3) Why is this feature so important? **It is the home to native plants and animals.**

Examine the following photograph taken at near Waihe'e Point on the map, looking south:

4) If this area was not protected, what do you think it would look like today? **It would probably be a golf course or be covered in houses or commercial buildings.**

What is the named feature on the coast just southeast of the refuge, just north of Leisure Estates Park? **Waiehu Golf Course**

Does this give a hint on the kind of development that the refuge could have become if it had not been protected? **Yes**

5) Is there an area near where you live that you think should be protected? Why? Name at least 3 reasons why it is special? **The area around the Great Salt Lake should be protected, if it isn't already, because it is the home to many migrating birds. It isn't safe for development because it is not good ground and could destroy the habitat of many animals and plants.**