

Lake Keowee Geo-videography Collection, Process, and Implementation

Project Description

Duke Energy Lake Services' GIS consultant Orbis GIS, Inc. (Orbis) collected GPS referenced digital video shoreline imagery of Lake Keowee. The geo-referenced shoreline video data was collected on the lake shoreline - an estimated 390 miles. The collection of the video imagery provides a permanent visual record of geo-referenced shoreline features at a high resolution.

This project will serve as an inventory tool to assess the shoreline and near shore environment. Currently no visual comprehensive shoreline inventories exist with the exception of high resolution color digital aerial photography obtained in 2005. This project created properly scaled geospatial baseline data of critical features like shoreline modifications, shoreline conditions, over-water structures, and in-water structures, and undisturbed important habitat areas. Due to its visual nature, video serves as a highly intuitive method of communicating natural resource information quickly and easily. When video is integrated into a GIS system, it becomes an important tool for organization of large geographic areas that contain highly variable landscapes.

Collection and Processing

The collection team consisted of a boat driver and video/GPS operator. The team collected geo-referenced video of the entire lake shoreline including islands. Video was shot between 10 and 50 meters perpendicular to the shoreline during calm water conditions. The collection view was aimed to record data between the waterline and the top of the riparian zone. Date, time, latitude, and longitude positions were recorded and associated with each video image. The video collection of the estimated 390 miles of shoreline was conducted over a two week period in May 2006.

The standard collection projection for the project was Geographic WGS84. This standard projection was directly collected by the WASS (Wide Area Augmentation System) GPS unit used in the collection process. The accuracy of the GPS data collected averaged less than 3 - 5 meters based on satellite and WASS coverage.

Video and GPS Conversion

The consultant post processed the video data and referenced GPS data into geo-video. The video collected was converted into digital MPEG2 videos. The video tape segments were clipped and edited by the consultant. The consultant ensured the proper coverage of the shoreline and ensured each video segment overlapped the previous and consecutive segments of video. Each video segment was edited to remove any taping errors associated with collection. The consultant then converted, reviewed and edited all collected GPS point data. The consultant modified all erroneous points collected due to

GPS and field collection errors and provided a “stream”-like point file along the shoreline depicting the path of the boat and collection team.

Upon the completion of the video and GPS data conversions, the processed data was merged into a geo-video dataset. The location and time linkage established between these files will allow Lake Services the ability to spatially review the shoreline video.

Information implementation

These datasets will be incorporated into Lake Services’ existing data management processes. A copy of these datasets is also maintained on the consultant’s server for additional security and availability purposes. One-day training will be provided to the Lake Services personnel on data access and review. This will ensure Lake Services has the ability to readily obtain vital information from the collected geo-video.

The resulting video is viewable by using a video software and viewable from a geo-referenced standpoint by users using the ArcGIS Video Extension. The digital data is topologically structured, attributed and spatially continuous. The geo-referenced video was provided on an external hard drive in a MPEG2 format and ESRI format (shapefile or geo-database).



Geovideo Collection Lake Keowee May 2006

- ④ Duke Energy Lake Services (DE-LS) has initiated a process to collect Global Positioning System (GPS) referenced digital video shoreline imagery as part of the development of the Shoreline Management Plan for Lake Keowee.
- ④ This activity will be conducted by Duke's contract personnel starting Monday (5/8/06) and will continue for several weeks until the entire shoreline of Lake Keowee (including island shorelines) is video taped. The contract crew will include a boat driver and a video-GPS operator using a single boat. Taping will be conducted at idle to low speed to ensure the clarity of the imagery and to lessen any wake that may be created.
- ④ The collection of this video imagery will provide a permanent visual record of geo-referenced shoreline features at a high resolution. This project will be conducted as an inventory tool to assess the shoreline and near-shore environment. The videography will create baseline data of critical features like shoreline modifications, overall shoreline conditions/characteristics, over-water structures (e.g., piers, boathouses, etc.), and in-water structures (e.g., water intakes, seawalls, etc.) and undisturbed areas along the lake shoreline.
- ④ Due to its visual nature, video serves as a highly intuitive method of communicating man-made and natural resource information quickly and easily. When video is integrated into a Geographical Information System (GIS), it becomes an important tool for organization of large geographic areas that contain variable landscapes, and natural and man-made features.

Should you have any questions regarding this activity, please contact Duke Energy Lake Services at 1-800-443-5193 or Benji Cannon at 864-885-4458 or Joe Hall at 704-382-8576.

Lake Keowee Geo-Video Project Write-Up/Lessons Learned

Equipment

GPS Data Recorder

1. The GPS data recorder used in the Lake Keowee Geo-Video project operates by converting the GPS location to a tone that is recorded on the left audio track of the video. GPS data is captured every second, and then a trigger is used to capture the GPS location of any feature of interest, in the case of Lake Keowee this was for any dock/floating structure.

Video Camera

1. For recording a shoreline from a boat, it is recommended that the video camera used does not record on spinning media (DVD). The spinning media may have a higher likelihood of skipping.
2. In order to record the GPS location on the left audio track, the video camera used must have a mic in jack. Many of the newer cameras no longer contain a mic in jack and are not compatible with the GPS data recorder.
3. Battery life is an issue. External power supplies are required. This can range from having a set of video camera batteries, a direct plug into the boat's power supply, or some sort of portable power supply. Because both the video camera and the GPS data recorder require constant power, a portable power supply was utilized that was charged in full each night and had enough power in reserve to power the video camera and the GPS data recorder for a full 10 hour day, or more. The portable power supply was never drained.

Equipment Setup

1. When setting up the camera it is important to be consistent from one day to the next. A tripod was utilized that was set to the same height and facing perpendicular to the boat at all times.
2. It is important to maintain a level of protection from the elements for the equipment. On windy days there will be spray from the waves/wakes, on foggy mornings the mist can cover the equipment, and sudden rain storms can cause many problems. The equipment is typically not water proof itself, so measures need to be taken to protect the GPS data recorder and the video camera in all possible weather events.
3. It is important to have a canopy on the boat that will cover the area where the camera is set up. This will keep the camera out of direct sunlight or any other weather elements that could potentially damage the equipment or degrade the quality of video captured.

Lessons Learned

Limit Zooming/Panning

1. The contractor (Orbis GIS, Inc.) developed a method of video capture that would minimize the need for zooming in or out while capturing video of the shoreline. The lakebed contour had some control over this when entering areas that forced the boat to travel further from the shore. In those cases the camera needed to utilize the zooming capabilities to maintain a level of consistency.
2. The camera was never panned from side to side. The camera faced perpendicular to the boat at all times and when making turns the boat driver was responsible for slowing down (especially while making inside turns).
3. During collection, one member of the crew was required to sit behind the camera at all times, ready to make any adjustments to zoom, and to relay information to the boat driver on speed of the boat as well as distance from the shoreline.

GPS Connection

1. An unanticipated factor in the collection of data on Lake Keowee was maintaining a solid GPS Connection with the GPS data recorder. It was anticipated that in some of the areas with tall cliffs or high voltage wires there may be some break in GPS connectivity. What was not anticipated was the regular cycle of GPS satellites in the area having periods of time (similar from one week to the next) where a satellite may be out of range for a time period between 20-90 minutes before the GPS connection was regained. During that time, the crew was forced to float in open water or pull up on shore in an area with clear, unobstructed view of the sky to allow the GPS data recorder to regain its connection with the GPS satellites.

Boat Size/Boat Driver

1. The boat used for the collection of video footage must possess several characteristics in order to maximize the data collection. On Lake Keowee a 16' flat bottom metal boat with a 50hp outboard motor was used. The boat had an electronic trim and heavy-duty prop which proved critical in some of the areas the boat traveled during collection. There was a canopy which covered the entire passenger area, including the area where the camera's tripod was set up. There was one swiveling chair in the front next to the tripod which proved to be invaluable during the collection process.
2. The boat driver on Lake Keowee had many intimate years traversing the lake. The boat driver's knowledge of various coves, creeks, and sand bars proved invaluable during the data collection on Lake Keowee. A boat driver without this level of knowledge would have not only slowed the data collection, but would have potentially missed areas that were possible to capture given the driver's knowledge.
3. On numerous occasions the boat traveled through less than 12" of water, and encountered several sand bars, stumps, and on occasion became stuck. The boat setup combined with the boat driver's skill allowed for data collection in areas that would have otherwise been considered inaccessible.

Boat Speed and Distance From Shore

1. Early in the data collection efforts, footage from one day's collection would be sent back to the contractor's office for review. Feedback was provided to the field crew the next day to avoid any potential consistency problems in the data collection process. It was determined early on in the collection process that when conversing between the field crew and the review team, speed in mph or rpm, and distance in feet or any other unit of measure was not a viable form of communication. The review team could not tell while reviewing the footage on screen what the distance or speed of the boat actually was. Discussion between the review team and the field team regarding boat speed required the use of generally descriptive terms such as faster or slower instead of specific references to rate of speed (e.g., mph or rpm). It was determined that the ideal speed for viewing any given object should take roughly 5 seconds to pass through the data frame, and this varied depending on distance from the shore and other factors. Likewise, any discussion between the review team and the field team on the distance of the boat from shore required utilizing generally descriptive terms such as closer or further and not hard distances in feet or other units of measure.

Sun Angle/Weather Conditions/Best Time of Day

1. Overcast days were by far the best for data collection. This eliminated any problems with sun angle, time-of-day, etc. However, this is uncontrollable, and it is more important for consistency of vegetative cover to capture all the footage around the lake in as short a time period as possible.
2. Mid-day was the best time of day for sun angle. This is not required, but direct sun into the lens of the camera, either in the early morning or late evening hours, could potentially cause problems in the clarity of footage.
3. Flexibility in dealing with various weather conditions is very important. The ability to work through a light mist, fog, or windy conditions is critical in the ability to continue capturing data in a timely manner.
4. Weekend capture proved difficult due to the increased boat traffic on the lake, but the clear weather offset the traffic concerns. The data capture was timed to put the crew in an area that was not heavily used by other boaters during the weekend days (Friday – Sunday).

Wear and Tear on Crew

1. Lake Keowee was captured over the course of 12 consecutive 10-12 hour days in May. The crew was leaving the boat house between 6:30am and 7:00am to make the trip to the point where the previous day had left off. It was extremely cold in the mornings which caused difficulty in being able to operate the equipment etc due to cold fingers/limbs.
2. Wearing layers of clothing and being prepared for unexpected weather events (wind, rain, fog) was extremely important. The boat does not have very much free space, but having the proper clothing is very important even if layers are taken off as the temperature rises during the day.
3. Non-slip boat shoes were a must on the metal boat. Improper footwear could result in slipping while climbing in and out of the boat along the banks of the lake.
4. The camera operator had to remain seated in a position that allowed the imagery to be viewed in the camera viewfinder to ensure good quality imagery was being captured. It is critically important to minimize strain and fatigue on both the

boat and camera operators by providing seating arrangements that are as comfortable as possible.

Wear and Tear on Equipment

1. During the video capture on Lake Keowee, the constant vibration of the boat actually caused some wires within the camera to come loose causing some malfunctions. Initially, the field crew needed to devise a way to secure these loose connections. It is advisable to carry tools to tighten all possible connections while out on the water.

Data

Storage/Transfer

1. Using a Hi-8 video camera with the LP setting for the best quality footage, each tape will hold no more than two (2) hours of footage. The entire +300 miles of shoreline on Lake Keowee was collected on approximately 90 video tapes.
2. The originally the intent was to provide this data on DVD. This was found to be an unviable option given the fact that one complete set of coverage for the entire shoreline of Lake Keowee would require over 90 DVDs. External hard drives were the preferred method of data storage/transfer.
3. Data Storage is an issue that must be prepared for. Upon conversion to a digital format, the raw video occupied roughly 250GB (Gigabytes) of hard drive space. The edited data was reduced to roughly 235GB, but during the data conversion/editing process both files were located on the workstation at the same time. This requires roughly ½ of a Terabyte disk space, plus any other files on the given workstation.