PEMA Statewide Imagery Project

August 2021

Submitted by Penn State's Institutes of Energy and the Environment

Overview

Penn State's Institutes of Energy and the Environment (IEE) began discussions with the Pennsylvania Emergency Management Agency (PEMA) in 2018 to plan to manage, host, and distribute the statewide imagery generated by PEMA's initiative with Quantum Spatial. This imagery is vital to PEMA's NG911 efforts and in supporting emergency response across the Commonwealth. In addition, the imagery is an important part of economic development and environmental planning for counties, non profit organizations, state agencies, as well as supporting research and teaching across Pennsylvania's universities, colleges, and secondary schools. IEE was selected to support this project due to the fact that it is the home of Pennsylvania Spatial Data Access (PASDA) and the project could take advantage of the PASDA team's expertise with processing, hosting, and storing large data sets including the PAMAP, federal, and county and regional imagery for the last 25 years.

Activities

There were several key activities that the PASDA team undertook on behalf of this project.

The first major activity was acquiring and setting up storage and backup capabilities. The estimate for the amount of data was between 40 and 60 TB (including backup and archiving). The PASDA team worked with the College of Earth and Mineral Sciences and the Institute for Computational and Data Sciences to set up storage and servers to support both FTP download and map service development and use.

The PASDA team also made sure that effective communication between Quantum Spatial and the group was set up to ensure that we were sharing information and informed about upcoming issues. Maurie Kelly was designated the primary contact for Quantum deliveries and status reports. Scott Dane was the primary contact for issues, updates, and for the counties. The final initial activity was to develop procedures for managing and delivering the data.

Processes and Procedures

There were several challenges that were encountered during the first phases of the project. The largest hurdle was the weather, which caused delays and uncertainty in terms of capturing the data and creating the imagery. This also led to significant inquiries from the public about availability of the data. These inquiries were addressed with information provided by Quantum Spatial and updates on what data was acquired, processed, and available were shared with the PA GeoBoard through Jeffrey Boyle (PEMA) and through conference presentations, the PA GTSC, PAMAGIC, and the GIS Pros. The PASDA team also worked with Laura Simonetti (Mifflin County GIS and PA GeoBoard) to keep the GIS Pros up to date.

Once data began coming in, the procedures that were followed were:

- Time check and QA all Quantum deliveries
- Rename and zip all data and metadata on drives
- Create list and detailed information about each incoming drive from Quantum
- Create a record of all zipped drives
- Tally and keep track of survey feet imagery files and storage space used on PASDA
- Move and consolidate data onto existing drive space
- Managing the flow of data and keeping track of data that came in block by block in order to create and prepare single county hard drives
- Determining which tiled data (6 categories) from which blocks to combine into complete drives
- Creating drives (either full or partial) for each county and including shipping lists
- Send email and shipping list to county recipient with tracking number for drive
- Follow up with county contact about returning drive

PEMA Imagery as of July 2021

	<<<<<<<<<<<<<<<<<<<< Tiles >>>>>>>>>>>>>>>>>>>>						<<<<< Mosaics >>>>>	
North	**TIF**	**(GB)**	**JP2**	**(GB)**	**SID**	**(GB)**	**ECW**	**SID**
10000000	39	43	39	3	39	3	67 counties	67 counties
20000000	842	1024	842	62	842	63	78 zips	78 zips
30000000	1413	1714	1413	104	1413	105	538	1430
40000000	1599	1939	1599	118	1599	118		
50000000	1526	1861	1526	112	1526	113		
60000000	1356	1664	1356	100	1356	100		
70000000	99	123	99	7	99	7		
	6874	8368	6874	506	6874	509		
South	**TIF**	**(GB)**	**JP2**	**(GB)**	**SID**	**(GB)**		
10000000	769	926	769	57	769	57		
20000000	1554	1880	1554	114	1554	115		
30000000	1614	1992	1614	119	1614	120		
40000000	1534	1872	1534	113	1534	114		
50000000	1129	1337	1129	83	1129	84		
60000000	323	363	323	24	323	24		
70000000	0	0	0	0	0	0		
	6923	8370	6923	510	6923	514		
TOTAL GB:	20,745							

Figure 1. List of PEMA imagery data available for download from PASDA including size and number of files.

Date	Title	Provider
2018 - 2020	**PEMA Orthoimagery - cached mapservice**	Pennsylvania Emergency Management Agency
2018 - 2020	**PEMA Orthoimagery - County Mosaics**	Pennsylvania Emergency Management Agency
2018 - 2020	**PEMA Orthoimagery - JP2**	Pennsylvania Emergency Management Agency
2018 - 2020	**PEMA Orthoimagery - SID**	Pennsylvania Emergency Management Agency
2018 - 2020	**PEMA Orthoimagery - TIFF**	Pennsylvania Emergency Management Agency
2018 - 2020	**PEMA Orthoimagery - Tile Index North**	Pennsylvania Emergency Management Agency
2018 - 2020	**PEMA Orthoimagery - Tile Index South**	Pennsylvania Emergency Management Agency

Figure 2. List of PEMA imagery data on PASDA as of July 2021.

- Moving data onto FTP site
- Backing up data onto nearline storage
- Creating metadata for each delivery on the PASDA site
- Creating JP2 mosaics of deliveries/counties
- Develop map services for each delivery
- Integrate new data into the PA Imagery Navigator

Data Deliveries to Counties

There were 31 deliveries from Quantum Spatial to Penn State which conveyed 80 partial or full county data deliveries. The PASDA team acquired 6 large WD external drives to store data, 20 2TB external drives to ship data, and 3 128GB USB drives to ship partial data. There were 83 full or partial shipments from Penn State to counties. In addition, one of the challenges of the project was identifying who should receive the data. Using information we had at PASDA and some information from PEMA, the team was able to create a full, up to date list of county contacts who should receive the data (see excel spreadsheet for complete list). Some counties received a delivery to the 911 office and the GIS office. In many counties, the GIS program was also the 911 program so only one delivery was required to meet their needs. A special request was filled for Luzerne 911, which included Luzerne County plus an expanded area into surrounding counties and therefore included a large number of tiles plus seven sets of county mosaics. There were also some corrupt files on the drives which had to be replaced off and on throughout the project. This was done either by using the backup data on PASDA or by contacting Quantum for a replacement. Each county received an email from Scott Dane (Jeff Boyle and Maurie Kelly were copied on the emails) with information on what was on the drive and instructions on how to return the drive. Each drive contained at least the following:

- Tiles (in Metric and Survey Feet) in the following formats:
  - GeoTIFF
  - MrSID
  - JPEG2000
- County Mosaics (in Metric and Survey Feet) in the following formats:
  - MrSID
  - ECW

Figure 3. Initial map services by county or delivery region.

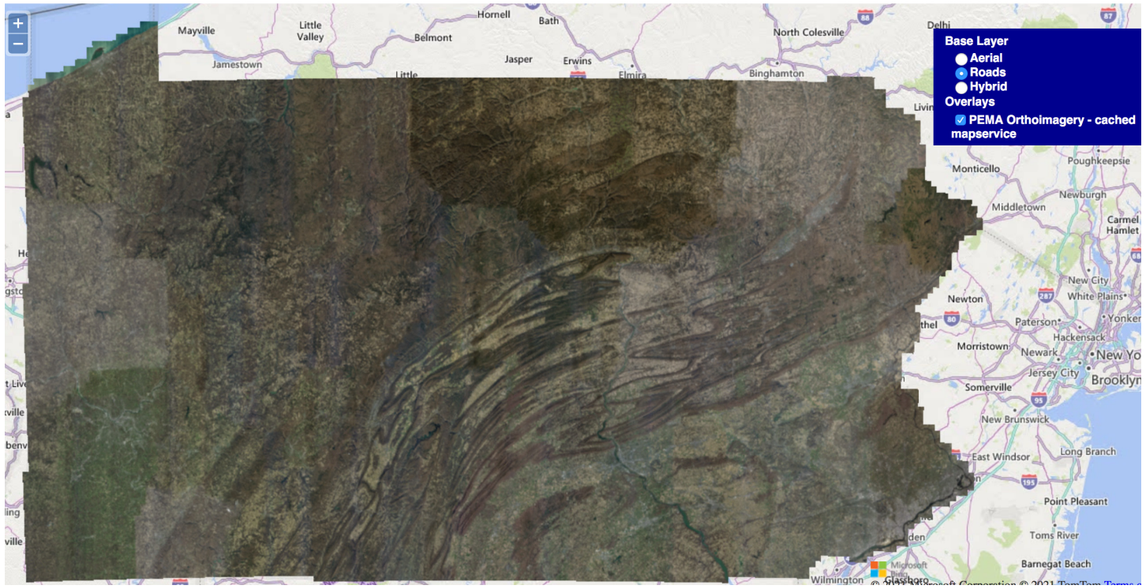

Figure 4. Statewide cached service

- FGDC-compliant XML Metadata for all imagery products
- Tile Layout shapefiles for the North and South Pennsylvania State Plane zones
- Flightlines shapefile for collection of PEMA imagery data

One barrier to progress was that some counties did not have the storage capacity to store the imagery locally. These counties held onto the external hard drives for months until they could either find the space or purchase an external drive to put the data on. These counties rely on PASDA to access the data.

Data on FTP site

Almost 21 TB of downloadable PEMA imagery data is available on PASDA. This includes Tiff, JP2, SID, ECW, and SID files in Survey Feet units (Figure 1). James Spayd moved all the data to the FTP site and created the PASDA compliant metadata in our data base for each delivery.

Accessing Data via PASDA

In the first year and a half of the project, the data was accessed by county (some partial). Since interest in accessing the data was so high, we decided to put data up as it came in even if it was not a complete county. Wherever possible, mosaics were provided for download along with individual tiles. Users could access the data by going to the PASDA homepage and clicking on the PEMA imagery link. As most of the data was completed, we consolidated the metadata records into the statewide cached service (see map service discussion below), county mosaics, JP2, SID, Tiff, and the two tile indexes (Figure 2).

(https://www.pasda.psu.edu/uci/SearchResults.aspx?Keyword=PEMA+Orthos)

Map Service Development

In the last 15 years, the use of map services has grown exponentially. This is particularly true of big data sets such as imagery which are challenging to host locally. In the first stages of the project, James Spayd, who managed the service development component of the project, created JPEG2000 mosaics of county imagery. Each county had its own mosaic that could be consumed as a service. (Figure 3)

Once three quarters of the statewide imagery was complete, these individual services were combined into a single statewide cached service (Figure 4). This was done for two key reasons. First, the individual regional or county services were consuming significant space on the servers as well as using significant processing power. Second, the statewide cache is significantly faster and performs better than individual services that users might have to consume one by one.
In addition to the map services, the data was incorporated into the PA Imagery Navigator for viewing and downloading. This application provides access to all of the imagery data that is hosted by PASDA from 1937 to present. A flight lines application using a flight lines shapefile was also created so users could find out when a particular area was flown

(https://pasda.maps.arcgis.com/apps/webappviewer/indexhtml?id=64abb100b2b24e72a68924585a600b72)

Conclusion

The PEMA statewide imagery project has been a huge benefit to the commonwealth. It was a significant undertaking by all the parties involved from PEMA to Quantum to Penn State. The collaboration with all the partners was exceptional and resulted in access to vital data for the commonwealth.