

Developing a Tactical-Level Geospatial Course for Army Engineers

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Why Now and Why ESRI?

New Geospatial Engineering Doctrine

ATP 3-34.80

Geospatial Engineering

[2016 Revision]

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Headquarters, Department of the Army

Geospatial Engineering Force Structure Changes

Projected Engineer Force FY 2020...

- *Multiple-capable organizations*
- **21%** of total Engineer Force Organic to BCTs
- *Aligns GPCs to 6 ASCCs and USASOC; provides EN Brigades with Geospatial database management capability*

Commonality

ArcGIS Online Map



The USACE ArcGIS Online Map taps into ESRI's powerful online webmap to enable map content creation, sharing, management, manipulation, and more.

"Esri technology, such as the templates, gives the army an easy-to-use, technical advantage that helps soldiers optimize GEOINT capability resident in DCGS-A," said Col. Ed Riehle, the Army Training and Doctrine Command's Capability manager for sensor processing.

A recent survey by **Worldwide Business Research** determined that nearly 90 percent of all government and military agencies in Europe and the Americas use Esri's ArcGIS as their primary geographic information system (GIS).

Using the customized maps, apps, templates, and other tools found in [ArcGIS for the Military](#) and [ArcGIS for Intelligence](#), organizations can easily solve complex problems and quickly make critical decisions.

In addition, as nations and agencies move towards greater use of open source intelligence, including crowd sourced and volunteered geographic information, the ability of systems like ArcGIS to collect, fuse, and analyze disparate information from a wide variety of sources becomes increasingly important in building a common operational picture.



MaritimeOperations / ArcGIS for the Military

From the Army Geospatial Engineer Leadership on the GETOC Curriculum Development

- “Directed by the Chief of Engineers, we are trying to build a bench of ASI W2 Geospatial Officers.”

COL Kevin Brown, Director – Training and Leader Development,
United States Army Engineer School

- *“I also like the idea of getting the lieutenants into the product, research phase of geospatial engineering. They need the fundamentals: what do I need, where do I go, and how can I produce what I need.”*

COL John Connor, Training and Doctrine Command (TRADOC)
Capabilities Manager - Geospatial



Expectations of an Engineer Officer at the Tactical Level

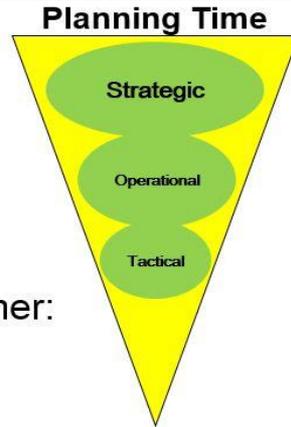
ENGINEER STAFF OFFICER

3-17. The engineer staff officer, usually the senior engineer officer on the staff, is responsible for coordinating engineer assets and operations for the command. Regardless of the distribution of the engineer staff or their section of assignment, the engineer staff officer ensures the synchronization of the overall engineer effort.

3-18. The engineer staff officer is responsible for the integration of geospatial engineering throughout the operations process. On behalf of the chief of staff, he provides direction to the geospatial engineer team. The officer in charge of the GET and GEOINT Cell is responsible for daily operations. The engineer staff officer performs the following tasks to support the GET:

- Generate.
 - Coordinate with the S-2/G-2, S-3/G-3, other staff elements, and the geospatial engineering technician for terrain products that will help describe the physical environment to the commander and staff, facilitate a better understanding of the operational environment, and enable decision making.
 - Coordinate with the S-2/G-2 for the production and distribution of maps and terrain products based on established priorities.
 - Coordinate for terrain models and products to facilitate rehearsals.
- Manage.
 - Establish and maintain a continuous, open link between engineer cells and supporting engineer command posts to assess the effectiveness of geospatial engineering operations.
 - Work with the S-2/G-2 and geospatial engineering technician in assessing the effectiveness of terrain products based on feedback from the commander, the staff, and subordinate units.
- Analyze.
 - Recommend adjustments to the priorities for the geospatial engineering technician in concert with the S-2/G-2.
 - Work with the S-2/G-2 to integrate updated estimates, tactical decision aids, and geospatial products into the orders process.
- Disseminate.
 - Provide recommendations on the priorities of geospatial engineering to the S-2/G-2 that coincide with the geospatial engineer team and geospatial intelligence cell.
 - Establish procedures for effectively transferring updated SSGF data on mounted and handheld platforms.

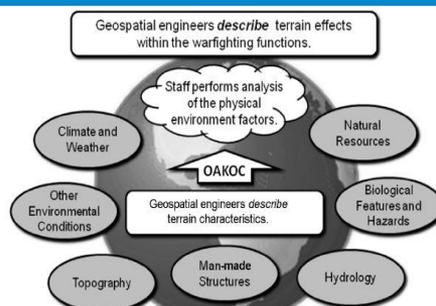
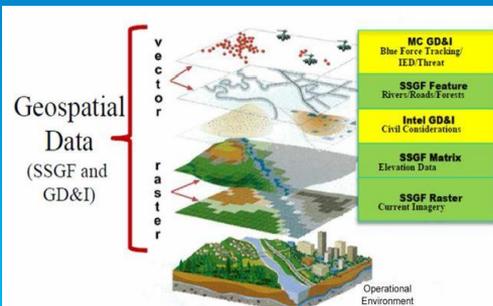
- OPLAN
 - CONPLAN
- Geospatial Annex
- Operation
 - Exercise
- OPORD Annex
- Training
 - Contingency
 - Ad hoc
- Directly to Customer:
Softcopy and/or
Hardcopy



Deliberate planning requires more time to address mission requirements, as the development of geospatial products are theater-wide and joint in nature

Most geospatial mission requirements have minimal planning time, require less product fidelity, and a result in a quick turn-around time. These requirements generally occur in the tactical level and support multiple customers.

PRODUCT/WARFIGHTING FUNCTION	MOVEMENT MANEUVER	INTEL	FIRES	SUSTAINMENT	COMMAND CONTROL	PROTECTION
Lines of communication	X	X		X	X	
Overpass/bridges/subterranean	X	X				
Line of sight	X	X	X		X	
Cover and concealment	X	X			X	X
Helicopter landing zones	X			X	X	X
Perspective Views	X	X	X		X	
Ford Analysis	X	X				
On/off road speed	X	X		X	X	X
Soil diggability	X	X				X
Target acquisition	X	X	X		X	
Flight line target locator	X	X	X		X	
(Un)obstructed signal	X	X	X		X	X



Course Development Parameters

- Use Realistic Planning Scenarios (a likely yet challenging tactical operation that company-grade officers can plan)
- Use Real Data that would be available for any military operation
- Develop baseline skills for simple geospatial applications and analysis (basic consumer-level skill sets)
- **Use ESRI Software and Products (Program of Record)**
 - **ArcReader (10.4 for Windows 10, 10.1 for Window 7)**
 - **ArcGIS Earth (In the testing phase now using existing online services with a set of scenario-based shapefiles)**
- Make it accessible to all customers (Using Blackboard and Laptop)
- Instruction can be *onsite* in a classroom delivered by a live instructor OR solely *online* (stand-alone with a portable device)
- Tie it to the most recent doctrine, tactics, techniques and procedures
- Make it easy to update as things (people, ideas, systems) change

Course Content

- **Fundamental Concepts of Geospatial Information and Services (GI&S)**
- **Fundamental Concepts of Data Accuracy**
- **Fundamental Formats of Digital Geospatial Data**
- **Fundamental Concepts of Geographic Information Systems (GIS)**
- **Fundamental Concepts of Satellite Imagery and Remote Sensing**
- **Fundamentals of Global Positioning System & GPS Surveying for GIS**
- **Fundamental Concepts of Digital Terrain Modeling**
- **Fundamental Concepts of Digital Cartography, Mapping and Products**
- **Fundamental Concepts of Geospatial Analysis for Tactical Operations**
- **Capstone Exercise**
- **30 Question Exam**

Course Expectations

- **What the course does:**

- Provides a fundamental understanding of geospatial engineering and common geospatial products
- Provides tactical-level leaders a foundation level of understanding of their roles and responsibilities with respect to geospatial information and products
- Focuses on the application of geospatial information and products for tactical-level military operations

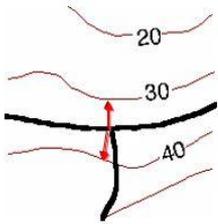
- **What the course is NOT:**

- Executive training, analysis training or TRADOC MOS certification.
- Focused on joint, strategic, academic, or theoretical areas
- A hardware or software course
- A geospatial intelligence (GEOINT) course
- A geospatial analysis or “button pusher” course

Former Versus New Look

Map Accuracy (Vertical)

- Example for a 1:50,000 TLM with 10m Contour Intervals



The 90% LE for this map is 1 contour interval (category 2 from the previous slide)

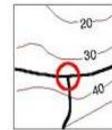
That means that the elevation depicted has a 90% chance of being within 1 contour interval of where it actually belongs on the map

- At map scale, 1 contour interval is 10m in elevation. That means that the true elevation at that point is $\pm 10\text{m}$ (up or down) at 90% confidence or **$\pm 10\text{m}@90\%$** .

Stand-alone slide

Map Accuracy (Horizontal)

- Example for a 1:50,000 TLM



The 90% CMAS for this map is 1mm (category 2 from the previous slide)

That means that this intersection has a 90% chance of being within 1mm of where it actually belongs on the map

- At map scale, 1mm covers 50m on the ground. Because it is a 1mm radius circle it is $\pm 50\text{m}$ in any direction at 90% confidence or **$\pm 50\text{m}@90\%$** .

Why does this matter?

Most tactical maps like the TLM are at a scale of 1:50,000

What can you actually depict on a map at a 1:50,000 scale?

Very large features like roads, ponds, and built-up areas

What does this mean in terms of determining accuracy?

Let's take a look at an example.



Interactive

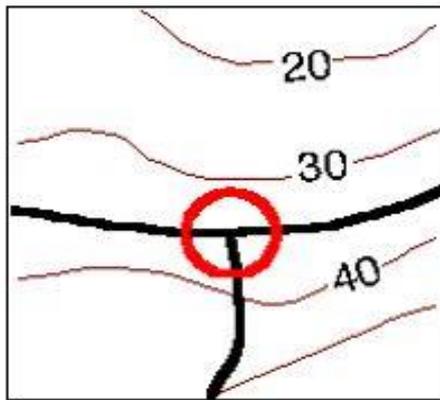
Specific learning objective

Consistent data and software examples

Legacy Look – Plain Slide with Text and Small Picture

Map Accuracy (Horizontal)

- Example for a 1:50,000 TLM



The 90% CMAS for this map is 1mm (category 2 from the previous slide)

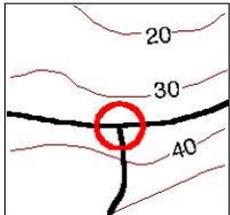
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New Look – Animation with Real Data and Images

Map Accuracy (Horizontal)

- Example for a 1:50,000 TLM



The **90% CMAS** for this map is **1mm** (category 2 from the previous slide)

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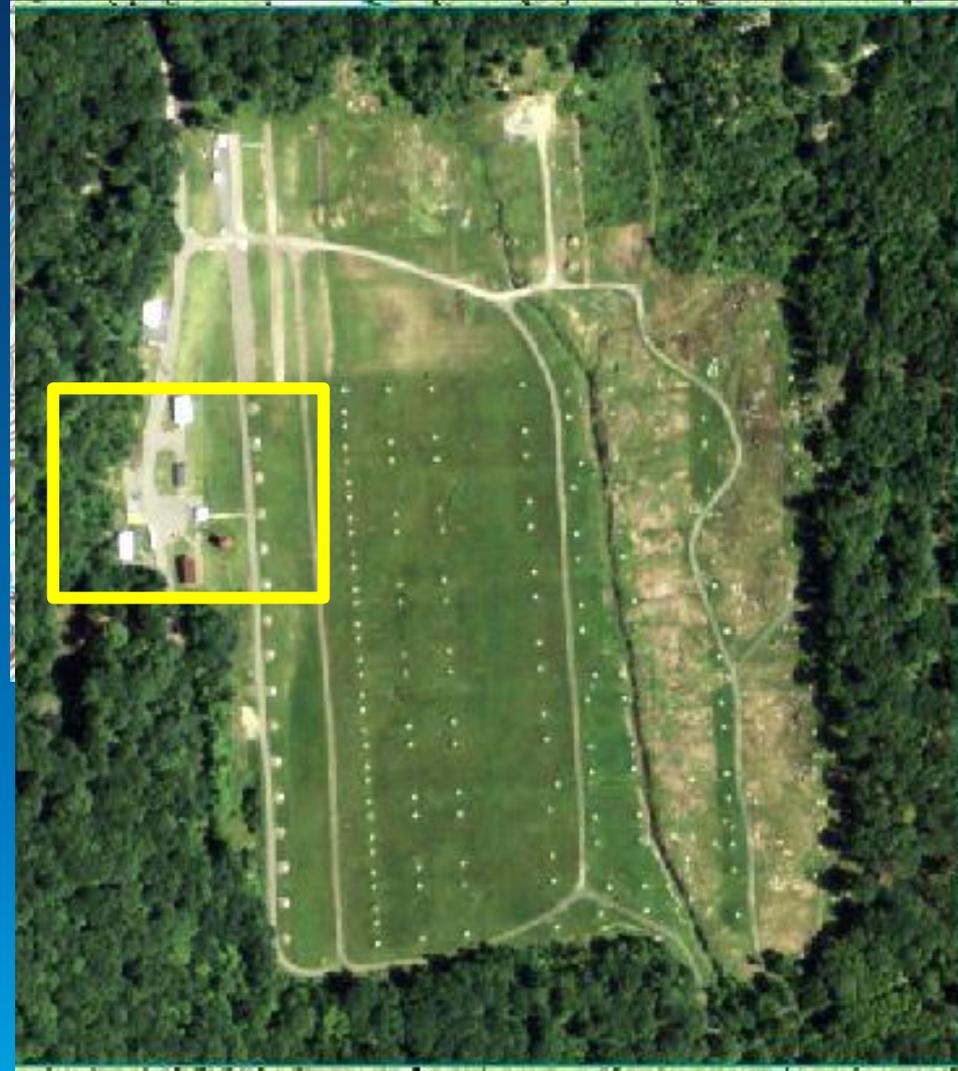
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New Look – Focused on a Tactical Learning Objective

Understanding Scale and Accuracy – A Tactical Example

This distance is 1 millimeter on a 1:50,000 scale map



From the center of the circle to the outer edge, the distance is 50 meters.

For a 1:50,000 TLM map common for tactical-level planning and operations, there is a 90% likelihood that the feature in the center of **this** circle is within 50 meters of its actual position.

With most modern GPS systems, the precise will show a 10-digit grid coordinate, which is precision (but not necessarily accuracy) to 1 meter.

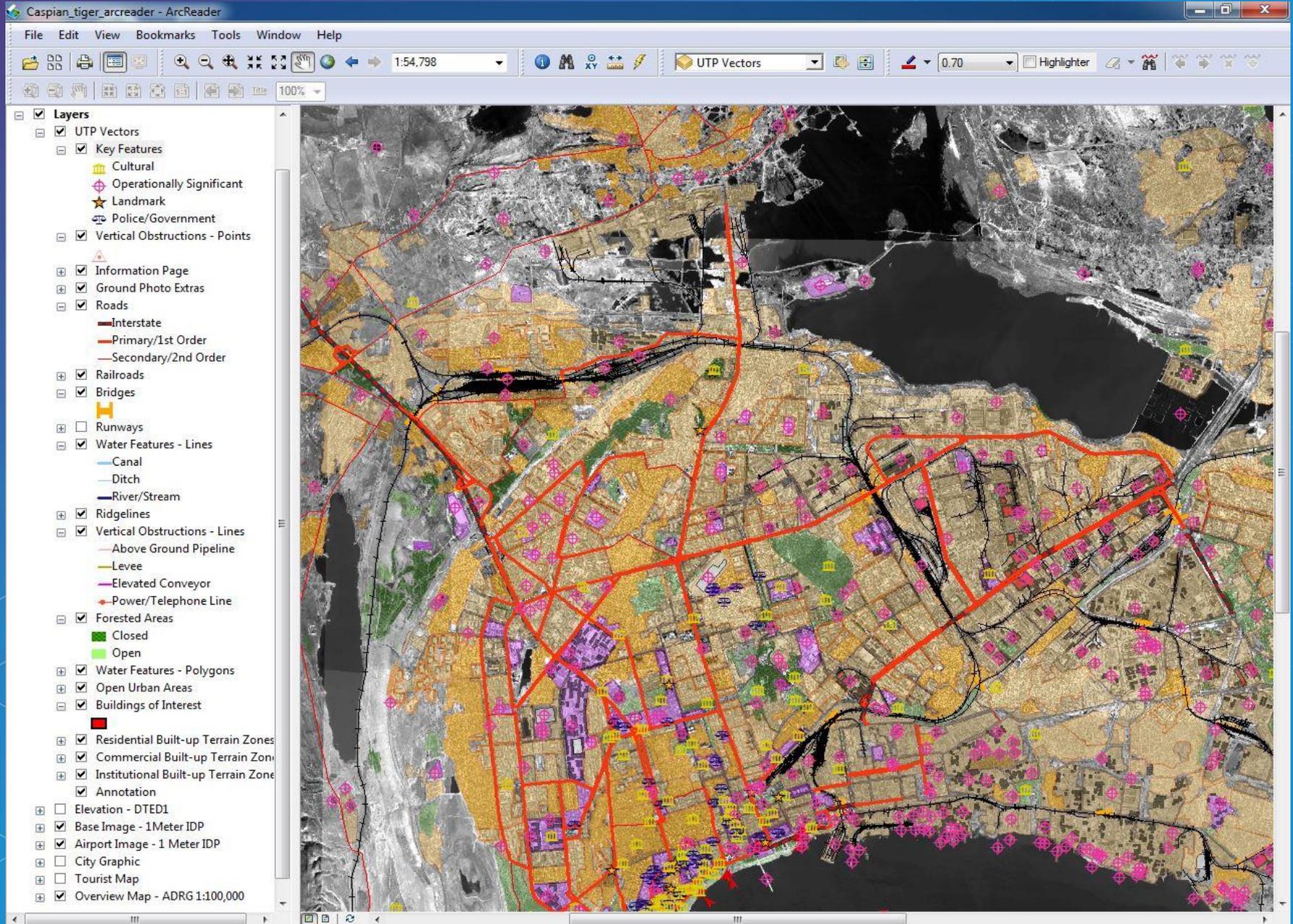
The 1:50,000 TLM is accurate to ± 50 meters from the actual absolute accuracy of point on the ground.

To plan an operation to take out these buildings, you need a good leader's recon of the area or geospatial products with higher spatial resolution and accuracy to ensure mission success.

High resolution satellite imagery used in ArcGIS Earth

Given the accuracy of a 1:50,000 TLM, any building could be “the building” given the product’s scale and accuracy

Operational Overview (ArcReader)



Geospatial Engineering Assessment - Perimeter (ArcReader)

The screenshot displays the ArcReader interface with a map of Kirovsky Rayon. The map shows various features including roads, railroads, and buildings. A red line indicates a measured perimeter. Two windows are open: a 'Measure' window and an 'Identify' window.

Measure Window:

- Area measurement
- Perimeter: 932.167885 Meters
- Area: 44,603.860752 Square Meters

Identify Window:

Identify from: <Top-most layer>

- AK040

Location: 401,775.389 4,475,315.386 Meters

Field	Value
Subfield	Athletic Field
Feature Code	AK040
Name (nam)	UNK
Existence Category (exs)	Operational (28)
Key Feature Classification	Operationally Significant (opersig)
Building Function Code (bfc)	Null (-32768)

Identified 1 feature

Legend (Left Panel):

- UTP Vectors
 - Key Features
 - Cultural
 - Operationally Significant
 - Landmark
 - Police/Government
 - Vertical Obstructions - Points
 - Information Page
 - Ground Photo Extras
 - Roads
 - Interstate
 - Primary/1st Order
 - Secondary/2nd Order
 - Railroads
 - Bridges
 - Runways
 - Water Features - Lines
 - Canal
 - Ditch
 - River/Stream
 - Ridgelines
 - Vertical Obstructions - Lines
 - Above Ground Pipeline
 - Levee
 - Elevated Conveyor
 - Power/Telephone Line
 - Forested Areas
 - Closed
 - Open
 - Water Features - Polygons
 - Open Urban Areas
 - Buildings of Interest
 - Residential Built-up Terrain Zones
 - Commercial Built-up Terrain Zones
 - Institutional Built-up Terrain Zones
 - Annotation
 - Elevation - DTED1
 - Base Image - 1Meter IDP
 - Airport Image - 1 Meter IDP
 - City Graphic
 - Tourist Map
 - Overview Map - ADRG 1:100,000

Geospatial Engineering Assessment - Urban Port (ArcReader)

The screenshot displays the ArcReader interface with a map of an urban port area. The map shows various features including roads, buildings, and green spaces. The 'UTP Vectors' layer is active, and the 'Identify' window is open, showing details for a feature named 'GB030'.

Map Layers (Left Panel):

- UTP Vectors
 - Key Features
 - Cultural
 - Operationally Significant
 - Landmark
 - Police/Government
 - Vertical Obstructions - Points
 - Information Page
 - Ground Photo Extras
 - Roads
 - Interstate
 - Primary/1st Order
 - Secondary/2nd Order
 - Railroads
 - Bridges
 - Runways
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 - Airport Image - 1 Meter IDP
 - City Graphic
 - Tourist Map
 - Overview Map - ADRG 1:100,000

Identify Window:

Identify from:

GB030

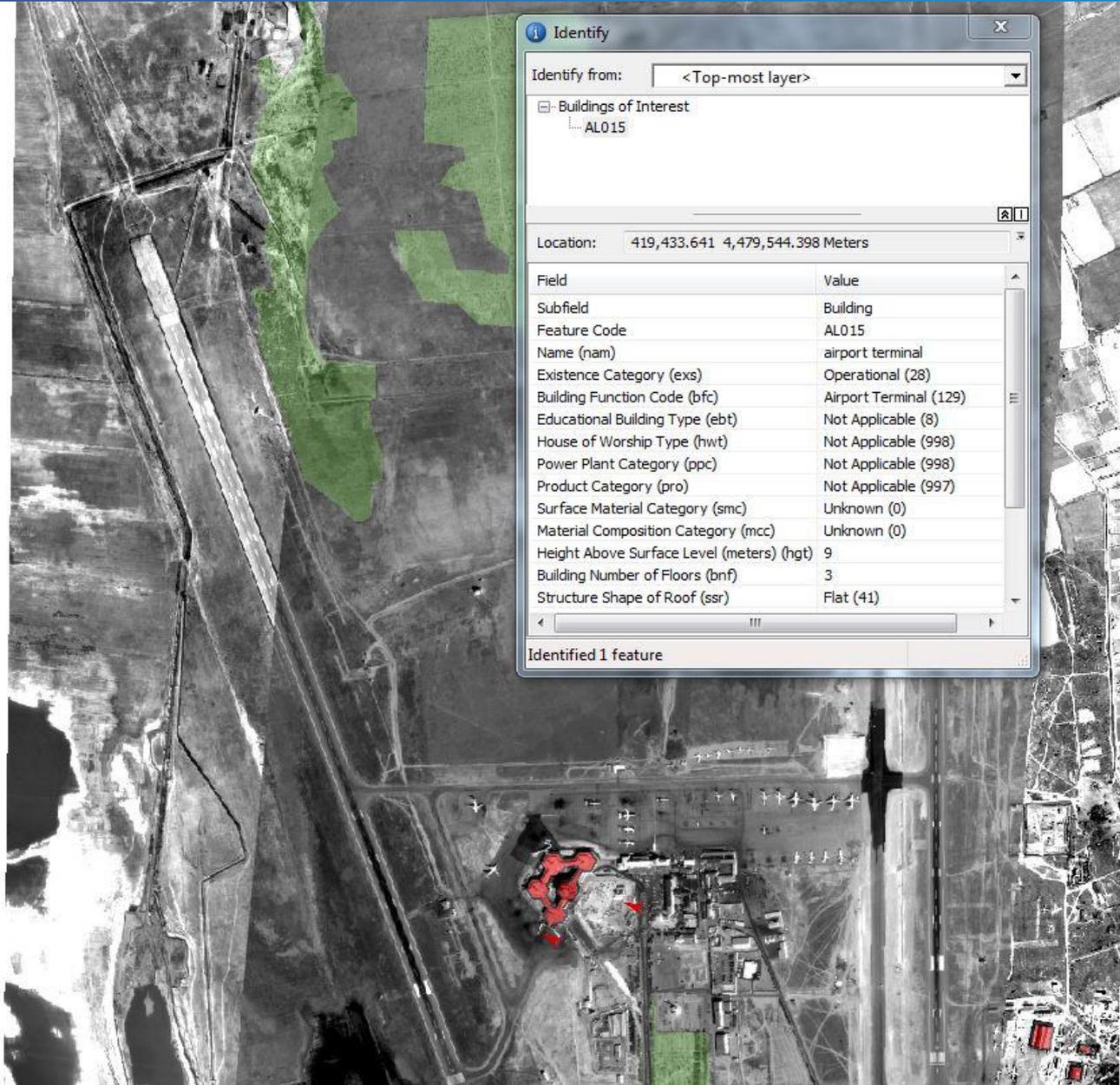
Location: 410,398.706 4,467,055.942 Meters

Field	Value
Subfield	Helicopter Landing Pad
Feature Code	GB030
Name (nam)	UNK
Existence Category (exs)	Operational (28)

Identified 1 feature

Geospatial Engineering Assessment - Airfield (ArcReader)

- UTP Vectors
 - Key Features
 - Cultural
 - Operationally Significant
 - Landmark
 - Police/Government
 - Vertical Obstructions - Points
 - Information Page
 - Ground Photo Extras
 - Roads
 - Interstate
 - Primary/1st Order
 - Secondary/2nd Order
 - Railroads
 - Bridges
 - Runways
 - Water Features - Lines
 - Canal
 - Ditch
 - River/Stream
 - Ridgelines
 - Vertical Obstructions - Lines
 - Above Ground Pipeline
 - Levee
 - Elevated Conveyor
 - Power/Telephone Line
 - Forested Areas
 - Closed
 - Open
 - Water Features - Polygons
 - Open Urban Areas
 - Buildings of Interest
 - Residential Built-up Terrain Zones
 - Commercial Built-up Terrain Zones
 - Institutional Built-up Terrain Zones
 - Annotation
- Elevation - DTED1
- Base Image - 1Meter IDP
- Airport Image - 1 Meter IDP
- City Graphic
- Tourist Map
- Overview Map - ADRG 1:100,000



Curriculum Using ArcGIS Earth

Military Geospatial Engineering

Curriculum Development using ArcGIS Earth

- 01c_Key_Features_-_Police_Gover
- 01d_Key_Features_-_Landmarks
- 02_Vertical_Obstructions_-_Points
- 03_Information_Pages
- 04_Ground_Photos
- 05_Roads
- 06_Railroads
 - Branch_Line
 - Main_Line
- 07_Bridges
- 08_Runways
- 09_Water_-_Lines
- 10_Ridgelines
- 11_Vertical_Obstructions_-_Lines
- 12_Forests
- 13_Water_-_Polygons
- 14_Open_Urban_Areas
- 15_Buildings_of_Interest
- 16_Builtup_Terrain_Zone_-_Reside
- 17_Builtup_Terrain_Zone_-_Comm
- 18_Builtup_Terrain_Zone_-_Institu
- Marginalia
- USA Topographic Maps (Mature Sup
- World Imagery

49°59'14"E 40°21'07"N elev 0.00m, eye alt 2.19 km

Geospatial Engineering Assessment - Road Network

Find address or place

My Data

- Water_Polygons
- Water_Lines
- VerticalObstructions_Points
- VerticalObstructions_Lines
- Runways
- Roads
- Ridgelines
- Railroads
- OpenUrbanAreas
- KeyFeatures
- InformationPages
- GroundPhotos
- Forests
- BuildingsOfInterest
- BTZ_Residential
- BTZ_Institutional
- BTZ_Commercial
- Bridges
- Water_Lines
- World Street Map
- World Topographic Map
- World Street Map
- World Topographic Map
- World Imagery
- World Imagery
- Pansharpended Landsat

Length
1.858 Kilometers

Heading
185.970 Degree

Name
Untitled Line

Color

Weight

Type

Opacity

49°49'18"E 40°18'29"N elev 0.00m, eye alt 24.84 km

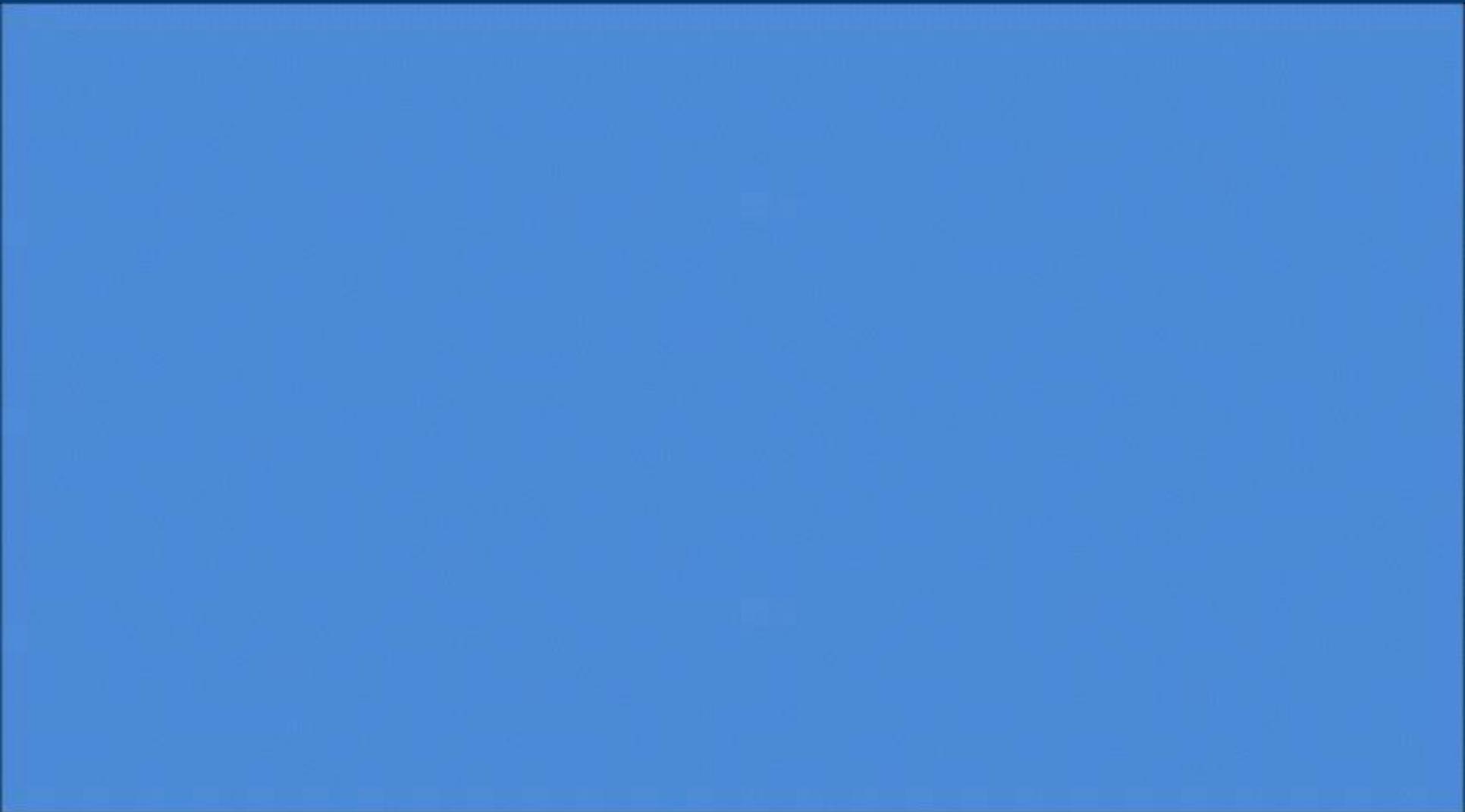
esri

Geospatial Engineering Assessment - Vertical Obstructions

The image displays a GIS software interface for a geospatial engineering assessment. The main map area shows an aerial view of a city with several yellow dotted lines tracing paths across the urban landscape, representing vertical obstructions. On the left, a dark sidebar contains a 'My Data' folder with a list of layers. The 'VerticalObstructions_Lines' layer is selected and checked. Other layers include 'Water_Polygons', 'Water_Lines', 'VerticalObstructions_Points', 'Runways', 'Roads', 'Ridgelines', 'Railroads', 'OpenUrbanAreas', 'KeyFeatures', 'InformationPages', 'GroundPhotos', 'Forests', 'BuildingsOfInterest', 'BTZ_Residential', 'BTZ_Institutional', 'BTZ_Commercial', 'Bridges', 'Water_Lines', 'World Street Map', 'World Topographic Map', 'World Imagery', and 'Pansharpened Landsat'. On the right, a 'Properties' panel is open, showing the 'Appearance' tab for the selected layer. The settings are: Type (dashed line), Color (#FFDE42), Weight (6), and Opacity (1). The panel includes 'OK', 'Cancel', and 'Apply' buttons at the bottom.

Curriculum Using ArcGIS Earth – Setting Up The Data

Curriculum Using ArcGIS Earth – Viewing Features



Making It Accessible

Online via Blackboard and using pre-developed data sets compatible with ArcReader or ArcGIS Earth

US Army Engineer School LIFELONG LEARNING CENTER

WOOD Home My Institution Courses Con

BRUCE C. CLARKE LIBRARY
Fort Leonard Wood, Mo

For Your Research Needs
[Bruce C. Clarke Library](#)
[Engineer Regiment's Resource](#)

Engineer School

Construction Engineer

- Chief, Construction Engineer Branch:
 - Mr. Brian Nering
✉ brian.j.nering.civ@mail.mil
☎ 1-573-563-7553
- Academic Assistance with Construction Courses (Enrollments and tests):
 - SGM David A. Vandermark
✉ David.a.vandermark.mil@mail.mil
☎ 1-573-563-5069
 - MSG Stephen D. Mackellar
✉ stephen.d.mackellar.mil@mail.mil
☎ 1-573-563-8075
- Group Email:
 - ✉ leon.usaesdotditd@conus.army.mil
- Vertical Skills Section (12R10,12K10,12W10,12H30,12H40)
 - (12K10) Mr. David T. Kessler
✉ david.t.kessler.civ@mail.mil
☎ 1-573-563-7570
 - (12R10) SSG Charles Toomer
✉ charles.d.toomer2.mil@mail.mil
☎ 1-573-563-7509
 - (12W10) SSG David R. Huling
✉ david.r.huling.mil@mail.mil
☎ 1-573-563-2408
 - (12H40) Vacant
- Horizontal Skills Section (12N10,12N30,12N40, 12G10, 12V10)
 - (12N10) Mr. Tim Blake
✉ timothy.d.blake2.civ@mail.mil
☎ 1-573-563-7594
 - (12N30) Vacant
 - (12N40) Vacant
 - (12V10) Vacant
 - (12G10) Vacant

Geospatial Skills

- Geospatial Engineers (12Y)
 - SFC Willingham, Timothy N Sr
✉ timothy.n.willingham.mil@mail.mil
☎ 1-573-563-4125
- Geospatial Engineering Technician (125D)
 - CW4 Stephen Joseph
✉ stephen.e.joseph.mil@mail.mil
☎ 1-573-563-3816

IPad: depends on the services available

esri Industries Products Support & Services About Community

ArcReader

Overview
Key Features
Common Questions
System Requirements
Download Now

Download ArcReader

Software Downloads

- Choose your ArcReader version to download

See system requirements for running ArcReader.

Visit the ArcGIS Help for information on getting started with ArcReader.

What's New

What's New in ArcGIS

See how ArcGIS helps you put mapping and GIS into the hands of more people.

Training Available for ArcGIS

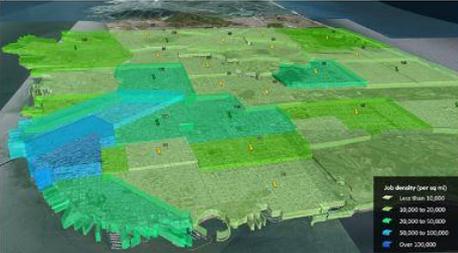
Check out the new instructor-led curriculum for ArcGIS.

ArcGIS Earth

Home Use Administer Forum

ArcGIS Earth allows anyone to easily and quickly view 3D maps.

[GET ARCGIS EARTH](#)

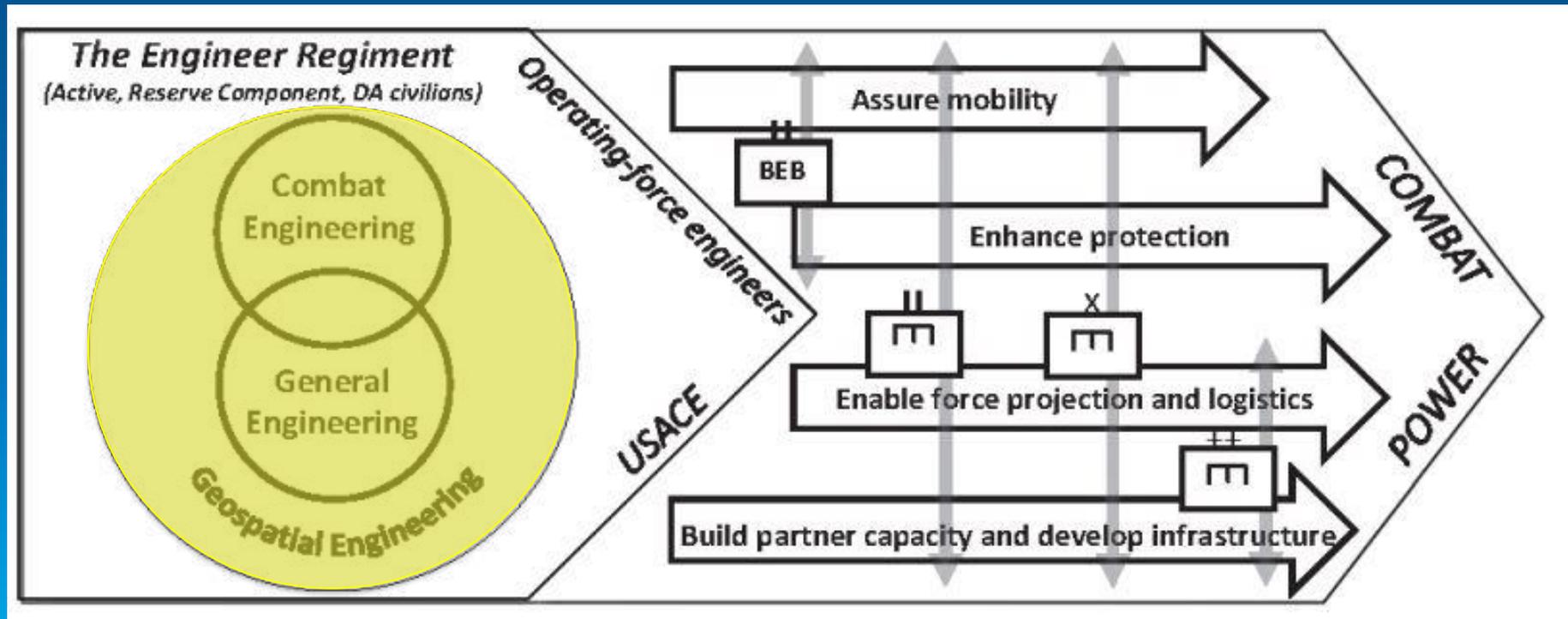


Navigate ArcGIS Earth
Use your mouse, keyboard, or touch screen to explore terrains, oceans, and mountains anywhere in the world.

View KML or KMZ files and ArcGIS services

A Tactical-Level Course in Geospatial Engineering What's The "So What"?

From FM 3-34
Engineer Operations



Everything is tied to Geospatial Engineering

Why is it important? We end up hiring our own!

