Predictive Capability to Assess Military Training Impacts on Military Installation Streams Utilizing Remote Sensing

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Issues

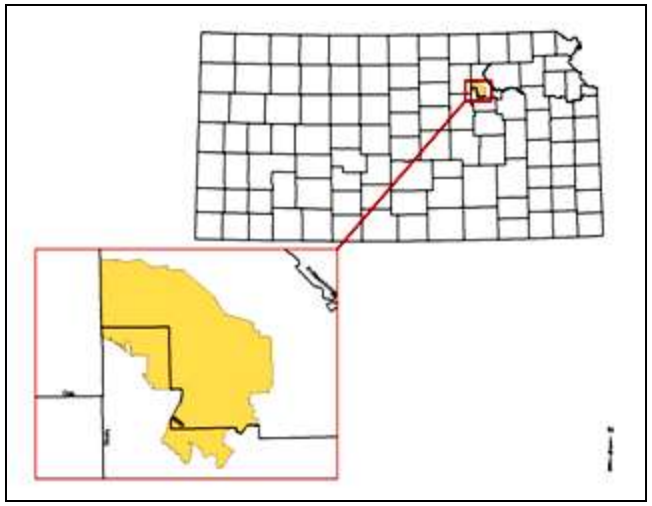
- Lack of understanding of how military maneuvers impact stream morphology
  - Mission requires vehicles to traverse streams
  - Damage to stream banks, beds, approach roads
- In-field stream assessments
  - Resource intensive
  - Difficult to see due to vegetation: may miss important changes
- Remote sensing
  - Orthophotography
  - Light Detection and Ranging (LiDAR)
  - Combination: LiDAR with orthophotography

Remote Sensing

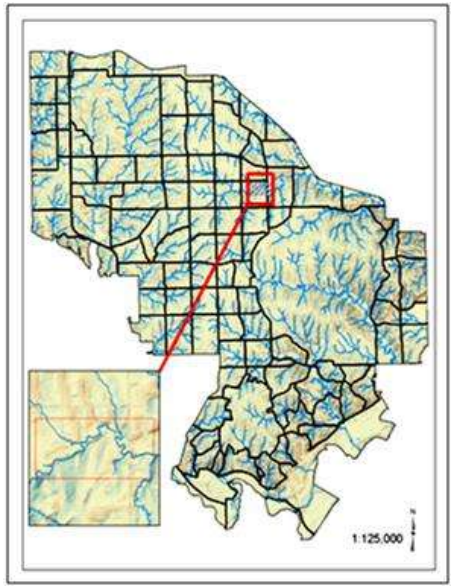
- Historic orthophotography
  - Does not measure landscape depth
  - Leaf cover obstructs topography
- Light Detection and Ranging (LiDAR)
  - Three-dimensional coordinate of point
  - Leaf-on or leaf-off
- Combination: LiDAR with orthophotography
  - LiDAR digital elevation model (DEM) overlaid on orthophotograph
  - Provides detailed terrain features
  - Can accomplish geomorphological analysis:
    - Abandoned channels, landslides
    - Incised streams, stream bank erosion, gully formation
  - Drawback: Can not penetrate water

Study Area

- Wind Creek
  - Located on Fort Riley, KS in the Flint Hills region
  - 3rd order stream, total drainage area 25.5 km^2
  - Bed and bank material composition: silt, clay, gravel, cobble, boulders



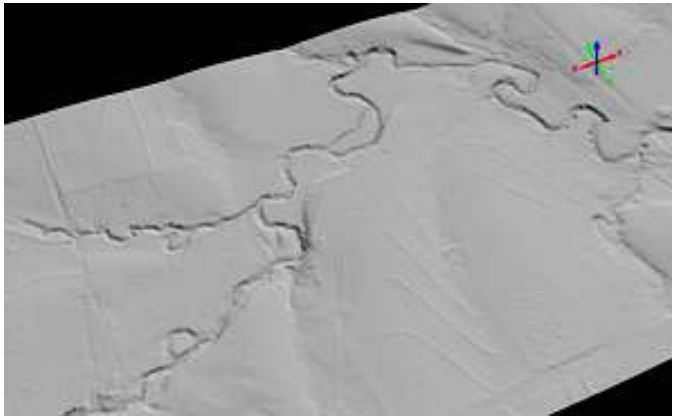
Location of Fort Riley within the county lines in the State of Kansas.



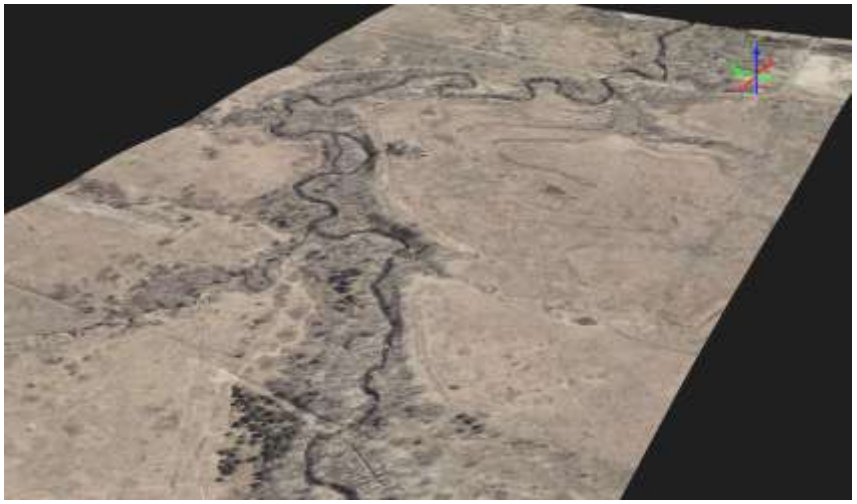
Map showing the location of Wind Creek Fort Riley, Kansas.

Imagery

- Initial imagery
  - Orthophotography: 25 Mar -1Apr 07, resolution 0.25 m
  - LiDAR: 1-9 Apr 06, 1.4 m point spacing, 0.5 m horizontal, 0.3 m vertical
- Follow-on imagery
  - Orthophotography: 18-30 Mar 10, resolution 0.127 m
  - LiDAR: 18-30 Mar 10, 1.4 m point spacing, 0.15 m vertical



LiDAR DEM image taken March 2010.



LiDAR DEM with 6 inch resolution Color Digital Orthophotography taken March 2010 Comparison Methodology.

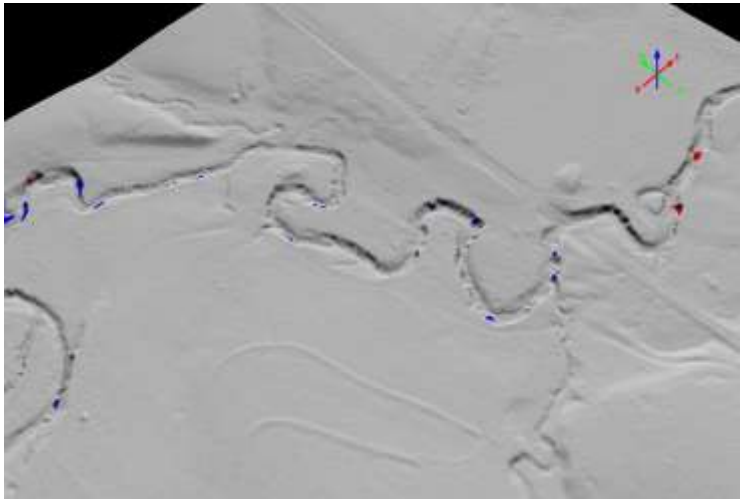
Visual Comparison

- Does indicate changes
  - Large changes are visible
  - Cannot discern small changes

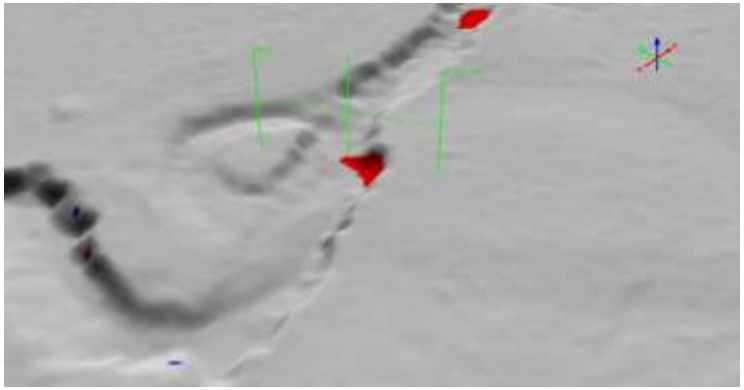
Blimp aerial photograph of section of Wind Creek, 12 April 2006.

2010 orthophotography of the same area as the 2006 image (left).

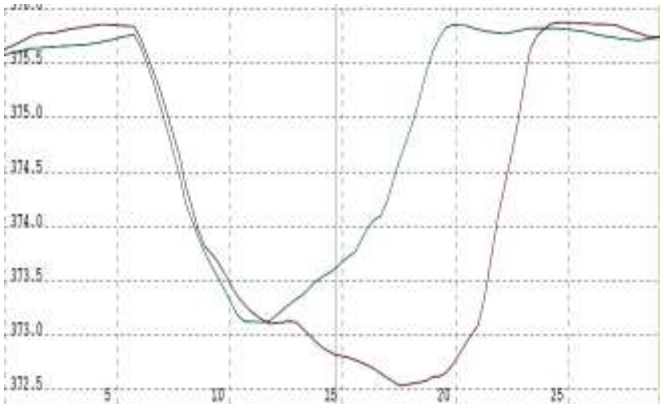
Results



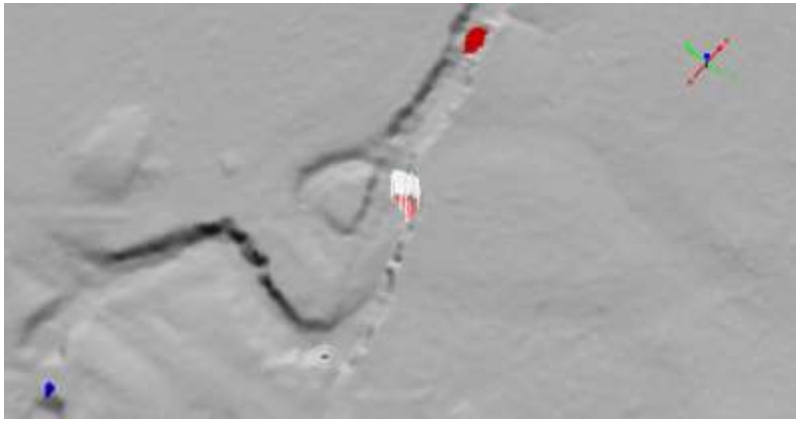
Areas of change from 2007 to 2010.



Selected cross-section of Wind Creek indicating area of change.



Cross section at the selected location along Wind Creek in 2007 and 2010.



Estimated volume of change as indicated in red and white in the figure was determined to be a loss of 77 m^3 between 2007 and 2010.

Conclusion

2010 orthophotography of Wind Creek with cross section survey points plotted.

Downstream view from the last cross section on a study reach on Wind Creek toward the site of soil loss.

Conclusion

- High quality data for locating temporal changes
- Quick evaluation
- Identifies areas of concern
- Field work can focus on points of interest
- Maximizes human and fiscal investment