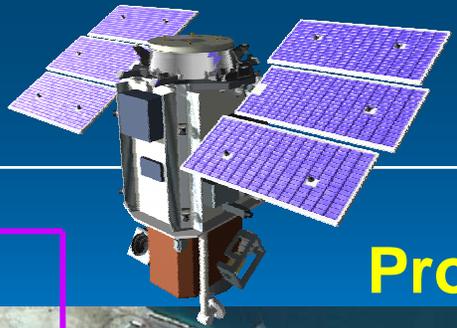


QuickBird Imagery Products and Applications



QuickBird Imagery: The Best of Both Worlds

Aerial Photography



Applications:

- Photogrammetry
- Moderate Feature Identification
- Visual Interpretation
- Cartography
- Mapping

- High Spatial Accuracy
- High Resolution
- Lower Information Content
- Manually Intensive

Satellite Imagery



Applications:

- Multispectral Remote Sensing
- Superior Feature Identification
- Status of Features (Veg. Health)
- GIS modeling
- Quantitative Analysis

- Lower Spatial Accuracy
- Lower Resolution
- Higher Information Content
- Automatic Image Processing

QuickBird Imagery



**For the first time,
Satellite imagery can
be used for the
day-to-day operations
of local governments:**

- High Resolution
- Geometric Accuracy
- Typical Mapping apps
- GIS-Ready
- Rich Info Content
- Multispectral Analysis
- Visual Analysis
- Cartography

1.5 Foot Traditional Orthophoto vs 2 foot QB Orthoimage

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1.5 Foot Traditional Orthophoto



2 foot QuickBird Orthoimage

1" = 400' Orthorectified Imagery

➤ Ortho Corrected

- 2 foot resolution
- 1" = 400' scale (8.1' RMSE)
- Panchromatic (450-900nm)
- Cloud Free Seamless mosaic
- Radiometric, sensor and topographic distortions removed corrections
- Map projection & datum of choice
- Customer defined area
- Minimum order
 - ◆ 10 mi² for Off-the-Shelf imagery
 - ◆ 25 mi² for custom image collection
- Civil Government License



1" = 400' Orthoimagery Features and Benefits

Features

- 1" = 400' mosaicked orthoimagery
- Current imagery Off-the-Shelf
- Crisp 2 foot resolution
- Affordable
- Attractive licensing
- Fast Delivery
- Easy to Use
- Subscription Program Available

Benefits

- Standard 1' = 400' scale
- Map & monitor new development
- Suitable for multiple mapping applications
- Inventory and monitor assets
- Lock in promotional pricing
- Data sharing across or between multiple organizations
- Open directly into your GIS
- Maintenance Program
 - Continue to update your GIS over time at affordable rates

Order size	10mi ²	11-1000 mi ² *	Greater than 1000mi ²
Price	Special Promotion \$4999 total	\$115/mi ² (\$44.40km ²)	Call for quote

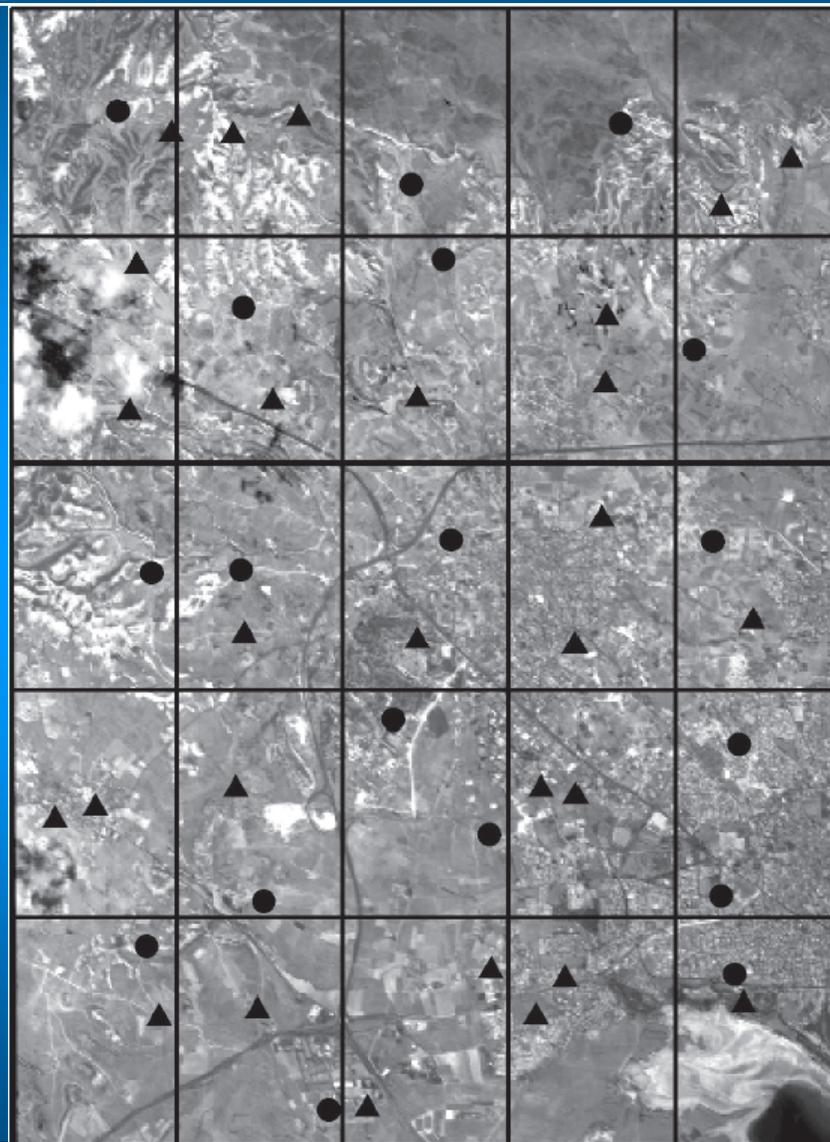
1" = 400' Orthoimage Applications

- **Map new development**
 - Infrastructure such as roads, utilities, buildings
- **Transportation Planning/Routing**
- **Asset Inventory and Management**
- **Parcel Mapping and Property Appraisal**
- **Regional Economic Development**
- **Hydrographic, River Management**
- **Sewer and Water Planning & Mgt.**
- **Single/Multi-Parcel Development Analysis and Tracking**
- **Building Code Enforcement**
- **Emergency Planning and Management**
- **Environment Compliance**
- **GIS Database Creation and Update**

Recently Published Study of QuickBird Orthorectified Imagery

DIGITALGLOBE™

- **European Union, Common Agriculture Policy¹**
- **QuickBird Basic Imagery**
 - 60 cm pan, 19.8 degrees off nadir
- **DEM**
 - 25m grid, 5m RMSE
- **GCP**
 - 18 calibration points,
 - ▲ 28 check points
 - All points better than .08m RMSE
- **Grid ensures GCP well distributed**
- **16 orthoimages produced**
 - RPCs used
 - Image split into 4 sections
 - 4 ortho generated per section
 - ◆ 1, 2, 3, 4 GCPs used per section



Kay et. al., May 2003, "Geometric Quality Assessment of Orthorectified VHR Space Image Data". *Photogrammetric Engineering & Remote Sensing*, vol. 69, NO. 5, pp. 484-491

EU Common Agriculture Policy Study Results

1 GCP

RMSE (E)	RMSE (N)
1.03	1.74
1.16	1.13
1.12	1.30
1.12	1.27

2 GCP

RMSE (E)	RMSE (N)
1.11	1.12
0.99	1.23
1.72	1.10
1.06	1.10

3 GCP

RMSE (E)	RMSE (N)
1.01	1.26
1.38	1.11
1.06	1.11
0.98	1.28

4 GCP

RMSE (E)	RMSE (N)
1.26	1.09
1.06	1.21
0.91	1.05
1.02	1.13

- No significant difference between results using more than 2 GCPs
- Mean RMSE 1.29 east & 1.15m north achieved
- 2 Dimensional RMSE (95%) 1.72m
- Suitable for 1:5,000 class 1 mapping; requirement of 1.77m RMSE

QuickBird Imagery Application Examples

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An Imaging and Information Company

Applications by Region

- **West**
 - Base mapping and GIS update
 - Storm water management
 - Fire
- **North East**
 - Emergency Management,
 - Homeland Security,
 - environmental compliance
- **South East**
 - Base mapping, planning, storm water management
- **North West**
 - Forest management
- **International**
 - Base mapping and GIS update
- **Grab Bag o' Imagery Applications**

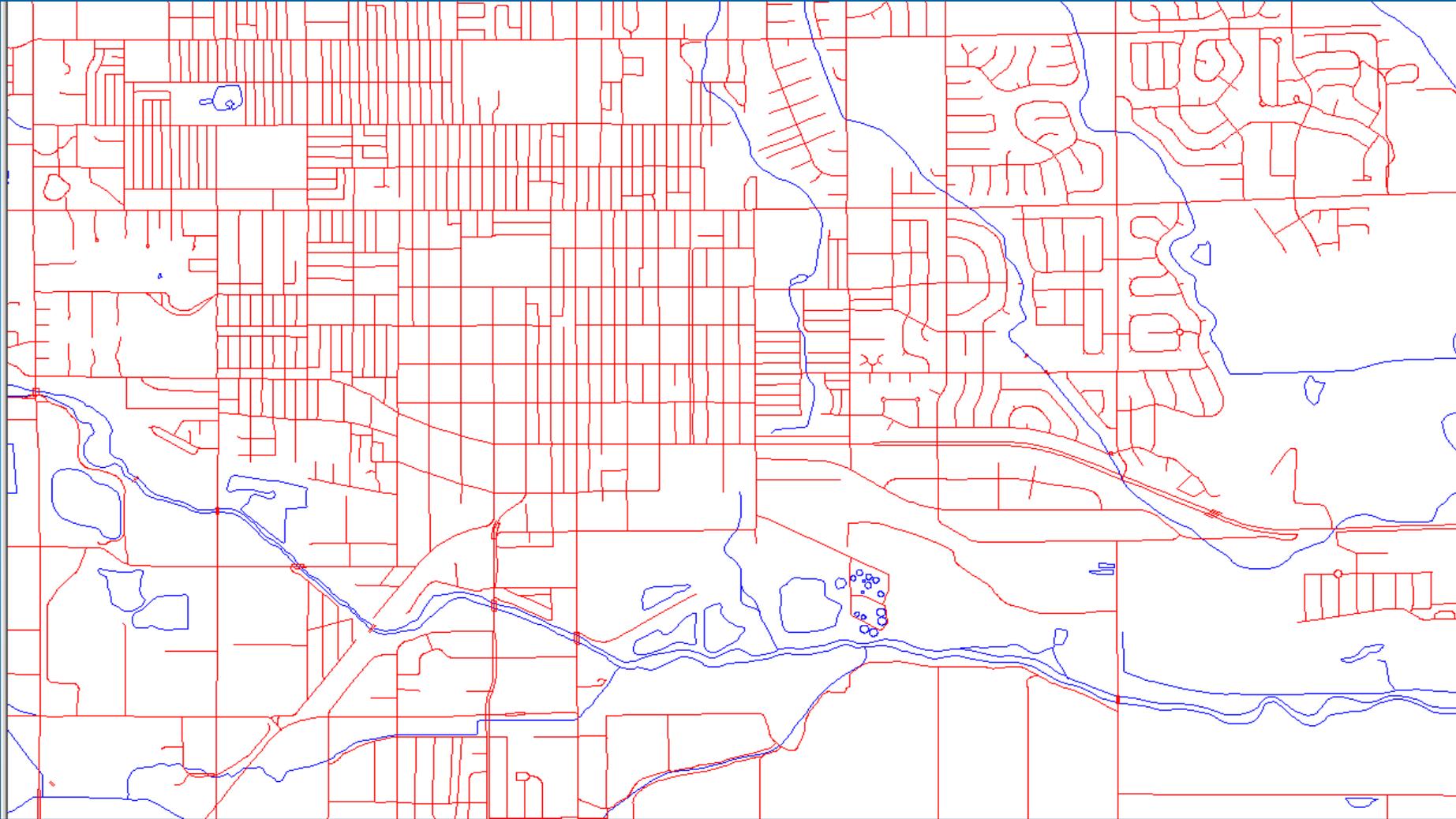
QB Imagery Applications – West

- Base mapping and GIS update
- Storm water management
- Fire

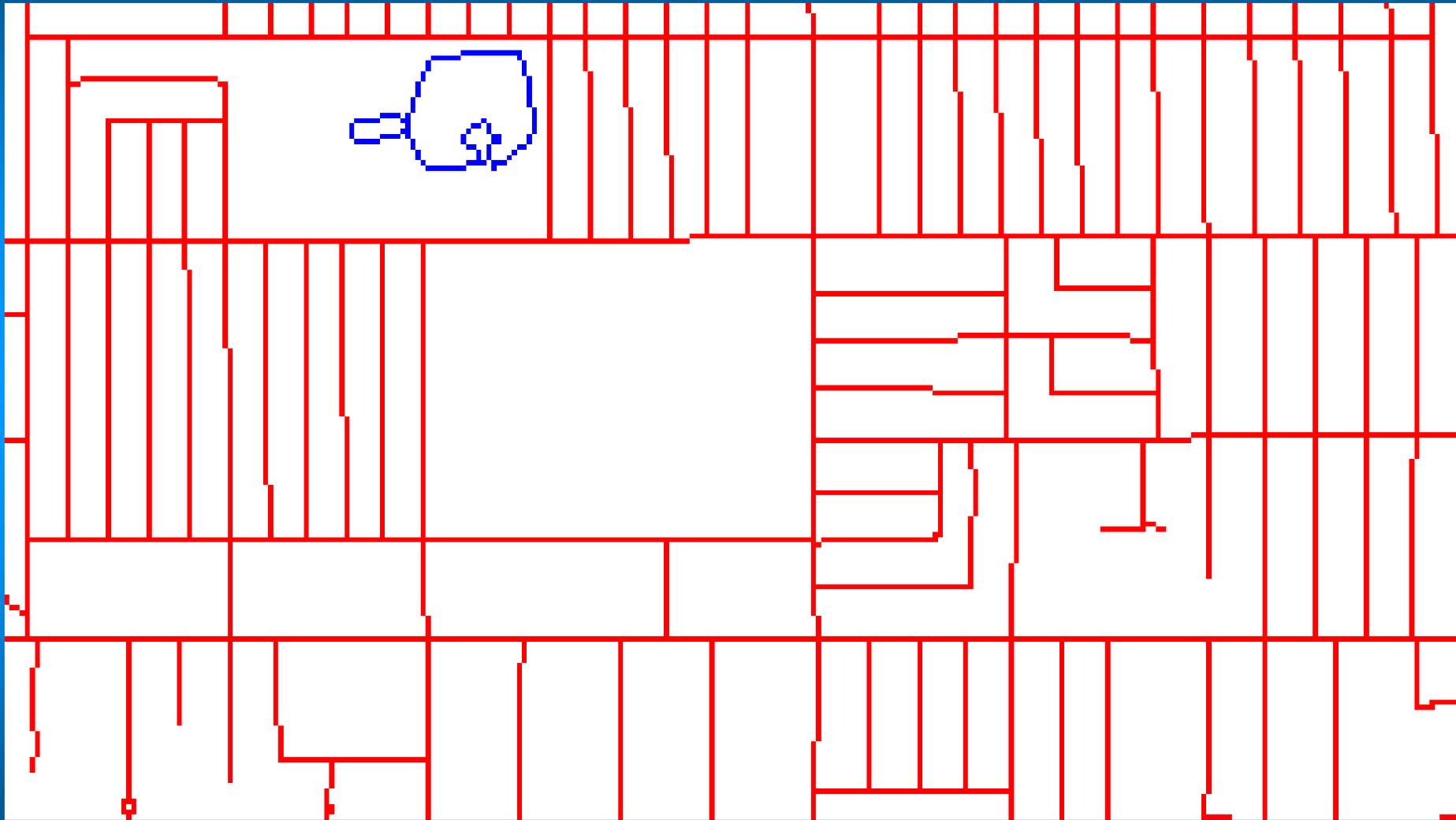
- **CoL is a DigitalGlobe Partner**
- **Typical Mid-sized Municipality**
 - Population of 71,000 (980 cities 75,000 – 25,000 in USA)
 - Moderate growth for several land uses (Commercial, industrial, residential)
 - Applications include
 - ◆ Base mapping – GIS update of new development. All other services use orthoimage base map for their specific applications such as:
 - ◆ Planning, economic development, land and asset monitoring

GIS Symbology of Selected Features

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Typical GIS Line Map



The Power of Imagery

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1999 1.5 Foot OrthoPhoto, East Longmont

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2002 2 Foot QuickBird OrthoImage, East Longmont

DIGITALGLOBE™

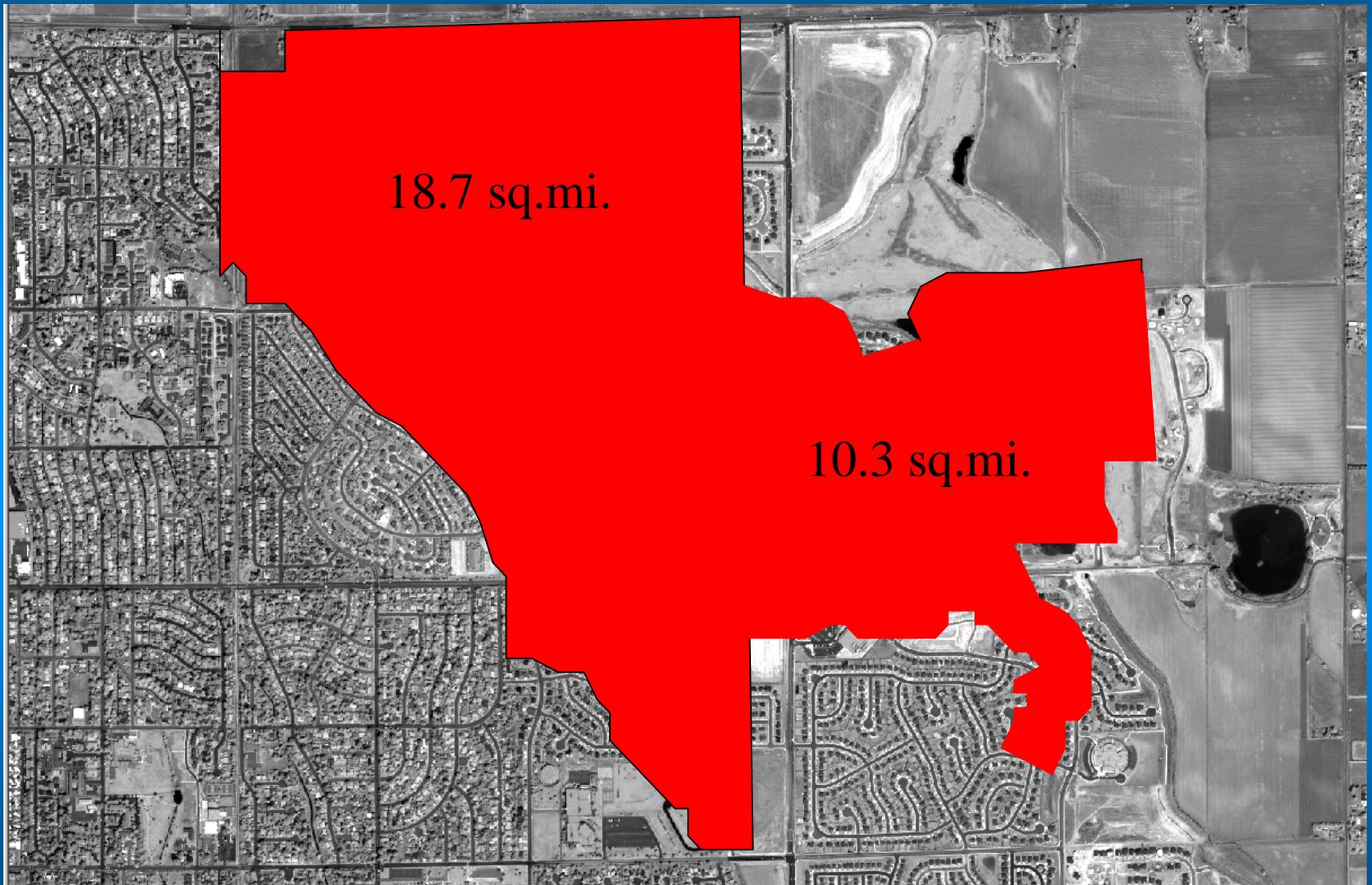


DigitalGlobe.com

An Imaging and Information Company

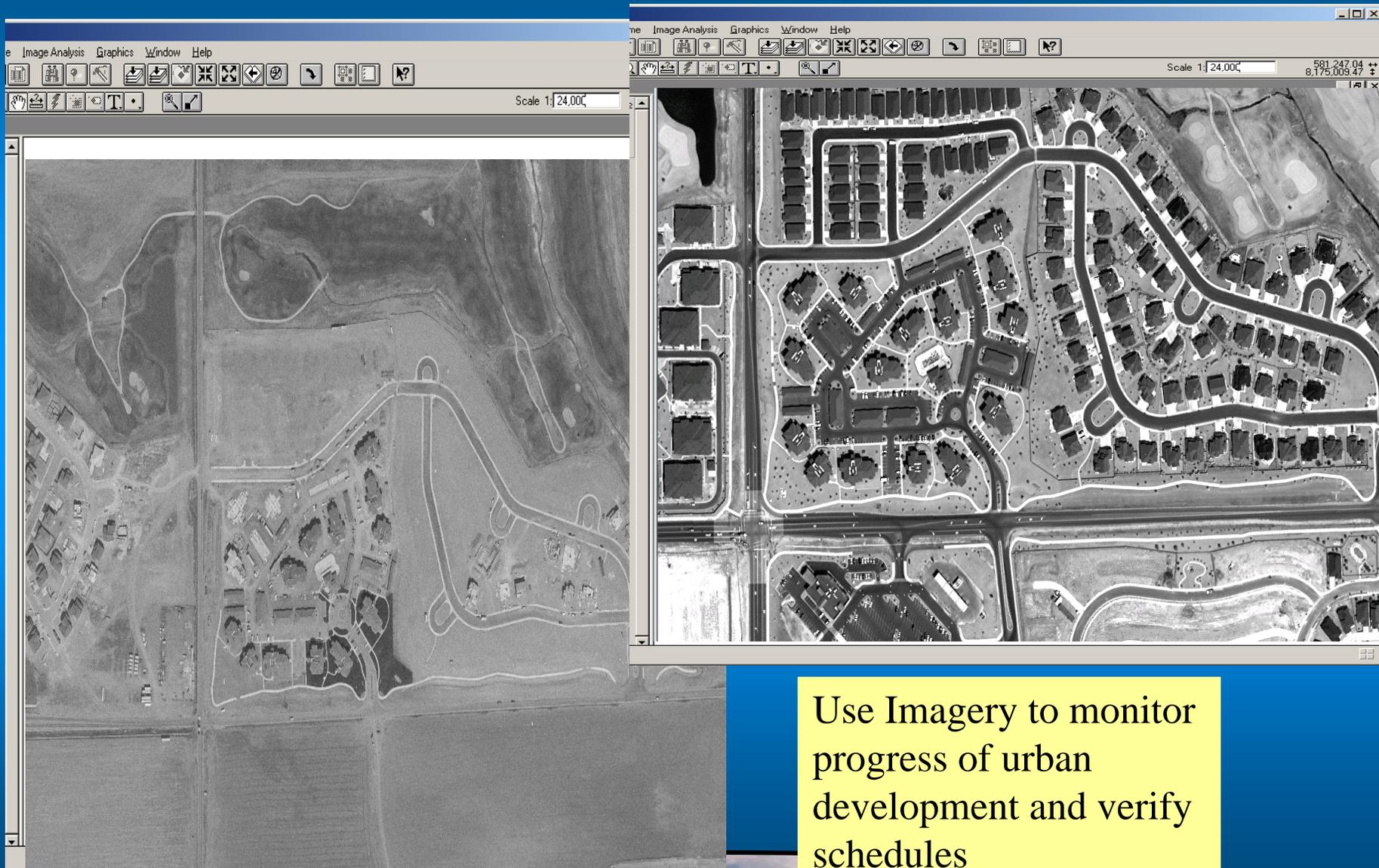
2002 Quantified Change, East Longmont

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Imagery as a Monitoring Tool

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Use Imagery to monitor progress of urban development and verify schedules

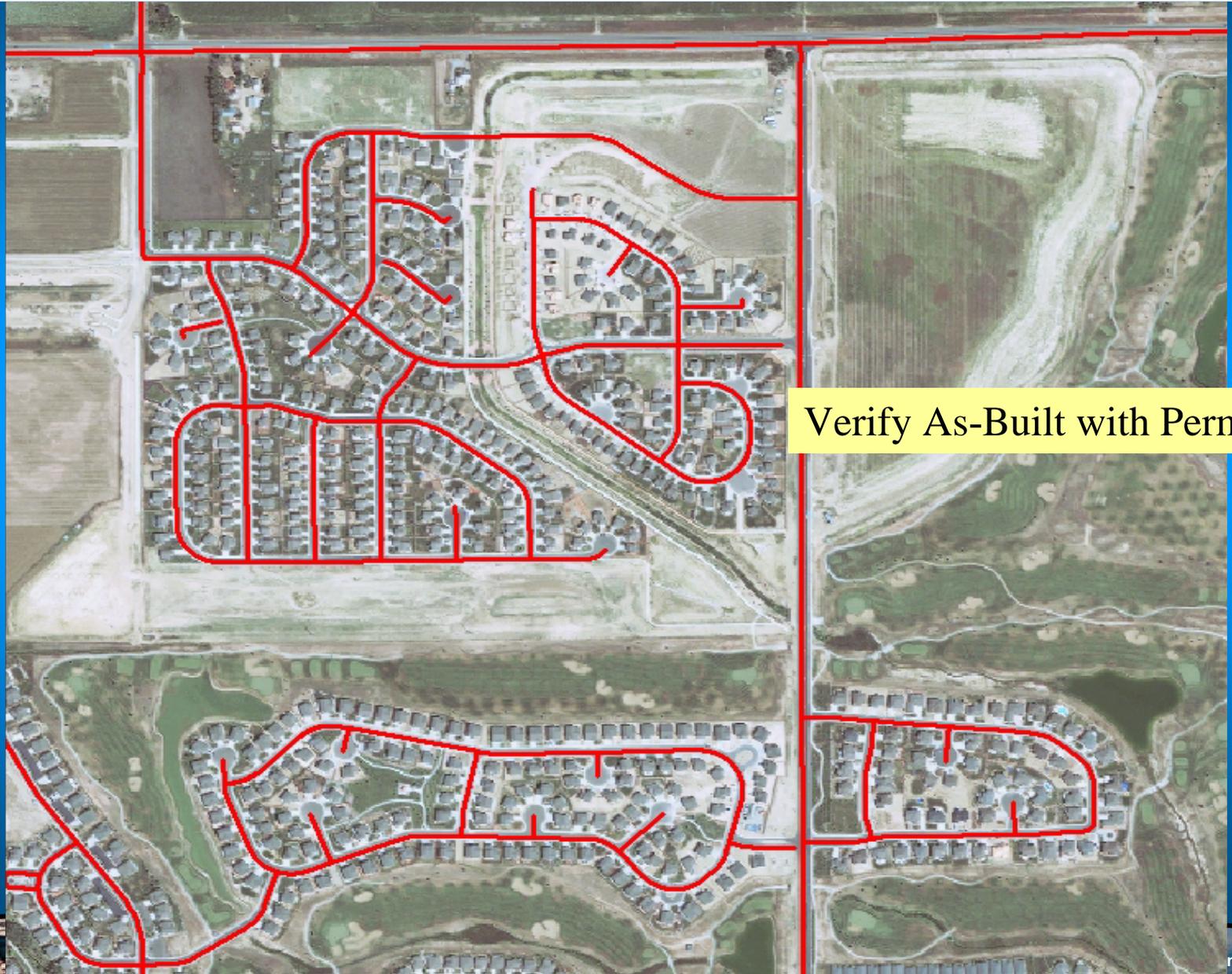
Update Inaccurate Landbases Longmont, CO 1999

DIGITALGLOBE™



Road and LandBase Update, City of Longmont, CO, 2003

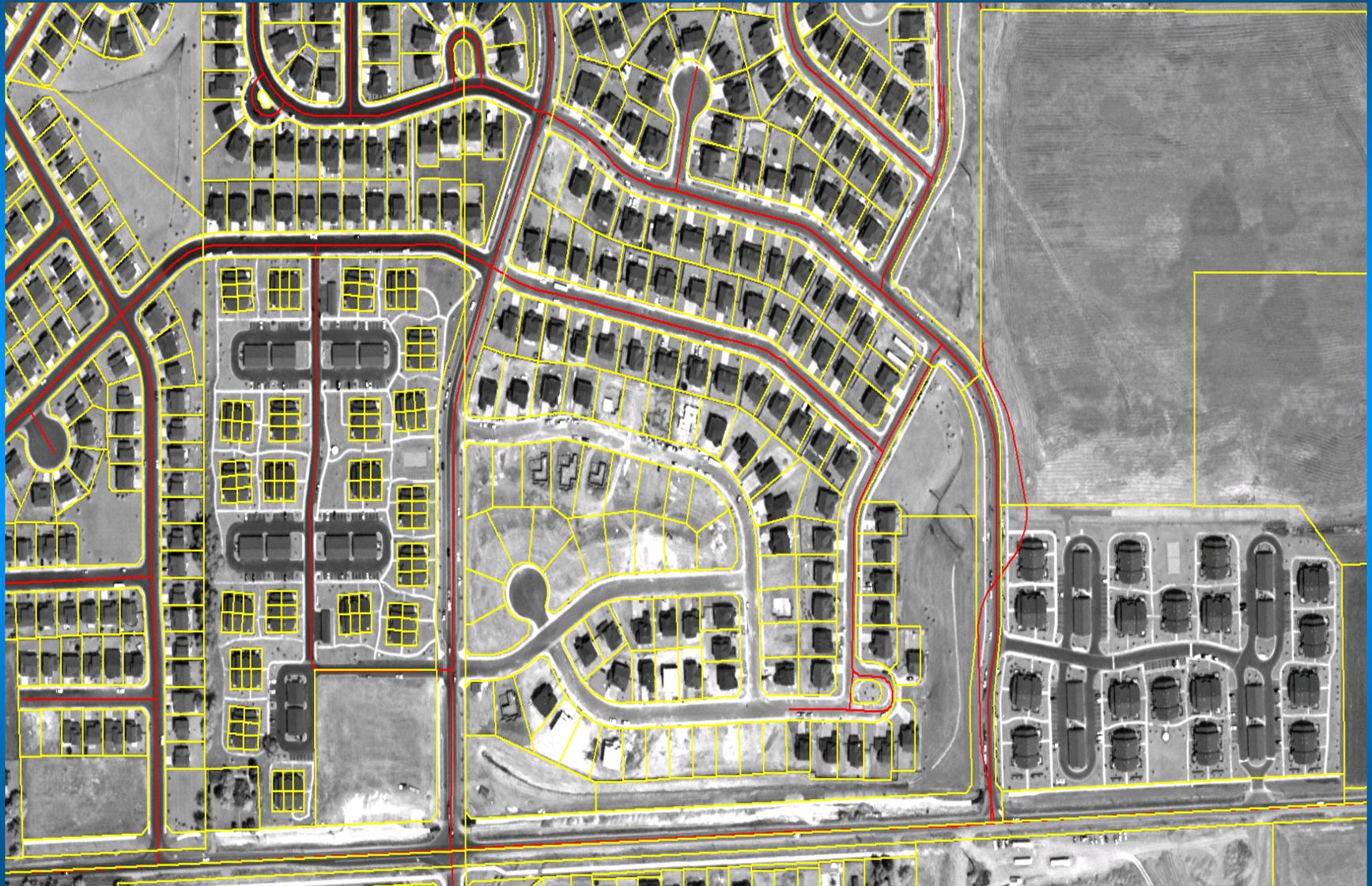
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Verify As-Built with Permits

Update GIS & Map Databases with Orthoimage Backdrop

DIGITALGLOBE™



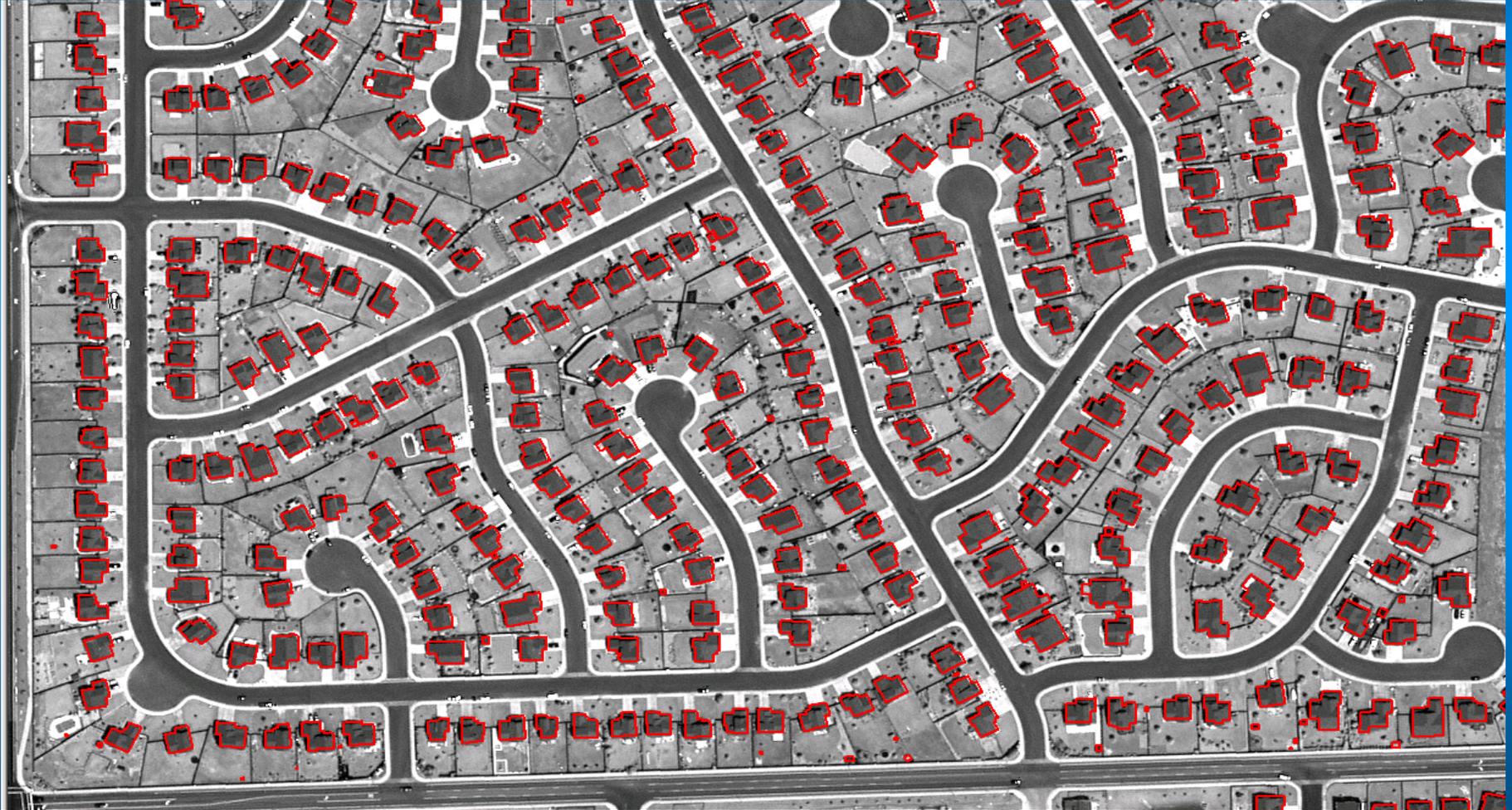
DigitalGlobe.com

An Imaging and Information Company

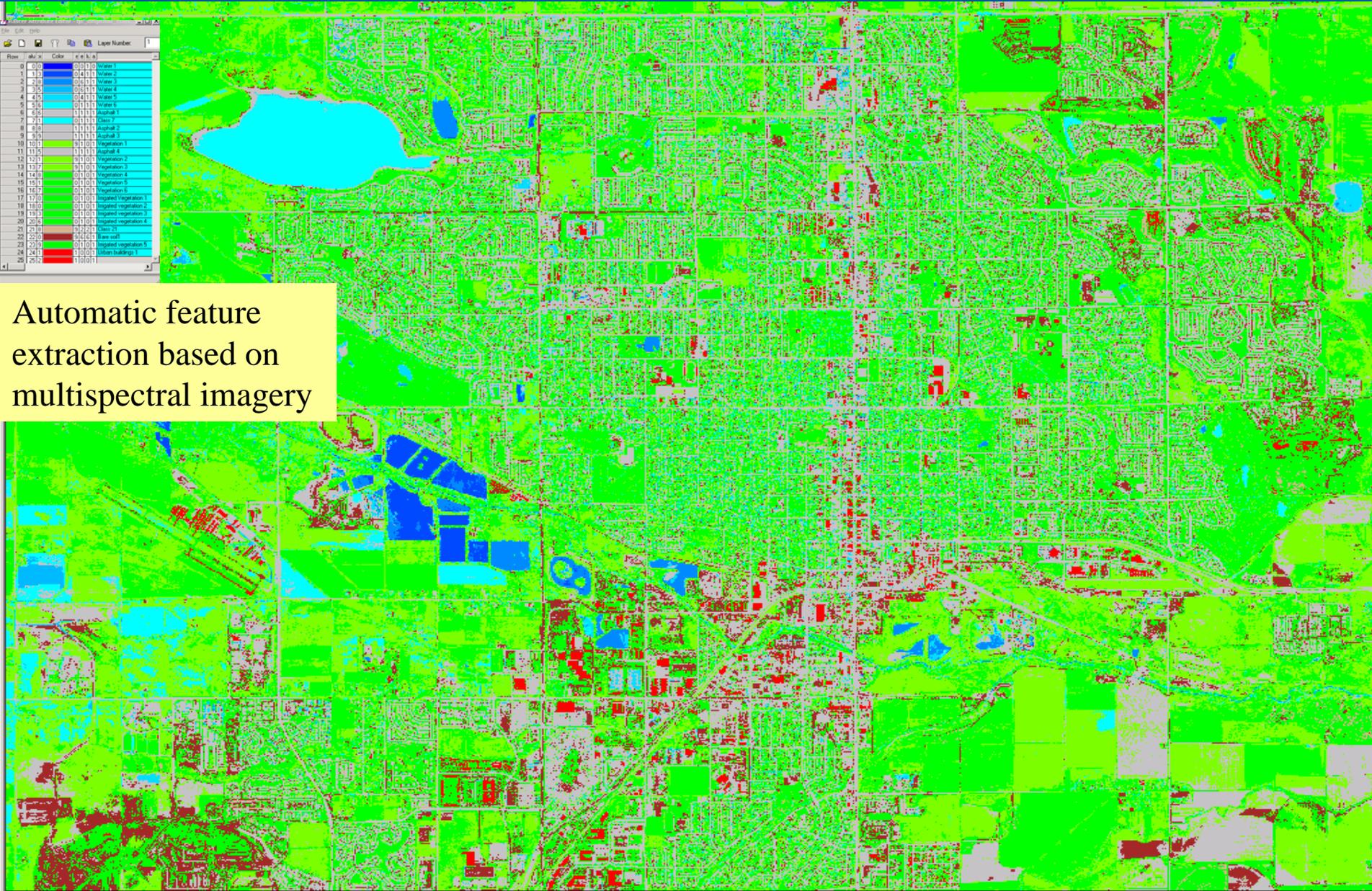
Imagery for Parcel Mapping & Code Enforcement



“One of the most important uses for QuickBird imagery is for property tax revenue (parcel mapping) and building code enforcement purposes”. Nale Report, 2002



Use Image Processing Techniques to Update GIS Databases



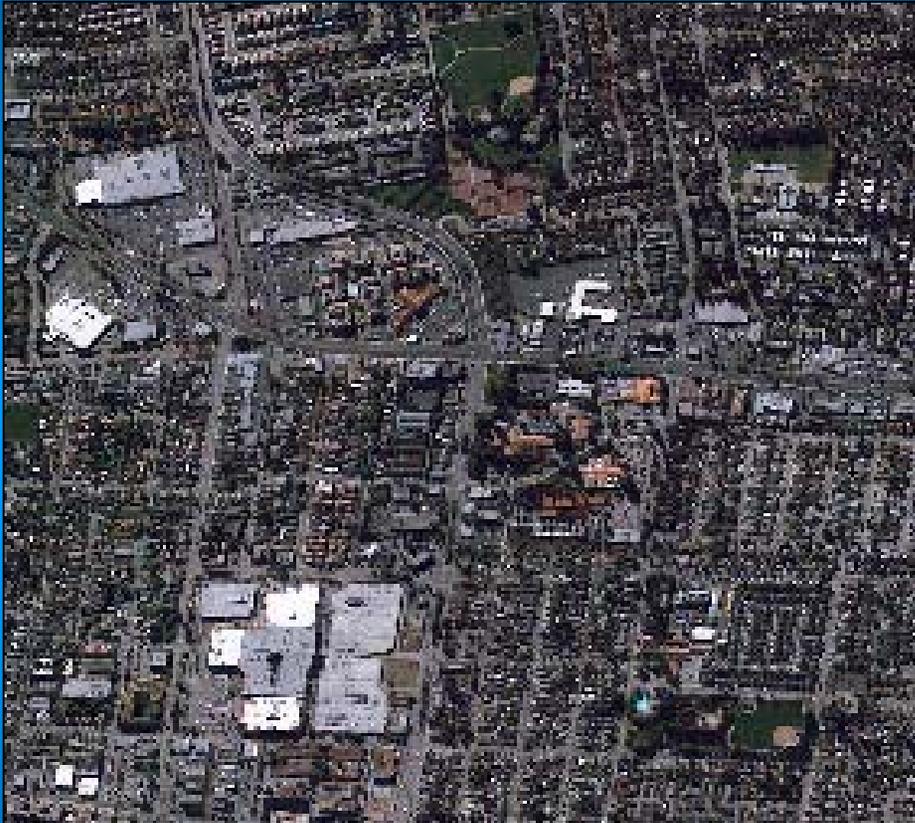
Automatic feature extraction based on multispectral imagery

Storm Water Management

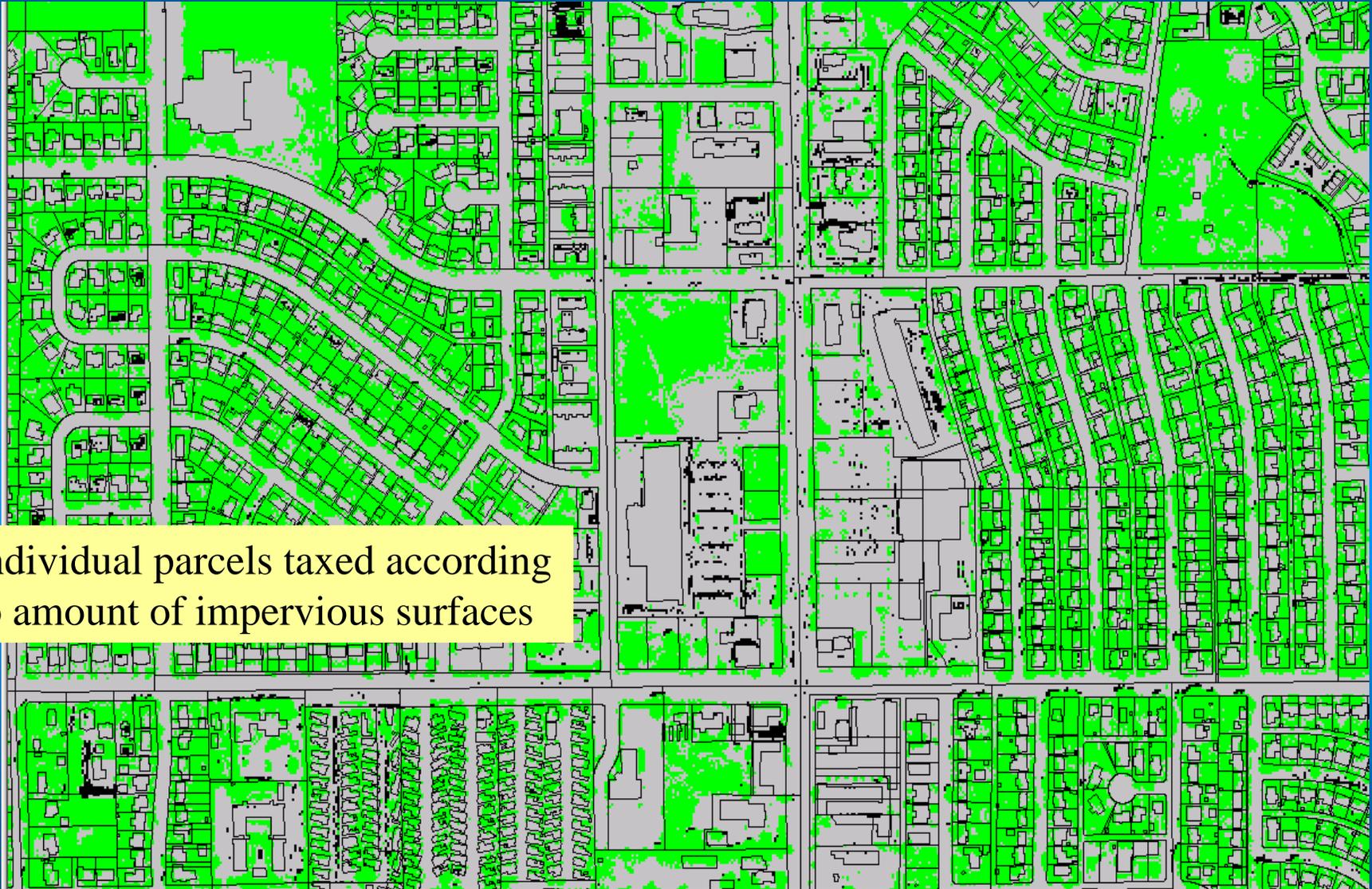
Utilizing the spectral properties of QuickBird MS imagery, it is possible to determine total area of pervious versus impervious surfaces to assist in storm water management

--Green is pervious to water

--Blue, Pink, and white are impervious



Taxation Based on Contribution to Storm Water Runoff



Individual parcels taxed according to amount of impervious surfaces

Vegetation Index Longmont, CO, August, 2002

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QuickBird Imagery is Cost Effective



- Many municipalities update 6-inch imagery every 3-4 years
 - Municipalities cannot afford to acquire 6-inch imagery annually
 - For many purposes, 6-inch resolution imagery is not necessary
 - Satellite imagery is a cost-effective solution for current land base updates in interim years
 - ◆ Find the change with satellite orthoimagery on an annual basis, focus on the change with 6-inch resolution aerial orthophotos

- Satellite imagery provides current and accurate data needed for planning and management decisions
 - Important for an enterprise GIS to link timely image information with other current city-wide databases, especially for fast growing areas

- Estimated price to acquire 6-inch resolution B&W orthophotos from aerial photography (1:1,200; 1"=100') for 160 km²: **\$60,000**

- Price to acquire 2 foot (60cm) QuickBird resolution B&W satellite orthoimagery (1'=400') for 60 mi²: **<\$11,500**

Increase the efficiency of federal programs associated with the National Fire Plan through cost-effective remote sensing solutions.

■ Firefighting

- ◆ Archived imagery as a source for accurate area pre-incident base maps
- ◆ Fire behavior modeling for prescribed burns

■ Rehabilitation and restoration

- ◆ Burned Area Rehabilitation

■ Hazardous Fuel Reduction

- ◆ Fuel classification mapping
- ◆ Fire risk assessment

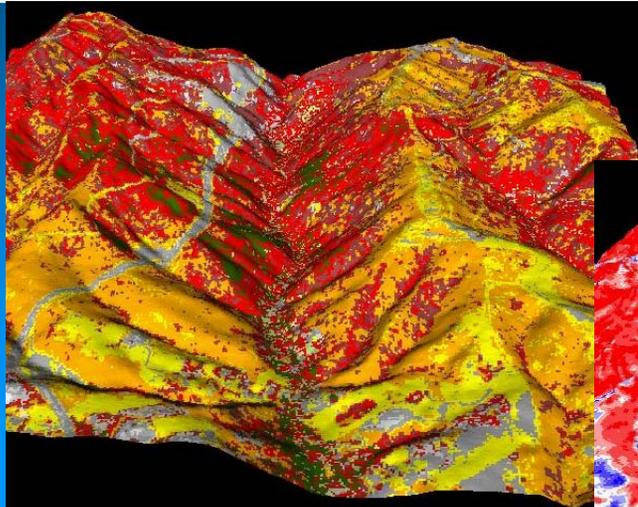
■ Community Assistance

- ◆ Parcel-based risk analysis

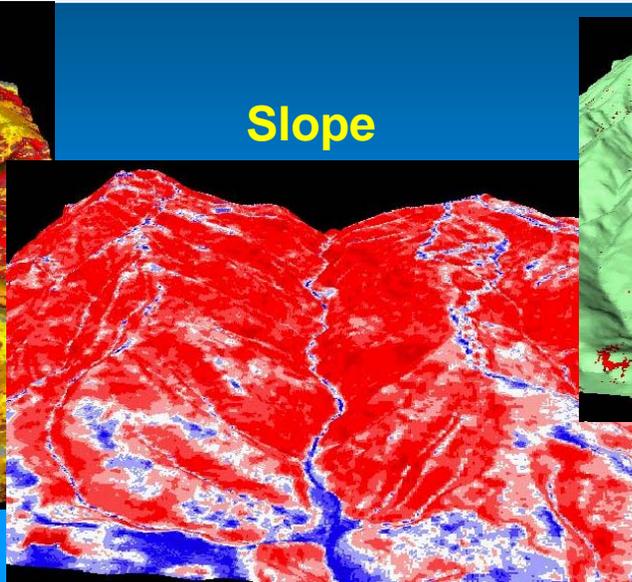
■ Accountability

- ◆ Addressing the high cost of suppression property loss with intelligent fire prevention

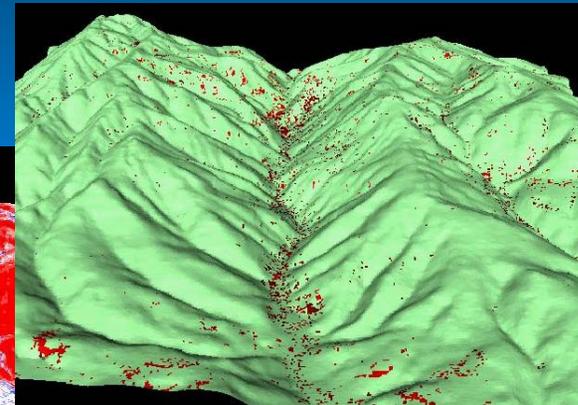
Firefighting - Fire Behavior Modeling



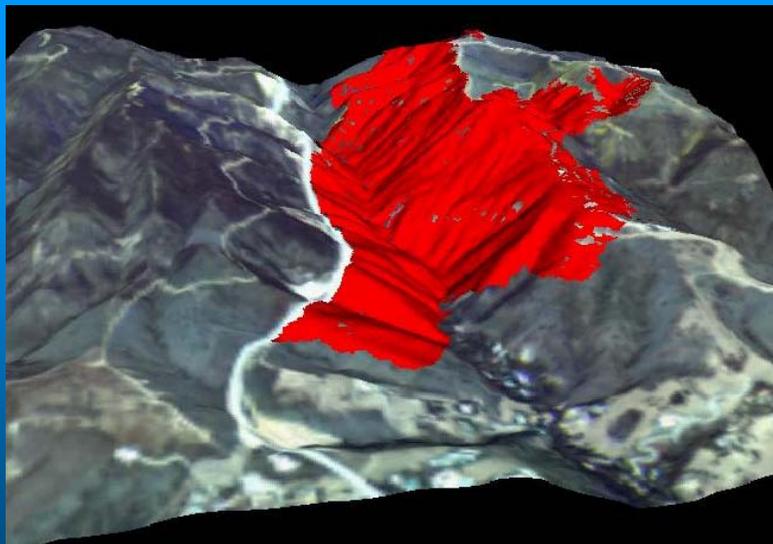
Fuel



Slope



Canopy Closure



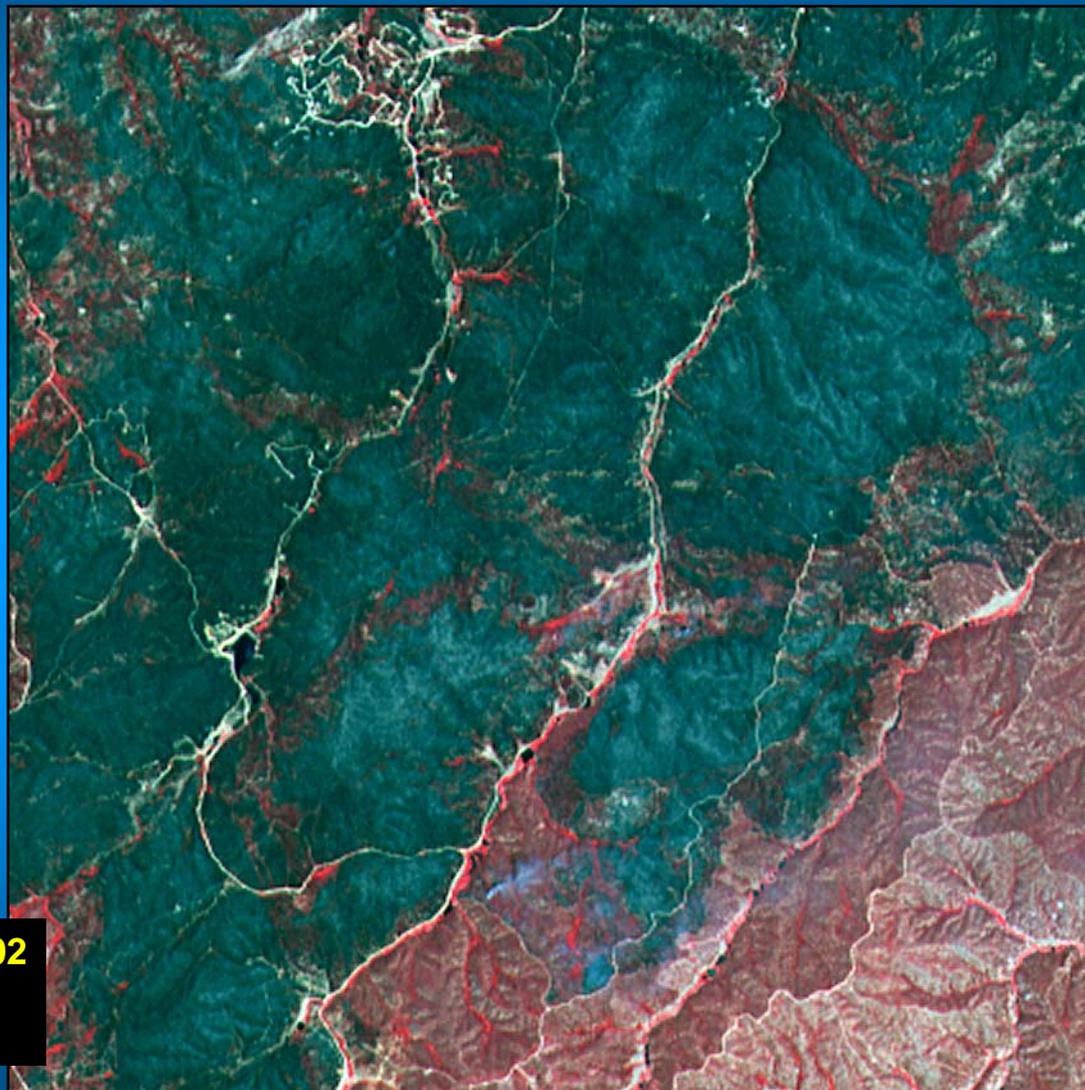
Fuel + Slope + Canopy

For

Basic Fire Behavior Analysis

➤ Monitor:

- Extent
- Response
- Severity
- Mitigation



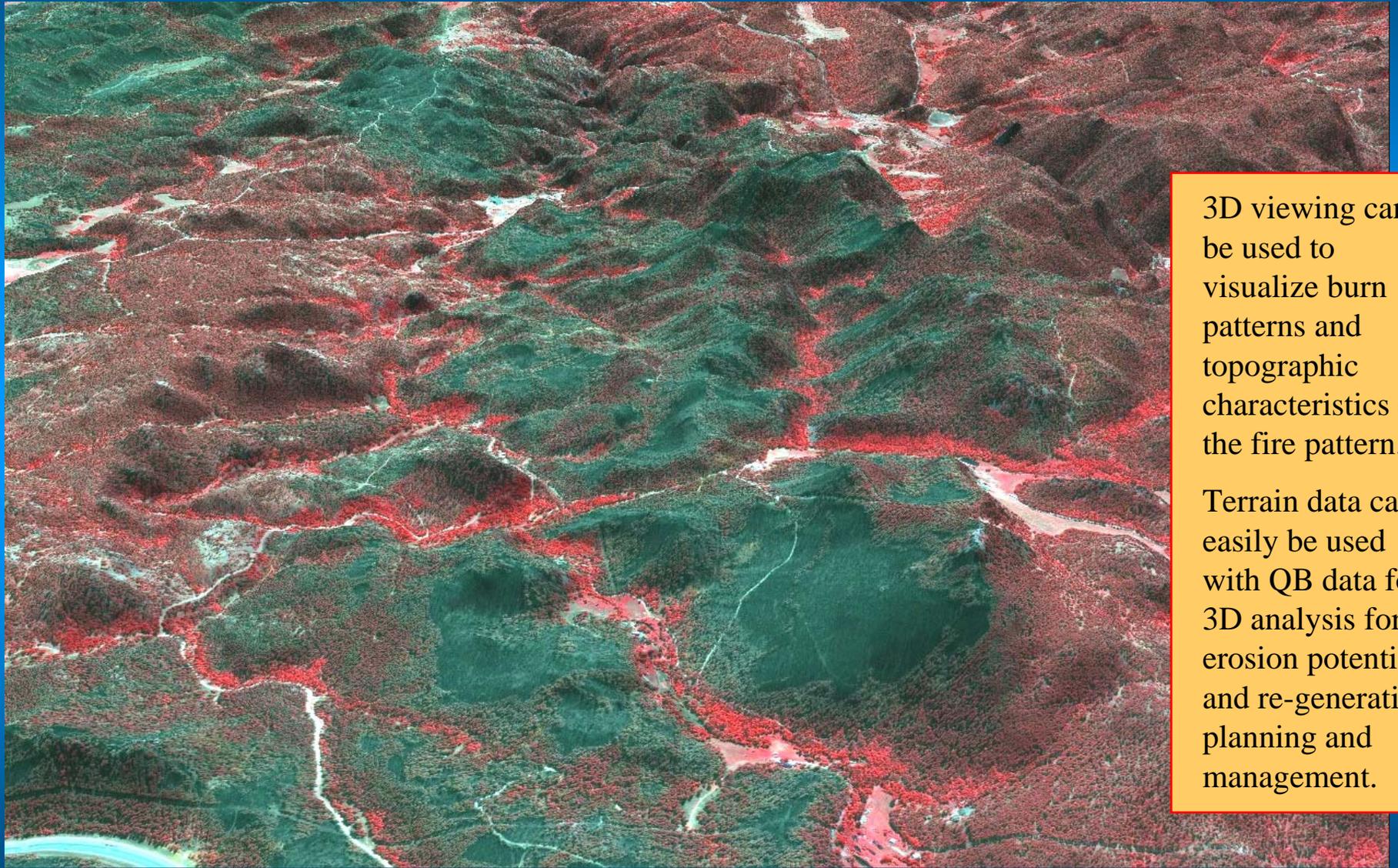
Hayman Fire, Colorado, July 2002
SPOT-5 10-Meter Multispectral

Courtesy: SPOTImage

Battle Creek Wildfire, South Dakota

Perspective View, CIR

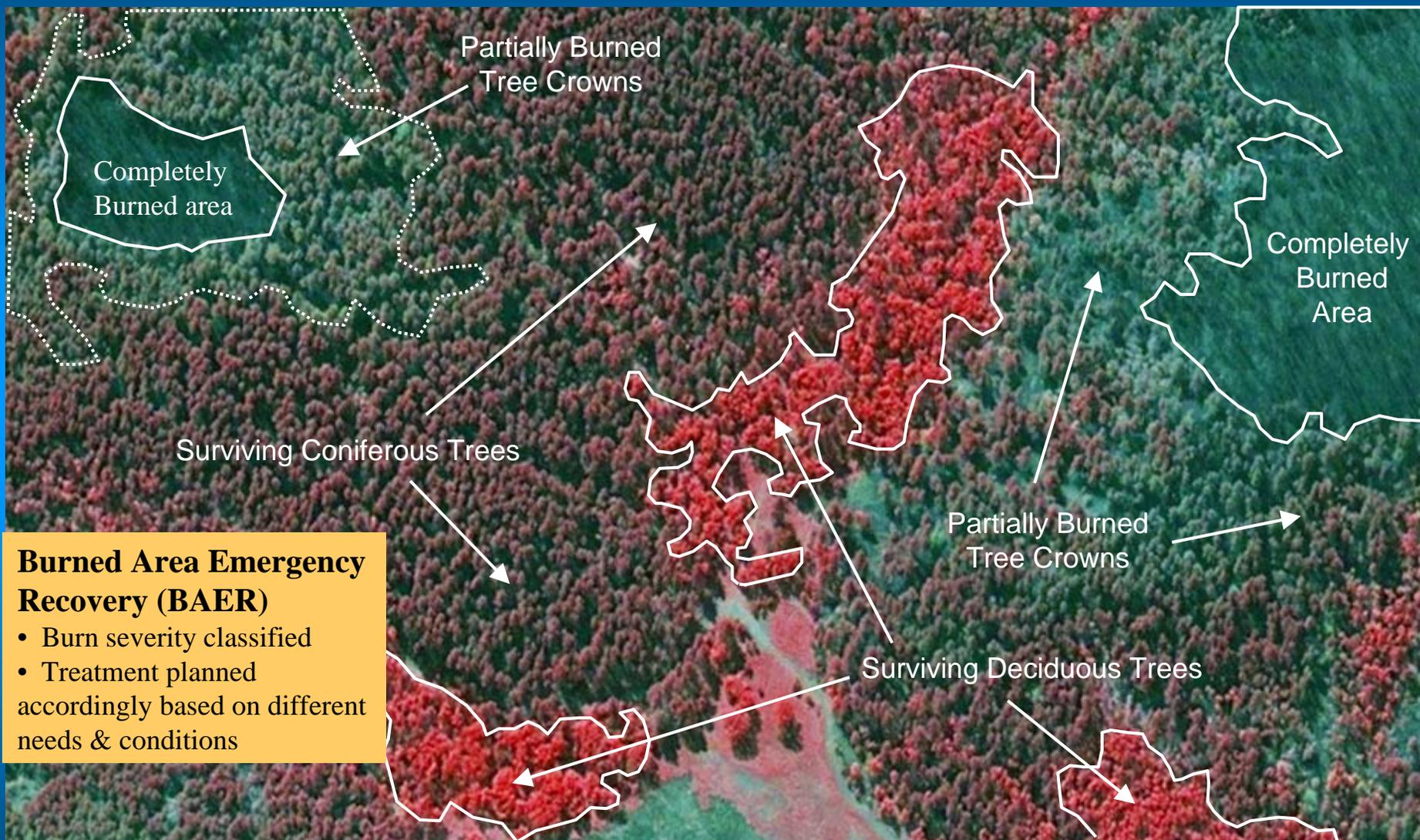
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3D viewing can be used to visualize burn patterns and topographic characteristics of the fire pattern.

Terrain data can easily be used with QB data for 3D analysis for erosion potential and re-generation planning and management.

Fire Damage Assessment, Battle Creek Wildfire



Burned Area Emergency Recovery (BAER)

- Burn severity classified
- Treatment planned accordingly based on different needs & conditions

QB Imagery Applications – North East

- Emergency Management,
- Homeland Security,
- Environmental compliance

Emergency Response

- Risk Assessments
 - Pre-Event Planning

QuickBird imagery can assist city, county, and state officials in establishing detailed geographic information systems (GIS) containing:

-- Key Installations

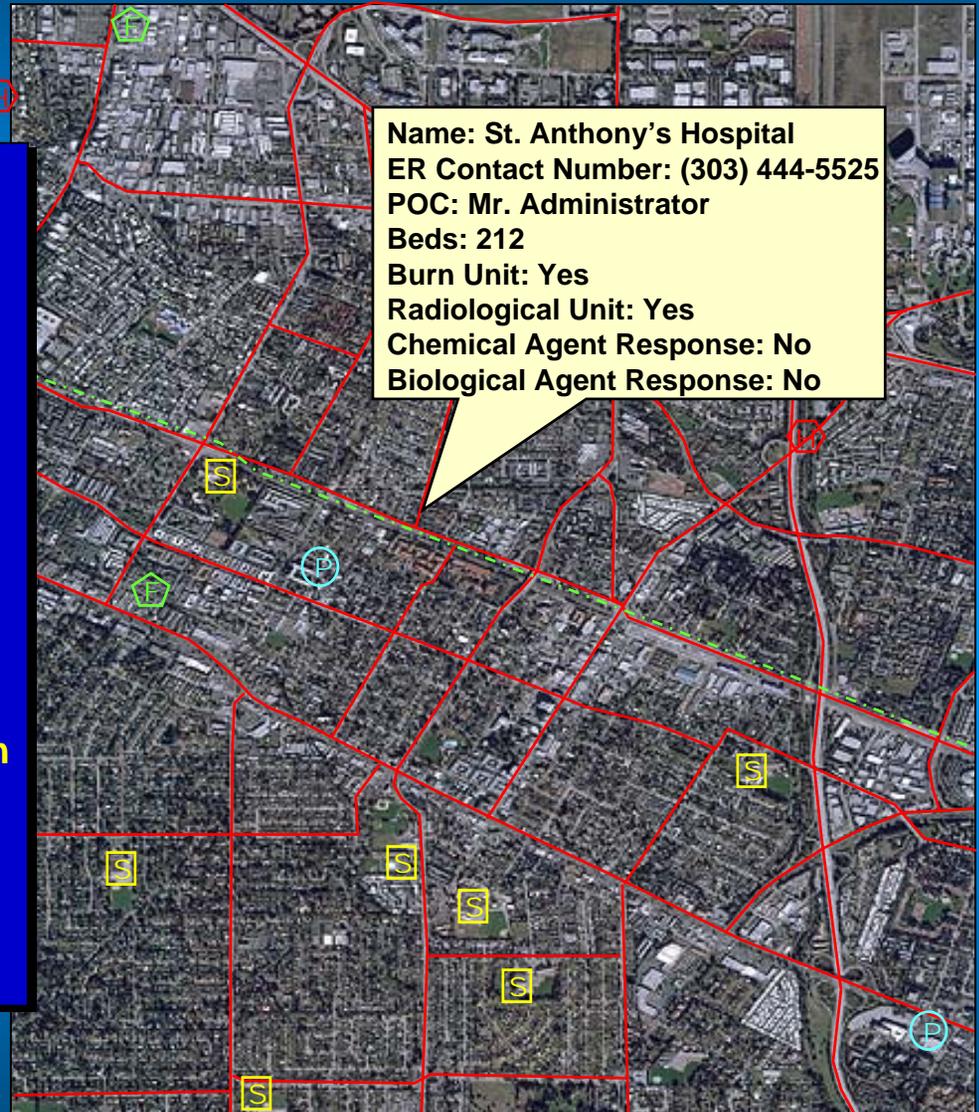
- Ⓜ Hospitals
- Ⓟ Police Stations
- Ⓡ Fire Departments
- Ⓢ Shelters (e.g., Schools)

-- Key Infrastructure

Roads, Rails, Bridges, Airports,
Utilities, Ports

Each data point can be attributed with critical information officials will need in the event of an emergency, including:

- Number of personnel by type
- Number of hospital beds
- Capabilities of facilities to handle certain types of emergencies



Emergency Applications

- Image Base for 911 System
 - Interactive Geographic Information System

“QB imagery is very valuable for Public Safety support operations”.
Nale Report, 2002

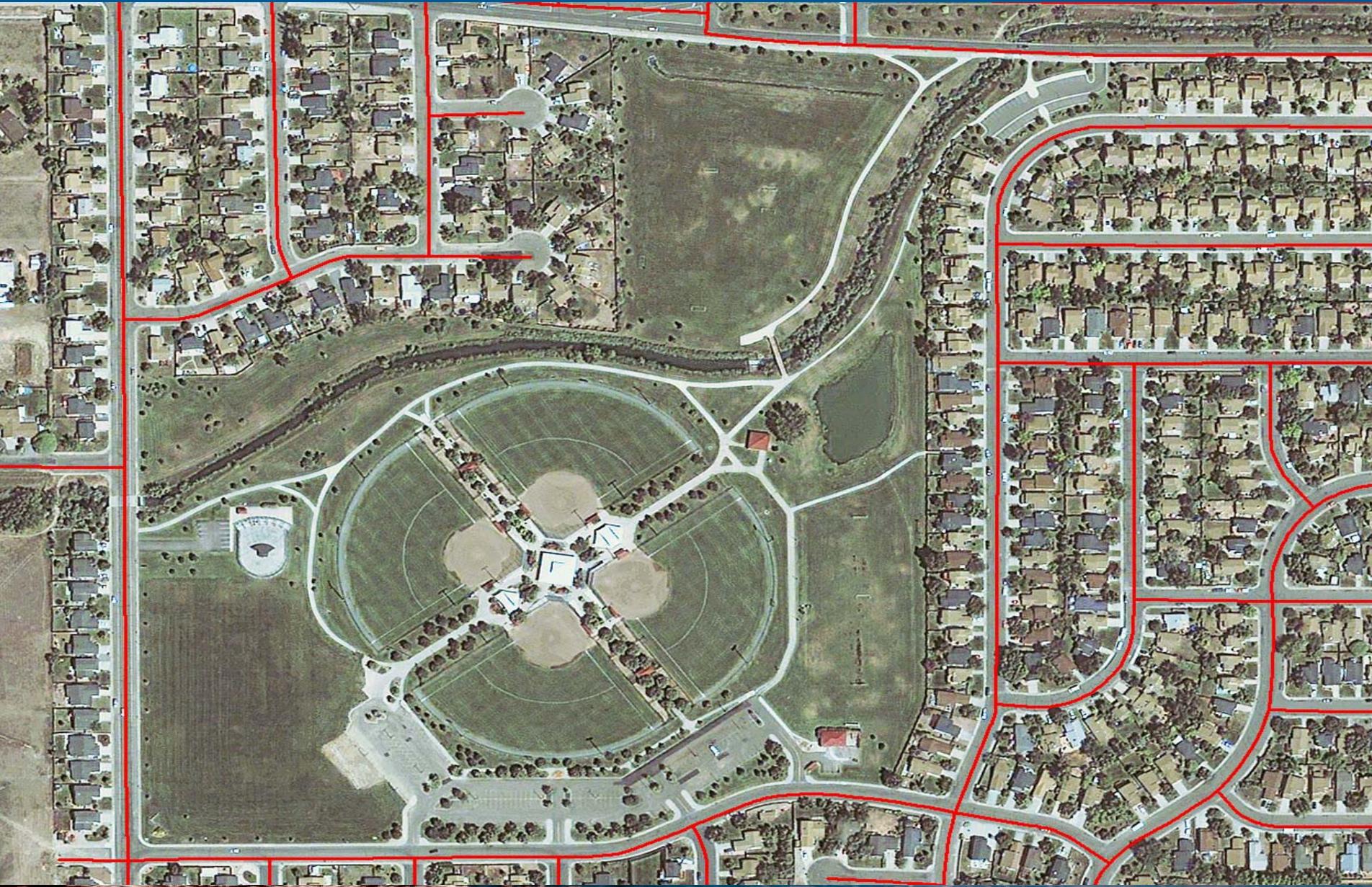
QuickBird 60 cm panchromatic imagery can be used by 911 operators to guide emergency personnel quickly and efficiently to the proper location.

Address Identified
Quickest Route Identified
Closest Fire Hydrant Identified



Emergency Planning and Response - Access

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Emergency Planning and Response - Access

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Emergency Applications - Flooding

- Disaster Response
- Mitigation
- Insurance



**Elbe River Flooding, Germany
QuickBird 60-Centimeter Panchromatic**

August 2002

Three Mile Island, Pennsylvania

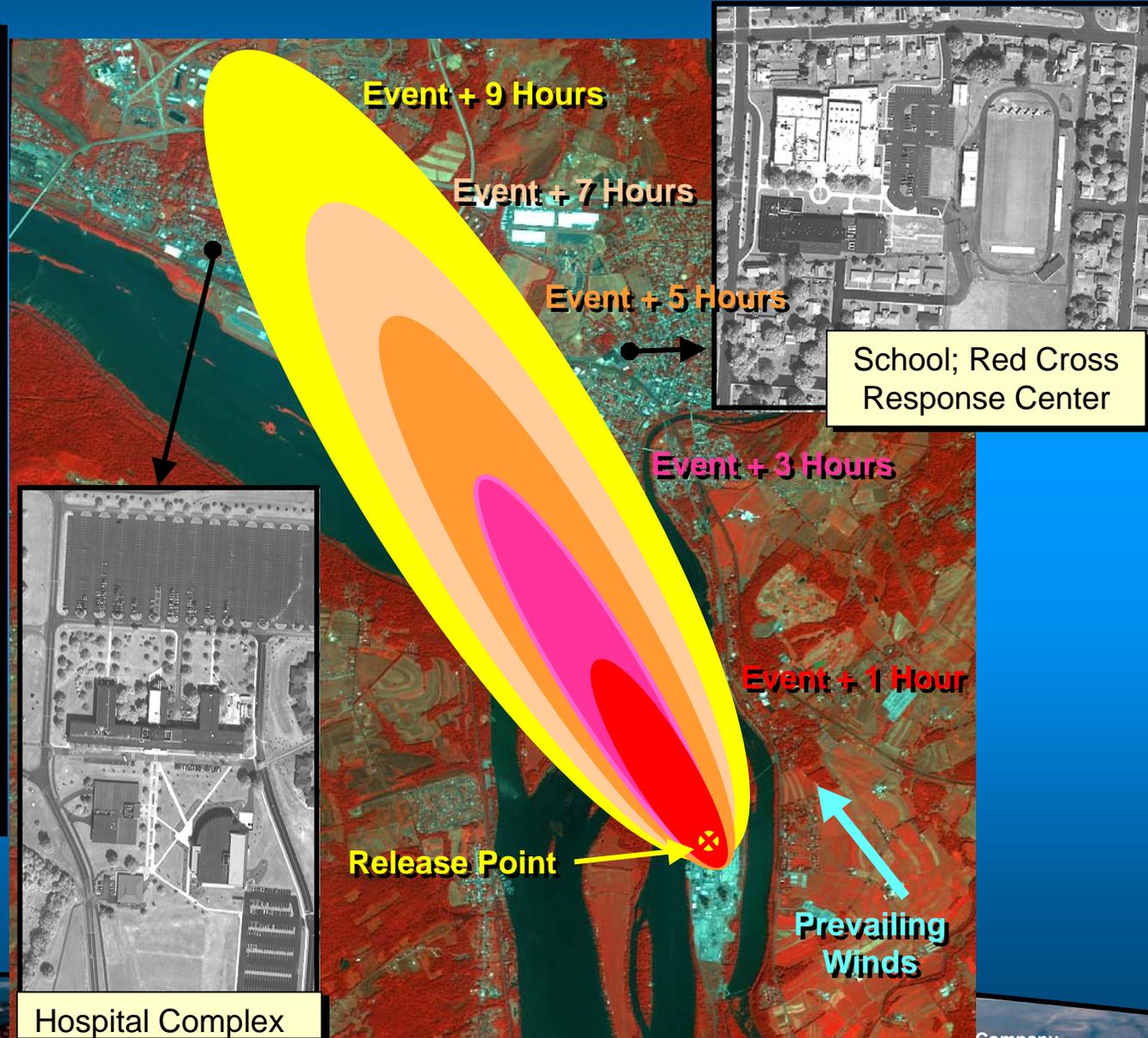


Emergency Response Applications

Event Modeling and Response

QB imagery can be used to help visualize output from a wide variety of models available to predict air and/or surface flows of potentially lethal releases (e.g., chemical weapons, bio-agents, radioactive materials, etc.) be it in a simulation mode or in response to crisis.

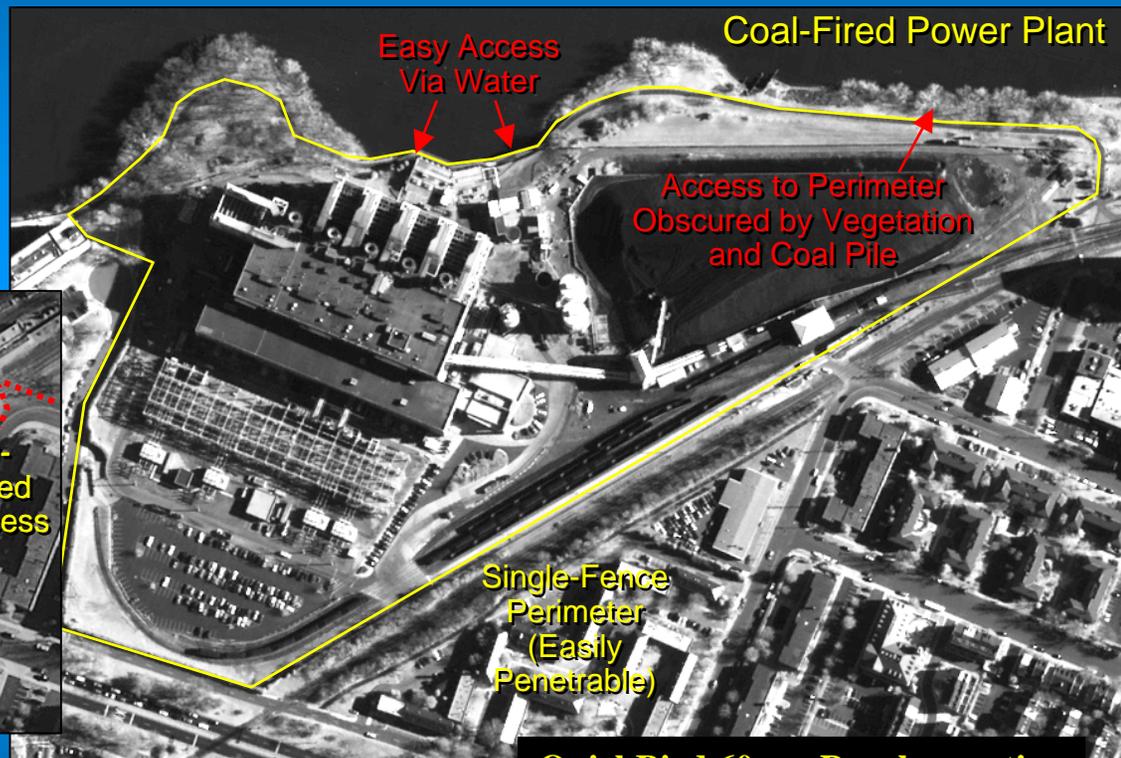
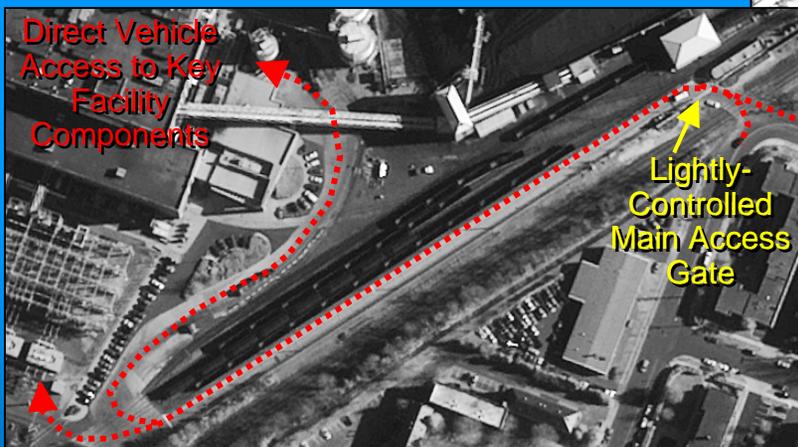
Imagery can assist by readily providing perspective on areas in the “danger” zone and subsequent populations that would need to be evacuated. This potentially would increase efficiencies for decision-makers and emergency personnel, reducing casualties.



➤ Risk Assessments

■ Facility Vulnerability

- ◆ Government Buildings
- ◆ Key Utilities
- ◆ Other Key Installations



**QuickBird 60 cm Panchromatic
Alexandria, Virginia**

QuickBird high-resolution 60 cm panchromatic imagery can assist Security personnel in identifying potential areas of vulnerability of key facilities.

Environmental Monitoring



QuickBird 2.4 m multispectral imagery allows for detection of environmental problems otherwise difficult to detect.

Damaged Vegetation from Possible Oil Leak

➤ Monitoring

- Change Detection
- Industrial Compliance
- Pollution Sources
- Habitat and Vegetation Monitoring
 - ◆ Wetlands
 - ◆ Coastal Environments

QuickBird 2.44 m Multispectral
Sunnyvale, California



QuickBird near-infrared bands can be used to assess damage to wetlands. Damage is clearly evident from placement of a pipeline through these wetlands.

Environmental Monitoring

➤ Commercial Industry Assessment

- Extraction
 - ◆ e.g., Mining
- Processing
 - ◆ e.g., Mills
- Light-to-Heavy Fabrication
 - ◆ e.g., Steel Rolling,
- Power Generation
 - ◆ e.g., Nuclear Power Plants



QuickBird 2.44 m Multispectral and 61 cm Panchromatic
Palo Alto, California

QB Imagery Applications – South East

- **Base Mapping – automatic feature extraction**
- **Planning**
- **Storm Water Management**

Original QB Pan-Sharpended Orthoimage

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Edge Extraction

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Feature Mask

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Automatic Feature Extraction

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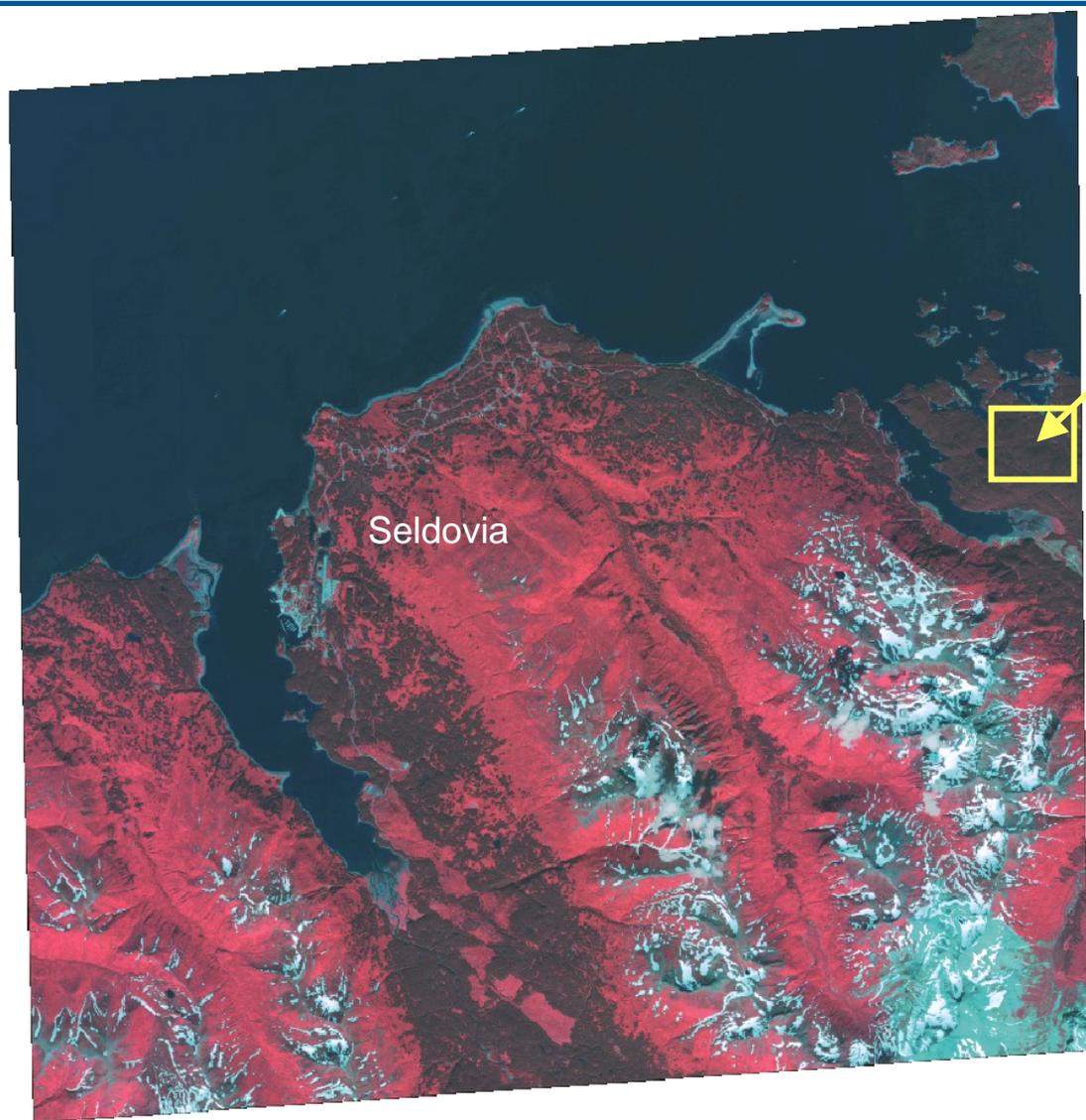
An Imaging and Information Company

QB Imagery Applications – North West

- Forest Management

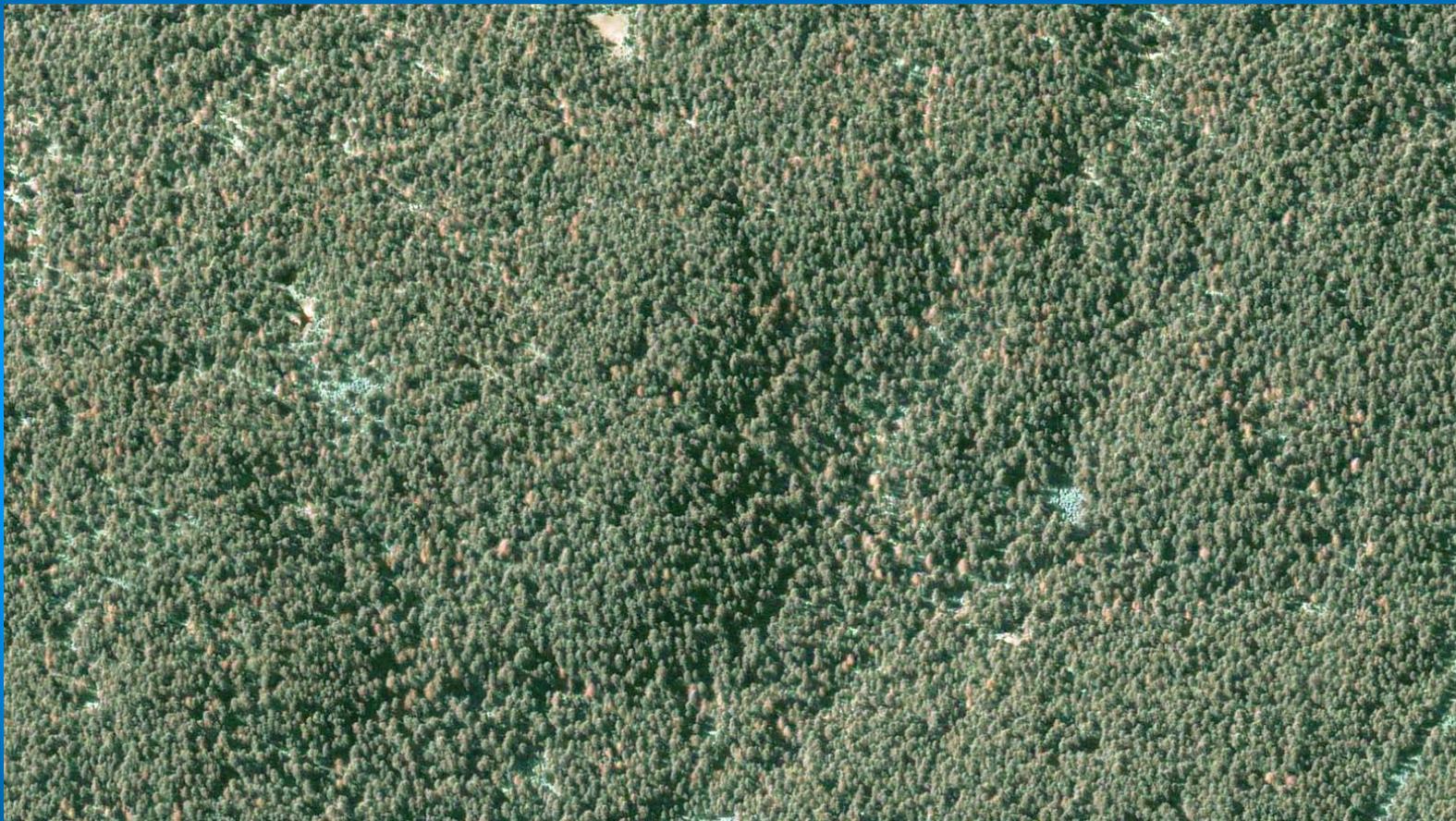
Kenai Peninsula, AK

QuickBird Multispectral – Forest Health Monitoring **DIGITALGLOBE™**



QuickBird imagery
collected July 11, 2002

Spruce Beetle Infestation – Pan-sharpened Natural Color



Individual dying or dead tree crowns can be identified by their light-brown color with natural color QB imagery.

Spruce Beetle Infestation – Pan-sharpened CIR



Green trees
infected

Red trees
healthy
or partially
infected

Pan-sharpened presents a high level of detail in individual tree crowns for detailed Visual analysis of dead and stressed spruce.

Spruce Beetle Infestation – Multispectral CIR



Green trees
infected

Red trees
healthy
or partially
infected

Multispectral QB imagery facilitates spectral analysis to assess forest health conditions.

QB Imagery Applications – International

- Base Mapping

Map Update

- **Europe, 200,000km²**
- **QuickBird Imagery used:**
 - Basic Imagery
 - Ortho-Ready Standard Imagery
 - 60cm pan, 6.5 degrees off nadir
- **DEM**
 - 10m posting, 2.5m LE90%
 - Terrain variation 0-800m, mean 248m
- **GCP**
 - 81 GCPs, well distributed



Results

- No significant improvement using more than 4 GCPs
- Basic Imagery
 - 1.82m RMSE, first order polynomial
- Ortho-Ready Standard Imagery
 - 1.96m RMSE, first order polynomial
- Suitable for mapping applications at 1:5,000

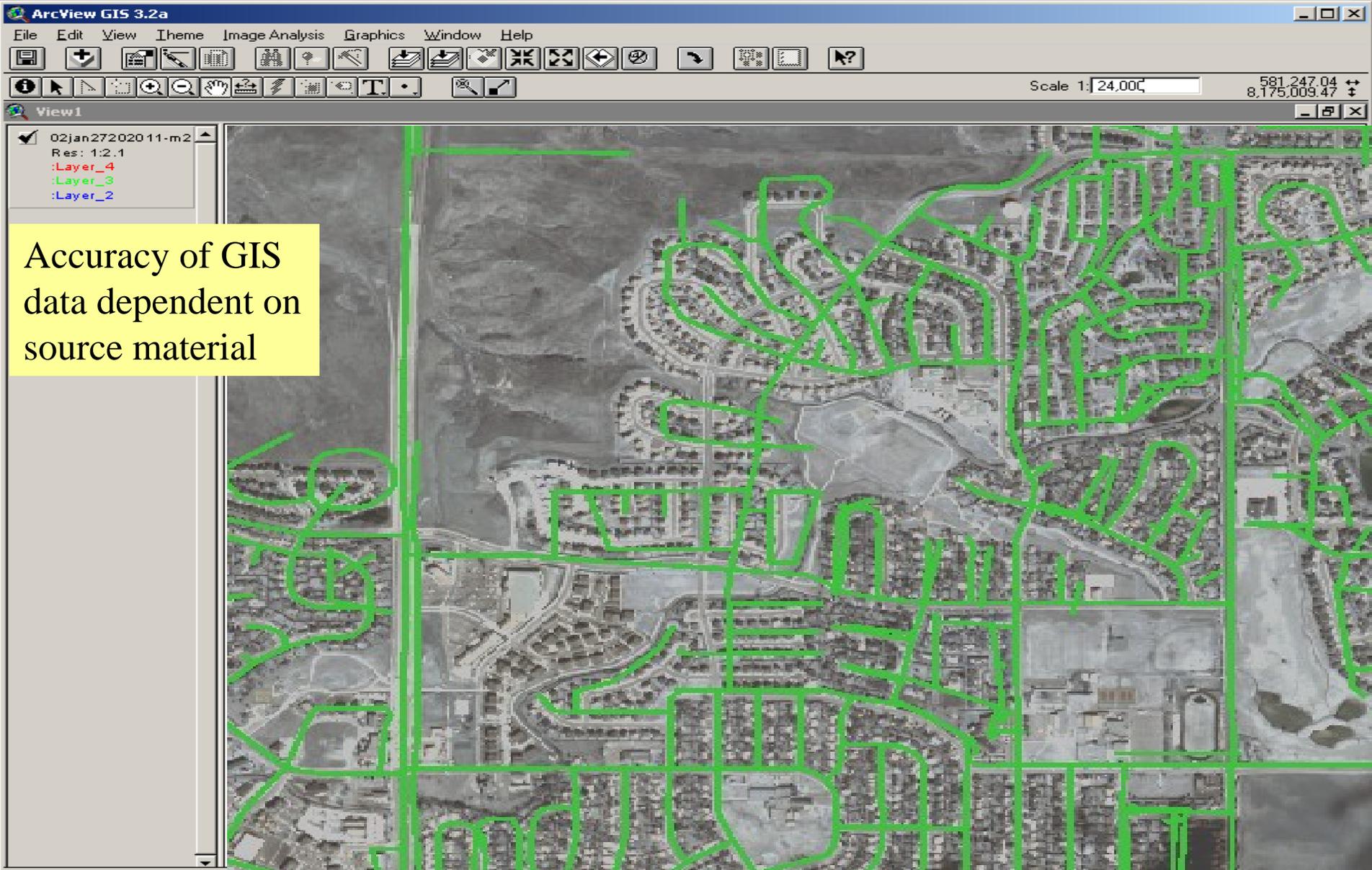


Grab Bag 'o Imagery Applications



- Water Quality
- Environmental Monitoring
- Monitoring Construction
- Forestry
- Agriculture

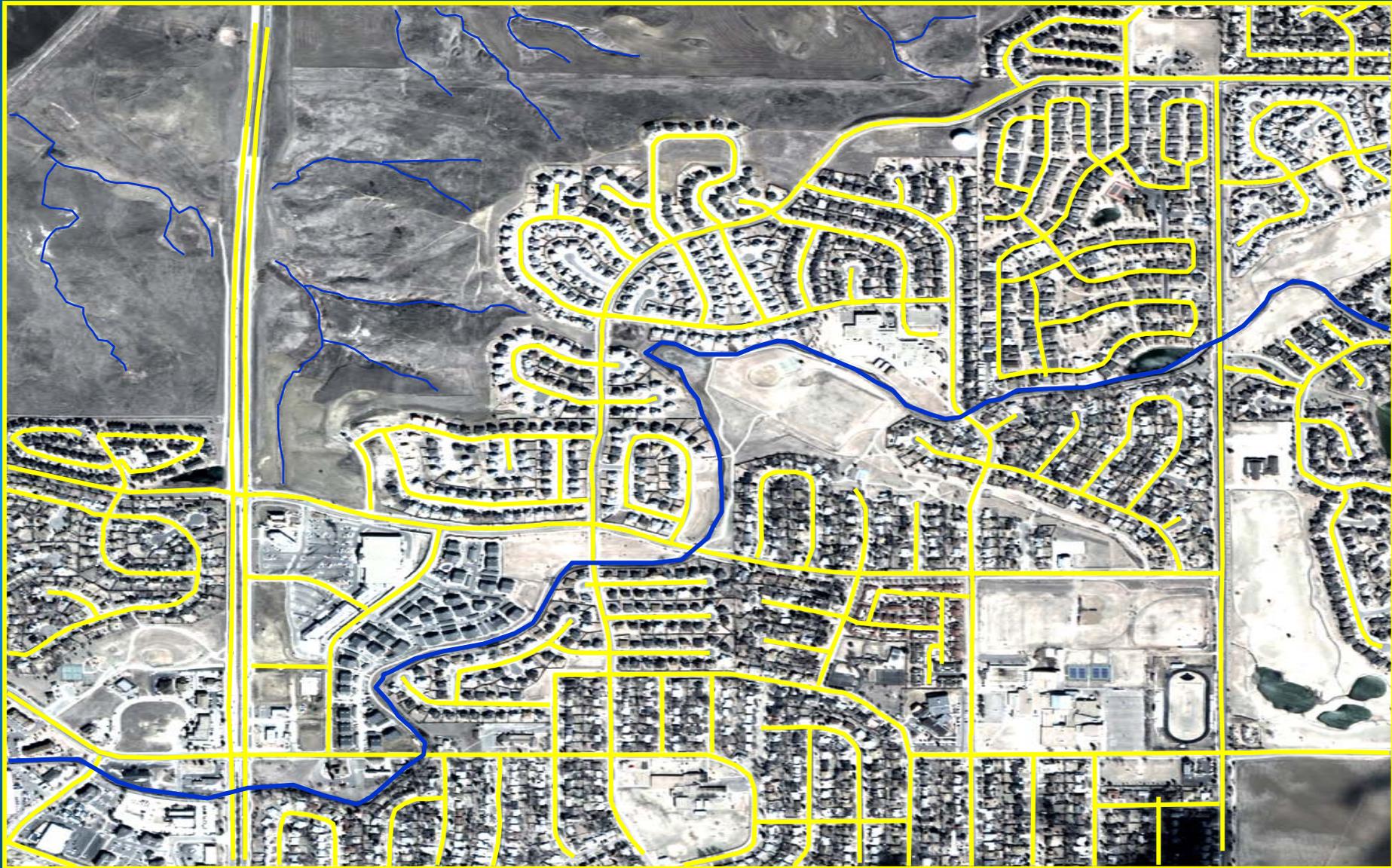
Transportation, 1964 USGS DLG



Accuracy of GIS data dependent on source material

Transportation Network Update, based on 2002 QuickBird Imagery

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Infrastructure Mapping

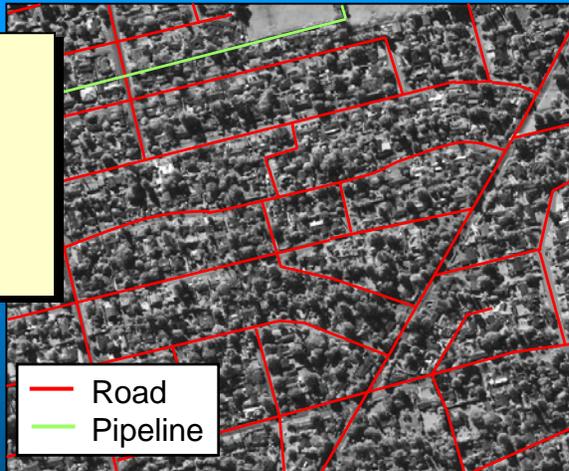
Infrastructure Assessments

- Utilities
 - ◆ Power Plants
 - ◆ Water/Sewage Treatment
- Road Networks
- Power Networks

**QuickBird 61 cm Pan
Los Angeles, California.**



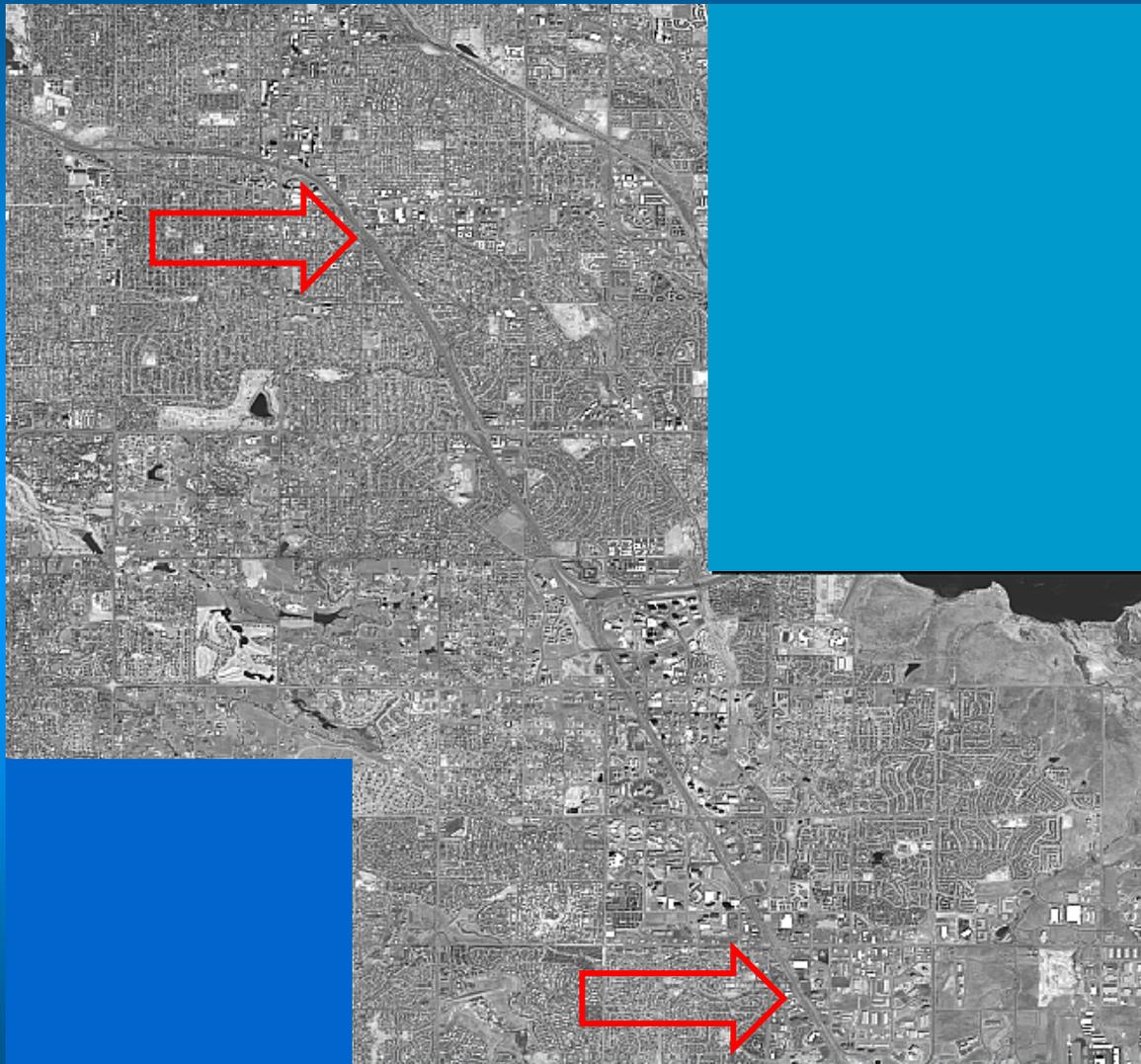
QuickBird high-resolution 60 cm panchromatic imagery allows for backdrop for GIS databases



QuickBird high-resolution imagery supports creation of detailed site diagrams of facilities.

Transportation Applications

I-25 Corridor – Denver, CO



Panchromatic mosaic
image of I-25 corridor
in south Denver

Bridge for 119 Alignment, Longmont, Colorado

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QuickBird B&W, June 2002

QuickBird Color, August 2002

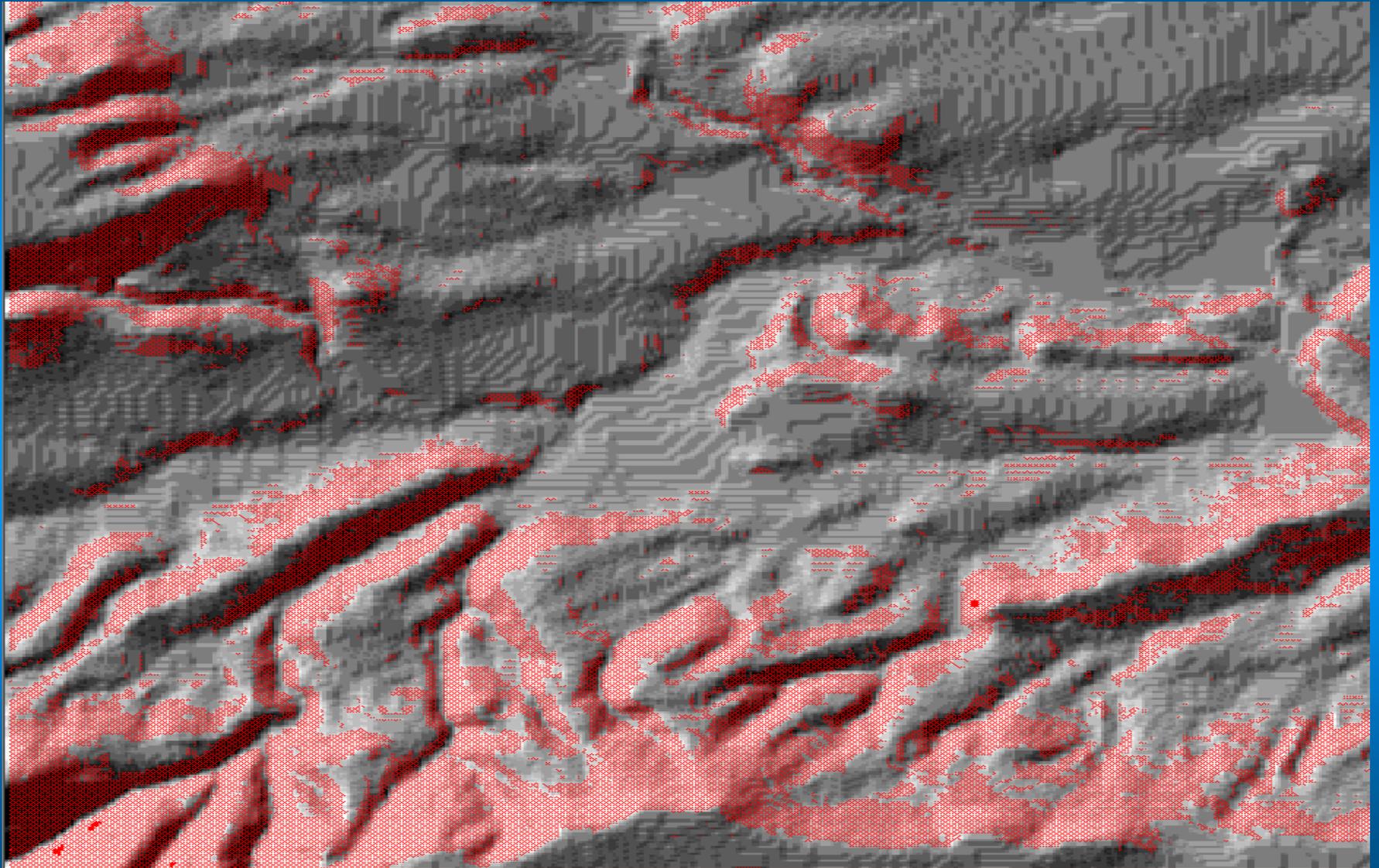


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Steep Slopes Greater Than 10%

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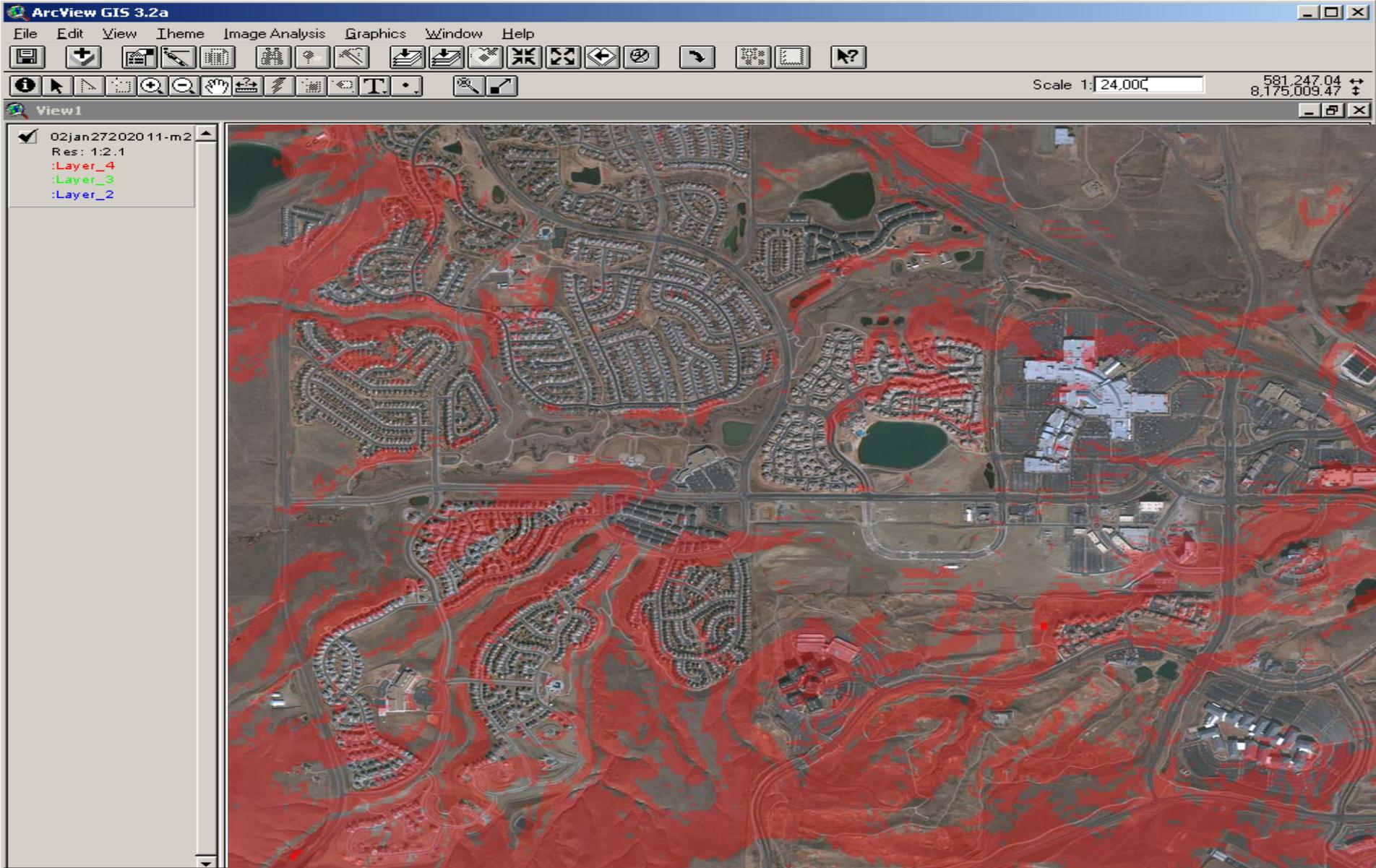


DigitalGlobe.com

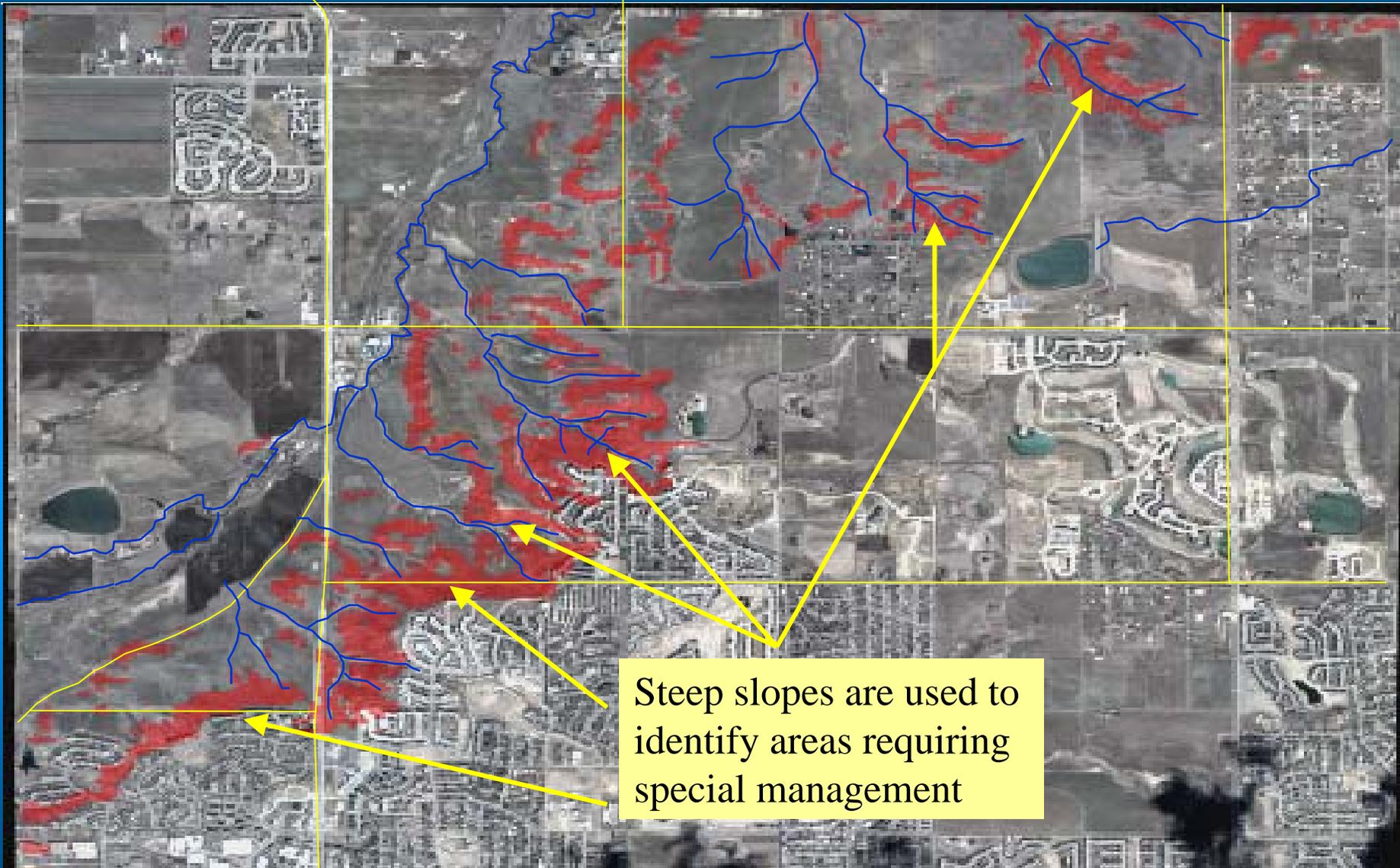
An Imaging and Information Company

Steep Slopes Overlaid on 2002 QB Orthoimage

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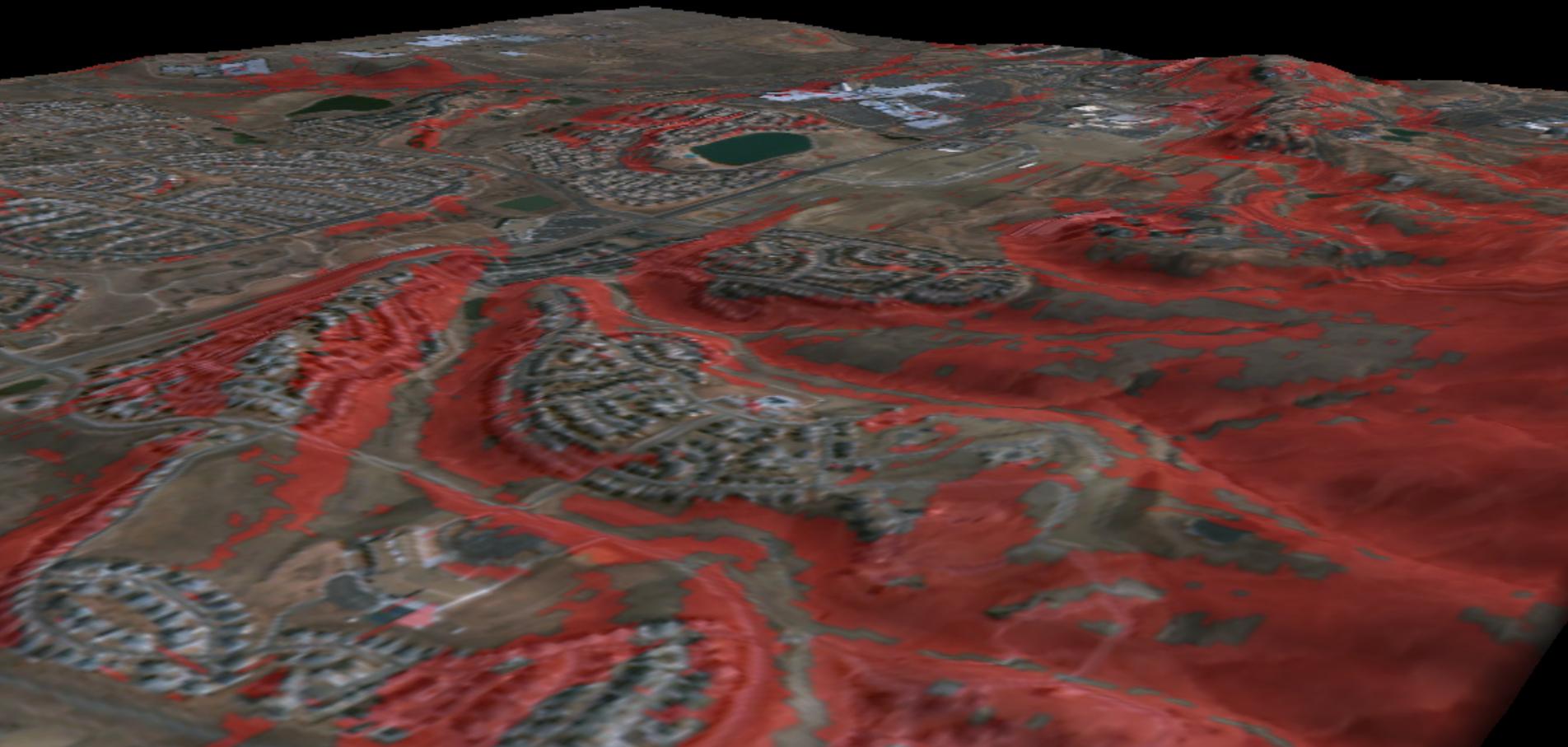
Steep Slopes, Denver NW Metro Area, Colorado, 2002



Steep slopes are used to identify areas requiring special management

3-D Perspective View with Steep Slopes

DIGITALGLOBE™



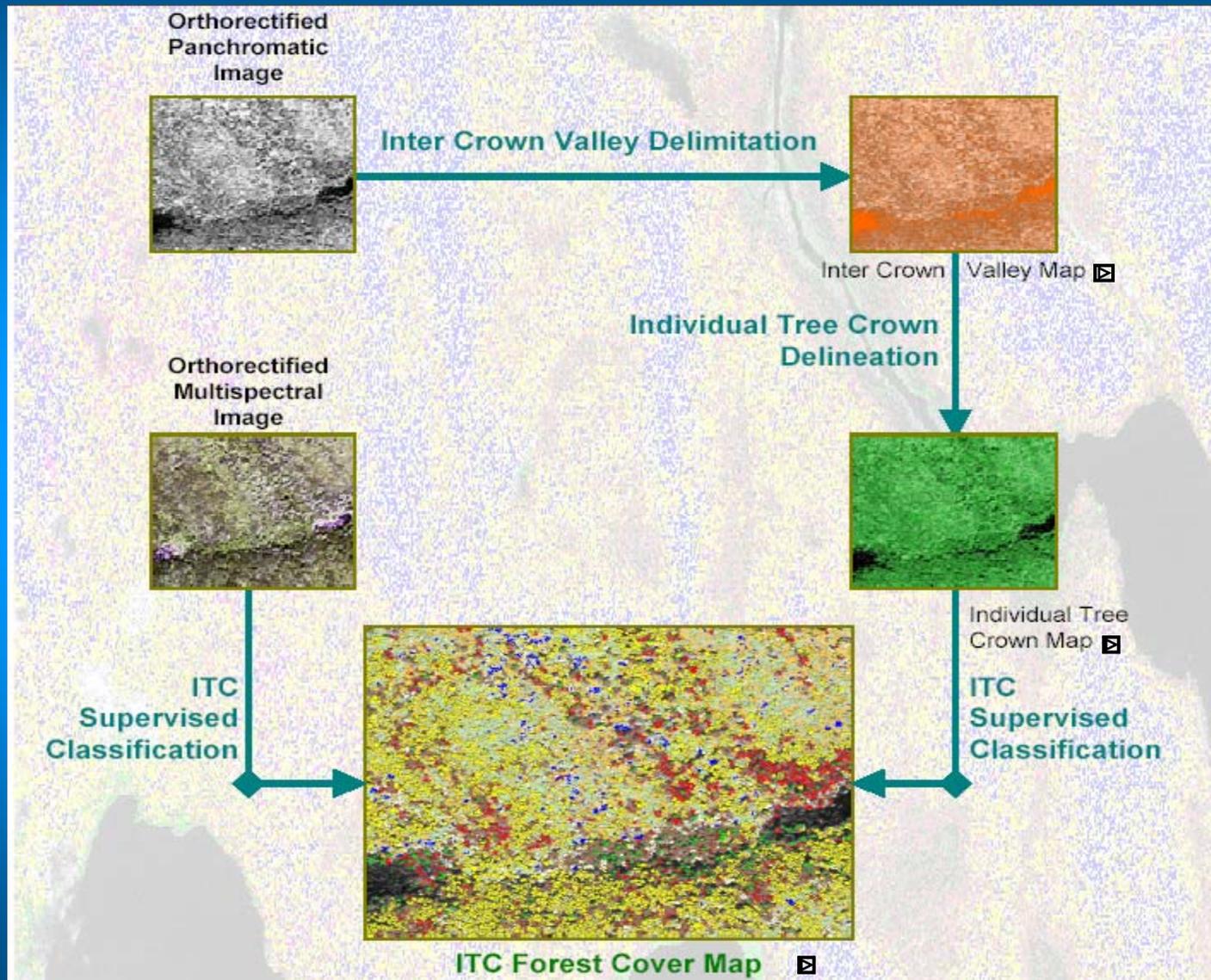
Water Quality Applications

DIGITALGLOBE™



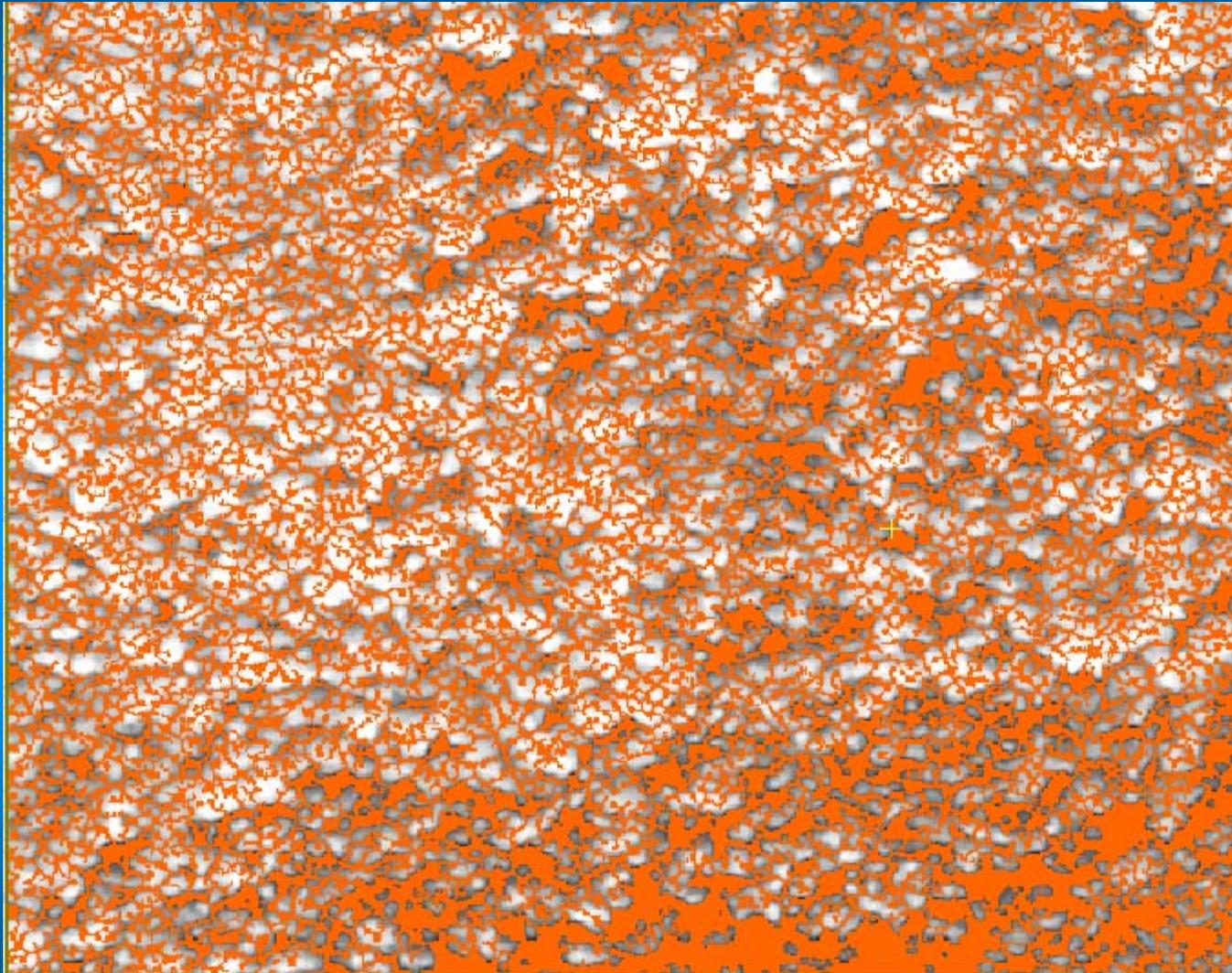
DigitalGlobe.com

CLC Cament – Individual Tree Crown ID



CLC Cament – Individual Tree Crown ID

DIGITALGLOBE™



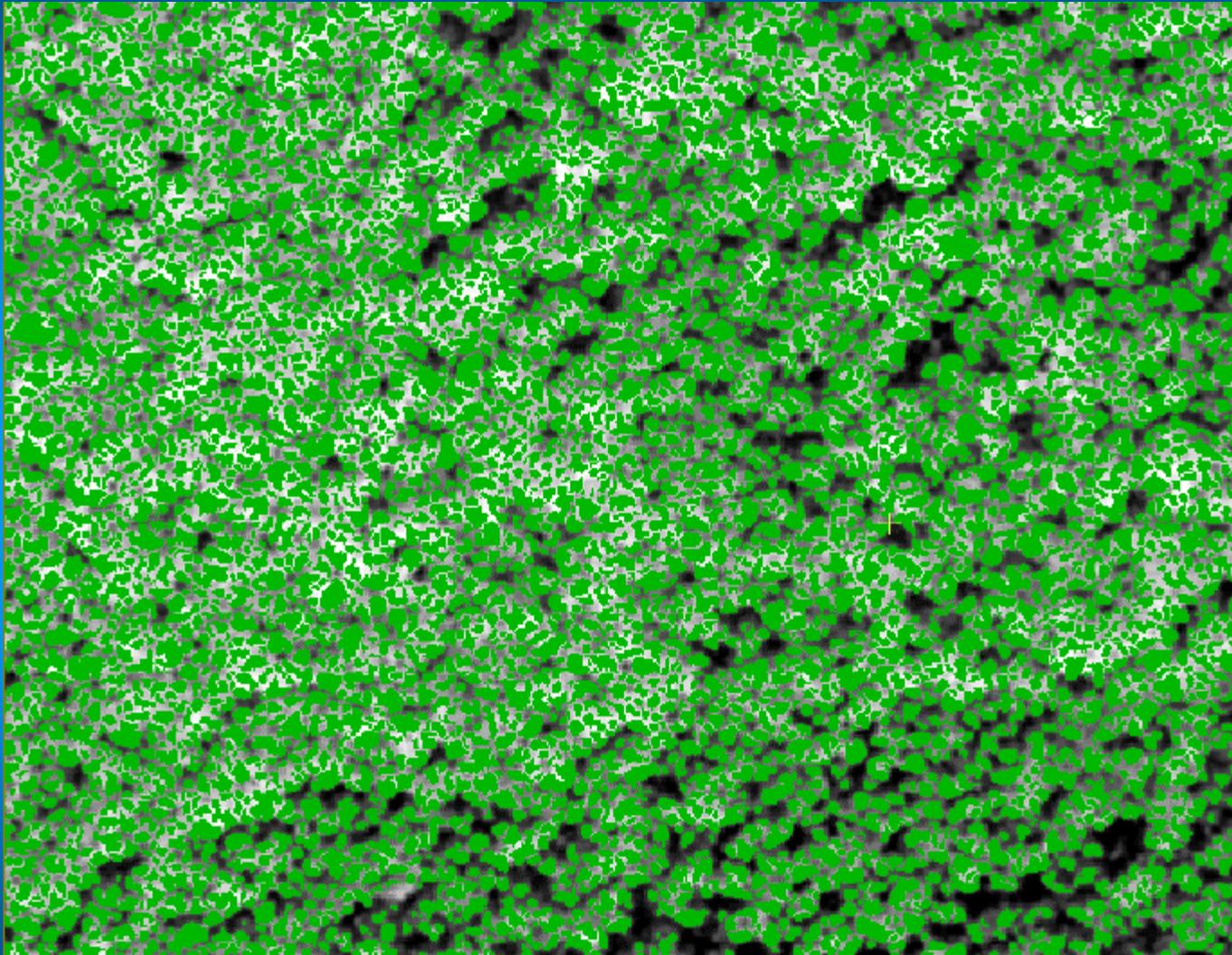
Inter-tree crown map

DigitalGlobe.com

An Imaging and Information Company

CLC Cament – Individual Tree Crown ID

DIGITALGLOBE™



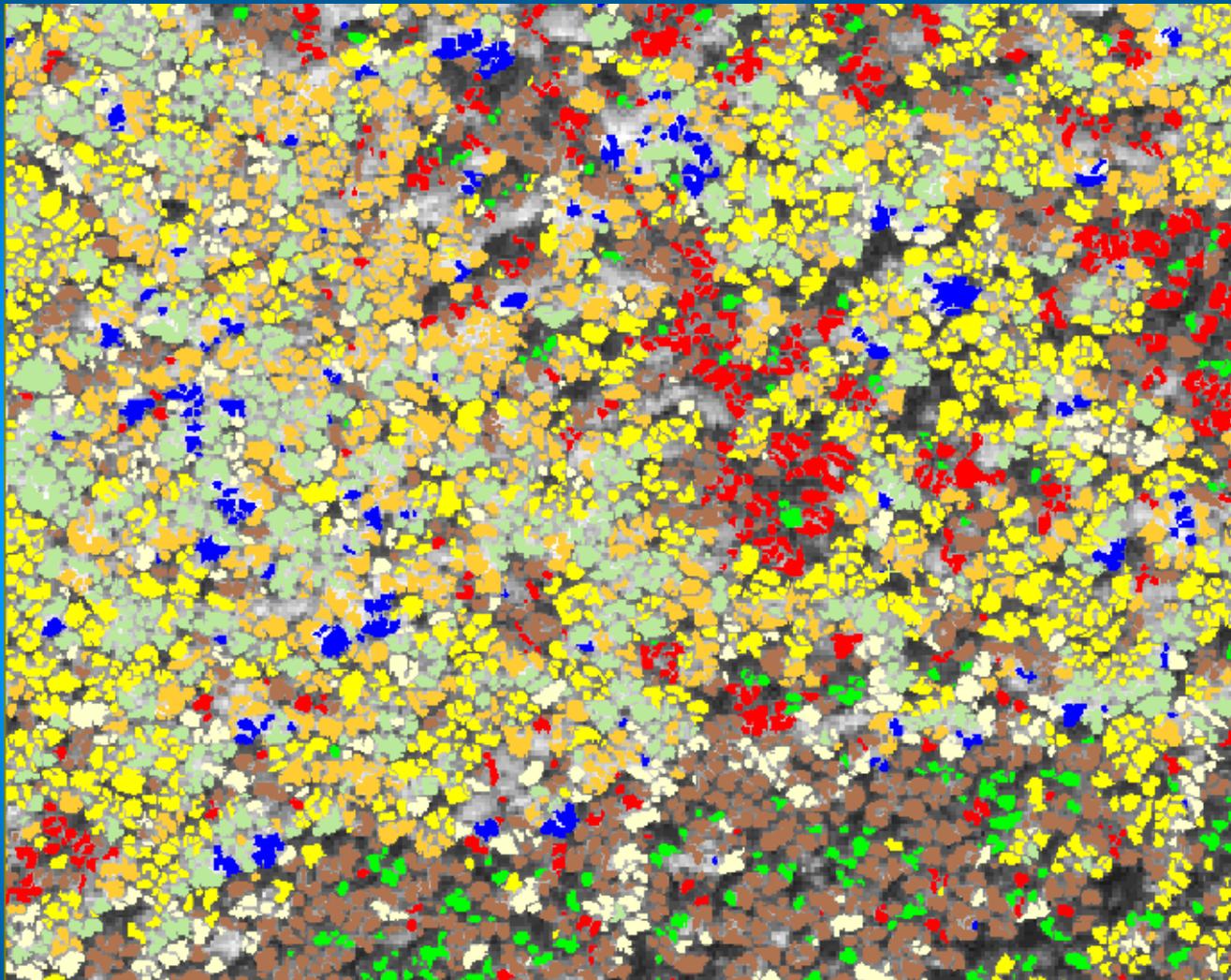
Individual Tree Crown Map

DigitalGlobe.com

An Imaging and Information Company

CLC Cement – Individual Tree Crown ID

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ITC Forest Cover Map

DigitalGlobe.com

An Imaging and Information Company

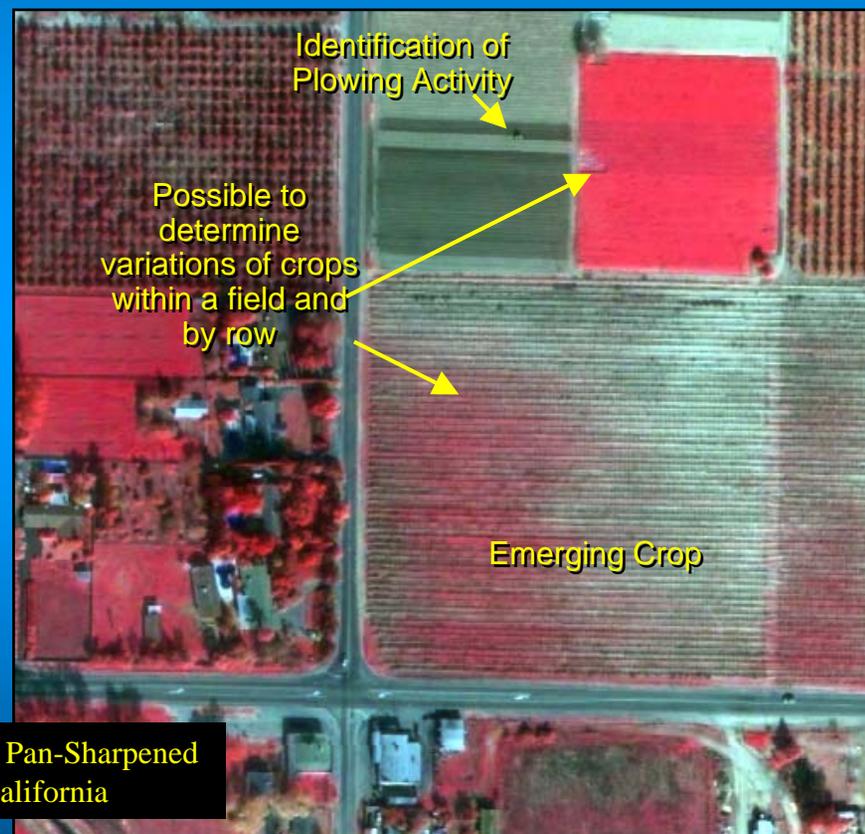
➤ Agricultural Assessments

■ Food Commodity assessment

- ◆ Crop Health
- ◆ Yields
- ◆ Agricultural Infrastructure

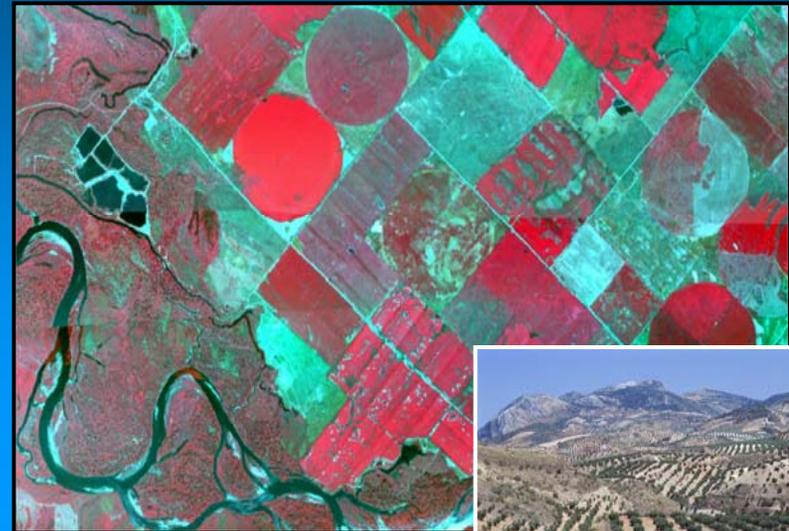
■ Illicit Crops

- ◆ Monitoring Eradication Efforts
- ◆ Identifying Processing Labs
- ◆ Identification of Growing Areas



QuickBird 61 cm Pan-Sharpener
Fresno Region, California

- **Cross-Type Classification**
- **Assessment of Farming Practices**



- **Precision Crop Management**
- **Growth Stage Detection**
- **Yield Prediction**



Advanced Geo-Technology Enables Informed Decisions

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