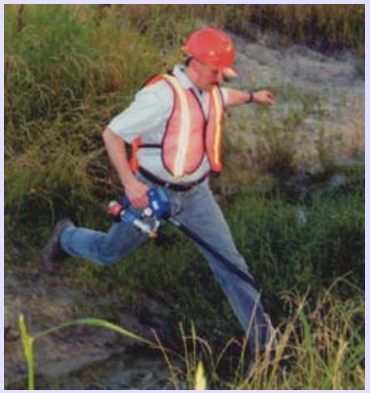
Airborne Lidar Pipeline Inspection Service (ALPIS™)

Overview

- Statement of the problem
- Technology
- Benefits
- Field results
- Discussion

Conventional Inspection Methods

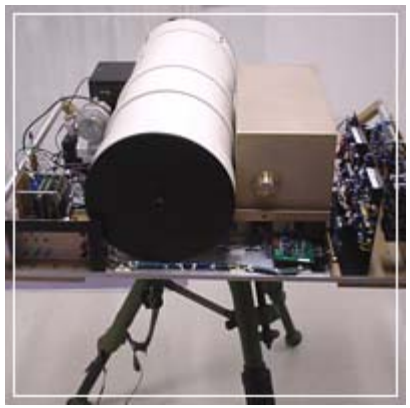


- **Hand-held or truck mounted "sniffers":**
  - Allow maximum coverage of only 8-10 miles a day
  - Scan the swath of one bumper width at best
  - Are ineffective over rough terrain and unwelcome over private land
- **Aerial patrols only look for secondary signs of leaks and right-of-way encroachments**

What is ALPIS

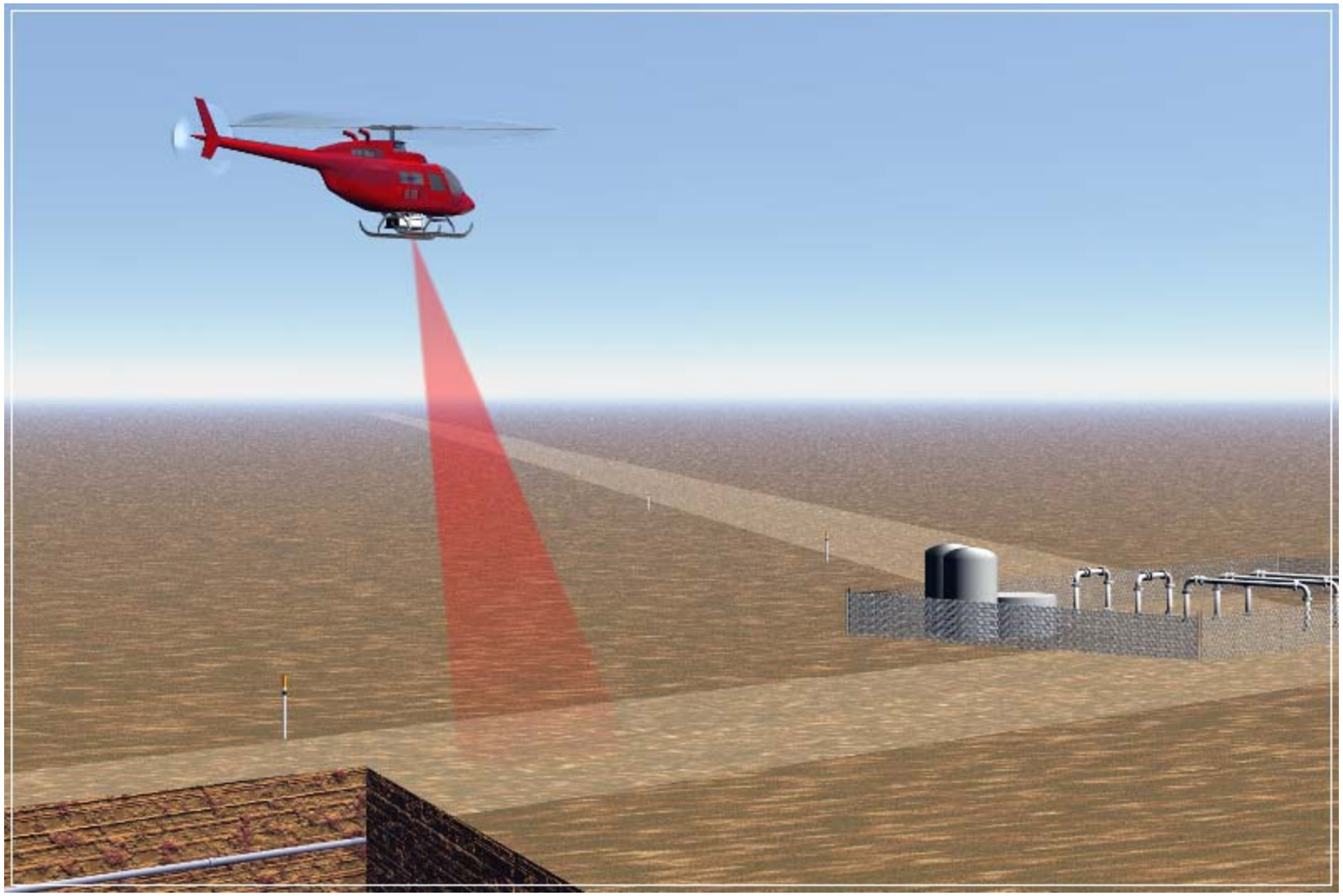
ALPIS (Airborne Lidar Pipeline Inspection Service) is a revolutionary new way to find leaks in natural gas transmission and gathering lines

ALPIS Evolution



1998 2000 2002 2004 2006

How ALPIS Works



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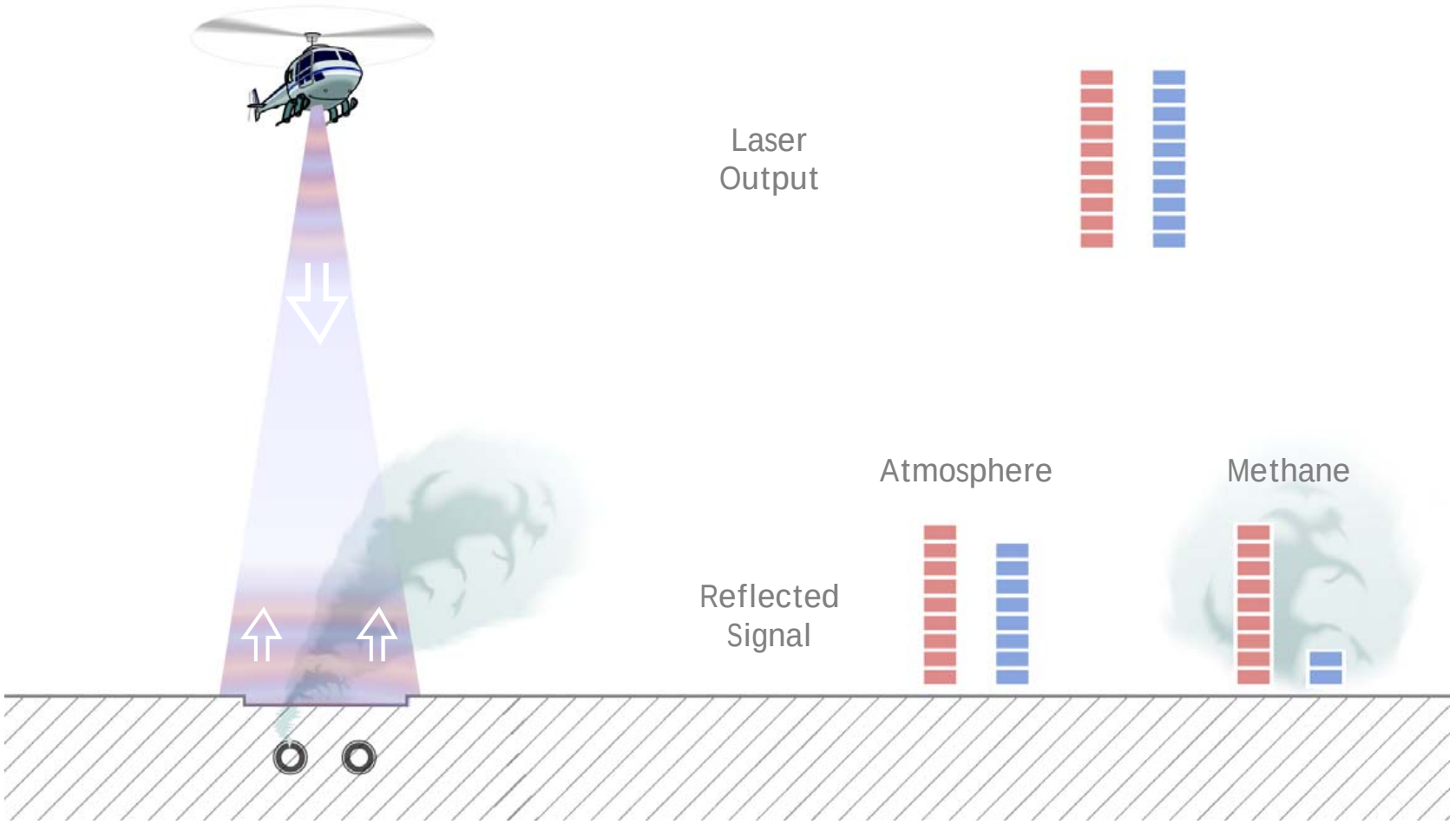
How Technology Works



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How It Looks

Package weight: 250 lbs.

ALPIS at Work

ALPIS Benefits to Customers

- **Over ten times faster than ground surveys**
- **Highest sensitivity in remote gas detection**
- Easy access to rough terrain
- Non-disruptive to private landowners
- GPS accuracy of results
- **Full coverage of the right-of-way**
- Digital photography of the entire survey route
- **Full reports delivered within 24 hours of inspection**
- 1-hour emergency response available
- Multimedia and Internet based reporting and archiving

Survey Results

Printed reports

- Conventional, easy to use format
- Convenient for field follow ups
- Available within an hour after survey

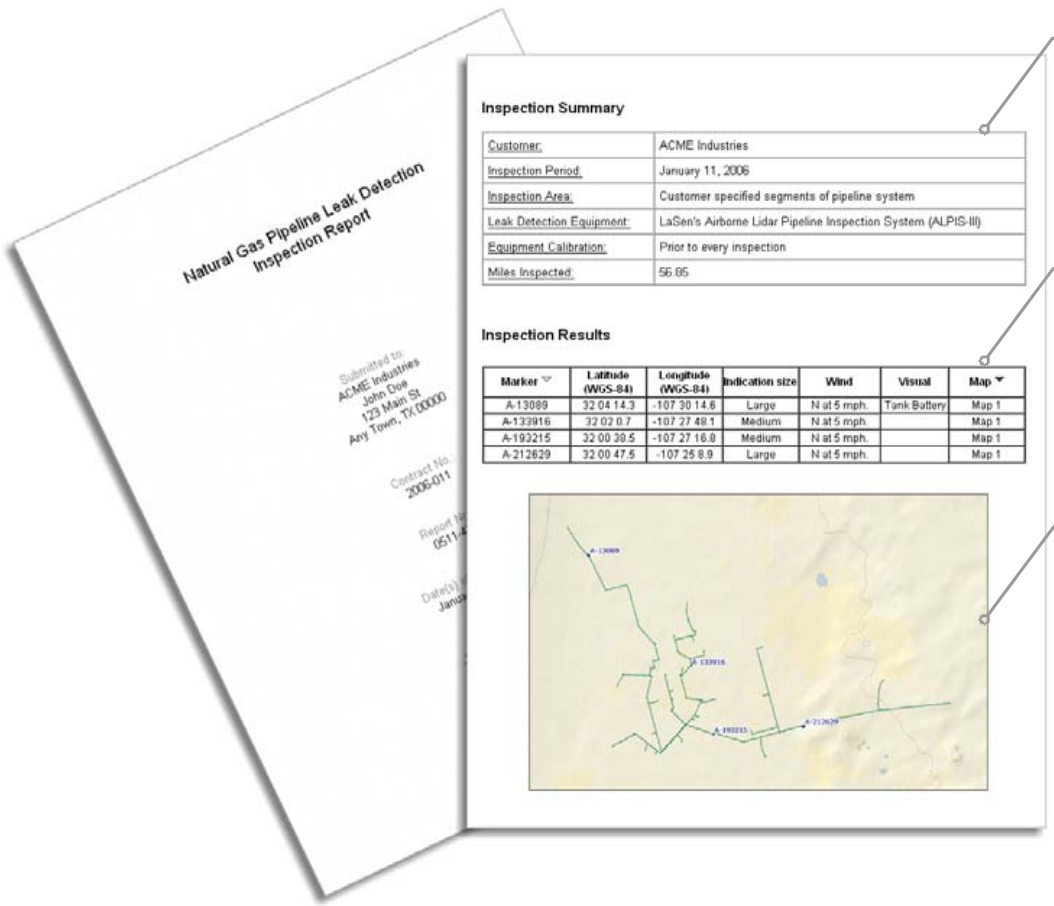
Interactive DVDs

- Combine maps and high-resolution digital imaging in one easy to use software package
- Allow to replay the entire inspection for visual verification

Secure online GIS - database

- Aids in maintenance and repair planning
- Improves long-distance collaboration
- Enhances field feedback

Printed Report



Inspection overview

Inspection results in a tabular format

Inspection results overlaid on a map

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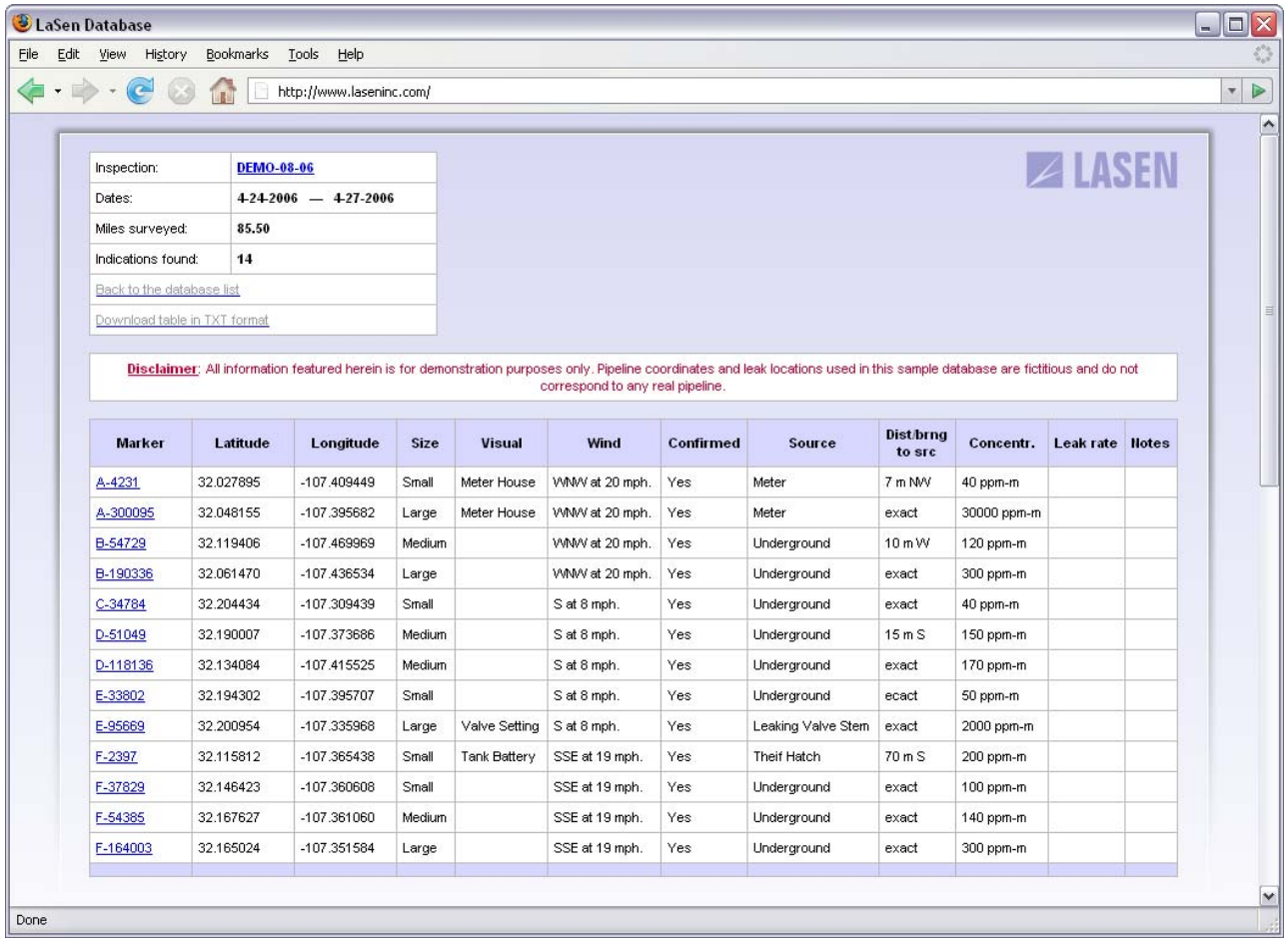
Complete Results on DVD

Map of the inspected area

Digital imaging

Detailed inspection information

Secure On-line Database



Inspection:	DEMO-08-06
Dates:	4-24-2006 — 4-27-2006
Miles surveyed:	85.50
Indications found:	14
Back to the database list	
Download table in TXT format	

Disclaimer: All information featured herein is for demonstration purposes only. Pipeline coordinates and leak locations used in this sample database are fictitious and do not correspond to any real pipeline.

Marker	Latitude	Longitude	Size	Visual	Wind	Confirmed	Source	Dist/brng to src	Concentr.	Leak rate	Notes
A-4231	32.027895	-107.409449	Small	Meter House	WNW at 20 mph.	Yes	Meter	7 m NW	40 ppm-m		
A-300095	32.048155	-107.395682	Large	Meter House	WNW at 20 mph.	Yes	Meter	exact	30000 ppm-m		
B-54729	32.119406	-107.469969	Medium		WNW at 20 mph.	Yes	Underground	10 m W	120 ppm-m		
B-190336	32.061470	-107.436534	Large		WNW at 20 mph.	Yes	Underground	exact	300 ppm-m		
C-34784	32.204434	-107.309439	Small		S at 8 mph.	Yes	Underground	exact	40 ppm-m		
D-51049	32.190007	-107.373686	Medium		S at 8 mph.	Yes	Underground	15 m S	150 ppm-m		
D-118136	32.134084	-107.415525	Medium		S at 8 mph.	Yes	Underground	exact	170 ppm-m		
E-33802	32.194302	-107.395707	Small		S at 8 mph.	Yes	Underground	ecact	50 ppm-m		
E-95669	32.200954	-107.335968	Large	Valve Setting	S at 8 mph.	Yes	Leaking Valve Stem	exact	2000 ppm-m		
F-2397	32.115812	-107.365438	Small	Tank Battery	SSE at 19 mph.	Yes	Theif Hatch	70 m S	200 ppm-m		
F-37829	32.146423	-107.360608	Small		SSE at 19 mph.	Yes	Underground	exact	100 ppm-m		
F-54385	32.167627	-107.361060	Medium		SSE at 19 mph.	Yes	Underground	exact	140 ppm-m		
F-164003	32.165024	-107.351584	Large		SSE at 19 mph.	Yes	Underground	exact	300 ppm-m		

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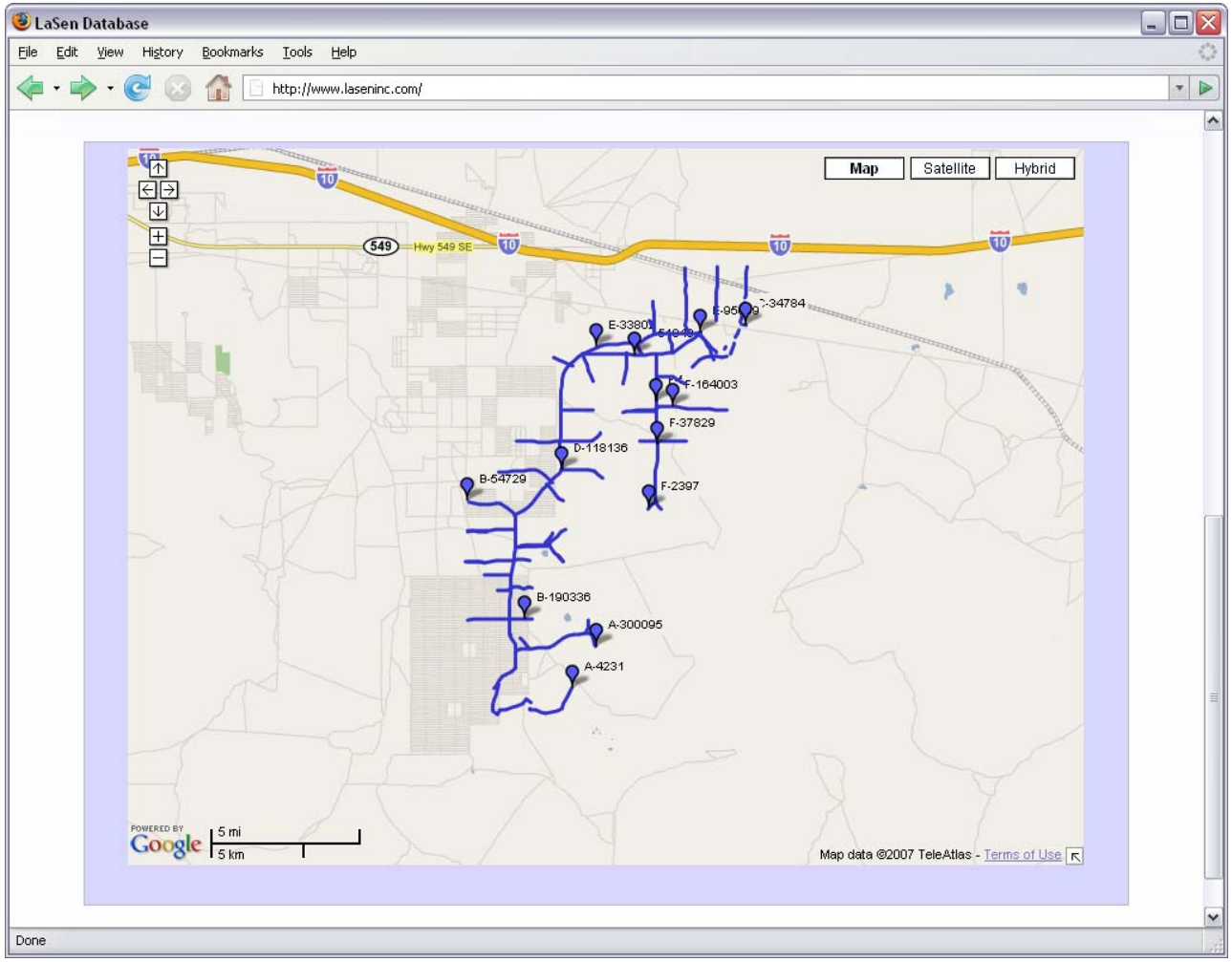
Survey Results Overlay on Map



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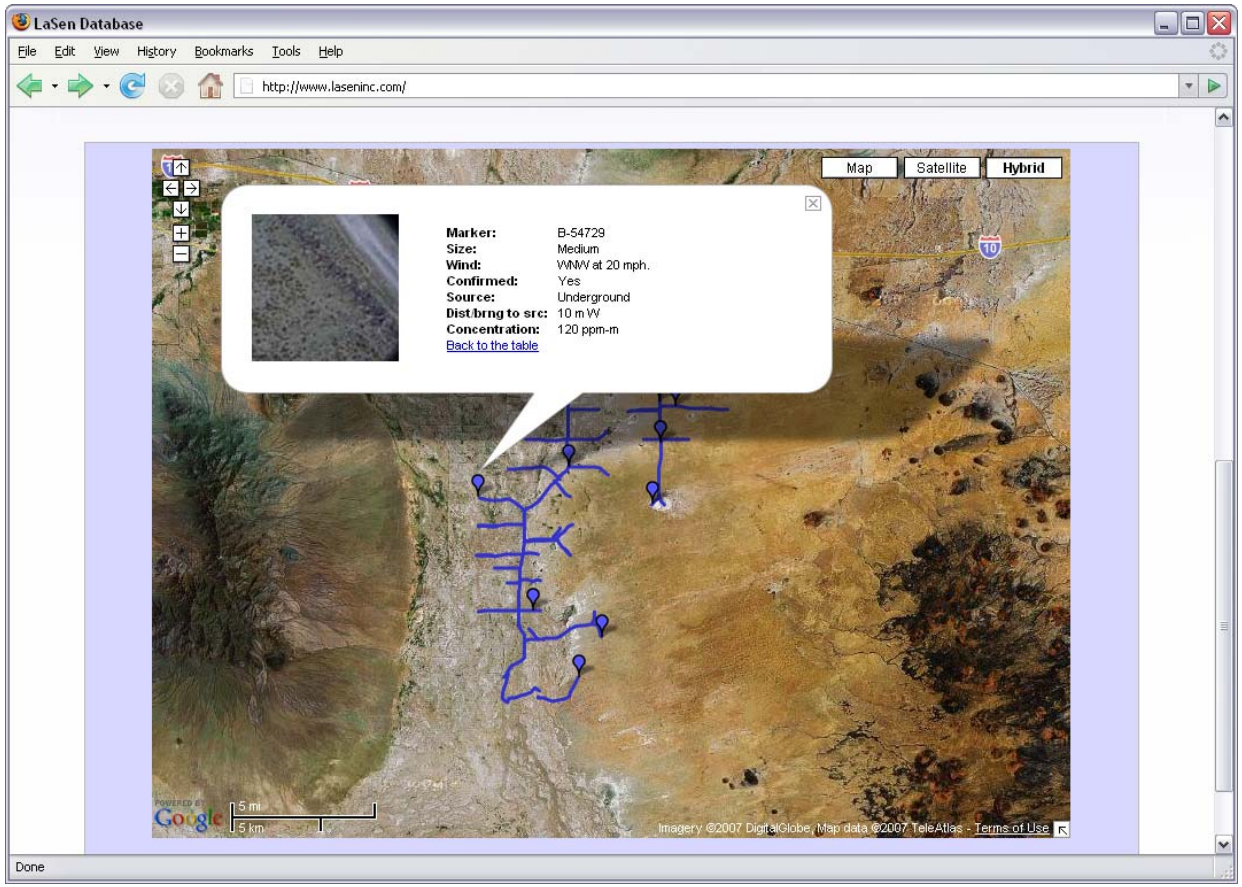
Survey Results Overlay on Satellite Imagery



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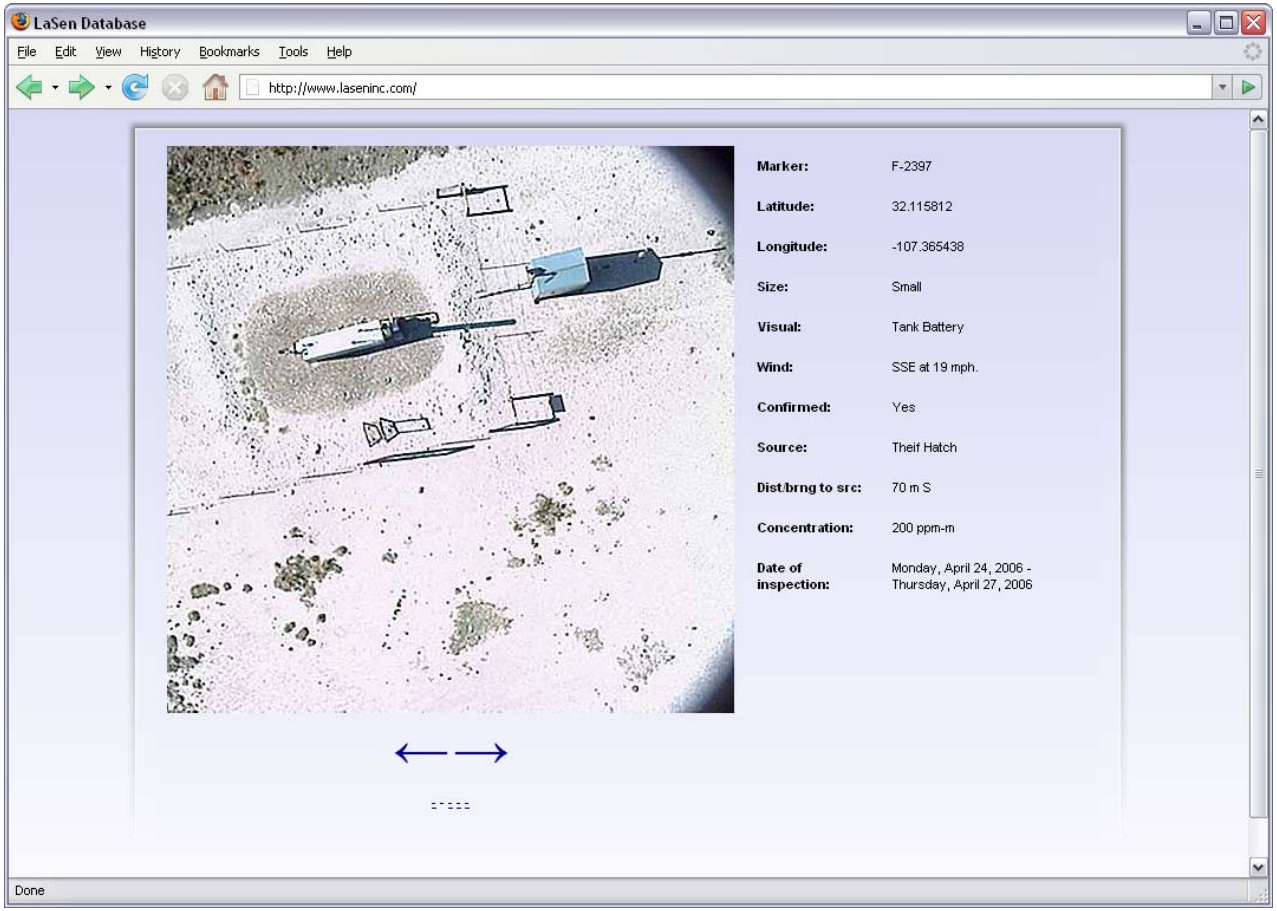
High-resolution Image of Leak Location



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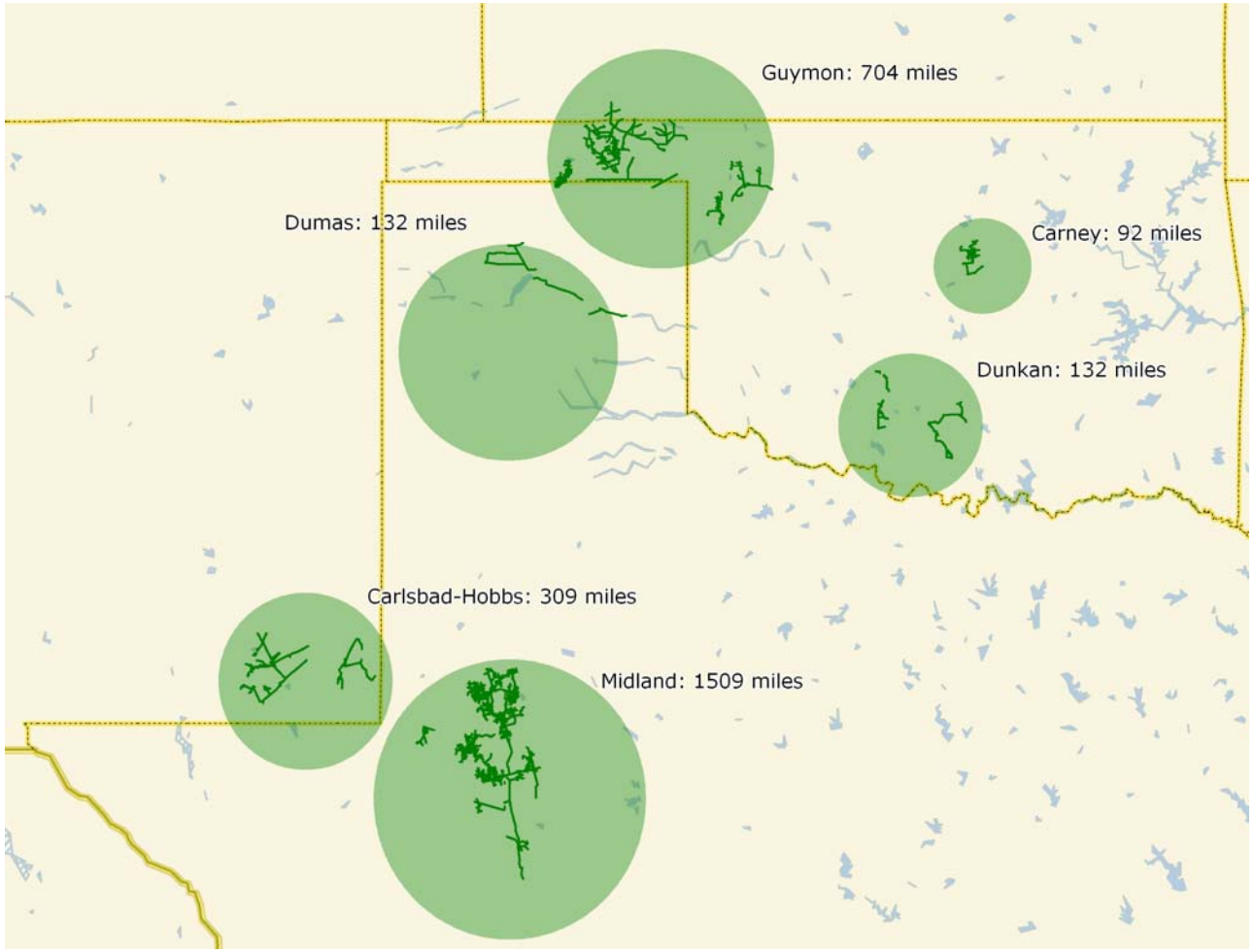
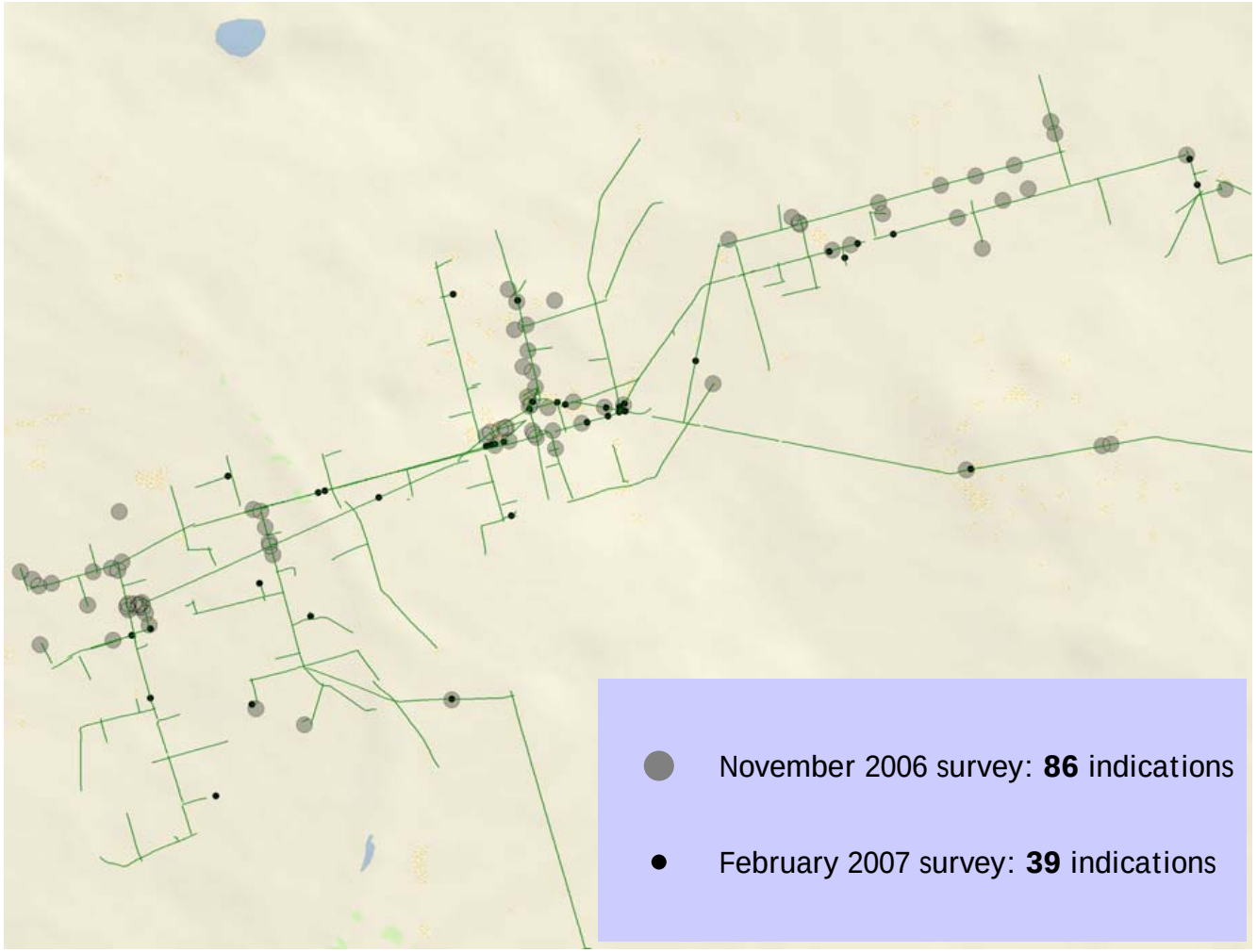
Right-of-Way High-Resolution Digital Imagery

DEFS Surveys 2006



Survey – Repair – Survey - … Cycle



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Field Results Summary

- Commercial application started: in **2004**
- Total miles inspected in 2006: **4,719**
- Total leak indications reported: **1,283** (approx. **1 leak** every **3.5 miles**)
- Customers served: **7**

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Effectiveness of Inspection

15 miles of transmission line inspected on April 13, 2006

Cost of Inspection	$1,875.00 *
Annual Product Loss	$16,407.00**

LASEN Marker	Indication size	As-Found Daily Leakage Rate (mcf)	Annual Leakage Rate (mcf) m=1,000	Annual BTU Loss	Annual product loss ($)	Description of leak and repair
A-210994	medium	0.1776	64.82	64,824,000	583.42	Leak found on fuel tap valve operator (booster station). Lubricated stem and operated valve to stop leak.
A-216681	small	0.4181	152.61	152,606,500	1,373.46	Leak found from plug in top of drip valve. Removed, cleaned, taped and replaced plug to stop leak.
A-231599	medium	0.1672	61.03	61,028,000	549.25	Leak found from plug in top of drip valve. Removed, cleaned, taped and replaced plug to stop leak.
A-316434	medium	0.5017	183.12	183,120,500	1,648.08	Leak found within booster station yard (piping). Will have to hand excavate to perform repair(s).
A-357112	large	1.5840	578.16	578,160,000	5,203.44	Leaking dresser coupling repaired with full encirclement sleeve.
A-357584	small	1.7280	630.72	630,720,000	5,676.48	Leaking dresser coupling repaired with full encirclement sleeve.
A-387233	small	0.4181	152.61	152,606,500	1,373.46	Leak was from a thermocouple in meter tube. Will isolate meter tube and replace leaking thermocouple.
Total		4.9947	1,823.07	**1,823,065,500**	**16,407.59**	

* Cost of inspection does not include setup fee
** Calculations are made based on the price of $9 for 1000000 BTU

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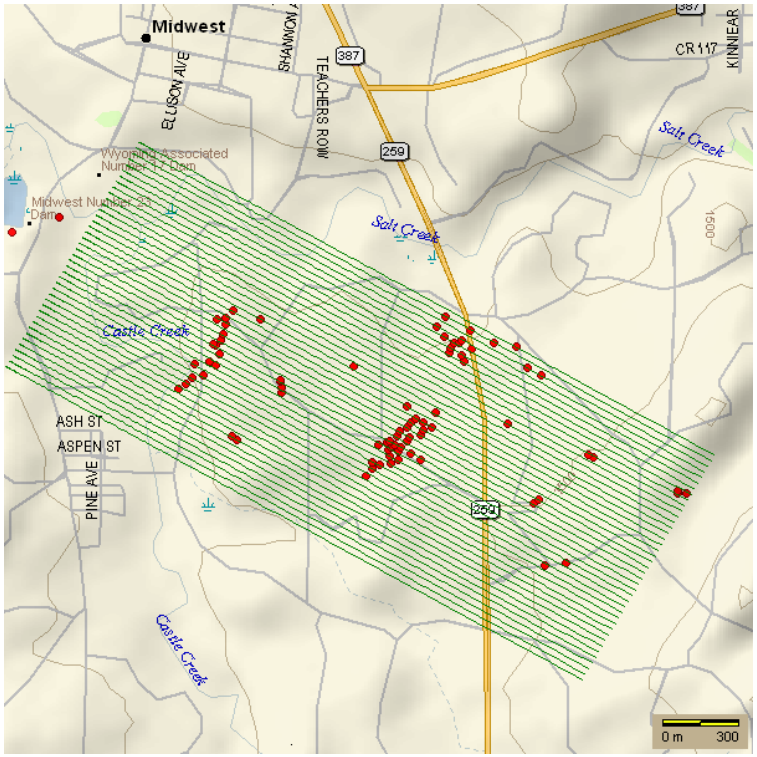
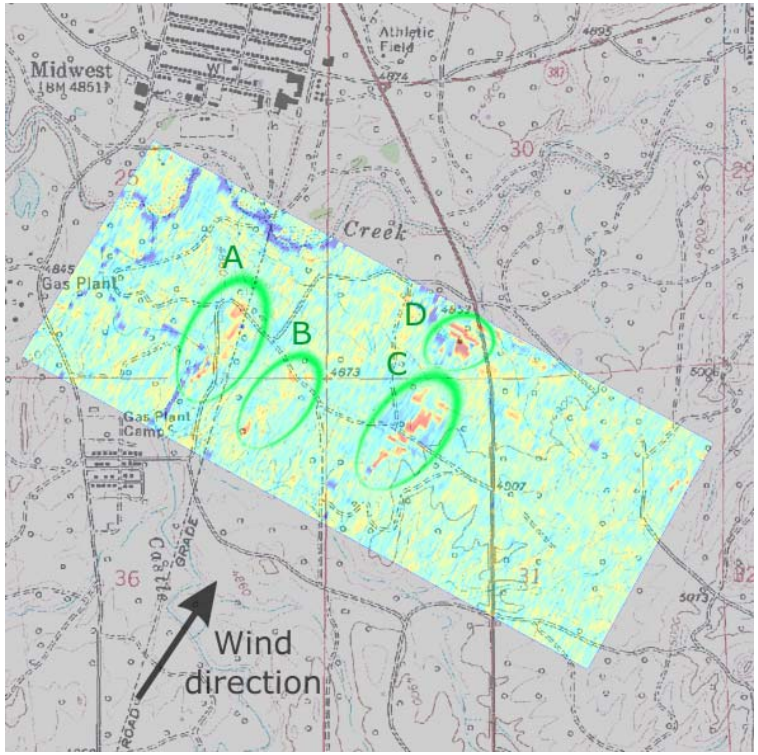
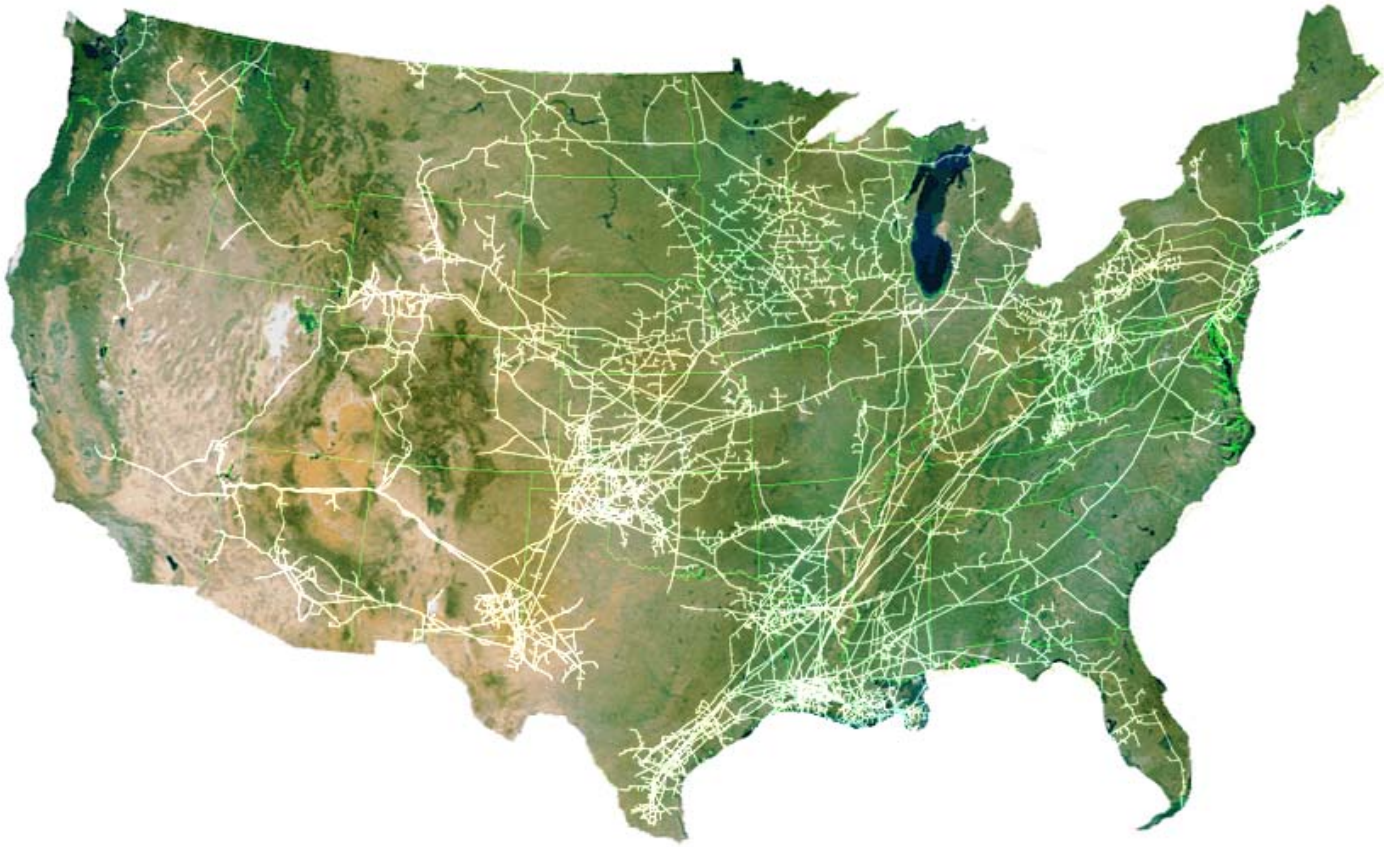
Congested Area Surveys





Results of grid-pattern survey of a partially abandoned oil field.
Areas marked as A,B,C and D represent identified plumes.

ALPIS Facts



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