

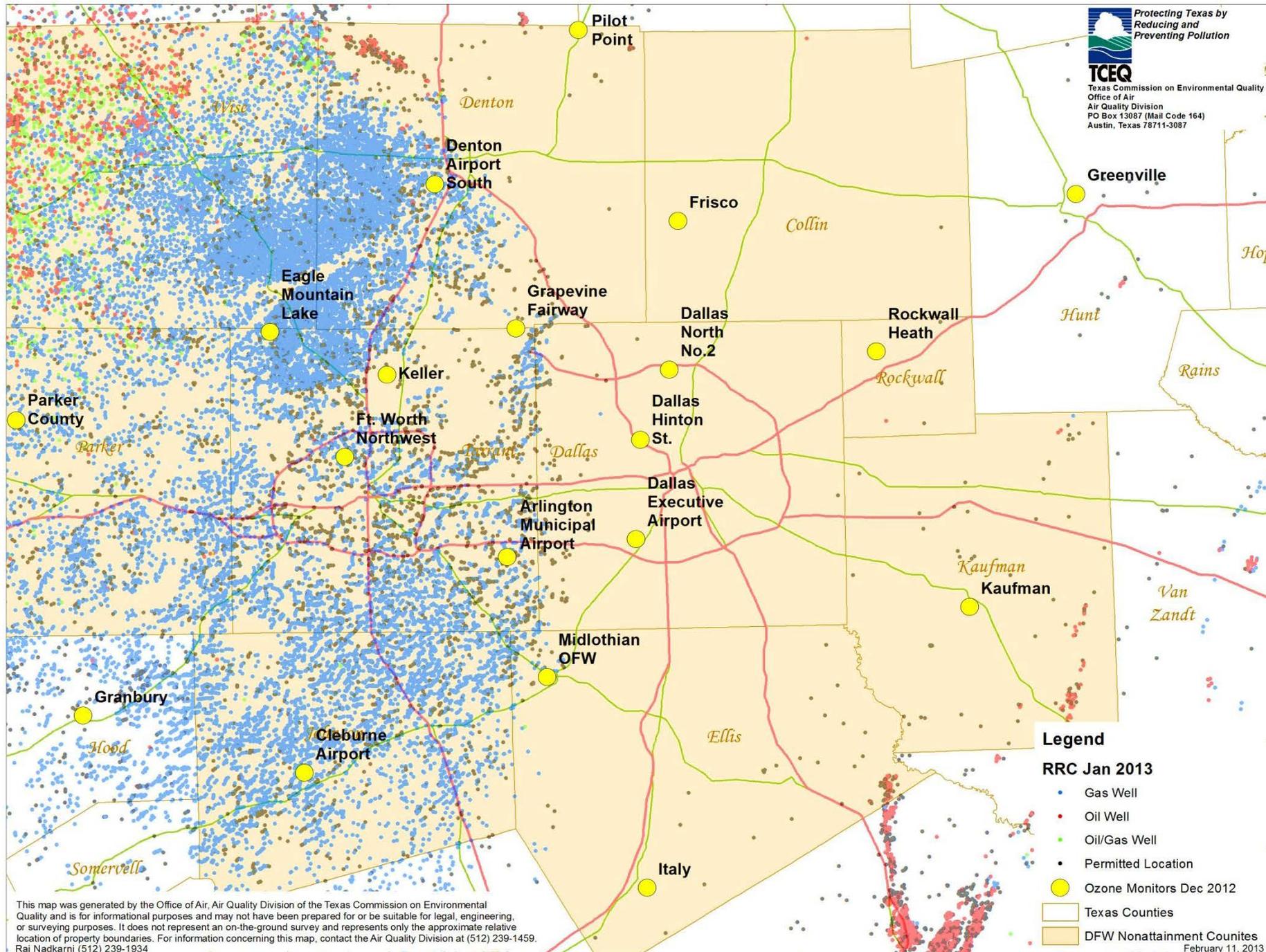


Air Quality Impacts of Natural Gas Operations in Texas

*Michael Honeycutt, Ph.D., Shannon Ethridge,
M.S., DABT, and Tiffany Bredfeldt, Ph.D.*

Toxicology Division

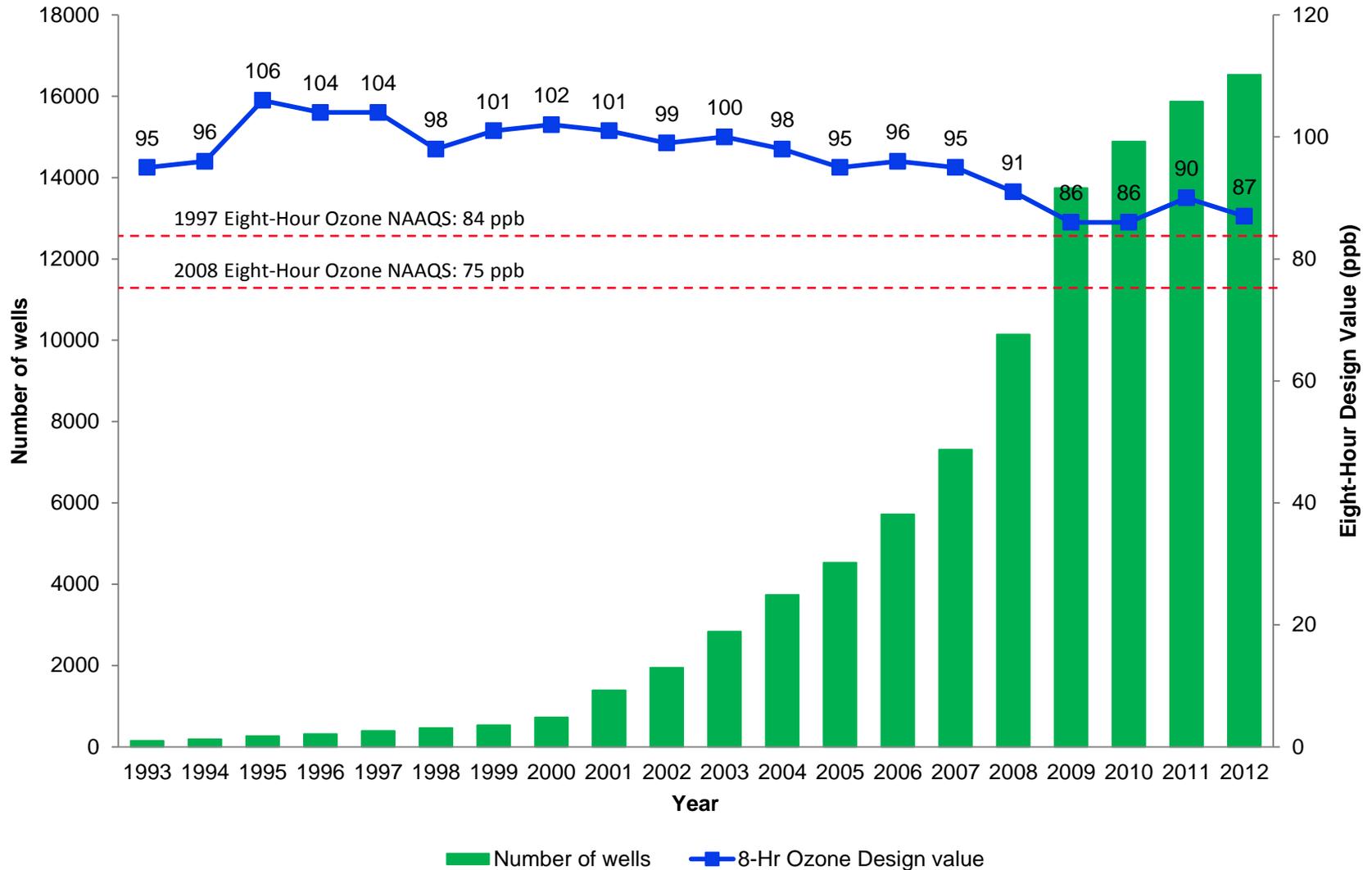
Texas Commission on Environmental Quality



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Dallas/Fort Worth Ozone Design Values and Barnett Shale Production





Fixed-Site Canister Sampler



\$75K - \$125K installation and first year operation cost



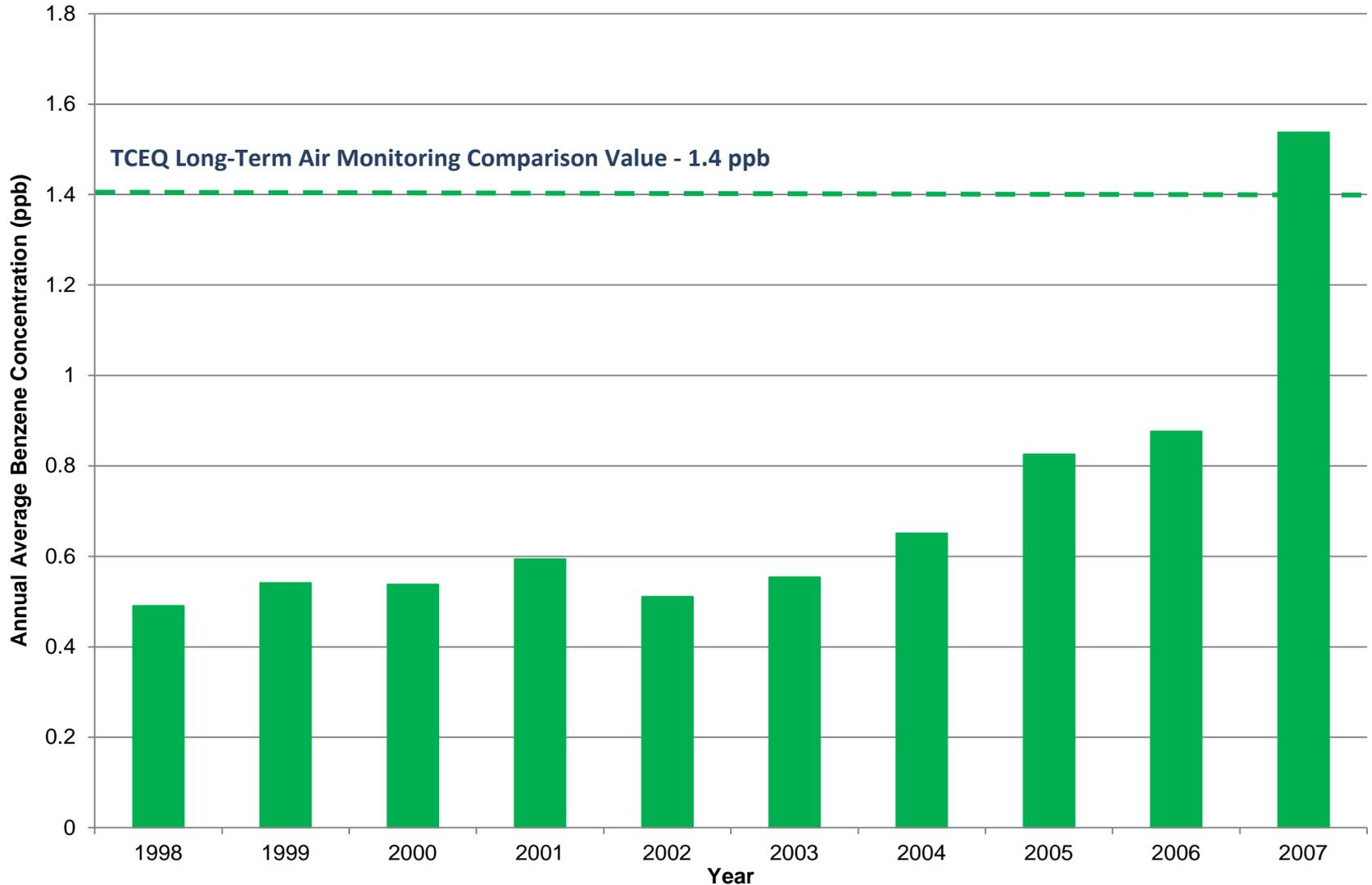
Mobile Monitoring and Fixed-Site Auto Gas Chromatographs



~\$250K installation and
first year operation
cost

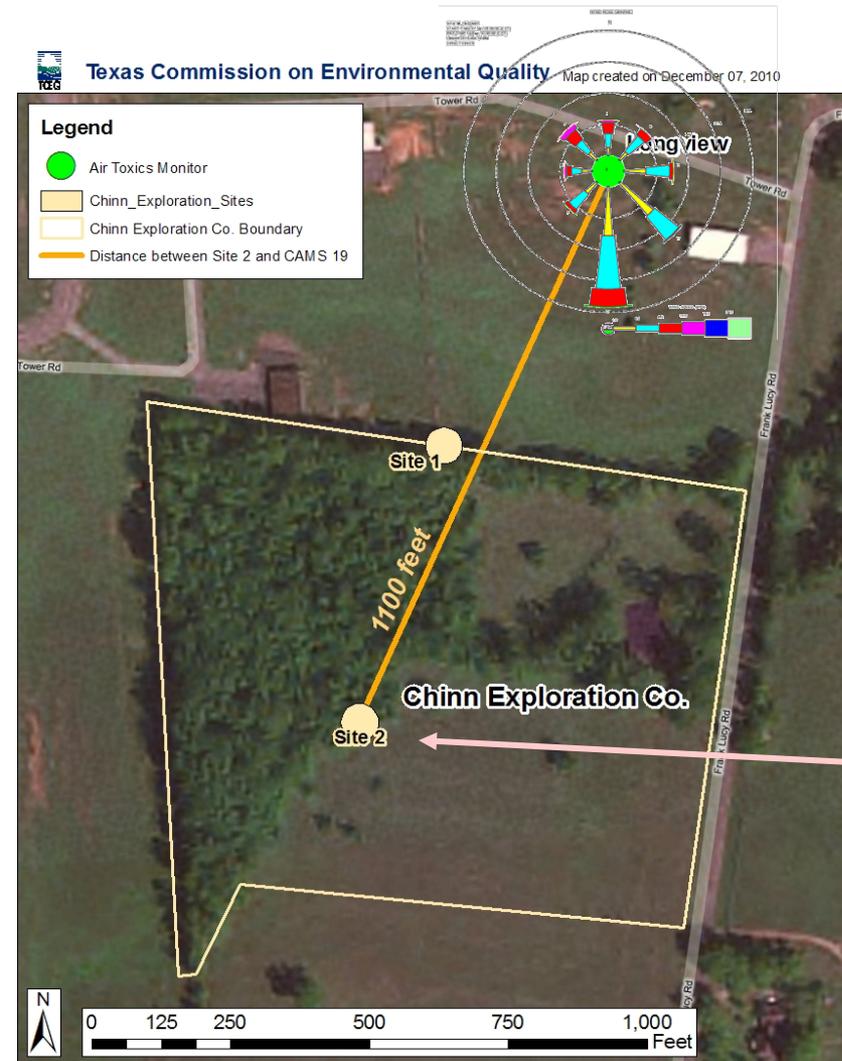


Benzene Trends: Longview Monitor (1998 – 2007)



TCEQ Region 5 – Longview

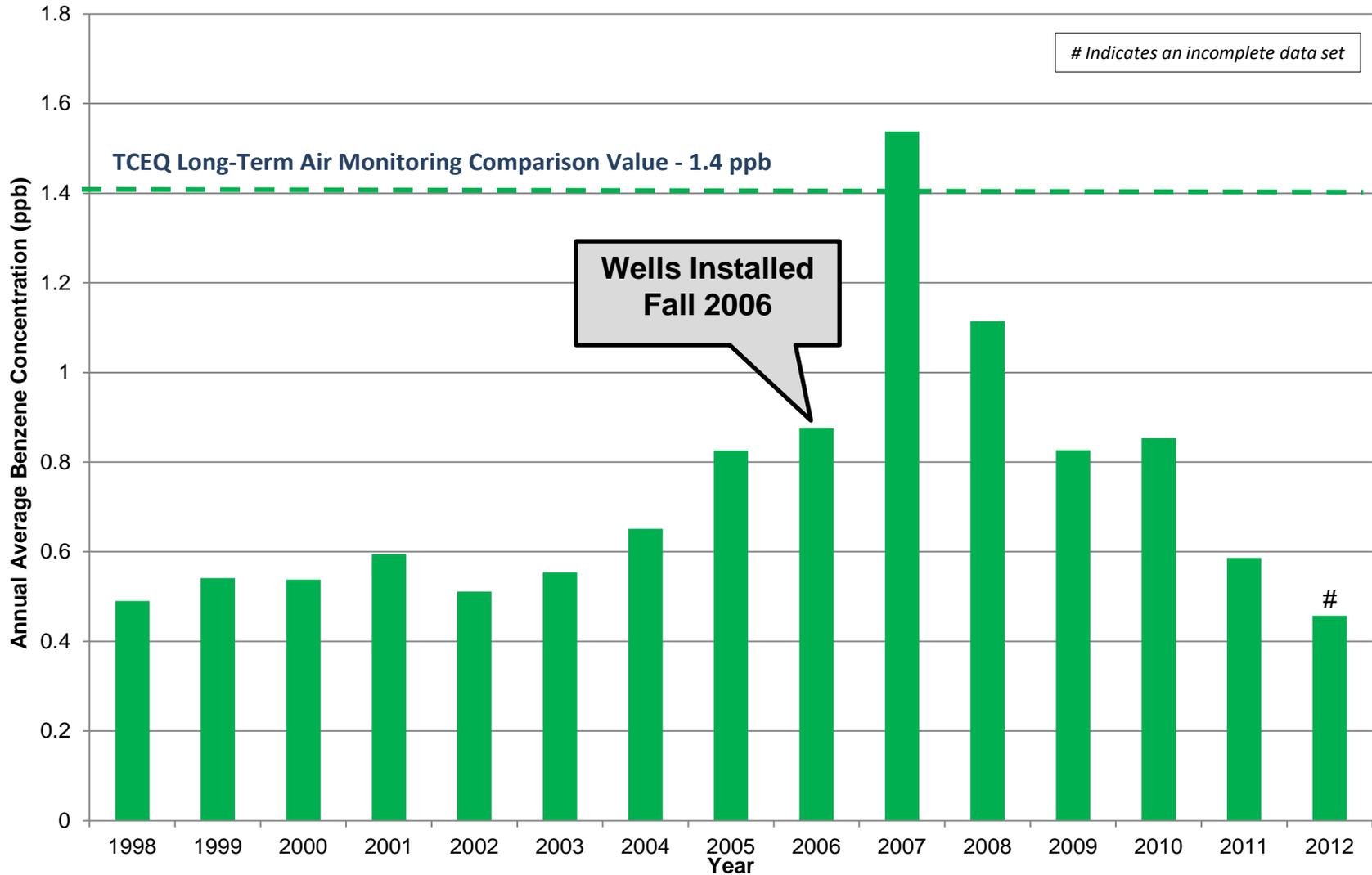
- Mobile Monitoring Investigation in January 2009
 - Used IR camera to survey
 - Collected air samples
 - Max instantaneous benzene concentration of 1100 ppb at Site 2 Tank Battery
- Most likely source of elevated benzene was Chinn Exploration Co.
- In 2008 benzene levels decreased to <1.4 ppb



Storage Tank Battery located at Site 2

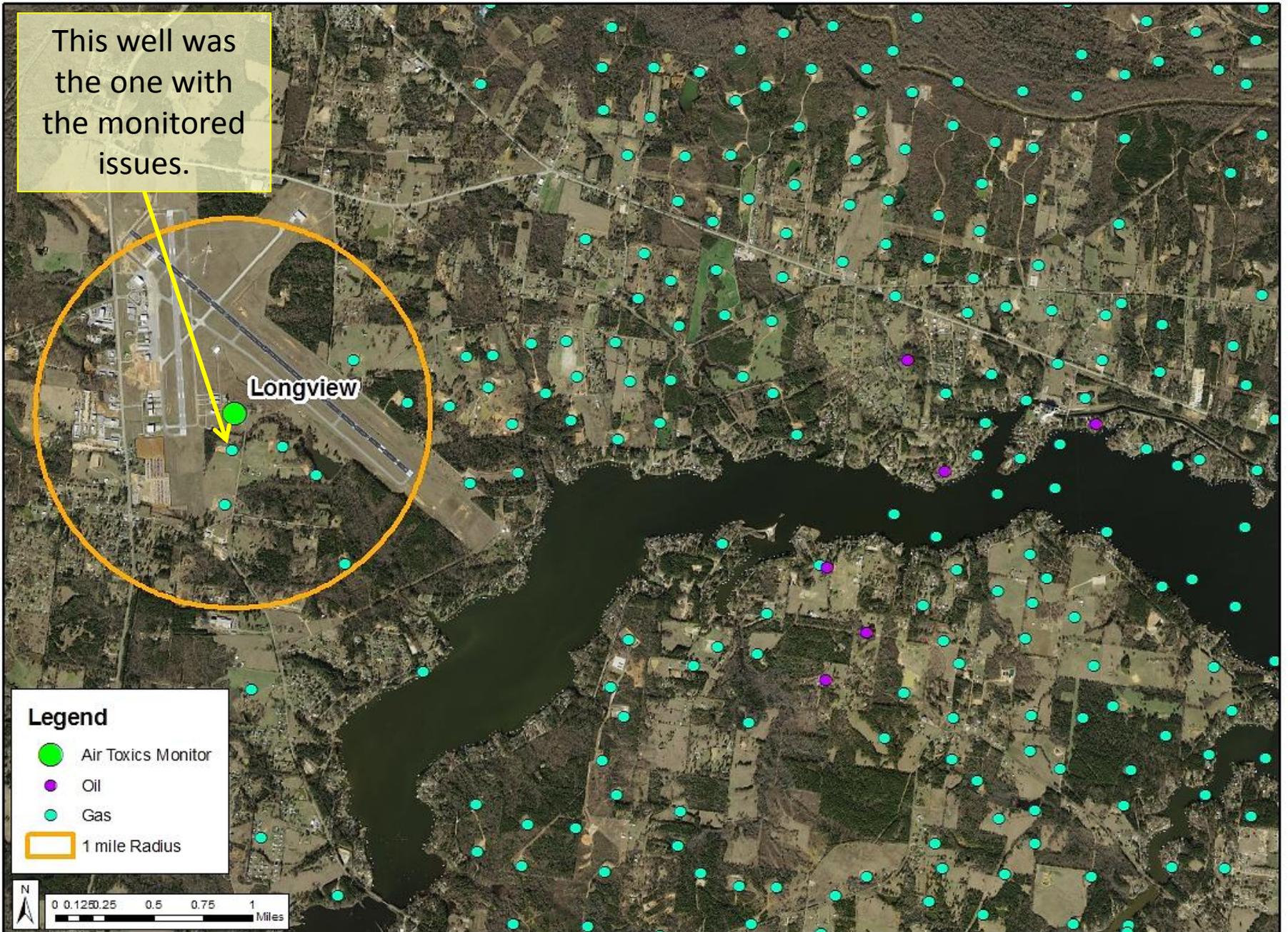


Benzene Trends: Longview Monitor (1998 – 2007)





This well was the one with the monitored issues.



Barnett Shale Area Flyovers

- Flyovers were conducted in 2007 and 2010
- The 2010 flyover resulted in images of over 5,000 individual storage tanks and identified 88 sources of significant hydrocarbon emissions.



Gas FindIR video

Short-term Monitoring

- Since August 1, 2009, the TCEQ has surveyed **2,838** sites using the GasFind IR camera.
- At **2,794** of these sites, a hand-held volatile organic compound sampler was also used.
- Based on observations with these instruments, **1,315** canister samples have been collected and analyzed for VOCs.
- Short-term samples have also been collected and analyzed for carbonyls, NO_x, and sulfur compounds.
- Barnett Shale Air Sampling Map Viewer:
<http://www.tceq.texas.gov/airquality/barnettshale/bshale-viewer>

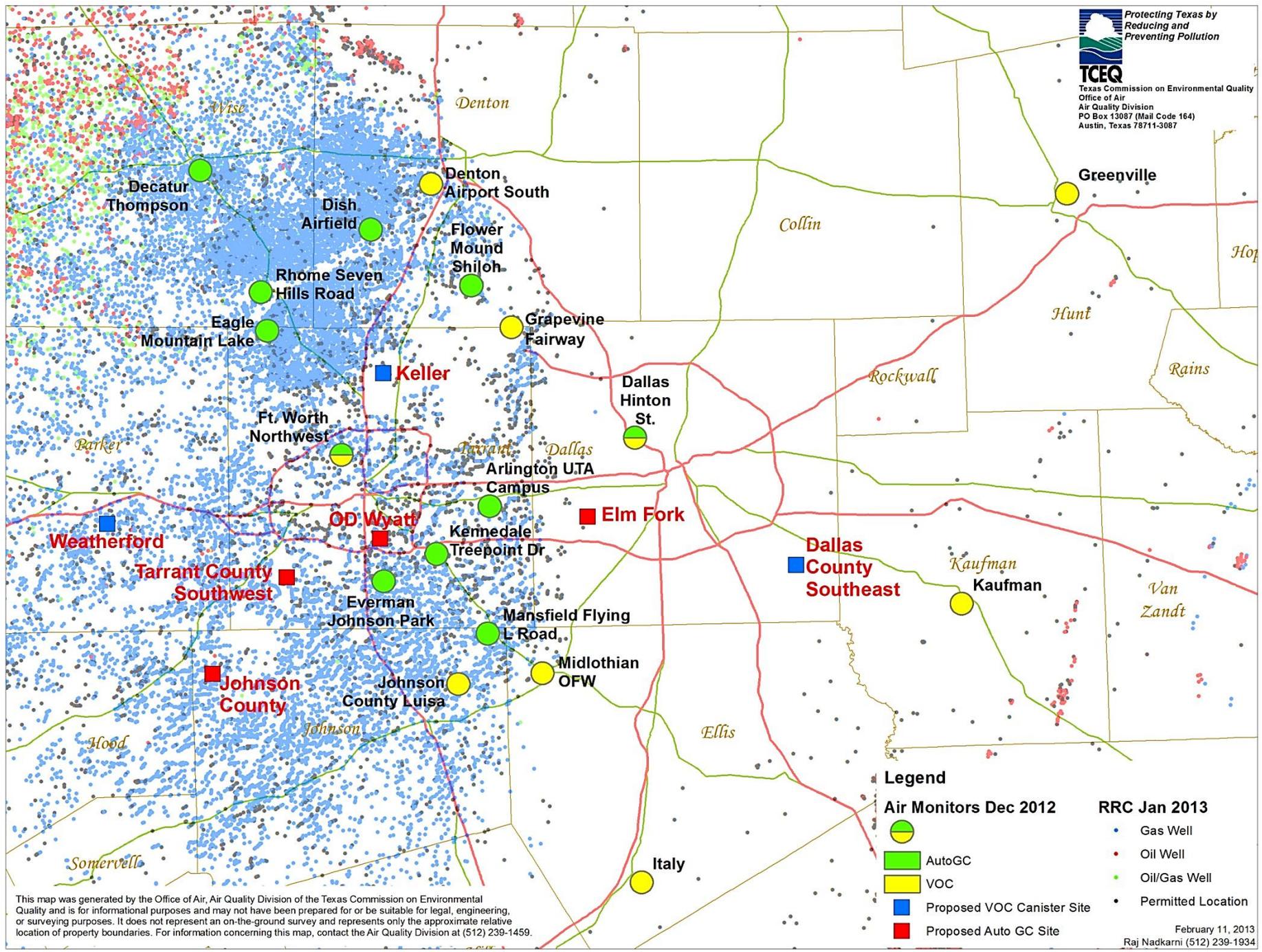




What Are We Finding?

- Short-term samples for carbonyls, NO_x, and sulfur compounds have not detected chemicals at short-term levels of concern.
- Less than 5% of VOC canister samples had a short-term, health- or odor-based AMCV exceedance.
 - VOCs detected above an odor-based AMCV*:
 - Isobutane, Isopentane, Isoprene, 2-Methylpentane, m & p-Xylene, n-Pentane, n-Propylbenzene, p-Diethylbenzene, Styrene, Cyclohexane, Methylcyclohexane
 - VOCs detected above a short-term, health-based AMCV*:
 - Benzene, Carbon Disulfide, 1,2-Dibromoethane, Isobutane, Isoprene, Methylcyclopentane, 2-Methylpentane, n-Butane, n-Heptane, n-Octane
- Citizen complaints – odor and irritation

*Samples evaluated using the most current short-term, health- and odor-based AMCVs



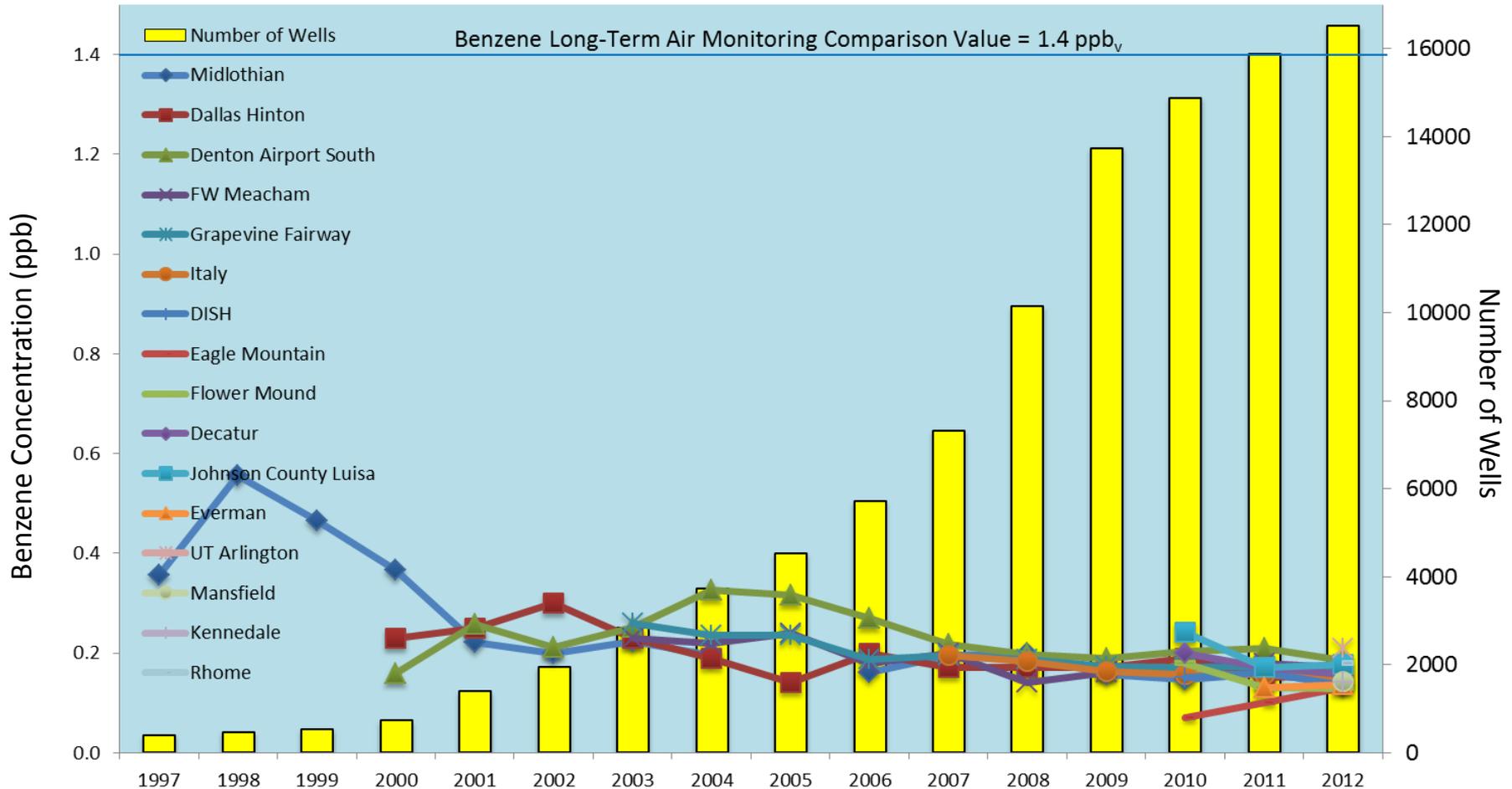
Legend

- | Air Monitors Dec 2012 | RRC Jan 2013 |
|----------------------------|--------------------|
| VOC | Gas Well |
| AutoGC | Oil Well |
| Proposed VOC Canister Site | Oil/Gas Well |
| Proposed Auto GC Site | Permitted Location |

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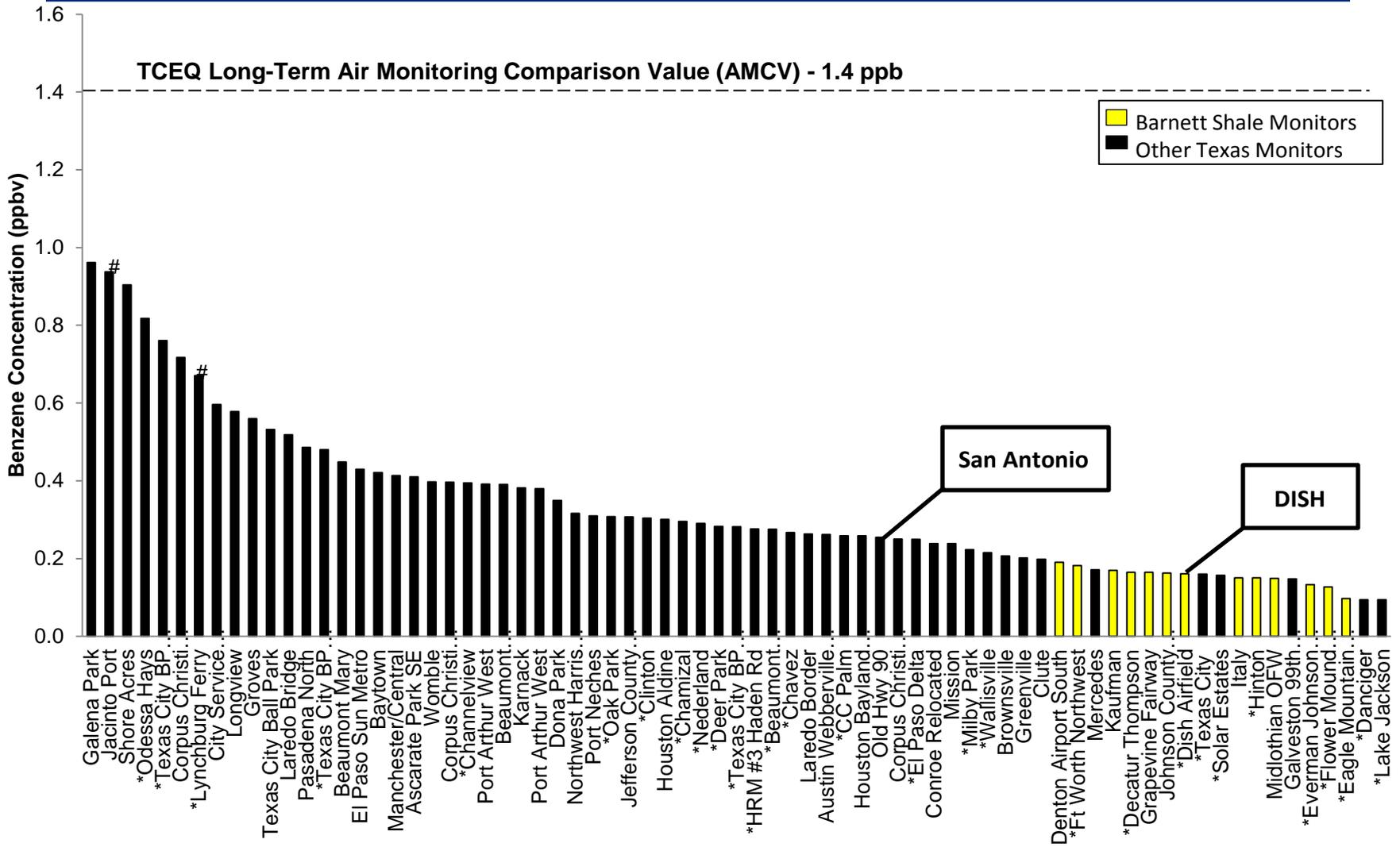
Annual Benzene Concentrations and Barnett Shale Production



NOTES: DISH and Eagle Mountain AutoGC monitors were installed in April 2010. Flower Mound and Decatur AutoGC monitors and Johnson County Luisa canister monitor were installed in November 2010. The Everman AutoGC monitor was installed in August 2011. The Kennedale AutoGC monitor was installed in June 2012. The UT Arlington, Mansfield, and Rhome AutoGC monitors were installed September, October, and November 2012, respectively. Data from monitors installed in 2012 are incomplete.



2011 Average Benzene Concentrations at Air Monitoring Sites in Texas



(Values shown are arithmetic means of hourly AutoGC measurements where available*; otherwise arithmetic means canister samples)

2012 North Texas Air Monitors



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Source Data: Railroad Commission of Texas, Jan. 2012, Wells
Texas Commission on Environmental Quality - Barred Shale Counties (Dec. 31, 2012)
TCEQ Field Operations - Air Monitoring Sites (November 2012)
January 3, 2013
Map Number: 15121 239-1852



DISH, Texas Exposure Investigation

- Conducted by the Texas Department of State Health Services
 - Sample population: 28 individuals living in or near DISH, Texas
 - Blood samples analyzed for VOCs
 - Urine samples analyzed for breakdown products of VOCs
 - Tap water samples from 27 homes analyzed for VOCs
 - **Conclusion: Community-wide exposures from gas wells or compressor stations were not occurring in the sample population based on the pattern of VOCs in the samples.**
- Full report available online:
<http://www.dshs.state.tx.us/epitox/assess.shtm>

What Are We Finding?

- Nearly all of the issues documented arose from human or mechanical failures.
- These items were quickly remedied and could have been avoided through increased diligence on the part of the operator.
- Corrective actions amounted to little more than replacing worn gaskets, closing open hatches, and repairing stuck valves.





TCEQ Activities

- Outreach and education for operators – % vs ppb
- New rules – Best Management Practices
- Compliance investigations – handheld monitoring
- Public education – open houses
- Website – transparency and information
 - <http://www.tceq.texas.gov/airquality/barnettshale>

Thank You!



Questions?