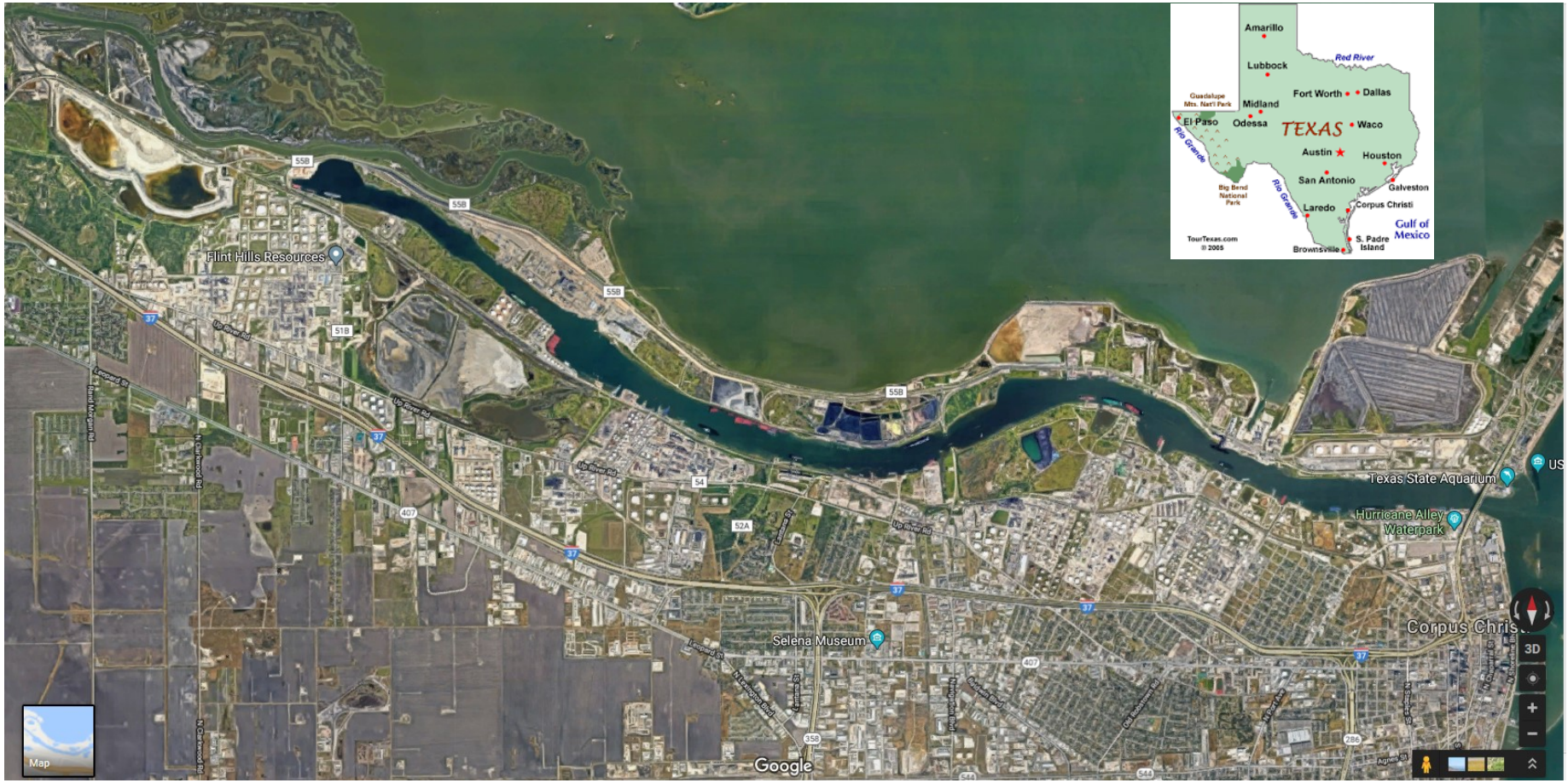
TCEQ

Analysis of the Corpus Christi Refinery Row Public Health Assessment

Sabine Lange, PhD, DABT
Toxicology Division
Texas Commission on Environmental Quality

National Air Quality Conference
Austin, Texas
January 24-26, 2018

Corpus Christi “Refinery Row”



Google Maps

Refinery Row

- Refinery Row is an area of Corpus Christi, Texas, along the Corpus Christi ship channel. This area is heavily industrialized, and several neighborhoods are located adjacent to the boundaries of these facilities.

- For decades, the TCEQ and US EPA have worked together with the companies and the citizens of Refinery Row to ensure clean air, clean water and the safe disposal of waste.

Google Maps

ATSDR Refinery Row Public Health Assessment, 2016

- In 2003, the Agency for Toxic Substances Disease Registry (ATSDR) agreed to evaluate the lingering concerns of the residents about pollutants in outdoor air.

- In August of 2016, ATSDR released a draft public health assessment of the refinery row area of Corpus Christi. Upon release, TCEQ read and provided comment on this public health assessment

- ATSDR reviewed the data for more than 150 chemicals and reached two health-based conclusions:
  - **Conclusion 1**— On rare occasions, breathing maximum measured concentrations of benzene, hydrogen sulfide (H_2S), particulate matter (PM), or sulfur dioxide (SO_2) could potentially harm peoples' health; and
  - **Conclusion 2**— Breathing the mixture of chemicals found in Refinery Row air for many years could increase cancer risk

Chemical Risk Assessment

- Hazard Assessment – What are the possible health effects caused by the chemical? Use toxicity comparison values
- Dose-Response Assessment – At what concentrations of the chemical do different effects occur? Use toxicity comparison values
- Exposure Assessment – What concentrations of chemical were people exposed to, and over what period of time? Use monitored concentrations of chemicals in air, measured where people could be exposed to them
- Risk Integration and Characterization – Based on the hazard, dose-response, and exposure assessments together, what are the risks to people from this chemical?

Chemical Example: Benzene

- Hazard Assessment – Benzene exposure in humans causes leukemia
- Dose-Response Assessment – TCEQ air monitoring comparison value of 1.4 ppb (for a 70 year exposure) is projected to increase the risk of leukemia by 1/100,000 (1×10^{-5})
- Exposure Assessment – 12 year average benzene concentration at the residential Hillcrest monitor (1998-2010) was 0.81 ppb
- Risk Integration and Characterization - There is an increased risk of leukemia of < 1/100,000 from exposure to benzene in the Hillcrest neighborhood

Important Consideration: Duration

- In general, the longer the exposure, the lower the concentration of a chemical that will cause a health effect
- The duration of exposure (that is, the duration of the measurement) must be matched to the duration for the hazard and dose-response (and the toxicity factor)
- E.g. Benzene:
  - 40 ppm-years exposure (~ 120 ppb for 24 hours per day for 76 years) increases risk of leukemia in workers
  - An exposure of 1 hour to 10 ppm benzene has no effect on the hematopoietic system

ATSDR Conclusion 1 – Acute Exposures

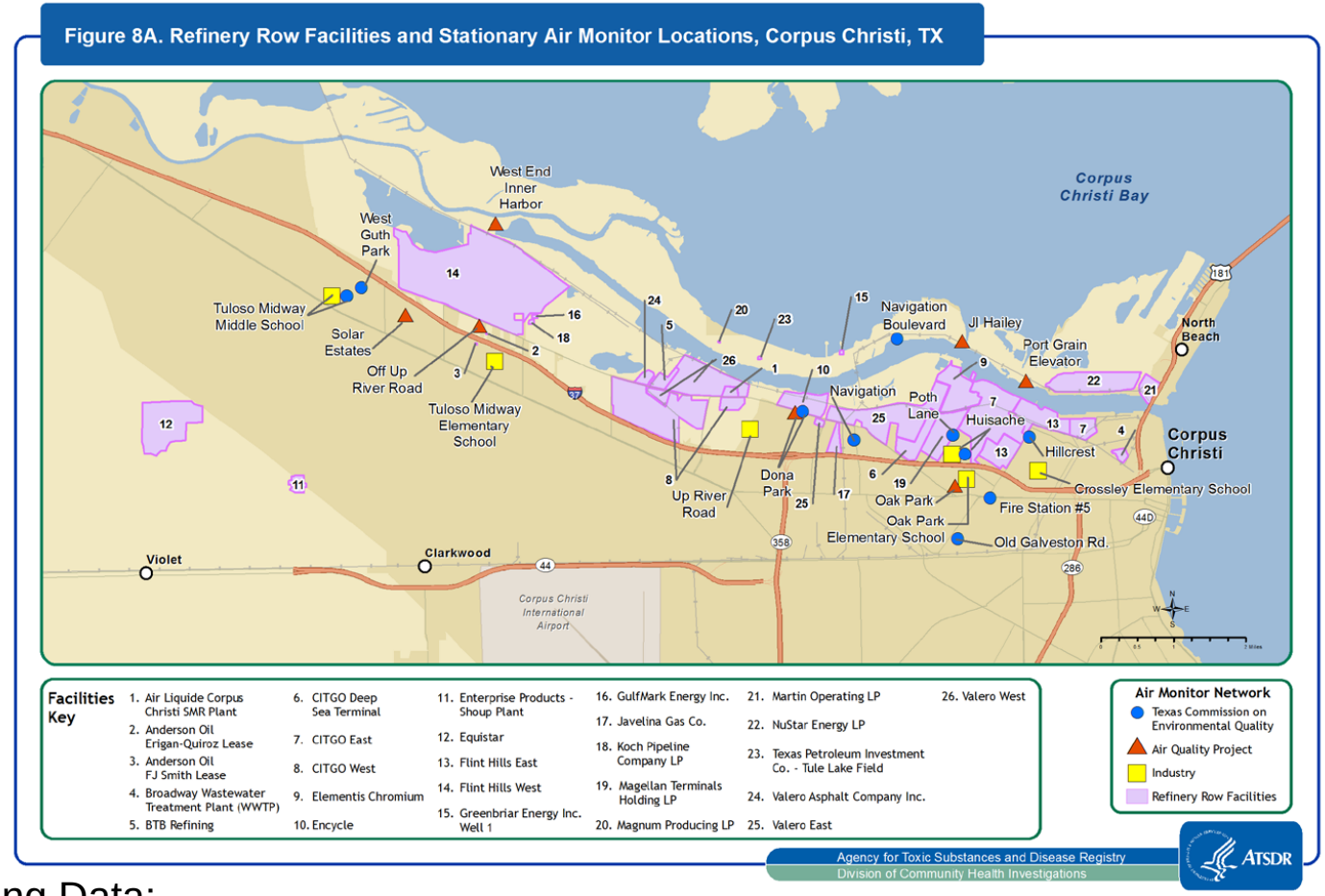
ATSDR: On rare occasions, breathing maximum measured concentrations of benzene, hydrogen sulfide (H_2S), particulate matter (PM), or sulfur dioxide (SO_2) could potentially harm peoples' health.

Short-Term Exposure Comparison Values

These comparison values represent concentrations below which no health effects would be expected to occur

Chemical	Agency	Duration	Value	Notes	Measurement Duration(s)
Benzene	ATSDR	1 – 14 days	9 ppb		1 hr, 24 hr
	TCEQ	1 hour	180 ppb		
	TCEQ	24 hour	100 ppb		
Hydrogen Sulfide	ATSDR	1 – 14 days	70 ppb		1 hr
	TCEQ	30 minute	80 ppb	State standard; downwind-upwind	
Particulate Matter 2.5 µm	US EPA	24 hour	35 $\mu g/m^3$	NAAQS; 98th percentile, averaged over 3 years	24 hr
Sulfur Dioxide	ATSDR	1 – 14 days	10 ppb		1 hr
	US EPA	1 hour	75 ppb	NAAQS; 99th percentile of daily maximum 1 hour concentrations, averaged over 3 years	

Figure 8A – Refinery Row Air Monitors



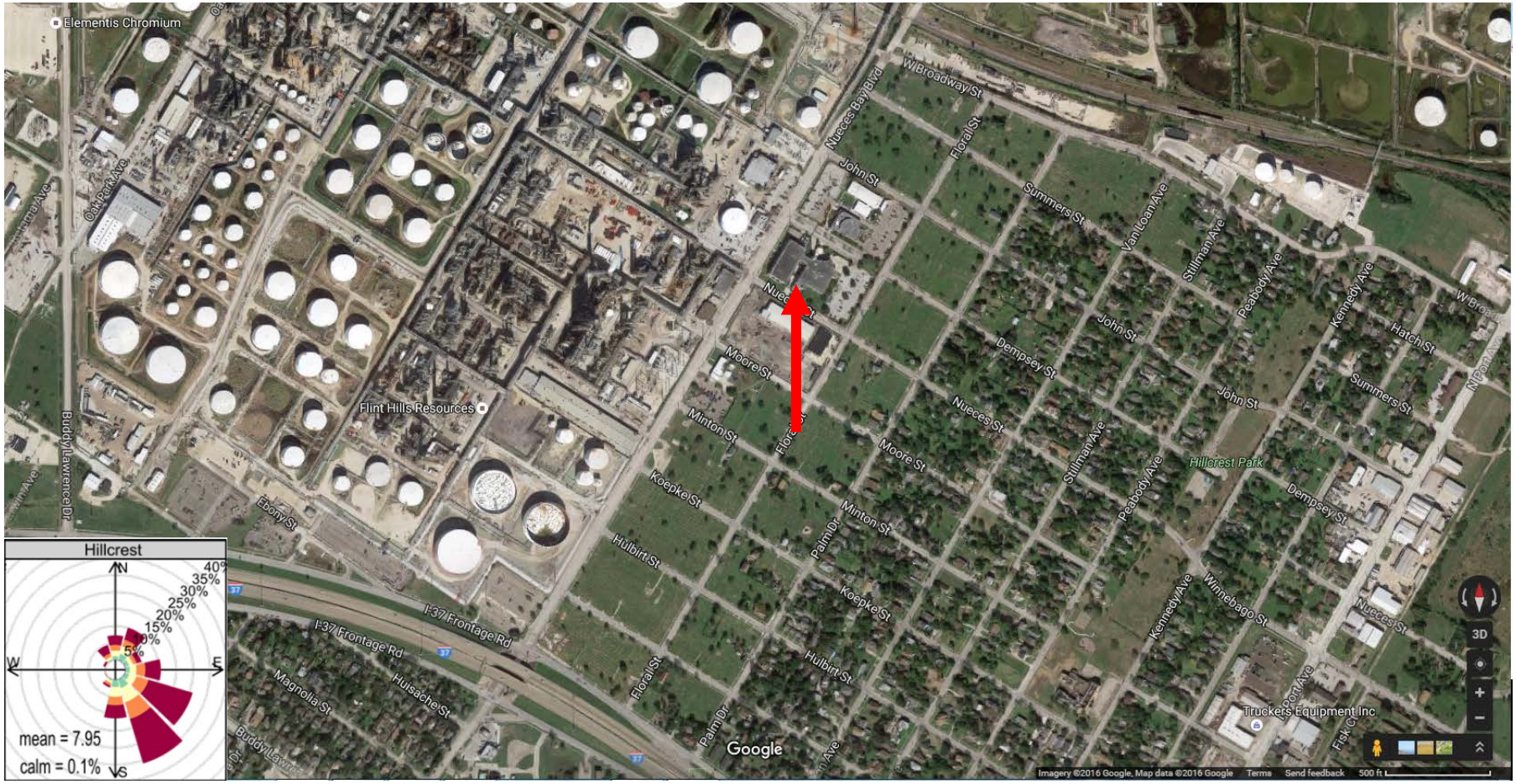
<u>Air Monitoring Data:</u>

- Corpus Christi Air Quality Project (AQP) network (2005-2010),
- Corpus Christi industry network (1996-2010),
- TCEQ network (1980-2010),
- Mobile monitoring data

Huisache Monitor – Industrial Access Only

Google Maps

Hillcrest Monitor – Residential

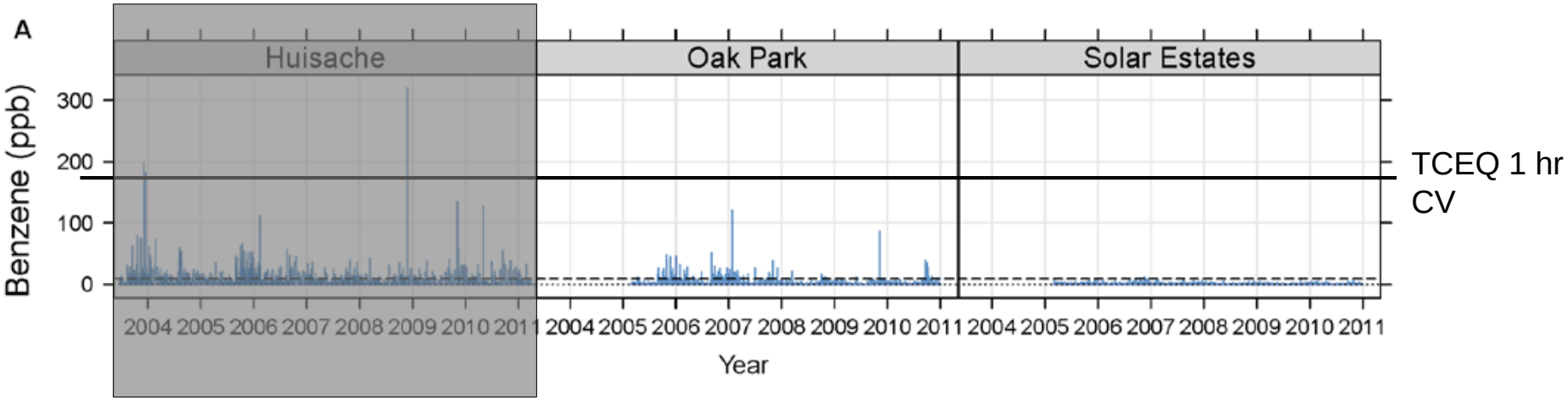


Google Maps

Dona Park Monitor - Residential

Google Maps

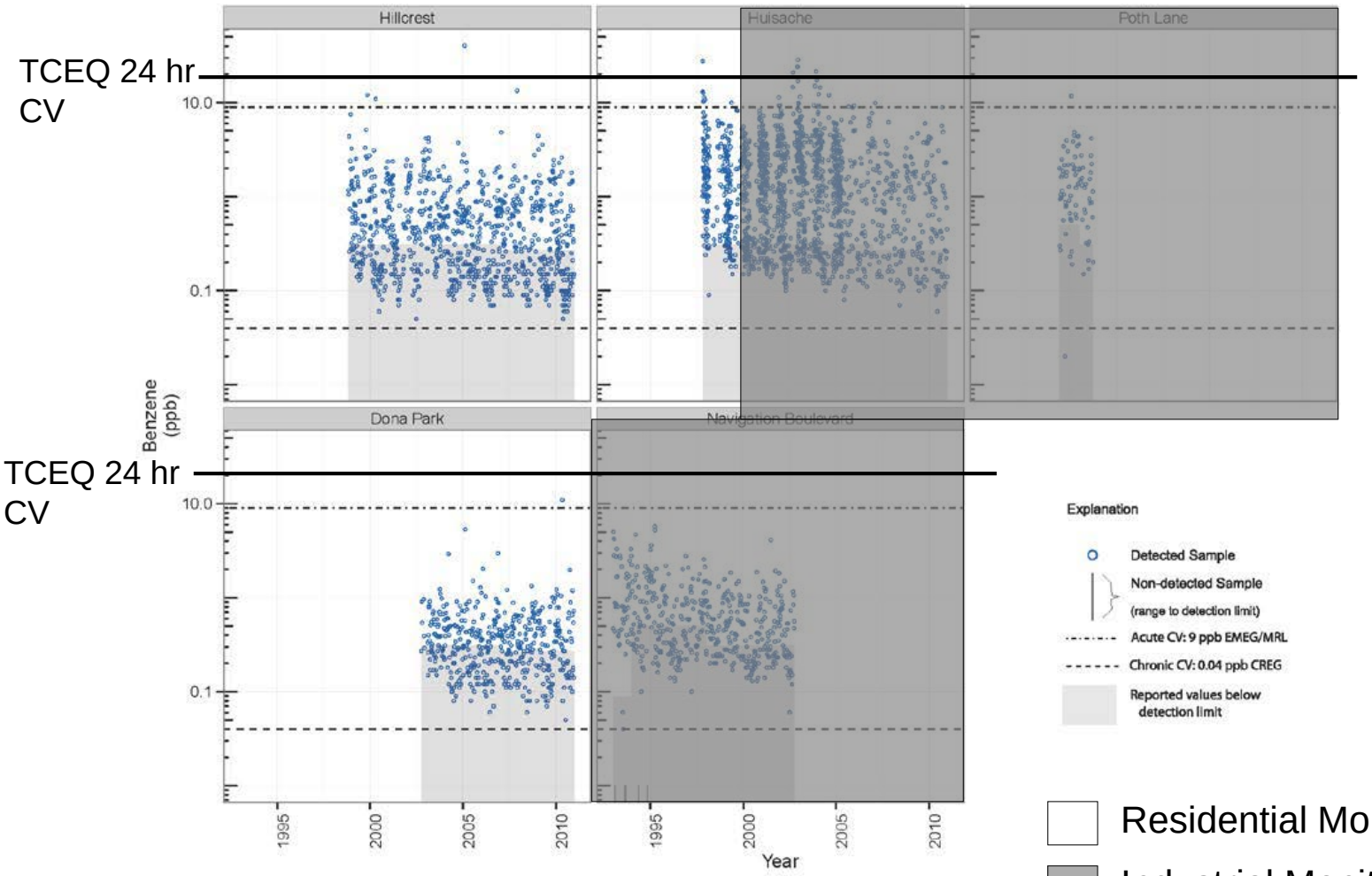
Benzene – One-Hour Concentrations



Residential Monitor

Industrial Monitor

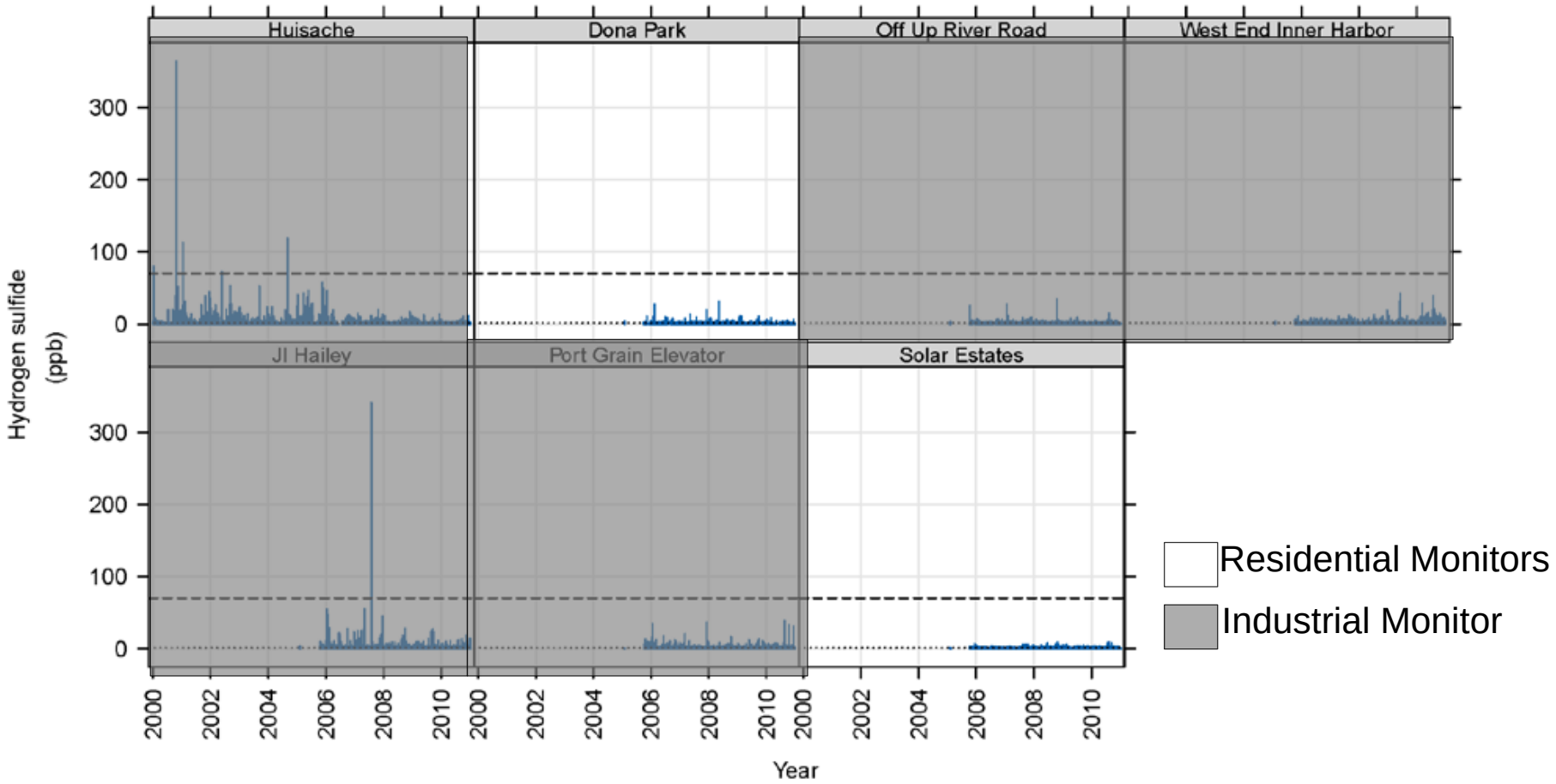
Benzene – 24-Hour Concentrations



Residential Monitor

Industrial Monitor

Hydrogen Sulfide – One-Hour Concentrations



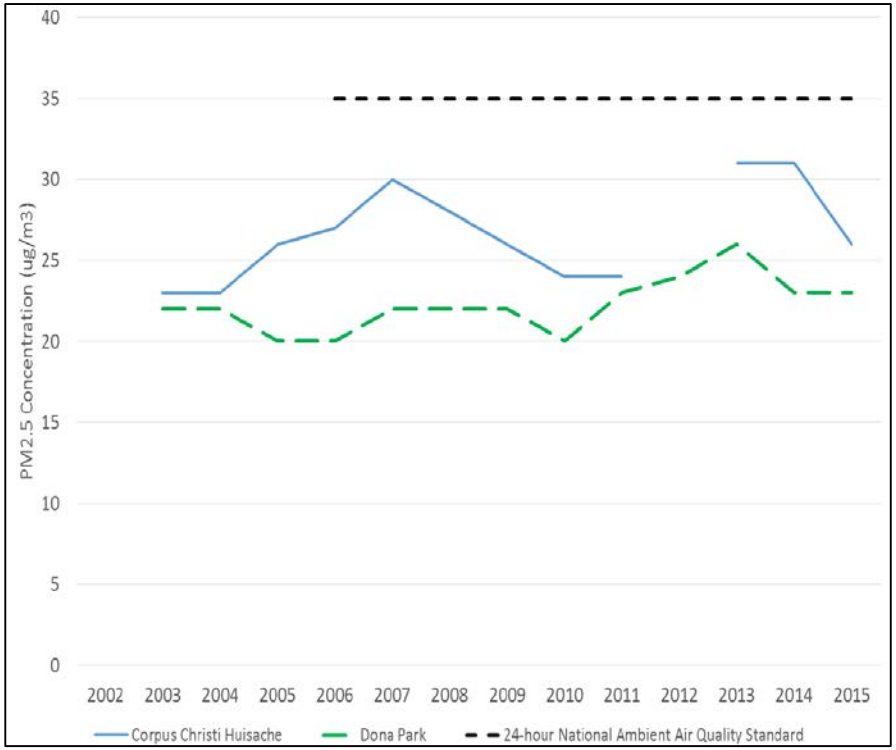
Explanation:

----- Acute CV: 70 ppb Acute EMEG/MRL

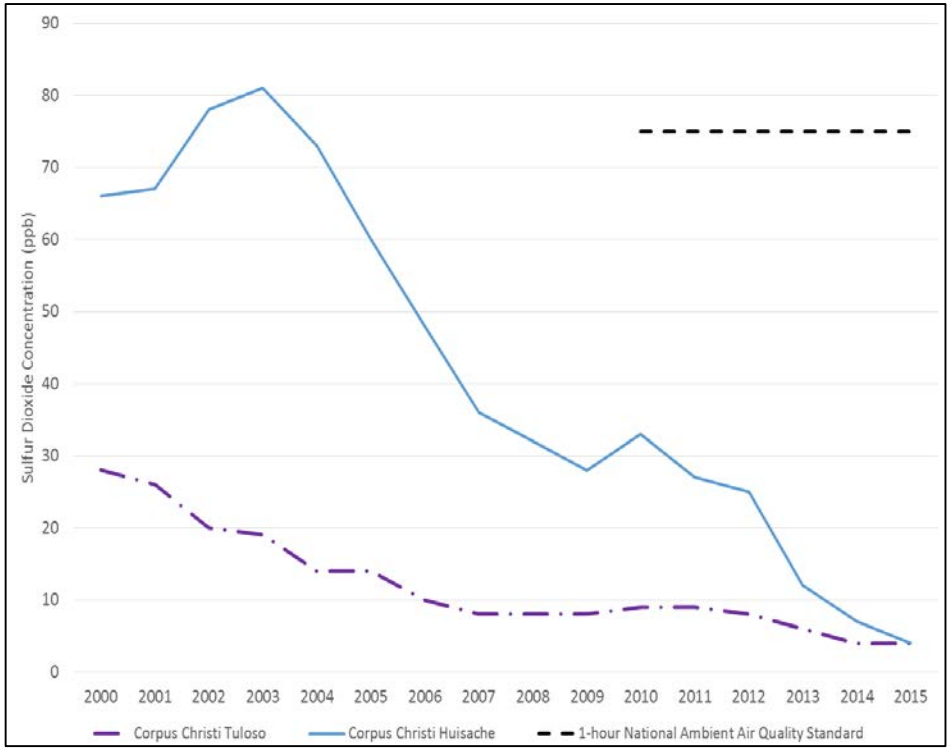
..... Chronic CV: 1.4 ppb RfC – I

NAAQS for $PM_{2.5}$ (24-hour) and SO_2 (1-hour)

$PM_{2.5}$



SO_2



Source of Data: EPA Air Quality Service

ATSDR Conclusion 1 – Acute Exposures

ATSDR: On rare occasions, breathing maximum measured concentrations of benzene, hydrogen sulfide (H_2S), particulate matter (PM), or sulfur dioxide (SO_2) could potentially harm peoples' health.

TCEQ: There is little evidence that exposure of the public to benzene, hydrogen sulfide (H_2S), particulate matter (PM), or sulfur dioxide (SO_2) could potentially harm peoples' health.

ATSDR Conclusion 2 – Chronic Exposures

ATSDR: Breathing the mixture of chemicals found in Refinery Row air for many years could increase cancer risk.

Predicted additive cancer risk from 19 chemicals was 2/10,000 (2×10^{-4})

80% of the cancer risk was attributed to benzene, 1,2-dibromoethane, chromium, cadmium, and napthalene

Long-Term Exposure Comparison Values

These comparison values represent concentrations below which the increased cancer risk for a **lifetime** exposure is less than 1/100,000

Chemical	Agency	Value
Benzene	US EPA (2003)	0.4 ppb
	TCEQ (2007)	1.4 ppb
1,2-dibromoethane	US EPA (2004)	0.0022 ppb
	TCEQ (2017)	0.029 ppb
Chromium VI	US EPA (1998)	0.00083 $\mu g/m^3$
	TCEQ (2014)	0.0043 $\mu g/m^3$
Cadmium	US EPA (1987)	0.0056 $\mu g/m^3$
	TCEQ (2016)	0.011 $\mu g/m^3$
Naphthalene	Cal EPA (2004)	0.14 ppb

ATSDR Cancer Risk Calculations

Chemical	Highest Mean Concentration ($\mu g/m^3$)	Cancer Risk Estimate	Notes
Benzene	7.06	5.5×10^{-5}	Highest annual, not mean annual measured at industrial Huisache monitor; uses older US EPA comparison value
1,2-dibromoethane	0.077 (95th percentile)	4.6×10^{-5}	Highest annual, not mean annual; <10% of measured values were above method reporting limit so 95th percentile was used instead of the mean; uses older US EPA comparison value
Chromium	0.0017	2.0×10^{-5}	Highest annual, not mean annual; assumes that 100% of measured Cr is toxic Cr VI (actually probably ~1%); uses older US EPA comparison value
Cadmium	0.0059 (95th percentile)	1.1×10^{-5}	Highest annual, not mean annual; <10% of measured values were above method reporting limit so 95th percentile was used instead of the mean; uses older US EPA comparison value
Napthalene	0.304	1.0×10^{-5}	Highest annual, not mean annual; data source unclear
Sum of Risk		1.4×10^{-4}	

Alternative Cancer Risk Calculations

Chemical	Multiyear Mean Concentration (µg/m³)	Cancer Risk Estimate	Notes
Benzene	2.61	5.7×10^{-6}	12 year mean at residential monitor; uses TCEQ newer comparison value
1,2-dibromoethane	-	-	No estimate made, because < 10% of samples were above the method reporting limit
Chromium	0.00015	3.4×10^{-7}	9 year mean concentration; assumes that 10% of measured Cr is toxic Cr VI; uses newer TCEQ comparison value
Cadmium	-	-	No estimate made, because < 10% of samples were above the method reporting limit
Napthalene	0.304	1.0×10^{-5}	Highest annual, not mean annual; data source unclear
Sum of Risk		1.6×10^{-5}	

ATSDR Conclusion 2 – Chronic Exposures

ATSDR: **Breathing the mixture of chemicals found in Refinery Row air for many years could increase cancer risk.**

TCEQ: The increased cancer risk from breathing the air in Refinery Row would be less than 1 in 10,000

Conclusions

- It is important to follow standard regulatory risk assessment practice when completing any public health assessment, particularly:
  - Using concentrations measured in areas accessible to the public, not industrial areas
  - Considering sampling and exposure duration when calculating risk
  - Using data from the entire sampling period when estimating lifetime cancer risk
  - Refrain from calculating excess risk if there are not enough long-term data to do so correctly
  - Properly communicating assumptions and uncertainties to the public

- A public health assessment that uses inappropriate risk assessment methods and improperly communicates uncertainties in the analysis can cause undue alarm in the population, and can damage hard-won relationships between the public and regulatory agencies