TCEQ's Mobile Monitoring Capabilities

Office of Compliance and Enforcement

Texas Commission on Environmental Quality

June 27, 2024

Mobile Monitoring Vehicles

- Measures chemical concentrations while in transit
- Provide information for investigations and emergency events
- Greater geographic coverage with potentially additional speciation

Handheld Monitoring Equipment

Optical Gas Imaging Camera

Summa canister

MultiRAE

Toxic Vapor Analyzer

UltraRAE

TCEQ's Mobile Monitoring Instrumentation

Duvas DV3000 Ultraviolet Spectrometer

- Semi-quantitative analysis of 14 compounds including benzene, toluene, ethylbenzene, xylenes (BTEX)
- Dedicated tablet creates real-time maps for data visualization

TCEQ's Mobile Monitoring Instrumentation

Selected Ion Flow Tube – Mass Spectrometer (SIFT-MS)

- Current calibrated methods:
  - BTEX, styrene, 1,3-butadiene, and H_2S
- Can add uncalibrated analytes for qualitative analysis
- Library of over 1,000 analytes

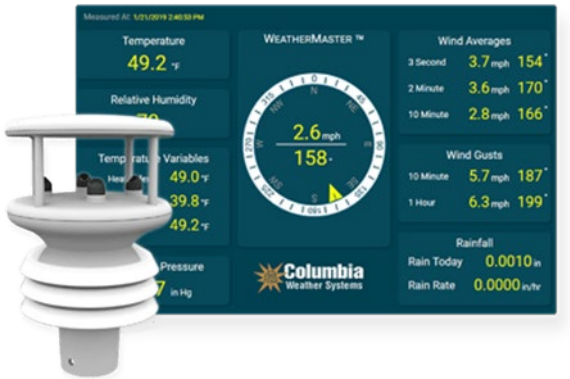
TCEQ's Mobile Monitoring Instrumentation

Ambilabs Dual Wavelength Nephelometer

- Particulate matter with diameter of 10 and 2.5 micrometers or less (PM_{10} and $PM_{2.5}$)
- Used only in certain emergency response events

Magellan MX500 Weather Station

- GPS coordinates, wind speed, and wind direction
  - Can account for vehicle speed and direction up to 20 mph



TCEQ's Mobile Monitoring Instrumentation

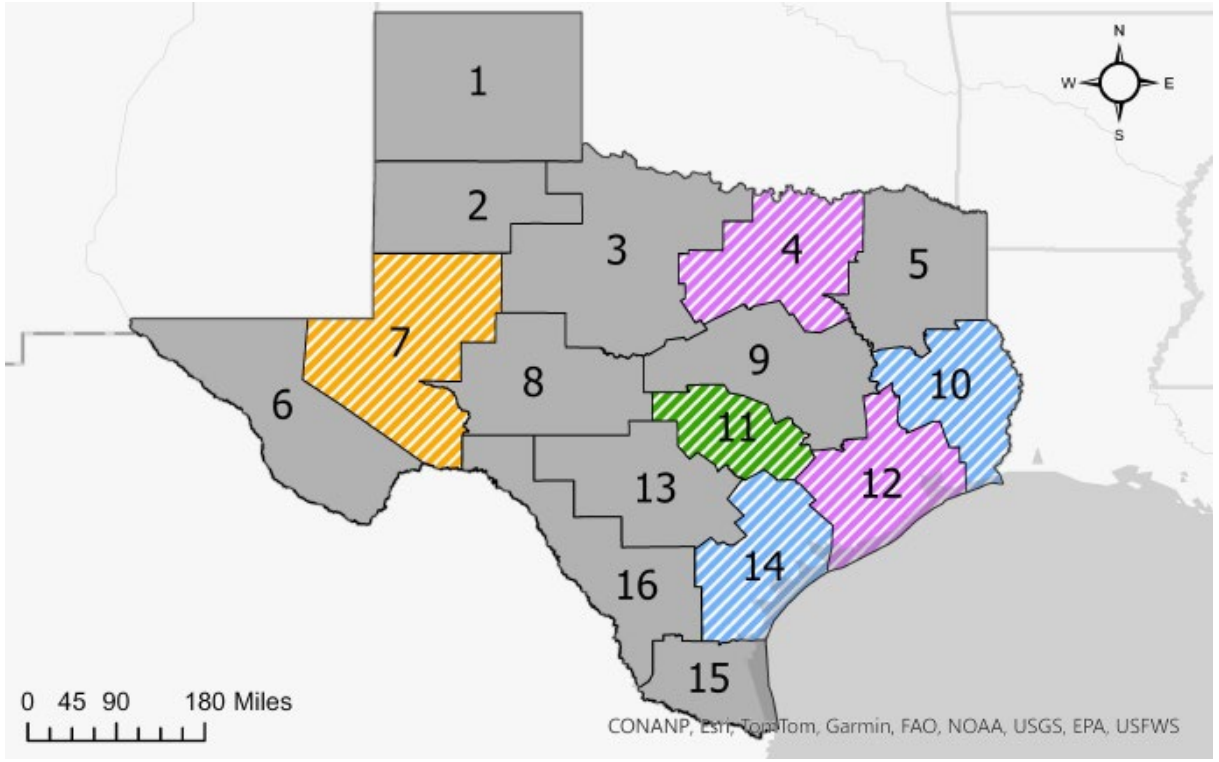
Picarro G2204

- Real time monitoring:
  - Hydrogen sulfide (H_2S)
  - Methane (CH_4)

- Location:
  - Midland Region – Permian Basin
  - Austin – can be dispatched statewide

Regional Survey Vehicles

- The RSVs have some of the same instrumentation as MMT
  - Allows Regions to have increased capabilities for investigations and emergency events
- Over 160 surveys
  - 60% area surveillance
  - 24% emergency response
  - 16% investigative



MMT Headquarters

Duvas and Nephelometer Mobile Monitoring

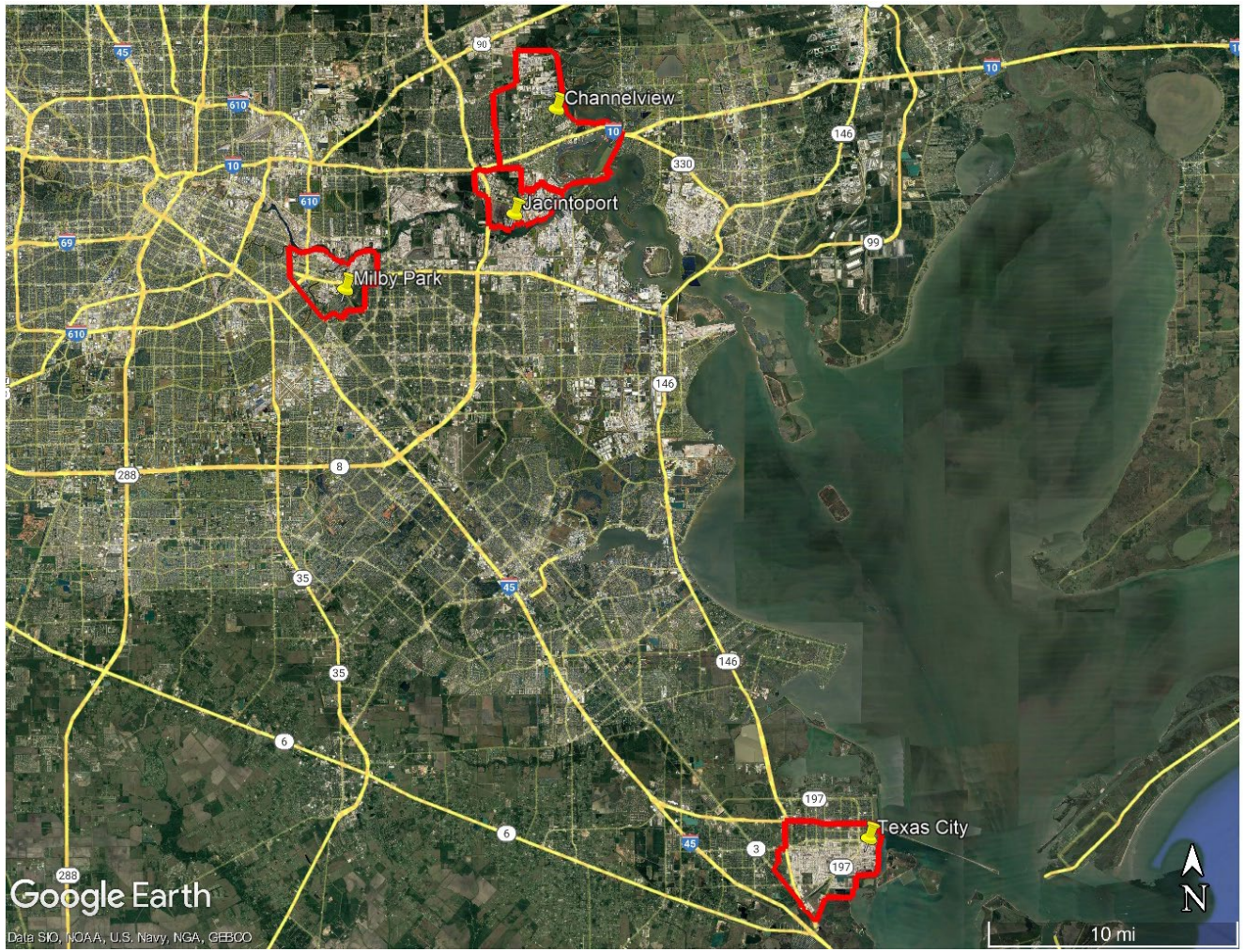
Duvas and Picarro H_2S Mobile Monitoring

Duvas Mobile Monitoring

Example Survey Areas Near Houston

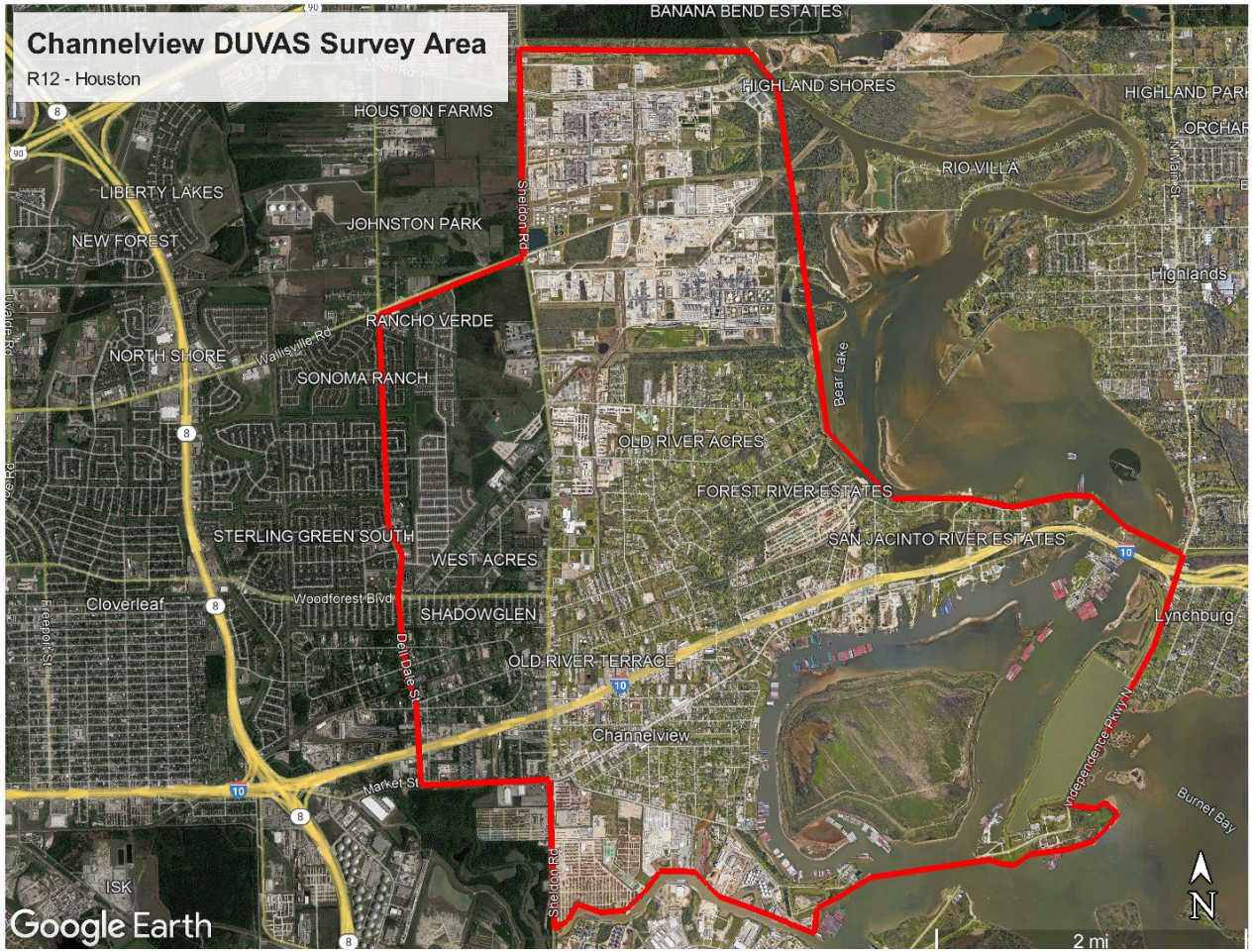
- Survey area includes industrial and residential areas

- Focus areas:
  - Channelview
  - Jacintoport
  - Milby Park
  - Texas City



Example Survey Area Near Houston

- Data Use:
  - Assist with potential source identification so TCEQ can conduct further investigation
  - Assist with emergency response activities
- Other Equipment
  - Handheld monitors
  - Optical gas imaging camera



Comparison Values and Action Levels for Use in Mobile Air Monitoring

Toxicology, Risk Assessment, and Research Division

Texas Commission on Environmental Quality

June 27, 2024

Outline

- Ambient air monitoring tools
- Mobile monitoring and need for comparison values
- Mobile monitoring comparison values
  - Levels to identify chemical releases
  - Levels to determine toxicity
  - Fact sheets and decision guides
- Examples of application of mobile monitoring comparison values
- Summary

Toxicology MMCV Webpage: https://www.tceq.texas.gov/toxicology/mmcvs

Ambient Air Monitoring

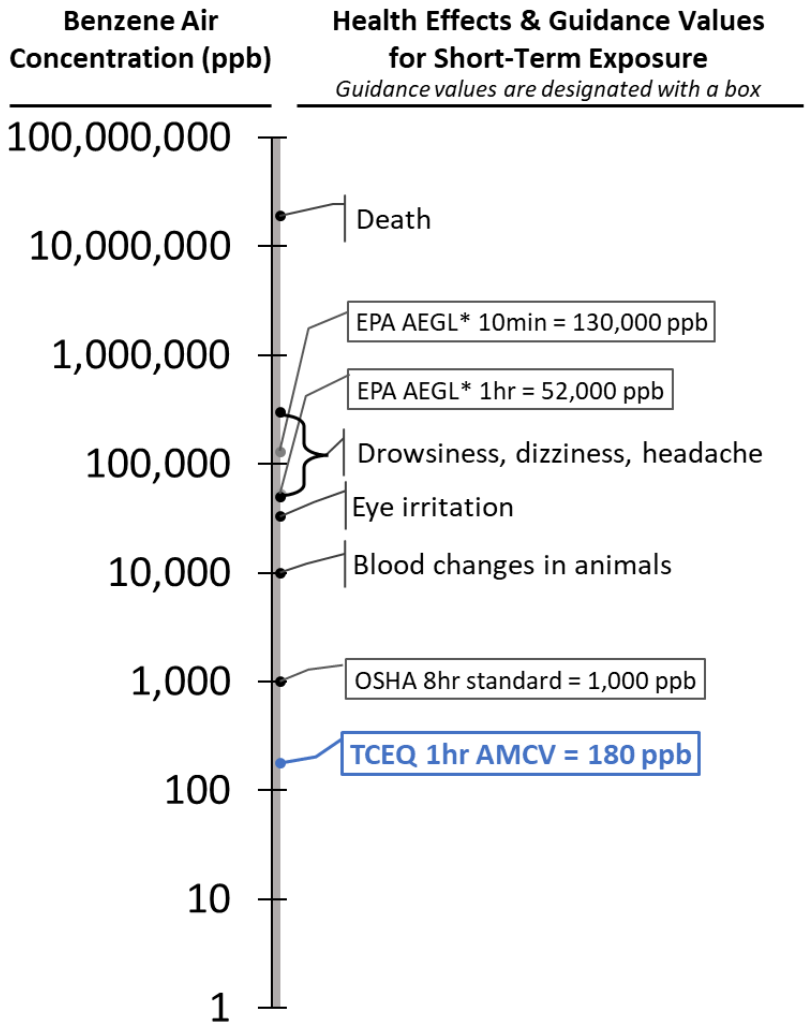
- Many purposes for ambient air monitoring of pollutants, including:
  - Compliance with air quality standards
  - Information for air quality modeling
  - Evaluation of potential health or welfare effects
  - Verifying effectiveness of air permitting program
  - Evaluating impacts of chemical releases for investigations or emergencies
  - etc…
- To address these purposes, a number of air monitoring devices are used with different monitoring platforms (stationary, handheld, mobile, airborne)
- For many of these purposes, comparison values are required for evaluating the air monitoring data

Ambient Air Monitoring Comparison Values

- **Toxicity factors:** a numerical value that describes the potency of a chemical to cause adverse effects, used to establish safe levels of contaminants in air, soil, and water.
- Concentrations of air toxics measured by ambient air monitors are compared to toxicity factors (air monitoring comparison values, **AMCVs**) to determine whether the chemical levels in air are protective of human health and welfare effects (e.g., nuisance odor, vegetation effects).
- TCEQ typically derives both acute (1-hr and 24-hr) and chronic (annual to lifetime) AMCVs for comparison to ambient air monitoring data.

TCEQ Health-Protective Comparison Values

- All comparison values derived and used by TCEQ are **safe levels**
- A health effect would not necessarily be expected if a safe level is exceeded because they are set well below levels that have been shown to cause harmful health effects
- Example: Benzene
  - TCEQ 1 hr AMCV = 180 ppb
  - Eye irritation has been observed in humans at 33,000 ppb
  - EPA 1 hr AEGL 1 = 52,000 ppb
    - *Acute Exposure Guideline Levels – AEGLs represent the level at which health effects occur*
      - *Level 1 AEGLs are the least severe, they represent effects such as notable discomfort, irritation, or certain asymptomatic non-sensory effects – these effects are not disabling and are transient and reversible once exposure ends.*
    - AEGL 1 levels for benzene are based on mild nervous system effects in humans (drowsiness, dizziness, headache)



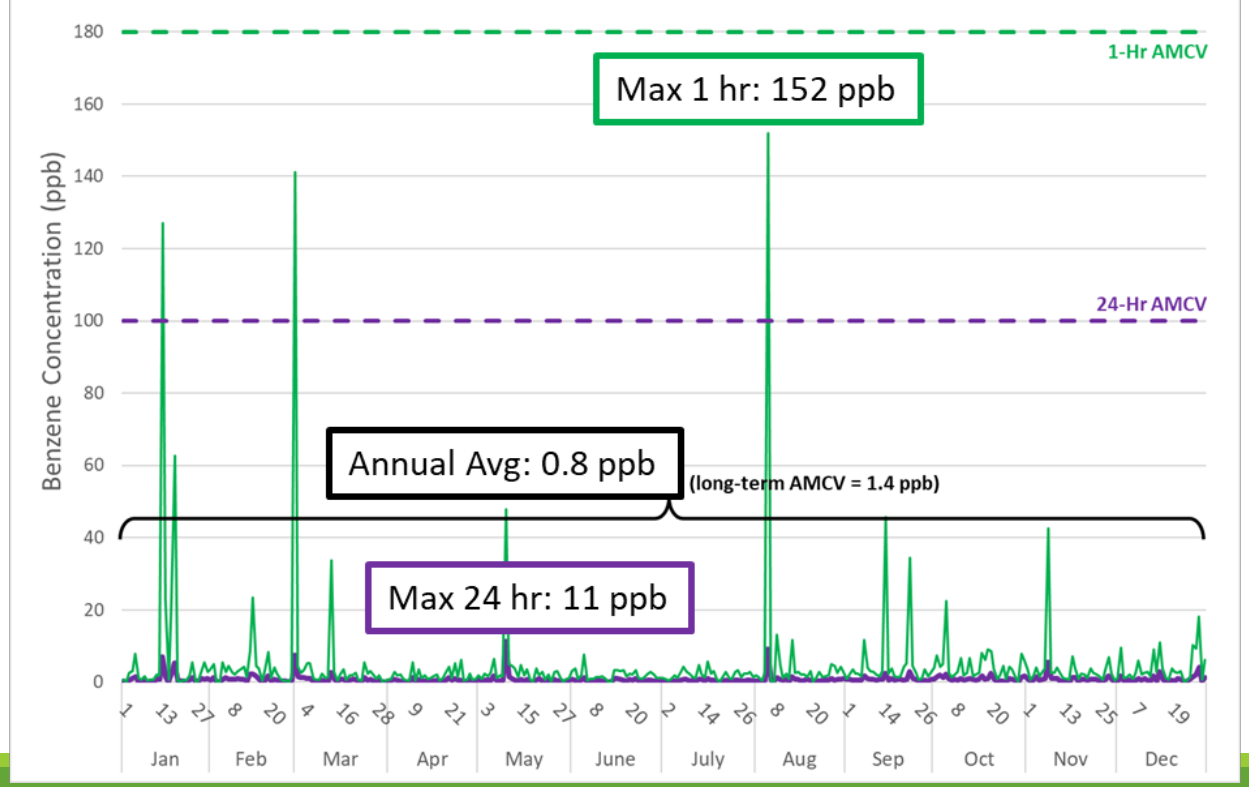
Mobile Monitoring

- Uses instruments that can accurately measure chemical concentrations in ambient air on an instantaneous basis (e.g., 1-30 second concentrations), **while in a moving vehicle**
- TCEQ uses multiple mobile monitoring instruments:
  - Selected Ion Flow Tube-Mass Spectrometer (SIFT) – quantitative and capable of evaluating many chemicals (equipped in 2 monitoring vans)
  - Differential Ultra-Violet Absorption Spectrometer (DUVAS) – semi-quantitative and capable of evaluating several dozen chemicals (equipped in 6 monitoring vans, 5 based out of regional offices)
  - Nephelometer – measures particulate matter
  - Picarro – chemical-specific instruments (e.g., hydrogen sulfide, ethylene oxide)

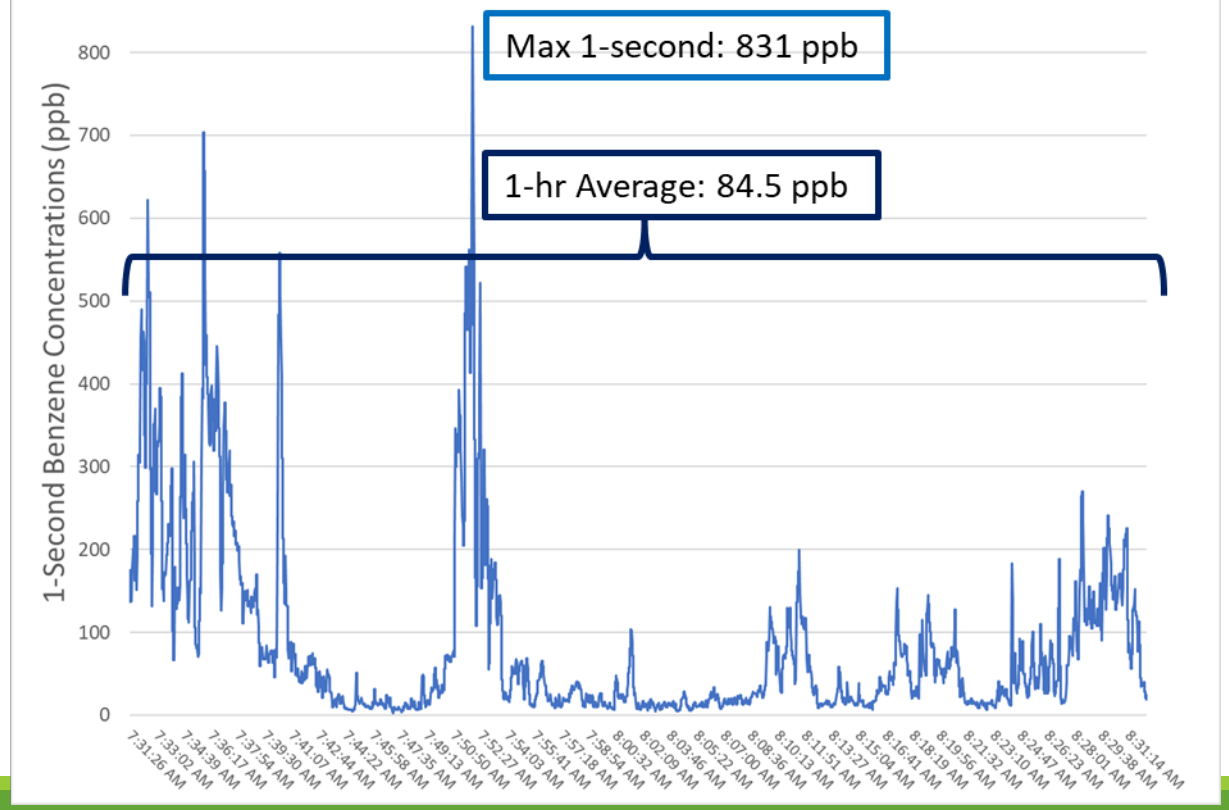
The Challenge of Averaging Times: 1 Year vs. 1 Hour; 1 Hour vs 1 Sec

- Health effects from chemical exposure depend on how much time a person is in contact with the chemical
- Generally, the shorter the exposure time, the lesser the effects, and therefore the higher a concentration that can be tolerated
- The amount of time that a chemical is measured impacts the concentration

1 Year of Hourly Concentration Data from Stationary Monitor

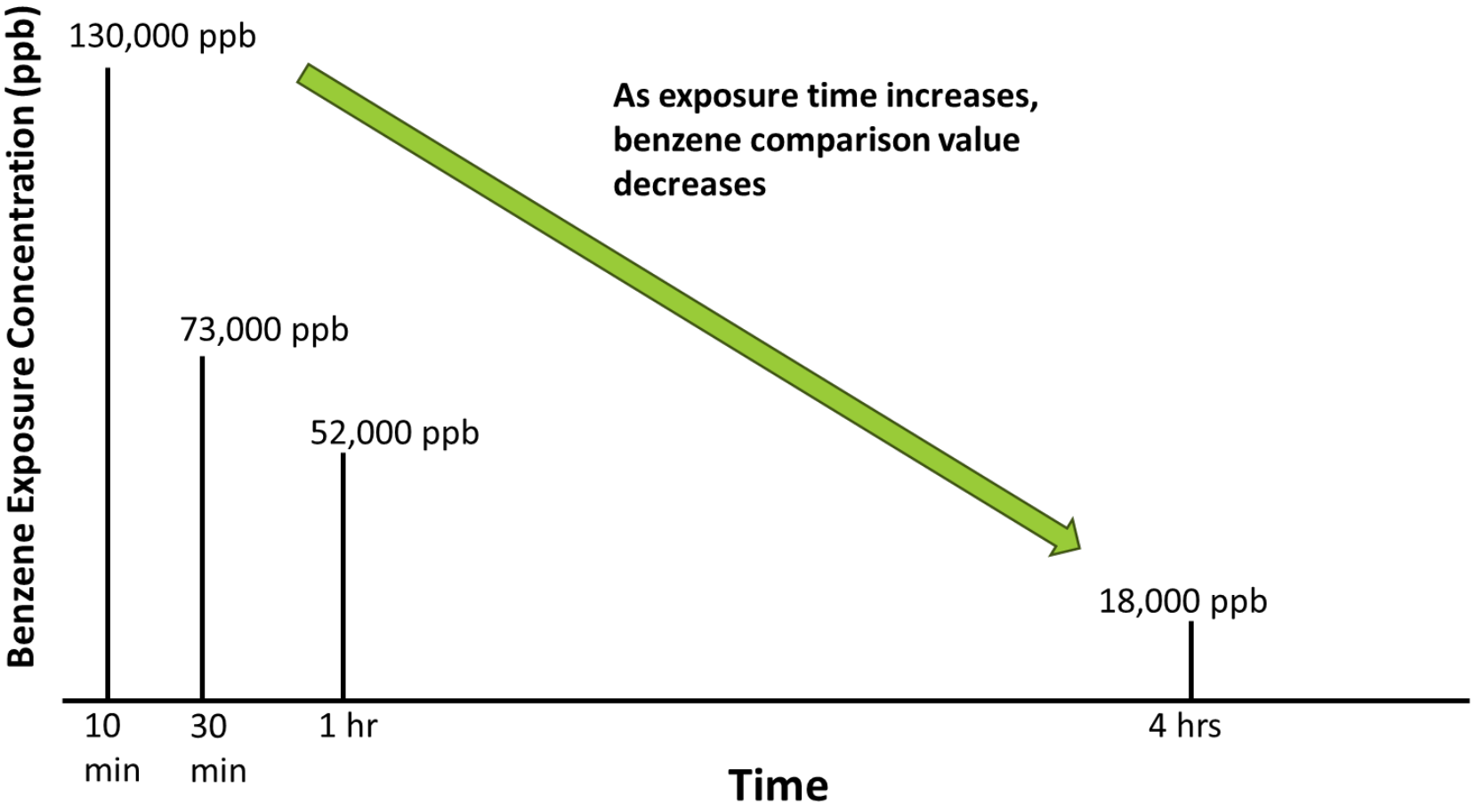


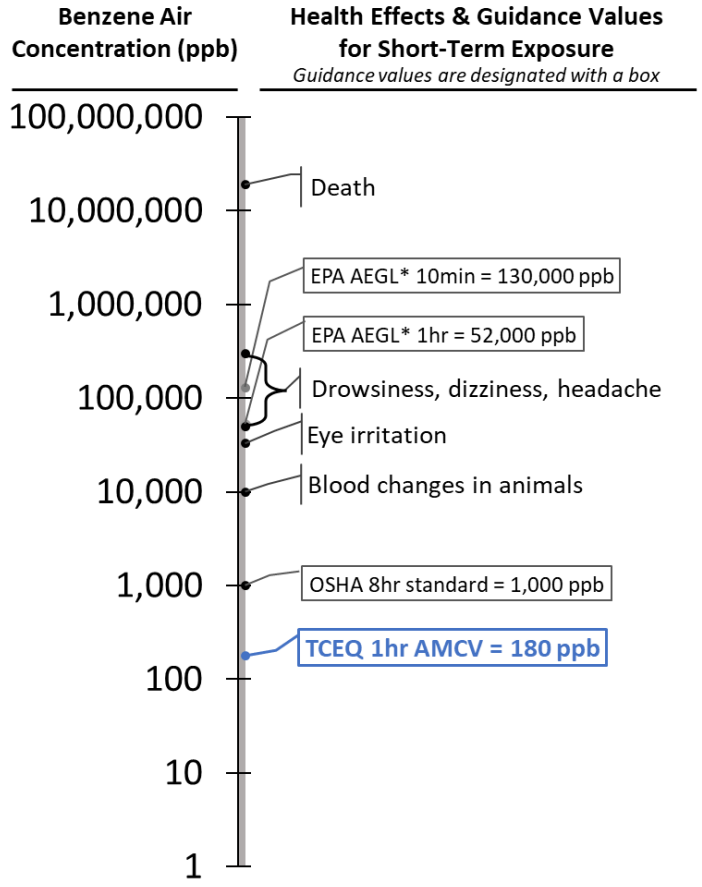
1 Hour of 6-sec Concentration Data from Mobile Monitor



Averaging Time Matters: Exposure Time vs Level of Comparison Value

- Example: EPA AEGL 1's for Benzene





Uses for Mobile Monitoring Data

- The mobile instruments generate continuous concentration data from in-motion or stationary (i.e., parked) monitoring
- Data uses while measurements are being collected:
  - Identify & investigate chemical sources; assess toxicity of measured levels; communicate information
- Data uses after measurements have been collected:
  - Assess toxicity of measured levels; communicate information; further compliance and enforcement activities
- All activities require comparison values:
  - To determine when levels indicate the need to look for a source
  - To determine whether chemical levels pose a health risk to the general public or staff
  - To provide context when communicating measured levels
  - To interpret in the context of violations and enforcement

<u>The Challenge</u>:

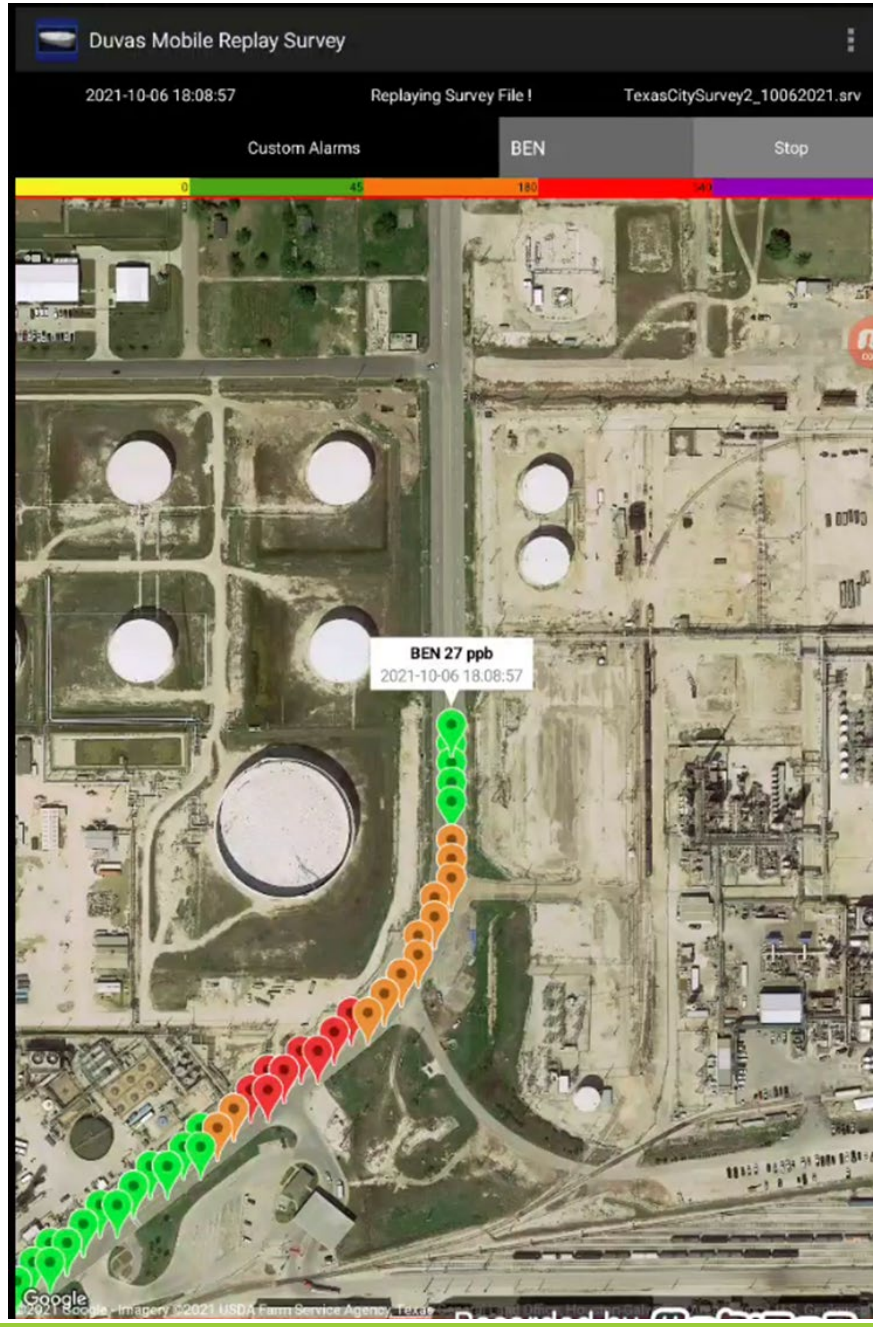
- Historically, comparison values for 1-30 second data have not been derived

Purpose of Mobile Monitoring Comparison Values

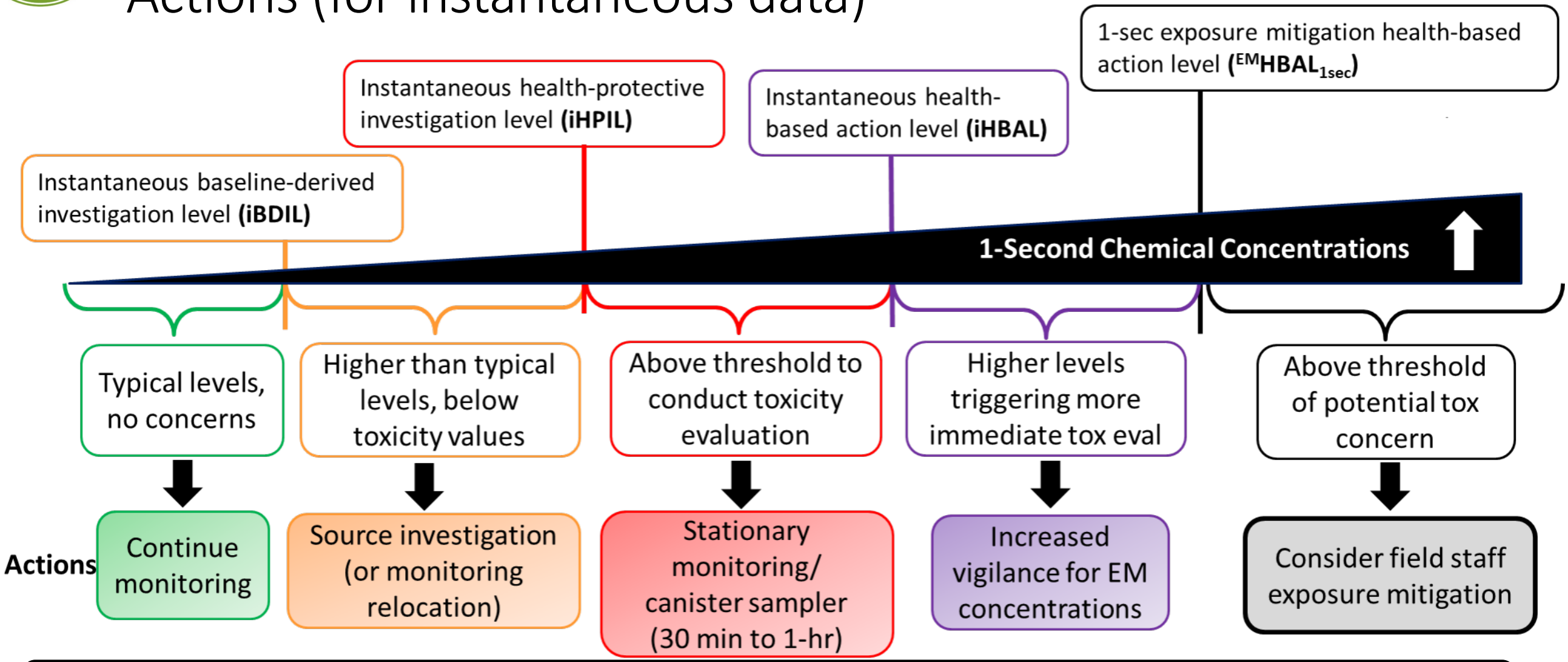
- Comparison values can be used in decision-making in the field during emergency response and investigations; and after the data have been collected
- Two primary goals for evaluating chemical concentrations from mobile monitoring data:
  - To identify chemical releases and respond with the goal of stopping the release
    - Not necessarily tied to chemical toxicity
  - To determine if the chemical levels could cause adverse effects and respond by mitigating exposure
    - Exposure mitigation can include working to stop the release, leaving the area, etc.
- Additionally, comparison values are useful for providing context for the measured concentrations when communicating the mobile monitoring results

Actions Associated with MMCVs

- Potential actions based on comparison value exceedances:
  - Source investigation
  - Monitoring relocation
  - Stationary monitoring to obtain longer averaging times of concentrations for toxicity evaluation
  - Exposure mitigation of field staff
- Identified levels associated with color coding of data for communication of results (green, orange, red, purple)

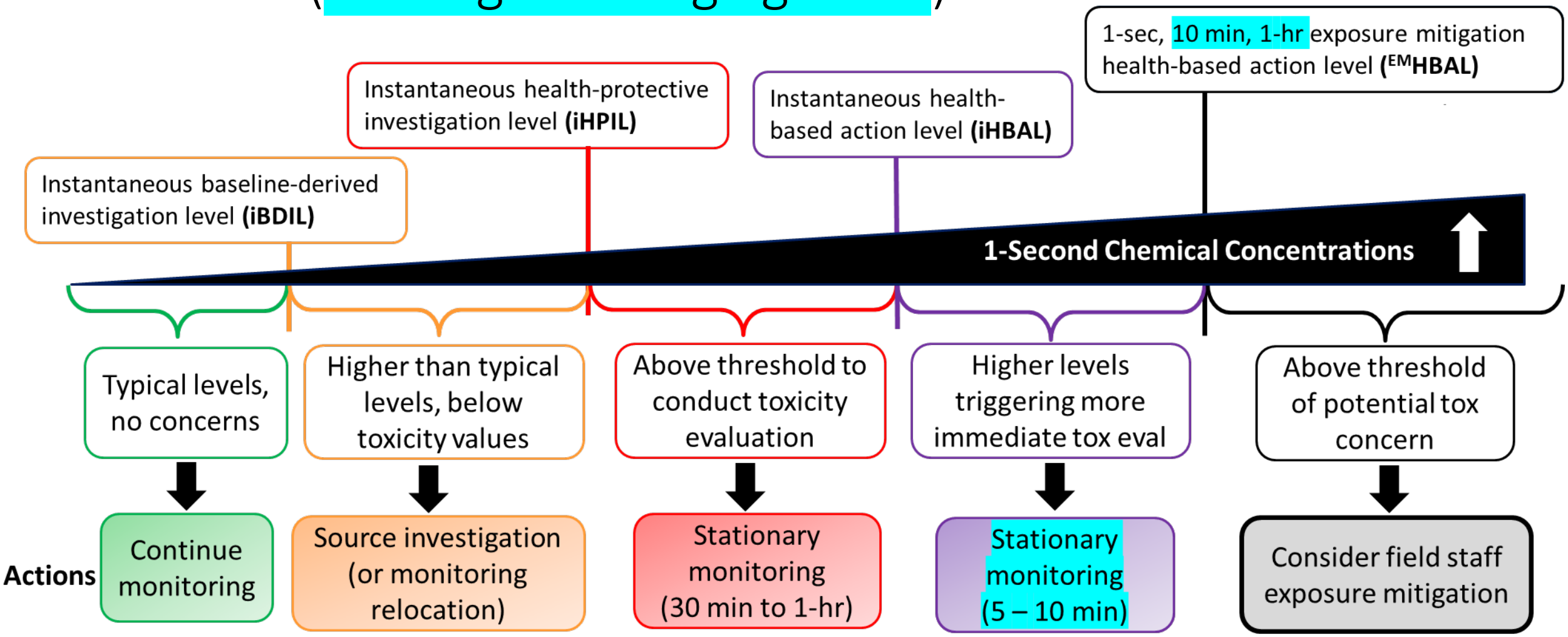


Mobile Monitoring Comparison Values & Associated Actions (for instantaneous data)



All comparison values are set at levels well below those that would cause health effects

Mobile Monitoring Comparison Values & Associated Actions (for longer averaging times)



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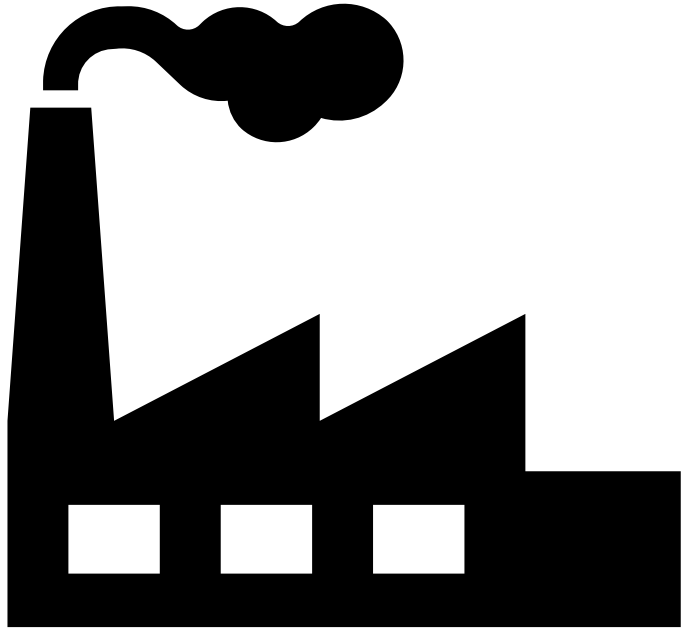
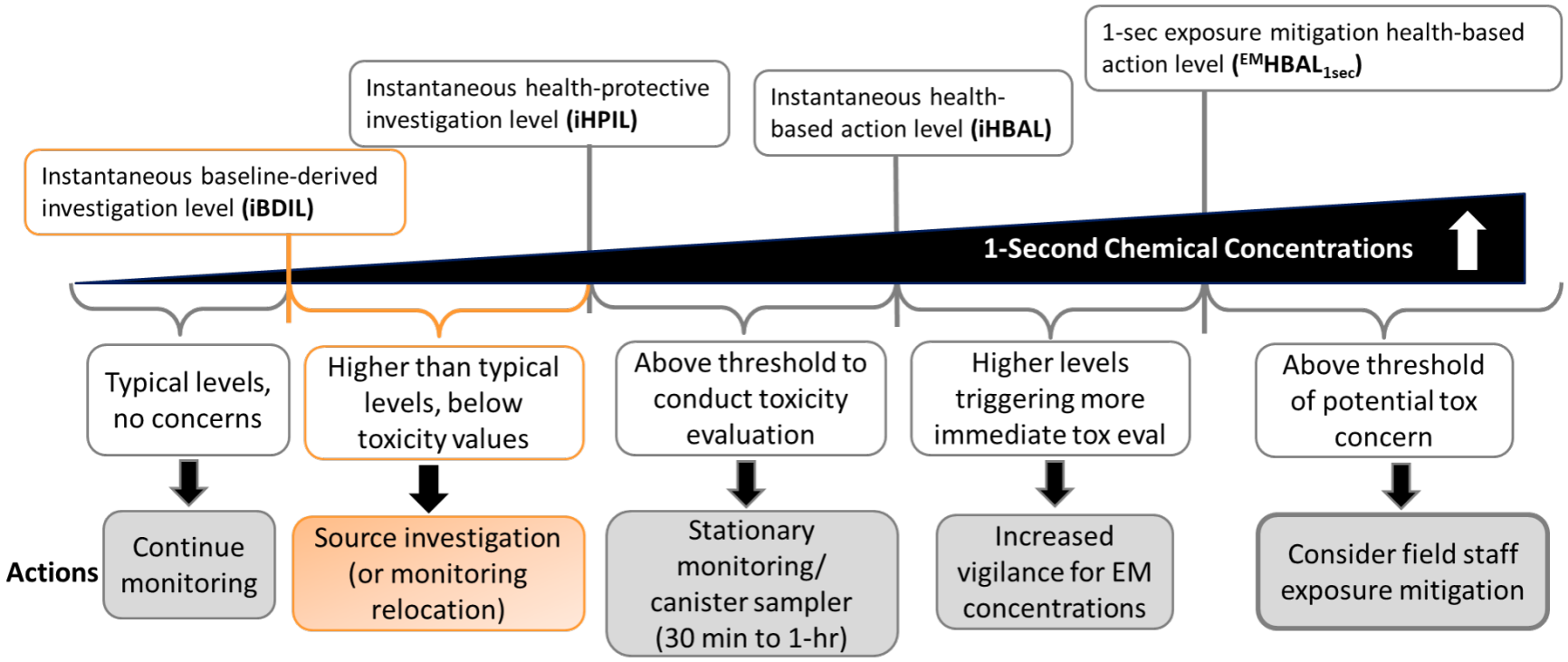


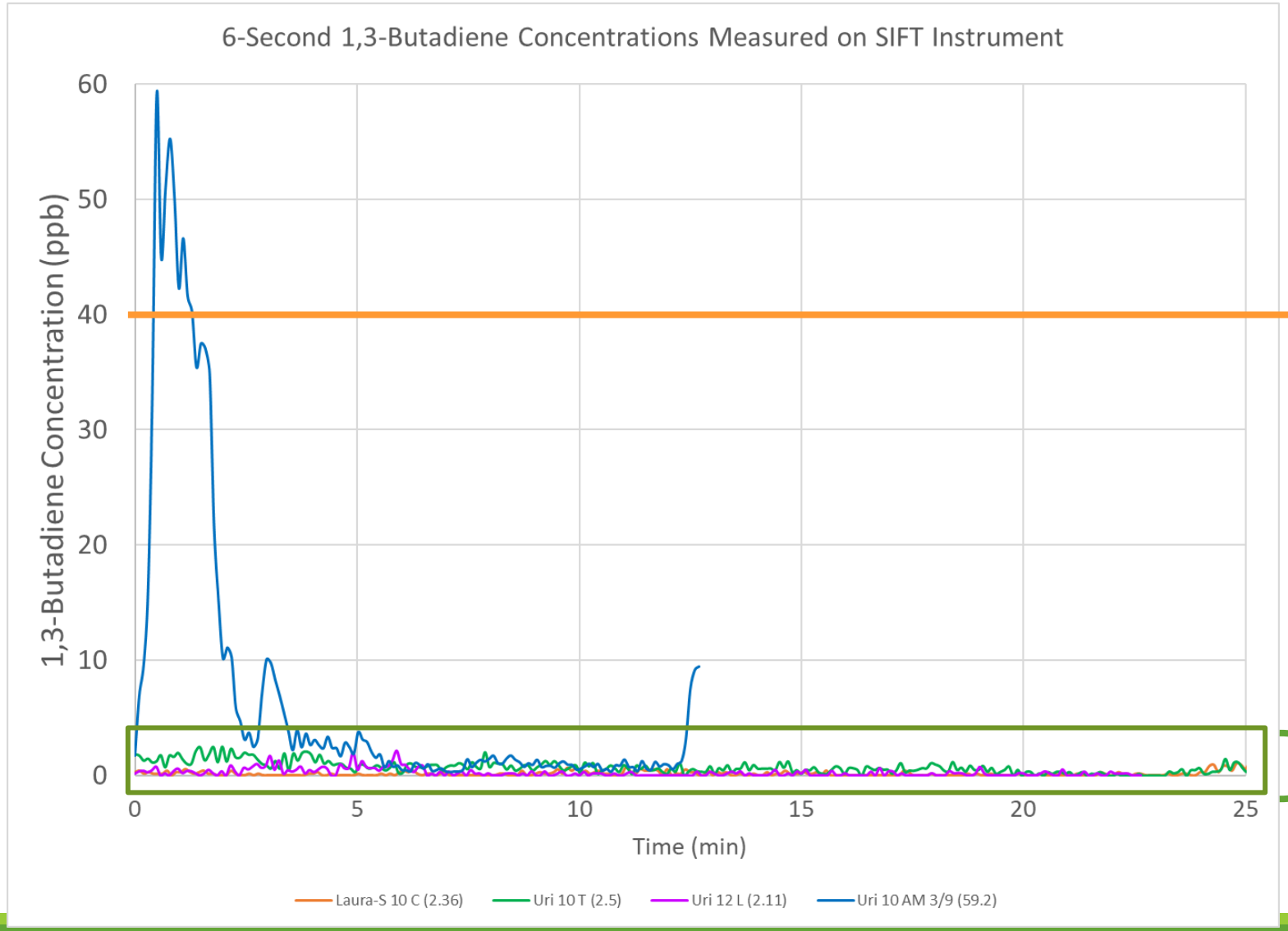
Levels to Identify Chemical Releases



Levels to Identify Chemical Releases

- Based on levels that indicate an abnormal amount of chemical in the air that may require a source investigation
- Not based on health effect levels
  - A chemical with a low toxicity that is being measured at levels much higher than are typical indicates a release that may require action
- Derive values by first assessing the typical background or baseline level for the chemical and instrument
  - Used data from hundreds of SIFT and DUVAS mobile monitoring surveys, gathered in Beaumont, Corpus Christi, and Houston areas
- **Instantaneous baseline-derived investigation level (iBDIL)** derived from baseline chemical levels:
  - 10-fold above baseline
  - Balances need to identify abnormally high chemical concentrations, while avoiding investigating spurious concentration changes

Baseline and Investigation Levels Example



iBDIL: 10-times baseline

Chemical Baseline

Instantaneous Baseline-Derived Investigation Levels (iBDILs)

- Different types of instruments and different chemicals have different data quality
  - DUVAS is less quantitative than SIFT, generally with higher baselines
  - For consistency, a single iBDIL is used for a chemical measured by multiple instruments

- Action when exceeded: source investigation, possible monitoring relocation (if source is known and in an area without public exposure)

SIFT

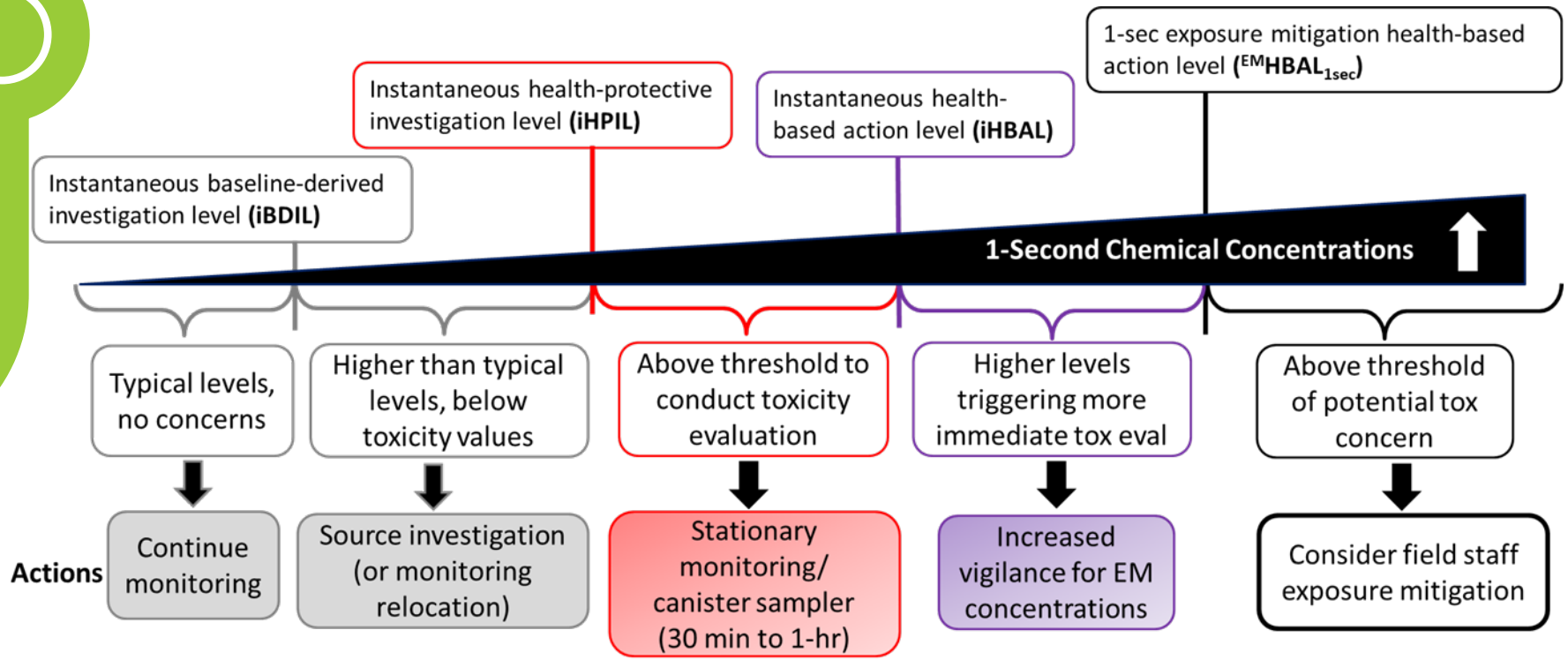
Chemical(s)	iBDIL (ppb)
Benzene	80
Toluene	70
Xylenes + Ethylbenzene	60
1,3-Butadiene	40
Styrene	60

DUVAS

Chemical(s)	iBDIL (ppb)
Benzene#	80
Toluene#	70
Ethylbenzene	350
1,3-Butadiene#	40
Styrene#	60
SO_2	70

DUVAS iBDILs for benzene, 1,3-butadiene, toluene, and styrene are based on SIFT baselines

Levels to Determine Toxicity



Instantaneous Toxicity-Based Comparison Values

- **Instantaneous health-protective investigation level (iHPIL)**
  - Conservatively based on 1-hour acute health-based comparison values – e.g., TCEQ 1-hour AMCVs
  - Action when exceeded: Initiate stationary monitoring for 30 min to 1-hour
- **Instantaneous health-based action levels (iHBALs)**
  - Set at levels 3-times higher than 1-hour AMCVs
  - Action when exceeded: Increase vigilance levels that exceed exposure mitigation values; initiate stationary monitoring with data evaluation after 5-10 minutes (only applicable to instruments capable of real time averaging)

Above threshold to conduct toxicity evaluation

↓

Stationary monitoring (30 min to 1-hr)

Chemical(s)	iHPIL (ppb)	iHBAL (ppb)
Benzene	180	540
Toluene	4,000	12,000
Ethylbenzene	20,000	60,000
1,3-Butadiene	1,700	5,100
Styrene	5,100	15,300

Higher levels triggering more immediate tox eval

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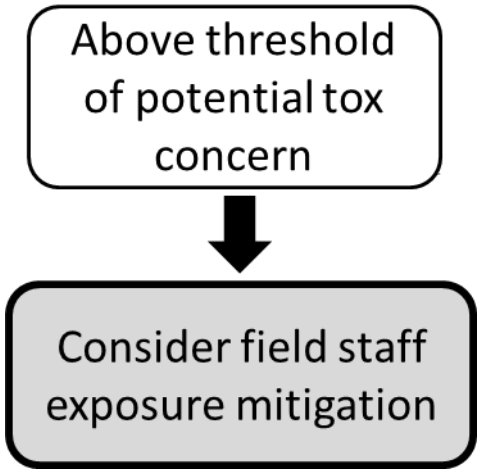
Increased vigilance for EM concentrations

Health-Based Action Levels for Exposure Mitigation (^{EM}HBALs)



- **Exposure mitigation health-based action levels (^{EM}HBALs)** represent concentrations that trigger considerations about staff exposure to the chemical.
- For use during longer duration sampling or when averaging is not available
- Because of inherent conservatism in the derivation, levels not expected to cause acute health effects
  - Provides time to initiate exposure mitigation
  - Can be used to assist staff in the field in taking or developing exposure avoidance strategies
- Derived for different concentration averaging times: 10 minutes, 1 hour, **1 second (for use with instruments that cannot calculate real-time concentration averages)**
- Action when exceeded: Consider exposure mitigation for field staff

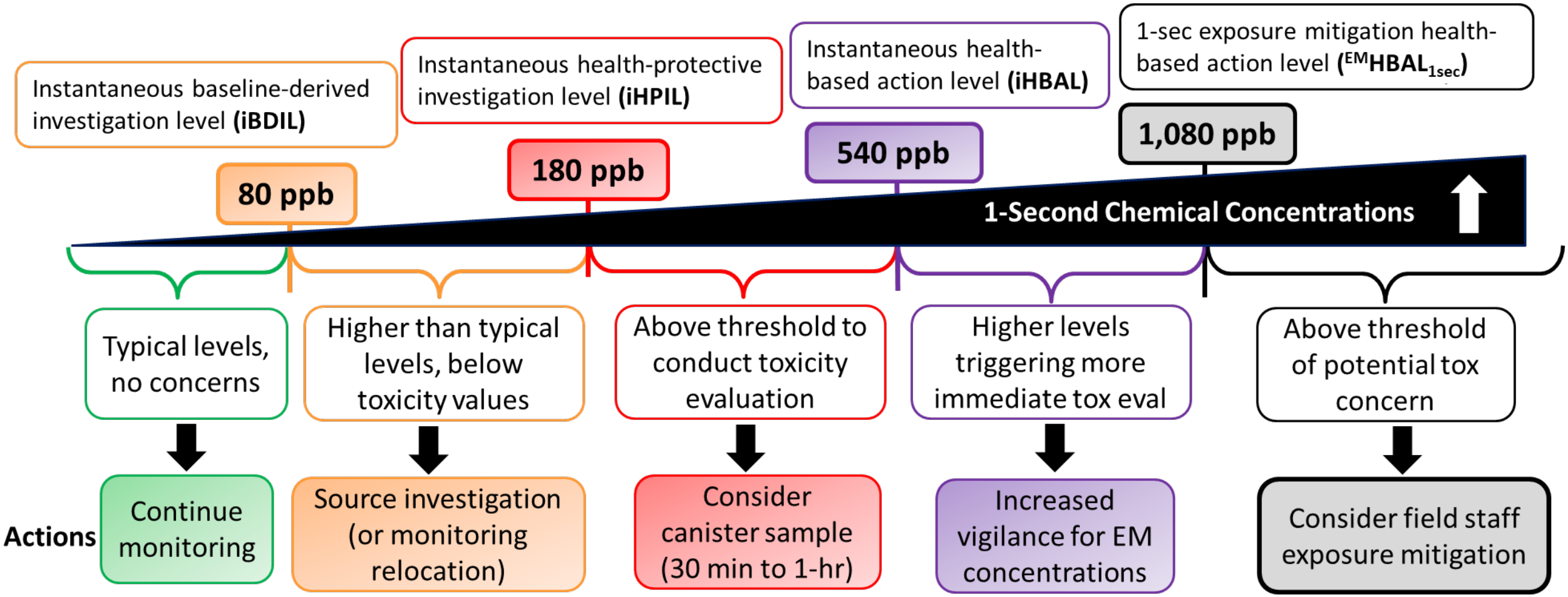
Exposure Mitigation Health-Based Action Levels (^{EM}HBALs)

- The 1-second ^{EM}HBAL is set at 6-times the 1-hour comparison value (e.g., TCEQ AMCV)

Chemical(s)	$^{EM}HBAL_{1sec}$ (ppb)	$^{EM}HBAL_{10min}$ (ppb)	$^{EM}HBAL_{1hr}$ (ppb)
Benzene	1,080	500	360
Toluene	24,000	12,000	8,000
Ethylbenzene	120,000	60,000	40,000
1,3-Butadiene	10,200	2,500	3,400
Styrene	30,600	10,000	10,200

- The choice of which of the three ^{EM}HBAL values to use depends on what averaging time of data that you have (can only use 1-second value in real time with DUVAS instrument)

Example: MMCV Values & Actions for Benzene



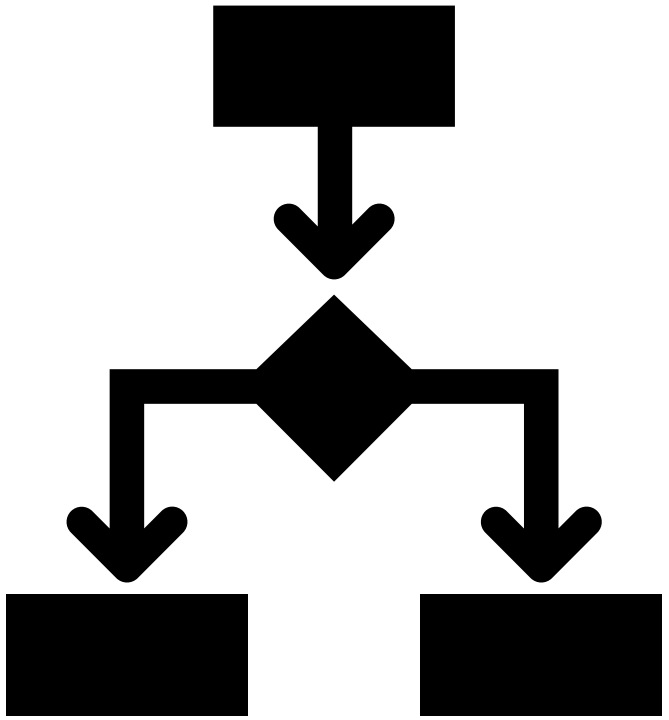
All comparison values are set at levels well below those that would cause health effects

Data Visualization

- TCEQ's DUVAS van produces real-time visualizations of monitored data
  - Caterpillar trails with 4 colors: Green, Orange, Red, Purple
- Basis for color designation:
  - Green: below instant baseline-derived investigation level (iBDIL)
  - Orange Threshold: above iBDIL
  - Red Threshold: above instant health-protective investigation level (iHPIL)
  - Purple Threshold: above instant health-based action level (iHBAL)

Example:

Chemical	Orange Threshold (ppb)	Red Threshold (ppb)	Purple Threshold (ppb)
Benzene	80	180	540
1,3-Butadiene	40	1,700	5,100



Fact Sheets and Decision Guides for Using Comparison Values in the Field

Benzene Fact Sheet

for field use with mobile monitoring instruments

This Field Guide provides a summary of the different mobile monitoring comparison values developed by the Toxicology, Risk Assessment, and Research Division for use in evaluating real-time instantaneous data in the field.

***All derived mobile monitoring comparison values are intended to be used as guidance**. Field investigators and mobile monitoring staff should use their own discretion when deciding to mitigate exposure, such as when experiencing health effects or intense odors, regardless of measured concentrations.*

What is Benzene?

- Benzene can be found everywhere in the environment
- Benzene rapidly degrades in the atmosphere
- Benzene has an aromatic, paint-thinner-like, sweet odor

At What Levels Can Benzene Cause Harm?

Breathing high levels of benzene for a short period of time can affect the central nervous system. Repeated exposure to high levels over several days or longer can cause damage to blood cells. Long-term exposure (e.g., many years) is associated with an increased risk for cancer (i.e., acute myelogenous and monocytic leukemia).

Mobile Monitoring Comparison Values

	Benzene
iBDIL (ppb) Orange	80
iHPIL (ppb) Red	180
iHBAL (ppb) Purple	540
$^{EM}HBAL_{10min}$ (ppb)	500
$^{EM}HBAL_{1hr}$ (ppb)	360
$^{EM}HBAL_{1sec}$ (ppb)	1,080

iBDIL - instantaneous baseline-derived investigation level

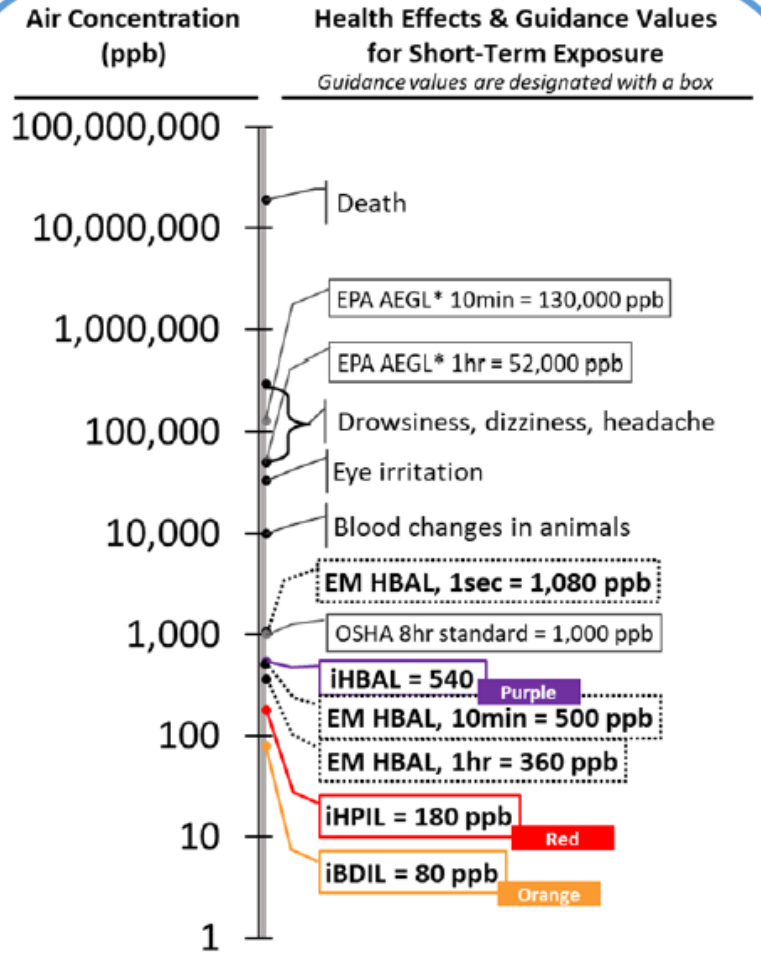
iHPIL - instantaneous health-protective investigation level

iHBAL - instantaneous health-based action level

$^{EM}HBAL_{10min}$ - 10-minute health-based action level for exposure mitigation

$^{EM}HBAL_{1hr}$ - 1-hour health-based action level for exposure mitigation

$^{EM}HBAL_{1sec}$ - 1-second health-based action level for exposure mitigation

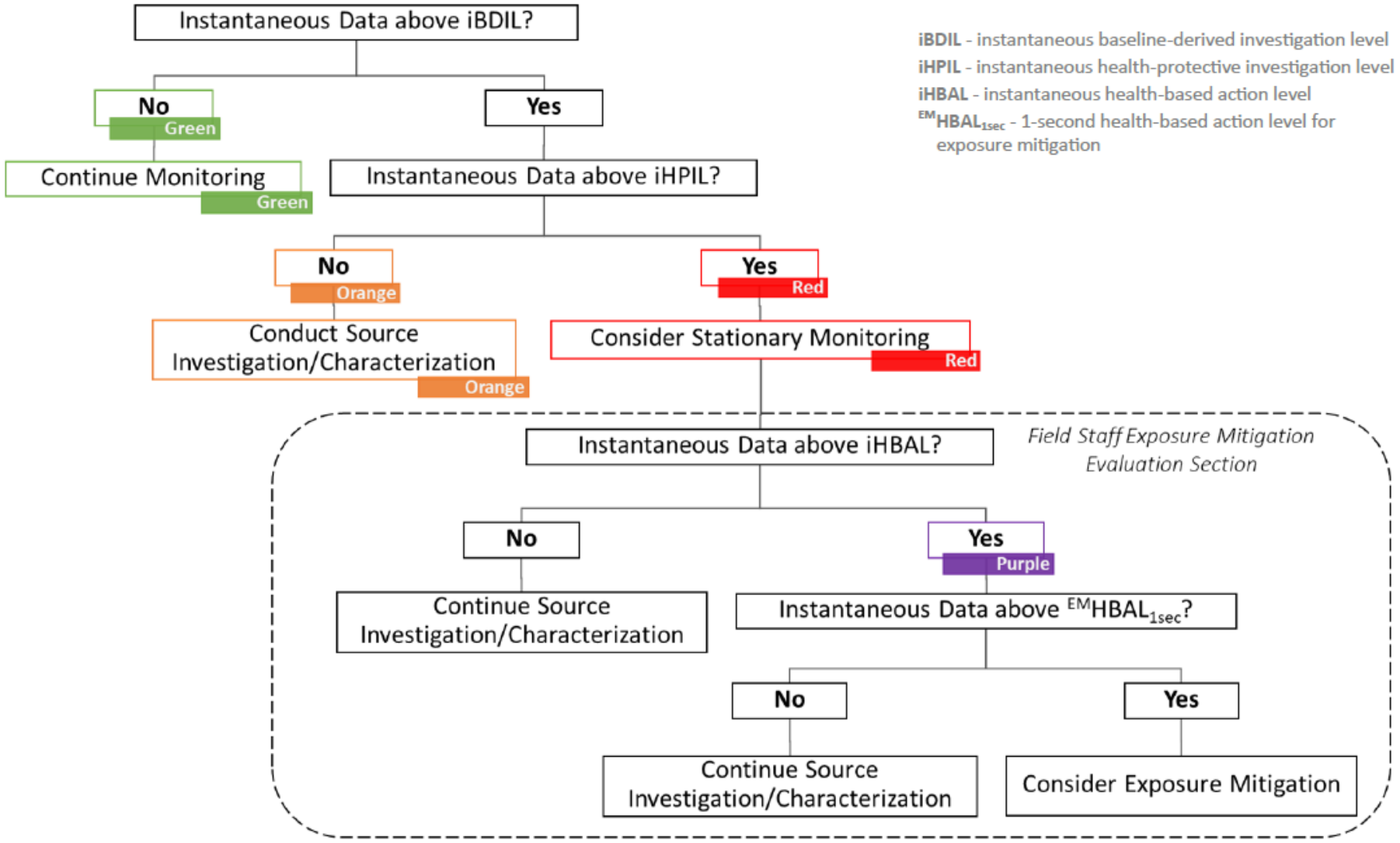


*AEGL = Acute Exposure Guideline Level. The AEGL levels shown are AEGL-1, which is the concentration above which notable discomfort, irritation, or certain asymptomatic non-sensory effects are expected.

For more information on EPA's AEGL values, please see EPA's website.

Data Decision Guide for Instantaneous Data Only

for field use with instantaneous instruments that do not have averaging capabilities in real-time



Note: When the source is known, monitoring should be conducted downwind in areas of public access.

DUVAS Data Mobile Monitoring Comparison Value Table Field Guide

for field use with instruments that do not have averaging capabilities in real-time

Chemical(s) DUVAS COLOR	UNITS	iBDIL ORANGE	iHPIL RED	iHBAL PURPLE	$^{EM}HBAL_{1sec}$ N/A
Ammonia	ppb	--	850	2,550	5,100
Benzene	ppb	80	180	540	1,080
1,3-Butadiene	ppb	40	1,700	5,100	10,200
Ethylbenzene	ppb	350	20,000	60,000	120,000
Styrene	ppb	60	5,100	15,300	30,600
Sulfur Dioxide	ppb	70	--	--	--
Toluene	ppb	70	4,000	12,000	24,000
Xylenes	ppb	--	5,000	15,000	30,000
Associated Actions		Conduct source investigation/ characterization	Consider canister sample	Evaluation for $^{EM}HBAL$ levels	Consider exposure mitigation if 1 sec value > level

"--"no value available; ppb – parts per billion; N/A not applicable

$^{EM}HBAL_{1sec}$ *– 1-second exposure mitigation health-based action level;*

iBDIL *– instantaneous baseline-derived investigation level;*

iHBAL *– instantaneous health-based action level;*

iHPIL *– instantaneous health-protective investigation level*

For chemicals lacking iBDILs - source investigation initiated at iHPIL value

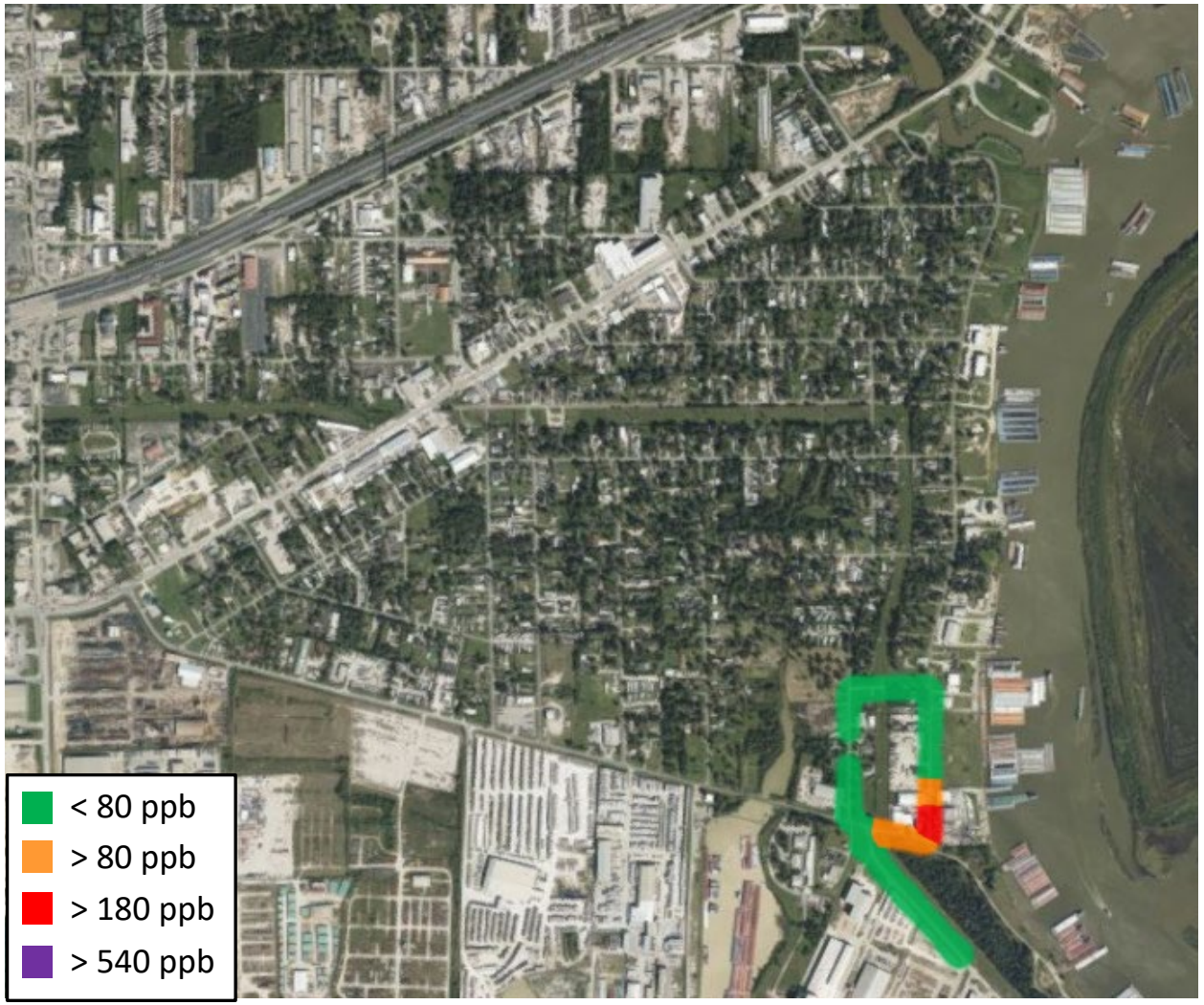
Hypothetical Example TCEQ Monitoring Surveys and Actions

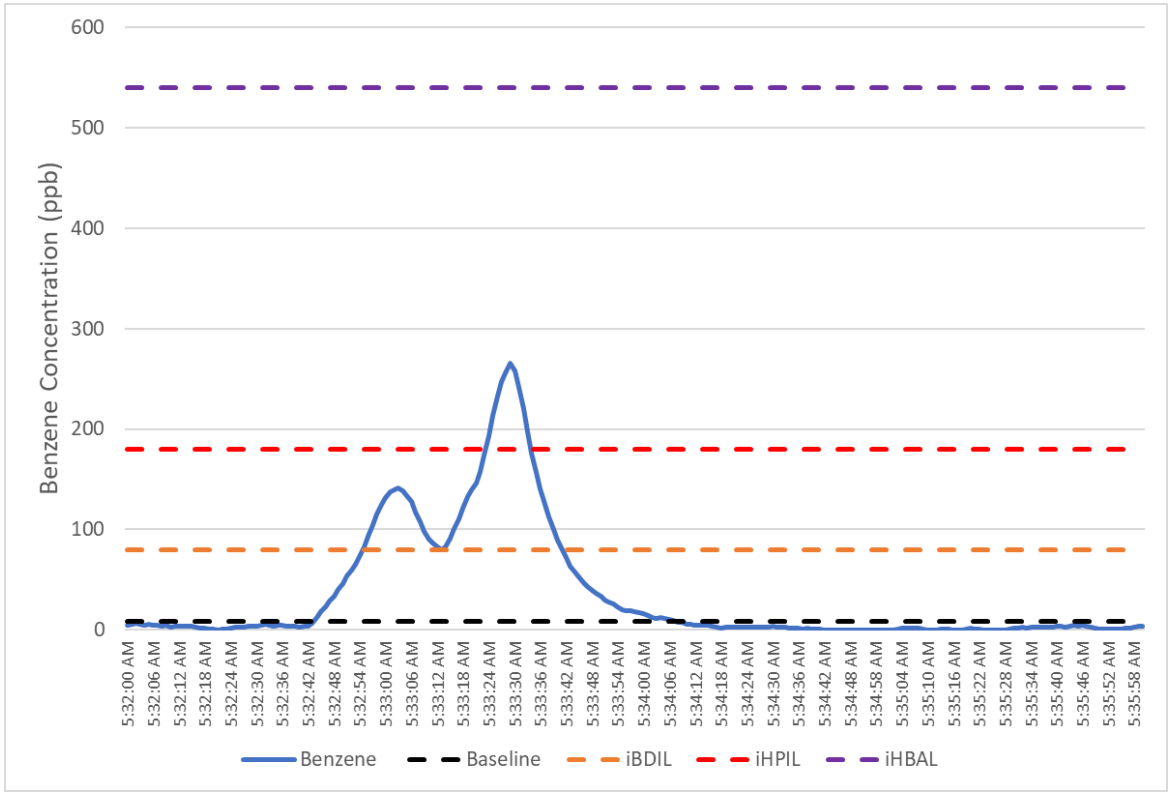
What would these comparison values look like in practice?

Example 1: Unknown source

Example 1: Unknown Source

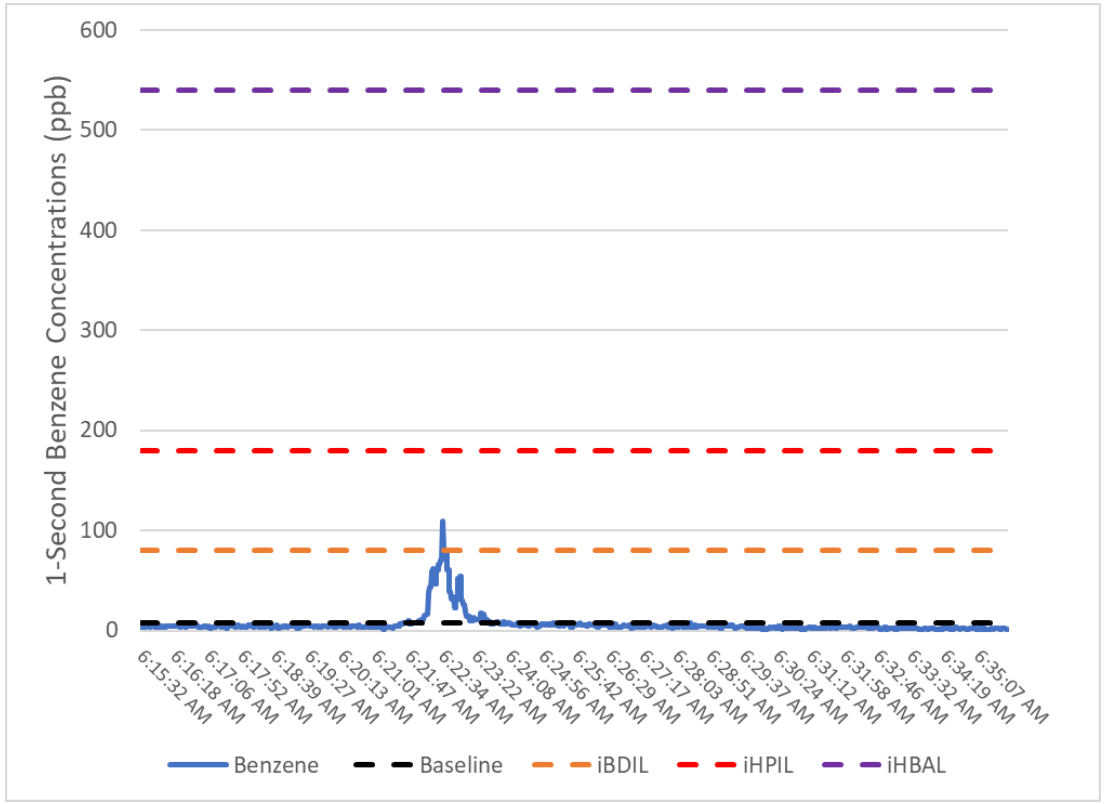
Mobile survey: area with levels higher than iBDIL and iHPIL





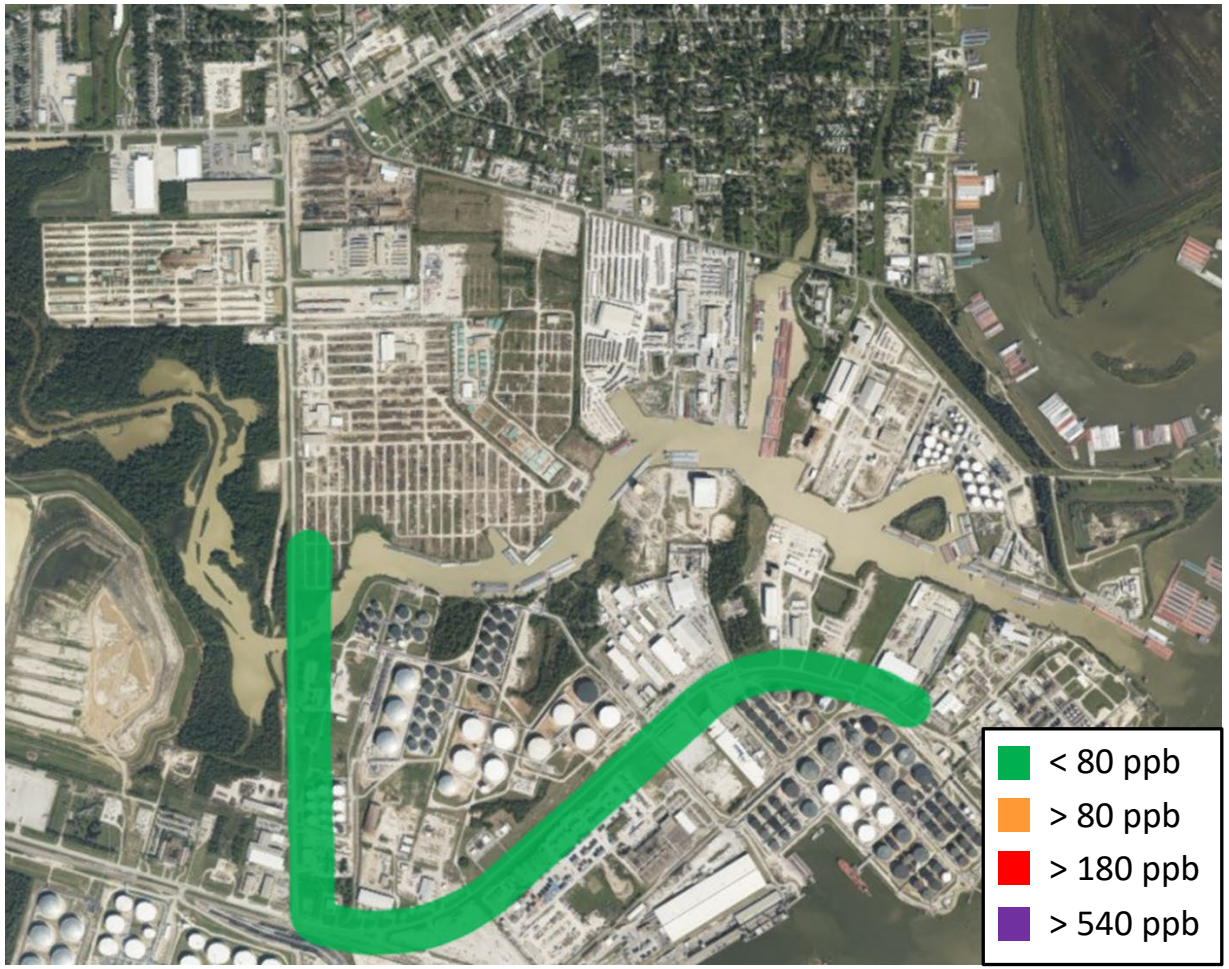
Example 1: Unknown Source

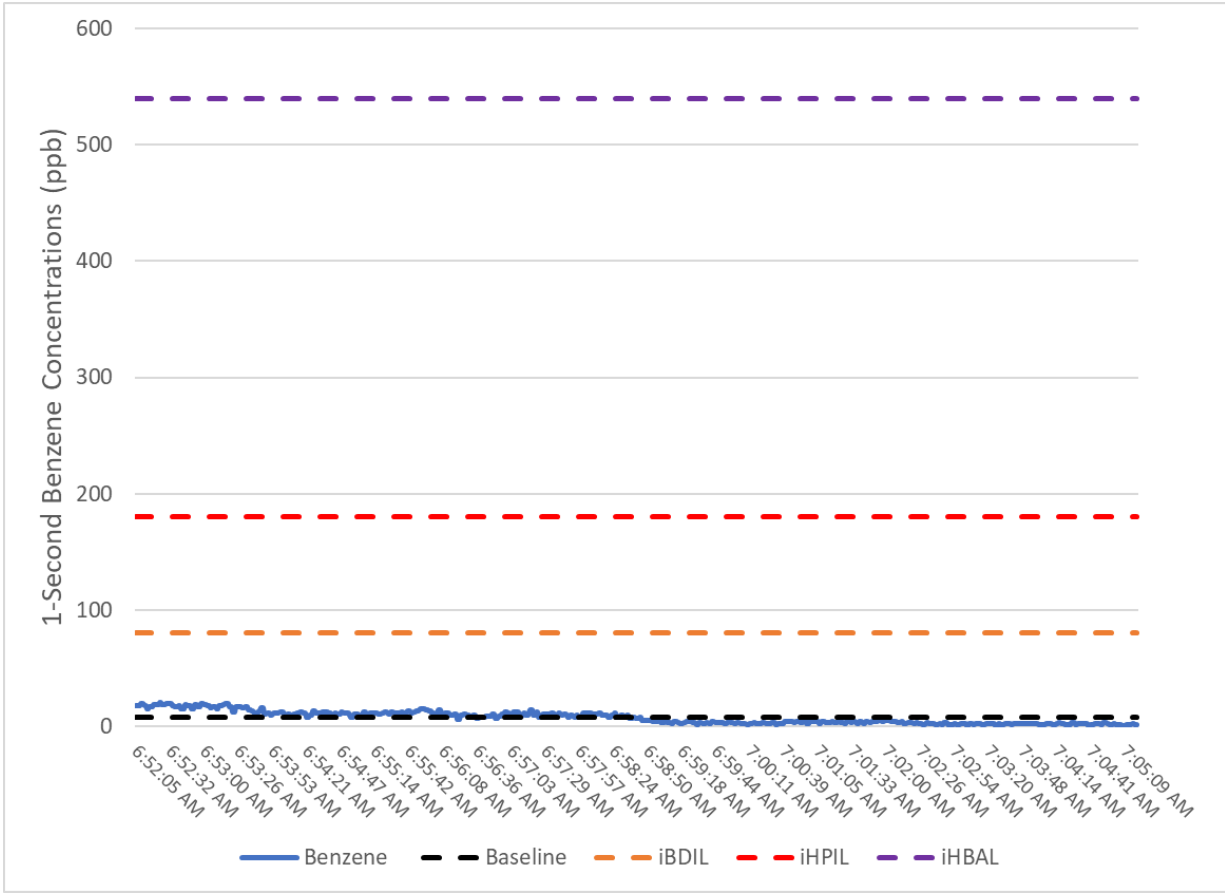
Mobile survey: investigated area again, confirmed levels higher than iBDIL



Example 1: Unknown Source

Mobile survey: investigated different area, benzene levels low





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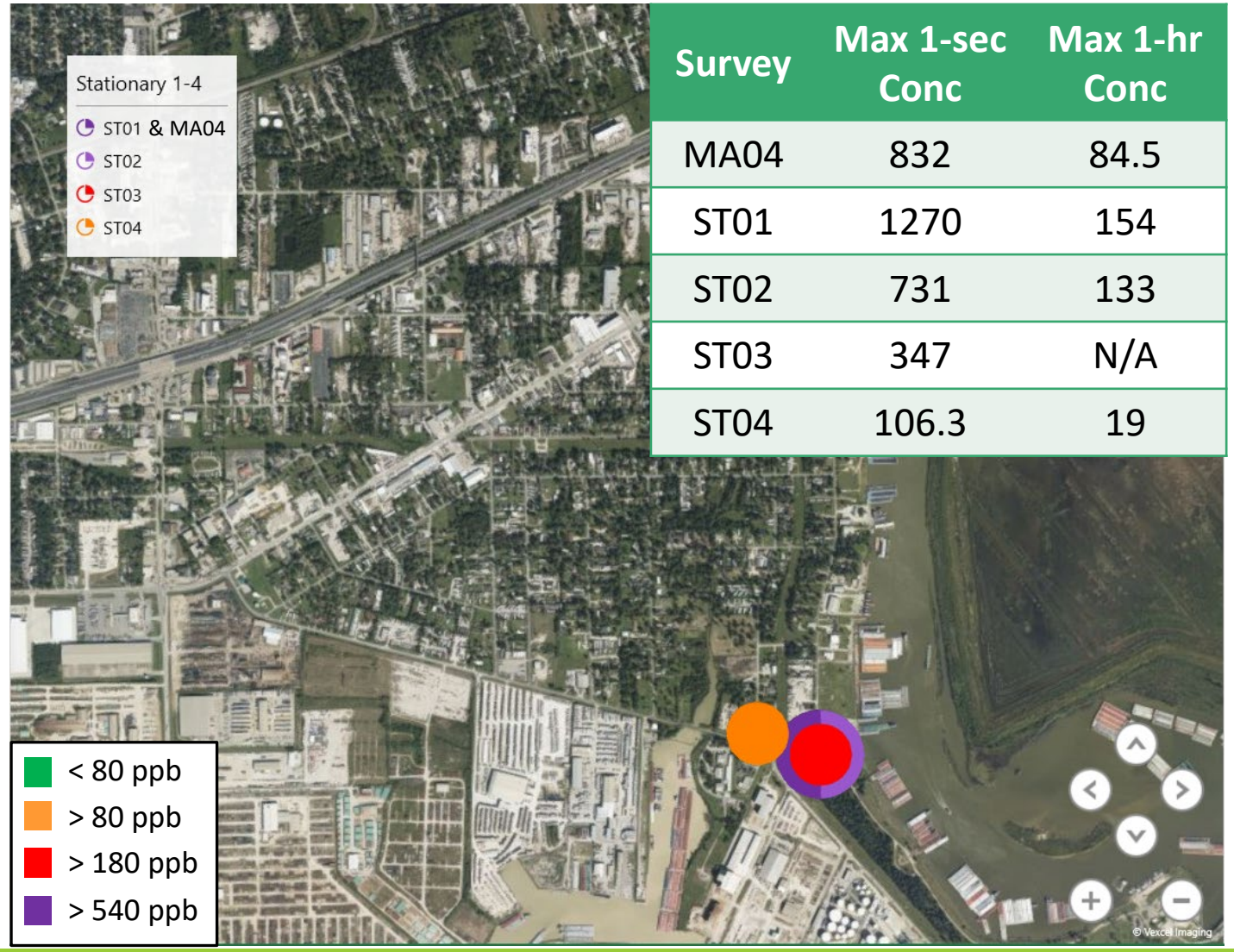
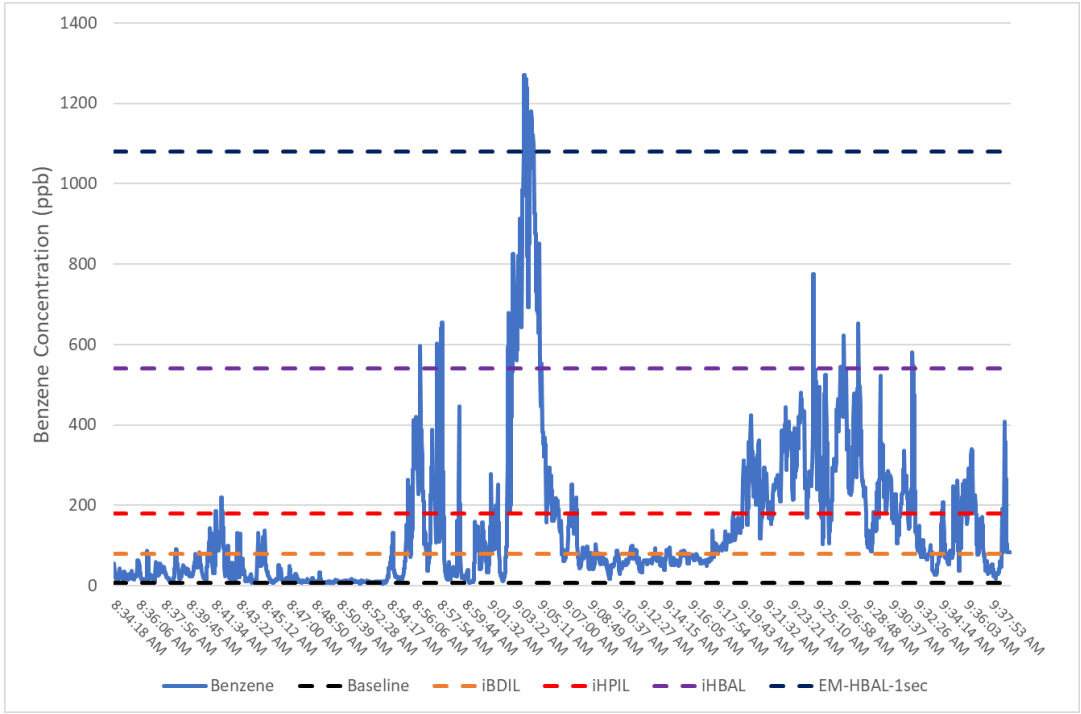


Survey	Max 1-sec Conc	Max 1-hr Conc
MA04	832	84.5
ST01	1270	154
ST02	731	133
ST03	347	N/A
ST04	106.3	19

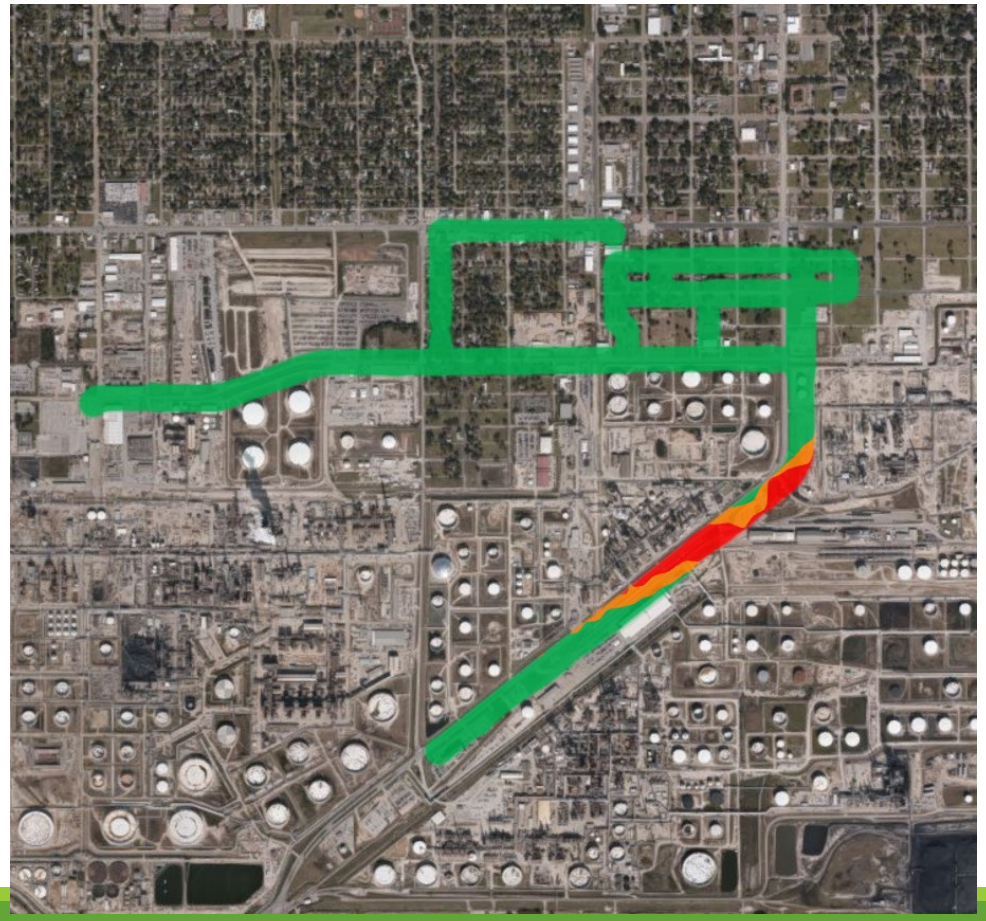
5 stationary surveys: longer averaging times could be compared to 1-hr AMCV; potential for source triangulation with wind direction data

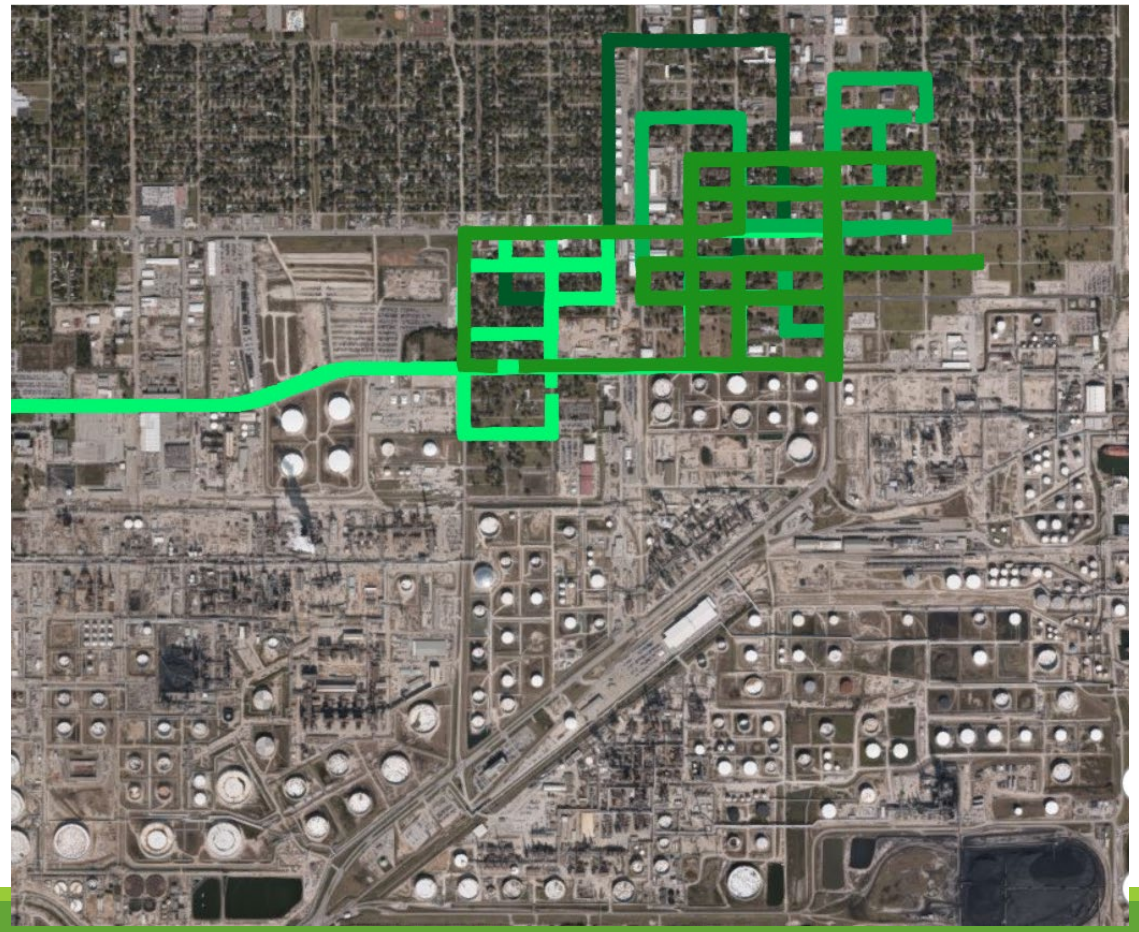


Example 2: Known Source

Example 2: Known Source

- Several surveys confirmed higher chemical levels in the vicinity of the known source (levels almost up to iHBAL)
- Remaining surveys evaluated chemical concentrations in nearby neighborhoods (all concentrations below investigation level)





Summary

Derived comparison values for mobile air monitoring data

- To identify abnormally high levels of chemicals (investigation levels)
- To determine potential toxicity of measured chemical levels (health-based action levels)

Identified potential actions to take when the values are exceeded

- Source identification
  - Relocation to areas where general public may be exposed
- Stationary monitoring
- Exposure mitigation

Developed visualization tools for communication of values and actions

Posted derivation documents, tables of values, and field guides for TCEQ staff

- Toxicology MMCV webpage: https://www.tceq.texas.gov/toxicology/mmcvs

Acknowledgements

- TCEQ Mobile Monitoring Team and EPA Region 6 have been involved in either data gathering, developing protocols, and/or field testing the MMCVs and Field/Decision Guides
- A team of TCEQ toxicologists contributed to developing these tools:
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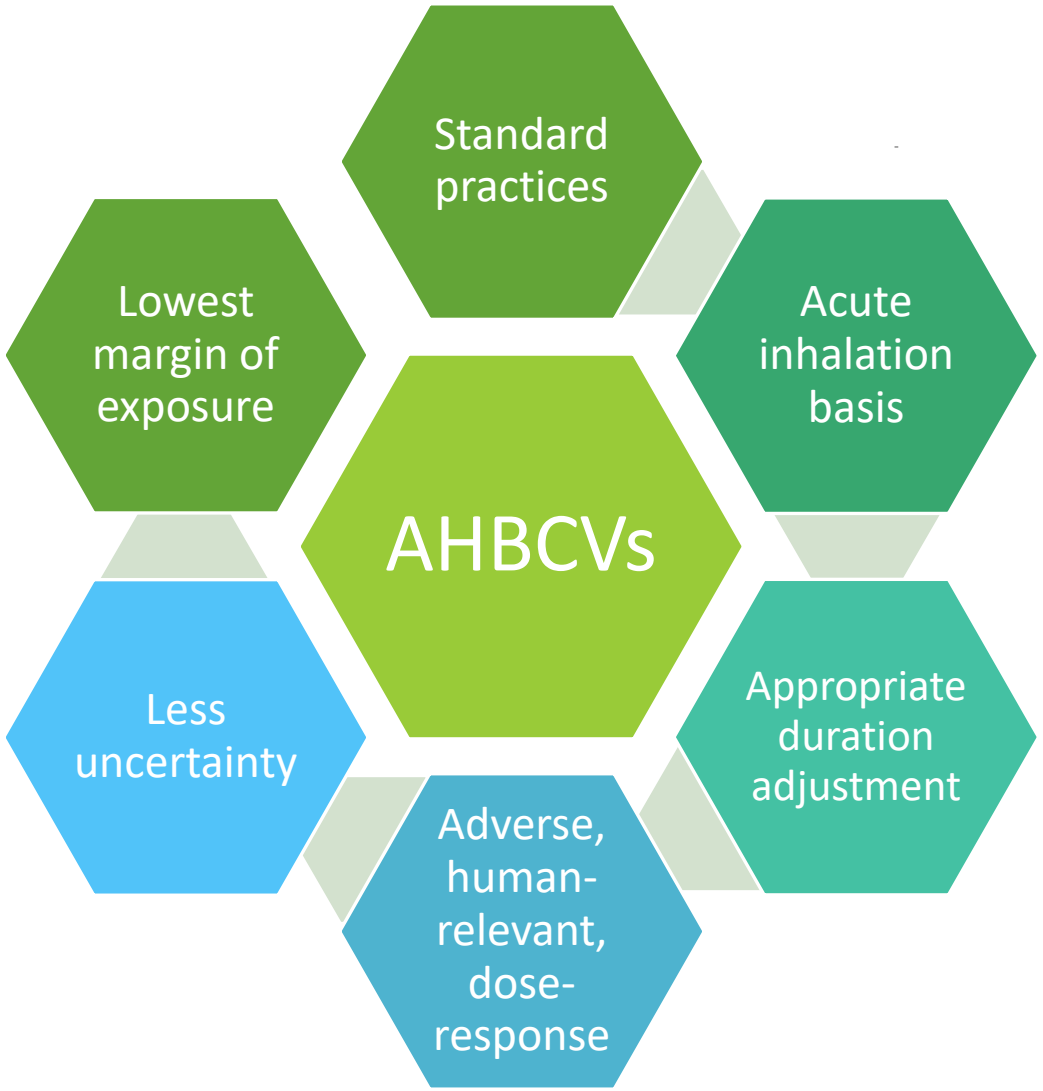
Questions?

Additional Slides

Acute Health-Based Comparison Values (AHBCVs)

- Used to derive all toxicity-based mobile monitoring comparison values
- Fit-for-purpose for application to short-term exposures for investigations or emergency events
- Acute (1-hour) values developed by TCEQ and other agencies
  - E.g., TCEQ's air monitoring comparison values (AMCVs)
- Health-protective without being unduly conservative
  - Not as high as US EPA acute exposure guideline levels (AEGLs)
  - 1-hr AHBCVs are not health-effect levels



Exposure Mitigation Health-Based Action Levels (^{EM}HBALs)

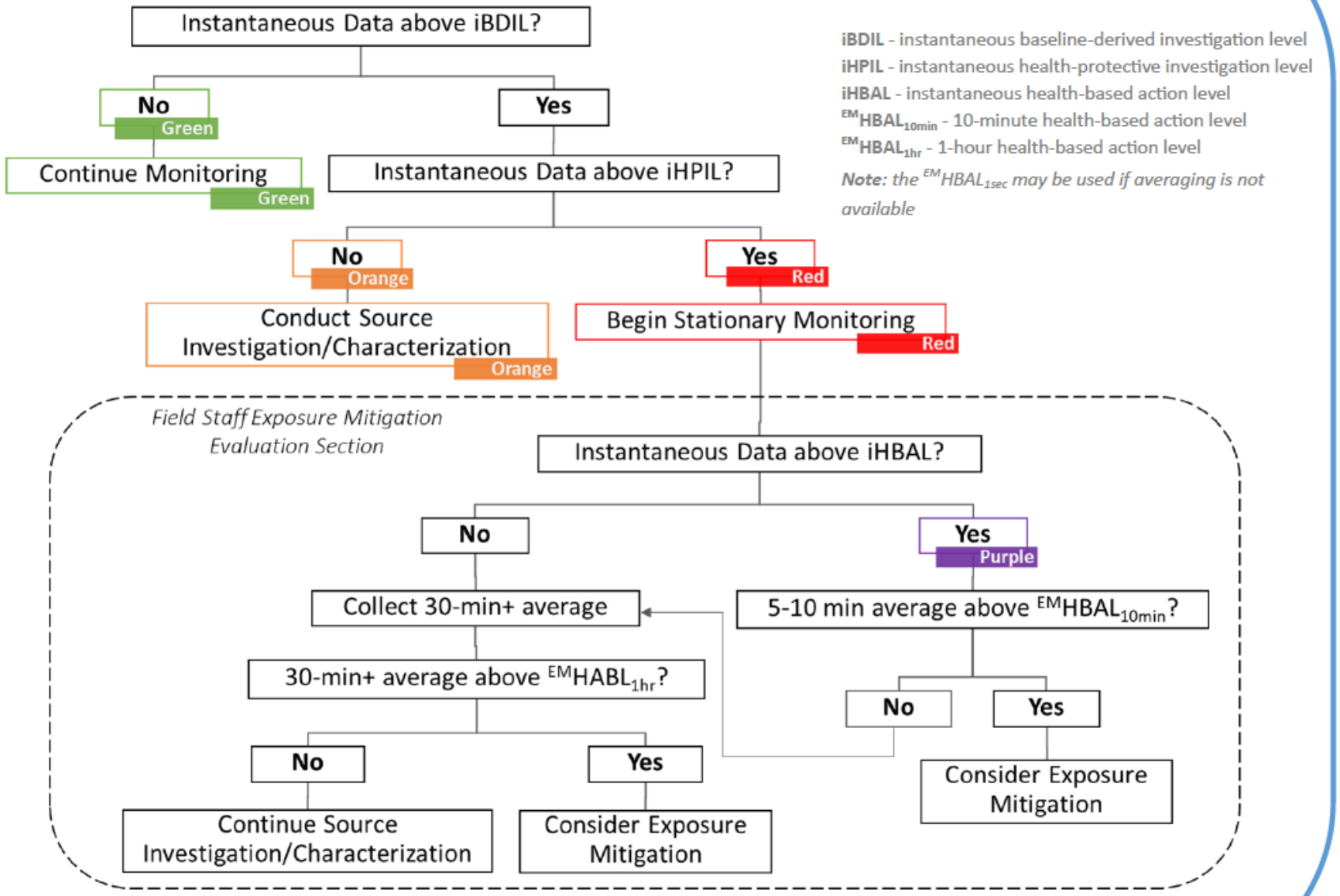
- Based on the 1-hour AHBCV, or on applicable occupational exposure levels

Comparison Value (Acronym)	Basis
10-min Health-Based Action Level for Exposure Mitigation ($^{EM}HBAL_{10min}$)	Lowest of: 3X acute health-based comparison value (AHBCV), or ½ 15-min occupational short-term exposure limit (STEL)[a], or ½ occupational ceiling value[b]
1-hour Health-Based Action Level for Exposure Mitigation ($^{EM}HBAL_{1hr}$)	2X AHBCV
1-sec Health-Based Action Level for Exposure Mitigation ($^{EM}HBAL_{1sec}$)	3X $^{EM}HBAL_{1hr}$

[a] Short-term exposure limit (STEL) – 15-minute short-term occupational exposure limit; [b] Ceiling (C) – occupational value that should not be exceeded at any time.

Data Decision Guide for Instantaneous and Average Data

for field use with instruments that provide real-time averaging of data while stationary



Note: When the source is known, monitoring should be conducted downwind in areas of public access.

Mobile Monitoring Comparison Value Table Field Guide for Instantaneous and Average Data

for field use with instruments that provide real-time averaging of data while stationary

Chemical(s) DUVAS COLOR	iBDIL (ppb) ORANGE	iHPIL (ppb) RED	iHBAL (ppb) PURPLE	$^{EM}HBAL_{10min}$ (ppb) N/A	$^{EM}HBAL_{1hr}$ (ppb) N/A	$^{EM}HBAL_{1sec}$ (ppb) N/A
Acetylene	80	25,000	75,000	75,000	50,000	150,000
Benzene	80	180	540	500[a]	360	1,080
1,3-Butadiene	40	1,700	5,100	2,500[a]	3,400	10,200
1-Butene	110	27,000	81,000	81,000	54,000	162,000
C3-C4 Saturated	960	--	--	--	--	--
Cyclohexane	120	1,000	3,000	3,000	2,000	6,000
n-Hexane	340	5,400	16,200	16,200	10,800	32,400
Hydrogen Sulfide	--	70	210	210	140	420
Isobutane	280	33,000	99,000	99,000	66,000	198,000
n-Octane	160	4,100	12,300	12,300	8,200	24,600
Propane	540	--	--	--	--	--
Styrene	60	5,100	15,300	10,000[a]	10,200	30,600
Toluene	70	4,000	12,000	12,000	8,000	24,000
Xylenes + Ethylbenzene	60	5,000[b]	15,000[b]	15,000[b]	10,000[b]	30,000[b]
Associated Actions	Conduct source investigation/ characterization	Consider stationary monitoring	Consider stationary monitoring & evaluation for $^{EM}HBAL$ levels	Consider exposure mitigation if 5-10 min avg > level	Consider exposure mitigation if 30+ min avg > level	Consider exposure mitigation if 1 sec value > level

[a] Based on ½ STEL; [b] Values are based on AHBCV for xylenes; "--"no value available; ND – not determined; ppb – parts per billion; N/A not applicable

$^{EM}HBAL_{1hr}$ *– 1-hour exposure mitigation health-based action level;*

$^{EM}HBAL_{10min}$ *– 10-minute exposure mitigation health-based action level;*

$^{EM}HBAL_{1sec}$ *– 1-second exposure mitigation health-based action level;*

iBDIL *– instantaneous baseline-derived investigation level;*

iHBAL *– instantaneous health-based action level;*

iHPIL *– instantaneous health-protective investigation level*