“Blowdowns” and the Fore River Bridge: What could go wrong?
(what was left out of the permit)

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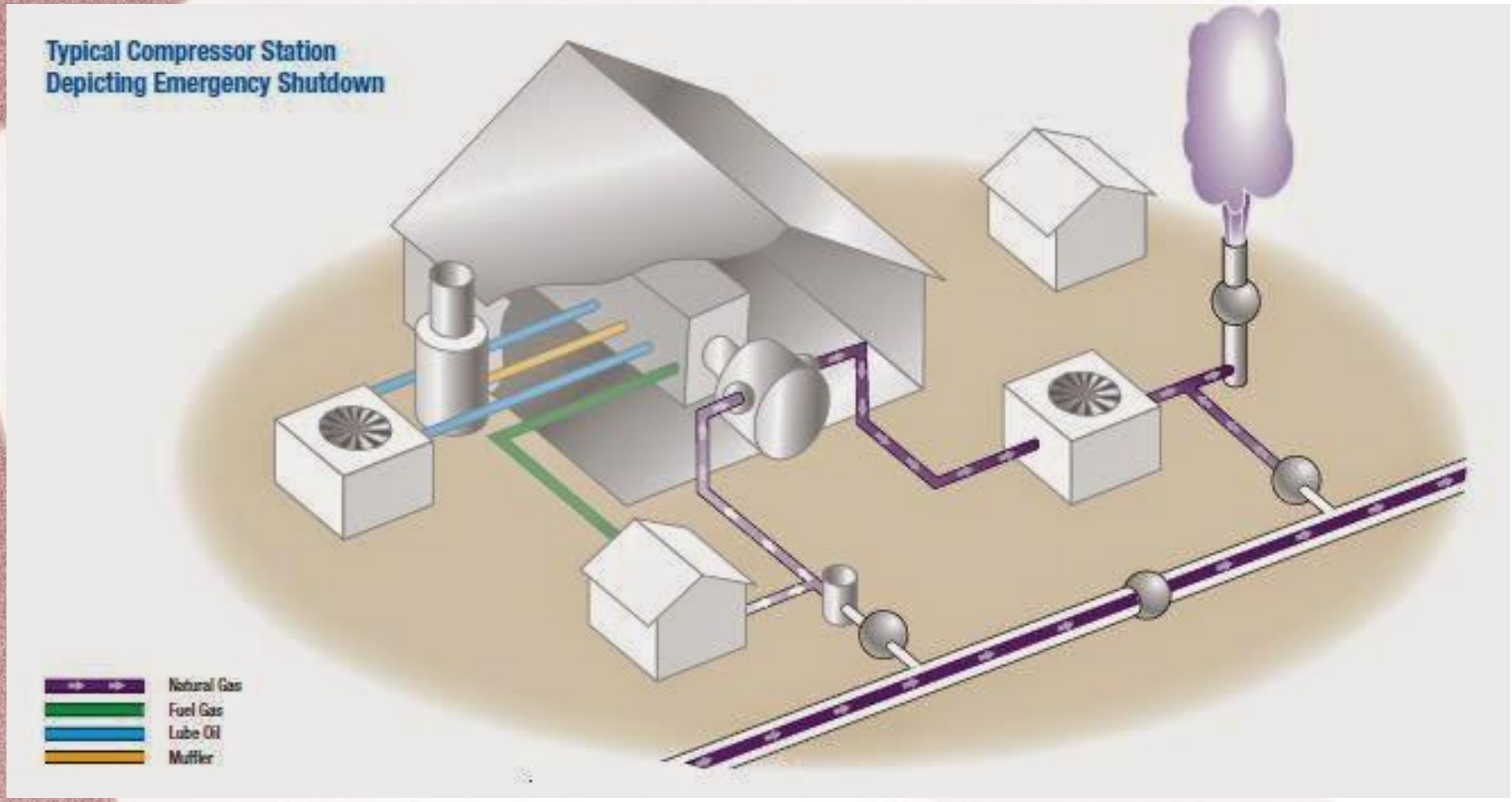
On behalf of:
Fore River Residents Against
the Compressor Station

Disclosures

- No individuals involved with this effort received personal compensation
- I have training, experience, and peer reviewed publications in cell biology, cancer biology, ophthalmology, and clinical medicine
  - But not air pollution modeling
- Some of my patients live in Quincy, Weymouth, and Braintree

Gas pipeline compressor stations vent (blow down) natural gas

What is the purpose of blowdowns?



How are blowdowns addressed in the MassDEP draft air pollution permit?

- No pollution control device
- Monthly/annual limits on tons of VOCs & hazardous air pollutants (~19 & 1 tons/yr)
- Spectra must track gas releases
- Notify MassDEP/Weymouth BOH for blowdowns > 1 million cubic feet gas
- Stack height: No stack

The new Fore River Bridge!
Plus,
a natural gas compressor station?

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Plus,
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ALOHA modeling software: pipeline releases & more

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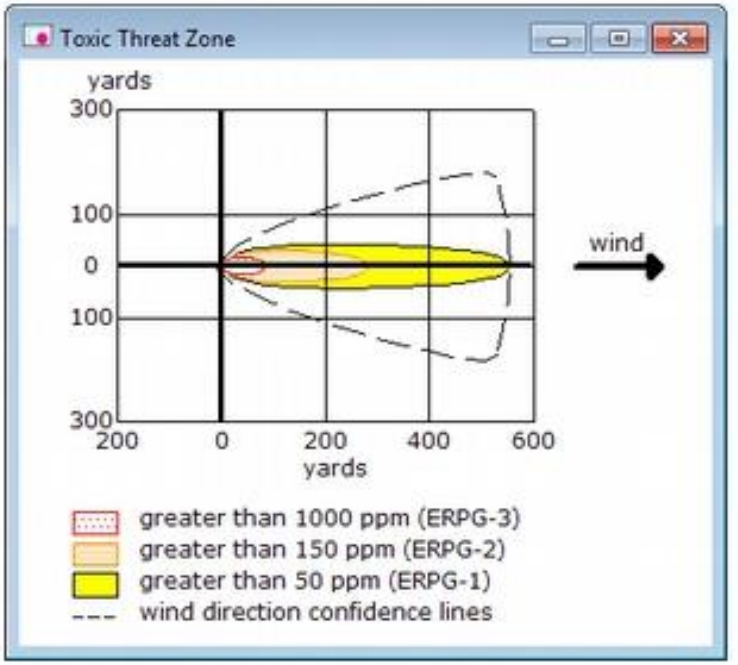
ALOHA Software

ALOHA® is the hazard modeling program for the CAMEO® software suite, which is used widely to plan for and respond to chemical emergencies. Learn more about the CAMEO software suite.

ALOHA allows you to enter details about a real or potential chemical release, and then it will generate threat zone estimates for various types of hazards. ALOHA can model toxic gas clouds, flammable gas clouds, BLEVEs (Boiling Liquid Expanding Vapor Explosions), jet fires, pool fires, and vapor cloud explosions. The threat zone estimates are shown on a grid in ALOHA, and they can also be plotted on maps in MARPLOT®, Esri's ArcMap, Google Earth, and Google Maps. The red threat zone represents the worst hazard level, and the orange and yellow threat zones represent areas of decreasing hazard.



Downloading ALOHA

Blowdown ("Gas release") data from Spectra

Atlantic Bridge Fina... × | Atlantic Bridge final...

752 / 986 | 112%

TABLE G-1C
Gas Releases
Hourly and Annual Emission Estimates
Project Related Increases

Category	Station Operations					
Source	WEYM-GR-ST			WEYM-GR-PL		
	Avg. Hourly	Max. Annual	Max. Hourly	Avg. Hourly	Max. Annual	Max. Hourly
Gas Release	1,747 scfh	15,300,000 scf/yr	975,000 scfh	0 scfh	0 scf/yr	0 scfh
	81 lb/hr	708,097 lb/yr	46,959 lb/hr	0 lb/hr	0 lb/yr	0 lb/hr
NO_X						
CO						
SO_2						
$PM_{10/2.5}$						
CO_{2e}	1,818 lb/hr	7,963 tpy	1,008,687 lb/hr	0 lb/hr	0 tpy	0 lb/hr
CO_2	0.7729 lb/hr	3.3851 tpy	448.9760 lb/hr	0.0000 lb/hr	0.0000 tpy	0.0000 lb/hr
N_2O						
TOC (Total)	80 lb/hr	349 tpy	46,262 lb/hr	0 lb/hr	0 tpy	0 lb/hr
Methane	73 lb/hr	318 tpy	40,330 lb/hr	0 lb/hr	0 tpy	0 lb/hr
Ethane	5 lb/hr	21 tpy	2,600 lb/hr	0 lb/hr	0 tpy	0 lb/hr
VOC (Total)	2.2567 lb/hr	9.8844 tpy	3,331.6441 lb/hr	0.0000 lb/hr	0.0000 tpy	0.0000 lb/hr
VOC (non-HAP)	2.2095 lb/hr	9.6777 tpy	3,261.9765 lb/hr	0.0000 lb/hr	0.0000 tpy	0.0000 lb/hr
HAP (Total)	0.0472 lb/hr	0.2067 tpy	69.6676 lb/hr	0.0000 lb/hr	0.0000 tpy	0.0000 lb/hr
Acetaldehyde						
Acrolein						
Benzene	0.0076 lb/hr	0.0334 tpy	11.2516 lb/hr	0.0000 lb/hr	0.0000 tpy	0.0000 lb/hr
Biphenyl						
Butadiene (1,3-)						
Carbon Tetrachloride						
Chlorobenzene						
Chloroform						
Dichloropropene (1,3-)						
Ethylbenzene						
Ethylene Dibromide						
Formaldehyde						
Hexane (n-)	0.0267 lb/hr	0.1171 tpy	39.4559 lb/hr	0.0000 lb/hr	0.0000 tpy	0.0000 lb/hr
Methanol						
Methylene Chloride						

Blowdown data from Kinder Morgan

Vented Compressor Blowdowns

Short-term Emissions

450 actual cf/blowdown
26,567 scf/blowdown = 450 acf/blowdown * (964.7 psia / 14.7 psia) * (519.67ºR / 577.67ºR)
1 blowdown/day/compressor @ < 1 min/blowdown
1159.415 lb/compressor/day = 26567 scf/blowdown * 0.0436 lb/scf
2 compressors
2318.829 lb/day = 1159.415 lb/compressor/day * 2 compressors

11.914 lb VOC/day = 2318.829 lb/day * 0.5138 wt. % VOC
0.174 lb HAPs/day = 2318.829 lb/day * 0.0075 wt. % HAP
1.852 lb CO2/day = 2318.829 lb/day * 0.0799 wt. % CO2
2,183.216 lb CH4/day = 2318.829 lb/day * 94.1517 wt. % CH4
27.29 ton CO2e/day = (1.852 lb CO2/day + (2183.216 lb CH4/day * 25 CO2e/CH4)) / 2000 lb/ton

0.00 lb/day n-Hexane = 2318.829 lb/day * 0 wt. % n-Hexane
0.000 lb/day Benzene = 2318.829 lb/day * 0 wt. % Benzene
0.00 lb/day Toluene = 2318.829 lb/day * 0 wt. % Toluene

Annual Emissions

450 actual cf/compressor blowdown
75 blowdowns/year
2 compressors
67,500 acf/yr = 450 acf/compressor blowdown * 75 blowdowns/yr * 2 compressors
3,984,984 scf/yr = 67500 acf/yr * (964.7 psia / 14.7 psia) * (519.67ºR / 577.67ºR)
86.955 ton/yr = 3984984 scf/yr * 0.0436 lb/scf / 2000 lb/ton

0.447 ton VOC/yr = 86.955 ton/yr * 0.5138 wt. % VOC
0.007 ton/yr HAPs/yr = 86.955 ton/yr * 0.0075 wt. % HAPs
0.069 ton CO2/yr = 86.955 ton/yr * 0.0799 wt. % CO2
81.869 ton CH4/yr = 86.955 ton/yr * 94.1517 wt. % CH4
2,046.80 ton CO2e/yr = 0.069 ton CO2/yr * (8186.926 ton CH4/yr *25 CO2e/CH4)

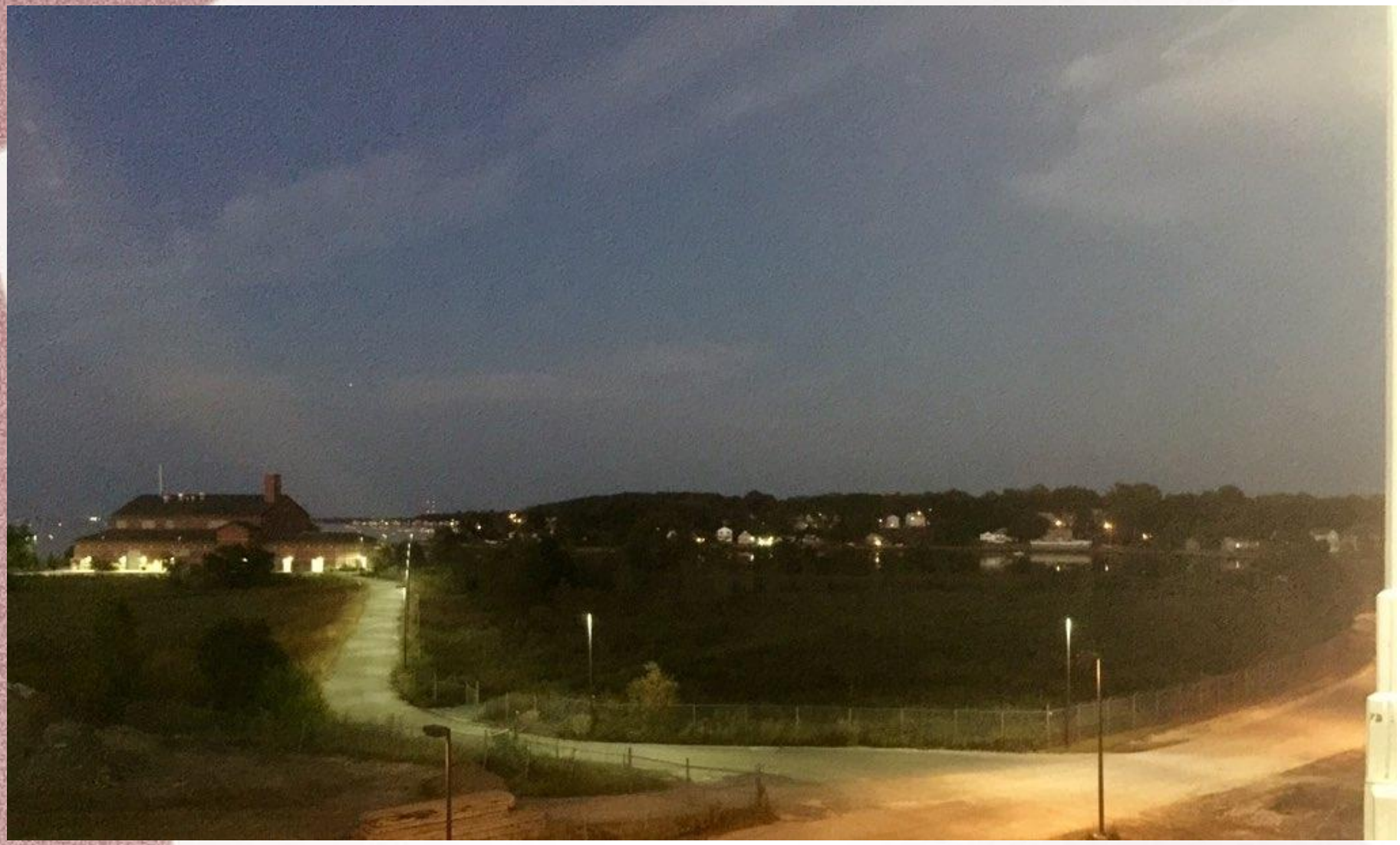
11.20 lb/yr n-Hexane = 86.955 ton/yr * 0 wt. % n-Hexane
1.23 lb/yr Benzene = 86.955 ton/yr * 0 wt. % Benzene
0.65 lb/yr Toluene = 86.955 ton/yr * 0 wt. % Toluene

actual conditions	standard conditions
950 psig	0 psig
964.7 psia	14.7 psia
118 ºF	60 ºF
577.67 ºR	519.67 ºR

Calculation of compressor blowdown from acf to scf based on ideal gas law

$V_{std} = V_{act} * (P_{act} / P_{std}) * (T_{std} / T_{act})$

“Near site” on the bridge



“Far site” on the bridge

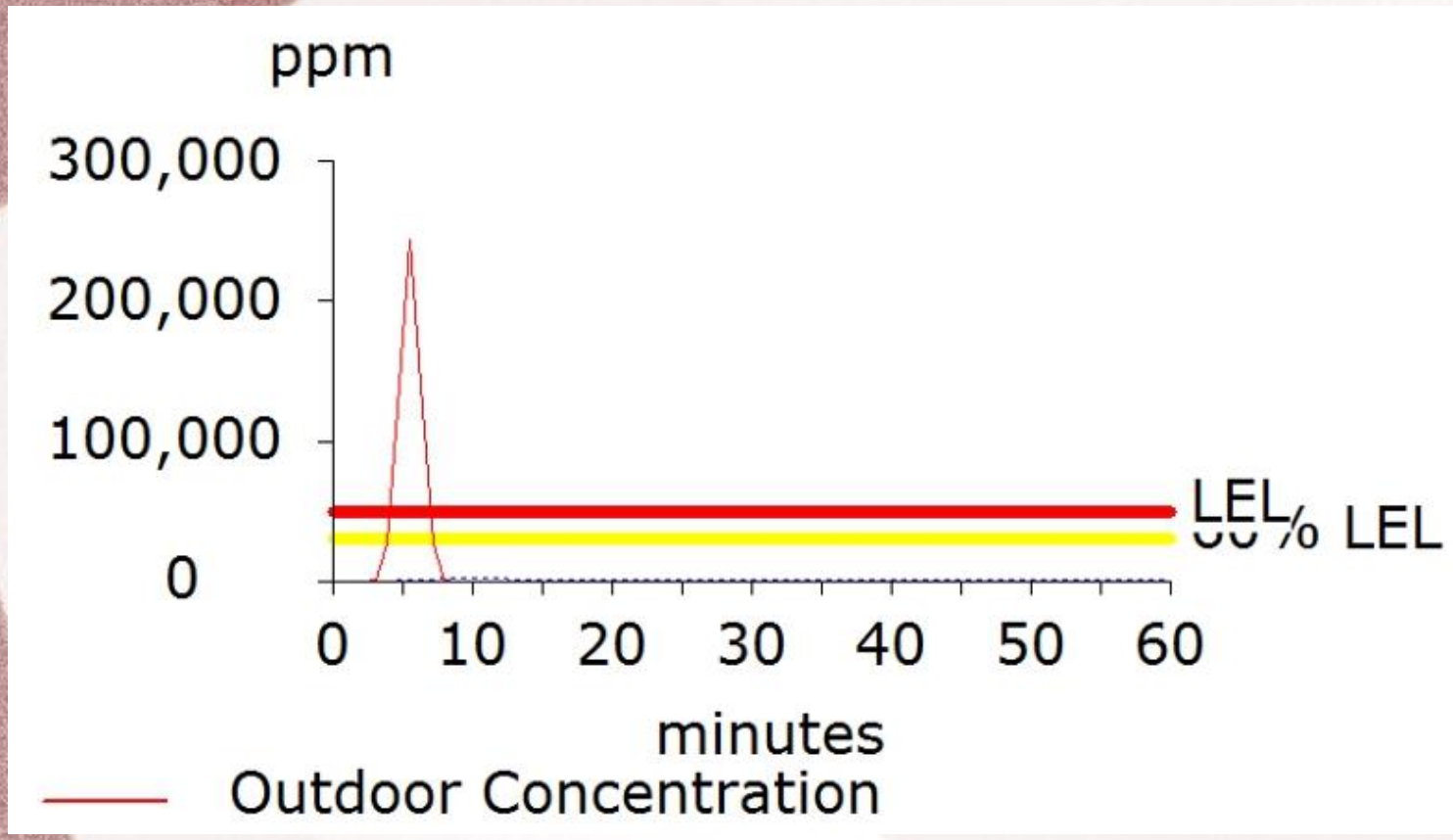
Site locations

MWRA sewage pump station

Gas release location

Near/far locations

What ALOHA calculates

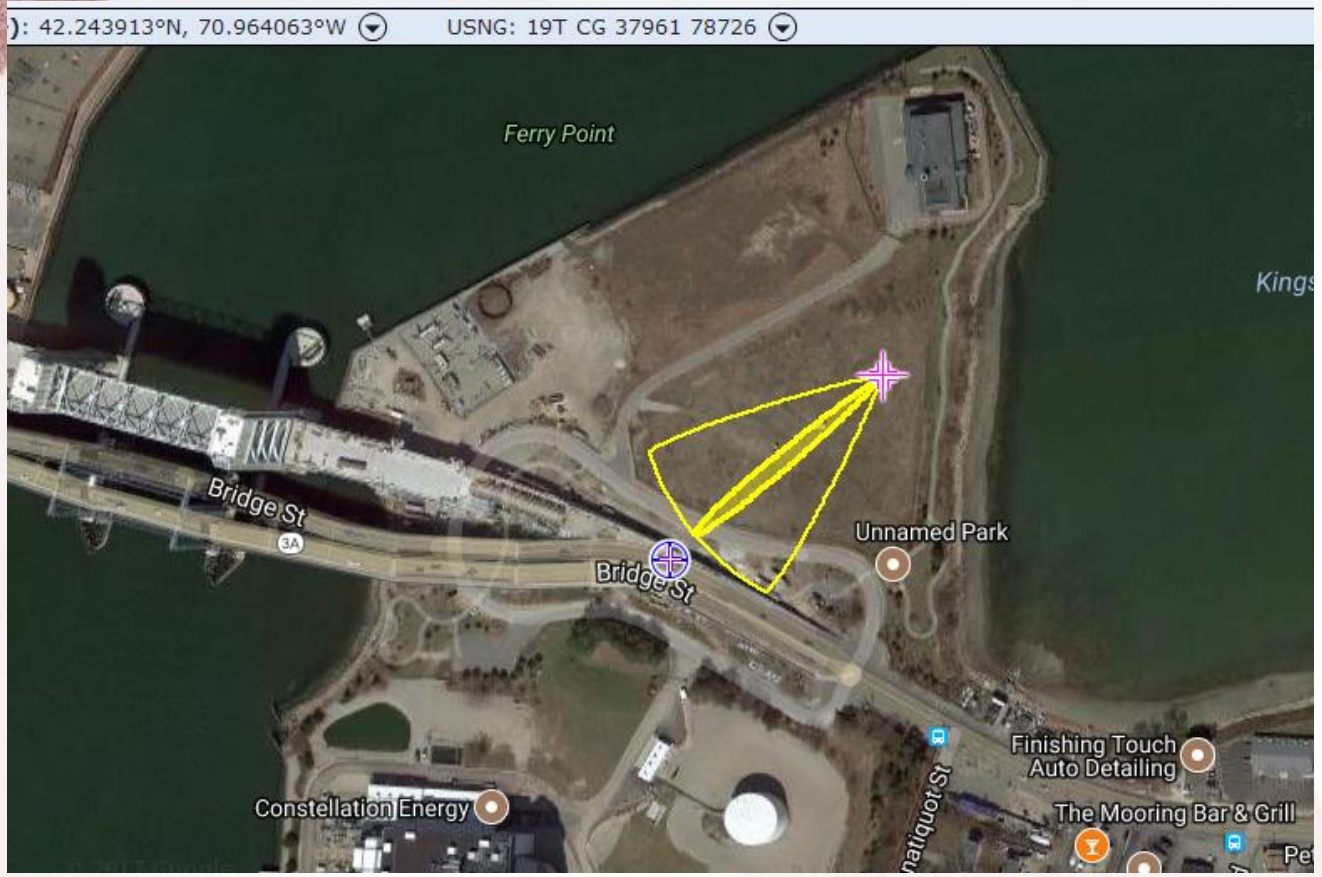


PPM: Parts per million of methane
LEL: “Lower explosive limit”
(concentration where methane ignites/explodes)

Many gas release conditions evaluated with ALOHA

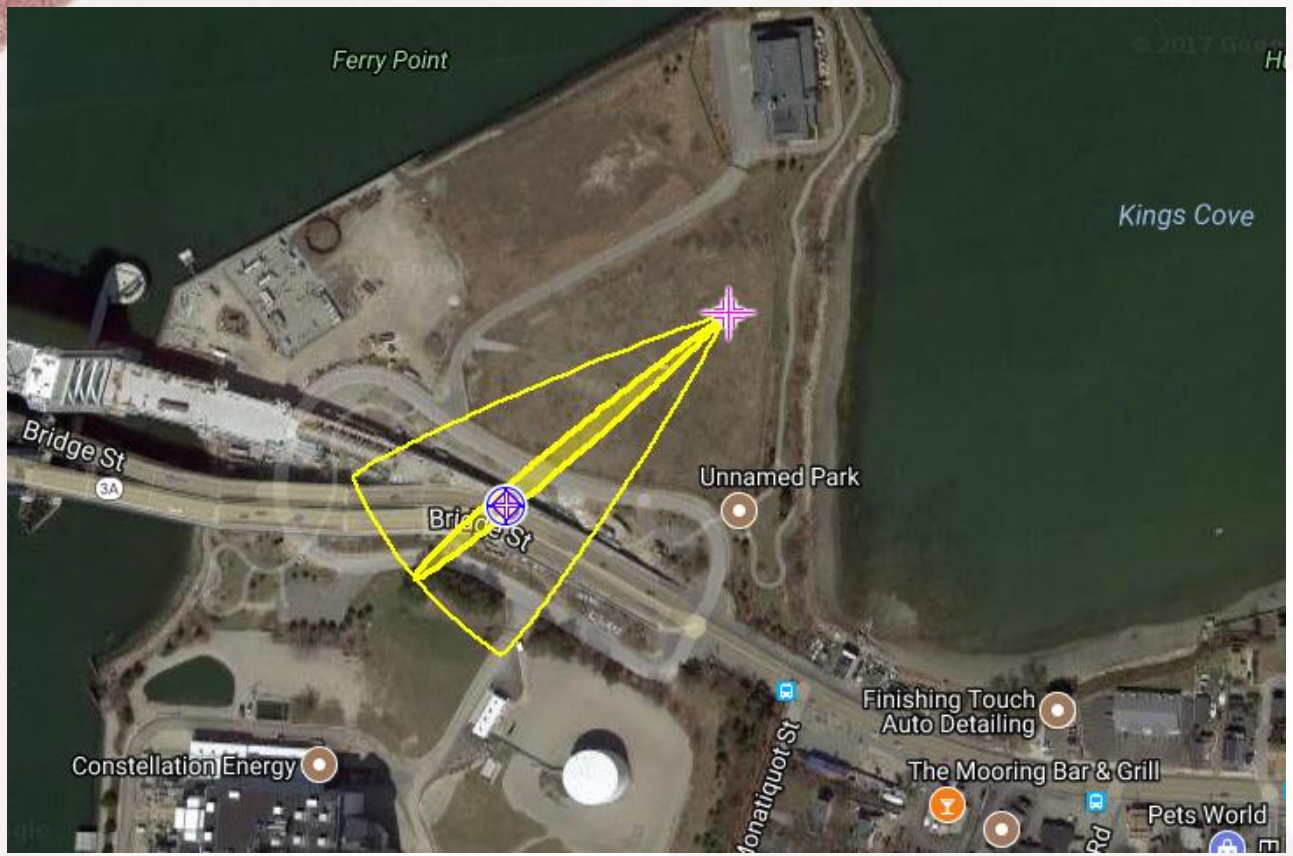
- Site: Near vs far
- Weather: Stable/neutral/unstable
- Size of release (small/typical/large)
- Size of opening
- Pipeline temperature & pressure
- Release conditions (immediate or slow)

Typical size blowdown



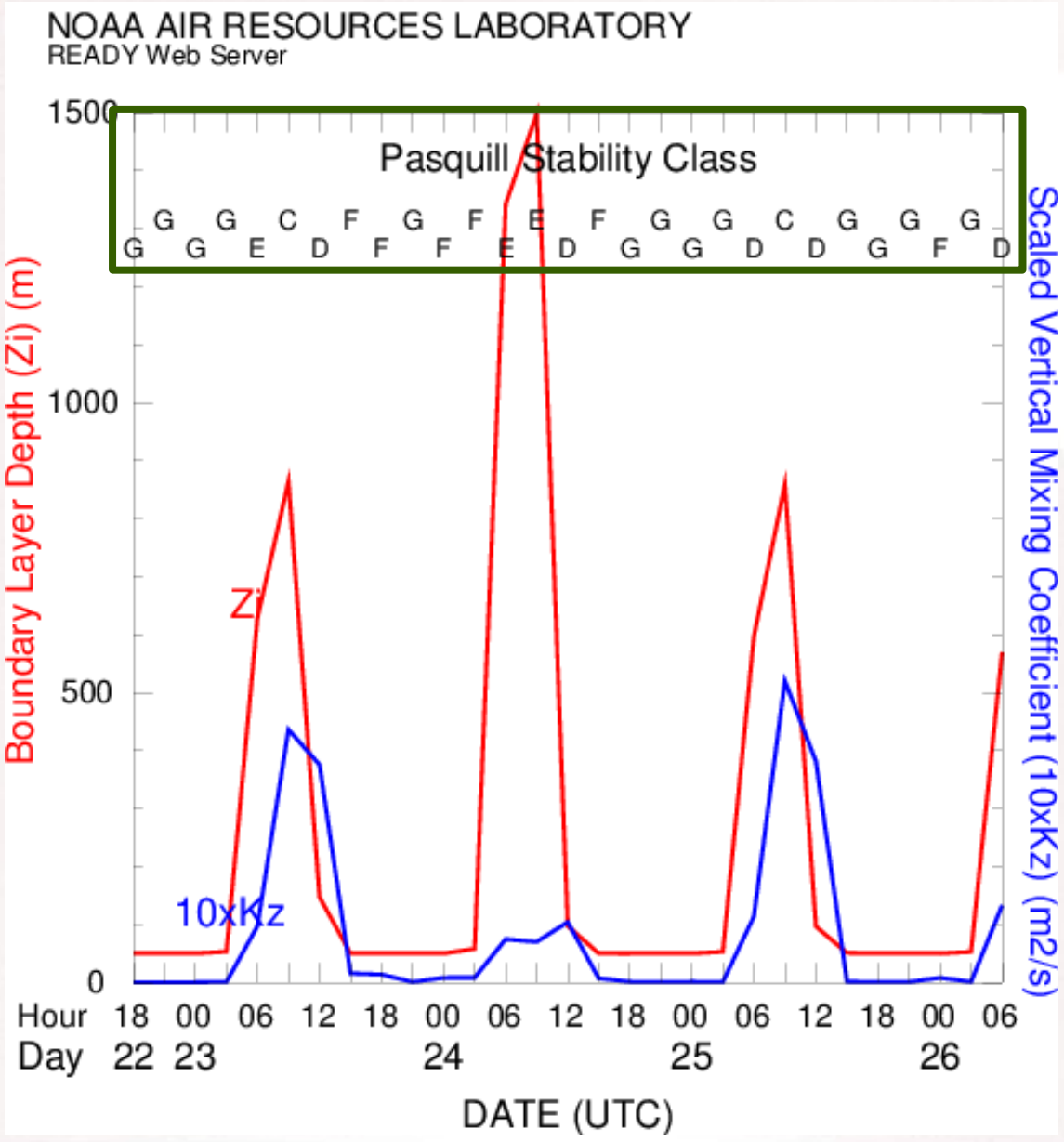
- Yellow = LEL, flammable area
- 26,600 cubic feet of natural gas
- Released under high pressure
- Neutral atmospheric conditions

Typical size blowdown

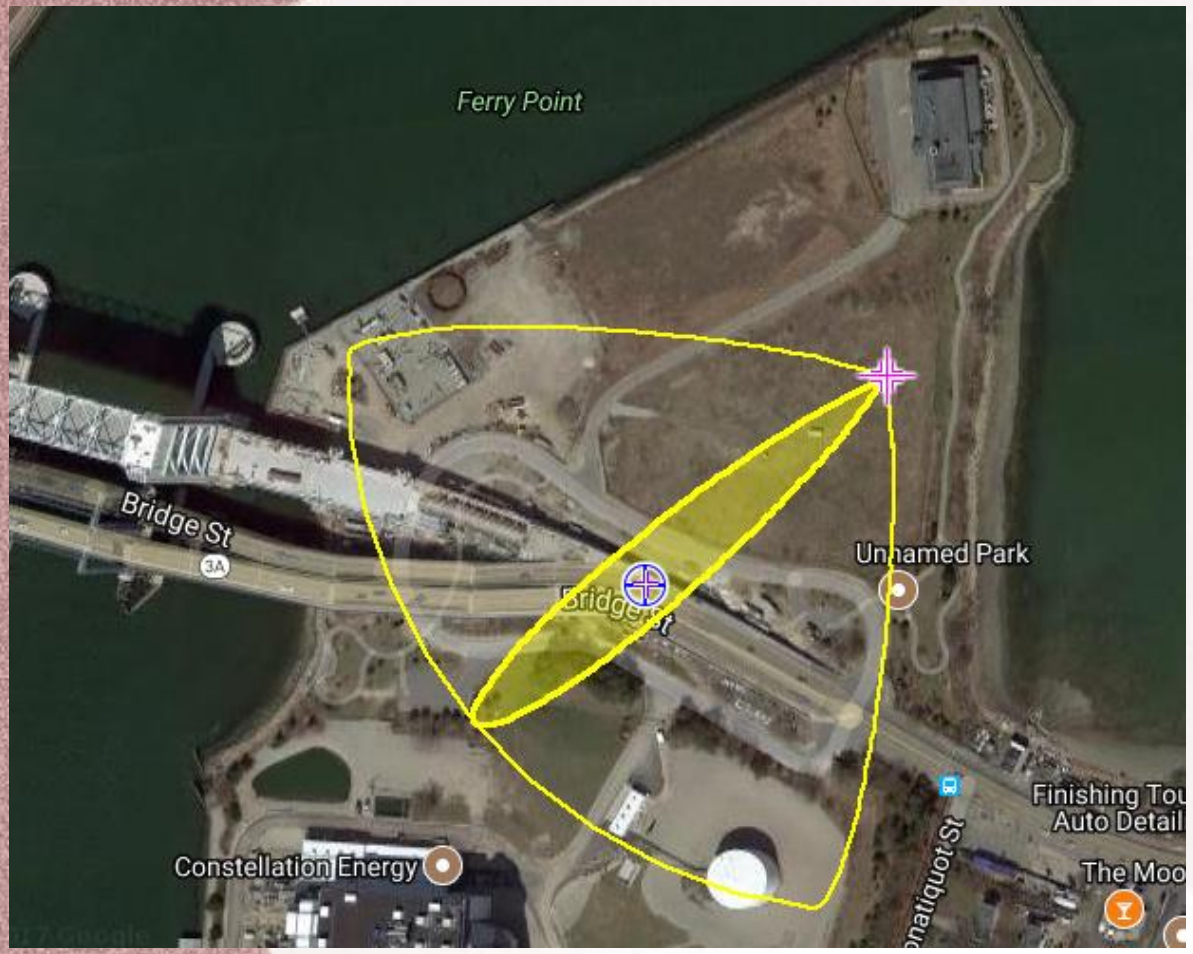


- Yellow = LEL, flammable area
- 26,600 cubic feet of natural gas
- Released under high pressure
- Stable atmospheric conditions

A quick aside... Atmospheric stability

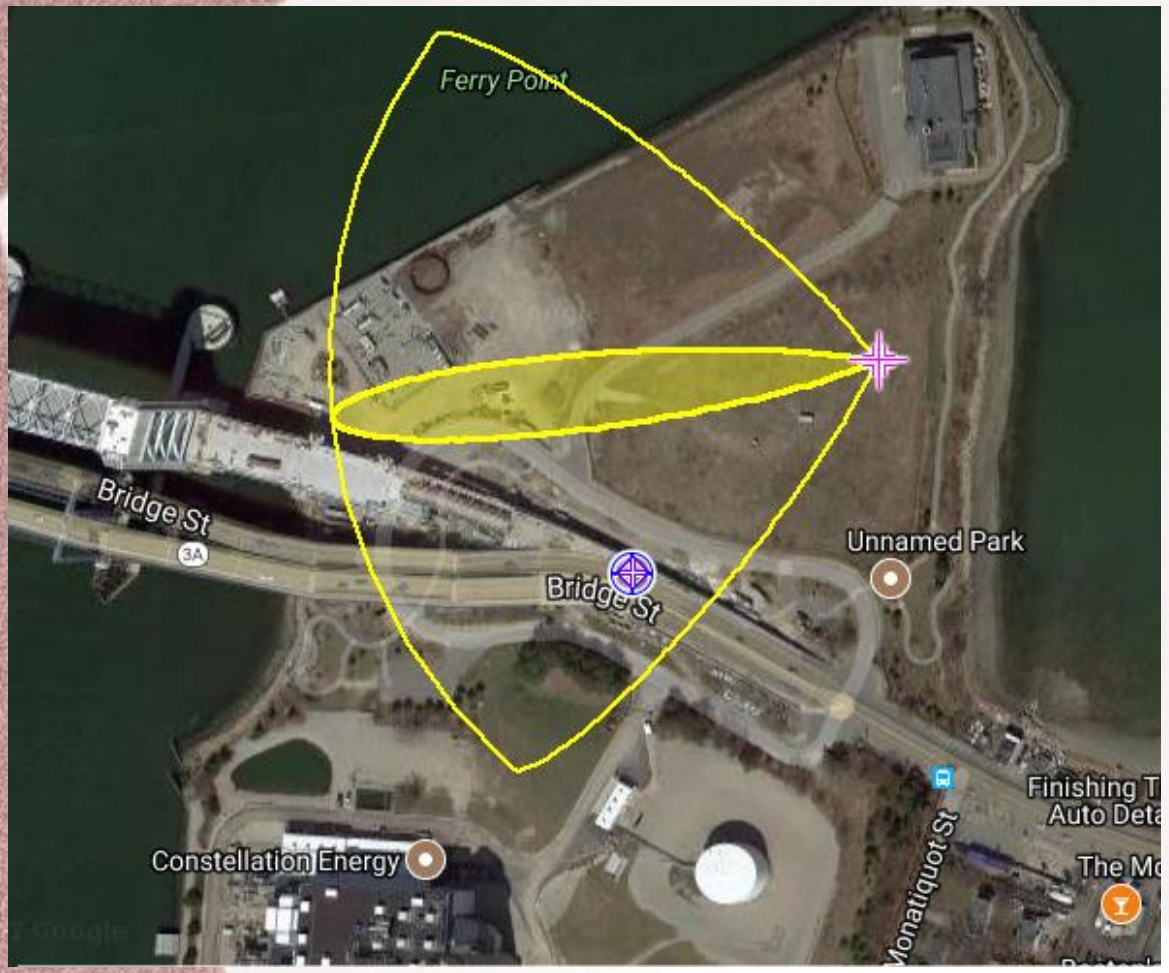


"Large release" scenario, near location



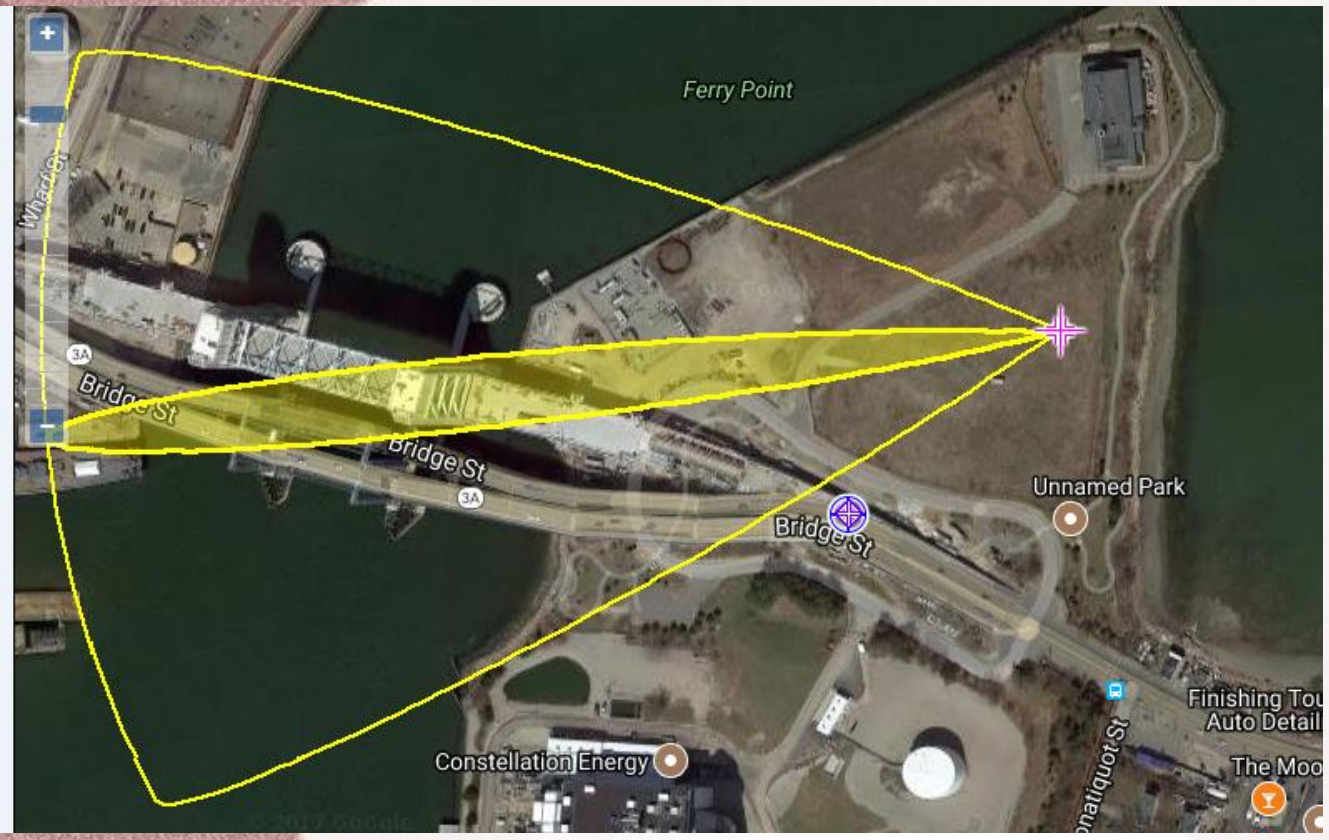
- ~900K cubic feet of natural gas
- Released under high pressure
- Turbulent atmospheric conditions (lots of mixing)

"Large release" scenario, far location



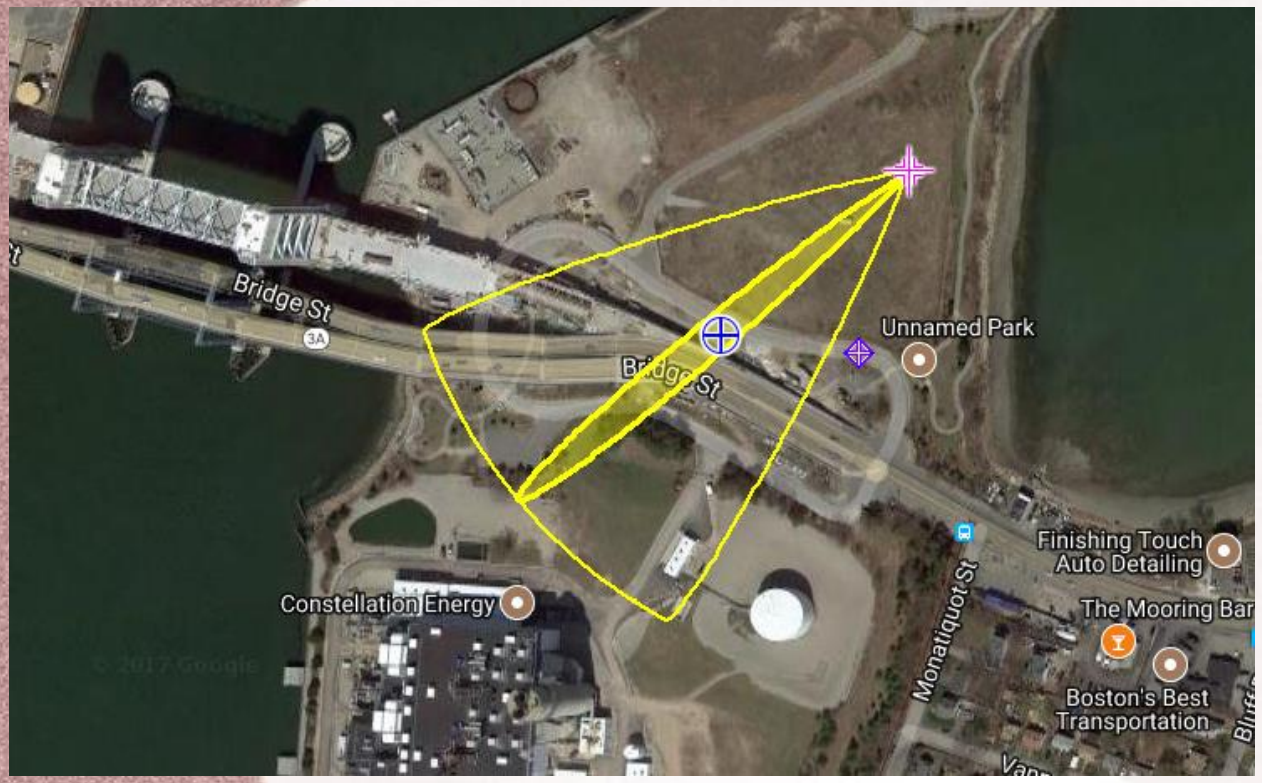
- ~900K cubic feet of natural gas
- Released under high pressure
- Turbulent atmospheric conditions

"Large release" scenario, far location



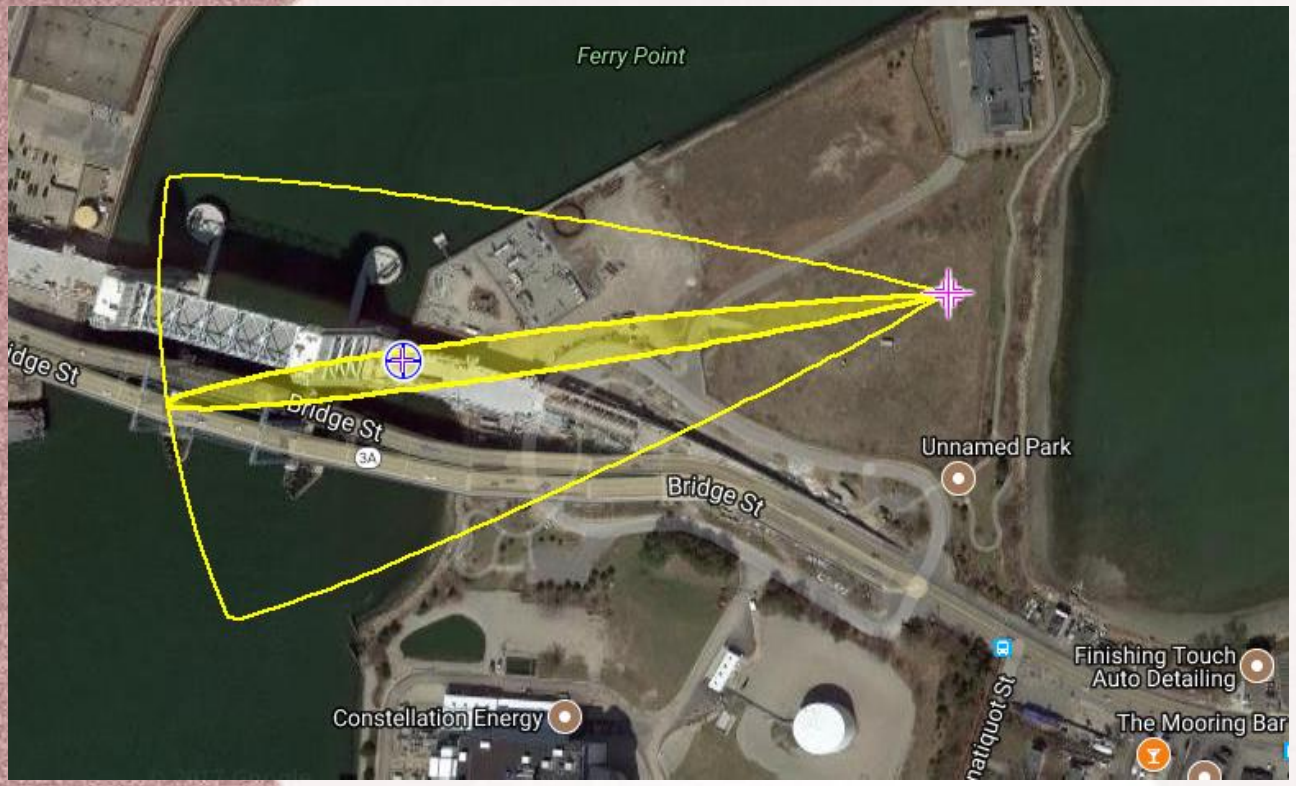
- ~900K cubic feet of natural gas
- Released under high pressure
- "Neutral" atmospheric conditions

“Large release”, controlled pressure



- ~950,000 cubic feet of natural gas
- Released under 200 psi, > 1 hour release time
- Neutral atmospheric conditions

“Large release”, controlled pressure



- ~950,000 cubic feet of natural gas
- Released under 200 psi, > 1 hour release time
- Stable atmospheric conditions

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Title 49: Transportation
PART 192—TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE: MINIMUM FEDERAL SAFETY STANDARDS
Subpart D—Design of Pipeline Components

§192.167 Compressor stations: Emergency shutdown.

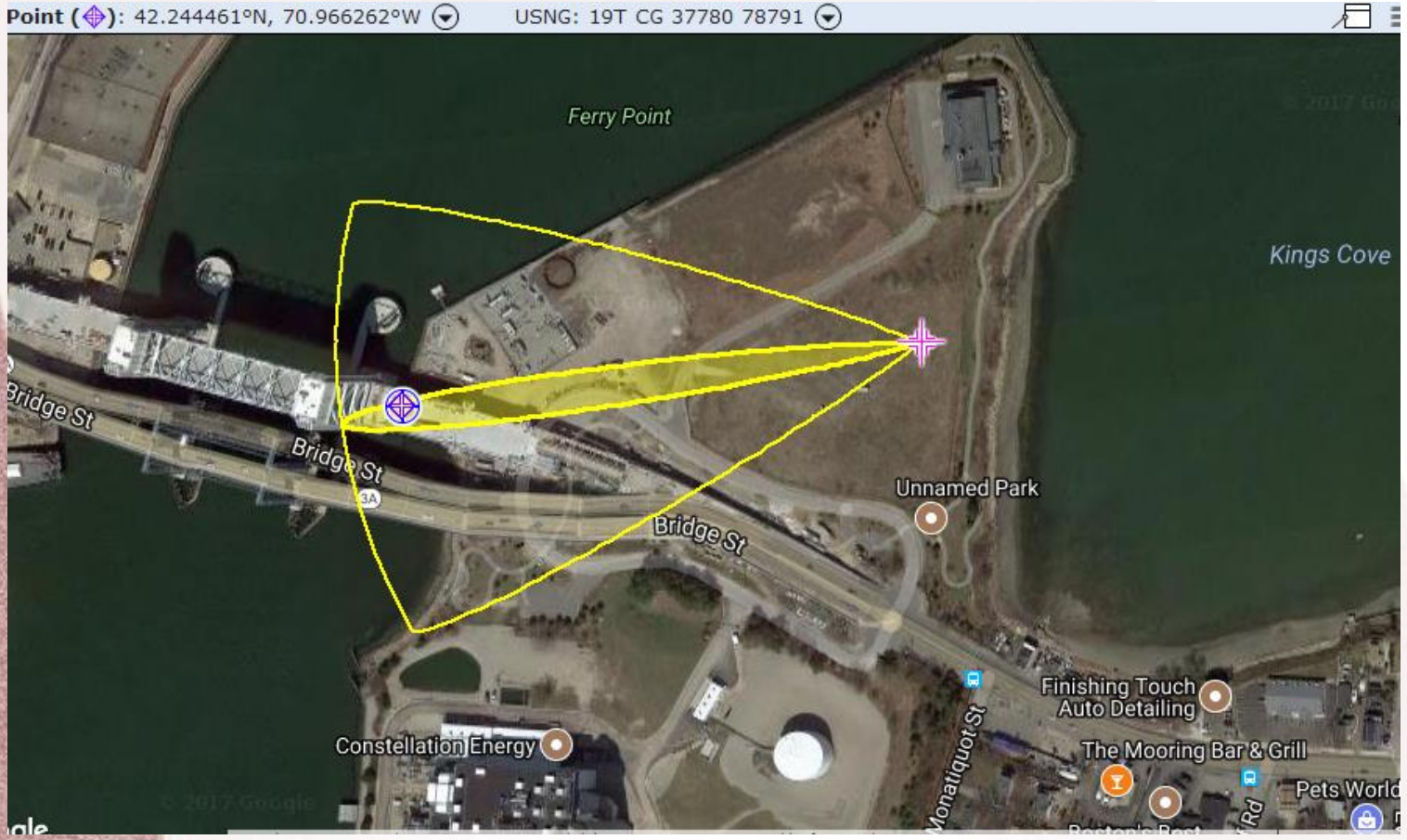
(a) Except for unattended field compressor stations of 1,000 horsepower (746 kilowatts) or less, each compressor station must have an emergency shutdown system that meets the following:

(1) It must be able to block gas out of the station and blow down the station piping.

(2) It must discharge gas from the blowdown piping at a location where the gas will not create a hazard.

Emergency shutdown: Station piping only

- 1200 ft of 24” pipe blowdown (pipeline to station)
- Released under high pressure (750 psi)
- Neutral atmospheric conditions



Conclusions

- Small gas releases could create flammable conditions on the Fore River Bridge under some weather conditions
- Large gas releases could create flammable conditions on the Fore River Bridge under most weather conditions, if it is downwind at the time of release
- There is no indication at this time that the facility will be operated to ensure no flammable conditions around the site

What was left out of the MassDEP draft air permit?

- Effects of blowdowns at Fore River Bridge, MWRA pumping station, tankers, homes, the road under the bridge, etc?
- Health effects of blowdowns including asphyxiation?
- Any regulation of individual blowdowns or blowdown conditions

At this time, we have no indication that the facility will be operated in a way that <u>eliminates</u> flammability risks

Disclaimers

- The ALOHA model is not perfectly accurate
- Not all data about pipeline & blowdowns are publicly available
- Analysis should be treated as “initial rough estimate”
- Relevant details need to be made public to ensure transparency, confidence, safety