MEHA Educational Seminar
Environmental Noise
March 30, 2011

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Presented by: John Hovsepian

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- Founded in 1989
- Providing a full range of EHS & Sustainability Services to Government, Chemical, Financial, Construction, Environmental, Biotech, Semiconductor & General Industry Clients
- Locations: World Headquarters in Burlington, MA, Offices in Newport Beach, CA, Chicago, IL, Atlanta, GA, Baltimore, MD., Phoenix, AZ., Portland OR., Dallas, TX., Los Angles, CA., Naples, FL., San Francisco, CA., & Denver, CO.

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MUNICIPALITY CONTRACTING WITH EBI

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Service No.	Service Category
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E2	Title V Septic System Inspection
E3	Asbestos Testing
E4	Soil, Water and Hazardous Material Characterization
E5	Lead Testing
E6	Underground Storage Tank Testing (petroleum and other hazardous materials)
E7	LSP Services
E8	Environmental Multi-media Auditing Services
E9	Stage II Compliance Certification
E10	Lab Services

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Outline

1. Principles of Sound/Noise
2. Applications
3. Sound and Human Perception
4. Measuring Sound
5. Modeling Sound/Noise
6. Environmental Noise Regulation
7. Case Study

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Principles of Sound

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What is Sound?

- A rapid pressure fluctuation above and below the static atmospheric pressure measured in decibels (dB).
- Audible Frequency Range 20 Hz to 20,000 Hz
- Elements of sound include power, intensity and pressure

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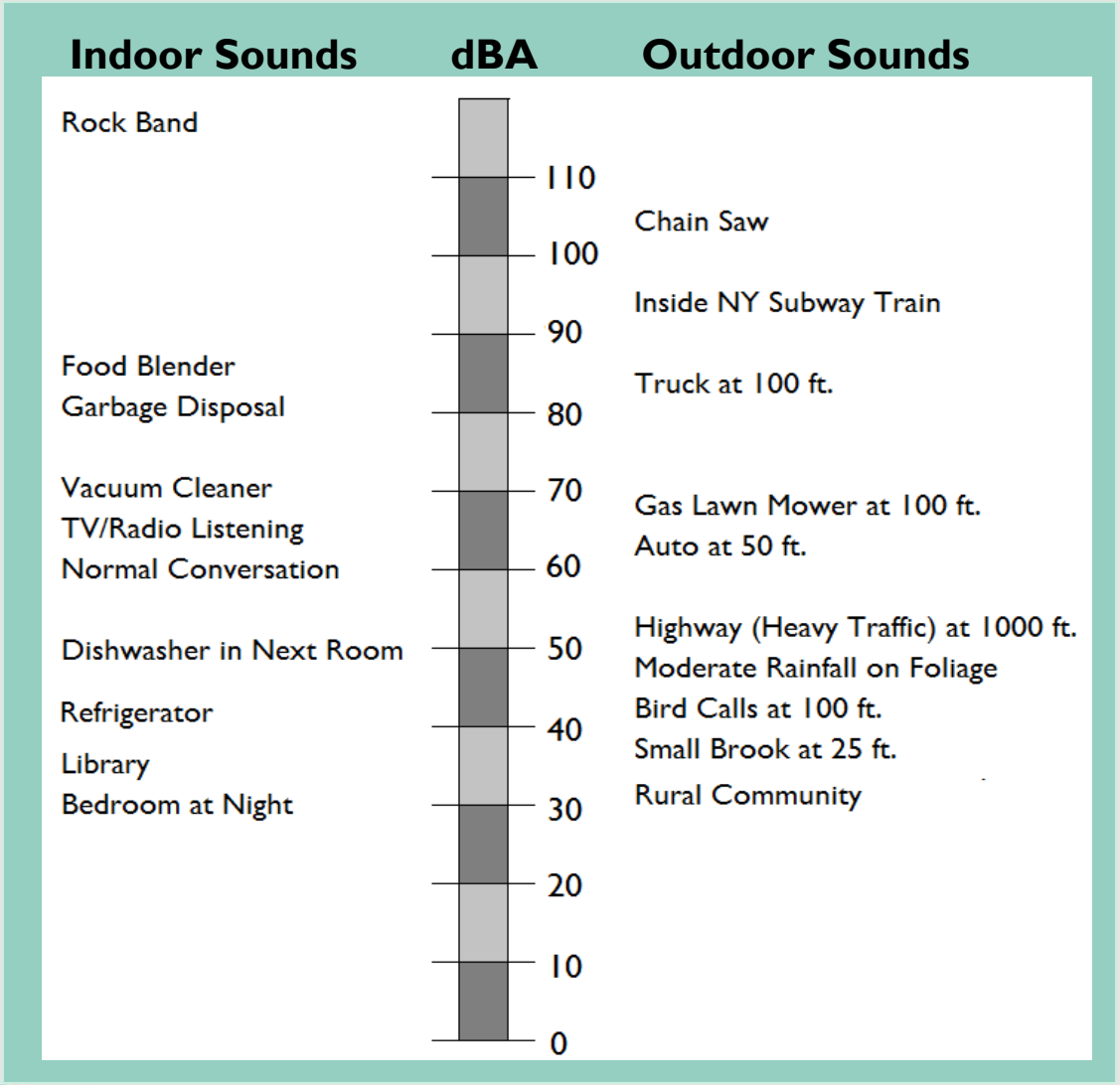
Common Sounds



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What is Noise?

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Applications / Industries

- Industrial Equipment
- Commercial Appliances
- Power/Turbines
- Transportation

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Why is Environmental Noise Important?

- Noise is a health risk.
- As cities and transportation routes expand, more people are exposed to noise.

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Sound and Human Perception

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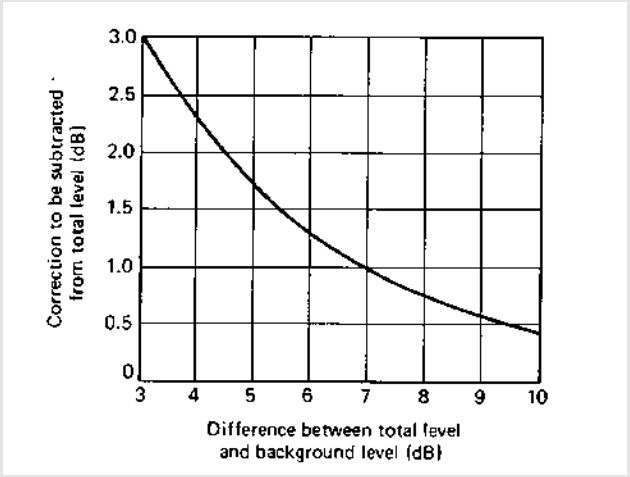
Definitions

- Decibel (dB) is a measure of the sound pressure level
  - Logarithmic scale
  - 70 dB + 70 dB = 73 dB
- L_{eq} Average
- L_{90} - Quietest 10%
- L_{10} - Loudest 10%
- L_{dn} - D



Increase in Sound Level (dB)	Increase in Perceived Loudness
1-3	Barely perceptible
5	Noticeable
10	Twice as loud
15	Significant change
20	Four times as loud

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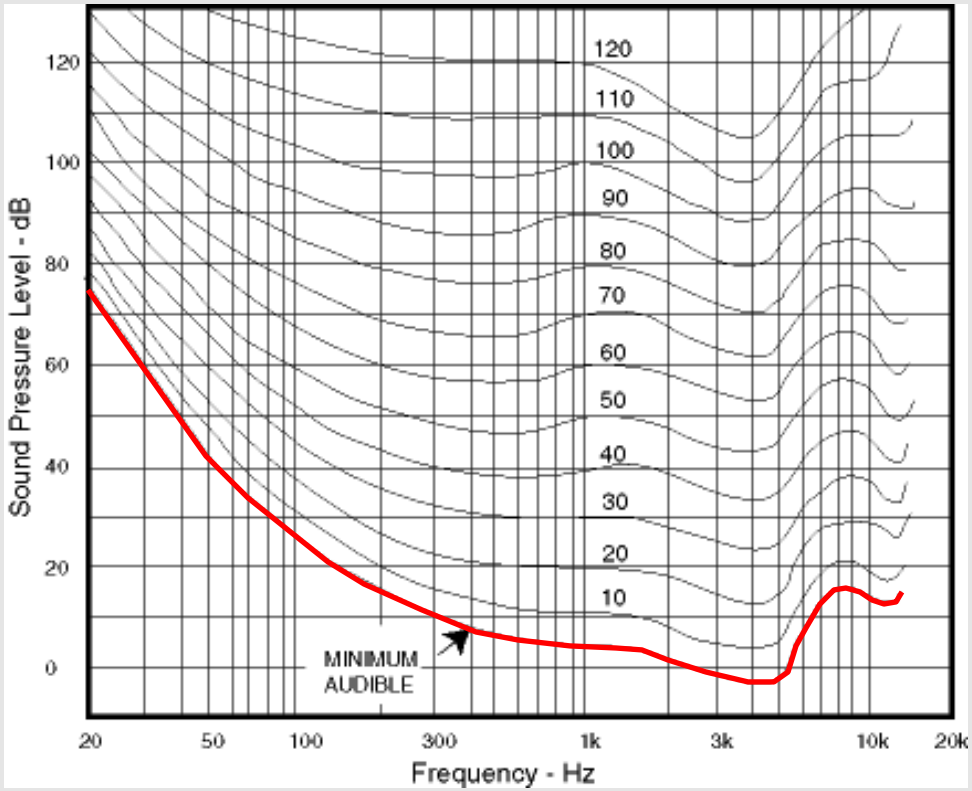
Sound and Human Perception



Threshold of hearing is higher for lower frequencies

All frequencies are audible if level is high enough.

30 dB @ 1000 Hz is equally as loud as 65 dB @ 40 Hz.

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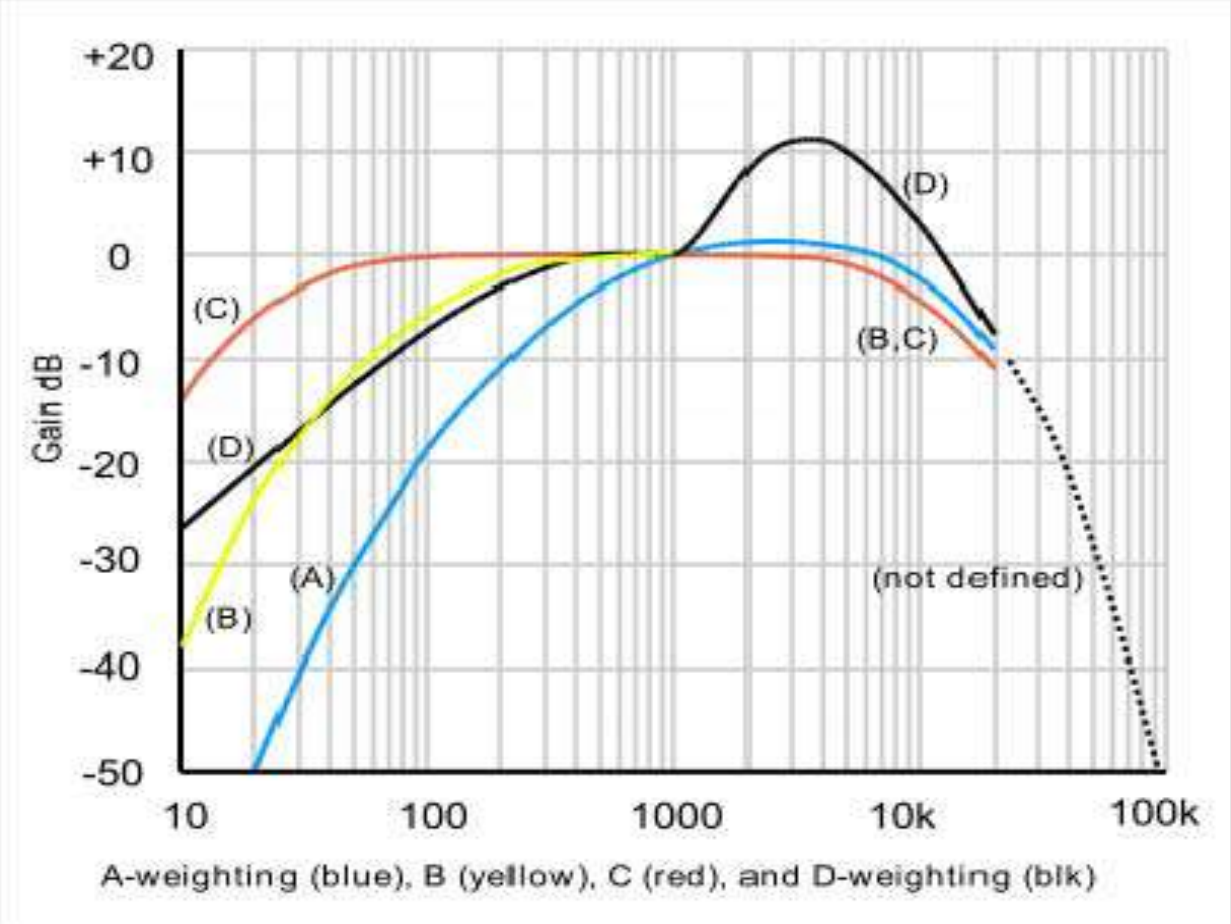
Frequency Weighting Curves



A-weighting (blue), B (yellow), C (red), and D-weighting (blk)

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Subjectivity of Perceived Noise

- Tonal
- Impulsive or excessively amplitude modulated
- Community Characteristics
  - Urban/Rural
  - Terrain

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Adverse Effects of Sound

- Hearing Loss >80-85 dBA
- Speech Interference
  - 50-55 dBA raised voices
  - 80+ dBA shouting required
- Task Interference > 70 dBA
- Sleep Disturbance – variable
- Annoyance - variable

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Measuring Sound

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Noise Field Work

- Field Considerations
  - Weather
  - Wind Speed
  - Sampling Area (Source/Receptors)
  - Time of Day
  - Instrument (Octave Band Analyzer vs Sound Level Meter)

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Modeling Noise

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Noise Modeling

- Modeling Incorporates: Source, Path and Receiver
- Inputs
  - Topography / Structures (GIS/CAD files)
  - Existing Sound Levels
  - Equipment Sound Specifications
  - Barriers
- Outputs
  - Post-construction sound levels at receptors
  - Sound Level maps

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Environmental Noise Regulations

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Exterior Noise Federal Guidelines (dBA)

Agency	L_{eq}	L_{dn}
U.S. Environmental Protection Agency (EPA)	49	55
U.S. Department of Housing and Urban Development (HUD)	59	65
Federal Highway Administration (FHWA)	67	67
Federal Aviation Administration (FAA)	59	65

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State Regulations

- The MassDEP's Noise Policy states that a new noise intrusion may not increase the broadband sound level by more than 10 dBA over the pre-existing L90 ambient level.
- Tonal sounds, defined by any octave band level that exceeds the levels in adjacent octave bands by 3 dB or more, are also prohibited.
- The MassDEP usually defers to applicable quantitative local ordinances when available.

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Effective Local Regulation (Lowell)

- Defines ambient Noise Level
- Specifies equipment, procedures and ANSI standards to be used in measuring noise.
- Sets daytime and nighttime noise limits

	District	Time	Sound Level db(A)
	Single-Family	7:00 a.m. to 6:00 p.m.	50
	Two-Family	6:00 p.m. to 10:00 p.m.	45
	SSF, TSF, TTF, USF*	10:00 p.m. to 7:00 a.m.	40
	Multifamily	7:00 a.m. to 6:00 p.m.	60
	Neighborhood Business	6:00 p.m. to 10:00 p.m.	55
	SMF, TMF, NB, UMF*	10:00 p.m. to 7:00 a.m.	50
	Regional Retail	7:00 a.m. to 6:00 p.m.	60
	RR*	6:00 p.m. to 10:00 p.m.	55
		10:00 p.m. to 7:00 a.m.	55
	Mixed Use and Downtown	7:00 a.m. to 6:00 p.m.	60
	SMU, TMU, UMU, DMU*	6:00 p.m. to 10:00 p.m.	55
		10:00 p.m. to 7:00 a.m.	50
	Light Industry	7:00 a.m. to 6:00 p.m.	60
	LI*	6:00 p.m. to 10:00 p.m.	55
		10:00 p.m. to 7:00 a.m.	55
	Heavy Industry	7:00 a.m. to 6:00 p.m.	70
	GI*	6:00 p.m. to 10:00 p.m.	55
		10:00 p.m. to 7:00 a.m.	55
	Office Park and Institutional	7:00 a.m. to 6:00 p.m.	70
	OP, HRC, INST*	6:00 p.m. to 10:00 p.m.	55
		10:00 p.m. to 7:00 a.m.	55
	Public Parks and Recreation	7:00 a.m. to 6:00 p.m.	60
		6:00 p.m. to 10:00 p.m.	55
		10:00 p.m. to 7:00 a.m.	40
	*Refers to zoning districts.		

(2)
Where the ambient noise from other than identifiable sound sources is determined to be higher that the maximums listed above, the maximum permissible sound level shall be five decibels higher than the ambient noise level.

(3)
Where properties in two or more districts join at a common boundary, the maximum noise level shall be the arithmetic mean of the maximum levels for each of the properties affected.

C.
Residential.

(1)
For residential dwelling units contained in a single structure, it shall be unlawful for any person to operate or cause to be operated within a dwelling unit any source of sound or allow the creation of any sound which causes the sound level when measured inside another dwelling unit located in the same structure to exceed the sound level limits set forth below:

	10:00 p.m. to 7:00 a.m.
	7:00 a.m. to 10:00 p.m.

than identifiable sound sources is determined to be higher than the sound-level limits listed above, the maximum permissible interior sound level shall be five decibels higher than the ambient noise level.

D.
Enclosed places of public entertainment.

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Less Effective Local Regulation

Noise, Litter and Smoke Standards Article III, Section 3.8

- No noise, sound from public address or other amplification systems, vibration, or flashing shall be normally perceptible more than 350 ft. from the premises if in an industrial or general district, more than 50 ft. from the premises if in a commercial district, and more than 20 feet from the premises if in a residential district. Interferences originating in an industrial or general district shall not normally be perceptible more than 150 feet within a commercial district, or more than 100 feet within a residential district.

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What Makes a "Good" Regulation?

- Specify noise limits and parameters (day, night, zoning district, etc.)
- Exemptions
- Details pre and post-construction noise study parameters.
  - Criteria for establishing background levels
  - Acceptable modeling methods and assumptions
  - Identification of receptors

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MEHA Educational Seminar
Outdoor Nuisance Odor
March 30, 2011

Prepared & Presented by: Andy Roland

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Topic Outline

- Odor in the News
- Defining Odor and Nuisance Odor
- Response to Complaints
- Odor Monitoring
- Odor Abatement Methods & Technologies

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Odor in the News

- Washington D.C. (October 2010)
  - Steptoe & Johnson (law firm) vs. Rogue States (burger Joint)
  - Law firm sues restaurant, claiming odors from the grill exhaust constitute an unreasonable interference.
  - D.C. Superior Court orders Rogue States to shut down its restaurant.

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Odor in the News

- Raynham, MA (May 2010)
  - Town of Raynham petitions MassDEP to investigate nuisance odors emanating from a grease and sewerage processing plant.
  - The town has been in dispute with the facility since 2006.

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Defining Odor

- An individual's perception of odor involves cognitive interpretation.
- A person's interpretation can be related to:
  - Gender
  - Age
  - Sensitivity and Ability to Discriminate Odors
  - Personal Preference/Aversion
- Therefore, no analytical measurement method is available.

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Defining Odor

- Odor is Perceived in Four-Dimensions
  - Concentration
    - detection vs. recognition
  - Intensity
    - perceived strength
  - Character
    - “fishy”, “rancid”, “ammonia”, etc.
  - Hedonic Tone
    - perceived pleasantness or unpleasantness

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The Gray Line

- It is hard to draw a distinct lines between an acceptable odor, a nuisance odor and an outright public health problem based on physical symptoms in the impacted community.
- Effects that are not always considered symptoms of chemical exposure have been sufficient for people to claim an odor nuisance.
  - i.e. anxiety, depression, etc.

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Odor Rule of Thumb

When to Act?

- Measures to contain or eliminate unpleasant odors and prevent their migration to the community are warranted when these odors create a persistent nuisance.

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Odor Complaint Response

- Developing an effective response protocol to address odor complaints is critical. Issues that need to be considered in developing a protocol:

  1) Is this a legitimate complaint?

  2) When is enough, enough?

  3) Are we making progress?

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Odor Monitoring

- Monitoring odor events will help verify the sources of odor and the environmental conditions that might affect the events.
- Can be used to assess effectiveness of control technologies.

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Quantifying Odor Nuisance

- Direct field observations are a dependable and cost-effective method for quantifying environmental odor impacts.
- Quantifiable results can be obtained with simple word intensity scales or n-butanol intensity scales with standard odor description nomenclature.

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Quantifying Intensity

- ASTM E544-89: Standard Practice for Suprathreshold Intensity Measurement
- Odor intensity quantification can be accomplished by using an “Odor Intensity Referencing Scale” (OIRS)[3].
- Compares the odor in the ambient air to the odor intensity of a series of concentrations of a reference odorant. Commonly n-butanol is used.

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Quantifying Concentration

- ASTM E679-91: Standard Practice for Determination of Odor Threshold
- A laboratory procedure where successive dilutions are used to estimate an odor's "detection threshold" and "recognition threshold".
- This procedure can be simulated in the field using a "Field Olfactometer"

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The Smell-o-meter

- An experienced technician can estimate an odor's concentration using a field dilution device.
- Also, they look pretty cool doing it!

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Air Sampling

- Air sampling around the facility and in the community can identify chemical constituents of odorous emissions, and can narrow down the list of possible sources.
- It can also assist in selecting the most effective odor control technology.

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Odor Abatement

- When an odor source is identified and determined to be creating an odor nuisance condition, odor abatement technologies should be implemented.

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Odor Abatement Strategies

- There are three general categories of odor control technologies:

1) Reduce the Generation of Odor
2) Decrease the Emission of Odor
3) Increase the Dilution of Odor

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Reduce Odor Generation

- Technologies that reduce the production of odorous gases include:
  - Process modification
  - Elimination of the odor source
  - Chemical addition or adjustment
  - Biological additives

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Decrease Odor Emission

- Technologies that decrease the emission of odorous gases include:
  - Gas capture and treatment systems:
    - Biological (i.e. thiobacillus biofilters)
    - Chemical (i.e. gas neutralization)
    - Physical (i.e. carbon scrubber, flare)

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Increase Odor Dilution

- Technologies that increase odor dispersion and help increase the dilution of odorous gases include:
  - Moving process to increase setback
  - Increase source stack height
  - Windbreak walls

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Successful Odor Abatement

- Successful odor abatement can be extremely difficult to demonstrate.
- Some quantitative analysis is necessary to show real improvement.

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Community Outreach

- The most important part of any odor abatement program might be a comprehensive community communication and education program.
- Should try to keep the community abreast of the progress of any abatement program.
- Demonstrate a desire to correct the problem and minimize odor impact.

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Questions?

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