Ambient Impact Analyses for Air Permitting

NTH Consultants, Ltd.
Infrastructure Engineering
and Environmental Services

AWMA PTI Workshop

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Agenda

- Ambient Impact Analyses for Air Permitting
  - How do we determine if Dispersion Modeling is necessary?
  - What other options are available?
    - Guidance and Methodology
    - Case Study

Methodology for Permitting Projects

- **Step 1**
  - Determine if Modeling Is Necessary ← Our focus today.
- **Step 2**
  - Model Project Only Emissions
- **Step 3**
  - Conduct Refined Modeling:
    - Prevention of Significant Deterioration (PSD) Increments
    - National Ambient Air Quality Standards (NAAQS)
- **Step 4**
    - Address Ozone and $PM_{2.5}$ Precursors, if required

Methodology for Permitting Projects

- **Determine if Modeling is Needed**
  - All PSD major modifications and new major sources require modeling
  - Other “minor” PTI applications
    - Criteria pollutant modeling completed at AQD request or guidance
    - Based on emission rates, stack parameters/dispersion, and local impacts
    - State toxics modeling may be required
  - Modeling can dictate project parameters including stack heights, emission rates, and operational flexibility.
  - Modeling can drastically delay PTI preparation and review, but so can back and forth with AQD over whether it is required.

Methodology for Permitting Projects

- **Determine if Modeling is Needed**
  - Possible Outcomes:
    - No Modeling Required

Methodology for Permitting Projects

- **Determine if Modeling is Needed**
  - Possible Outcomes:
    - Qualitative Demonstration Allowed for Criteria Pollutants (Michigan)
    - Screening Level Analysis for Ambient Impact Ratios (AIR) for Toxics

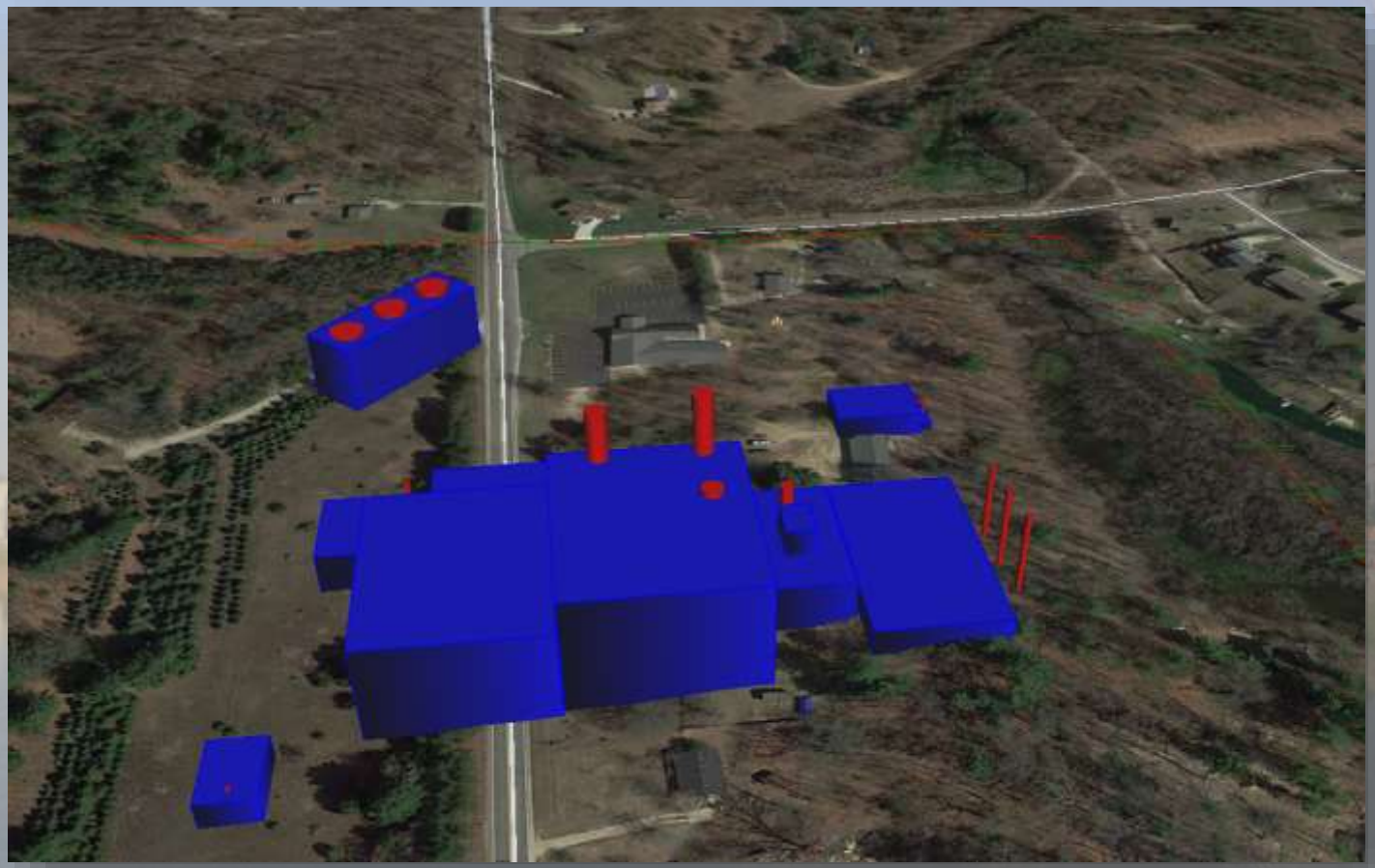
Methodology for Permitting Projects

- **Determine if Modeling is Needed**
  - Possible Outcomes:
    - Modeling for One or More Pollutants Required

Case Study

- **New Combined Cycle Combustion Turbine Facility**
  - 200 Megawatt Capacity
  - 2 Combined Cycle Turbines
  - Ancillary Equipment
    - Engines
    - Auxiliary Boiler
    - Fuel Gas Heater
    - Cooling Towers
- **Pollutants of Concern Typically Include**
  - Nitrogen Oxides (NO_x)
  - Fine Particulate Matter ($PM_{10/2.5}$)
  - State Air Toxics

Case Study



Case Study

- Criteria Pollutants

Pollutant	Emission Rate (tpy)	SER (tpy)	Modeling Required?
NO_x	300	40	Yes
SO_2	39	40	Maybe
$PM_{10/2.5}$	100	10 / 15	Yes
CO	400	100	Yes
VOC	200	NA	NA

- State Air Toxics - Allowable Emission Rates (AER)

Case Study

- **Determine if Modeling is Needed**
  - Consult AQD-022 Policy Memo for criteria pollutants.
    - AQD-022 tells us when we are required to model, not how.
    - Updated November 30, 2018 (Really Spring 2019)
  - State Air Toxics (Rules 225 – 227)
    - Allowable Emission Rates (AER)
    - Ambient Impact Ratios (AIR)

Case Study – AQD-022

- **Some updates in the recent version of AQD-022:**
  - Easier to read and better organized
  - "Demonstration" is defined
  - Examples of when a Qualitative Assessment may be appropriate
    - Sources modeled in the last 3 years
    - Switching to cleaner fuels
    - Installation of control equipment with similar stack parameters
  - Streamlined the Examples section
  - Helpful language:
    - *"Because there is no increase in potential or allowable hourly emissions… the requirement to submit a demonstration would not typically apply to the project.*

Case Study – AQD-022

- **AQD-022 requires us to consider:**
  - Facility size (major PSD source vs. minor source)
  - Project size (significant increase or significant net increase)
  - Project emissions
    - All potential emissions from installed or modified sources!
    - No netting reductions allowed!

Case Study – AQD-022 Tables

Pollutant	Emission Rate (tpy)	SER (tpy)	Stack Height Meets AQD-22 Table 1?	Demonstration Required?
SO_2	39	40	Yes	No

Allowable Emissions	Stack Requirements[1]	Demonstration Required[2]
Greater than SER	As necessary to meet NAAQS and PSD increment	Y[3]
100%-50% of SER	Minimum height: 60 feet and 1.5 times the building height Orientation: Vertically unobstructed	N
	Minimum height: 30 feet Orientation: Vertically unobstructed Building: No Downwash[4]	N
25%-50% of SER	Minimum height: 40 feet and 1.5 times the building height Orientation: Vertically unobstructed	N
	Minimum height: 20 feet Orientation: Vertically unobstructed Building: No Downwash[4]	N
Less than 25% of SER	None	N

Case Study – AQD-022

- **Demonstrations**
  - If not meeting AQD-022 tables, a “demonstration” will be required. A “demonstration” means:
    - Qualitative Assessment (QA); or
    - Dispersion Modeling

Pollutant	Emission Rate (tpy)	SER (tpy)	Stack Height Meets AQD-22 Table 1?	Demonstration Required?
SO_2	39	40	Alternate Scenario - No	Yes

Qualitative Assessment for Criteria Pollutants (Michigan)

- **From AQD-022:**
  - *"A qualitative assessment is an evaluation of the emissions from a potential project that does not include air dispersion modeling, but instead includes a demonstration that the proposed emissions will not interfere with the NAAQS and/or the PSD Increment."*
  - *"For an existing source that is not triggering a major PSD modification and the emissions are not greater than the SER, a qualitative air quality assessment may be used. For emissions greater than SER, a qualitative assessment may be considered with prior approval from the AQD."*
  - *"If the qualitative assessment cannot demonstrate that no adverse impacts to air quality would be expected, a screening analysis should be performed next."*

Qualitative Assessment for Criteria Pollutants (Michigan)

- **Some Factors to Consider:**
  - Current Air Quality Conditions
  - Expected Impact of Permitted Source
  - Previous Modeling Results (if Available)
  - Emissions Decreases
  - Meteorology
  - Terrain
  - Distance to Ambient Air
  - Associated Release Characteristics
  - Quality of Data
  - Other

Qualitative Assessment for Criteria Pollutants (Michigan)

- **Expectations**
  - There are certain situations where a QA is obviously not appropriate. If there are questions, consult AQD before you submit a QA.
  - NTH has had QAs accepted on several projects, so reviewing them is becoming more routine around AQD. We hope that AQD will continue to approve using a QA on most projects where guidance allows.
  - QA is intended to give permit applicants and AQD engineers an off-ramp to avoid costly and time consuming modeling.
  - QA section of AQD-022 includes the phrase "AQD's judgement".

State Air Toxics

- **Determine If Modeling is Necessary**
  - Review exemptions from toxics:
    - < 10 lb/month and 0.14 lb/hr for non-carcinogens and non-high concern toxics
    - Subject to certain NESHAPs
    - Case-by-case exemptions
    - Certain gas and diesel combustion equipment (1.5x building height)
  - Meet Allowable Emission Rates (AER)
  - Use Ambient Impact Ratio (AIR) Matrix
  - Or have fun modeling!

Case Study - State Air Toxics

- **Allowable Emission Rates (AER)**
  - 1st we calculate project emissions from each source, and calculate total emissions for each pollutant:

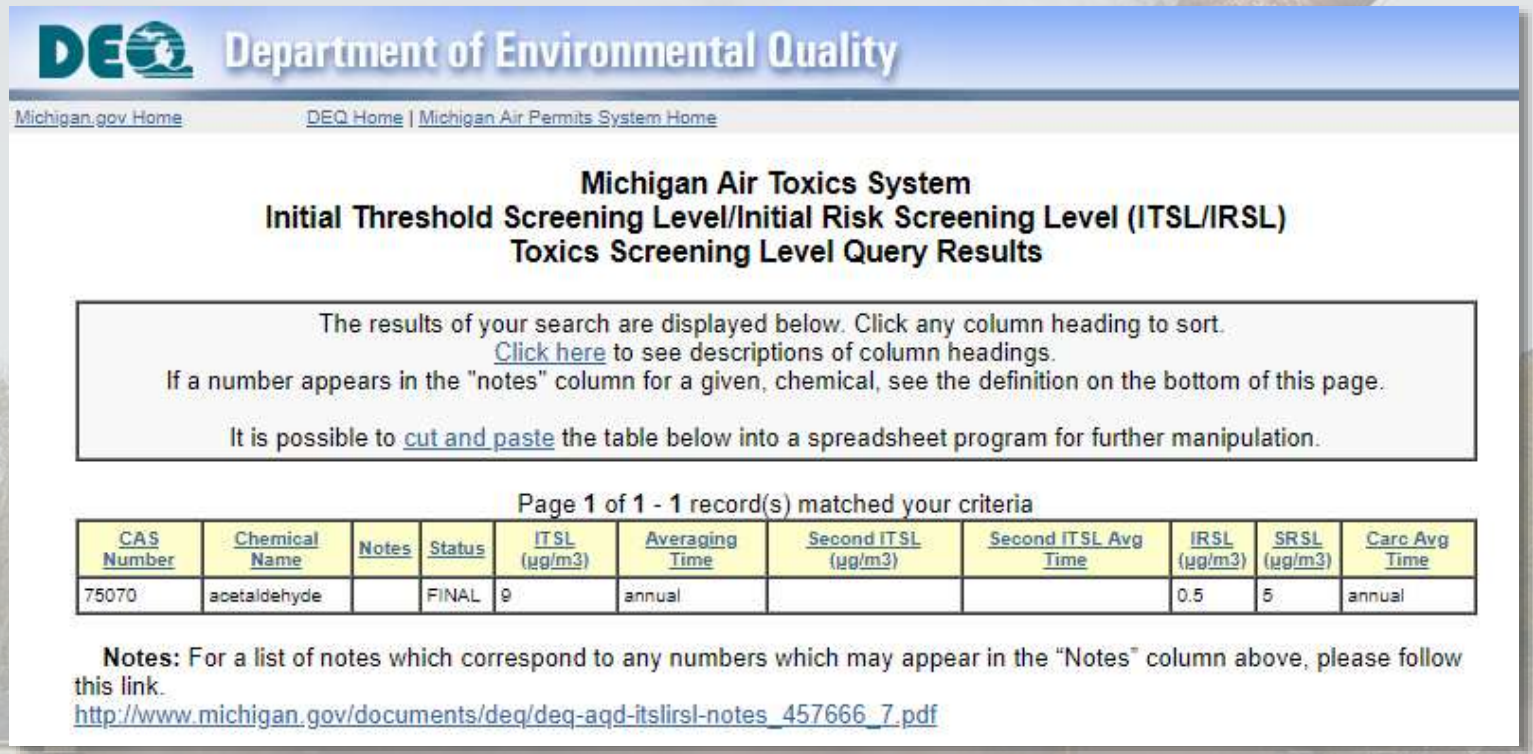
Hazardous Air Pollutants	CAS	Emission Factor		CTG/HRSGs (2)			
				Combustion Turbine		Duct Burner	
		Stationary Internal Combustion Sources AP-42 Ch.3.1, Table 3.1-3	External Combustion Sources AP-42 Ch. 1.4, Table 1.4-3 and Table 1.4-4	Emission Rates Per Unit (Controlled)		Emission Rates Per Unit (Controlled)	
		(lb/MMBtu)	(lb/MM scf)	(lb/hr) [1,2]	(tpy) [2,3]	(lb/hr) [1,2]	(tpy) [2,3]
Acetaldehyde	75070	4.0E-05		1.3E-02	5.3E-02		
Acrolein	107028	6.4E-06		2.1E-03	8.5E-03		
Arsenic	7440382		2.0E-04			4.0E-05	1.7E-04
Benzene	71432	1.2E-05	2.1E-03	4.0E-03	1.6E-02	2.1E-04	9.2E-04
Beryllium	7440417		1.2E-05			2.4E-06	1.0E-05

- For a typical power plant installation project, there are 60+ toxics to evaluate!

Case Study - State Air Toxics

- **Allowable Emission Rates (AER)**

  - 2nd we compile EGLE's screening levels:



Department of Environmental Quality

Michigan.gov Home | DEQ Home | Michigan Air Permits System Home

Michigan Air Toxics System
Initial Threshold Screening Level/Initial Risk Screening Level (ITSL/IRSL)
Toxics Screening Level Query Results

The results of your search are displayed below. Click any column heading to sort.
Click here to see descriptions of column headings.
If a number appears in the "notes" column for a given, chemical, see the definition on the bottom of this page.

It is possible to cut and paste the table below into a spreadsheet program for further manipulation.

Page **1** of **1** - **1** record(s) matched your criteria

CAS Number	Chemical Name	Notes	Status	ITSL (µg/m3)	Averaging Time	Second ITSL (µg/m3)	Second ITSL Avg Time	IRSL (µg/m3)	SRSL (µg/m3)	Carc Avg Time
75070	acetaldehyde		FINAL	9	annual			0.5	5	annual

Notes: For a list of notes which correspond to any numbers which may appear in the "Notes" column above, please follow this link.
http://www.michigan.gov/documents/deq/deq-aqd-itslirsl-notes_457666_7.pdf

* I took this screenshot yesterday, even though it says DEQ.

Case Study - State Air Toxics

- **Allowable Emission Rates (AER)**

  - 3rd we adjust total project emissions for averaging times, and compare to AERs:

HAP/TAC	CAS Number	Proposed Emission Rate (ER)				Screening Level (SL)			Allowable Emission Rate (AER)		Comply With Health-Based SL?	
		Hourly Emissions (lb/hr) [1,2]	8-Hour Emissions (lb/8hr)	Daily Emissions (lb/24hr)	Monthly Emissions (lb/mo)	ITSL (ug/m^3)	Averaging Time	IRSL (ug/m^3)	AER (lb/mo, lb/24hr, lb/8hr, or lb/1hr)	1-Hr Max Allowable Emission Rate (lb/hr)	Proposed ER Less than AER (Screening Level Specific ER)?	Proposed ER Less than AER (MAX Hourly Emission Rate)?
acetaldehyde	75070	1.3E-01	1.0E+00	3.1E+00	9.7E+01	9	annual		360	4.86	Y	Y
acetaldehyde	75070	1.3E-01	1.0E+00	3.1E+00	9.7E+01		annual	0.5	20.00	0.27	N	Y
acrolein	107028	3.2E-02	2.5E-01	7.6E-01	2.4E+01	0.16	annual		6.40	0.09	N	Y
acrolein (secondary ITSL)	107028	2.8E-01	2.2E+00	6.6E+00	2.1E+02	5	1 hr		0.01	0.01	N	N
arsenic	7440382	9.9E-05	7.9E-04	2.4E-03	7.4E-02		annual	0.0002	0.01	0.0001	N	Y

- We generally model any pollutants that exceed the AER (in red above).
- Alternatively, we could use the AIR matrix method to avoid modeling.

Case Study - State Air Toxics

- **Ambient Impact Ratios (AIR) matrix**

  - AIR simulates screening modeling
  - Requires stack height, building height, and fenceline distance.
  - Pick AIR values from Rule 227:

Table 22. Ambient Impact Ratio (AIR) Matrix

Annual Averaged Hourly Emission Rate Ambient Impact Ratios in Units of (lbs/hr)/(µg/m^3) for Toxic Air Contaminants with Annual Averaged Screening Levels

	BLDG HT (ft)	10			20			30			40			50		
	H_s / H_b	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50	1.25	1.75	2.50
	Stack Height->	12.5	17.5	25.0	25.0	35.0	50.0	37.5	52.5	75.0	50.0	70.0	100.0	62.5	87.5	125.0
D	25	0.0085	0.022	0.159	0.032	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941	0.263	0.736	4.630
I	50	0.0087	0.022	0.159	0.032	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941	0.263	0.736	4.630
S	75	0.0096	0.022	0.159	0.032	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941	0.263	0.736	4.630
T	100	0.011	0.023	0.159	0.033	0.084	0.679	0.075	0.220	1.603	0.152	0.421	2.941	0.263	0.736	4.630
A	200	0.020	0.040	0.159	0.042	0.084	0.679	0.082	0.220	1.603	0.157	0.421	2.941	0.266	0.736	4.630
N	300	0.030	0.053	0.178	0.059	0.113	0.679	0.099	0.221	1.603	0.174	0.421	2.941	0.282	0.736	4.630
C	400	0.040	0.065	0.171	0.077	0.140	0.679	0.126	0.268	1.603	0.200	0.421	2.941	0.312	0.736	4.630
E	500	0.051	0.077	0.189	0.094	0.164	0.679	0.153	0.318	1.603	0.243	0.505	2.941	0.351	0.743	4.630
	600	0.063	0.091	0.222	0.112	0.188	0.746	0.181	0.368	1.603	0.287	0.588	2.941	0.409	0.838	4.630
F	700	0.075	0.104	0.241	0.130	0.211	0.812	0.208	0.413	1.603	0.328	0.664	2.941	0.468	0.951	4.717
T	800	0.089	0.119	0.257	0.148	0.235	0.768	0.235	0.459	1.608	0.370	0.740	2.941	0.528	1.064	4.803
	900	0.103	0.134	0.264	0.167	0.258	0.770	0.261	0.502	1.672	0.411	0.812	2.941	0.585	1.168	4.854
	1000	0.119	0.151	0.272	0.187	0.282	0.800	0.289	0.545	1.786	0.452	0.883	2.959	0.644	1.276	4.950
	1500	0.209	0.245	0.318	0.290	0.406	1.080	0.428	0.756	1.953	0.654	1.214	3.521	0.924	1.761	5.376
	2000	0.311	0.350	0.383	0.408	0.539	1.256	0.573	0.965	2.304	0.861	1.534	3.731	1.205	2.222	5.882

Case Study - State Air Toxics

- **Ambient Impact Ratios (AIR) matrix**

  - Use AIR value, screening level (ITSL/IRSL), and emission rates:

Building and Stack Specifications		
Stack Height (H_s) =	60	feet
Influential Building Height (H_b) =	31	feet
Ratio H_s/H_b =	1.92	
Minimum Distance from Stack to Property Line =	406	feet
AIR Matrix Annual Averaged Hourly Emission Rate AIR		
annual AIR [1] =	0.268	(lb/hr)/(µg/m^3)
Maximum Hourly Emission Rate (ER) to Comply With the Health Based Screening Level (SL) for Acetaldehyde (IRSL):		
Maximum ER (lb/hr) =	SL x AIR	
Maximum ER (lb/hr) =	0.5 µ/m^3 x 0.268 (lb/hr)/(µg/m^3)	
Maximum ER (lb/hr) =	**0.134**	
Comply With Health-Based SL?		
Maximum ER from all sources =	0.130	lb/hr
Maximum ER that would comply with the SL =	0.134	lb/hr
Is the maximum ER from all sources less than the maximum ER to comply with the SL?	**Yes**	

[1] Based on a building height of 30 feet, H_s/H_b ratio of 1.75, and a minimum distance from the property line of 400 feet.

Summary

- Regulations, guidance, or AQD request may compel modeling.
- Modeling can slow down the process of getting the application to AQD, but sometimes it can actually speed up AQD's review.
- It may be worth trying a Qualitative Analysis to avoid modeling.
- Applicants should work with the permit engineer to determine what type of analysis is needed prior to submitting the permit.
- Whether modeling by regulation or request, make sure to do it well!

Thank You!

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