Air Quality Conformity Determination Report (Draft)

Ozone Attainment Maintenance Area

Boone, Hamilton, Hancock, Hendricks,
Johnson, Madison, Marion, Morgan, and Shelby Counties

– Indianapolis Metropolitan Planning Organization –
– Madison County Council of Governments –
– Indiana Department of Transportation –

2045 Long Range Transportation Plan

Month XX, 2018

(US DOT Approval Date)

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1. Executive Summary

This Air Quality Conformity Determination Report accompanies the Indianapolis MPO's 2045 Long-Range Transportation Plan (LRTP), which serves as a major update of the most recent 2035 LRTP (updated in April 2011 and March 2014), in accordance with the four-year update required for air quality nonattainment areas by federal transportation legislation (23 CFR 450.324c) & (40 CFR 93.104b3). LRTP updates must be accompanied with an air quality conformity determination by FHWA/FTA under Section 176(C) of the Clean Air Act of 1990. This Air Quality Conformity Determination Report accompanies only the 2045 LRTP as adopted by the Indianapolis Regional Transportation Council (IRTC) in December 2017, and the projects therein. The Madison County Council of Governments (MCCOG) is undergoing a major update, to be completed by Spring 2019. MCCOG's air quality conformity analysis model results have been incorporated into this report's air quality conformity analysis.

The 9-County Central Indiana region (Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, Marion, Morgan, and Shelby counties) is designated by the U.S. Environmental Protection Agency as an attainment maintenance area under the 1997 8-hour standard for ozone (72 FR 59210).

Based on Federal EPA regulations (40 CFR 93.105) and the interagency consultation process, it was agreed to conduct the following target years (beginning January 1 each year) for air quality conformity determination for the current 8-hour ozone standard.

- 2020 (conformity attainment year)
- 2025 (intermediate year allowing no more than ten years between modeled years)
- 2035 (intermediate year allowing no more than ten years between modeled years)
- 2045 (current horizon year of LRTP)

To demonstrate conformity, forecast emissions must be below the most recent budget for 8-hour ozone standard designations established in 2012by the Indiana Department of Environmental Management (IDEM) for the 9-county region of Central Indiana. The following table shows the emissions budgets and forecasts for the model years 2020, 2025, 2035, and 2045. **The results of the air quality conformity analysis indicate the area is under the allowable attainment budgets for ozone pollutants.**

Table 1: Emissions Analysis, Ozone Results

Emissions Analyses Ozone Results (Tons per Summer Day) Running + Non-Running Emissions				
Year	**VOC Budget (2020)**	**VOC Forecast**	**NOx Budget (2020)**	**NOx Forecast**
2020	25.47	25.12	69.00	46.71
2025	25.47	20.55	69.00	33.05
2035	25.47	11.50	69.00	20.94
2045	25.47	9.90	69.00	20.49

Table 2: Vehicle Miles Traveled (VMT) for each model year for the Ozone Attainment Maintenance Area

Year	System VMT (non-Centroid Connectors)
2020	57,084,659
2025	63,994,360
2035	71,948,047
2045	80,166,245

2. Introduction

Regulation 23 CFR 450.324 (c) mandates that the long-range transportation plan (LRTP) be updated at least every four years in nonattainment and maintenance areas to confirm the transportation plan's validity. Any update or amendment to the LRTP is to be accompanied by an air quality conformity determination from the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) under section 176(c) of the Clean Air Act of 1990. The need for conformity analysis is also triggered by amendments to the LRTP for the addition, removal, or a change in time period of any regionally significant project.

The US Environmental Protection Agency (EPA) sets National Ambient Air Quality Standards (NAAQS) for six common air pollutants called "criteria" pollutants. These are: carbon monoxide (CO), nitrogen oxide (NOx), ozone (O3), lead (Pb), particulate matter (PM) and sulfur dioxide (SO2). The Clean Air Act, last amended in 1990, requires the EPA to set NAAQS for pollutants that cause adverse effects to public health and the environment. Of the six criteria pollutants, ozone and particulate matter are of particular interest for transportation planning purposes as motor vehicle exhaust is considered to be a significant source of these pollutants. This report will primarily focus on ozone pollutants.

3. Ozone Pollutants and Standards

Ozone is a colorless, odorless gas composed of three oxygen atoms. Ground-level ozone is not emitted directly into the air, but forms when oxygen, nitrogen oxides (NOx), and volatile organic compounds (VOC) chemically react in the presence of sunlight. The major sources of NOx and VOCs are industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents.
The standard set by the EPA for ozone is the 8-hour ozone standard. Under the current standard (last designated in 2008), ozone must not exceed 0.075 parts per million (ppm), calculated as a 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year.

In accordance with the attainment/maintenance status for ozone for the 9-county area, this document addresses an air quality conformity analysis for the 8-hour ozone standard.

4. Current Designations

Ozone – Attainment Maintenance

In October 2007, the 9-county central Indiana region (Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, Marion, Morgan, and Shelby counties) was designated by the U.S. Environmental Protection Agency as an attainment maintenance area under the 1997 8-hour standard for ozone (72 FR 59210).

At the time of the 2045 LRTP's adoption, the Indianapolis MPO had been given guidance that it was no longer necessary to report projects' air quality conformity. A recent court case (*South Coast Air Quality*

Management District v. EPA) reinstating the anti-backsliding rule has made necessary the approval of this air quality conformity report, regarding the Indianapolis MPO's regional conformity for ozone pollutants.

PM 2.5 - Unclassifiable/Attainment

Five counties in Central Indiana were previously designated as nonattainment for fine particulate matter (PM 2.5), but as of July 2013 (as indicated by 78 FR 41698 and 80 FR 2205, Central Indiana has achieved the status of Unclassifiable/Attainment, therefore this area is in compliance for the annual PM 2.5 standard.

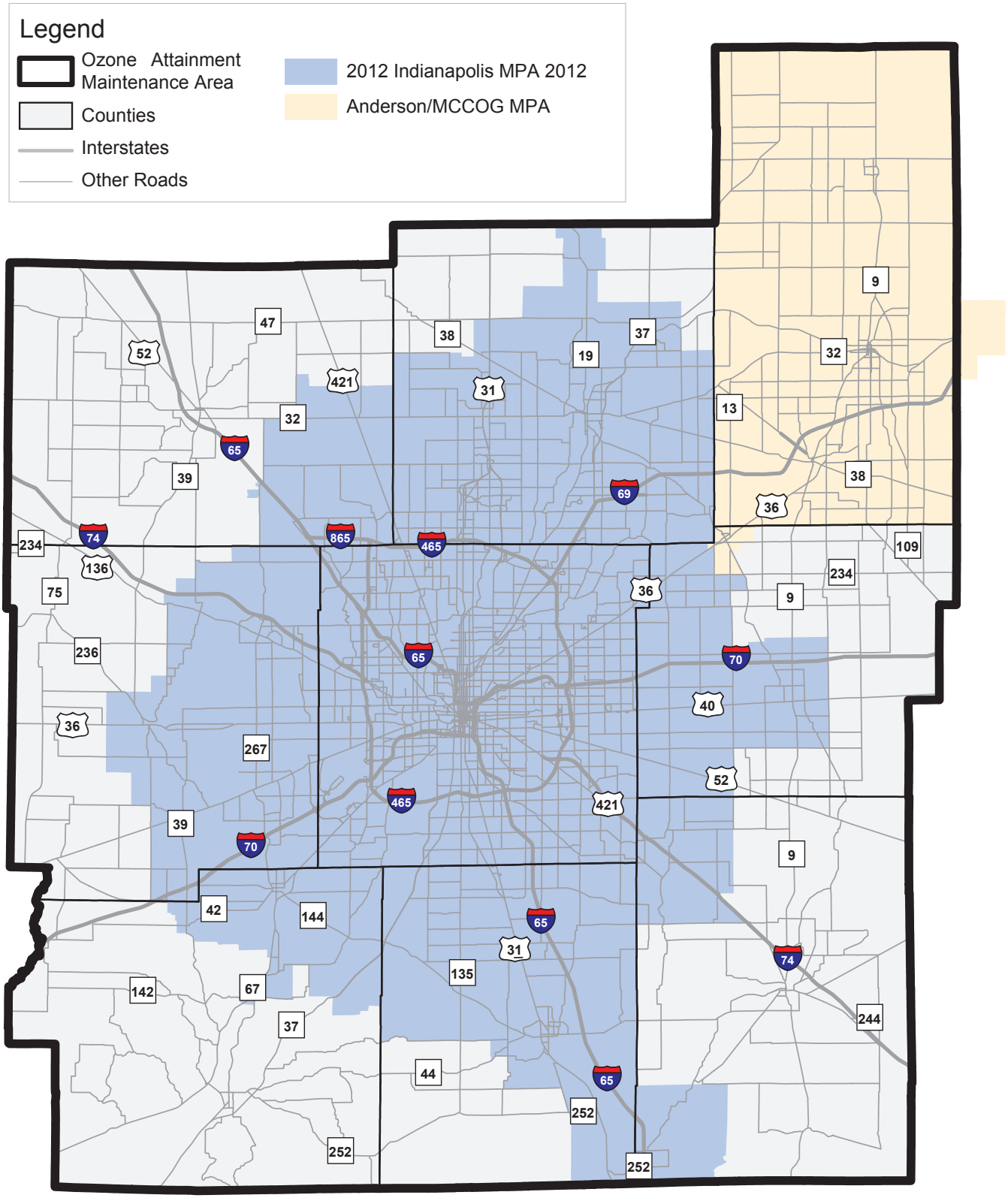
5. Geographic Area

The Indianapolis Metropolitan Planning Area (MPA) consists of the area defined as urbanized in the year 2010 plus the contiguous area expected to be urbanized by 2045. The MPA boundary includes approximately 1,520 square miles and a population of approximately 1.5M. It contains Marion County and parts of Boone, Hamilton, Hancock, Hendricks, Johnson, Morgan, and Shelby Counties, as well as the cities of Beech Grove, Carmel, Fishers, Franklin, Greenfield, Greenwood, Indianapolis, Lawrence, Noblesville, Southport, and Westfield, and the towns of Arcadia, Atlanta, Avon, Bargersville, Bethany, Brooklyn, Brownsburg, Cicero, Cumberland, Danville, Edinburgh, McCordsville, Mooresville, New Palestine, New Whiteland, Pittsboro, Plainfield, Speedway, Spring Lake, Whiteland, Whitestown, and Zionsville.

Modeling areas for transportation plans have historically been larger than the planning area itself, to account for influences on the transportation system of growth occurring beyond the planning area boundary. The full 9-county region of Central Indiana (Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, Marion, Morgan, and Shelby) is designated as the geographic area of analysis for ozone. This geographic area is also referred to as the Ozone Attainment Maintenance Area (Figure 1).

The MPA for the Madison County Council of Governments (MCCOG) is also included in the Ozone Attainment Maintenance Area. The Indianapolis MPO and MCCOG have separate long range plans and transportation improvement programs, but coordinate with each other to meet the federal reporting and monitoring requirements required for the Ozone Attainment Maintenance Area.

Figure 1: Ozone Attainment Maintenance Area



6. Interagency Consultation

Federal regulation (40 CFR 93.105b) requires that a region's MPO representatives, state and local air quality planning agencies, state and local transportation agencies, and other organizations with responsibilities for developing, submitting, or implementing provisions of an implementation plan required by the Clean Air Act (CAA) must consult with each other and with local or regional offices of EPA, FHWA, and FTA on the development of transportation plans and associated air quality conformity determinations. Central Indiana's Interagency Consultation Group (ICG) includes representatives from the different stakeholders that oversee air quality analysis in the geographic area.

Interagency Consultation Group Members

The following individuals were included on invitations to 2018 meetings of the Interagency Consultation Group and have been instrumental in reviewing the processes and procedures used to demonstrate air quality conformity.

Name	Organization	Title/Area
Anthony Maietta	EPA	Region V
Robert Dirks	FHWA	Indiana Division
Susan Weber	FTA	Region V
Shawn Seals	IDEM	Senior Environmental Manager
Katie Robinson	Indianapolis DPW	Director, Office of Sustainability
Matt Mosier	Indianapolis DPW	Office of Sustainability
Stephanie Belch	INDOT	Long Range Planning Section
Jay Mitchell	INDOT	Long Range Planning Section
Katherine England	INDOT	Capital Program Management Director
Ryan Wilhite	IndyGo	Strategic Planner
Jerry Bridges	MCCOG	Executive Director
Bobby Wertman	MCCOG	Principal Transportation Planner
Brandon Kendara	MCCOG	Transportation Planner
Ryan Phelps	MCCOG	Transportation Planner
Dean Munn	Convergence Planning LLC	IMPO/MCCOG consultant
Andy Swenson	MPO	Principal Planner, Data/Modeling
Catherine Kostyn	MPO	Senior Planner, Data/Modeling
Jen Higginbotham	MPO	Principal Planner, LRTP
Steve Cunningham	MPO	Principal Planner, Transportation Improvement Program
Anna Gremling	MPO	Executive Director
Laura Thayer	CAMPO	Executive Director
	LPA / Project Sponsor	Project Manager if needed

Meeting summaries that correspond to the discussion, development, and approval of this report can be found in *Appendix A: ICG Meeting Summaries*.

7. Target Years and Projects

Target Years

Federal regulations governing air quality conformity require that, for the Ozone Attainment Maintenance Area, certain time periods be analyzed to estimate emissions of relevant pollutants and precursors from mobile sources. For each analysis year modeled, the implementation of planned and programmed capacity enhancement projects is reflected using best planning assumptions.

Based on Federal EPA regulations (40 CFR 93.105) and the interagency consultation process, it was agreed to conduct the following target years (beginning January 1 each year) for air quality conformity determination for the current 8-hour ozone standard for the Ozone Attainment Maintenance Area.

- 2016 (base year for transportation network)
- 2020 (conformity attainment year)
- 2025 (intermediate year allowing no more than ten years between modeled years)
- 2035 (intermediate year allowing no more than ten years between modeled years)
- 2045 (current horizon year of LRTP)

The following LRTP project time periods reflect the air quality conformity analysis requirements (40 CFR 93.106). It should be noted that these time periods are based on open-to-traffic dates. To be included in an air quality conformity analysis, a project's full impact needs to be measured by a full year of traffic data before it is included in that time period. Consequently, the following time periods correspond with the dates below.

- **2016 – 2025** = open to traffic between 01/01/2016 and 12/31/2024
- **2026 – 2035** = open to traffic between 01/01/2025 and 12/31/2034
- **2036 – 2045** = open to traffic between 01/01/2035 and 12/31/2044

It was also agreed that, in the absence of budgets for the horizon years, the 2045 LRTP must show conformity with the available 2020 attainment budgets. For this update, the LRTP is required to demonstrate that implementation of the fiscally constrained projects will attain emissions levels of regulated pollutants and their precursors within the budgets established by IDEM in 2012. The 2020 attainment budget is used for 2020, 2025, 2035, and 2045 forecasts for 8-hour ozone.

Table 3: Summary of Modeling Requirements

Criteria Pollutant	Geographic Area	Pollutants and Precursors	Conformity Test	Analysis Years
8-Hour Ozone	9 County Attainment Area Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, Marion, Morgan, & Shelby	NOx & VOCs (precursors to ozone)	Attainment Test Emissions forecasts in future years must not exceed SIP Attainment Budget (2020)	2020* 2025 2035 2045
*2020 is both the attainment and budget year for this ozone determination.				

Projects

Projects that are regionally significant, regardless of funding source, are included in the regional air quality analysis. Projects that are exempt from inclusion in air quality analysis can be found in 40 CFR 93.126 and 40 CFR 93.127.

A comprehensive list of fiscally constrained projects (40 CFR 93.108) included in this Air Quality Conformity Analysis of the 2045 LRTP can be found in the 2045 Long Range Transportation Plan, "2045 LRTP Recommended Project List" on pages 48-56 of the plan, which can be found online at https://www.indympo.org/whats-underway/lrtp.

8. Calculating Emissions and Reporting Results

Ground level ozone levels are highest in the summer as heat catalyzes its formation from NOx and VOC. Since ozone is not directly emitted from vehicles, the mobile source emissions of VOCs and NOx are modeled instead. To obtain emissions forecasts for these precursors, environmental conditions for a typical July day are assumed throughout the modeling process.

The Indianapolis MPO uses a set of models and a simple output conversion routine to calculate daily ton outputs of 8-hour ozone components VOC (in terms of hydrocarbons) and NOx for the year in question. These values are used for 8 of the 9 counties.

For Madison County, the Indianapolis MPO provides rate tables generated by the MOVES 2014a model to the Madison County Council of Government (MCCOG) for their use in emissions calculations. This ensures that rate tables, vehicle fleet mix, and underlying Air Quality Post-Processor assumptions are the same for both MPOs.

The MCCOG uses the Indianapolis MPO-generated rate tables and its own TDM to model Madison County projects and provides the Indianapolis MPO with Madison County running emissions for VOC and NOx for each target year. The Indianapolis MPO staff adds Madison County emissions to those of the other 8 counties to calculate final summary calculations for running emissions.

The Indianapolis MPO calculates non-running emissions for all 9 counties, including Madison County. These are based on rates generated by the MOVES 2014a model. Running and non-running emissions are summarized and are then compared with the appropriate SIP ozone budget for each target year.

The following tables represent a sample of emissions analyses performed for the conformity determination on the 2045 LRTP. The total emissions for the criterion pollutants are compared to the allowable budget set in the SIP for the 2020 attainment year.

Table 4: Emissions Output Sample

Emissions	HPMS Class	Pollutant (tons/day)	
		VOC	NOX
Running	Rural Interstate	0.42	3.97
Running	Rural Principal Arterial	0.70	3.68
Running	Rural Minor Arterial	0.14	0.73
Running	Rural Local	0.28	1.07
Running	Urban Interstate	1.95	12.11
Running	Urban Principal Arterial	0.23	1.28
Running	Urban Other Arterial	1.78	6.06
Running	Urban Minor Arterial	1.50	4.92
Running	Urban Local*	0.77	2.01
Non-Running	ALL	17.37	10.90
Total Emissions for 2020		**25.12**	**46.71**

*The Indianapolis MPO model networks do not include Urban Collectors, but the MCCOG networks do. These emissions have been added into the "Urban Local" summary total.

For more information on these emissions and the model outputs, refer to *Appendix C: Modeling Environment Overview.*

9. Ozone Analysis Results

Consistent with federal requirements (40 CRF 93.118) and guidance from the ICG, mobile source emissions forecasts of ozone precursors, NOx and VOC, were modeled for 2020 (attainment year), 2025, 2035, and 2045. As shown below, emissions forecasts for both the attainment and future years are below the 2020 Attainment budget.

Table 5: Mobile Source Emission Forecasts for the Ozone Maintenance Attainment Area and the 2020 SIP Attainment Ozone Budget

Emissions Analyses Ozone Results (Tons per Summer Day) Running + Non-Running Emissions				
Year	**VOC Budget (2020)**	**VOC Forecast**	**NOx Budget (2020)**	**NOx Forecast**
2020	25.47	25.12	69.00	46.71
2025	25.47	20.55	69.00	33.05
2035	25.47	11.50	69.00	20.94
2045	25.47	9.90	69.00	20.49

Table 6: Vehicle Miles Traveled (VMT) for each model year for the Ozone Attainment Maintenance Area

Year	System VMT (non-Centroid Connectors)
2020	57,084,659
2025	63,994,360
2035	71,948,047
2045	80,166,245

10. Public Review and Comment

The Indianapolis MPO held 16 meetings during September 2017 to gather public feedback on the 2045 Long Range Transportation Plan and its list of projects, as well as advertising an official public comment period from October 8 – November 10, 2017, in accordance with the MPO's Public Involvement Plan. The IRTC Joint Meeting of the Technical and Policy Committees approved the 2045 LRTP during a public hearing on December 13, 2017. Public comment received during all these opportunities can be found in *Appendix Q: Public Comments* of the *2045 Long Range Transportation Plan*, available online at IndyMPO.org.

This Air Quality Conformity Determination Report is being reviewed and approved separately from the 2045 LRTP due to a federal change in guidance. This report was available for public review and comment between September 20, 2018 and October 23, 2018. A summary of public comments received can be found in *Appendix D: Air Quality Conformity Determination Report Public Comment*.

Approval Timeline

In order to be eligible for conformity finding by the U.S. Department of Transportation, approval of the 2045 LRTP and Air Quality Conformity Determination Report is required from the two metropolitan planning organizations (Indianapolis MPO and MCCOG) within or overlapping the Ozone Attainment Maintenance Area.

The Indianapolis MPO will seek approval of the 2045 LRTP Air Quality Conformity Determination Report by the Policy Committee of the Indianapolis Regional Transportation Council (IRTC) on October 24, 2018.

MCCOG will seek approval of the 2045 LRTP Air Quality Conformity Determination Report by the Policy Board of the Madison County Council of Governments on _____, 2018.

U.S. Department of Transportation (USDOT) will review the 2045 LRTP Air Quality Conformity Determination Report following approvals by the MPO boards and is expected to issue an official conformity finding for the 2045 LRTP by _____ 2018.

11. Conclusion

The modeling and analysis with respect to the 8-hour ozone standard designation demonstrates that the updated plan will attains emissions levels of regulated pollutants (VOC and NOx) in future years within the prescribed budgets and hence conforms to federal air quality requirements.

12. Approvals

IRTC Policy Committee Resolution

US EPA Approval Letter

US DOT Approval Letter

Appendix A: ICG Meeting Summaries

Included are the agendas and meeting summaries from Interagency Consultation Group (ICG) meetings that included discussion regarding the air quality conformity status, projects, assumptions, and results for the 2045 Long Range Transportation Plan.

Meeting Summary

Interagency Consultation Group
Conference Call | May 18, 2018 | 10am

Attended

- Andy Swenson (Indianapolis MPO)
- Catherine Kostyn (Indianapolis MPO)
- Steve Cunningham (Indianapolis MPO)
- Jen Higginbotham (Indianapolis MPO)
- Anna Gremling (Indianapolis MPO)
- Robert Dirks (FHWA)
- Joyce Newland (FHWA)
- Stephanie Belch (INDOT)
- Jay Mitchell (INDOT)
- Anthony Maietta (EPA)
- Shawn Seals (IDEM)
- Jerry Bridges (MCCOG)
- Bobby Wertman (MCCOG)
- Ryan Phelps (MCCOG)

Invited / Did Not Attend

- Susan Weber (FTA)
- Kate Robinson (Indianapolis Office of Sustainability)
- Mike Terry (IndyGo)
- Bhaumik Gowande (MCCOG)

Latest Planning Assumptions / Methodology

- Catherine –Any guidance come out of the Evansville ICG phone call? MPO Ozone years are 2006 and 2020, but model years extend after that
    - Jay – About 6 questions from Evansville have been shifted up to headquarters for answers; Waiting on those responses
- Catherine – which budget do we need to use? Mobile 6 or Moves 2014?
    - Jay – no answer yet
    - Tony – no answer yet, still being addressed
        - Catherine – we have 2012 replacement budget…?
    - Anna – when will we have an answer?
        - Joyce – Bernadette has answers but can't send out yet. MPO does need to have Base standard + 10 years
    - Catherine – had a base year of 2010, new base year is ~~2015~~ **[edit: 2016],** model years 2025/35/45; can we comply with the 2025 or do we need to use previous base year of 2020?
        - Joyce – waiting on answer
        - Catherine – may or may not need to create a new network
        - Tony – still waiting on answer – had a court decision to remove areas, but they're trying to figure it out

- Catherine – ozone, any need to model 1997 PM 2.5 as well?
    - Tony – not that he knows of
- Anna – hold off on model runs until we have more info?
    - Joyce – Janice Osadczuk and Michelle Allen were at a seminar but are out now, so they're waiting to see
    - Shawn – no definitive info, but go ahead and do what you do with year 2020, just to get ahead of it
- Jerry (MCCOG) – PM 2.5 – doesn't affect Anderson but does affect Indy; if court case only affected ozone, should we be doing PM 2.5 anyway?
    - Tony – no indication right now that there will be a future court case
    - Jay – same
    - Jerry – just don't want to be behind
    - Catherine – Indianapolis MPO calculates them at the same time anyway
- Catherine – regarding base year, Anderson is working on a new model, and their base years are different from Indianapolis MPO's. How should we coordinate for the original base year? 2010 and 2020?
    - Tony – wouldn't have to worry about 2010 (in the past)
    - Catherine – so just coordinate on 2020 (pending guidance)
    - Robert – to be clear, Anderson has a different base year?
        - Catherine, yes, but it's in the past
    - Jerry – looking for network, couldn't find it
        - Catherine – We will coordinate on that

Project Exemption Status

- **Project Description**: LRTP #4001 - Amendment to the LRTP/TIP - the Added Travel Lane work has been removed from the I-70 project Lead Des 1592433 (the project is now an I-70 pavement replacement in FY 20). The SR 39 Bridge over I-70 is being removed & the whole interchange is being modified from a Diamond interchange to a two Bridge Divergent Diamond in FY 19.
- Jerry – Anderson has a procedure on defining "regionally significant", based on mileage of change
- Steve – this project is REMOVING travel lanes, so does it qualify?
    - Jay – had a meeting this week on that project; interchange will move forward as a separate project, and added travel lanes is now simply a reconstruction
    - Jay – INDOT considers it to be two projects
        - Jay – (1) added travel lanes was never in a conforming plan – want to change from added lanes to reconstruction so not regionally significant
            - Stephanie – should move this one to LRTP illustrative list
            - Shawn – reconstruction is not "significant"
            - Jay – agree that it is exempt
            - Tony – agrees that it's exempt

        - Jay – (2) interchange modification is probably regionally significant
            - Catherine – not adding any lanes outside of bridge/diamond
            - Shawn – document says interchanges are significant?
            - [didn't catch speaker's name] (MCCOG) – there are different criteria for different types of interchanges
            - Jerry – pretty sure it requires that we have to do AQC analysis
            - [didn't catch speaker's name] (MCCOG) – A roundabout in Anderson was a modified interchange that didn't require AQC
            - Steve – no new movements or access? Less that ½ mile?
                - Jay – don't think so
                - Joyce – exempt if not adding capacity
                - Catherine – no change in lanes on either side
                - [didn't catch speaker's name] – eliminating left turns?
            - Shawn – wants to see more information for the project
                - Catherine – will send screenshot of before/after image to ICG
            - Anna – need another meeting?
                - Group – no, just email (probably)
        - Andy – approval subject to no objections via email?
            - Group – yes (Shawn/Tony)
- Jerry – I-69 project
    - Jay – met conformity to previous standards?
        - Jerry – yes
        - Jay – may be in a lapse right now due to 4-year v. 5-year Anderson LRTP requirements
            - Jerry – it was understood that Anderson had until March 2019
            - Jay – same, but need to make sure; project may or may not be in a conforming plan
    - Joyce – because of court case, Anderson would need to do 4-year conformity despite 5-year plan update
        - Jerry – so Anderson doesn't have until March 2019?
        - Jay – I-69, may need to be on hold until new conformity is done for the Indianapolis region
    - Catherine – since IMPO needs to show 2045 conformity anyway, can we do it all at the same time Anderson + IMPO?
        - Jay – that would be advisable, Anderson will need to do their update anyway
        - Catherine – has a 2022 network she can modify to 2020
        - Jerry and Andy will coordinate
    - Jerry – need to move I-69 to illustrative list?
        - Jay – leave it alone, just don't have a conforming plan right now
        - Jay – neither MPO/INDOT can advance amendment until conforms

Schedules

- Jen – if exempt, all done?
    - Group – yes
- If non-exempt – do a phone call or email?
    - Send email to group of what model shows
    - Call or not depending on results of model run
- Catherine – if we have to use Mobile 6, what would comprise failure?
    - Years 2025/35/45 with addition of 2020
    - [didn't catch speaker's name] – don't demonstrate conformity to history, but do show for all future years where there's a budget

Wrap up

- Anna – anxious to get guidance on budget, and will send out before and after I-70 info
- Bobby and Catherine will coordinate on Anderson I-69 project
- Joyce – reminder, Randy Simon (KIDPA) to bounce ideas off
- Bobby – IMUG meeting next week to discuss with other model users

Meeting Summary

Interagency Consultation Group
Conference Call | July 16, 2018 | 10am

Attended

- Andy Swenson (Indianapolis MPO)
- Catherine Kostyn (Indianapolis MPO)
- Steve Cunningham (Indianapolis MPO)
- Jen Higginbotham (Indianapolis MPO)
- Anna Gremling (Indianapolis MPO)
- Sean Northup (Indianapolis MPO)
- Trevor Preddy (Indianapolis MPO)
- Janice Osadczuk (FHWA)
- Anthony Maietta (EPA)
- Shawn Seals (IDEM)
- Jerry Bridges (MCCOG)
- Bobby Wertman (MCCOG)
- Ryan Phelps (MCCOG)
- Brandon Kendara (MCCOG)
- Dean Munn (RSG - MCCOG On-Call)
- Stephanie Belch (INDOT)
- Jay Mitchell (INDOT)

Invited / Did Not Attend

- Robert Dirks (FHWA)
- Joyce Newland (FHWA)
- Susan Weber (FTA)
- Laura Thayer (Columbus MPO)
- Kate Robinson (Indianapolis Office of Sustainability)
- Mike Terry (IndyGo)
- Vince Bernardin (RSG - MCCOG On-Call)

Project Exemption Status

- **Project Description**: US 31 at 236th Street Interchange. New Interchange Construction. The project includes development of a new graded separated interchange on US 31 at 236th Street in Hamilton County, Indiana. Currently proposed as a tight diamond interchange with roundabout ramp terminals, the interchange will advance corridor mobility and congestion reduction goals.
    - The Interagency Consultation Group determined this project to be regionally significant, non-exempt.
- **Project Description**: US 36 from Raceway to I-465. Added travel lanes and sidewalks. Widening roadway from 4 to 6 travel lanes with sidewalks. US 36 is on the National Highway System and provides access to the CXS Avon Yard intermodal connector.
    - The Interagency Consultation Group determined this project to be regionally significant, non-exempt.
- IndyGo had intended to amend the Long Range Transportation Plan for an upcoming project, but are holding off on that until a later date.

Latest Planning Assumptions / Methodology

- Hypothetically, if the air quality projections for Ozone do not meet the required budget, what would be the next course of action?
    - Jay – move projects around until you meet budget
        - Anna – coordination between MPO & INDOT? Scenario runs?
        - Jay – yes, different scenarios, different dates; becomes a discussion with the entire MPO board and INDOT
- Catherine gave an update on coordination, moving toward having the combined model outputs for the IMPO and MCCOG models.
    - Dean – there are preliminary/interim outputs that need further coordination in the near future between the MPOs
- Tony – if there are any specific questions for our areas, Tony can take them to HQ
    - Sean – our question is whether we need to run 2025 and 2035
        - Tony – probably yes, but I will look into it
    - Andy – can we look at 2019?
        - Tony – everyone must test for 2020, but MPOs can add in any additional years they want.
- Jay – where does I-65 south terminate?
    - Catherine – in the IMPO's model, I-65 stops at the southern Johnson County Line

Meeting Agenda

Interagency Consultation Group – Central Indiana Region | August 28, 2018 | 2pm
Conference Call | 605-472-5278 -> Access Code: 736210 #

Introductions ..... 5 minutes

Anthony Maietta (EPA); Robert Dirks (FHWA); Susan Weber (FTA); Shawn Seals (IDEM); Katie Robinson (Indianapolis Office of Sustainability); Matt Mosier (Indianapolis Office of Sustainability); Stephanie Belch (INDOT); Jay Mitchell (INDOT); Katie England (INDOT); Ryan Wilhite (IndyGo); Jerry Bridges (MCCOG); Bobby Wertman (MCCOG); Brandon Kendera (MCCOG); Ryan Phelps (MCCOG); Dean Munn (Convergence Planning); Anna Gremling (Indianapolis MPO); Andy Swenson (Indianapolis MPO); Catherine Kostyn (Indianapolis MPO); Steve Cunningham (Indianapolis MPO); Jen Higginbotham (Indianapolis MPO); Laura Thayer (Columbus MPO)

Latest Planning Assumptions / Analysis Methodology..... 15 minutes

1. Via research into legal case outcomes and regulations currently in effect, we have concluded that the MOVES Replacement Emissions Budget applies.
2. The Indianapolis MPO's 2045 Long Range Transportation Plan meets air quality conformity requirements for future years. (Detailed summary available upon request.) Since our previous draft results:
    - We updated our vehicle fleet mix to reflect the most current data from the Indiana Bureau of Motor Vehicles.
    - We created new ozone rate tables with MOVES 2014a using that same data.
    - We updated our HPMS Adjustment Factor.

LRTP 2045 Amendment Air Quality Results
Adjusted with Updated Madison County Emissions
Running + Non-Running Emissions
MOVES Emissions Replacement Budget (2012)

Updated Vehicle Fleet Mix, Ozone Rate Tables, and HPMS Adjustment Factor

Year	VOC Budget (2020)	VOC Forecast	NOx Budget (2020)	NOx Forecast
2020	25.47	25.20	69.00	47.17
2025	25.47	20.55	69.00	33.05
2035	25.47	11.50	69.00	20.94
2045	25.47	9.90	69.00	20.49

Latest Planning Assumptions / Analysis Methodology (continued)

3. Do we need an official signed letter from USDOT acknowledging our conformity status prior to amending the LRTP or TIP, or can we move forward with October amendments?
4. Next Steps: LRTP & TIP amendments, planned for
    - 3 INDOT amendments (2 regionally significant[1], 1 undetermined)
    - 1 INDOT modification (exempt[1])
    - 1 IndyGo amendment (undetermined)

Project Exemption Status..... 10 minutes

- SR 32 (Westfield) Reconstruction from Poplar Street to East Street (aerial)
    - LRTP Amendment / TIP Amendment
    - Des #: 1801731
    - Improve traffic capacity with additional through lanes for the full length (0.5 miles) of the project, reconstruct asphalt pavement, curb and gutter, pedestrian facilities, and storm sewer.
    - 2 lanes before / 4 lanes after
    - Principal Arterial
    - Open to traffic 2024
    - **We are looking for guidance on regional significance**
- Blue Line Route Amendment (project site)
    - LRTP Amendment / TIP Amendment
    - Des #: 1801413
    - LRTP: Move route on west side from Holt to High School Road, to Airport (stops at InfoSys and FedEx)
    - TIP: Extend Final Route (approximately 1.25-1.5 miles) to take Washington St west to High School Road to Airport (stops at InfoSys and FedEx)
    - Possible model changes for dedicated lanes and left turn restrictions throughout route
    - **We are looking for guidance on regional significance**

[1] Already discussed at previous ICG meetings during 2017.

Meeting Summary

Interagency Consultation Group
Conference Call | August 28, 2018 | 2pm

Attended

- Andy Swenson (Indianapolis MPO)
- Catherine Kostyn (Indianapolis MPO)
- Jen Higginbotham (Indianapolis MPO)
- Anna Gremling (Indianapolis MPO)
- Sean Northup (Indianapolis MPO)
- Robert Dirks (FHWA)
- Anthony Maietta (EPA)
- Jerry Bridges (MCCOG)
- Bobby Wertman (MCCOG)
- Ryan Phelps (MCCOG)
- Brandon Kendara (MCCOG)
- Laura Thayer (Columbus MPO)
- Dean Munn (Convergence Planning)
- Stephanie Belch (INDOT)
- Katie England (INDOT)
- Ryan Wilhite (IndyGo)
- Matt Mosier (Indianapolis Office of Sustainability)

Invited / Did Not Attend

- Joyce Newland (FHWA)
- Susan Weber (FTA)
- Kate Robinson (Indianapolis Office of Sustainability)
- Mike Terry (IndyGo)
- Vince Bernardin (RSG - MCCOG On-Call)
- Jay Mitchell (INDOT)
- Shawn Seals (IDEM)
- Janice Osadczuk (FHWA)
- Steve Cunningham (Indianapolis MPO)

Latest Planning Assumptions / Methodology

- Budget
    - Tony, agree that we should use MOVES replacement budget
    - Robert – FHWA defers to EPA on budget
- US DOT letter
    - Katie would be more comfortable with MPO getting a letter
    - Anna – take a dual track and do letter and amendments for October
        - At least 10 projects are impacted from TIP / LRTP hold-up
    - Tony – conduct approval via email chain – finish out with FHWA FTA letter
    - Robert – just need one letter?
        - Anna – yes
        - Jerry – letter should address all 3 MPOs
            - Check and see if Joyce Newland has an old letter

Project Exemption Status

- **Project Description**: US 36, Added Lanes, Westfield.
    - 50/50 funding split with locals
    - The Interagency Consultation Group determined this project to be non-exempt
- **Project Description**: Blue Line route amendment, IndyGo.
    - The Interagency Consultation Group determined this project to be non-exempt

Appendix B: Modeling Environment Overview

Introduction

To forecast mobile air pollutant emissions in the Indianapolis metropolitan area, the Indianapolis MPO (IMPO) uses the EPA's MOVES 2014a air quality emissions model and a travel demand model (TDM) equipped with a custom Air Quality Post-Processor module (AQPP).

The EPA MOVES 2014a model

See https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

EPA's Motor Vehicle Emission Simulator (MOVES) is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants, greenhouse gases, and air toxics. MOVES 2014b is the latest version of the MOVES model, but the EPA has specifically allowed for the use of MOVES 2014a in conformity analysis where a significant investment has already been made.

"*Policy Guidance on the Use of MOVES2014 and Subsequent Minor Revisions for State Implementation Plan Development, Transportation Conformity, and other Purposes*" is available at www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves.

Table B1 shows the general parameter inputs for MOVES 2014a, while Table B2 demonstrates the MOVES 2014a county data manager inputs, as agreed upon during interagency consultation in May and June of 2011 when the initial change to MOVES for use in Air Quality Conformity first occurred.

Table B1: 9-County Ozone Runs (MOVES Input Item)

	Screen	Ozone
Description	Description	User Choice
Scale	Domain/Scale	County
	Calculation Type	Emission Rate
Time Spans	Time Aggregation Level	Hour
	Year	2015, 2020, 2025, 2035, 2045
	Months	July
	Days	Weekday
	Hours	Select All
Geographic Bounds	Geographic Bounds	Marion County*
Vehicles	Vehicles	All Gas and Diesel Combinations
Road Type	Road Type	Select All
Pollutants/ Processes	Pollutants/ Processes	VOC, NOx, and supporting
General Output	Database Name	Indy Ozone
	Units	Select "Grams" and "Miles" and "Joules"
	Activity	Distance, Population
Output Emissions Detail	On Road	Select "Source Use Type" and "Road Type"

Table B2: County Data Manager Input

	Input	
Source (Vehicle) Type Population	sourceTypeYear	Local Registration for Source Types 11, 21, 31, and 32; Estimated population using default MOVES mileage accumulation rates and local VMT for all other source types. Future year vehicle populations based on population growth rates for source types 11, 21, 31, and 32. Employment growth used for all other source types.
Vehicle Type VMT (by 13 MOVES Vehicle Types)	HPMSVTypeYear	Statewide default vehicle distributions across road types developed by INDOT using an analysis of permanent count station data from a statewide data set.
	MonthVMTFraction	Statewide default monthly fractions developed by INDOT using an analysis of permanent count station data from a statewide data set.
	DayVMTFraction	Statewide default daily fractions developed by INDOT using an analysis of permanent count station data from a statewide data set.
	HourVMTFraction	Statewide default hourly fractions developed by INDOT using an analysis of permanent count station data from a statewide data set.
Average Speed Distribution (% of VHT in each 5-mph speed bin)	avgSpeed Distribution	National defaults.
Road Type Distribution (VMT by 5 MOVES Road Types)	roadType Distribution	Calculated from local VMT data. Use travel demand model base year distributions for all years.
Age Distribution (Vehicle Population by Age of Vehicle)	sourceTypeAge Distribution	Local age distributions developed from vehicle registration data (updated in 2018) for source types 11, 21, 31, and 32. Default MOVES age distributions for all other source types.
Ramp Fraction	RoadType	Based on Indianapolis travel demand model.
Meteorology Data	ZoneMonthHour	MOBILE6 Summer Met Data Converted to MOVES format
Fuel (% of Market Share by Fuel Type)	FuelFormulation	MOVES Defaults
	FuelSupply	County MOVES Defaults for Summer
I/M Program	IMCoverage	N/A

The IMPO Travel Demand Model (TDM)

The primary purpose of the IMPO TDM is the estimation of existing vehicle flow and the forecasting of that flow for future years. The IMPO travel demand model, or TDM, uses a modified 4-step approach to model transportation demand. The TDM is really a set of models that result in network link flow estimates. In the first two sub-models (Trip Generation and Destination Choice), the model uses demographic and socio-economic forecasts for each TAZ (traffic analysis zone), to estimate how much travel will occur in the region and where specific households are likely to travel. The model identifies which mode each household is likely to use using a nested-logit Mode Choice sub-model and finally uses a Trip Assignment sub-model to assign that travel to the most likely route each household would use to get to each destination.

Current planning assumptions used in modeling are described in the 2045 LRTP, especially chapters 3 and 4, which can be found online at IndyMPO.org.

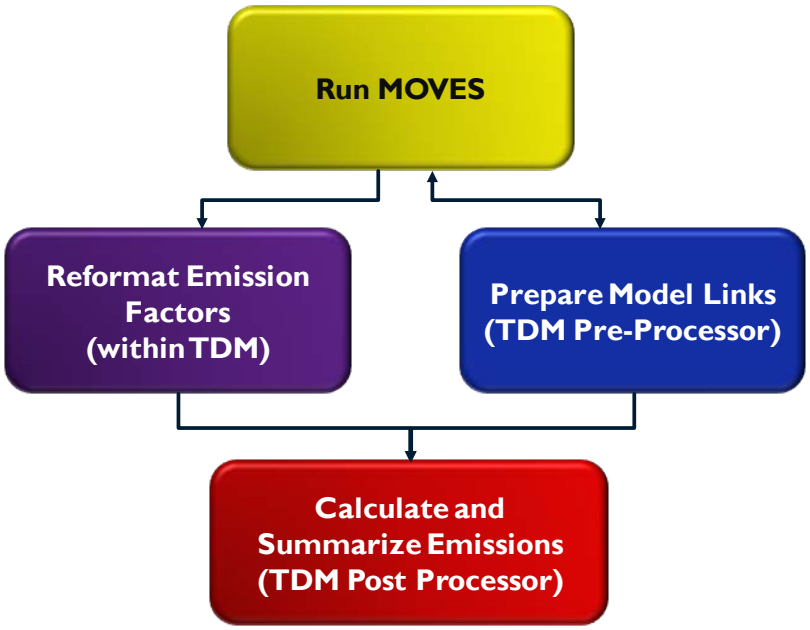
The IMPO AQPP Model

IMPO consultants tasked with updating the AQPP in 2011 coordinated with INDOT's AQPP consultant team to assure that the underlying methodology for the integrated AQPP within the IMPO TDM is consistent with the AQPP that INDOT developed for other Indiana MPOs. The TDM AQPP module contains both the TDM pre- and post-processor and is run from the MPO model interface by checking the "Air Quality" option in the "Assignment" stage of the TDM's flowchart user interface. The entire process takes approximately 20-30 minutes to run depending on the computer system's specifications.

Model Interactions

The TDM pre-processor provides some inputs to MOVES, such as VMT and road type distribution. Once emission factors are generated from MOVES, the emission factors are reformatted within the TDM in order to streamline the reading of the factors within the GISDK script and to get them in the format needed to apply to the travel activity data. The TDM pre-processor prepares the travel activity data on the model links in order to apply these factors and then the TDM post-processor calculates and summarizes both the running and non-running emissions using the emission rate tables generated by MOVES 2014a, and updated in 2018 to reflect the most current available fleet mix data from the Indiana BMV. The fleet mix update, as well as the updated HPMS adjustment factor, was discussed with the ICG. More information on both the vehicle fleet mix and HPMS Adjustment factor is available after the summary of the AQPP module.

Figure B1: Overview of Emissions Calculation Process



Indianapolis MPO and the Madison County Council of Governments (MCCOG) Coordination

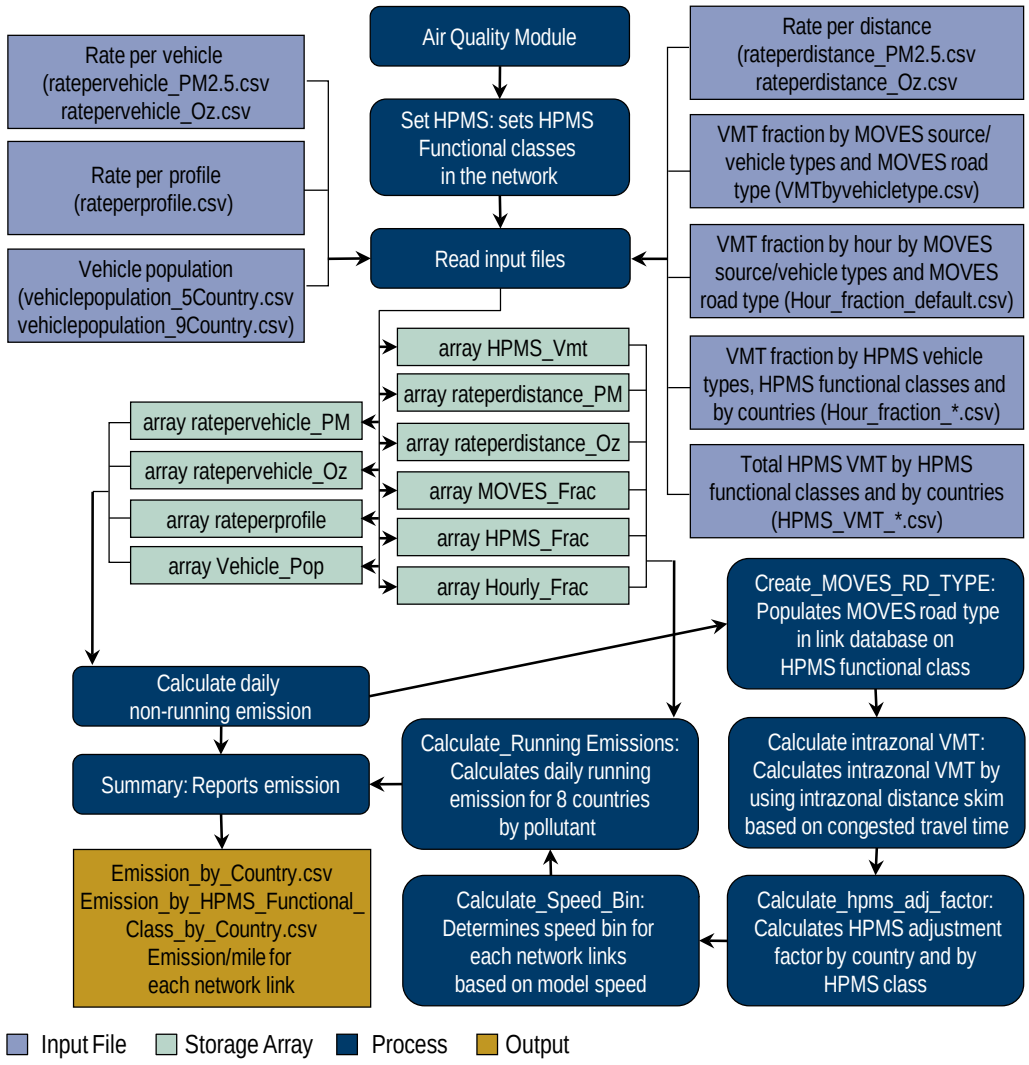
The TDM AQPP generates daily running emissions at the county level and at the Highway Performance Monitoring System (HPMS) functional class level. The AQPP generates the non-running daily emissions at the regional level based on vehicle population data. The counties included within the Indianapolis MPO boundary are: Marion, Hamilton, Johnson, Hendricks, Hancock, Shelby, Boone, Morgan, and Madison. The Madison County Council of Government (MCCOG) TDM generates daily running emissions for Madison County. The Indianapolis MPO calculates non-running emissions for Madison County using vehicle populations from INDOT and the same non-running emissions rates used for the other counties. As a result, the TDM air quality module does not output running emissions for Madison County, but does output non-running emissions for Madison County.

Air Quality Module Script Structure (Macros)

The air quality post-processing script was written in GISDK to make it compatible with the other components of the TransCAD model. The air quality module script is embedded in the macro titled "AQ" within the overall model stream script. It calls the following macros, which is followed by a flowchart (Figure B2) of the AQPP Module that illustrates how the AQPP interacts with the TDM.

- Set_HPMS: Sets the HPMS functional class code in the line layer of the model network based on specified Facility Type and Area Type combinations on each link.
- ReadFiles: Reads the input files and stores the input data in arrays.
- Calculate_NonRunning_Emissions: Calculates the daily non-running emissions based on emission rates generated by MOVES and the vehicle population within the MPO model boundary.
- Create_MOVES_RD_TYPE: Populates each network link with a MOVES road type code based on an HPMS functional class code equivalency table.
- CalculateIntrazonalVMT: Calculates intrazonal Vehicle Miles Traveled (VMT) based on intrazonal travel distance and intrazonal trips. The intrazonal VMT includes all travel activity that begin and end within the same traffic analysis zone and it is calculated for each time period and for both AB and BA directions.
- Calculate_hpms_adj_factor: Calculates adjustment factors based on the ratio of HPMS VMT to the model VMT. The adjustment factors are calculated for each of the HPMS functional class codes and for each of the nine counties. The current HPMS Adjustment Factor for is set to 0.865.
- Calculate_Speed_Bin: Sets the speed bins for each network link based on congested model speeds for different times of day. It uses the five mile per hour (mph) speed bin ranges defined in MOVES to determine the speed bins for the network links.
- Calculate_Running_Emissions: This macro calculates the daily running emissions by applying the emission rates generated by MOVES to the weighted VMT.

Figure B2: Flow Diagram of GISDK Script for Air Quality Module



Setting the HPMS Functional Classification

The assignment of HPMS Functional Class codes to each link in the network provides:

1. An equivalency attribute for MOVES road type codes, and
2. The ability to calculate HPMS adjustment factors.

Table B3: HPMS Functional Class Codes Assigned Based on Area Type and Facility Type Combinations

HPMS Functional Class	Area Type	Facility Type
1	3, 5	1, 4, 5, 11, 12
2	2, 3, 5	2, 3, 4, 5, 7
6	4, 5	3, 4, 5
9	4, 5	3
11	1, 2, 3, 4, 5	1, 4, 5, 10, 11, 12, 13
12	2, 3, 4	2, 5, 12,13
14	2, 3, 4	2, 3, 4, 5, 7,13
16	1, 2, 3, 4	3, 4, 5, 12

Reading Input Data

The air quality module reads the input files and stores the input data in multidimensional arrays. Table B4 provides a description of the input data.

The air quality module sets the HPMS functional class code for each network link based on its area type and facility type combination

Table B4: Description of Input files and Array Variables for Ozone

Input File Name	File Content	Source	Array Variable
rateperdistance_Oz.csv	Ozone Emission rate by pollutants, by process, by speed bin, by source type, by MOVES road type and by hours of day	MOVES	rateperdistance[8][hour][pollutant index[1]][process index[2]][sourceType index[3]][roadType index[4]][speed bin]
ratepervehicle_Oz.csv	Ozone Emission rate by pollutant, by process, by source type and by hours of day	MOVES	ratepervehicle[8][hour][pollutant index[1]][process index[2]][sourceType index[3]]
rateperprofile.csv	Emission rate by pollutant, by process, by source type and by hours of day	MOVES	rateperprofile[8][hour][pollutant index[1]][sourceType index[3]]
vehiclepopulation_9County.csv	Total number of vehicles by source type for AQ analysis year **(2018)**[9] within nine counties (Ozone non-attainment area)	INDOT	Vehicle_Pop[1][source type index[3]]
VMTbyvehicletype.csv	Fraction of VMT by source type on different MOVES road types	MOVES	MOVES_Frac[road type index[4]] [HPMS vehicle class index[6]][2nd digit of source type]
Hour_fraction_default.csv	Hourly fraction of VMT by MOVES road types and source types	MOVES	Hourly_Frac[source type index[3]][road type index[4]][hour]
HPMS_VMT_*.csv	Total VMT by HPMS functional class for each of nine counties	INDOT	HPMS_Vmt[county index[5]][HPMS functional class index[7]]
HPMS_Fraction_*.csv	Fraction of VMT by HPMS vehicle classes and HPMS functional classes	INDOT	HPMS_Frac[county index[5]][HPMS functional class index[7]][HPMS vehicle class index[6]]

1 Pollutant index is the position of the pollutant ID in the array of pollutants, poll_seq = [3,87,110,116,117]
2 Process index is the position of process ID in the array of processes, proc_seq = [1,2,9,10,11,12,13,15,16,17,18,19,90]
3 Source type index is the position of source type ID in the array of MOVES source types, veh_seq = [11,21,31,32,41,42,43,51,52,53,54,61,62]
4 Road type index is the position of MOVES road type ID in the array of MOVES road types, road_seq = [2,3,4,5]
5 County index is the position of county ID in the array, county = [1,2,3,4,5,6,7,8,9]
6 HPMS vehicle class index is the position of HPMS vehicle class in the array of HPMS vehicle classes [10, 20, 30, 40, 50,60]
7 HPMS functional class index is the position of HPMS functional class in the array of HPMS functional classes
8 The array [rateperdistance], [ratepervehicle] and [rateperprofile] in embedded into the array of emission rate types, Emis_Array = [rateperdistance, ratepervehicle, rateperprofile]
9 Vehicle Fleet Mix updated with 2018 data from Indiana Bureau of Motor Vehicles and used to generate full set of updated rate tables [rateperdistance], [ratepervehicle] and [rateperprofile].

The following subsections provide further detail on each macro, or subroutine, of the AQPP.

Calculate Non-Running Emissions

Non-running emissions are produced by vehicles when they are not in motion. The calculation process uses [ratepervehicle], [rateperprofile] and the vehicle population as input. It calculates the emission based on the following equations:

$$\textit{Daily non-running emissions by pollutant} = \textit{emission from rate per vehicle by pollutant} + \textit{emission from rate per profile by pollutant}$$

$$\textit{emission from rate per vehicle by pollutant} = \sum hour \sum source \sum process\ ratepervehicle^{*}\ vehicle\ population$$

$$\textit{emission from rate per profile by pollutant} = \sum hour \sum source\ rateperprofile^{*}\ vehicle\ population$$

In order to calculate Ozone emission which includes NO_x and VOC, it uses the total vehicle population in all nine counties. The non-running emissions are stored in the array variable, NREmissions[pollutant index].

Create MOVES Road Type

The MOVES road type is set based on the functional class. Below is the script that provides the criteria for assigning MOVES road type codes:

If HPMS = 11 or HPMS= 12 then MOVES_TYPE = 4 where MOVES_TYPE = 4 for urban restricted access

If HPMS = 1 or (HPMS= 2 and facility type =2) then MOVES_TYPE = 2 where MOVES_TYPE = 2 for rural restricted access

If HPMS > 12 then MOVES_TYPE = 5 where MOVES_TYPE = 5 for urban unrestricted access

If (HPMS >2 and HPMS <=9) or (HPMS = 2 and FACILTY_TYPE<>2) where MOVES_TYPE = 3 for rural unrestricted access

It was noticed in the model network that the roadways with an HPMS functional class code = 2 can be both restricted-access and unrestricted-access roadways. Therefore, the attribute "facility type" is used to differentiate between the roadways with restricted-access and the roadways with unrestricted-access. The air quality module sets the HPMS functional class code for each network link based on its area type and facility type combination.

Table B5: HPMS Functional Class to MOVES Road Type Equivalency Table

MOVES Road Types	HPMS Functional Class
1	Out of network
2	1, 2
3	2, 6, 9
4	11, 12
5	14, 16

Calculate Intrazonal VMT

The air quality module calculates the model VMT by using assigned flow and the length of the network links. The model generates assigned flow table for 5 different time periods: AM, MD, PM, EV, and NT as defined in Table C6.

Table B6: Time period ranges

Period	Time
AM	6 am. to 9 am
MD	9 pm. to 3 pm
PM	3 pm to 6 pm
EV	6 pm to 9 pm
NT	9 pm to 6 am

The intrazonal VMT at each TAZ is calculated from the time of day trip tables and the intrazonal distance skim. The intrazonal distance skim is generated from the shortest path based on congested travel time. In order to get the intrazonal skim, the average distance to the three nearest neighboring zones were multiplied by a factor of 0.5. The intrazonal VMT at each TAZ is distributed to the centroid connectors based on their share of the assigned VMT. The intrazonal VMT on each link connector is calculated from the following equations:

*AB/BA InrazonalVMT for centroid connector i= IntrazonalVMT at TAZ * share of assigned VMT at i*

share of assigned VMT at i = (AB/BA assigned flow)/(sum of the assigned flow at each centroid connectors of the TAZ)

The calculated intrazonal VMT at each link are then added to the assigned VMT of that link. The daily VMT on each link is being calculated by adding the VMTs of three time of day periods.

Calculate HPMS Adjustment Factor

The model VMT gets adjusted by the HPMS VMT. The HPMS VMTs are provided by INDOT. The HPMS VMTs are available by counties and by HPMS functional classes. The air quality module sets the HPMS adjustment factors for each of the network links by using the county and the HPMS functional class attribute of that link. The HPMS adjustment factor is 0.865 as discussed with the ICG on August 28, 2018. HPMS adjustment factor is calculated by using the following equation:

HPMS_ADJ_FACT for county c and HPMS functional class h = (HPMS VMT for c and h)/(sum of model VMT for c and h)

HPMS Adjustment Factor Update

Links were matched between the 2016 MPO model network and the INDOT 2016 AADT GIS layer. VMT was computed for the INDOT links: *(Length * AADT)*. The IMPO TDM overestimates VMT. VMT is available for the model links via the EMIS output file, this is the same VMT used in the AQPP analysis (see section: Calculate Running Emissions). This analysis covers 94.7% of all VMT on modeled road segments. This excludes centroid connectors. An HPMS adjustment factor of 0.865 is justified.

Table B7: Links with Common Road Coverage

Links with Common Road Coverage	
INDOT Counts VMT	46,505,599
Modeled VMT	53,763,699
Ratio of Count/Model	0.865

Vehicle Fleet Mix Update

In 2018, the IMPO was provided new vehicle fleet mix data from INDOT and this data was used to provide updated Ozone Rate tables. The fleet mix for Central Indiana has changed since 2015, the last time the vehicle fleet mix and rate tables were updated. This input data provides information on the age distribution of each MOVES vehicle type. Figures B3 - B4, and Table B8 - B9 provide comparisons of the new vehicle fleet mix, age distribution, updated projected source type population, and fuel AVT updates related to the new vehicle fleet mix.

Figure B3: Comparison of the Vehicle Fleet Mix between 2015 and 2018

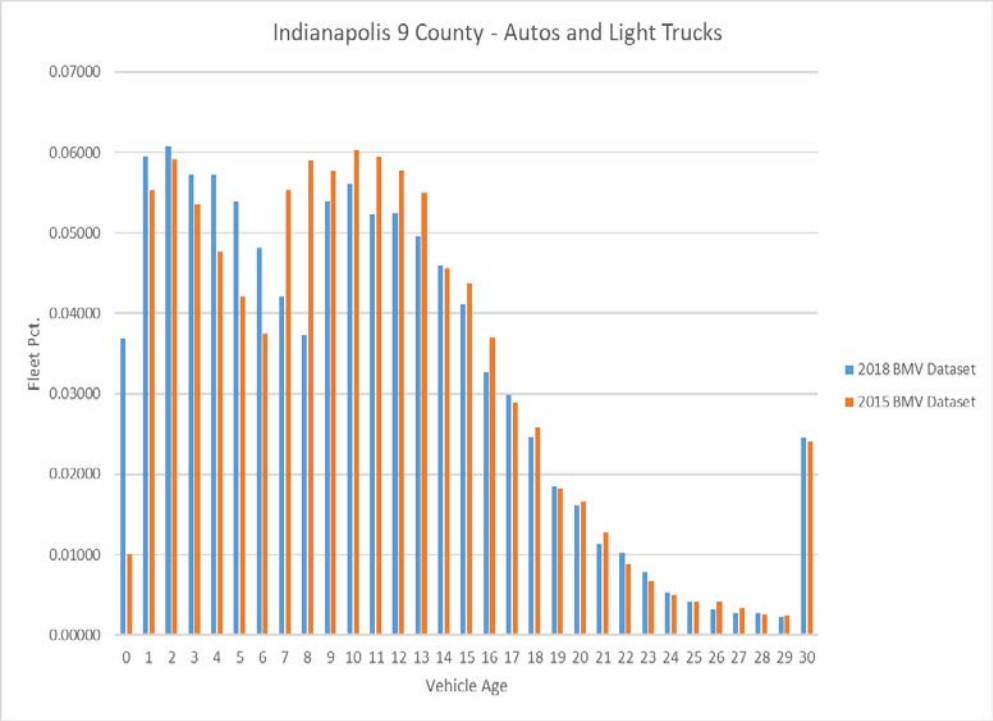


Figure B4: Comparison of the Vehicle Age Distribution between the 9-County Region and Statewide

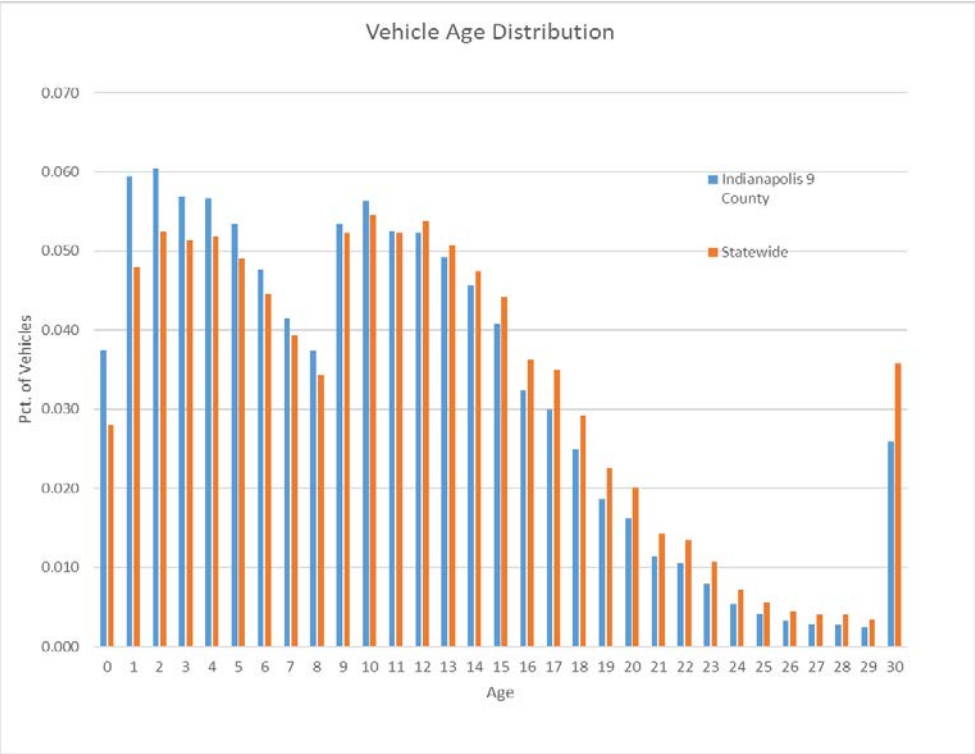


Table B8: Updated 9-County Vehicle Source Type Population

sourceTypeID	2015	2020	2025	2030	2035	2040	2045
11	51,119	55,258	56,540	59,232	61,367	64,616	67,308
21	891,754	933,485	961,588	1,005,443	1,039,422	1,093,154	1,137,009
31	509,921	533,784	549,853	574,930	594,360	625,085	650,162
32	158,227	165,631	170,618	178,399	184,428	193,962	201,743
41	745	808	821	857	885	929	965
42	389	422	429	448	462	485	503
43	5,065	5,496	5,586	5,833	6,022	6,326	6,572
51	174	182	194	203	214	223	233
52	11,947	12,558	13,307	13,996	14,706	15,375	16,064
53	1,534	1,612	1,709	1,797	1,888	1,973	2,062
54	2,762	2,903	3,077	3,236	3,400	3,554	3,714
61	19,494	21,275	21,594	22,573	23,316	24,531	25,510
62	23,321	25,452	25,833	27,005	27,894	29,347	30,519

Fuel Type and Vehicle Technology

During the vehicle fleet mix update, the fuel AVT was also updated from the same BMV data source and incorporated into the new MOVES 2014a rate tables.

Table B9: 9-County Fuel Type and Vehicle Technology

Fuel Type and Vehicle Technology *9-County Indianapolis Ozone Area*			**FuelType -->**	1	2	5	1	9	X
			EngTech -->	1	1	1	12	30	X
Data Source	**Vehicle Type**	**Code**	**Year**	**Gasoline**	**Diesel**	**E-85**	**Hybrid**	**Electric**	**Other**
BMV	Passenger Car	21	2018	89.05%	0.30%	8.89%	1.65%	0.06%	0.05%
BMV	Passenger Truck	31	2018	77.83%	8.42%	13.71%	0.03%	0.00%	0.01%
BMV	Light Commercial Truck	32	2018	34.20%	61.50%	4.30%	0.00%	0.00%	0.00%

Fuel Type and Vehicle Technology *Statewide*			**FuelType -->**	1	2	5	1	9	X
			EngTech -->	1	1	1	12	30	X
Data Source	**Vehicle Type**	**Code**	**Year**	**Gasoline**	**Diesel**	**E-85**	**Hybrid**	**Electric**	**Other**
BMV	Passenger Car	21	2015	90.80%	0.43%	7.49%	1.18%	0.01%	0.09%
BMV	Passenger Truck	31	2015	81.84%	7.23%	10.89%	0.02%	0.00%	0.02%
BMV	Light Commercial Truck	32	2015	53.06%	40.89%	5.94%	0.00%	0.00%	0.11%
MOVES Default	Passenger Car	21	2015	93.73%	1.17%	5.10%	0.00%	0.00%	0.00%
MOVES Default	Passenger Truck	31	2015	78.92%	2.00%	19.07%	0.00%	0.00%	0.00%
MOVES Default	Light Commercial Truck	32	2015	76.99%	5.31%	17.70%	0.00%	0.00%	0.00%

Calculate Speed Bin

The air quality module sets the speed for each network link based on their congested speeds. The congested speed for each link is calculated from the link length and the congested travel time. The congested travel time is generated by the highway assignment component of the model. The speed varies by time of day periods and by the direction of flow. Therefore, speed bin is determined for each time of day periods and for each of AB and BA direction. The speed bin for each link is being set by using the following criteria identified in Table B10.

Table B10: Speed Ranges Within Each Speed Bin

avgSpeedBinID	avgSpeedBin Description
1	speed < 2.5mph
2	2.5mph <= speed < 7.5mph
3	7.5mph <= speed < 12.5mph
4	12.5mph <= speed < 17.5mph
5	17.5mph <= speed <22.5mph
6	22.5mph <= speed < 27.5mph
7	27.5mph <= speed < 32.5mph
8	32.5mph <= speed < 37.5mph
9	37.5mph <= speed < 42.5mph
10	42.5mph <= speed < 47.5mph
11	47.5mph <= speed < 52.5mph
12	52.5mph <= speed < 57.5mph
13	57.5mph <= speed < 62.5mph
14	62.5mph <= speed < 67.5mph
15	67.5mph <= speed < 72.5mph
16	72.5mph <= speed

Calculate Running Emissions

Running emissions are generated from moving vehicles. They are calculated using running emission rates per distance, travel data and the network attributes. The AQPP uses the following equation to calculate running emission for each of the network link:

> *Daily running emission by pollutant = ∑hour∑HPMS Veh Class (hourly adjusted vmt * ∑process rateperdistance) Where rate per distance depends on speed bins and MOVES road type*

In order to facilitate the calculation process, the air quality module creates a database titled EMIS_daily.bin. Each record in this file can be identified by network link Ids. Table B11 describes the fields in the database EMIS_Daily.bin.

Table B11: Field Descriptions of the Link Database (EMIS_Daily.bin)

Fields	Description
LinkID	TransCAD network link ID
Dir	Direction
Length	Length in miles
County	County =1 is “Marion”, County =2 is “Hamilton”, County =3 is “Johnson”, County = 4 is “Hendricks”, County = 5 is “Hancock”, County = 6 is “Shelby”, County = 7 is “Boone”, County = 8 is “Morgan”, County = 9 is “Madison”
HPMS	HPMS functional class code
FACILTY_TYPE	Facility type code
AREA_TYPE	Area type code
AB_AM_VMT	AB VMT for AM=length * AB assigned flow for AM
BA_AM_VMT	BA VMT for AM=length * BA assigned flow for AM
AB_AM_VHT	AB VHT for AM= AB assigned flow for AM * AB time from AM assignment
BA_AM_VHT	BA VHT for AM= BA assigned flow for AM * BA time from AM assignment
AB_AM_SPEED	AB speed for AM = Length*60/AB time from AM assignment
BA_AM_SPEED	BA speed for AM = Length*60/BA time from AM assignment
AB_PM_VMT	AB VMT for PM=length * AB assigned flow for PM
BA_PM_VMT	BA VMT for PM=length * BA assigned flow for PM
AB_PM_VHT	AB VHT for PM= AB assigned flow for PM * AB time from PM assignment
BA_PM_VHT	BA VHT for PM= BA assigned flow for PM * BA time from PM assignment
AB_PM_SPEED	AB speed for PM = Length*60/AB time from PM assignment
BA_PM_SPEED	BA speed for PM = Length*60/BA time from PM assignment
AB_OFFP_VMT	AB VMT for OFFP=length * AB assigned flow for OFFP
BA_OFFP_VMT	BA VMT for OFFP=length * BA assigned flow for OFFP
AB_OFFP_VHT	AB VHT for OFFP= AB assigned flow for OFFP * AB time from OFFP assignment
BA_OFFP_VHT	BA VHT for OFFP= BA assigned flow for OFFP * BA time from OFFP assignment
AB_OFFP_SPEED	AB speed for OFFP = Length*60/AB time from OFFP assignment
BA_OFFP_SPEED	BA speed for OFFP = Length*60/BA time from OFFP assignment
AB_DAILY_VMT	$\sum_{TOD=AM, MD PM, EV, NT}$(AB_TOD_VMT + AB_TOD_Intra_VMT)
BA_DAILY_VMT	$\sum_{TOD=AM, MD PM, EV, NT}$(BA_TOD_VMT + BA_TOD_Intra_VMT)
TOT_DAILY_VMT	Total daily vmt = AB_DAILY_VMT+BA_DAILY_VMT
HPMS_ADJ_FACT	HPMS adjustment factor
AB_DAILY_VMT_ADJ	Daily VMT in AB direction adjusted by HPMS adjustment factor
BA_DAILY_VMT_ADJ	Daily VMT in BA direction adjusted by HPMS adjustment factor
AB_DAILY_VHT	Daily VHT in AB direction
BA_DAILY_VHT	Daily VHT in BA direction
DAILY_NOx	Daily NO_x (pollutant ID = 3)
DAILY_VOC	Daily VOC (pollutant ID = 87)
DAILY_PM_Exhaust	Daily $PM_{2.5}$ Exhaust (pollutant ID = 110)
DAILY_PM_Brake_Wear	Daily $PM_{2.5}$ Brake Wear (pollutant ID = 116)
DAILY_PM_Tire_Wear	Daily $PM_{2.5}$ Tire_Wear (pollutant ID = 117)
MOVES_TYPE	MOVES road type = 2 for rural restricted, 3 for rural unrestricted, 4 for urban restricted and 5 for urban unrestricted
ANODE	A node ID
BNODE	B node ID
Centroid	Centroid node ID for the centroid connector and null for other links

Table B11 (cont.): Field Descriptions of the Link Database (EMIS_Daily.bin)

Fields	Description
AB_AM_Intra_VMT	Intrazonal VMT in AB direction for AM
BA_AM_Intra_VMT	Intrazonal VMT in BA direction for AM
AB_PM_Intra_VMT	Intrazonal VMT in AB direction for PM
BA_PM_Intra_VMT	Intrazonal VMT in BA direction for PM
AB_OFFP_Intra_VMT	Intrazonal VMT in AB direction for off-peak
BA_OFFP_Intra_VMT	Intrazonal VMT in BA direction for PM
AM_ModelVMT	AB_AM_VMT + BA_AM_VMT
AM_ModelVMT_by_Centroid	Total model VMT on centroid connector links for each centroid nodes at AM
AB_AM_intravmt_factor	AB_AM_VMT/AM_ModelVMT_by_Centroid
BA_AM_intravmt_factor	BA_AM_VMT/AM_ModelVMT_by_Centroid
PM_ModelVMT	AB_PM_VMT + BA_PM_VMT
PM_ModelVMT_by_Centroid	Total model VMT on centroid connector links for each centroid nodes at PM
AB_PM_intravmt_factor	AB_PM_VMT/PM_ModelVMT_by_Centroid
BA_PM_intravmt_factor	BA_PM_VMT/PM_ModelVMT_by_Centroid
OFFP_ModelVMT	AB_OFFP_VMT + BA_OFFP_VMT
OFFP_ModelVMT_by_Centroid	Total model VMT on centroid connector links for each centroid nodes at OFFP
AB_OFFP_intravmt_factor	AB_OFFP_VMT/OFFP_ModelVMT_by_Centroid
BA_OFFP_intravmt_factor	BA_OFFP_VMT/OFFP_ModelVMT_by_Centroid
AB_AM_BIN	Speed bin in AB direction for AM based on AM AB_speed
BA_AM_BIN	Speed bin in BA direction for AM based on AM BA_speed
AB_PM_BIN	Speed bin in AB direction for PM based on PM AB_speed
BA_PM_BIN	Speed bin in BA direction for PM based on PM BA_speed
AB_OFFP_BIN	Speed bin in AB direction for Off-peak based on Off-peak AB_speed
BA_OFFP_BIN	Speed bin in BA direction for Off-peak based on Off-peak BA_speed
HPMS_VMT_FRAC_1	HPMS VMT fraction for HPMS vehicle type 10
HPMS_VMT_FRAC_2	HPMS VMT fraction for HPMS vehicle type 20
HPMS_VMT_FRAC_3	HPMS VMT fraction for HPMS vehicle type 30
HPMS_VMT_FRAC_4	HPMS VMT fraction for HPMS vehicle type 40
HPMS_VMT_FRAC_5	HPMS VMT fraction for HPMS vehicle type 50
HPMS_VMT_FRAC_6	HPMS VMT fraction for HPMS vehicle type 60

The running emission is calculated for each of the network links from rate per distance and the adjusted VMT. The rate per distance varies with hours of day, MOVES source type, MOVES road types, speed bins, emission processes and pollutants. The emission rate is calculated for each of the HPMS vehicle type categories. In order to do that, the program aggregates the rates by 13 MOVES source types to the rates by 6 HPMS vehicle classes be using a weighting factor. The factor is calculated from the array variable, MOVES_Frac, as described earlier in Table 2.2. This array stores the fraction of VMT by MOVES road type and MOVES source (vehicle) type. As a result, the weighting factor varies with MOVES road types and MOVES vehicle types. The factor is calculated by using the following equation:

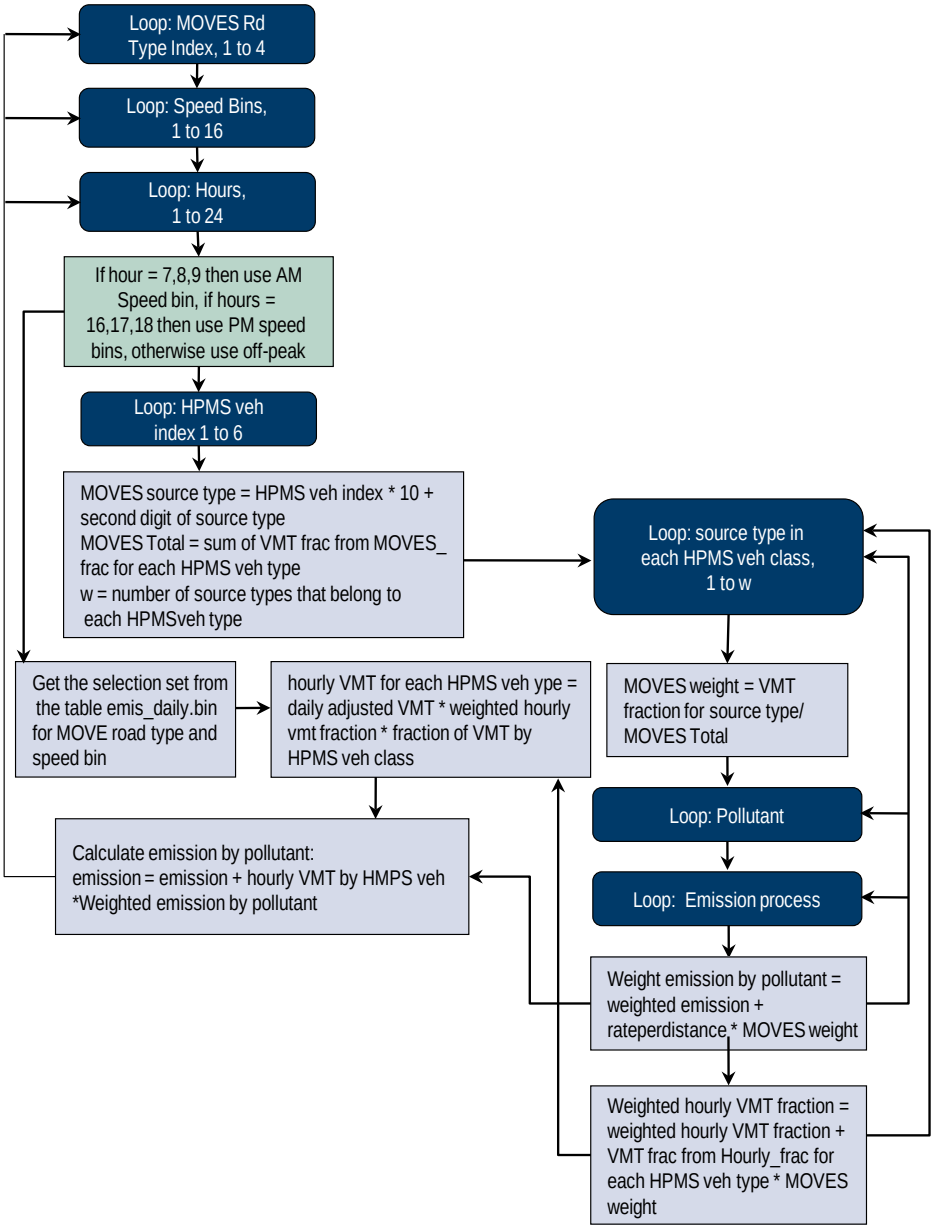
The weighting factor = MOVES_Frac[road type index4][HPMS vehicle class index6][2nd digit of source type]/∑MOVES_Frac[road type index4][HPMS vehicle class index6]

For each link of the network, the air quality module looks up the emission rates from the array variable, rateperdistance, by using the attributes such as the speed bins and road types for each MOVES source

(vehicle) type, emission process, pollutant and hour of the day. The following flow chart (Figure B5) describes the process of calculating daily emissions by pollutant by HPMS vehicle classes.

The air quality module populates three new fields in the network's line layer: *Daily_NOx_per_mile, Daily_VOC_per_mile*, and *DAILY_PM25_per_mile*. These fields show the running emissions per mile for each link.

Figure B5: Process for Calculating Daily Running Emissions



Summary Macro

The air quality module stores the emission summaries in two separate files:

1. Emission_by_HPMS_Functinal_Class_by_County.csv
2. Emission_by_County.csv

The first file reports the daily running emissions by HPMS functional class and County. The second file reports the daily running emissions by County. Both of the files report daily non-running emissions for the region. Following is an example of Emission_by_County.csv for 2020. As noted previously, the AQPP does not generate Running emissions for Madison County, this is added to the calculations for the final summation.

[Emission Type]	County	[Daily NOx for Ozone]	[Daily VOC]
Running	Marion	15445139.96	3620772.00
Running	Hamilton	5010229.23	1157226.32
Running	Johnson	2169840.44	460076.84
Running	Hendricks	2375072.28	505625.02
Running	Hancock	1475003.75	311161.70
Running	Shelby	1523797.21	242045.36
Running	Boone	2119745.76	326535.80
Running	Morgan	1388625.82	285607.88
Running	All 8 Counties	31507454.43	6909050.93
Non-running	All Counties	9886894.83	15759809.38

Post-Model Processing: Converting Emissions Output from Grams to Tons

The MOVES 2014a based Air Quality Post Processor (AQPP) component of the Travel Demand Model provides output emissions in grams. The SIP Budget is presented in tons, thus making conversion necessary and the following formula is used for Ozone related pollutant emissions output:

Convert grams to tons: *[emission] * 0.000001102*

The above calculation is applied to all running and non-running emissions output to convert emissions output to tons. The converted emissions output values are summed to provide the final emissions output which is then compared with the appropriate budget.

Appendix C: Air Quality Conformity Determination Report Public Comment

This report was available for public review and comment between September 20, 2018 and October 23, 2018. Public Comments received are as follows:

(to be added after October 23, 2018)