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MEMORANDUM

Date:	February 26, 2014
To:	Scott Prisco
Organization:	Arlington Public Schools
From:	Diane Lambert, Senior Planner and Alia Anderson, Deputy Director of Planning
Project:	APS GO! Transportation Demand Management Master Plan
Re:	Task 2, Section 2.2: Greenhouse Gas Emissions Estimate

Introduction

The APS GO! project will result in a set of proposed transportation demand management (TDM) strategies that will help reduce congestion, improve sustainability and increase the efficiency of the APS transportation system. Because TDM strategies help people and organizations reduce driving, they can lead to lower levels of transportation-related greenhouse gas (GHG) emissions. For this reason, Toole Design Group (TDG) was tasked with estimating the GHG emissions related to transportation at Arlington Public Schools. This memo provides an overview of the methodology and findings from this analysis. The findings can serve as a baseline for measuring the impact of transportation demand management strategies on GHG emissions over time. If APS begins to collect school-based travel data for students and staff in the future, the baseline for GHG emissions may need to be updated using new data.

Methodology

This estimate of greenhouse gas emissions includes transportation-related emissions from student driving, staff driving and school vehicles (buses and other APS fleet vehicles). These emission sources were included in this analysis because they represent the largest trip categories, and thus largest sources of transportation-related emissions at APS. Because the focus of APS GO! is transportation demand management, other emission sources like utilities, building energy and lighting are not included in this calculation.

To calculate emissions from **student driving**, TDG began by estimating the vehicles miles traveled (VMT) from students driving or being driven by a caregiver to school. Student driving rates and distances were reported in the APS GO! travel surveys conducted in October and November 2013. For students Pre-K – 10th grade, parents were asked to report their child's most common travel mode to school and were also asked to indicate how far they live from school: less than .25 miles, .25 - .5 miles, .5 - 1 miles, 1 - 1.5 miles, or more than 1.5 miles. For each distance, the following calculations were used to estimate VMT:

Step 1:

School Enrollment x % driving less than ¼ mile = # driving less than ¼ mile

Step 2:

 # driving less than ¼ mile x Estimated round trip mileage = VMT per day, students living less than ¼ mile

For survey respondents living less than 1.5 miles from school, the estimated round trip mileage used was the midpoint of the distance range (e.g., for 1 – 1.5 miles, the midpoint of 1.25 miles was doubled to get round trip mileage). For survey respondents who indicated that they live more than 1.5 miles from school, the estimated round trip mileage was calculated using anonymous student address data.

A separate survey was conducted with 11th and 12th grade students. This survey did not include a question about how far students live from school, so a slightly different method was used to estimate VMT. For this group, the percent of survey respondents who indicated that they drive or are driven by a caregiver was multiplied by each school's 11th and 12th grade enrollment. The result was multiplied by the estimated average round trip mileage, calculated using the anonymous student address data for each school.

For all students, the estimated VMT per day was multiplied by the number of school days per year to determine student VMT per year.

To estimate VMT related to **staff driving**, TDG calculated an average home-to-work distance for each APS site using anonymous staff zip code data. Then the percent of staff driving to each site (from the staff surveys) was used to calculate round trip mileage per day. This was multiplied by the average number of staff work days per site per year, resulting in the estimated annual VMT for staff.

Following the international standard, greenhouse gases were calculated in units of metric tons of carbon dioxide equivalent ($mtCO_2e$), which incorporates the Global Warming Potential (GWP) for multiple greenhouse gases into one figure. For student and staff driving, GHG emissions were calculated using Environmental Protection Agency (EPA) estimates for average vehicle emissions per mile of three GHGs: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). To convert to $mtCO_2e$, EPA conversion factors for GWP were applied to each greenhouse gas, as follows:

Greenhouse Gas	Estimated Emissions, Average Passenger Vehicle (grams per mile)[1]	Global Warming Potential Conversion Factor[2]
Carbon Dioxide (CO_2)	423	1
Methane (CH_4)	.0173	21
Nitrous Oxide (N_2O)	.0036	310

VMT per year x Estimated Emissions *(grams per mile)* ÷ 1,000,000 *(metric tons per mile)* x GWP = $mtCO_2e$ per year

[1] U.S. Environmental Protection Agency, *Greenhouse Gas Emissions from a Typical Passenger Vehicle*, December 2011. http://www.epa.gov/otaq/climate/documents/420f11041.pdf

[2] U.S. Environmental Protection Agency, *Emission Factors for Greenhouse Gas Inventories*, November 2011. http://www.epa.gov/climateleadership/documents/emission-factors.pdf

For GHG emissions from the **APS buses and vehicle fleet**, TDG used the figures calculated as part of the Arlington County Government Operations Greenhouse Gas Inventory.[3] The Arlington County estimates were used because the data was recent (2013) and the results were more precise than what would have been feasible as part of this study (Arlington County used individual vehicle make, model and efficiency data for all APS buses and vehicles).[4] The methodology and conversion factors used in the Arlington County report were the same as those applied above, so the resulting emission figures are comparable to those calculated by TDG for student and staff driving. TDG reviewed the methodology used for the APS GO! calculations with the Arlington County staff who worked on the 2012 County Inventory to confirm that the methods and processes were comparable.

Findings

Vehicle Miles Traveled

It is estimated that APS student driving, including those who drive to school or are driven by caregivers, totals approximately 3.3 million vehicle miles per year. This is an estimated 117 miles per APS student per year.

APS staff drive an estimated 12.7 million miles per year traveling to and from work. This is an estimated 2,641 miles per staff member per year. Overall staff VMT is significantly higher than student VMT for three reasons:

- Staff driving rates (88%) are higher than student's rates of driving or being driven to school (~30% for Pre K – 10th grade, ~50% for 11th and 12th grade)
- Staff live further from schools/APS sites than students
- Staff work more days per year than students attend school

Greenhouse Gas Emissions

Greenhouse gas emissions for transportation sources are estimated as follows:

Source	Emissions ($mtCO_2e$ per year)
Student and Staff Driving	7,684
APS vehicle fleet (non-bus)	359
Buses	2,354
TOTAL	10,398 metric tons of CO_2e per year

Considering that the APS community includes 28,128 people (students and staff), this is an estimated 370 kilograms of CO_2e per person per year. Again, this estimate can serve as a baseline for measuring the impact of transportation demand management programs over time.

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[3] SAIC and Arlington County, *2012 Government Operations Greenhouse Gas Inventory*, May 2013. http://freshaireva.us/wp-content/uploads/2013/05/2012-ArCo-Gov-Ops-Inventory-with-cover.pdf

[4] APS buses use an engine regeneration system that is designed to process and reduce emissions. This system was not a factor in the emissions calculated in the Arlington County report. The emission reduction rate from the regeneration system is not known at this time. If that data becomes available, the bus emissions estimate should be refined.