

INTRODUCTION

Ensuring that students, faculty, and staff have safe and reliable means of transportation to and from campus is clearly important to maintaining a high quality of life at Princeton; however, campus transportation also has the potential to adversely affect the quality of life of members of the Princeton Community in a variety of ways.

First, motor vehicles are responsible for releasing several hazardous and perhaps even toxic materials into the air – among these are:

Pollutant	Established harms
carbon dioxide	a known greenhouse gas that contributes to global warming
carbon monoxide	can lead to oxygen starvation, increase the risk of heart attack in those with heart disease, and cause birth defects in pregnant women
particulate matter	can trigger asthma attacks and increase the risk of developing asthma and other respiratory problems
oxides of sulfur	specifically sulfur dioxide, which can trigger asthma and produces acid rain
hydrocarbons	can be toxic or cancerous and combine with oxides of nitrogen in sunlight to make ozone
nitrogen oxides	combine with hydrocarbons in sunlight to produce ozone and can produce acid rain
ozone	can cause asthma or eye irritation when high levels are present

New Jersey's air quality for most of these pollutants is in compliance with federal standards, as designated by the U.S. Environmental Protection Agency and the Clean Air Act. However, as of April 15, 2004 all of New Jersey's counties failed to meet the U.S. Environmental Protection Agency's eight-hour ground-level ozone designations, meaning that each of these areas has violated the national eight-hour ozone standards in the last three years.¹ In 2003, there were nineteen days during which New Jersey failed to meet

¹ United States Environmental Protection Agency. (EPA) "Region 2: State Designations." April 15, 2004. Online resource. Last accessed 07.31.04. URL: <http://www.epa.gov/ozonedesignations/regions/region2desig.htm>

the eight-hour ozone standard, which was set to ensure safety from the significant health problems of long-term ozone exposure.²

The link between congestion, ozone production, and asthma rates is clearly demonstrated by the case study of Atlanta, Georgia during the 1996 Summer Olympics. A traffic reduction program involving enhanced public transportation, closing downtown Atlanta to motor vehicles, and encouraging telecommuting and alternative work hours led to a twenty-eight percent decline in peak ozone levels and an almost twenty percent decline in asthma hospitalizations over the seventeen day period the program was in effect.³

The adverse environmental effects of motor vehicle emissions are not limited to health problems. The U.S. transportation sector is responsible for approximately one-third of the nation's carbon emissions. Carbon dioxide is "the dominant greenhouse gas that causes global warming."⁴ Further, sulfur dioxide and nitrogen oxides, which can produce acid rain, have already damaged the Princeton campus - blackening the walls of University buildings such as McCosh or the Chapel and accelerating the decay of building materials and paints.

Additionally, the use of motor vehicles has the potential to adversely affect water quality in the Princeton area. Runoff that travels over parking lots and roads may be contaminated by litter, motor oil, or gasoline and has the potential to harm local flora and fauna. Moreover, the impervious surface cover of roads and parking structures can

² New Jersey Department of Environmental Protection. "Ozone Nonattainment Areas." Online Resource. Last accessed 07.31.04. URL: <http://www.state.nj.us/dep/ipoca/nonattain.htm>

³ Environmental Defense. "Asthma Attack." 2004. Online resource. Last accessed 07.31.04. URL: <http://www.environmentaldefense.org/system/templates/page/subissue.cfm?subissue=21>

⁴ Environmental Defense. "Carbon Emissions Fact Sheet: Clearing the Air on Climate Change." July 2002. Online resource. Last accessed 07.31.04 URL: http://www.environmentaldefense.org/documents/2209_CarEmissionsFactSheet.pdf

increase the rate of storm water runoff, aggravating its harmful effects such as less infiltration for groundwater recharge (this, in turn, can cause diminished stream flows during dry seasons – harming riparian wildlife and vegetation), stream bank erosion, or increased risk of flooding.

Finally, the use of motor vehicles potentially threatens the social and economic welfare of the Princeton community. Motor vehicle use results in wear and tear on roads, increases citizen vulnerability to oil shocks and high oil prices, and encourages investment in building new roads, parking lots, and parking garages or buying fuel. Funds spent on these goods and services might better be spent minimizing or mitigating the aforementioned harms of motor vehicle use by investment in public transportation or other programs that reduce reliance on motor vehicles.

This report examines existing transportation patterns at Princeton University, their adverse environmental effects, and some ways in which the University might improve its transportation options. As Mercer County's largest employer, and with a number of students who bring vehicles to campus, it is clear that Princeton University has the potential to act as a major influence in the region. This report expands on the 2000 Environmental Audit conducted by the undergraduate students of the Environmental Studies Program, as well as on work conducted by students in ENV 201 in 2004. This report addresses two main areas:

1. Student Transportation
2. Transportation for Faculty and Staff

Recommendations are incorporated into the body of the report.

1. STUDENT TRANSPORTATION

A. Student-owned Vehicles

In 2003-2004 the Parking Office issued approximately 1,010 parking permits to University undergraduate students, and approximately 1,000 permits to graduate students. The number of permits issued to both populations has declined since the 2000 Environmental Audit. For the undergraduate population, this decline was probably caused by the ban on freshman parking that was instituted at the beginning of the 2003-2004 school year. For the graduate population, this decline might be attributed to the success of the recent P-rides shuttle system expansion overseen by Ms. Harvey.

Undergraduate students who belong to Eating Clubs with parking lots may sometimes park their vehicles there instead of choosing to park in a University lot. I did not hear back from many of the eating clubs regarding the number of students parking in their lots, but would presume based on a survey of lot sizes that no more than 175 students are able to park at their Eating Club.

B. Environmental Impacts of Student Travel Habits

In January 2004, several students in the Environmental Studies 201 course conducted a survey of undergraduate student travel habits. This survey found that students drive, on average, 30.7 miles per week. Based on this information, I calculated undergraduate student emissions of hydrocarbons, carbon monoxide, carbon dioxide, oxides of nitrogen, as well as gasoline consumption. In my calculations, I assumed that approximately twenty-five percent of the undergraduate student population (1,186)

owned a vehicle (approximately twenty-one percent of the population received a permit and an additional four percent might be accommodated by Eating Club lots) and that the survey conducted by the Environmental Studies 201 students was representative of the Princeton undergraduate population.

At 30.7 miles per week, and with 1,186 students driving, Princeton students drive a total of 36,410.2 miles per week. In the survey: 32% of undergraduates with a motor vehicle on campus had SUVs and 68% had smaller passenger vehicles. Because SUVs have much higher fuel consumption and pollutant emissions rates, I calculated emissions and consumption information for these vehicle types separately. Thus, SUVs were responsible for a total of approximately 11,651 vehicle miles traveled per week while cars were responsible for approximately 24,759 vehicle miles traveled per week.

Pollutant / Fuel Use⁵	SUVs (11,651.264 VMT per week)	Cars (24,758.936 VMT per week)	Total per week	24 class weeks / year
hydrocarbons	3.51 grams per VMT = 40,895.94 grams/week	2.80 grams per VMT = 69,325.02 grams/week	110,220.96 grams	2,645,303.04 grams/year = 5,831.80 lbs/year ⁶
carbon monoxide	27.7 grams per VMT = 322,828.11 grams/week	20.9 grams per VMT = 517,461.76 grams/week	840,289.87 grams	20,166,956.88 grams/year = 44,459.85 lbs/year
oxides of nitrogen	1.81 grams per VMT = 21,088.79 grams/week	1.39 grams per VMT = 34,414.92 grams/week	55,503.71 grams	1,332,089.04 grams/year = 2,936.70 lbs/year
carbon dioxide	1.15 lbs per VMT = 3,398.95 lbs/week	0.916 lbs per VMT = 22,679.19 lbs/week	36,078.14 lbs	865,875.36 lbs/year
gasoline consumption	.0581 gallons/VMT = 676.94 gallons/week	.0465 gallons/VMT = 1,151.29 gallons/week	1828.23 gallons	43,877.52 gallons/year

⁵ Calculations made using average SUV and car emissions data from the United States Environmental Protection Agency. "Emission Facts." EPA Office of Transportation and Air Quality EPA-420-F-00-013. April 2000. Online resource. Last accessed 07.31.04. URL: <http://www.epa.gov/otaq/consumer/f00013.htm>

⁶ 1 lb = 453.6 grams

By these calculations, Princeton's undergraduate population produces a little less than three tons of hydrocarbons per school year, approximately twenty-two tons of carbon monoxide per school year, over one and a half tons of nitrogen oxides per school year, over 433 tons of carbon dioxide per year, and consumes almost 44,000 gallons of gasoline per year. These figures will only rise after the construction of Whitman College.⁷

If we were to assume that the graduate student population had similar travel patterns to the undergraduate student population, the emissions figures listed above would double. These figures demonstrate a compelling need to improve or enact programs to reduce student dependence on their motor vehicles and, consequently, reduce student emissions of these harmful pollutants.

C. Alternative Transportation Options for Students

The undergraduate student government (USG) has worked to provide carpooling options and alternatives to motor vehicle use for student transportation. The Electronic Ride Board, hosted on the USG website, allows students to post their desire to either provide or receive transportation to a particular location. This service is not currently widely advertised on the Princeton Campus. However Matt Margolin, President of the USG, informed me that the USG intends to launch a new website called "The Princeton Portal" with a link to the Electronic Ride Board. Mr. Margolin hopes that most of the University's students will choose to make The Princeton Portal their home page, and that this will increase use of the Electronic Ride Board.

⁷ According to Steve Virostko, of the facilities department, this increase in the student population is not expected to create a need to construct more parking facilities.

Additionally, Mr. Margolin informed me that the USG has been working to strengthen the school's relationship with McCaffrey's supermarket, such that students will be able to have groceries reliably delivered to their dorm rooms, eliminating the need to drive to the grocery store. Regrettably, Mr. Margolin noted that several USG-conducted focus groups found limited student interest in short-range shuttle transportation such as buses to nearby shopping centers. However, Mr. Margolin did note that the USG intends to provide long-range shuttle service to Washington D.C. and Boston over the Thanksgiving, Fall, and Spring Breaks in the coming year. Advertising these long-range shuttle options on The Princeton Portal website will surely attract student attention to a program that was popular before it was discontinued in the 2004 Spring Semester. Beyond the measures the USG intends to take next year, there does not seem to be much potential for the USG to decrease student reliance on motor vehicles.

The Princeton University Administration is uniquely capable of mandating reductions in student vehicle use. Specifically, the administration could ban sophomore parking on campus. If we were to assume that sophomores represented one-third of the undergraduate population parking at Princeton, then denying them the ability to park would reduce undergraduate student hydrocarbon emissions by almost one ton, carbon monoxide emissions by almost seven and a half tons, nitrogen oxide emissions by approximately half a ton, and carbon dioxide emissions by approximately 144 tons per year. Additionally, undergraduate student gasoline consumption would be reduced by approximately 15,000 gallons per school year. The administration should strongly consider a sophomore parking ban.

2. TRANSPORTATION FOR FACULTY AND STAFF

A. Employee-owned Cars

Data regarding faculty and staff transportation is collected by the University Parking Office and overseen by public safety. Currently, faculty and staff permits are issued every three years, which makes it difficult to gather an exact count of the number of permits issued in a given year. According to the Parking Office, during the 2003-2004 school year there were approximately 6,800 parking passes issued to Princeton faculty and staff members. This represents an increase of almost 1,000 parking permits since the Princeton Environmental Oversight Committee 2000 Environmental Audit of Princeton University. The parking office was unable to break this information down by part-time versus full-time employees and thus it is difficult to ascertain exactly how many faculty and staff vehicles are brought to campus each day.⁸ However, the University's Office of Human Resources provided information on the part-time employee population size. Specifically, the University employed 1,179 part-time employees in 2003-2004. An additional 650 employees were classified as "casual or hourly," and 5,253 employees and faculty members were considered permanent or full-time.

All of the University's faculty parking lots are oversubscribed, meaning that some employees with permits to park in a University lot (typically those arriving later in the day) are forced to use overflow parking currently available in Lot 21 and use the P-rides shuttle system to get to campus. The twenty-five lots other than Lot 21 provide a total of 3,070 parking spaces. An additional 621 spaces are available in Lot 21, of which 300 are

⁸ Barbara Basel, of Public Safety, has been working to institute a new parking management system. This system, expected to be completed by 2005, will be able to accurately track employee and student parking permits.

permitted. It is thus presumable that between 3,400 and 3,700 University employees drive to campus and utilize the University parking lots on any given business day. The remaining Princeton employees might walk, use public transportation, or receive a ride to campus.

The oversubscription of University parking lots has led the University to create a Parking Committee. A July 08, 2004 meeting with Steve Virostko, a Facilities employee and member of the parking committee, revealed that the University has plans to begin construction on a new parking structure on Lot 26, behind the Canon Club, next year. The construction of this garage will provide approximately 570 new parking spaces, fifty of which are reserved for the DEC (Dial Elm Canon) club that is expected to be re-opened sometime in the near future. Because this area is already a parking lot, this construction will not result in a loss of green space or an increase in impervious surface cover. However, Mr. Virostko also noted that the University is considering the construction of an additional four to five-story parking garage by Lot 21, and that this structure might result in the loss of an unspecified amount of grassy area.

B. Environmental Impacts of Employee Commuting

In the hopes of estimating pollutant emissions caused by employee commuting, I asked the Parking Office for permission to survey approximately 100 employee parking permit requests for addresses and the make/model of their vehicle. However, citing concerns for employee privacy, Don Reichling of Public Safety denied my request. This information would probably best be collected through a voluntary survey of a random sample of faculty and staff members.

However, we can calculate employee emissions based on varying estimates of employee commute lengths. The following calculations provide a very rough estimate of employee emissions based on the following three assumptions: first, that the employee population has a break down of SUVs and cars similar to that of the student population; second, that employees commute to work 48 weeks out of the year; and third, that the number of employees who drive is approximately three times the number of students who drive (3,558 in total).

Employee Emissions	3.07 miles each way (based on undergraduate student estimates of an average of 30.7 VMT per week)	10 miles each way	25 miles each way
hydrocarbons	= 34,990.8 lbs/48 weeks = 17.50 tons per 48 weeks	57.05 tons per 48 weeks	142.63 tons per 48 weeks
carbon monoxide	= 266,759.1 lbs/48 weeks = 133.38 tons per 48 weeks	434.82 tons per 48 weeks	1,087.05 tons per 48 weeks
oxides of nitrogen	= 17,620.2 lbs/48 weeks = 8.81 tons per 48 weeks	28.72 tons per 48 weeks	71.80 tons per 48 weeks
carbon dioxide	= 5,195,252.16 lbs/48 weeks = 2,597.63 tons per 48 weeks	8,468.27 tons per 48 weeks	21,170.68 tons per 48 weeks
gasoline consumption	= 263,265.12 gallons/48 weeks	858,244.29 gallons per 48 weeks	2,145,610.73 gallons per 48 weeks

Although these numbers provide only a rough idea of employee emissions based on varying commuting distances, it is clear than even an average employee commute of only 30.7 miles per week, or 6.14 miles five days a week, has significant environmental consequences. These consequences become truly staggering if it is assumed that the employee commute is larger. Clearly, there is a need to reduce employee reliance on motor vehicles.

I contacted the Facilities Service Center over email to try and ascertain the total impervious surface coverage of campus parking lots but received no reply.

C. Employee Trip Reduction

The 2000 Environmental Audit noted that Princeton had chosen to eliminate its Employee Trip Reduction Program. Currently, responsibility for the administration of Princeton's transportation has been assumed by Laurel Harvey in the Office of the Vice President for Administration. Although Princeton does not currently have a specific Employee Trip Reduction Program, Ms. Harvey noted in a July 9, 2004 interview that she is interested in reducing employee reliance on motor vehicles. She has considered expanding the P-rides shuttle system to areas in Princeton that house large numbers of University employees or faculty however no definite plans institute this expansion have been made. This possibility should be more thoroughly explored, and if feasible, enacted in the near future.

Ms. Harvey also displayed a positive attitude towards increasing carpooling among Princeton University faculty and staff commuters. However, Ms. Harvey also noted that many University employees, particularly faculty and administrators, work long and frequently irregular hours in the service of the University. At the same time, she stated that she could see "no downside" to encouraging those employees who were able to engage in ride-sharing programs.

The Greater Mercer (County) Transportation Management Authority has an active employee "RideMatch" system, administered by Adele Clark, which is easily accessed online at <http://www.gmtma.org/app.htm>. University employees that fill out this online application are contacted with the names of other participating employees that are a good

match for carpooling in terms of location and work hours. Employees that register with the Greater Mercer Transportation Management Authority, and ultimately choose to carpool, are automatically eligible for the Authority's "Home Free" program. This program issues registered employees a voucher for A-1 Limousine, which can be used to hire a car to take them home if they have to work late (with supervisor approval), have to leave work early because of illness (self or family member), or have an unanticipated emergency. Although this program does not pay for rides due to pre-planned appointments, personal errands, business related travel, weather related early dismissals, or missing a carpool, it goes a long way towards alleviating employee apprehensions about needing their vehicle at the workplace in case of emergencies.

Sandra Brillheart, Executive Director of the Greater Mercer Transportation Management Authority, noted in a July 7, 2004 interview that a campus wide effort to increase participation in the Ride Match program at the Princeton Day school eliminated the use of approximately fifty vehicles through carpooling. A similar program would be sure to have positive results at Princeton as well. University employees and faculty should be notified of the Greater Mercer Transportation Management Authority's Ride Match service and encouraged to use it. Although the fact that the University does not currently charge faculty and staff for parking permits means that financial incentives for employees to use the program are limited to gas and toll savings, these savings would probably be significant for employees commuting to campus from a long-distance or on tolled roads.

Further, the University might be encouraged to offer some sort of financial incentive for participation in this program by the prospect of eliminating the need to construct costly parking structures in the future. For example, the University might allow

employees that carpool to refuel the carpool vehicle for free at the University gasoline pumps that are currently used to fuel the campus fleet. The University might also consider offering free E-ZPasses for carpool use.

A third option for reducing faculty and staff reliance on motor vehicles would be for the University to participate in the TransitChek Program. This program allows for the cost of public transportation, and parking at public transportation stations, to be deducted from an employee's pay prior to the assessment of income taxes. Alternatively, the University could provide transit passes and parking as a tax-free employee benefit. Again, the reduced need to accommodate employee parking through the construction of costly parking structures might encourage the University to consider offering TransitChek to its employees.

Even if the University were to choose not to provide TransitChek benefits itself, it should work with the Greater Mercer Transportation Management Association to institute a TransitChek or New Jersey Transit Business Pass (similar to TransitChek but specific to New Jersey Transit) program that would allow employees to purchase transit passes themselves with pre-tax income. Employees that participate in the program and register with the Greater Mercer Transportation Management Association are also eligible for the agency's "Home Free" guaranteed ride home program, which would alleviate employee concerns regarding the need to have a motor vehicle at the workplace in case of emergency.

SUMMARY AND CONCLUSIONS

Princeton University clearly has the potential to significantly influence local environmental quality. Student and employee transportation habits currently produce literally tons of hydrocarbons, nitrogen oxides, carbon monoxide, and carbon dioxide as student and employee commuting consumes tens of thousands (if not hundreds of thousands) gallons of gasoline each year. As the campus grows its green spaces will become more and more limited and it will become harder and harder for the administration to accommodate increasing transportation demands. University parking lots are already oversubscribed, and it is clear that the problem will only increase without the provision of transportation options that could serve as an alternative to individual motor vehicle use.

The Princeton University administration should work to increase awareness of the harms of current campus transportation habits, and to provide alternative transportation methods. Specifically, the University should ban sophomore parking, expand its shuttle system to nearby employee residences, encourage employee participation in ride sharing programs, and provide TransitChek as an employee benefit. Investing in alternative transportation options will improve the quality of life in the Princeton area, particularly with respect to air quality. Further, such programs will reduce the need to invest in costly parking structure or other measures that respond to increased transportation demand, rather than prevent it.