



A Study of Stormwater Utility Fees in Select North Carolina Municipalities

Prepared by Abigail Ferrance-Wu, Pollution Prevention Coordinator
-July 2010-



Introduction

The Clean Water Act of 1972¹ helps protect our rivers, streams, and lakes from pollution. Under this act, the Environmental Protection Agency (EPA) created the National Pollutant Discharge Elimination System (NPDES). This system tracks and controls sources of pollution through permits.

In 1990, cities with large populations were required to get NPDES permits for their stormwater drainage systems. (This water is considered a source of pollution because of all the contamination it collects as it runs off impervious surfaces such as roofs, driveways, sidewalks and roads.) In North Carolina, this meant that Durham, Raleigh, Charlotte, Greensboro, Fayetteville, and Winston-Salem all had new stormwater requirements. About ten years later, other small to mid-size cities started having similar requirements when Phase II of the NPDES was implemented.

This new NPDES Permit from the State of North Carolina requires cities to develop a stormwater management program that has the following activities:

- Provide education about polluted stormwater runoff
- Give residents the opportunity to be involved in activities that reduce polluted stormwater runoff
- Find and stop illegal sources of pollution
- Control runoff from construction site both during and after construction
- Take steps to prevent runoff from city buildings and activities

All of these activities are designed with the goal of making sure clean water is available both now and in the future. Of course, these program requirements all have their cost. The federal government requires municipalities to designate a steady source of funds to cover these costs. As with other such expenses, the costs for these services are passed on to the citizens within the municipality (this is allowed by State of North Carolina regulations).²

This study was designed to determine how various municipalities have chosen to fund their new stormwater management programs. It is largely based on an earlier survey conducted by the Triangle J

¹ A full copy of the CWA is available online at: <http://www.epa.gov/lawsregs/laws/cwa.html>.

² These regulations are available online at:
http://www.ncga.state.nc.us/enactedlegislation/statutes/html/bysection/chapter_160a/gs_160a-314.html.

Council of Governments (TJCOG) completed in November of 2006.³ This methodology was used primarily to allow for easy comparisons of funding methods across municipalities.

Methods

Data was collected for municipalities in North Carolina with populations higher than 50,000 according to 2008 estimates made by the North Carolina Office of State Budget and Management.⁴ Eighteen municipalities in North Carolina currently have populations of sufficient size to be included in the study.

Research was conducted to determine the stormwater utility funding method for each of the eighteen municipalities. Almost all of the municipalities in the study have websites with information about their utility fees.⁵ Another goal of this study was for this collected information to make comparisons of fees across municipalities easier. The initial survey revealed that funding mechanisms varied and would be difficult to compare. For example, municipalities may use different billing periods or different units of measurement (square feet versus acres or an equivalent residential unit).

The 2006 study completed by TJCOG used the monthly fee charged for the impervious area of an average household residence and an average gas station, which is a business most communities will have, as a mechanism to convert the varying fees into a set of easily comparable values. (Their study determined these areas to be 2,455 square feet and 25,976 square feet respectively.) This mechanism will be used in this study as well. In addition, commercial property fees have also been reported as a monthly fee per 1000 square feet of impervious area - another easily comparable value. The calculations used to convert the fees provided by the municipalities to those used for comparisons are included in Appendix 2.

Results

Seventeen (17) out of the 18 municipalities included in this study use a utility fee to fund their stormwater management programs. The Town of Cary is the only municipality in this study that does not currently have a stormwater utility fee. The Town Council waited to make a decision about creating a utility fee as there was some discussion of having it assessed at the county level instead.⁶ Currently money is transferred from their general fund to pay for their stormwater management program. This makes it the only municipality in the study population to fund their program through property taxes rather than a utility fee. Because of this, data for the Town of Cary is not included in the results below.

³ The complete TJCOG rate study is available online at: <ftp://ftp.ticog.org/pub/ticog/regplan/water/swratesur2006.pdf>.

⁴ Data from the North Carolina State Office of State Budget and Management 2008 Population Estimates (Available online: http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic_data/population_estimates/demog/rankm08.htm.)

⁵ See Appendix 1a and 1b for information about where data for each city and town was found.

⁶ This decision is apparent from Cary Town Council Minutes from August 11, 2005. (Available online at: http://vic.townofcary.org/Sunshine/Agendas_Minutes/Town_Council/Minutes_Archive/councilmin05/cm081105b3.htm.)

The six largest municipalities in the study are: Charlotte, Raleigh, Greensboro, Durham, Winston-Salem, and Fayetteville. These cities had a population of over 100,000 in 1990 when Phase I of the NPDES permits⁷ was put into place. They were therefore the first cities required to have a stormwater management plan. Because these programs have been in place as much as ten years longer than the programs created in Phase II of the NPDES permits, results are presented here divided three different ways: Phase I cities, Phase II cities and towns, and the average of all 17 cities and towns.

Residential fees were generally based on a flat (53%) or tiered (41%) rate structures. Most municipalities (82%) use Equivalent Residential Units (ERUs) in determining their fees for commercial and other non-residential properties.⁸ The types of basic structures used by the municipalities have been aggregated below in Table 1 and Table 2.

Table 1: Residential Stormwater Utility Fee Rate Structure

	Flat Rate	Tiered Rate	Equivalent Residential Units
Phase I Municipalities	1	5	0
Phase II Municipalities	8	2	1
All Cities	9	7	1

Table 2: Commercial Stormwater Utility Fee Rate Structure

	Equivalent Residential Units	Acres of Impervious Surface	Flat Rate
Phase I Municipalities	4	2	0
Phase II Municipalities	10	0	1
All Cities	14	2	1

⁷ Information about Phase I and Phase II is available online at: <http://cfpub.epa.gov/npdes/stormwater/munic.cfm>.

⁸ A statistical analysis is used to determine the average amount of impervious area on a residential lot within a municipality. This average is then labeled the ERU. A set rate is general charged for each ERU of impervious area on a property.

The average monthly residential rate in Phase I municipalities for a residence with 2,455 square feet of impervious surface is \$4.56. For Phase II municipalities this rate was \$3.76. The average for both Phase I and Phase II municipalities was \$4.04. More detailed information on these rates is available in Table 3 and Table 4.

Table 3: Collected Residential Stormwater Utility Fee Rate Data for Phase I Cities

Municipality	2008 Population Estimate	Residential Fee Structure		Monthly Fee for Average Property	Rate Structure Last Updated
		tier break downs	fee/year		
Charlotte	683,541	4 tiers based on impervious area:		\$8.25	2009
		<2,000 sq. ft.	\$69.96		
		2,000-2,999 sq. ft.	\$99.00		
		3,000-4,999 sq. ft.	\$105.36		
Raleigh	377,353	5 tiers based on impervious area:		\$4.00	2008
		400-1,000 sq. ft.	\$19.20		
		1,001-3,870 sq. ft.	\$48.00		
		3,871-6,620 sq. ft.	\$81.60		
		6,621-9,500 sq. ft.	\$139.20		
Greensboro	263,268	3 tiers based on impervious area:		\$2.70	2004
		600-1,999 sq. ft.	\$18.00		
		2,000-2,899 sq. ft.	\$32.40		
		2,900 sq. ft. +	\$46.80		
Durham	228,480	3 tiers based on impervious area:		\$4.92	2010
		<2,000 sq. ft.	\$28.44		
		2,000-4,000 sq. ft.	\$59.04		
		>4,000 sq. ft.	\$118.08		
Winston-Salem	228,362	4 tiers based on impervious area:		\$4.50	2007
		1-2,000 sq. ft.	\$51.00		
		2,001-4,000 sq. ft.	\$54.00		
		4,001-6,000 sq. ft.	\$81.00		
Fayetteville	181,481	each property is billed a flat rate of \$36.00/year (\$3.00/month)		\$3.00	2007
Average	327,081	n/a		\$4.56	2008

Table 4: Collected Residential Stormwater Utility Fee Rate Data for Phase II Cities

Municipality	2008 Population Estimate	Residential Fee Structure		Monthly Fee for Average Property	Rate Structure Last Updated
		tier break downs	fee/year		
Wilmington	101,526	each property is billed a flat rate of \$60.00/year (\$5.00/month)		\$5.10	2008
High Point	100,645	each property is billed a flat rate of \$24/year (\$2.00/month)		\$2.00	2007
Jacksonville	81,873	each property is billed a flat rate of \$48.00/year (\$4.00/month)		\$4.00	2006
Greenville	81,092	4 tiers based on impervious area		\$5.70	2002
		200-2,000 sq. ft.	\$34.20		
		2,001-4,000 sq. ft.	\$68.40		
		4,001-6,000 sq. ft.	\$102.60		
		>6,000 sq. ft.	\$136.80		
Concord	79,264	3 tiers based on impervious area		\$4.30	2007
		401-1,899 sq. ft.	\$30.96		
		1,890-5,507 sq. ft.	\$51.60		
		>5,507 sq. ft.	\$92.88		
Asheville	78,313	each property is billed a flat rate of \$28.08/year (\$2.34/month)		\$2.34	2005
Gastonia	74,518	each property is billed a flat rate of \$33.00/year (\$2.75/month)		\$2.75	2002
Rocky Mount	59,228	each property is billed a flat rate of \$45.00/year (\$3.75/month)		\$3.75	2005
Chapel Hill	55,616	bill based on 2,000 sq foot ERUs		\$6.50	2004
Burlington	50,927	each property is billed a flat rate of \$24.00/year (\$2.00/month)		\$2.00	2005
Wilson	50,643	each property is billed a flat rate of \$35.28/year (\$2.94/month)		\$2.94	2002
Average	73,968	n/a		\$3.76	2005

The average monthly commercial rate in Phase I municipalities for a gas station with 25,976 square feet of impervious surface is \$46.85. For Phase II municipalities this rate was \$33.72. The average for both Phase I and Phase II municipalities combined was \$38.35.

In Phase I communities the monthly commercial fee for 1000 square feet of impervious surface was \$1.77. In Phase II communities this rate was \$1.39. The average rate for all communities in the study was \$1.54. More detailed information on these rates is available in Table 5 and Table 6.

All of the data in Table 1 - Table 6 has also been plotted and is presented as graphs in Appendix 3.

Table 5: Collected Commercial Stormwater Utility Fee Rate Data for Phase I Cities

Municipality	2008 Population Estimate	Commercial Fee Structure (rates/month)	Monthly fee/1000 square feet	Monthly Fee for Average Gas Station Property	Rate Structure Last Updated
Charlotte	683,541	\$124.12/acre of impervious area	\$2.85	\$74.02	2009
Raleigh	377,353	\$4.00 per ERU of 2,260 square feet	\$1.77	\$45.98	2008
Greensboro	263,268	\$2.70 per ERU of 2,543 square feet	\$1.06	\$29.70	2004
Durham	228,480	\$4.92 per ERU of 2,400 square feet	\$2.05	\$54.12	2010
Winston-Salem	228,362	\$69.25/acre of impervious area	\$1.59	\$41.30	2007
Fayetteville	181,481	\$3.00 per ERU of 2,266 square feet	\$1.32	\$36.00	2007
Average	327,081	n/a	\$1.77	\$46.85	2008

Table 6: Collected Commercial Stormwater Utility Fee Rate Data for Phase II Cities

Municipality	2008 Population Estimate	Commercial Fee Structure (rates/month)	Monthly fee/1000 square feet	Monthly Fee for Average Gas Station Property	Rate Structure Last Updated
Wilmington	101,526	\$5.10 per ERU of 2,500 square feet	\$2.04	\$51.00	2008
High Point	100,645	\$2.00 per ERU of 2,588 square feet	\$0.77	\$20.07	2007
Jacksonville	81,873	\$4.00 per ERU of 2,850 square feet	\$1.40	\$36.46	2006
Greenville	81,092	\$2.85 per ERU of 2,000 square feet	\$1.43	\$37.05	2002
Concord	79,264	\$4.30 per ERU of 3,120 square feet	\$1.38	\$35.80	2007
Asheville	78,313	\$2.34 per ERU of 2,442 square feet	\$0.96	\$25.74	2005
Gastonia	74,518	\$2.75 per ERU of 2,650 square feet	\$1.04	\$27.50	2002
Rocky Mount	59,228	\$3.75 per ERU of 2,519 square feet	\$1.49	\$38.67	2005
Chapel Hill	55,616	\$6.50 per ERU of 2,000 square feet	\$1.63	\$42.25	2004
Burlington	50,927	flat rate of \$24.00/year (\$2.00/month)	\$2.00	\$24.00	2005
Wilson	50,643	\$2.94 per ERU of 2,585 square feet	\$1.14	\$32.34	2002
Average	73,968	n/a	\$1.39	\$33.72	2005

Conclusions

Besides the City of Cary, the municipalities that make up the study population all established a stormwater utility (and an associated fee) to deal with the need for a stormwater management program. All but one municipality, the City of Burlington, charged residential customers differently than non-residential customers. Almost half (47%) of the municipalities had a residential fee structure where the fee was based on the amount of impervious area on the property. The rest (53%) charged residents a flat rate. A large majority of the municipalities (96%) charge non-residential properties based on the amount of impervious area on the property. Within the communities selected for this study, there was no statistically significant difference between either residential or commercial utility fee rates charged by Phase I municipalities and Phase II municipalities.

Early analysis of the collected data indicated that there was a possible positive correlation between the population of a municipality and its utility fee rate. Similarly, a correlation between how recently the utility fee had been established or updated and the utility fee rate was considered. Linear regression analyses were performed to determine if such correlations were statistically significant. (See Appendix 3 and Appendix 4 for scatter plots, regression lines, r^2 values, and P -values). Interestingly, Phase I utility fee rates seemed more strongly correlated (at a 90% level of confidence) to both population (mean r^2 value = 0.703) and how recently the fee had been established or updated (mean r^2 value = 0.548) than Phase II utility fee rates (mean r^2 value = 0.017 and 0.025 respectively). These figures also indicate a stronger relationship between the utility fee and a municipality's population than when the utility fee was established. This indicates that a larger population (and the pollution and impervious surfaces that are generally linked to more populous areas) lead to higher stormwater utility rates. Future studies may better be able to determine the relationship between these variables. It will be interesting to observe how these relationships evolve as stormwater management plans mature.

References

- State of North Carolina. "2008 Municipal Populations Ranked by Size." Municipal Population Estimates. 2009. Office of State Budget and Management: Balancing Needs – Improving Government. 07 June 2010 <http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic_data/population_estimates/demog/rankm08.htm>.
- State of North Carolina. "NPDES: History." North Carolina Division of Water Quality. North Carolina Department of Environment and Natural Resources. 07 June 2010 <<http://portal.ncdenr.org/web/wq/swp/ps/npdes/history>>.
- Town of Cary. "Cary Town Council Minutes - August 11, 2005 - b3." 2005 Council Minutes. Town of Cary North Carolina. 07 June 2010 <http://www.townofcary.org/Sunshine/Agendas___Minutes/Town_Council/Minutes_Archive/councilmin05/cm081105.htm>.
- Triangle J Council of Governments. "Survey of NC Stormwater Fees: November 2006." Stormwater, and Water & Sewer Rates Surveys. 2009. Triangle J Council of Governments. 07 June 2010 <<http://www.tjcog.dst.nc.us/regplan/watsew.shtml>>.
- U.S. Environmental Protection Agency (US EPA). "Stormwater Discharges From Municipal Separate Storm Sewer Systems (MS4s)." National Pollutant Discharge Elimination System (NPDES). 2009. US EPA. 07 June 2010 <<http://cfpub.epa.gov/npdes/stormwater/munic.cfm>>.

Appendix 1a: Data Source for Each Phase I City

City of Charlotte-Mecklenburg County. "Current Storm Water Fees (Effective July 1, 2009)." Charlotte-Mecklenburg Stormwater Services. 2009. City of Charlotte-Mecklenburg County. 07 June 2010 <<http://www.charmeck.org/Departments/StormWater/Storm+Water+Fee/SWS+Fees.htm>>.

City of Durham. "Stormwater Utility Fee." Stormwater Services Division. 2009. City of Durham. 07 June 2010 <http://www.durhamnc.gov/departments/works/stormwater_fees.cfm>.

City of Fayetteville. "New Stormwater Fee to Improve Drainage." Media Release Archives. 2007. City of Fayetteville North Carolina. 07 June 2010 <http://www.ci.fayetteville.nc.us/portal/media_release/archive/2007/06/27/1516.aspx>.

City of Greensboro. "Stormwater Rates." Greensboro Water Resources. City of Greensboro. 07 June 2010 <<http://www.greensboro-nc.gov/departments/Water/customer/stormwaterrates.htm>>.

City of Raleigh. "Utility Rates." Stormwater and Drainage. 2008. City of Raleigh. 07 June 2010 <http://www.raleigh-nc.org/portal/server.pt/gateway/PTARGS_0_2_306_202_0_43/http%3B/pt03/DIG_Web_Content/category/Resident/Stormwater/Utility_Information/Cat-1C-20041129-130545-Stormwater_Utility_Rates.html>.

City of Winston-Salem. "Articles: Utility Rates." Stormwater Division. 2007. City of Winston-Salem. 07 June 2010 <<http://www.cityofws.org/Home/Departments/Stormwater/Articles/UtilityRate>>.

Appendix 1b: Data Source for Each Phase II City Included in this Study

- City of Asheville. "Billing Information." Stormwater Utility. City of Asheville North Carolina. 07 June 2010 <http://www.ashevillenc.gov/residents/public_services/stormwater/default.aspx?id=854>.
- City of Burlington. "Stormwater Fee." Stormwater Management. City of Burlington, NC: Connecting the Triad and Triangle. 07 June 2010 <<http://www.ci.burlington.nc.us/index.aspx?NID=850>>.
- City of Concord. "Current Stormwater Fee." Stormwater Services. 2008. Concord North Carolina: High Performance Living. 07 June 2010 <<http://www.ci.concord.nc.us/Departments/StormwaterServices/StormwaterFee/CurrentFees/tabid/542/Default.aspx>>.
- City of Gastonia. "Stormwater Utility Fee." Engineering Department. 2005. Gastonia NC: Great Place. Great People. Great Promise. 07 June 2010 <<http://www.cityofgastonia.com/dept/engineering/stormwater/fees/stormwaterutilityfee.cfm>>.
- City of Greenville. "Stormwater Utility." Public Works. 2005. City of Greenville, NC. 07 June 2010 <http://www.greenvillenc.gov/departments/public_works_dept/information/default.aspx?id=114>.
- City of High Point. "Stormwater Billing." Stormwater Services Division. 2009. High Point North Carolina's International City. 07 June 2010 <<http://www.high-point.net/pubsrv/stormbill.cfm>>.
- City of Jacksonville. "City of Jacksonville Stormwater Utility Factsheet." Stormwater. 2009. City of Jacksonville North Carolina. 07 June 2010 <<http://www.ci.jacksonville.nc.us/Government---City-Services/Storm-Water/Stormwater-Utility.aspx>>.
- City of Rocky Mount. "Stormwater Management." Public Works. City of Rocky Mount North Carolina. 07 June 2010 <<http://www.rockymountnc.gov/publicworks/stormwater.html>>.
- City of Wilmington. "Stormwater Billing." Stormwater Services. 2009. City of Wilmington North Carolina. 07 June 2010 <http://www.ci.wilmington.nc.us/public_services/stormwater/billing_fees.aspx>.
- City of Wilson. "Stormwater Utility Fee: Frequently Asked Questions." Stormwater Management. 2009. Wilson North Carolina. 07 June 2010 <<http://www.wilsonnc.org/userimages/image/swutilityfee.pdf>>.
- Town of Chapel Hill. "Billing and Funding." Stormwater Management Utility and Fees. 2009. Town of Chapel Hill: the Southern Part of Heaven. 07 June 2010 <<http://www.townofchapelhill.org/index.aspx?page=385>>.

Appendix 2a: Calculations for Phase I Cities

Abbreviations:

sq ft = square feet

IA = impervious area

City of Charlotte:

Fee for a residential property with 2,455 sq ft of IA: \$8.25/month (no conversions needed).

Fee for a commercial property: \$124.12/month/acre of IA.

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$124.12}{1 \text{ acre}} \times \frac{1 \text{ acre}}{43560 \text{ sq ft}} \times 1000 \text{ sq ft} = \$2.85$$

Calculations to determine monthly fee/25,976 sq ft of IA:

$$25,976 \text{ sq ft} \times \frac{1 \text{ acre}}{43560 \text{ sq ft}} \times \frac{\$124.12}{\text{acre}} = \$74.02$$

City of Raleigh:

Fee for a residential property with 2,455 sq ft of IA: \$4.00/month (no conversions needed).

Fee for a commercial property: \$4 per 2,260 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$4.00}{2,260 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,260 \text{ sq ft} (\$X)}{2,260 \text{ sq ft}} = \frac{\$4.00 * 1000 \text{ sq ft}}{2,260 \text{ sq ft}} \rightarrow X = \$1.77$$

Calculations to determine monthly fee/25,976 sq ft of IA:

$$25,976 \text{ sq ft} \times \frac{\$4.00}{2,260 \text{ sq ft}} = \$45.98 \text{ (no rounding of ERUs}^9\text{)}$$

City of Greensboro:

Fee for a residential property with 2,455 sq ft of IA: \$2.70/month (no conversions needed).

Fee for a commercial property: \$2.70 per 2,543 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$2.70}{2,543 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,543 \text{ sq ft} (\$X)}{2,543 \text{ sq ft}} = \frac{\$2.70 * 1000 \text{ sq ft}}{2,543 \text{ sq ft}} \rightarrow X = \$1.06$$

Calculations to determine monthly fee/25,976 sq ft of IA:

$$25,976 \text{ sq ft} / 2,543 \text{ sq ft} = 10.2 \text{ ERUs (this city rounds up to the nearest whole ERU}^{10}\text{)}$$

$$11 \text{ ERUS} * \$2.70 = \$29.70$$

⁹ The bill calculation method and an example calculation were on this city's website; there was no rounding involved.

¹⁰ Rounding practices for this city were explained on their website.

City of Durham:

Fee for a residential property with 2,455 sq ft of IA: \$54.00/year.

$$\frac{\$59.04}{\text{year}} \times \frac{1 \text{ year}}{12 \text{ months}} = \$4.92/\text{month}$$

Fee for a commercial property: \$4.50 per 2,400 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$4.92}{2,400 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,400 \text{ sq ft} (\$X)}{2,400 \text{ sq ft}} = \frac{\$4.92 * 1000 \text{ sq ft}}{2,400 \text{ sq ft}} \rightarrow X = \$2.05$$

Calculations to determine monthly fee/25,976 sq ft of IA:

25,976 sq ft / 2,400 sq ft = 10.8 ERUs (this city would round this to 11 ERUs¹¹)

11 ERUS * \$4.92 = \$54.12

City of Winston-Salem:

Fee for a residential property with 2,455 sq ft of IA: \$54.00/year.

$$\frac{\$54.00}{\text{year}} \times \frac{1 \text{ year}}{12 \text{ months}} = \$4.50/\text{month}$$

Fee for a commercial property: \$69.25/moth/acre of IA.

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$69.25}{1 \text{ acre}} \times \frac{1 \text{ acre}}{43560 \text{ sq ft}} \times 1000 \text{ sq ft} = \$1.59$$

Calculations to determine monthly fee/25,976 sq ft of IA:

$$25,976 \text{ sq ft} \times \frac{1 \text{ acre}}{43560 \text{ sq ft}} \times \frac{\$69.25}{\text{acre}} = \$41.30$$

City of Fayetteville:

Fee for a residential property with 2,455 sq ft of IA: flat rate of \$36.00/year.

$$\frac{\$36/00}{\text{year}} \times \frac{1 \text{ year}}{12 \text{ months}} = \$3.00/\text{month}$$

Fee for a commercial property: \$3.00 per 2,266 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$3.00}{2,266 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,266 \text{ sq ft} (\$X)}{2,266 \text{ sq ft}} = \frac{\$3.00 * 1000 \text{ sq ft}}{2,266 \text{ sq ft}} \rightarrow X = \$1.32$$

Calculations to determine monthly fee/25,976 sq ft of IA:

25,976 sq ft / 2,266 sq ft = 11.4 ERUs (this city would round this to 12 ERUs¹²)

12 ERUS * \$3.00 = \$36.00

¹¹ Rounding practices for this city were explained on their website.

¹² Rounding practices for this city were reported in the TJCOG study.

Appendix 2b: Calculations for Phase II Cities

Abbreviations:

sq ft = square feet

IA = impervious area

City of Wilmington:

Fee for a residential property with 2,455 sq ft of IA: flat rate of \$5.10/month (no conversions needed).

Fee for a commercial property: \$5.10 per 2,500 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$5.10}{2,500 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,500 \text{ sq ft } (\$X)}{2,500 \text{ sq ft}} = \frac{\$5.10 * 1000 \text{ sq ft}}{2,500 \text{ sq ft}} \rightarrow X = \$2.04$$

Calculations to determine monthly fee/25,976 sq ft of IA:

$$25,976 \text{ sq ft} / 2,500 \text{ sq ft} = 10.39 \text{ ERUs (this city would round to the nearest ERU}^{13})$$

$$10 \text{ ERUS} * \$5.10 = \$51.00$$

City of High Point:

Fee for a residential property with 2,455 sq ft of IA: flat rate of \$2.00/month (no conversions needed).

Fee for a commercial property: \$2.00 per 2,588 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$2.00}{2,588 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,588 \text{ sq ft } (\$X)}{2,588 \text{ sq ft}} = \frac{\$2.00 * 1000 \text{ sq ft}}{2,588 \text{ sq ft}} \rightarrow X = \$0.77$$

Calculations to determine monthly fee/25,976 sq ft of IA:

$$25,976 \text{ sq ft} \times \frac{\$2.00}{2,588 \text{ sq ft}} = \$20.07 \text{ (no rounding of ERUs}^{14})$$

City of Jacksonville:

Fee for a residential property with 2,455 sq ft of IA: flat rate of \$4.00/month (no conversions needed).¹⁵

Fee for a commercial property: \$4.00 per 2,850 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$4.00}{2,850 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,850 \text{ sq ft } (\$X)}{2,850 \text{ sq ft}} = \frac{\$4.00 * 1000 \text{ sq ft}}{2,850 \text{ sq ft}} \rightarrow X = \$1.40$$

Calculations to determine monthly fee/25,976 sq ft of IA:

$$25,976 \text{ sq ft} \times \frac{\$4.00}{2,850 \text{ sq ft}} = \$36.46 \text{ (no rounding of ERUs}^{16})$$

¹³ Rounding practices for this city were reported in the TJCOG study.

¹⁴ The bill calculation method and an example calculation were on this city's website; there was no rounding involved.

¹⁵ This city's stormwater manager was contacted to determine this rate as the website did not have the information available. (It stated, "Single-family residences will pay a monthly flat fee of ???." at the time of this study.)

¹⁶ The bill calculation method and an example calculation were on this city's website; there was no rounding involved.

City of Greenville:

Fee for a residential property with 2,455 sq ft of IA: \$5.70/month (no conversions needed).

Fee for a commercial property: \$2.85 per 2,000 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$2.85}{2,000 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,000 \text{ sq ft } (\$X)}{2,000 \text{ sq ft}} = \frac{\$2.85 * 1000 \text{ sq ft}}{2,000 \text{ sq ft}} \rightarrow X = \$1.43$$

Calculations to determine monthly fee/25,976 sq ft of IA:

25,976 sq ft / 2,000 sq ft = 12.98 ERUs (this city would round to the nearest ERU¹⁷)

13 ERUS * \$2.85 = \$37.05

City of Concord:

Fee for a residential property with 2,455 sq ft of IA: \$4.30/month (no conversions needed).

Fee for a commercial property: \$4.30 per 3,120 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$4.30}{3,120 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{3,120 \text{ sq ft } (\$X)}{3,120 \text{ sq ft}} = \frac{\$4.30 * 1000 \text{ sq ft}}{3,120 \text{ sq ft}} \rightarrow X = \$1.38$$

Calculations to determine monthly fee/25,976 sq ft of IA:

$$25,976 \text{ sq ft} \times \frac{\$4.30}{3,120 \text{ sq ft}} = \$35.80 \text{ (no rounding of ERUs}^{18}\text{)}$$

City of Asheville:

Fee for a residential property with 2,455 sq ft of IA: flat rate of \$2.34/month (no conversions needed).

Fee for a commercial property: \$2.34 per 2,442 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$2.34}{2,442 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,442 \text{ sq ft } (\$X)}{2,442 \text{ sq ft}} = \frac{\$2.34 * 1000 \text{ sq ft}}{2,442 \text{ sq ft}} \rightarrow X = \$0.96$$

Calculations to determine monthly fee/25,976 sq ft of IA:

25,976 sq ft / 2,442 sq ft = 10.64 ERUs (this city would round this to 11 ERUs¹⁹)

11 ERUS * \$2.34 = \$25.74

City of Gastonia:

Fee for a residential property with 2,455 sq ft of IA: flat rate of \$2.75/month (no conversions needed).

Fee for a commercial property: \$2.75 per 2,650 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$2.75}{2,650 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,650 \text{ sq ft } (\$X)}{2,650 \text{ sq ft}} = \frac{\$2.75 * 1000 \text{ sq ft}}{2,650 \text{ sq ft}} \rightarrow X = \$1.04$$

Calculations to determine monthly fee/25,976 sq ft of IA:

25,976 sq ft / 2,650 sq ft = 9.80 ERUs (this city would round to the nearest ERU²⁰)

10 ERUS * \$2.75 = \$27.50

¹⁷ Rounding practices for this city were reported in the TJCOG study.

¹⁸ Rounding practices for this city were reported in the TJCOG study.

¹⁹ Rounding practices for this city were reported in the TJCOG study.

²⁰ Rounding practices for this city were explained on their website.

City of Rocky Mount:

Fee for a residential property with 2,455 sq ft of IA: flat rate of \$3.75/month (no conversions needed).

Fee for a commercial property: \$3.75 per 2,519 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$3.75}{2,519 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,519 \text{ sq ft} (\$X)}{2,519 \text{ sq ft}} = \frac{\$3.75 * 1000 \text{ sq ft}}{2,519 \text{ sq ft}} \rightarrow X = \$1.49$$

Calculations to determine monthly fee/25,976 sq ft of IA:

$$25,976 \text{ sq ft} \times \frac{\$3.75}{2,519 \text{ sq ft}} = \$38.67 \text{ (no rounding of ERUs}^{21}\text{)}$$

Town of Chapel Hill

Fee for a residential property with 2,455 sq ft of IA: \$39.00/year/2000 sq ft of IA (ERU).

2,455 sq ft / 2,000 sq ft = 1.27 ERUs (this city rounds up to the nearest whole ERU²²)

$$2 \text{ ERUS} * \frac{\$39.00}{\text{year}} \times \frac{1 \text{ year}}{12 \text{ months}} = \$6.50/\text{month}$$

Fee for a commercial property: \$39.00/year/2000 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$39.00}{2,000 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,000 \text{ sq ft} (\$X)}{2,000 \text{ sq ft}} = \frac{\$39.00 * 1000 \text{ sq ft}}{2,000 \text{ sq ft}} \rightarrow X = \$19.50/\text{year}$$

$$\frac{\$19.50}{\text{year}} \times \frac{1 \text{ year}}{12 \text{ months}} = \$1.63/\text{month}$$

Calculations to determine monthly fee/25,976 sq ft of IA:

25,976 sq ft / 2,000 sq ft = 12.99 ERUs (this city rounds up to the nearest whole ERU)

$$13 \text{ ERUS} * \frac{\$39.00}{\text{year}} \times \frac{1 \text{ year}}{12 \text{ months}} = \$42.25/\text{month}$$

City of Burlington

Fee for a residential property with 2,455 sq ft of IA: flat rate of \$2.00/month (no conversions needed).

Fee for a commercial property: flat rate (and minimum rate) of \$2.00/month (no conversions needed).

City of Wilson

Fee for a residential property with 2,455 sq ft of IA: flat rate of \$2.94/month (no conversions needed).

Fee for a commercial property: \$2.94 per 2,585 sq ft of IA (ERU).

Calculations to determine monthly fee/1000 sq ft:

$$\frac{\$2.94}{2,585 \text{ sq ft}} = \frac{\$X}{1000 \text{ sq ft}} \rightarrow \frac{2,585 \text{ sq ft} (\$X)}{2,585 \text{ sq ft}} = \frac{\$2.94 * 1000 \text{ sq ft}}{2,585 \text{ sq ft}} \rightarrow X = \$1.14$$

Calculations to determine monthly fee/25,976 sq ft of IA:

25,976 sq ft / 2,585 sq ft = 10.05 ERUs (this city rounds up to the nearest whole ERU²³)

$$11 \text{ ERUS} * \$2.94 = \$32.34$$

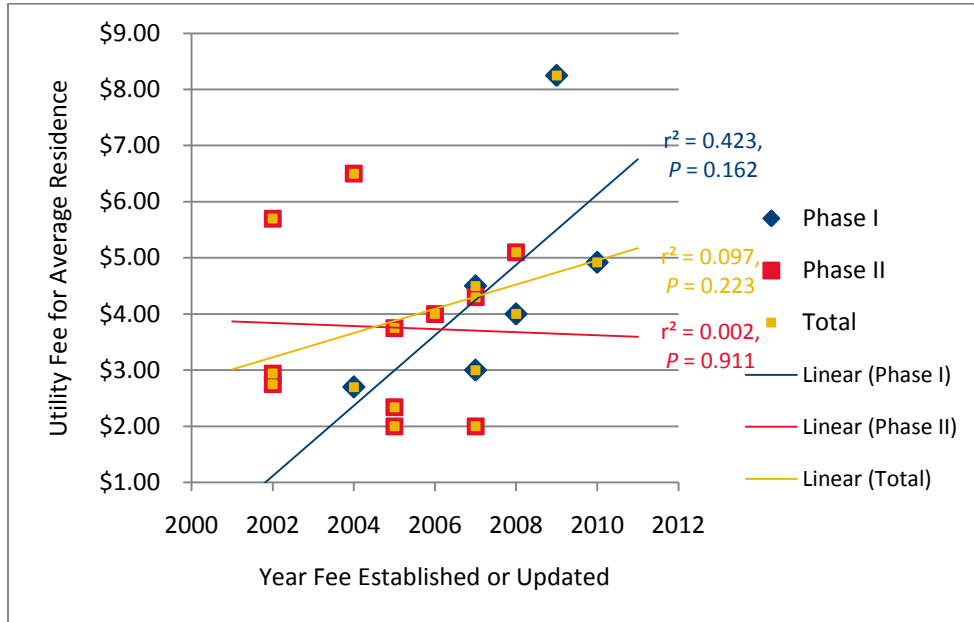
²¹ The bill calculation method and an example calculation were on this city’s website; there was no rounding involved.

²² Rounding practices for this city were explained on their website.

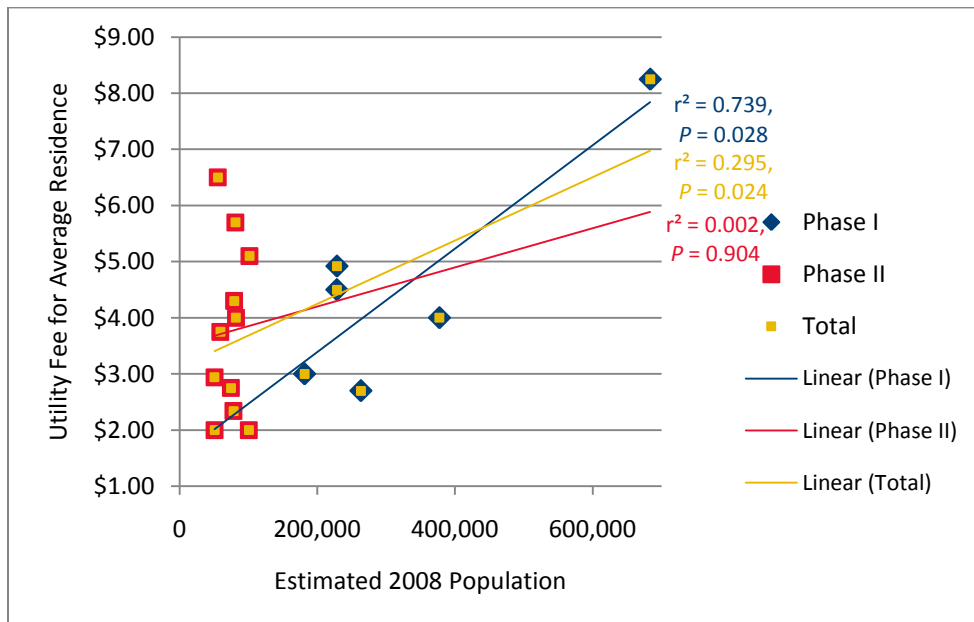
²³ Rounding practices for this city were reported in the TJCOG study.

Appendix 3: Data Presented as Graphs

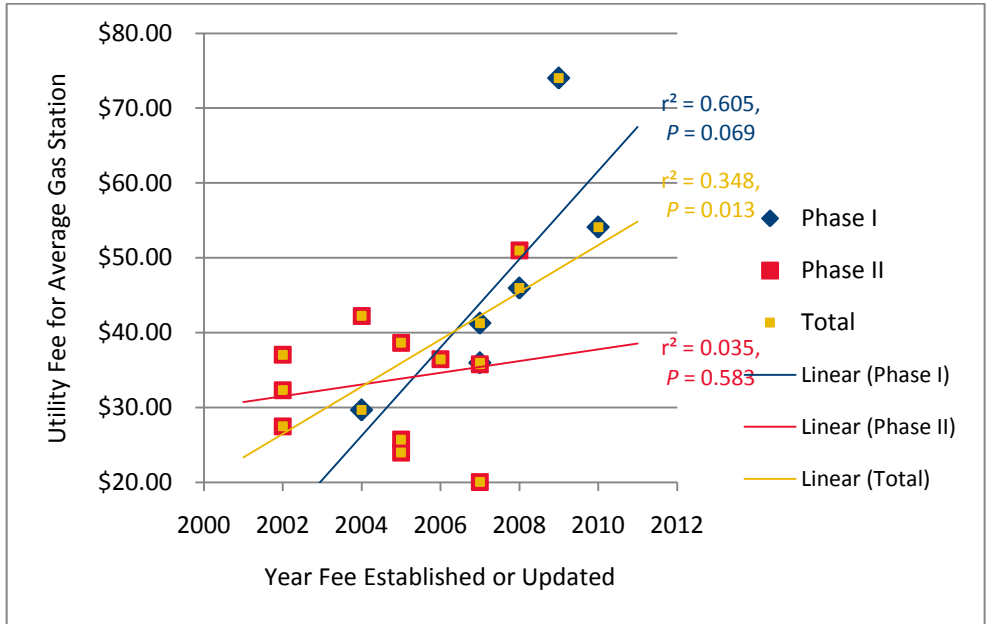
Graph 1: Monthly Utility Fee for an Average Residence over Time



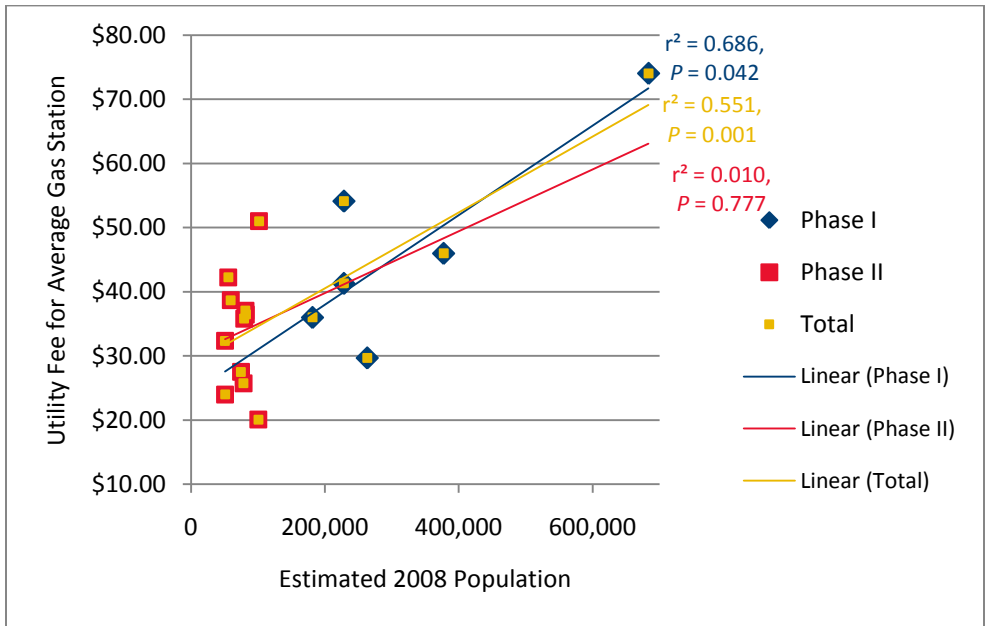
Graph 2: the Effect of Population on the Monthly Utility Fee for an Average Residence



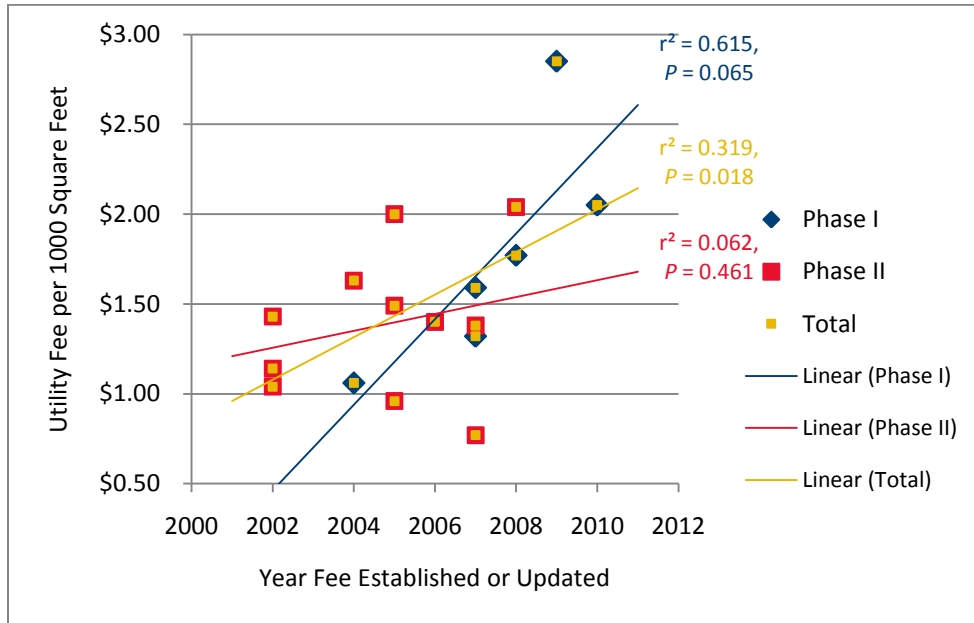
Graph 3: Monthly Utility Fee for an Average Gas Station over Time



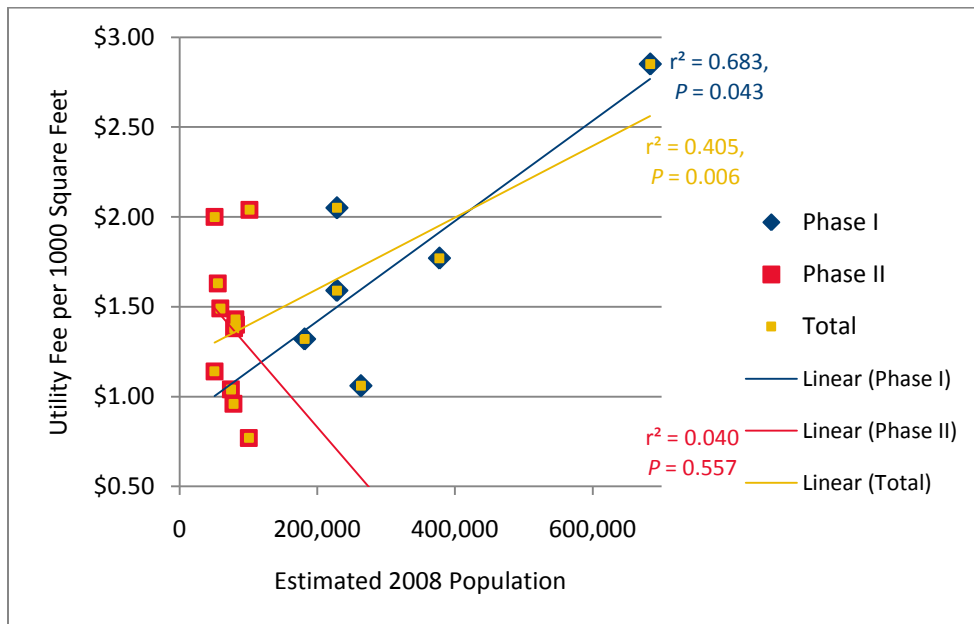
Graph 4: the Effect of Population on the Monthly Utility Fee for an Average Gas Station over Time



Graph 5: Monthly Commercial Utility Fee per 1000 Square Feet over Time



Graph 6: the Effect of Population on the Monthly Commercial Utility Fee per 1000 Square Feet



Appendix 4: Analysis of Statistical Relationship between Variables

The Effect of City Population on Utility Fee Rates		
Average Residential		
	r^2	<i>P</i> -value
Phase I	0.739	0.028
Phase II	0.002	0.904
Total	0.295	0.024
Average Gas Station		
	r^2	<i>P</i> -value
Phase I	0.686	0.042
Phase II	0.010	0.777
Total	0.551	0.001
Average Fee/1000 sq ft		
	r^2	<i>P</i> -value
Phase I	0.683	0.043
Phase II	0.040	0.557
Total	0.405	0.006
Average of Fee Types (Residential and Commercial)		
	r^2	<i>P</i> -value
Phase I	0.703	0.038
Phase II	0.017	0.746
Total	0.417	0.010

The Effect of the Year the Fee was Established on Fee Rates		
Average Residential		
	r^2	<i>P</i> -value
Phase I	0.423	0.162
Phase II	0.002	0.911
Total	0.097	0.223
Average Gas Station		
	r^2	<i>P</i> -value
Phase I	0.605	0.069
Phase II	0.035	0.583
Total	0.348	0.013
Average Fee/1000 sq ft		
	r^2	<i>P</i> -value
Phase I	0.615	0.065
Phase II	0.062	0.461
Total	0.319	0.018
Average of Fee Types (Residential and Commercial)		
	r^2	<i>P</i> -value
Phase I	0.548	0.099
Phase II	0.025	0.652
Total	0.255	0.085

- = suggests a statistical relationship between variables
- = does not suggest a statistical relationship between variables
- = negative correlation between variables (all others positive)