Economic Impact of the Proposed Riverwalk Casino, Philadelphia, PA

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Riverwalk Casino

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I. Executive Summary

Gaming Market Advisors was retained by the operators of the Riverwalk Casino to prepare a Local Economic Impact Study that addresses Appendix 31 of the Application and Disclosure Information Form, issued by the Pennsylvania Gaming Control Board. This report addresses the economic impact that the Riverwalk Casino ("Project") would have on the City of Philadelphia, both during construction and after commencement of gaming operations. It also addresses other concerns raised in Appendix 31, including the impact that the Project will have on existing tourism, local police and emergency service capabilities and water and sewage systems.

The Consulting Team employed the Input-Output/Social Accounting Matrix Model to determine the economic impact of the Riverwalk Casino. The Input-Output economic model is used to depict how the total output of each industry in an economy depends on inter-industry demands and final demands, by putting transactions in a matrix framework.

Estimated impacts of pre-opening construction period expenditures for the Riverwalk Casino and those of visitors' expenditures stimulated by the Riverwalk Casino were calculated using the Input-Output/Social Accounting Matrix Model. As shown in Table 1, the estimated impact of construction-related expenditures would be significant, creating over 1,700 jobs in the casino and affiliated activities. Through the wages paid to employees in the local community, there will be an additional stimulus to the local economy, resulting in the creation of over 2,600 new jobs in the region.

After the opening of the Riverwalk Casino, located at the highly visible site near Interstate 95, the revenue brought into the Philadelphia region would not only benefit the operation of the casino itself, but will also benefit the greater Philadelphia economy as the casino operation will require significant amounts of input of local labor and local purchases of goods and services from other industrial sectors in order to provide services for casino visitors.

Two scenarios are presented to determine the impact of casino operations. One is a situation where non Philadelphia visitors are expected to spend almost all of their disposable budgets at the casino with little spent outside of the gaming operation (Scenario-2). The other is the situation where visitors are expected to spend a slight majority of their disposable budgets at the casino with the remainder being spent in the City at restaurants, bars, shopping and other tourism-related facilities outside of the casino (Scenario-1). While Scenario 2 represents a more traditional local's gaming market, the economic impact may be as high as that estimated under Scenario 1 given the large availability of non-gaming activities throughout Philadelphia, and the positive impact the Riverwalk Casino is expected to add to the entertainment value of Philadelphia. Many visitors may choose to spend more on non-gaming amenities than that typically experienced in other local casino destinations. In addition, as the Riverwalk Casino expands and adds more non-gaming amenities, the impact would likely

begin to be skewed away from Scenario 2 and more closely approximate that of Scenario 1.

The results of this analysis appear in the following table. **In looking at the following chart, it is important to note that the gaming taxes paid by the Riverwalk Casino are incremental to those estimated within this report.** Those gaming taxes are estimated at $182 million in the first year of operation, and are projected to increase in years following as the casino's revenue levels increase, and the Riverwalk Casino facility expands.

Total Output	$223,978	$45,999	$53,762	$323,740
Total Wages	$78,457	$18,160	$18,381	$114,999
Total Jobs	1,742	414	510	2,666
Total Indirect Tax	$1,344	$2,417	$3,230	$6,992
Total Output (scenario-1)	$535,439	$92,649	$83,377	$711,465
Total Output (scenario-2)	$264,893	$39,994	$31,218	$336,106
Total Wages (scenario-1)	$130,932	$29,703	$28,506	$189,143
Total Wages (scenario-2)	$46,773	$13,026	$10,673	$70,473
Total Jobs (scenario-1)	6,391	782	790	7,963
Total Jobs (scenario-2)	2,284	338	296	2,918
Total Indirect Tax (scenario-1)	$20,678	$4,639	$5,010	$30,329
Total Indirect Tax (scenario-2)	$8,282	$1,882	$1,875	$12,040

II. Project Overview

Gaming Market Advisors was retained by the operators of the Riverwalk Casino to prepare a Local Economic Impact Study that addresses Appendix 31 of the Application and Disclosure Information Form, issued by the Pennsylvania Gaming Control Board. This report addresses the economic impact that the Riverwalk Casino ("Project") will have on the City of Philadelphia. It also addresses other concerns raised in Appendix 31, including the impact that the Project will have on existing tourism, local police and emergency service capabilities and water and sewage systems.

The Consulting Team

Gaming Market Advisors ("GMA" or "Consulting Team") provides clients with market feasibility studies, primary research, due diligence, payroll control, operational consultations, economic impact studies, business and marketing plans, and player reward program design exclusive to the gaming industry. The principals and associates of GMA have hands-on experience in nearly all aspects of the gaming industry including domestic and international operations, project development, marketing expertise, and detailed market analysis. Biographies of the individuals who prepared this report can be found in the Appendices.

Methodology and Data Sources

Review of the Input-Output/Social Accounting Matrix Model

The Consulting Team employed the Input-Output/Social Accounting Matrix Model to determine the economic impact of the Riverwalk Casino. The Input-Output economic model is used to depict how the total output of each industry in an economy depends on inter-industry demands and final demands, by putting transactions in a matrix framework. The concept of inter-industry transactions is as old as the eighteenth century, W. Leontief first developed the model in the 1930's, resulting in a 1973 Nobel Prize in Economics[1]. W. Isard applied the model to the regional science field and established its usage for economic impact analyses in a region.

The model can be expressed briefly as $X = (I - A)^{-1} Y$

X= total output (an n x 1 vector),
I= identity matrix (an n x n matrix),
A= normalized inter-industry coefficient matrix in cents per dollar (an n x n matrix),
Y=final demand (an n x 1 vector),
n is the number of sectors included in the model.

[1] Dr. Leontief was awarded with Nobel Prize in Economics in 1973 "for the development of the input-output method and for its application to important economic problems"
(Source: http://nobelprize.org/economics/laureates/1973/)

The matrix, which here is a normalized inter-industry coefficient matrix, demonstrates the proportion of inputs that must be purchased by each sector in order to produce one unit of output. Thus, if one were to stimulate an increase in final demand in one sector (or final demand in aggregated sectors), such an increase would require a corresponding increase in another sector's output because that sector's intermediate goods and services are required to produce the final goods and services in the first sector. Here, the increase in final demand is called the "direct effect" (or initial impact), and the increase in output in response to the initial impact is called the "indirect effect." These two effects are summed up and called the "Type I multiplier."

Any increase in output produced by the Type I multiplier (= direct effect + indirect effect) will induce a corresponding increase in income for households in the region. This increase in household income is regarded as increasing regional expenditures in proportion to the increase in household income. In other words, once the output of an industry increases, household income will increase along with expenditures in the region. This increased expenditure effect induced by the increase in household income is called the induced effect, and the addition of the induced effect to the Type I multiplier (=direct effect + indirect effect) is called the Type II multiplier (=direct effect + indirect effect + induced effect).

The following table illustrates the Social Accounting Matrix (SAM) and is an extension of the I-O framework[2]. The column items represent expenditures by (=payment from) each entity. The row items depict receipts to (=payment to) each entity.

Figure 1: Social Accounting Matrix Framework

	Industry	Commodity	Factors	Institutions	Enterprises	Capital	Trade	Total
Industry		Make					Exports	Total Industry Income
Commodity	Use			Consumption		Consum.		Total Comm. Income
Factors	Value added						Exports	Total factor income
Institutions		Sales	Transfers	Transfers	Transfers		Exports	Total Institu. Income
Enterprises								Total Enterpri. Income
Capital						Transfer	Exports	Total Capital Income
Trade	Imports		Factor Trade	Imports		Transfer	Exports	Total Trade Income
Total	**Total Industry Income**	**Total Comm. Income**	**Total factor income**	**Total Institution Income**	**Total Enterprise Income**	**Total Capital Income**	**Total Trade Income**	

Made by the author based on the Database Guide, IMPLAN Pro, MIG Inc.

Following along the rows, "industry" represents industries producing goods and services[3]. "Commodity" represents the goods and services consumed by industries and institutions. "Factors" are factors of production, such as employee compensation, proprietors' income and other income. "Institutions" represent household and government accounts. "Capital" represents investment and borrowing. "Enterprises" represents the distribution of corporate profits. "Exports" and "Imports" show monetary flows into and out of a

[2] Sir Richard Stone was awarded with Nobel Prize in Economics in 1984 "for having made fundamental contributions to the development of systems of national accounts and hence greatly improved the basis for empirical economic analysis" (Source: http://nobelprize.org/economics/laureates/1984/index.html)
[3] The explanation of the SAM table is based on the database manual for the IMPLAN by MIG Inc.

region. The SAM is very useful because it adds non-industrial financial flows to an I-O framework. If one were to look at the industry column (second column from the left), for instance, industries receive commodities (= the goods and services), factors (=labor etc.), and imports in return for payment.

The I-O model is based on several assumptions (MIG Inc, 2000). They are:

- Constant Returns to Scale
- No Supply Constraints
- Fixed Commodity Input Structure
- Homogenous Sector Output
- Industry Technology Assumption

The Constant Returns to Scale assumption means that the production functions are linear and all inputs increase proportionately if additional output is required. The No Supply Constraints assumption means that as the demand for certain goods and services increases, they will be provided without any shortages in supply (due to shortages in raw materials, insufficient production capacity in the factory, etc.). This assumption also means that prices are not affected by supply constraints. The Fixed Commodity Input Structure assumption means that price changes do not cause industry to look for substitute goods and services. The Homogenous Sector Output assumption means that the industry does not change the proportion of its produced items. If a hotel, for example, mixes low-budget leisure guests with high-paying business customers, the hotel is assumed not to change the guest mix while the total sales changes with the constant proportion of the guest mix. The Industry Technology assumption means that an industry uses the same technology to produce all its products. The first three assumptions tend to be criticized more by researchers, particularly the assumption of constant returns to scale. The I-O/SAM is still, however, one of the most important and widely used regional analysis models, and more sophisticated attempts such as the Computable General Equilibrium model (CGE) still requires I-O/SAM data in its core programming.

I-O/SAM models are often used by governments and economic researchers to estimate the impacts of certain actions and policy choices. They are also used for estimating the positive impact of large development projects in a region, such as housing developments, large industrial developments, tourist developments, and income and other tax revenue. In a typical case, an increase in final demand in a given sector will be used as an initial shock, e.g., a new factory development in a county. Subsequently, assumptions of figures such as the annual sales of a factory, employment and payroll data, as well as construction effects, will be used as an initial shock to estimate the total impact of such development in the economy of that county, in terms of total outputs, jobs, and tax revenues.

The model is not normally used for micro-level hospitality projects, such as the impact of a single hotel development on a regional economy, due in large part to the model's complexity, as well as the hospitality industry's unfamiliarity with the model. However,

given the size and scope of the Riverwalk Project, the Consulting Team finds this to be an appropriate model.

How the economic impacts of the Riverwalk Project will be calculated is briefly reviewed below, though the logical flows are similar to those that characterize the above case of traditional positive impact studies. There will be a change in final demand—but in this case an increase caused by two different sets of impacts.

First, there will be series of impacts stimulated by the construction of the proposed gaming facilities, which is considered a non-recurring, one-time impact to the regional economy. As soon as construction is started, procurements of goods and services by a general contractor not only stimulate regional firms, which supply goods and services for the construction, but also new employment, created by the construction project as a whole, will stimulate local households, including the effect of poverty alleviation among lower income households.

Second there will be series of impacts stimulated by the operation of the proposed gaming facilities, which are considered a recurring, continuous impact to the regional economy. As soon as the gaming operator starts to hire and train the employees, the impact will be noticed through paid wages, but once the operation of the gaming facilities opens its door, there will also be substantial inflow of revenues to the gaming operation and to the local Philadelphia economy[4].

In order to increase the likelihood of achieving the projected impacts, all the stakeholders have to understand that vocational training to local residents is critical to position these residents as more employable in the hospitality industry[5] and that any form of public or private structural support for the small-to-medium local entrepreneurs in the tourism-related sectors would increase the impacts on income distribution over the local community.

[4] The combination of the location of Riverwalk Casino and the brand of Planet Hollywood is considered ideal to maximize the export revenue of the casino (i.e. component of visitors from out-of-Philadelphia), as the location is highly visible and the operator is highly recognizable with nationwide-appeal, and even possess strong appeal to international tourists.

[5] Tourists require consumption of "tourism commodities" (hotel rooms, casino experience, taxi cab rides, dining experiences, souvenirs, which can be tangible goods or intangible services). Production of commodities requires not only intermediate goods and services from other industrial sectors, but also the input of labor. In the hospitality industry, the labor component is relatively larger in terms of total inputs. By providing labor to the "factors" market, the tourism industry purchases the labor. Employees receive wages in exchange for this labor. Wages are considered "labor income", which provide employees with disposable income, leading to new wave of consumption. By converting unemployed residents to employed status, the effect on local government is significant, since government no longer has to transfer cash (in the form of government assistance) to those unemployed people anymore but in reverse receives tax income from those newly employed people.

Data Sources

IMPLAN

IMPLAN, which stands for "IMpact Analysis for PLANning," was developed by the USDA Forest Service. The Minnesota Implan Group (MIG) began work on the IMPLAN database in 1987 at the University of Minnesota. The MIG was formed as a private entity to develop and maintain IMPLAN data and software. GMA relied on the I-O/SAM data compiled by the IMPLAN for the county of Philadelphia in 2002, which is the latest version available at the time of analysis.

Other Data Sources

The Consulting Team utilized several other data sources, including the Final Report of the Philadelphia Gaming Advisory Task Force, data from US Census Bureau on Philadelphia County and the State of Pennsylvania, and comparable gaming facility data in other regions in the Unites States.

III. Estimation of the Impact of Construction of the Riverwalk Casino

Based on the estimates of construction costs for the Riverwalk Casino, the estimated impacts from construction activities, which include the costs for general construction, investment in Furniture, Fixture and Equipment ("FF&E"), other equipment, various business and consulting fees and pre-opening expenses are calculated. Note that the costs for land acquisition, financing costs and interest expense are not included in the construction impact calculation, thus allowing for better accuracy. In addition to the chart below, Riverwalk Casino has budgeted $33 million as a contingency. This contingency was not factored into this economic impact analysis.

The following table shows the breakdown of each construction cost item for the Riverwalk Casino.

General Construction	$165,324,000
FFE	
Slots and other gaming equipment	$45,000,000
Kitchen Items	$2,250,000
Computers and electronic items	$600,000
Other miscellaneous	$525,000
Consulting Fees	
Architecture	$7,625,000
Others	$1,380,000
Pre-opening Expenses	
Wages	$3,081,000
Others	$3,666,000
Total	$229,451,000

The results of these expenditures are discussed below.

Total Outputs

Total Output is the value of production by industry for a given time period, usually one year. Given the size of the Riverwalk casino, total output resulting from the construction is expected to be substantial. The chart on the following page illustrates the total output resulting from the construction phase of the Riverwalk Casino.

- Direct investment in construction-related activities, estimated at $224 million, excluding land costs and financing-related costs, will generate additional outputs from other regional sectors in the range of $46 million.
- Increased activities in construction and other sectors, which provide goods and services for the construction activities, will result in the creation of new jobs and labor income to otherwise unemployed local residents. This will lead to increased commercial activity induced by increases in wages and consumption in the amount of $54 million.
- In total, the Philadelphia region will enjoy a positive impact of $324 million once the construction and wage payments for workers start.

11 Ag, Forestry, Fish & Hunting (AGG)		$37	$7,945	$7,982
21 Mining (AGG)		$452	$16	$467
22 Utilities (AGG)		$1,161,383	$1,639,009	$2,800,393
23 Construction (AGG)	$148,314,256	$249,326	$224,659	$148,788,240
31-33 Manufacturing (AGG)	$5,862,227	$4,190,444	$2,903,989	$12,956,659
42 Wholesale Trade (AGG)		$4,779,787	$3,297,378	$8,077,166
48-49 Transportation & Warehousing (AGG)		$2,052,174	$1,355,188	$3,407,362
44-45 Retail trade (AGG)		$5,801,987	$5,081,985	$10,883,972
51 Information (AGG)		$1,606,808	$1,766,797	$3,373,605
52 Finance & insurance (AGG)		$3,351,611	$5,316,989	$8,668,599
53 Real estate & rental (AGG)		$2,991,001	$2,889,049	$5,880,050
54 Professional- scientific & tech svcs (AGG)	$6,850,060	$13,845,481	$2,089,073	$22,784,614
55 Management of companies (AGG)		$1,125,471	$558,575	$1,684,046
56 Administrative & waste services (AGG)	$1,078,884	$2,529,339	$1,102,703	$4,710,926
61 Educational svcs (AGG)		$55,624	$1,348,314	$1,403,938
62 Health & social services (AGG)		$1,145	$10,244,863	$10,246,008
71 Arts- entertainment & recreation (AGG)	$1,034,113	$182,278	$629,831	$1,846,222
72 Accommodation & food services (AGG)	$2,139,047	$497,158	$3,337,620	$5,973,826
81 Other services (AGG)		$993,439	$2,738,989	$3,732,428
92 Government & non NAICs (AGG)		$584,225	$7,229,892	$7,814,117
Institutions (Final Consumption)	$58,699,488			$58,699,488
Total	**$223,978,076**	**$45,999,169**	**$53,762,862**	**$323,740,106**

Wages

The impact of the construction of the Riverwalk Casino on wages appears in the table on the following page.

- Direct investment in construction will generate initial wages of $78.5 million, of which 92% will be in the construction sector. The surge in investment in the

construction sector leads to an increase in new jobs[6] in the Philadelphia region to meet the demands for goods and services for the Riverwalk Casino construction project, thus yielding $18.2 million of additional wages for those who would otherwise be unemployed.

- Increased activities in construction and other sectors, which provide goods and services for these construction activities will result in the creation of new jobs and labor income to otherwise unemployed local residents. This will lead to increased wages paid in other sectors in the amount of $18.4 million.
- In total, the Philadelphia region will enjoy a positive impact of $115.0 million in wages during construction.
- In order to maximize benefits to local community, it is advisable that local residents be given priority in the hiring and selection process so that these construction activities will create a larger economic impact that benefits the local community.

11 Ag, Forestry, Fish & Hunting (AGG)		$56	$1,319	$1,376
21 Mining (AGG)		$170	$6	$176
22 Utilities (AGG)		$142,372	$203,503	$345,875
23 Construction (AGG)	$72,483,992	$120,297	$93,701	$72,697,992
31-33 Manufacturing (AGG)	$794,572	$1,075,816	$593,781	$2,464,170
42 Wholesale Trade (AGG)		$1,851,953	$1,277,586	$3,129,540
48-49 Transportation & Warehousing (AGG)		$798,025	$527,231	$1,325,255
44-45 Retail trade (AGG)		$2,583,521	$2,235,412	$4,818,933
51 Information (AGG)		$394,990	$385,441	$780,432
52 Finance & insurance (AGG)		$1,102,254	$1,718,281	$2,820,535
53 Real estate & rental (AGG)		$393,154	$415,798	$808,952
54 Professional- scientific & tech svcs (AGG)	$3,587,357	$7,181,307	$1,032,703	$11,801,367
55 Management of companies (AGG)		$528,875	$262,482	$791,357
56 Administrative & waste services (AGG)	$462,299	$1,231,423	$499,427	$2,193,148
61 Educational svcs (AGG)		$33,284	$793,337	$826,621
62 Health & social services (AGG)		$396	$5,311,766	$5,312,162
71 Arts- entertainment & recreation (AGG)	$313,046	$72,735	$259,907	$645,688
72 Accommodation & food services (AGG)	$816,119	$206,294	$1,422,692	$2,445,105
81 Other services (AGG)		$325,757	$1,137,560	$1,463,316
92 Government & non NAICs (AGG)		$117,802	$209,350	$327,152
Total Wages	**$78,457,385**	**$18,160,481**	**$18,381,282**	**$114,999,149**

[6] Calculated increase in the number of jobs will be shown in the Employment analysis.

Employment

The impact of the Riverwalk Casino's construction on job creation is detailed in the table on the top of the following page.

- Direct investment in construction will generate employment of about 1,742, of which 91% will be in the construction sector and the rest in manufacturing and service-related jobs. This is due to the fact that while the majority of construction costs are estimated to enter the "construction sector," other portions will go into the acquisition of furniture, fixture and equipment necessary for casino operations.[7] The surge in investment in the construction sector leads to an increase in new jobs in the Philadelphia region to meet the demands for goods and services for the Riverwalk Casino construction, thus yielding about 414 jobs for those who would otherwise be unemployed.
- Increased activities in construction and other sectors, which provide goods and services for construction activities, will result in the creation of new jobs which are estimated at 510, all across broad industrial sectors.
- In total, the Philadelphia region will enjoy newly created jobs for about 2,666 people due to the construction activities of the Riverwalk Casino.
- In order to maximize benefits to local community, it is advisable that local residents be given priority in the hiring and selection process so that these construction activities will create a larger economic impact that benefits the local community.

[7] Pre-opening activities of the operation, including hiring and training of key personnel would start concurrently during construction, and such activities are also captured in the construction impacts.

11 Ag, Forestry, Fish & Hunting (AGG)				
21 Mining (AGG)				
22 Utilities (AGG)		1	1	2
23 Construction (AGG)	1,598	3	2	1,602
31-33 Manufacturing (AGG)	29	21	10	59
42 Wholesale Trade (AGG)		32	22	54
48-49 Transportation & Warehousing (AGG)		19	12	31
44-45 Retail trade (AGG)		101	86	187
51 Information (AGG)		5	6	11
52 Finance & insurance (AGG)		16	25	41
53 Real estate & rental (AGG)		17	23	40
54 Professional- scientific & tech svcs (AGG)	62	122	17	200
55 Management of companies (AGG)		7	4	11
56 Administrative & waste services (AGG)	15	45	18	78
61 Educational svcs (AGG)		1	21	22
62 Health & social services (AGG)			118	118
71 Arts- entertainment & recreation (AGG)	16	4	14	33
72 Accommodation & food services (AGG)	23	8	64	95
81 Other services (AGG)		11	64	75
92 Government & non NAICs (AGG)		3	4	7
Total Numbers of Jobs (unit in person)	1,742	414	510	2,666

Tax Impact

The impact of the Riverwalk Casino's construction on taxes are detailed in the following two tables.

- The construction of the Riverwalk Casino generates substantial tax revenues to federal, state and local governments. While its total is estimated to be $24 million, the largest component comes from social security tax of $12.8 million for the federal government. (See table 7)
- Local government will have the majority of its total tax revenue of $8.6 million coming from indirect business taxes of $5.5 million, such as increased property taxes ($2.5 million) and increased sales tax revenue ($2.2 million)[8] (See table 7).
- While the indirect business taxes' initial amount appears modest ($1.3 million), taxes generated from all other supplying sectors ($2.4 million) and taxes

[8] Increase in tax revenues may mean either revenue increases for local government or an opportunity to mitigate existing tax obligations to existing taxpayers due to the emerging alternative revenue sources from the Riverwalk Casino.

generated from increased consumption from newly employed workers ($3.2 million) are rather substantial[9] (See table 6).

Even though the impact from construction activities is one-time and non-recurring, the impact will bring significant positive impacts not only to the construction sector but also to other sectors that provide goods and services to the construction sector.

11 Ag, Forestry, Fish & Hunting (AGG)		$1	$422	$422
21 Mining (AGG)		$13		$13
22 Utilities (AGG)		$132,822	$185,481	$318,303
23 Construction (AGG)	$844,927	$1,568	$1,387	$847,882
31-33 Manufacturing (AGG)	$18,873	$28,745	$26,783	$74,401
42 Wholesale Trade (AGG)		$788,955	$544,268	$1,333,223
48-49 Transportation & Warehousing (AGG)		$43,302	$33,207	$76,509
44-45 Retail trade (AGG)		$826,154	$734,328	$1,560,483
51 Information (AGG)		$100,053	$90,647	$190,701
52 Finance & insurance (AGG)		$94,897	$141,746	$236,644
53 Real estate & rental (AGG)		$184,672	$262,905	$447,577
54 Professional- scientific & tech svcs (AGG)	$45,650	$110,779	$36,593	$193,021
55 Management of companies (AGG)		$12,270	$6,090	$18,359
56 Administrative & waste services (AGG)	$28,307	$37,681	$20,671	$86,660
61 Educational svcs (AGG)		$204	$10,163	$10,367
62 Health & social services (AGG)		$8	$78,144	$78,152
71 Arts- entertainment & recreation (AGG)	$67,590	$9,041	$35,131	$111,762
72 Accommodation & food services (AGG)	$338,811	$37,010	$151,415	$527,236
81 Other services (AGG)		$8,800	$26,162	$34,962
92 Government & non NAICs (AGG)		$100	$845,265	$845,365
Total	**$1,344,157**	**$2,417,075**	**$3,230,807**	**$6,992,039**

[9] Again, this can be deemed as additional revenue to the local government, or as an opportunity to mitigate existing tax structures in favor of the existing business community.

Table 7: Riverwalk Casino Project's Construction Phase Impact Analysis on Overall Tax Revenues

		Employee Compensation	Proprietary Income	Household Expenditures	Corporations	Indirect Business Taxes	Total
Federal Government NonDefense	Corporate Profits Tax				$663,256		$663,256
	Indirect Bus Tax: Custom Duty					$164,640	$164,640
	Indirect Bus Tax: Excise Taxes					$557,625	$557,625
	Indirect Bus Tax: Fed NonTaxes					$174,568	$174,568
	Personal Tax: Estate and Gift Tax						$0
	Personal Tax: Income Tax			$830,062			$830,062
	Personal Tax: NonTaxes (Fines- Fees)						$0
	Social Ins Tax- Employee Contribution	$6,297,487	$471,700				$6,769,187
	Social Ins Tax- Employer Contribution	$6,458,491					$6,458,491
	Total	**$12,755,978**	**$471,700**	**$830,062**	**$663,256**	**$896,833**	**$15,617,829**
State/Local Government NonEducation	Corporate Profits Tax				$139,974		$139,974
	Dividends				$451,302		$451,302
	Indirect Bus Tax: Motor Vehicle Lic					$63,038	$63,038
	Indirect Bus Tax: Other Taxes					$736,615	$736,615
	Indirect Bus Tax: Property Tax					$2,461,589	$2,461,589
	Indirect Bus Tax: S/L NonTaxes					$107,901	$107,901
	Indirect Bus Tax: Sales Tax					$2,226,713	$2,226,713
	Personal Tax: Estate and Gift Tax						$0
	Personal Tax: Income Tax			$1,704,803			$1,704,803
	Personal Tax: Motor Vehicle License			$120,040			$120,040
	Personal Tax: NonTaxes (Fines- Fees)			$304,517			$304,517
	Personal Tax: Other Tax (Fish/Hunt)			$37,975			$37,975
	Personal Tax: Property Taxes			$49,207			$49,207
	Social Ins Tax- Employee Contribution	$49,967					$49,967
	Social Ins Tax- Employer Contribution	$135,808					$135,808
	Total	**$185,776**	**$0**	**$2,216,543**	**$591,276**	**$5,595,856**	**$8,589,451**
	TOTAL	**$12,941,753**	**$471,700**	**$3,046,605**	**$1,254,532**	**$6,492,689**	**$24,207,280**

Source: made by the authors based on Impact Analysis using IMPLAN data.

Note: Sectors are aggregated to NAICS 2 digit level. While numbers are in $, it does not indicate accuracy to that level. The model is not a stochastic one, but deterministic one with fixed inter-industry coefficients. Also note that tax revenues may lag behind projected economic activities from which tax revenues are generated.

IV. Estimation of the Impact of Operations of the Riverwalk Casino

Based on the revenue projections for the Riverwalk Casino, GMA calculated the estimated impact from Casino Operations. The data is estimated from the first year of operation with $391 million as the first year's gross revenue. For the purposes of calculating the impact of Casino Operations, two different scenarios are presented since expenditure patterns of visitors may vary among gamblers.[10]

While it is understood that the Riverwalk Casino will primarily serve the local and regional communities around Philadelphia, the Project will still generate a portion of its revenue from casino patrons who reside outside of Philadelphia. Comparing expenditure patterns from visitors to Las Vegas, two expenditure patterns of visitors to the Riverwalk Casino are suggested as a basis for impact calculations for the Riverwalk Casino. One scenario is a guest who spends half of his/her overall budget on gambling at the Riverwalk Casino (Scenario-1) and the other half over several other activities, a pattern closer to what is seen for visitors to Las Vegas, where an average guest stays 3.6 nights. While visitors to the Riverwalk Casino may not stay as long as visitors to Las Vegas, resulting in less expenditures for lodging relative to total expenditures per visitor, the uniqueness of having a casino in the middle of a mature, Top-10 city with a substantial tourism infrastructure (developed restaurants, hospitality, entertainment and established business environment) has to be taken into consideration. The other pattern assumes a guest who spends the majority of his/her budget (80%) on gambling within the Riverwalk Casino (Scenario-2). This is the case in which visitors spend almost all the disposable budget at the Riverwalk Casino. While Scenario 2 is more typical of other regional gaming destinations throughout the United States, the attractiveness of Philadelphia as a city, and the positive impact the Riverwalk Casino is expected to have on the entertainment value of Philadelphia may likely result in spending patterns more similar to that as estimated under Scenario 1.

It is important to clarify that it was assumed that only those patrons frequenting the Riverwalk Casino from outside of Philadelphia (estimated at 50% of total patronage), are expected to result in non-gaming revenue not associated directly with the Riverwalk Casino facility. For example, the money a patron who resides in Philadelphia spends in a restaurant in Philadelphia the same night he/ she frequents the Riverwalk Casino was not considered in this analysis as it was assumed that the money would have been spent

[10] It is assumed that some of the revenues are "export" revenue, which is revenue generated by expenditures made by non-Philadelphia residents. While the combination of the Riverwalk Casino site and the established brand of the proposed operator would likely bring more "export" revenues than other combinations, for the sake of conservative calculations, approximately 50% of total revenues are considered "export" revenue, leaving 50% of the revenue out of the casino impact analysis. ($188 million is used as initial impact in casino sector). It is anticipated that export ratio will increase as time passes due to increased awareness by out-of-town visitors. While it is deemed reasonable for the Riverwalk Casino to capture local residents' latent demand for gaming expenditures outside of the Philadelphia, thus reducing the "import" (=cash outflow from Philadelphia to casinos elsewhere outside) for Philadelphia, such assumption was not reflected on the impact calculations to be on the conservative side.

within the community had the casino not been constructed. However, the money spent in a restaurant in Philadelphia from a casino patron who resides outside of Philadelphia who chose to dine in Philadelphia as part of his casino gaming visit was included in this analysis.

Average trip gambling budget	*40.7%*	***50.0%***	***80.0%***
Average hotel expenditure	*23.2%*	***10.0%***	***5.0%***
Average expenditure for Food & Drink	*17.8%*	***20.0%***	***8.0%***
Average expenditure for shopping	*9.3%*	***8.0%***	***2.0%***
Average expenditure for local transport	*4.8%*	***5.0%***	***2.0%***
Average expenditure for shows	*3.5%*	***5.0%***	***2.0%***
Average expenditure for sightseeing	*0.6%*	***2.0%***	***1.0%***
Total	*100.0%*	***100.0%***	***100.0%***

Estimating Operational Impact (Scenario-1)

In the following sections, the direct impact from the Riverwalk Casino operation is found in both the NAICS cost 71 (Arts- entertainment & recreation) and 72 (Accommodation & food services categories.)

Total Output

- Direct expenditures by visitors at the Riverwalk Casino and other hospitality outlets, such as restaurants, bars, shops and public transportation in Philadelphia, are estimated to be around $535 million, and will generate additional outputs from other regional sectors in the amount of $93 million.
- Increased activities in gaming and other sectors which provide goods and services for the gaming activities will result in the creation of new jobs and labor income to otherwise unemployed local residents. This will lead to increased commercial activities induced by increases in wages and consumption in the amount of $83 million.
- In total, the Philadelphia region will enjoy a positive impact of at least $711 million per year once the operation of the Riverwalk Casino starts and wage payments to employees are paid.

11 Ag, Forestry, Fish & Hunting (AGG)		$601	$12,322	$12,923
21 Mining (AGG)		$39	$24	$63
22 Utilities (AGG)		$6,528,312	$2,541,903	$9,070,214
23 Construction (AGG)		$1,583,686	$348,411	$1,932,097
31-33 Manufacturing (AGG)		$9,371,927	$4,503,702	$13,875,629
42 Wholesale Trade (AGG)		$8,931,076	$5,113,650	$14,044,726
48-49 Transportation & Warehousing (AGG)	$26,175,396	$5,291,895	$2,101,708	$33,569,000
44-45 Retail trade (AGG)	$25,185,128	$1,598,285	$7,881,220	$34,664,632
51 Information (AGG)		$7,821,551	$2,740,011	$10,561,562
52 Finance & insurance (AGG)		$6,342,394	$8,245,502	$14,587,895
53 Real estate & rental (AGG)		$10,736,600	$4,480,619	$15,217,219
54 Professional- scientific & tech svcs (AGG)		$10,202,906	$3,239,839	$13,442,745
55 Management of companies (AGG)		$4,048,308	$866,267	$4,914,575
56 Administrative & waste services (AGG)	$10,292,727	$6,035,487	$1,710,143	$18,038,356
61 Educational svcs (AGG)		$113,980	$2,091,054	$2,205,034
62 Health & social services (AGG)		$7,242	$15,888,742	$15,895,984
71 Arts- entertainment & recreation (AGG)	$92,527,952	$6,898,081	$976,786	$100,402,824
72 Accommodation & food services (AGG)	$173,906,688	$1,773,880	$5,175,872	$180,856,432
81 Other services (AGG)		$2,715,743	$4,247,853	$6,963,596
92 Government & non NAICs (AGG)		$2,647,179	$11,212,159	$13,859,338
Institutions (Final Consumption)	$207,351,120			$207,351,120
Total	**$535,439,011**	**$92,649,171**	**$83,377,784**	**$711,465,963**

Wages

The table on the following page details the operational impact under Scenario 1.

- Direct expenditures by visitors to the Riverwalk Casino will generate wages for its employees in the amount of $131 million[11] and employees at other tourism-related sectors, such as restaurants, ground transportation, retail shops, and existing hotels will receive wages due to direct expenditures by visitors. The surge in the gaming sector leads to an increase in new jobs in the Philadelphia region to meet the demands for goods and services for the Riverwalk Casino, thus yielding $29.7 million in additional wages for those who would otherwise be unemployed.

[11] In the simulation, jobs generated in the casino operation by the Riverwalk Casino project and the jobs generated to cater to smaller portion of overnight stay at existing hotels fall into the same initial impact. 70% of it ($130 million) can be attributed to Riverwalk Casino, and 30% ($56 million) to the wages for the existing hotels.

- Increased activities in tourism-related sectors which provide goods and services for gaming activities will result in the creation of new jobs and labor income to otherwise unemployed local residents. This will lead to increased wages paid in other sectors in the range of $28.5 million.
- In total, the Philadelphia region will enjoy a positive impact of at least $189 million per year in wages once the casino opens its doors.
- In order to maximize benefits to local community, it is advisable that local residents be given priority in the hiring and selection process so that the gaming operation's activities will create a larger economic impact, benefiting the local community. It would be beneficial to consider the notion of providing local unskilled residents with hospitality vocational training so that they can have an opportunity to be "more competitive and employable" in the hospitality industry.

11 Ag, Forestry, Fish & Hunting (AGG)		$556	$2,046	$2,602
21 Mining (AGG)		$15	$9	$24
22 Utilities (AGG)		$801,201	$315,607	$1,116,808
23 Construction (AGG)		$765,616	$145,317	$910,933
31-33 Manufacturing (AGG)		$2,215,071	$920,870	$3,135,941
42 Wholesale Trade (AGG)		$3,460,392	$1,981,310	$5,441,702
48-49 Transportation & Warehousing (AGG)	$9,888,140	$2,338,892	$817,664	$13,044,698
44-45 Retail trade (AGG)	$11,645,417	$711,688	$3,466,712	$15,823,816
51 Information (AGG)		$2,162,362	$597,756	$2,760,118
52 Finance & insurance (AGG)		$2,105,367	$2,664,681	$4,770,048
53 Real estate & rental (AGG)		$1,367,487	$644,858	$2,012,345
54 Professional- scientific & tech svcs (AGG)		$5,103,880	$1,601,567	$6,705,447
55 Management of companies (AGG)		$1,902,356	$407,071	$2,309,427
56 Administrative & waste services (AGG)	$3,812,703	$2,723,370	$774,544	$7,310,617
61 Educational svcs (AGG)		$67,755	$1,230,364	$1,298,119
62 Health & social services (AGG)		$2,362	$8,237,993	$8,240,355
71 Arts- entertainment & recreation (AGG)	$32,708,572	$1,573,621	$403,082	$34,685,276
72 Accommodation & food services (AGG)	$72,878,112	$748,071	$2,206,262	$75,832,448
81 Other services (AGG)		$864,701	$1,764,230	$2,628,930
92 Government & non NAICs (AGG)		$788,678	$324,677	$1,113,355
Total	**$130,932,944**	**$29,703,439**	**$28,506,619**	**$189,143,007**

Employment

The following table details the effects of the Riverwalk Casino on employment.

- Direct expenditures by visitors to the Riverwalk Casino and other tourism-related facilities in Philadelphia will generate direct employment of about 6,391, of which 56% will be in the gaming sector and the rest in tourism-related jobs outside of the Riverwalk Casino operations, such as ground transportation, retail shops, hotels, restaurants and bars. This is due to the fact that while the majority of visitors' direct expenditures are estimated to benefit gaming operations first, other significant portions will go to the suppliers of goods and services for the casino operations. The Tourism industrial sector tends to be more labor-intensive than average industrial sectors, because human labor inputs are required to produce and deliver the services for the visitors.
- The surge in casino operations leads to increases in new jobs in the Philadelphia region to meet the demands for goods and services provided by suppliers for the Riverwalk Casino operation, thus yielding about 782 jobs outside of the Riverwalk Casino for those who would otherwise be unemployed.
- Increased activities in Casino Operations and other sectors which provide goods and services for operational activities will result in the creation of new jobs, which is estimated to be an additional 790 jobs, all across broad industrial sectors.
- In total, the Philadelphia region will enjoy newly created jobs of about 7,963 people due to the Riverwalk Casino.
- In order to maximize benefits to local community, it is advisable that local residents be given priority in the hiring and selection processes, so that the casino operations will create a larger economic impact benefiting the local community.

22 Utilities (AGG)		5	2	7
23 Construction (AGG)		17	3	20
31-33 Manufacturing (AGG)		38	16	54
42 Wholesale Trade (AGG)		60	34	94
48-49 Transportation & Warehousing (AGG)	438	55	19	512
44-45 Retail trade (AGG)	525	28	134	687
51 Information (AGG)		32	9	41
52 Finance & insurance (AGG)		31	38	69
53 Real estate & rental (AGG)		77	35	113
54 Professional- scientific & tech svcs (AGG)		81	26	106
55 Management of companies (AGG)		25	5	31
56 Administrative & waste services (AGG)	94	92	28	213
61 Educational svcs (AGG)		2	33	35
62 Health & social services (AGG)		0	183	183
71 Arts- entertainment & recreation (AGG)	2,265	158	21	2,444
72 Accommodation & food services (AGG)	3,069	32	99	3,199
81 Other services (AGG)		33	99	133
92 Government & non NAICs (AGG)		17	7	23
Total Jobs	6,391	782	790	7,963

Tax Impact

The following two tables detail the possible impact of Riverwalk Casino over tax revenues under scenario 1. **In looking at the following chart, it is important to note that the gaming taxes paid by the Riverwalk Casino are incremental to those estimated within this report. Those gaming taxes are estimated at $182 million in the first year of operation, and are projected to increase** in years following as the casino's revenue levels increase, and the Riverwalk Casino facility expands.

- The operation of the Riverwalk Casino will generate substantial tax revenues to federal, state and local governments. While the total is estimated to be $60 million, the largest component will come from indirect business taxes for the local government. Compared with the tax impact from construction, there will be relatively more benefits generated from casino operations to local governments than to the federal government (see table 13).

- Local government will have the majority of its total tax revenue of $30 million coming from indirect business taxes ($24 million), such as increased property taxes ($10.5 million) and increased sales tax revenue ($9.5 million) (see table 13).
- While the indirect business taxes' initial amount appears solid ($21 million), taxes generated from all other supplying sectors ($4.6 million: indirect impact) and taxes generated from other sectors due to increased consumption from newly employed workers ($5.0 million: induced impact via new consumption by newly employed people) are also substantial. (See Table 12.) The indirect impact of tax revenues shows the depth of interdependency between tourism-related sectors and other sectors. Thus local government will have broad opportunities for additional tax revenues from across multiple sectors. The induced impact shows the power of wages to large numbers of local residents that engage in a new series of consumption activities.

11 Ag, Forestry, Fish & Hunting (AGG)		$7	$654	$661
21 Mining (AGG)		$1	$1	$2
22 Utilities (AGG)		$745,924	$287,658	$1,033,582
23 Construction (AGG)		$10,019	$2,151	$12,169
31-33 Manufacturing (AGG)		$88,192	$41,537	$129,729
42 Wholesale Trade (AGG)		$1,474,170	$844,063	$2,318,233
48-49 Transportation & Warehousing (AGG)	$526,360	$114,204	$51,499	$692,063
44-45 Retail trade (AGG)	$3,431,750	$227,582	$1,138,808	$4,798,140
51 Information (AGG)		$220,366	$140,580	$360,946
52 Finance & insurance (AGG)		$194,796	$219,819	$414,615
53 Real estate & rental (AGG)		$997,289	$407,742	$1,405,031
54 Professional- scientific & tech svcs (AGG)		$122,004	$56,750	$178,753
55 Management of companies (AGG)		$44,134	$9,444	$53,578
56 Administrative & waste services (AGG)	$222,938	$104,035	$32,058	$359,031
61 Educational svcs (AGG)		$490	$15,760	$16,251
62 Health & social services (AGG)		$50	$121,194	$121,244
71 Arts- entertainment & recreation (AGG)	$5,312,073	$163,799	$54,484	$5,530,355
72 Accommodation & food services (AGG)	$11,185,842	$101,898	$234,814	$11,522,554
81 Other services (AGG)		$30,276	$40,573	$70,849
92 Government & non NAICs (AGG)		$434	$1,310,835	$1,311,270
Total	**$20,678,963**	**$4,639,670**	**$5,010,423**	**$30,329,055**

Table 13: Riverwalk Casino Project's Operation Impact Analysis (1) on Overall Tax Revenues

		Employee Compensation	Proprietary Income	Household Expenditures	Corporations	Indirect Business Taxes	Total
Federal Government NonDefense	Corporate Profits Tax				$3,035,283		$3,035,283
	Indirect Bus Tax: Custom Duty					$703,486	$703,486
	Indirect Bus Tax: Excise Taxes					$2,382,660	$2,382,660
	Indirect Bus Tax: Fed NonTaxes					$745,907	$745,907
	Personal Tax: Estate and Gift Tax						$0
	Personal Tax: Income Tax			$1,287,388			$1,287,388
	Personal Tax: NonTaxes (Fines- Fees)						$0
	Social Ins Tax- Employee Contribution	$10,183,016	$509,084				$10,692,100
	Social Ins Tax- Employer Contribution	$10,443,358					$10,443,358
	Total	**$20,626,374**	**$509,084**	**$1,287,388**	**$3,035,283**	**$3,832,053**	**$29,290,182**
State/Local Government NonEducation	Corporate Profits Tax				$640,569		$640,569
	Dividends				$2,065,312		$2,065,312
	Indirect Bus Tax: Motor Vehicle Lic					$269,355	$269,355
	Indirect Bus Tax: Other Taxes					$3,147,460	$3,147,460
	Indirect Bus Tax: Property Tax					$10,518,053	$10,518,053
	Indirect Bus Tax: S/L NonTaxes					$461,046	$461,046
	Indirect Bus Tax: Sales Tax					$9,514,460	$9,514,460
	Personal Tax: Estate and Gift Tax						$0
	Personal Tax: Income Tax			$2,643,775			$2,643,775
	Personal Tax: Motor Vehicle License			$186,164			$186,164
	Personal Tax: NonTaxes (Fines- Fees)			$472,236			$472,236
	Personal Tax: Other Tax (Fish/Hunt)			$58,895			$58,895
	Personal Tax: Property Taxes			$76,306			$76,306
	Social Ins Tax- Employee Contribution	$80,797					$80,797
	Social Ins Tax- Employer Contribution	$219,602					$219,602
	Total	$300,399	$0	$3,437,376	$2,705,881	$23,910,373	$30,354,028
	TOTAL	**$20,926,773**	**$509,084**	**$4,724,764**	**$5,741,164**	**$27,742,426**	**$59,644,211**

Source: made by the authors based on Impact Analysis using IMPLAN data.

Note: Sectors are aggregated to NAICS 2 digit level. While numbers are in $, it does not indicate accuracy to that level. The model is not a stochastic one, but deterministic one with fixed inter-industry coefficients. Also note that tax revenues may lag behind projected economic activities from which tax revenues are generated.

Estimating Operational Impact (Scenario-2)

Total Output

- Direct expenditures by visitors to the Riverwalk Casino and other hospitality outlets, such as restaurants, bars, shops and public transportations in Philadelphia, estimated to be around $265 million, will generate additional outputs from other regional sectors for $40 million.
- Increased activities in gaming and other sectors which provide goods and services for gaming activities will result in the creation of new jobs and labor incomes to otherwise unemployed local residents. This will lead to increased commercial activity induced by increases in wages and consumption for $31 million.
- In total, the Philadelphia region will enjoy positive impacts for $336 million once the operation of the Riverwalk Casino starts and wage payments for employees are paid.

11 Ag, Forestry, Fish & Hunting (AGG)		$273	$4,613	$4,887
21 Mining (AGG)		$18	$9	$27
22 Utilities (AGG)		$3,060,335	$951,734	$4,012,070
23 Construction (AGG)		$889,246	$130,451	$1,019,698
31-33 Manufacturing (AGG)		$3,172,709	$1,686,267	$4,858,976
42 Wholesale Trade (AGG)		$2,900,338	$1,914,642	$4,814,981
48-49 Transportation & Warehousing (AGG)	$6,543,849	$2,226,893	$786,917	$9,557,660
44-45 Retail trade (AGG)	$3,935,177	$597,859	$2,950,870	$7,483,905
51 Information (AGG)		$3,645,267	$1,025,909	$4,671,177
52 Finance & insurance (AGG)		$2,741,855	$3,087,263	$5,829,118
53 Real estate & rental (AGG)		$4,897,648	$1,677,625	$6,575,272
54 Professional- scientific & tech svcs (AGG)		$5,027,028	$1,213,054	$6,240,082
55 Management of companies (AGG)		$1,912,030	$324,346	$2,236,376
56 Administrative & waste services (AGG)	$3,216,477	$2,908,361	$640,308	$6,765,147
61 Educational svcs (AGG)		$56,103	$782,928	$839,031
62 Health & social services (AGG)		$4,408	$5,949,034	$5,953,441
71 Arts- entertainment & recreation (AGG)	$68,944,496	$2,677,388	$365,735	$71,987,624
72 Accommodation & food services (AGG)	$46,164,720	$663,208	$1,937,940	$48,765,868
81 Other services (AGG)		$1,411,299	$1,590,473	$3,001,772
92 Government & non NAICs (AGG)		$1,202,517	$4,198,033	$5,400,549
Institutions (Final Consumption)	$136,089,216			$136,089,216
Total	**$264,893,935**	**$39,994,783**	**$31,218,152**	**$336,106,875**

Wages

The following table details the impact on wages under Scenario 2.

- Direct expenditure by visitors to the Riverwalk Casino will generate wages for its employees and employees at other tourism-related sectors, such as restaurants, ground transportation, retail shops and existing hotels, will receive a total of over $47 million in wages thanks to direct expenditures by visitors. The surge in the gaming sector leads to increases in new jobs in the Philadelphia region to meet the demands for goods and services for the Riverwalk Casino operation, thus yielding $13.0 million of additional wages for those who would otherwise be unemployed.
- Increased activities in tourism-related sectors which provide goods and services for gaming activities will result in the creation of new jobs and labor incomes to otherwise unemployed local residents. This will lead to $10.7 million in increased wages paid for other sectors.
- In total, the Philadelphia region will enjoy positive impacts of approximately $70.5 million in wages once the casino opens its doors.
- In order to maximize benefits to local community, it is advisable that local residents be given priority in the hiring and selection processes so that the gaming operation's activities will create a larger economic impact benefiting the local community. It would be beneficial to consider an idea of providing local unskilled residents with hospitality vocational training so that they can have an opportunity to be "more competitive and employable" in the hospitality industry.

11 Ag, Forestry, Fish & Hunting (AGG)		340	766	1,106
21 Mining (AGG)		7	3	10
22 Utilities (AGG)		376,835	118,169	495,004
23 Construction (AGG)		430,445	54,409	484,854
31-33 Manufacturing (AGG)		778,640	344,790	1,123,430
42 Wholesale Trade (AGG)		1,123,751	741,838	1,865,589
48-49 Transportation & Warehousing (AGG)	2,472,035	1,045,136	306,148	3,823,320
44-45 Retail trade (AGG)	1,819,597	266,216	1,297,999	3,383,811
51 Information (AGG)		1,020,899	223,811	1,244,710
52 Finance & insurance (AGG)		917,714	997,704	1,915,417
53 Real estate & rental (AGG)		640,173	241,446	881,619
54 Professional- scientific & tech svcs (AGG)		2,502,885	599,656	3,102,540
55 Management of companies (AGG)		898,489	152,415	1,050,904
56 Administrative & waste services (AGG)	1,191,470	1,321,199	290,003	2,802,671
61 Educational svcs (AGG)		33,247	460,671	493,918
62 Health & social services (AGG)		1,373	3,084,454	3,085,828
71 Arts- entertainment & recreation (AGG)	22,045,470	653,063	150,924	22,849,458
72 Accommodation & food services (AGG)	19,245,108	279,437	826,064	20,350,610
81 Other services (AGG)		433,803	660,560	1,094,363
92 Government & non NAICs (AGG)		302,644	121,565	424,208
Total	**46,773,679**	**13,026,296**	**10,673,395**	**70,473,372**

Employment

The impact on the number of jobs under Scenario 2 is detailed in the following table.

- Direct expenditures by visitors to the Riverwalk Casino and other tourism-related facilities in Philadelphia will generate direct employment of about 2,284, consisting of the employees at Riverwalk Casino and the rest in tourism-related jobs outside of the Riverwalk Casino such as ground transportation, retail, hotels, restaurants and bars. This is due to the fact that while the majority of visitors' direct expenditures are estimated to benefit gaming operations first, other significant portions go to the suppliers of goods and services for the tourism industry. The tourism industrial sector tends to be more labor-intensive than average industrial sectors, because human labor inputs are required to produce and deliver the services for the visitors.
- The surge in casino operation leads to increases in new jobs in the Philadelphia region to meet the demands for goods and services provided by suppliers for the Riverwalk Casino operation, thus yielding about 338 jobs outside of the Riverwalk Casino for those who would otherwise be unemployed.

- Increased activities in casino operations and other sectors, which provide goods and services for the operation's activities, will result in the creation of new jobs which are estimated to be an additional 296 jobs, all across broad industrial sectors.
- In total, the Philadelphia region will enjoy newly created jobs of about 2,918 people due to the operational activities of the Riverwalk Casino.

22 Utilities (AGG)		2	1	3
23 Construction (AGG)		10	1	11
31-33 Manufacturing (AGG)		13	6	19
42 Wholesale Trade (AGG)		19	13	32
48-49 Transportation & Warehousing (AGG)	110	23	7	140
44-45 Retail trade (AGG)	82	10	50	143
51 Information (AGG)		15	3	18
52 Finance & insurance (AGG)		14	14	28
53 Real estate & rental (AGG)		36	13	49
54 Professional- scientific & tech svcs (AGG)		40	10	49
55 Management of companies (AGG)		12	2	14
56 Administrative & waste services (AGG)	29	45	10	85
61 Educational svcs (AGG)		1	12	13
62 Health & social services (AGG)		0	68	68
71 Arts- entertainment & recreation (AGG)	1,267	64	8	1,339
72 Accommodation & food services (AGG)	796	12	37	845
81 Other services (AGG)		16	37	53
92 Government & non NAICs (AGG)		6	3	9
Total Jobs (unit in numbers of jobs)	2,284	338	296	2,918

Tax Impact

The following two tables detail the possible impact of the Riverwalk Casino from tax revenues under Scenario 2.

- The operation of the Riverwalk Casino generates substantial tax revenues to federal, state and local governments. While its total is estimated to be $23 million, the largest component comes from indirect business taxes of $9.6 million for local government. Compared with the tax impact from construction, there will be relatively more benefit generated from casino operations to local government than to the federal government. (See table 18).

- Local government will have the majority of its total tax revenue of $12 million, coming from indirect business taxes ($9.6 million), such as increased property taxes ($4.2 million) and increased sales tax revenue ($3.8 million).(See table 18).
- While the indirect business taxes' initial amount appear solid ($8.3 million), taxes generated from all other supplying sectors ($1.9 million: indirect impact) and taxes generated from other sectors due to increased consumption from newly employed workers ($1.9 million: induced impact via new consumption) are also substantial. (See Table 17) The indirect impact of tax revenue shows the depth of interdependency between tourism-related sectors and other sectors. Thus the local government will have broad opportunities for additional tax revenues from across the sectors. The induced impact shows the power of wages to large numbers of local residents to engage in new series of consumption activities including those who obtained new jobs and new spending power.

11 Ag, Forestry, Fish & Hunting (AGG)		$4	$245	$249
21 Mining (AGG)		$1		$1
22 Utilities (AGG)		$348,721	$107,704	$456,426
23 Construction (AGG)		$5,641	$805	$6,446
31-33 Manufacturing (AGG)		$29,334	$15,552	$44,886
42 Wholesale Trade (AGG)		$478,732	$316,032	$794,764
48-49 Transportation & Warehousing (AGG)	$131,590	$46,871	$19,282	$197,744
44-45 Retail trade (AGG)	$536,211	$85,130	$426,390	$1,047,731
51 Information (AGG)		$102,031	$52,636	$154,666
52 Finance & insurance (AGG)		$81,832	$82,304	$164,136
53 Real estate & rental (AGG)		$452,305	$152,666	$604,971
54 Professional- scientific & tech svcs (AGG)		$59,411	$21,248	$80,659
55 Management of companies (AGG)		$20,845	$3,536	$24,381
56 Administrative & waste services (AGG)	$69,668	$49,509	$12,003	$131,180
61 Educational svcs (AGG)		$258	$5,901	$6,159
62 Health & social services (AGG)		$31	$45,377	$45,408
71 Arts- entertainment & recreation (AGG)	$4,322,321	$67,797	$20,400	$4,410,518
72 Accommodation & food services (AGG)	$3,222,229	$38,643	$87,919	$3,348,791
81 Other services (AGG)		$15,645	$15,191	$30,837
92 Government & non NAICs (AGG)		$208	$490,800	$491,008
Total	**$8,282,019**	**$1,882,949**	**$1,875,993**	**$12,040,961**

Table 18: Riverwalk Casino Project's Operation Impact Analysis (2) on Overall Tax Revenues

		Employee Compensation	Proprietary Income	Household Expenditures	Corporations	Indirect Business Taxes	Total
Federal Government NonDefense	Corporate Profits Tax				$1,311,067		$1,311,067
	Indirect Bus Tax: Custom Duty					$281,569	$281,569
	Indirect Bus Tax: Excise Taxes					$953,656	$953,656
	Indirect Bus Tax: Fed NonTaxes					$298,548	$298,548
	Personal Tax: Estate and Gift Tax						$0
	Personal Tax: Income Tax			$482,022			$482,022
	Personal Tax: NonTaxes (Fines- Fees)						$0
	Social Ins Tax- Employee Contribution	$3,814,655	$189,569				$4,004,223
	Social Ins Tax- Employer Contribution	$3,912,182					$3,912,182
	Total	**$7,726,836**	**$189,569**	**$482,022**	**$1,311,067**	**$1,533,773**	**$11,243,266**
State/Local Government NonEducation	Corporate Profits Tax				$276,689		$276,689
	Dividends				$892,096		$892,096
	Indirect Bus Tax: Motor Vehicle Lic					$107,809	$107,809
	Indirect Bus Tax: Other Taxes					$1,259,766	$1,259,766
	Indirect Bus Tax: Property Tax					$4,209,834	$4,209,834
	Indirect Bus Tax: S/L NonTaxes					$184,533	$184,533
	Indirect Bus Tax: Sales Tax					$3,808,147	$3,808,147
	Personal Tax: Estate and Gift Tax						$0
	Personal Tax: Income Tax			$989,876			$989,876
	Personal Tax: Motor Vehicle License			$69,703			$69,703
	Personal Tax: NonTaxes (Fines- Fees)			$176,813			$176,813
	Personal Tax: Other Tax (Fish/Hunt)			$22,052			$22,052
	Personal Tax: Property Taxes			$28,570			$28,570
	Social Ins Tax- Employee Contribution	$30,267					$30,267
	Social Ins Tax- Employer Contribution	$82,265					$82,265
	Total	**$112,532**	**$0**	**$1,287,015**	**$1,168,784**	**$9,570,089**	**$12,138,420**
	TOTAL	**$7,839,369**	**$189,569**	**$1,769,036**	**$2,479,851**	**$11,103,862**	**$23,381,686**

Source: made by the authors based on Impact Analysis using IMPLAN data.

Note: Sectors are aggregated to NAICS 2 digit level. While numbers are in $, it does not indicate accuracy to that level. The model is not a stochastic one, but deterministic one with fixed inter-industry coefficients. Also note that tax revenues may lag behind projected economic activities from which tax revenues are generated.

V. Estimation of the Impact of Casino Operations on Public Services

In this section, possible impacts of casino operation over the local police, emergency services, social services, existing tourism and others will be reviewed.

Additional Operating Budget for Local Police

Based on the data in the Final Report made by the Philadelphia Gaming Advisory Task Force, current traffic volume at the Old Incinerator site is 28,467 per day (29,007 on Saturday), and the additional traffic due to casino operation is estimated to be 12,100 per day (27,500 on Saturday), representing 42% (94% on Saturday) increase in traffic volume. Based on a comprehensive report completed by Pennoni Associates for the proposed Riverwalk Casino, traffic volumes are estimated to approximate 20% lower than those put forth in the Philadelphia Task Force report.

Even though the site has excellent interstate access, the projected increase in traffic requires more allocation of traffic police officers and patrol cars. Also, the proportionate increase in crime rate per number of visitors is assumed to remain linear, which means the need for local police for general security and order will increase as well.

A review of recent gaming research studies reveals that previous studies have examined the topic of the assumed correlation between casino and other issues, such as crime rate. Baxandall and Sacerdote (2005) used the Ordinary Least Squares Regression Analysis to analyze the impact of the introduction of casinos in Massachusetts.[12] One of the findings was that there would be more total crimes due to increased numbers of population, while the crime rate (the number of crimes per 1,000 residents) would actually decline.[13] As the Riverwalk Casino is expected to result in only a small increase in population in Philadelphia, the resultant increase in crimes is expected to be only nominal, if any at all.

Albanese (1999) investigated the alleged link between casino gambling and the commission of white-collar crimes.[14] The result of this study did not support the claim that casino gambling contributes significantly to trends in embezzlement, forgery and

[12] "Betting the Future: The Economic Impact of Legalized Gambling."
Source: http://www.ksg.harvard.edu/rappaport/research/gambling.htm .

[13] They point out interesting aspects regarding the causality issues of casino to crimes. "In so far as crime rates increase near casinos, it can be hard to know whether gambling has promoted criminality or whether the increased visitors to an area simply increase the number of people who might potentially commit or fall victim to crime. Gaming-industry literature and websites often point to a spike in crime following the opening of Disney World in Orlando, Florida as evidence that casinos per se do not foster crime—just large numbers of cash-toting tourists." P 13 The Casino Gamble in Massachusetts – Full Report and Appendices.

[14] "Casino Gambling and White-Collar Crime – An Examination of the Empirical Evidence" J. Albanese, August 1999 American Gaming Association.

fraud. However, as evidenced in Atlantic City, petty crimes, such as purse snatching, within the casino complex will likely occur.

As crime is not expected to increase resulting from the increase in population and since the only impact on police is expected to occur as a result of increased traffic flow, requiring assistance during peak hours and an increase in petty crimes as a result of the casino development, the $4.5 million in incremental costs as estimated in the task force report appears aggressive.

While the authors of this study agree that an increase in police staffing is necessary, a separate police station would not be necessary. Based on the data presented in other reports referenced within this study, GMA estimates that the local police force will be expected to add traffic officers during peak periods and detectives to handle the increase in petty crimes associated with the casino. This incremental cost appears to be easily covered by the increase in non-gaming tax revenue as estimated within this document. Given the location of the proposed casino, expected impact on traffic, and levels of security employed within the casino, the incremental cost of police will likely approximate 25% to 50% of the $4.5 million as estimated in the Philadelphia Gaming Task Force report .

It is of mutual benefit for the local police and for the casino operator to coordinate the maintenance of security in and around the proposed casino area. It is understood that the success of the casino operation at this particular site would be a crucial catalyst for the overall viability of larger waterfront revitalization plan of the City and that the perception of safety and order in the minds of visitors would be very important and will determine, in large part, the speed of re-vitalization along the waterfront.

Additional Operating Budget for Local Fire Department

The impact on the local fire department would not be as large as the one over the local police, due to the fact that very few casino visitors would become long-term residents of Philadelphia. In addition, the old incinerator site consists of an aging building that is not likely up to fire code. This facility will be replaced with a new building that will be fully up to code. However, there will be an increased flow of visitors, which may contribute to an increase of incidents which requires emergency services. Although, there seems to be no other evidence to differentiate casino operation from other forms of large commercial operations, such as hotels, shopping malls or special events, in that they all attract large number of visitors. Similar to the police estimate, the addition of $0.9 million appears aggressive. The incremental expenses will likely approximate that same percentage as estimated for the incremental police burden. Again, this incremental cost will easily be covered by the increase in non-gaming tax revenue as estimated within this document.

Additional Operating Budget for Local Social Services

While there is a reasonable amount of scientific data on the issue of the increased need for social services, the results of these studies are mixed. The National Opinion Research Center at the University of Chicago conducted a study in 1999. Out of 100 randomly chosen communities, 40 had a casino development. Interestingly enough, "*fewer people in casino-affected communities received public assistance from local governments for unemployment or social welfare, because residents had higher earnings in construction, hotel and lodging and recreation industries. On the other hand, residents of communities near casinos were twice as likely to have pathological gambling problems.*"

At this moment, there seems to be mixed evidence to endorse the estimates presented by the Philadelphia Gaming Advisory Task Force for $2.3 million. The introduction of good paying jobs that generally do not require skilled laborers prior to the hire date, is expected to result in a reduction of social welfare and unemployment costs. Any training costs of employees would be born by the casino, and as such would not be considered a social cost. However, it is advised that the casino operator remain willing to cooperate with local social services in a proactive manner. In order to facilitate the employment opportunities for local community members, it is also advised that the casino operator to listen to local needs, such as day-care facilities in the vicinity.

Impact Over Water and Sewage Facilities

Given the age of the old incinerator site, certain upgrades may be necessary to accommodate the water and sewer lines for the casino project and integrate them into the city's water system. However, for purposes of this study, it is assumed that these costs are included in the total Riverwalk Casino project cost. Once the new infrastructure is in place, no increase cost is associated with water and sewer as a result of the casino except for those utility costs associated with the monthly/quarterly water and sewer bills that will be paid for by the casino complex.

VI. Disclaimer

Gaming Market Advisors has made a best effort to secure accurate information but much of the information contained in this report was received from third-parties which Gaming Market Advisors did not validate or verify. Accordingly, Gaming Market Advisors makes no warranty, real or implied, regarding the data contained in this report. This report also contains projections of future events based upon certain assumptions. As it is not possible to predict future outcomes with absolute accuracy, these projections should be treated only as estimates of potential future results. Actual results may differ due to unforeseen events. Consequently, Gaming Market Advisors assumes no liability for the accuracy of these projections.

VII. Appendices

Demographic Data

Table 19: Summary of US Census Bureau Data -- Philadelphia County in Perspective			
Demography	**Philadelphia County**	**Pennsylvania**	**USA**
Population, 2004 estimate	1,470,151	12,406,292	293,655,404
Population, percent change, April 1, 2000 to July 1, 2004	-3.10%	1.00%	4.30%
Population, 2000	1,517,550	12,281,054	281,421,906
Population, percent change, 1990 to 2000	-4.30%	3.40%	13.10%
Persons under 5 years old, percent, 2000	6.50%	5.90%	6.80%
Persons under 18 years old, percent, 2000	25.30%	23.80%	25.70%
Persons 65 years old and over, percent, 2000	14.10%	15.60%	12.40%
Female persons, percent, 2000	53.50%	51.70%	50.90%
White persons, percent, 2000 (a)	45.00%	85.40%	75.10%
Black or African American persons, percent, 2000 (a)	43.20%	10.00%	12.30%
American Indian and Alaska Native persons, percent, 2000 (a)	0.30%	0.10%	0.90%
Asian persons, percent, 2000 (a)	4.50%	1.80%	3.60%
Native Hawaiian and Other Pacific Islander, percent, 2000 (a)	Z	Z	0.10%
Persons reporting some other race, percent, 2000 (a)	4.80%	1.50%	5.50%
Persons reporting two or more races, percent, 2000	2.20%	1.20%	2.40%
White persons, not of Hispanic/Latino origin, percent, 2000	42.50%	84.10%	69.10%
Persons of Hispanic or Latino origin, percent, 2000 (b)	8.50%	3.20%	12.50%
Living in same house in 1995 and 2000', pct age 5+, 2000	61.90%	63.50%	54.10%
Foreign born persons, percent, 2000	9.00%	4.10%	11.10%
Language other than English spoken at home, pct age 5+, 2000	17.70%	8.40%	17.90%
High school graduates, percent of persons age 25+, 2000	71.20%	81.90%	80.40%
Bachelor's degree or higher, pct of persons age 25+, 2000	17.90%	22.40%	24.40%
Persons with a disability, age 5+, 2000	354,409	2,111,771	49,746,248
Mean travel time to work (minutes), workers age 16+, 2000	32	25.2	25.5
Housing units, 2002	660,450	5,328,251	119,302,132
Homeownership rate, 2000	59.30%	71.30%	66.20%
Housing units in multi-unit structures, percent, 2000	31.60%	21.20%	26.40%
Median value of owner-occupied housing units, 2000	$59,700	$97,000	$119,600
Households, 2000	590,071	4,777,003	105,480,101
Persons per household, 2000	2.48	2.48	2.59
Median household income, 1999	$30,746	$40,106	$41,994
Per capita money income, 1999	$16,509	$20,880	$21,587
Persons below poverty, percent, 1999	22.90%	11.00%	12.40%
Business	**Philadelphia County**	**Pennsylvania**	**USA**
Private nonfarm establishments with paid employees, 2001	25,621	295,096	7,095,302
Private nonfarm employment, 2001	609,775	5,123,111	115,061,184
Private nonfarm employment, percent change 2000-2001	0.50%	0.70%	0.90%
Nonemployer establishments, 2000	44,595	632,469	16,529,955
Manufacturers shipments, 1997 ($1000)	11,098,092	172,193,216	3,842,061,405
Retail sales, 1997 ($1000)	8,118,245	109,948,462	2,460,886,012
Retail sales per capita, 1997	$5,592	$9,150	$9,190
Minority-owned firms, percent of total, 1997	24.10%	5.90%	14.60%
Women-owned firms, percent of total, 1997	22.10%	24.20%	26.00%
Housing units authorized by building permits, 2002	554	45,114	1,747,678
Federal funds and grants, 2002 ($1000)	15,137,998	85,600,644	1,901,247,889
Geography	**Philadelphia County**	**Pennsylvania**	**USA**
Land area, 2000 (square miles)	135	44,817	3,537,438
Persons per square mile, 2000	11,233.60	274	79.6
Source: complied by authors based on US Census Bureau Data			

The Consulting Team

Gaming Market Advisors ("GMA") provides clients with market feasibility studies, primary research, due diligence, payroll control, operations consults, business and marketing plans, and player reward program design. The principals and associates of GMA have hands-on experience in nearly all aspects of the gaming industry including domestic and international operations, project development, marketing expertise, and detailed market analysis. Following are the vitas of the Consulting Team.

Andrew M. Klebanow

Andrew Klebanow specializes in Marketing Plan and Business Plan Development, Market Research, Casino Property Analysis, Market Assessments and Player Rewards Program Design exclusive to the gaming industries.

Mr. Klebanow has worked in the hospitality industry since 1975 and in the fields of casino marketing and casino business planning since 1991. He earned a Bachelor of Arts degree at New York University and Masters Degree in Marketing from Cornell University's School of Hotel Administration.

From 1991-1993 he was Director of Marketing at Sahara Gaming Corporation's Hacienda Hotel and Casino and Director of Marketing and Planning for the parent company's Development Group.

As a consultant to Horseshoe Gaming, Klebanow conducted an analysis of the gaming market in Tunica, MS and subsequently prepared its pre-opening business and marketing plans. In addition Mr. Klebanow wrote the opening marketing plan for the Horseshoe Casino in Bossier City, LA.

Mr. Klebanow also worked as Director of Marketing for Alliance Gaming Corporation where he conducted the initial market research, consumer testing and marketing plan development for Gamblers Bonus, the industry's first cardless slot club for the company's Nevada slot route division. Gamblers Bonus was the first player tracking system that allowed customers to redeem bonus points for game credits at the machine.

From 1996 to 1999 Klebanow was Vice President of Marketing for Santa Fe Gaming Corporation where he oversaw the marketing efforts for the Santa Fe Hotel and Casino in Las Vegas and the Pioneer Hotel and Gambling Hall in Laughlin NV. His most recent position was that of Vice President of Marketing at Sam's Town Hotel and Gambling Hall, where he oversaw the repositioning of the 22-year-old gaming property and the re-branding of its player rewards program.
In addition, Mr. Klebanow is a periodic lecturer at Cornell University's School of Hotel Administration and at the University of Nevada Las Vegas. He has participated on several panels at the World Gaming Congress, the Slot Managers Institute and at National

Indian Gaming Association conferences. Mr. Klebanow also authors a monthly column in Indian Gaming Magazine.

Steven M. Gallaway

Mr. Gallaway, a former Senior Vice President of The Innovation Group, has been consulting in the gaming industry for the past four years. He has completed over 100 feasibility studies with a strong focus in Native American gaming operations, public bond transactions, and international gaming developments. Steve has worked with over 35 Native American Tribes from California to Arizona to Florida. Many of these Native American engagements have resulted in Mr. Gallaway assisting his clients in obtaining the necessary funding to allow their projects to move forward. Steve worked with the Fantasy Springs Casino Resort in California in obtaining the first tax-free municipal bond to fund a casino project, and more recently worked with the Golden State Transportation Financing Corporation.

Internationally, Mr. Gallaway has worked on more than 40 projects in Western and Eastern Europe, the Bahamas, the Caribbean, Canada, and Mexico. The depth of his experience in Mexico prompted an invitation to speak at the 2002 G2E (Global Gaming Expo) to discuss the future of gaming in Mexico. Other experience in gaming consulting includes an extensive amount of primary research, operational reviews, completing due diligence for clients on potential gaming acquisitions, and assisting casinos in analyzing and maximizing the utility of their player database. Because of his proficiency in this area, Steve was asked to participate on a panel at the 2003 G2E.

Tadayuki (Tad) Hara, Ph.D, MPS, MBA, MS

Tad Hara spent 17 years in corporate finance and investment banking field in various assignments in the world, mainly in real estate, hospitality and energy-related projects before switching to academics. He holds a master's degrees in Hotel Administration (Cornell University), in Regional Science (Cornell University), in management (MBA, University of Glamorgan, U.K.) and a PhD (Cornell University). He taught courses of "tourism industry analysis" in which he utilizes Input-Output/Social Accounting Matrix modeling and the Tourism Satellite Accounts concepts at School of Hotel Administration, Cornell University.

Currently, he works at Rosen College of Hospitality Management, University of Central Florida as an Associate Professor, and teaches finance for both undergraduate and graduate students. He is also appointed as a senior research fellow at Dick Pope Institute for Tourism Studies, with current research interest in quantitative tourism industry analysis, particularly the economic impact of tourism for poverty alleviation and income distribution patterns in regional economy.

TRAFFIC IMPACT STUDY

RIVERWALK CASINO

Philadelphia, PA

Prepared for:

JAMES P. MARKHAM
PENNA. REG. P.E. NO. 33831-E

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December 2005
BLTA 0504

RIVERWALK CASINO

TRAFFIC IMPACT STUDY
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INTRODUCTION

The Riverwalk Casino is an electronic gaming facility which will be located on the Delaware waterfront on Pier's 27, 31, 32, 33, 34, and 35 in the City Philadelphia. The proposed development will consist of a total of 5,000 gaming units which will be installed in two phases: Phase 1A (3,000 gaming units) and Phase 1B (2,000 gaming units).

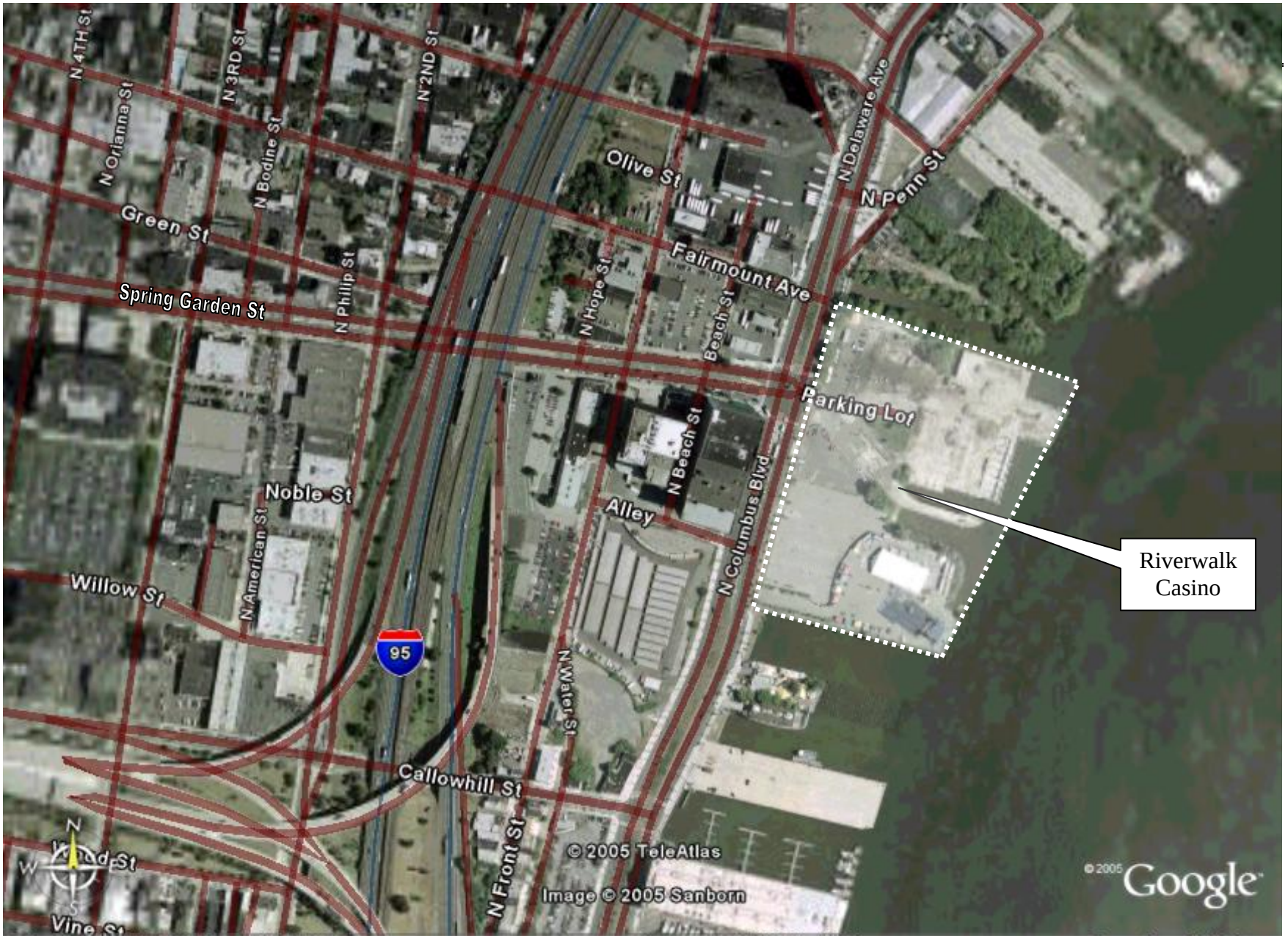
The proposed Riverwalk Casino will also contain other uses such as food and beverage areas, entertainment, amenity retail, employee facilities, public circulation and support space. The total site will be approximately 400,000 square feet, with a parking garage structure (which will be constructed in Phase 1A) consisting of 3,200 spaces.

The site is situated along the Delaware waterfront at the terminus of Spring Garden Street north of the Ben Franklin Bridge. The site will be highly visible from both Interstate 95 and the Benjamin Franklin Bridge. Excellent highway access is provided via I-95 to the northeast and southwest to bridges to the north and south into New Jersey, and via Interstate 76, to the Atlantic City Expressway. On and off-ramps to I-95 are relatively close by. The proposed primary access to the facility will be via Delaware Avenue. The location of the proposed electronic gaming facility and the overall study area is shown in **FIGURE 1**.

This study presents an evaluation of the existing and future traffic conditions in the vicinity of the proposed site and provides an analysis of the traffic impacts of the proposed development in accordance with the City of Philadelphia Zoning Code, Chapter 14-1803(3)(a)(.1).

Specific elements included in this study are:

- An inventory of the roadway facilities in the vicinity of this project, including the existing physical and traffic operating characteristics.
- Peak hour capacity analysis of the study intersections for 2005 existing conditions.
- Pre-development traffic volumes for the build year.
- Critical hour capacity analysis of the study intersections for pre-development conditions.
- Distribution and assignment of the new vehicle trips to be generated by the proposed Riverwalk Casino.
- Total build year post-development traffic volumes, including site-generated traffic.
- Critical hour capacity analysis of the study intersections and site access for build year post-development conditions.



Pennoni Associates Inc.
Consulting Engineers
One Drexel Plaza
3001 Market Street
Philadelphia, PA 19104-2897

Traffic Impact Study
City of Philadelphia
Pennsylvania

FIGURE 1
PROJECT LOCATION

EXISTING TRAFFIC CONDITIONS

Existing Roadway Facilities

The following roadways were evaluated as part of this study within the immediate vicinity of the project site:

Delaware Avenue is a six-lane arterial roadway that runs north-south. South of Spring this roadway is also known as Christopher Columbus Boulevard. For the purpose of this Study this roadway will be referred to as Delaware Avenue. Within the vicinity of the project, the roadway consists of six lanes plus median left turn lanes, shoulder/parking lane, bike lanes and a combination of concrete, landscaped and pavement marking medians. Within the vicinity of the proposed development, Delaware Avenue has signalized intersections at Callowhill Street, Spring Garden Street, and N. Penn Street. Delaware Avenue is posted at 30 mph.

N. Penn Street is a two lane local roadway that generally runs north-south (in a 30 degree angle to Delaware Avenue) and intersects Delaware Avenue at a right angle to form a signalized T-intersection approximately 610 feet north of the intersection of Delaware Avenue and Spring Garden Street. The total width of this roadway is 40 feet wide, each lane is 20 feet wide, and this includes space for on-street parking on both sides of the street, which leaves an effective travel lane of 12 feet. N. Penn Street will serve as the primary access for the Waterfront Square Towers and may be further developed in conjunction to the development of the Waterfront Square Towers.

Spring Garden Street is a five lane arterial roadway that generally runs east-west. Spring Garden Street intersects Delaware Avenue at one of the proposed site access driveways. The roadway consists of two lanes in each direction with a center lane for left turn movements, on-street parking is permitted on both sides of the street, and bike lanes exist for each direction. At its intersection with Delaware Avenue, the eastbound approach has separate right, through, and left turn lanes. If needed, additional turn lanes could be provided within the medians. Spring Garden Street is posted at 25 mph.

Noble Street is a two lane local roadway that generally runs east-west and intersects Delaware Avenue to form an unsignalized T-intersection approximately 450 feet south of the intersection of Delaware Avenue and Spring Garden Street. The total width of this roadway is 40 feet wide; each lane is 20 feet wide.

Callowhill Street is a one-way eastbound roadway between the I-95 southbound exit off-ramp and Delaware Avenue. On-street parking is permitted on both sides of the street and the roadway is posted at 25 mph. This roadway provides a direct link from I-95 southbound to the Delaware Waterfront properties and forms a signalized intersection with Delaware Avenue south of the proposed site. The eastbound approach to Delaware Avenue has separate left and right turn lanes.

Interstate 95 (Delaware Expressway) is a limited access highway carrying six to eight travel lanes. This Interstate runs north-south and has limited access interchanges through Central Philadelphia. Interchange access to the Delaware waterfront properties are at E. Girard Avenue (from SB/to NB), Callowhill Street (from SB), Lombard Street (to NB) Summer St. (to NB), Pemberton Street (from SB, to NB), and Wharton Street (from NB). The speed limit is posted at 55 mph.

Currently all signalized intersections within the study area are operating a 90-second cycle length and each utilizes the same timing plan during the evening period, which is from 3 PM to 6 PM. Signalized intersections along Delaware Avenue are coordinated with the master intersection at Race Street.

Transit Services

The Southeastern Pennsylvania Transportation Authority (SEPTA) has several transit alternatives to access the waterfront properties: SEPTA bus services along Delaware Avenue (Route 25) and Spring Garden Street (Route 43) provide direct connections to the proposed gaming facility; a SEPTA subway station for the Market-Frankford El is located at the intersection of Spring Garden Street and 2nd Street, which is two city blocks away from the proposed development. Additionally, taxi services and charter and private bus companies contracted by the Riverwalk casino will also provide transportation to the proposed development. The proposed Riverwalk Casino is also within close proximity to Old City and the Historic District.

Existing Land Uses

The proposed development is along a section of the Delaware River that is within the larger context of an established and expanding mix-used waterfront that includes significant residential, tourism, hotel, restaurant and commercial office development.

Existing Traffic Volumes

Turning movement counts, including heavy vehicles and pedestrian counts, were conducted on an average weekday evening (Thursday, December 8th, 2005) between the hours of 4:00 - 6:00 PM and Saturday evening (November 19th, 2005) between the hours of 4:00 - 7:00 PM.

The count data are provided in **APPENDIX A**.

The existing turning movement traffic volumes for the intersections within the study area are illustrated in **FIGURE 2**.

Existing Levels of Service

The peak hours of operation were evaluated at the study intersections. The analyses were performed in accordance with the procedures outlined in the Highway Capacity Manual,

Special Report 209, published by the Transportation Research Board, Washington D.C., using the Trafficware's Software, Synchro. The results of these analyses provide Level of Service, volume/capacity descriptions and average seconds of delay for the intersection movements.

Level of Service (LOS) is a measure of vehicle operator satisfaction with the driving experience. For the study intersections, this has been noted with designations "A" through "F" for the signalized intersection and "a" through "f" for unsignalized intersections based on the average vehicle delay per each approach and the overall intersection. The Level of Service concept is a rating system established to objectively evaluate the operational adequacy of an intersection or roadway. Definitions of the Levels of Service are contained in **APPENDIX B**.

Delay refers to the time a vehicle arriving at the intersection must wait before proceeding through the intersection. The volume/capacity ratio compares the number of vehicles attempting to utilize an approach or intersection to the capacity of the approach or intersection for a specific time period. As the traffic volumes near the capacity of the approach or intersection, congestion occurs. A V/C of 1.0 indicates that the volumes equal the estimated capacity of the intersection or approach.

Under the existing conditions, the intersection of Delaware Avenue and Callowhill Street and the intersection of Delaware Avenue and N. Penn Street both operates at overall LOS "A" during both weekday and Saturday evening peak hours. All movements at these intersections operate at LOS "D" or better.

The intersection of Delaware Avenue and Spring Garden Street operates at an overall LOS "E" during the weekday evening peak hour and overall LOS "C" during the Saturday evening peak hour. During the weekday evening peak hour, the eastbound left turn movement from Spring Garden Street onto northbound Delaware Avenue and the northbound left turn movement from Delaware Avenue onto Spring Garden Street both operate at a LOS "F". During the Saturday evening peak hour, the northbound left turn movement from Delaware Avenue onto Spring Garden Street operates at a LOS "E". All other movements operate at a LOS "D" or better.

Results of the existing conditions analysis are illustrated in **FIGURE 3**. Summary outputs from the analysis software are provided in **APPENDIX C**.

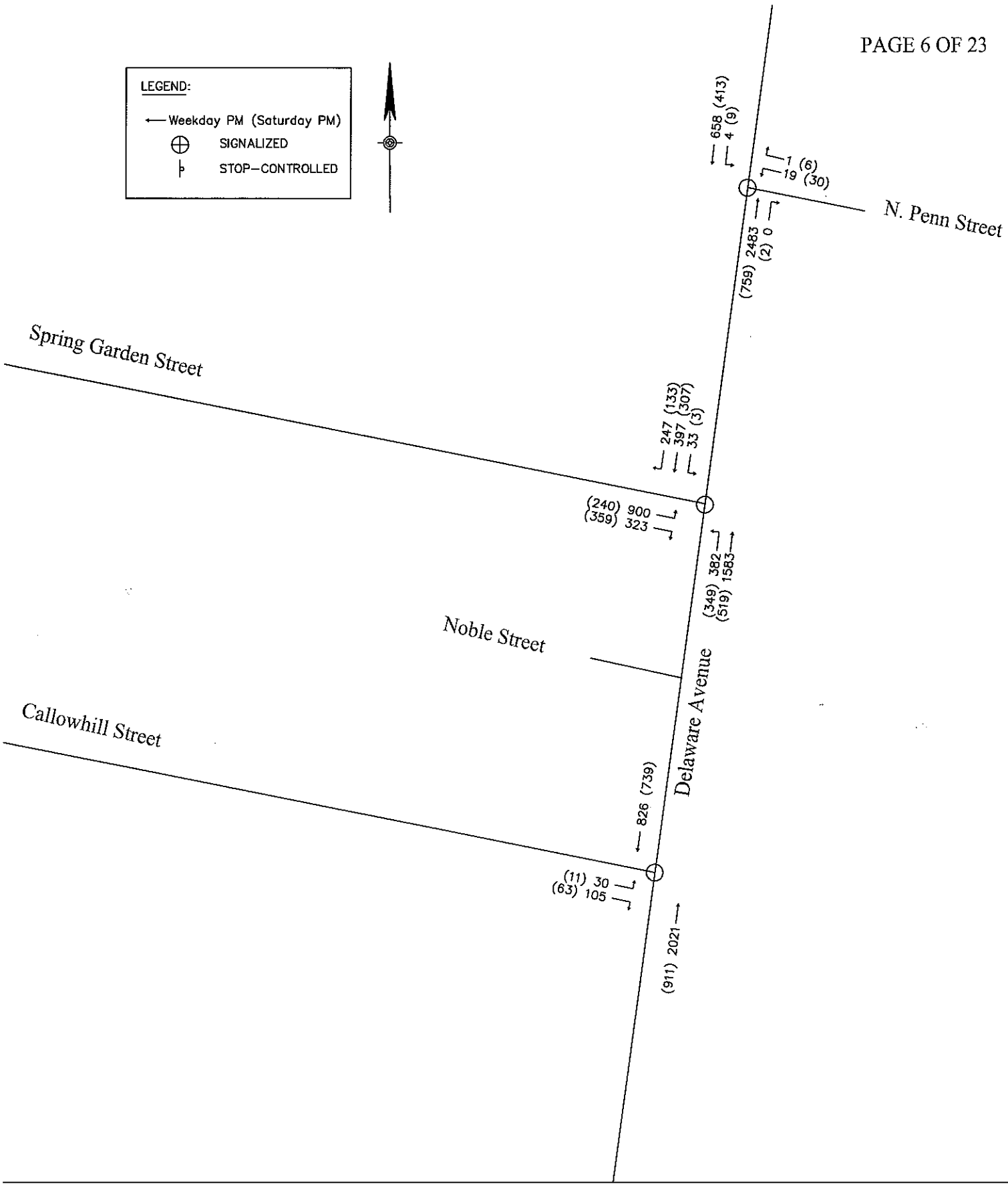


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FIGURE 2
EXISTING VOLUMES
(DATA COLLECTED: 2005)

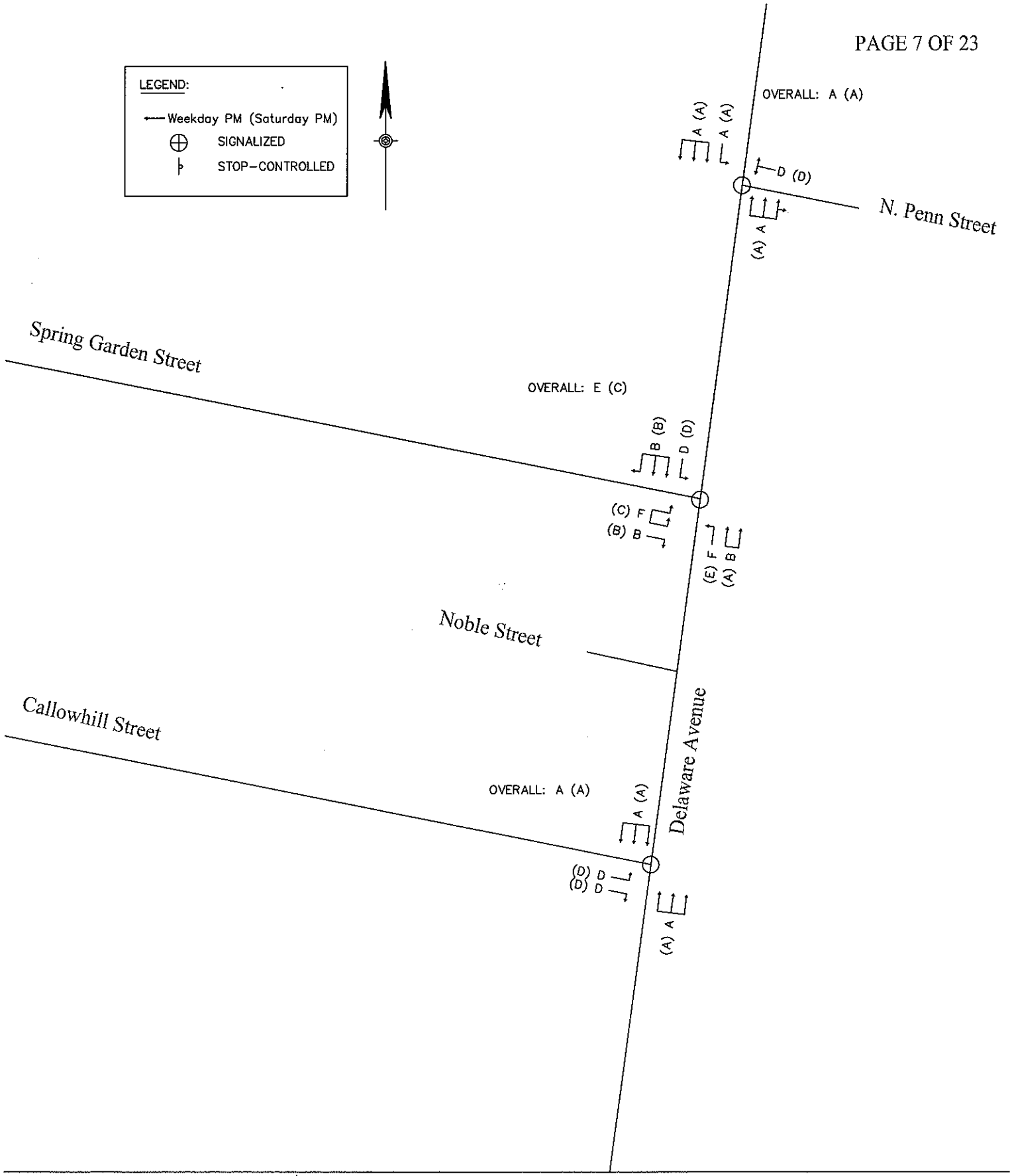

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FIGURE 3
EXISTING LEVELS
OF SERVICE

FUTURE "PRE-DEVELOPMENT" TRAFFIC CONDITIONS

Pre-Development Traffic Volumes

The future traffic conditions will account for the traffic volume increases that are expected to occur throughout the region over this period. Existing traffic volumes are typically increased by an annual growth factor of 2.1% (2002 PENNDOT Table 371) to account for traffic volume increases from general background growth. In addition, approved developments and the associated traffic generation within the project study are added to the roadway network.

Other Developments (Committed)

Based on information provided by Penn's Landing Corporation and the City of Philadelphia, several developments are being considered or under construction within the vicinity of the project site. These are:

- Waterfront Square. This is a proposed luxury condominium complex which will contain five towers located on North Penn Street. Phase 1 is expected to be completed by September 2006; Phase 2, by December 2007. This development is currently under construction.
- Marina View. This is a proposed residential tower located at 230 N Columbus Blvd just north of the Ben Franklin Bridge. The expected completion date is December 2007 to early 2008.
- World Trade Center. This is a proposed development which will include office, residential and retail uses. At this time, the size and time of completion for this development is unknown.

At the time this study is completed, it is estimated that on the year 2007, the Waterfront Square will have 170 condominium units completed and occupied. And as such, the traffic generated by these 170 units will be accounted for as part of the pre-development condition.

The future pre-development traffic volumes for the intersections within the study area are illustrated in **FIGURE 4**.

Pre-Development Levels of Service

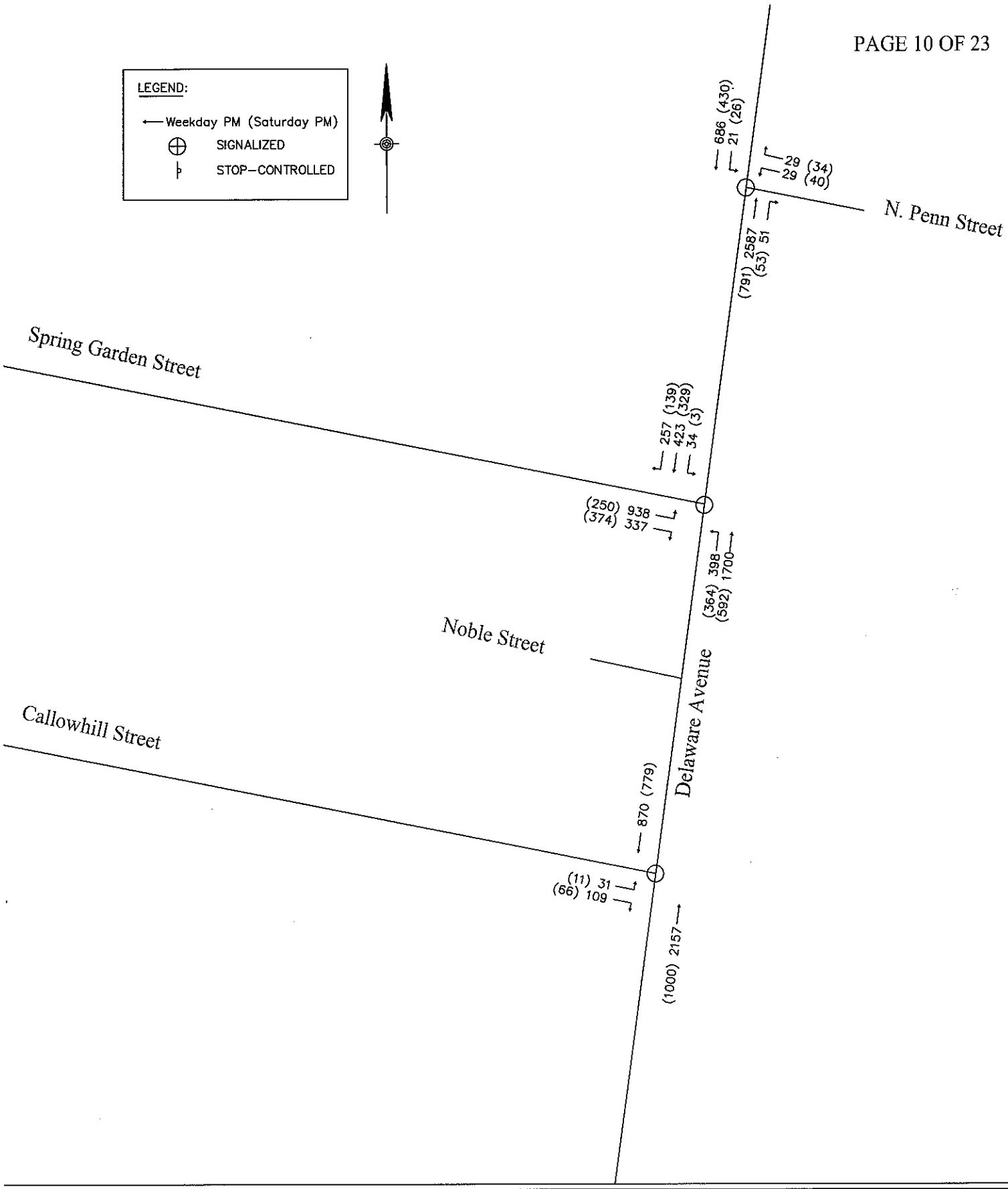
As with the existing condition evaluation, the peak hours of operation for the future pre-development condition were evaluated at the study intersections. The results of these analyses are as follows:

The intersection of Delaware Avenue and Callowhill Street and the intersection of Delaware Avenue and N. Penn Street both will operate at overall LOS "A" during both weekday and Saturday evening peak hours. All movements at these intersections will operate at LOS "D" or better.

The intersection of Delaware Avenue and Spring Garden Street will operate at an overall LOS "E" during the weekday evening peak hour and overall LOS "C" during the Saturday evening peak hour. During the weekday evening peak hour, the eastbound left turn movement from Spring Garden Street onto northbound Delaware Avenue and the northbound left turn movement from Delaware Avenue onto Spring Garden Street both will operate at a LOS "F". During the Saturday evening peak hour, the northbound left turn movement from Delaware Avenue onto Spring Garden Street will operate at a LOS "E". All other movements will operate at LOS "D" or better.

In summary, in the year 2007, prior to the completion of the proposed Riverwalk Casino, the study intersections will maintain the existing LOS.

Results of the future pre-development conditions analysis are illustrated in **FIGURE 5**. Summary outputs from the analysis software are provided in **APPENDIX E**.


LEGEND:
Weekday PM (Saturday PM)
SIGNALIZED
STOP-CONTROLLED
N. Penn Street
Spring Garden Street
Noble Street
Callowhill Street
Delaware Avenue
686 (430)
21 (26)
29 (34)
29 (40)
(791) 2587
(53) 51
257 (139)
423 (329)
34 (3)
(250) 938
(374) 337
(364) 398
(592) 1700
870 (779)
(11) 31
(66) 109
(1000) 2157

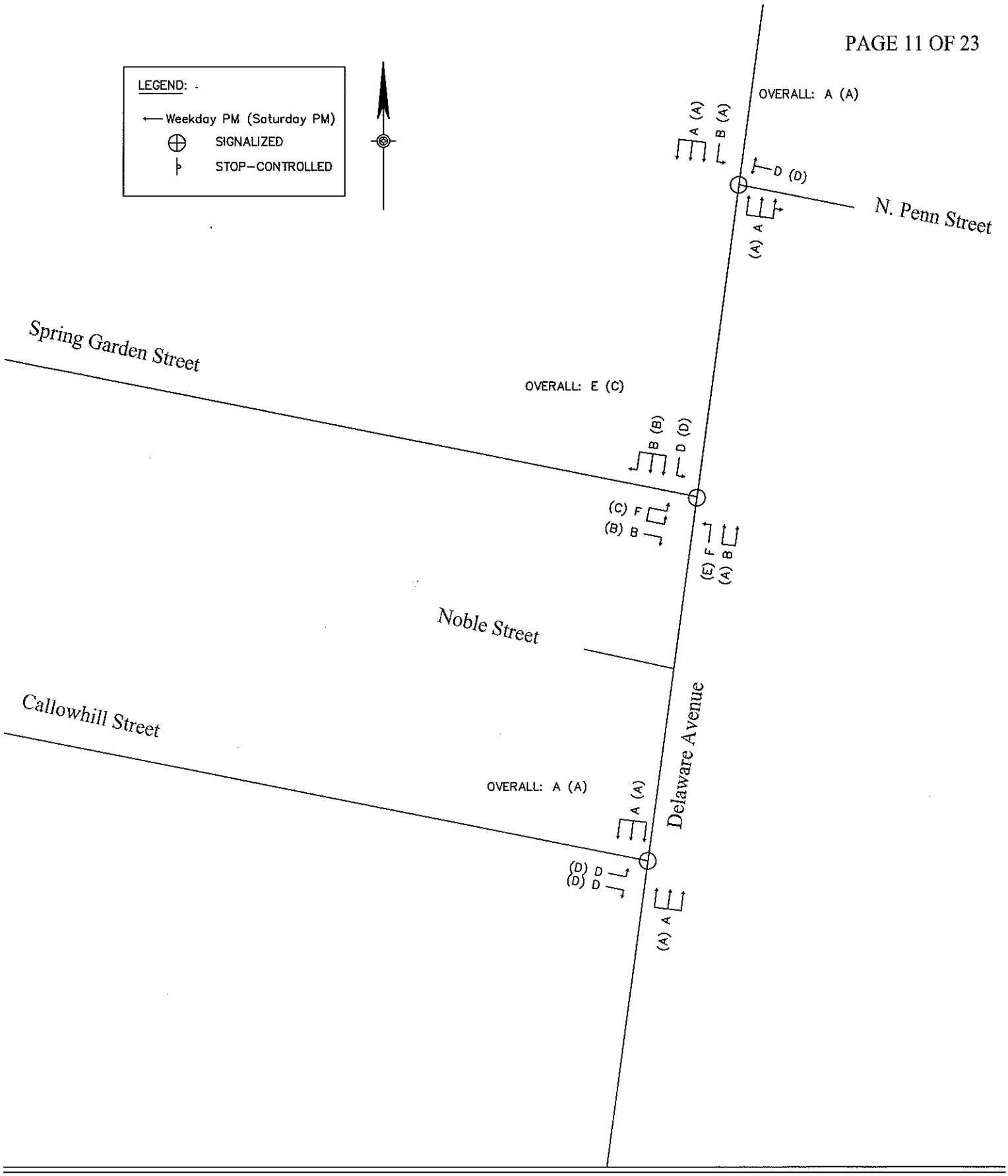


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FIGURE 5
PRE-DEVELOPMENT
LEVELS OF SERVICE

TRIP GENERATION AND DISTRIBUTION

Trip Generation

The standard reference generally utilized to estimate traffic generated by new developments is a publication entitled Trip Generation by the Institute of Transportation Engineers. However, Trip Generation does not include a significant amount of data for gaming uses. The data it does include, does not match up well with the proposed development. Therefore, additional research was conducted to identify other sources of trip data.

An article titled "Gaming Casino Traffic", published in the ITE Journal, March 1998, by Paul C. Box and William Bunte, provides trip generation rates and an analysis of the daily fluctuation in generated traffic for two gaming casino facilities. While the article establishes trip generation rates per gaming position for the study sites, the rates could not be reasonably applied to this site, because the sites included in the article contain table type gaming positions (blackjack, poker, Keno).

In order to develop an estimate of the future traffic for the proposed electronic gaming device facility, driveway count information from similar facilities were utilized that were conducted by Pennoni Associates in 2004. Traffic counts from the following facilities were analyzed:

- Freehold National, New Jersey
- Delaware Park, Delaware
- Dover Downs, Delaware

Out of this data, the trip generation rates from the Delaware Park Saturday evening driveway vehicle counts appear to be most suitable to be applied to the proposed site. This is primarily because the driveway traffic counts at this facility were conducted when the live horse racing facility was closed and therefore the trips attracted by the gaming device facility were isolated. Additionally, the Delaware Park site is compatible with the proposed development, in that it includes a similar number and type of supporting patron services within the gaming device facility.

In order to develop trip generation rates for the weekday evening peak hour, the Saturday evening rate was adjusted based on ratios provided in the Box and Bunte ITE article mentioned previously. The Saturday midday peak hour rate was obtained using Table 2 from the Box and Bunte article which provides an hourly breakdown of the daily traffic percentages. The resultant peak hour trip rates per gaming unit were 0.358 and 0.477 for the weekday evening and Saturday evening peak hours, respectively.

However, based on the close proximity to transit services, and discussion with the applicant, the following modal split is estimated:

- Automobiles, 80%
- Public Transit Modes, 20%

Thus, it is expected that these peak hour vehicle trips will be reduced by twenty (20) percent.

In order to determine the total daily traffic expected to be developed by the site for the peak days of the week, peak hour/daily traffic ratios were applied to the entering and exiting traffic for the proposed electronic gaming facility traffic. For the proposed facility, the ratios were taken from the Box and Bunte ITE article, while the daily traffic rates for the existing traffic were estimated using ITE Trip Generation. The *daily* site-generated traffic estimates are contained in TABLE 1 and the *peak hour* site-generated traffic estimates are contained in TABLE 2.

TABLE 1
Daily Trip Generation

Day	Weekday			Saturday		
	Enter	Exit	Total	Enter	Exit	Total
Phase 1A	7,154	7,371	14,525	9,718	9,754	19,472
Phase 1B	4,769	4,914	9,684	6,487	6,493	12,980
TOTAL	11,920	12,290	24,210	16,210	16,250	32,450
TOTAL After Modal Split Reduction of 20%	**9,540**	**9,830**	**19,370**	**12,960**	**13,000**	**25,960**

TABLE 2
Peak Hour Trip Generation

Peak Hour	Weekday Evening			Saturday Evening		
	Enter	Exit	Total	Enter	Exit	Total
Phase 1A	558	516	1074	758	673	1431
Phase 1B	372	344	716	506	448	954
TOTAL	930	860	1790	1260	1120	2390
TOTAL After Modal Split Reduction of 20%	**740**	**690**	**1,430**	**1,010**	**900**	**1,910**

Trip Distribution

The new vehicle trips generated by the proposed gaming facility development will be distributed and assigned to the roadway network based on a combined evaluation of existing traffic patterns, the anticipated characteristics and behavior of the development-generated traffic, the location of regional transportation facilities, public transportation facilities (SEPTA buses and trains) and the assumed access scenarios.

It is expected that the majority of site traffic generated during the peak periods will use Delaware Avenue to access the regional routes, such as I-95, I-676/76. In addition, local trips are expected to be distributed on the local roadways such as Spring Garden Street, Race Street and Fairmount Avenue. Based on the existing AADT volumes from PENNDOT interactive volume maps, the following percentages are expected from the regional roadways.

General Direction	Regional Traffic		Local Traffic (Metro Philadelphia)
To/From North	**I-95**	**33%**	**8%**
To/From South	**I-95**	**20%**	**7%**
To/From East	**I-676 and/or I-76**	**8%**	**8%**
To/From West	**I-676 and/or I-76**	**9%**	**7%**

In summary, it is estimated that the traffic generated by the Proposed Riverwalk Casino facility will be **70% regional** and **30% local**.

FIGURE 6 illustrate the anticipated distribution of project traffic and the assignment of the new trips to the roadway network in the vicinity of the project. A summary worksheet of trip generation and future traffic volumes is provided in **APPENDIX D.**

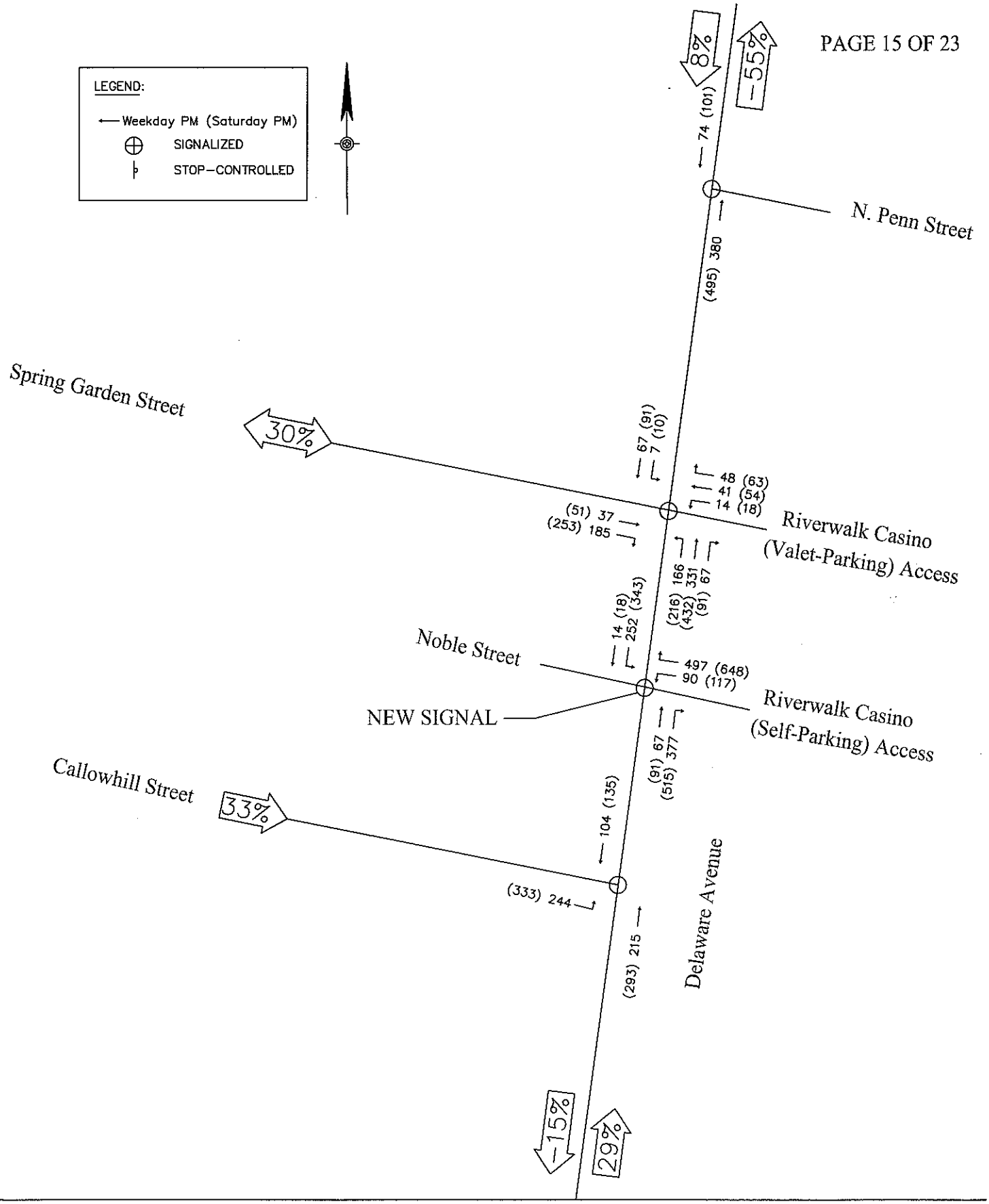

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FIGURE 6
DISTRIBUTION & ASSIGNMENT
OF PROJECT TRAFFIC

SITE ACCESS, PARKING AND CIRCULATION

Based on a conceptual sketch of the proposed facility provided by Bower, Lewis, Thrower Architects (BLTA), the site will have two primary full-movement access driveways on Delaware Avenue:

- One access driveway will be located on the east side of Delaware Avenue, opposite Spring Garden Street. It is restricted to valet parking and Taxi service.

- One access driveway will be located on the east side of Delaware Avenue, opposite Noble Street. It is the access for the majority of automobile site traffic and bus service and this intersection will be signalized as part of this development.

- There will also be a third access which will be a service entrance north of Spring Garden Street. This access will not be available to the patrons of the proposed Riverwalk Casino. This access is solely dedicated for service vehicles.

The garage will be a seven (7) story parking structure which will provide spaces for VIP/valet service, self-park and charter buses. Handicapped/accessible parking spaces will also be provided for patrons with disabilities.

The multi-story parking garage structure will be designed to contain 3,200 parking spaces that will be utilized for designated valet/VIP gamers, self-park, charter buses, and accessible parking for patrons with disabilities. The parking structure will be designed to permit easy access and circulation, bright lighting, enclosed entry to the casino, and a security system to provide a safe and secure environment for patrons. Off-street loading is also provided via a separate access.

Site-generated traffic assigned to both access driveways (opposite of Spring Garden Street and Noble Street) is based on the type and percentage of parking spaces that can be accessed through each entrance. Clear and informative signage will be implemented to inform patrons of the proposed Riverwalk Casino and the type of parking which will be available through each access point. Since the self-park spaces comprise about 85% of the total available parking spaces provided within the site and these parking spaces are not accessible through the access drive opposite of Spring Garden Street, it is expected that a majority of casino patrons who are driving to the site will utilize the access opposite of Noble Street.

It is also noted that there are no anticipated sight distance issues at the driveway accesses. Both the primary entrances to the proposed Riverwalk Casino will be via signalized intersections. There are sufficient sight distances to the adjacent signalized intersections for exiting vehicles. Sufficient sight distances for following vehicles along Delaware Avenue are also observed for entering vehicles.

FUTURE "POST-DEVELOPMENT" TRAFFIC CONDITIONS

Post-Development Traffic Volumes

The traffic volume generated by the proposed Riverwalk Casino development for both Phase 1A and 1B are added to the pre-development traffic volumes to provide the post-development traffic volumes for full build-out. These traffic volumes are illustrated in **FIGURE 7**.

Post-Development Levels of Service

Without any operational (i.e., signal timing and phasing changes) and physical (i.e., additional turn lanes, median removal/changes) changes, the critical intersection of Delaware Avenue and Spring Garden Street will degrade to an overall LOS "F" during both evening peak hours.

During the weekday evening peak hour, the eastbound approach and the northbound approach at this intersection will still operate at LOS "F".

During the Saturday evening peak hour, the northbound approach from Delaware Avenue onto Spring Garden Street will degrade from LOS "E" to LOS "F".

Several physical and operational improvements are considered to mitigate the impact of the development-generated traffic. The modifications are summarized as follows:

- The intersections of Delaware Avenue with Callowhill Street, Noble Street, Spring Garden Street and N. Penn Street will operate 110-second cycle length.

- Different signal timing will be required for the weekday evening and Saturday evening peak hours at the study intersections.

- There will be the following changes in lane configuration and signal timing as part of the proposed improvements:

  - At the intersection of ***Delaware Avenue and Spring Garden Street***:
    - Two eastbound (Spring Garden Street) left turn lane bays will be provided.
    - Two northbound (Delaware Avenue) left turn lane bays will be provided.
    - Three through lanes will be maintained along Delaware Avenue.
    - The access to the Riverwalk Casino (Valet Parking Access) will require a dedicated right turn lane and a shared through and left turn lane. This configuration is based on the estimated pattern and volume of site-generated traffic.
    - Signal timing and phasing at this intersection will be adjusted accordingly.

  - At the intersection of ***Delaware Avenue and Noble Street***:
    - A left turn lane bay will be provided for the southbound approach on Delaware Avenue into the site. An existing northbound left turn lane bay is

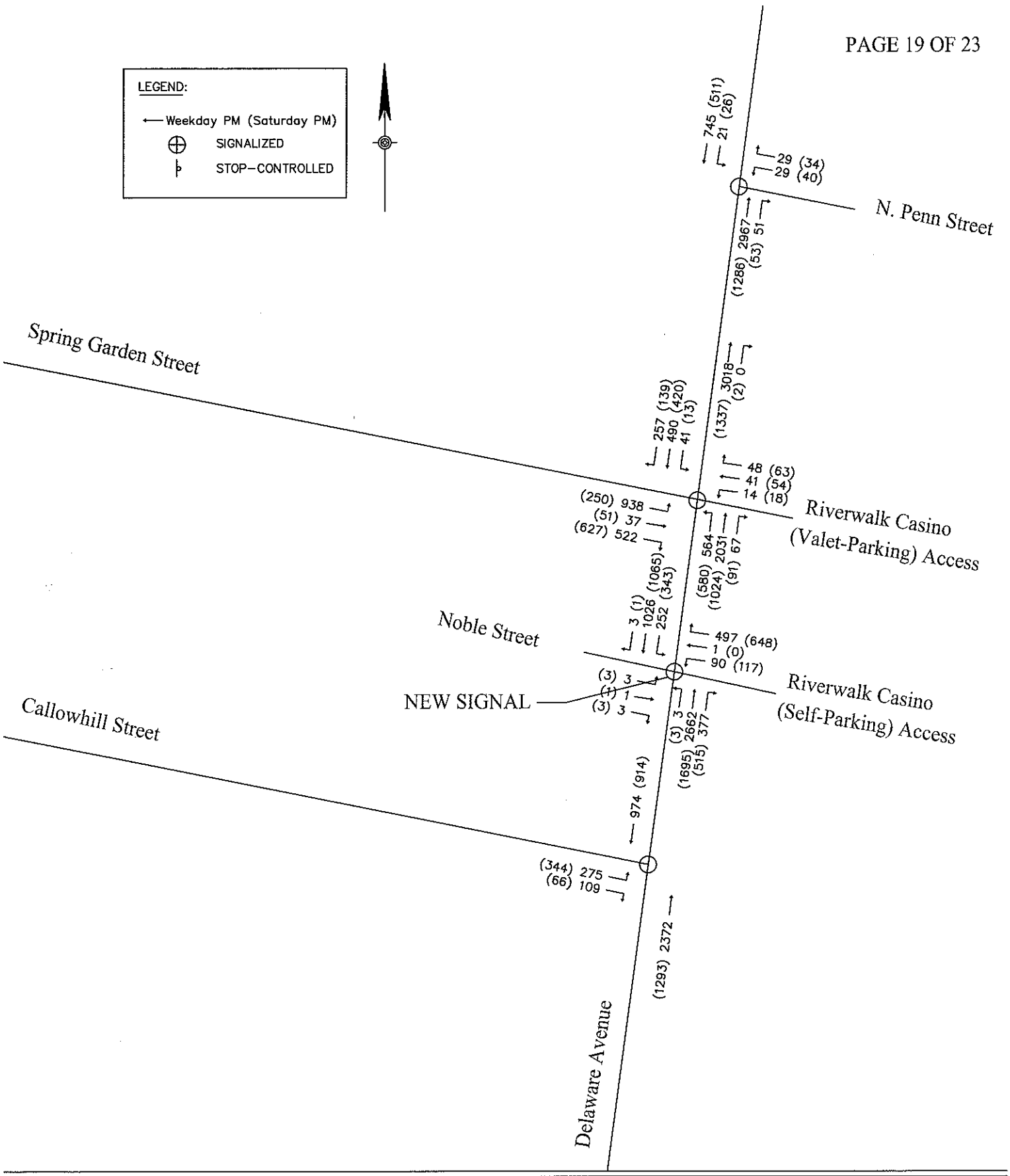
already provided. The left turn lane bays will be positioned to maximize visibility to the opposing traffic due to the permitted/permitted-protected phasing. The northbound left turn lane will require partial removal of concrete median. The southbound left turn lane will require modification of the pavement marking.

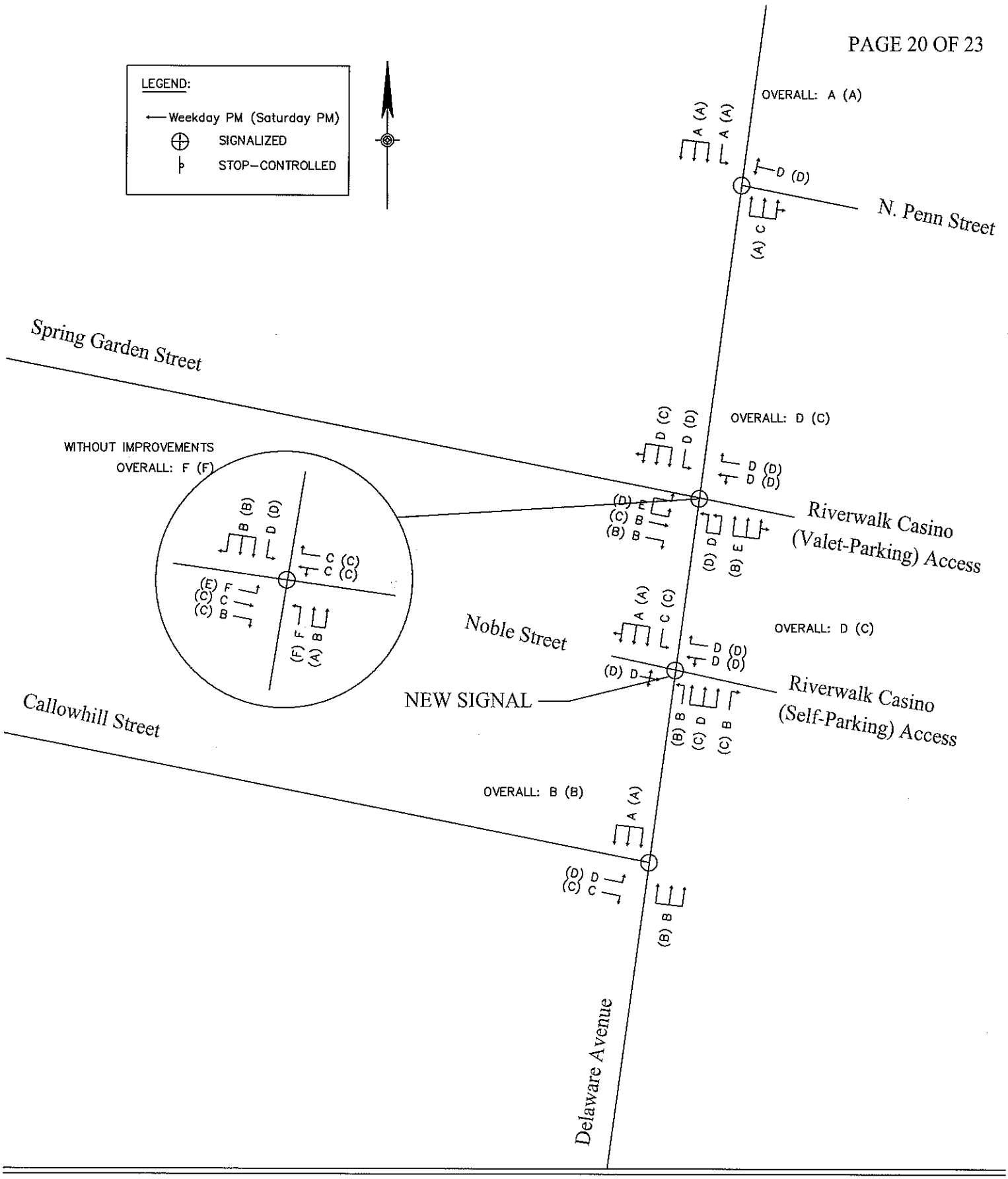
- A dedicated northbound right turn lane bay into the site will be provided.
- Three through lanes will be maintained along Delaware Avenue in each direction.
- The access to the Riverwalk Casino (Self-Park Access) will require a dedicated right turn lane and a shared through and left turn lane. This configuration is based on the estimated pattern and volume of site-generated traffic.
- Installation of a new signal.

Based on the above, the results of the post-development evaluations indicate that movements at all study intersections will operate at overall LOS "D/d" or better during both weekday and Saturday evening peak hours, *except* for the following movements:

At the intersection of Delaware Avenue and Spring Garden Street the eastbound left turn movement and northbound through movement will be operating at LOS "E" during the weekday evening peak hour. The Synchro software classifies delay between 35 to 55 seconds as LOS "D", the eastbound left turn movement and the northbound through movements have quantifiable delay of 56 seconds and 58 seconds, respectively.

Results of the future post-development conditions analysis are illustrated in **FIGURE 8**. Summary outputs from the analysis software are provided in **APPENDICES F AND G**.


LEGEND:
Weekday PM (Saturday PM)
SIGNALIZED
STOP-CONTROLLED
N. Penn Street
Spring Garden Street
Riverwalk Casino (Valet-Parking) Access
Noble Street
Riverwalk Casino (Self-Parking) Access
NEW SIGNAL
Callowhill Street
Delaware Avenue
745 (511)
21 (26)
29 (34)
29 (40)
(1286) 2967
(53) 51
(1337) 3018
(2) 0
257 (139)
490 (420)
41 (13)
48 (63)
41 (54)
14 (18)
(250) 938
(51) 37
(627) 522
(580) 564
(1024) 2031
(91) 67
3 (1)
1026 (1065)
252 (343)
497 (648)
1 (0)
90 (117)
(3) 3
(1) 1
(3) 3
(3) 3
(1695) 2662
(515) 377
974 (914)
(344) 275
(66) 109
(1293) 2372


LEGEND:
Weekday PM (Saturday PM)
SIGNALIZED
STOP-CONTROLLED
OVERALL: A (A)
N. Penn Street
Spring Garden Street
OVERALL: D (C)
WITHOUT IMPROVEMENTS
OVERALL: F (F)
Riverwalk Casino
(Valet-Parking) Access
Noble Street
OVERALL: D (C)
NEW SIGNAL
Riverwalk Casino
(Self-Parking) Access
Callowhill Street
OVERALL: B (B)
Delaware Avenue

CONCLUSIONS AND RECOMMENDATIONS

The Riverwalk Casino is an electronic gaming facility which will be located on the Delaware waterfront on Pier's 27, 31, 32, 33, 34, and 35 in the City Philadelphia. The proposed development will consist of a total of 5,000 gaming units which will be installed in two phases: Phase 1A (3,000 gaming units) and Phase 1B (2,000 gaming units). The proposed Riverwalk Casino will also contain other uses such as food and beverage areas, entertainment, amenity retail, employee facilities, public circulation and support space. The total site will be approximately 400,000 square feet, with a parking garage structure (which will be constructed in Phase 1A) consisting of 3,200 spaces.

The proposed primary access to the facility will be is via Delaware Avenue. The site is situated along the Delaware waterfront at the terminus of Spring Garden Street north of Ben Franklin Bridge. The site will be highly visible from both Interstate 95 and the Benjamin Franklin Bridge. Excellent highway access is provided via I-95 to the northeast and southwest to bridges to the north and south into New Jersey, and via Interstate 76, to the Atlantic City Expressway. On and off-ramps to I-95 is relatively close by.

Turning movement counts, including heavy vehicles and pedestrian counts, were conducted on an average weekday evening (Thursday, December 8th, 2005) between the hours of 4:00 - 6:00 PM and Saturday evening (November 19th, 2005) between the hours of 4:00 - 7:00 PM.

The peak hours of operation were evaluated at the study intersections. The analyses were performed in accordance with the procedures outlined in the Highway Capacity Manual, Special Report 209, published by the Transportation Research Board, Washington D.C., using the Trafficware's Software, Synchro.

Under the existing conditions, the intersection of Delaware Avenue and Spring Garden Street operates at an overall LOS "E" during the weekday evening peak hour and an overall LOS "C" during the Saturday evening peak hour. During the weekday evening peak hour, the eastbound left turn movement from Spring Garden Street onto northbound Delaware Avenue and the northbound left turn movement from Delaware Avenue onto Spring Garden Street both operate at a LOS "F". During the Saturday evening peak hour, the northbound left turn movement from Delaware Avenue onto Spring Garden Street operates at a LOS "E". All other movements operate at LOS "D" or better.

Analysis for the build year 2007 includes general growth and traffic generated by an adjacent committed development (Waterfront Square). The result of this analysis shows that the study intersections will maintain the existing LOS.

The standard reference generally utilized to estimate traffic generated by new developments is a publication entitled Trip Generation by the Institute of Transportation Engineers. However, Trip Generation does not include a significant amount of data for gaming uses. The data it does include, does not match up well with the proposed

development. Therefore, additional research was conducted to identify other sources of trip data.

Based on the close proximity to transit services and information gathered from discussions with the applicant, it is expected that these peak hour vehicle trips will be reduced by twenty (20) percent.

In summary the total peak hour trips generated by the proposed Riverwalk Casino is estimated to be **1,430 trips** during **the weekday evening peak hour (Entering = 740; Exiting = 690)** and **1910 trips** during **the Saturday evening peak hour (Entering = 1,010; Exiting = 900)**.

The traffic volumes generated by the proposed Riverwalk Casino development is added to the pre-development traffic volumes to provide the post-development traffic volumes.

The Post Development analysis is conducted based on the following modifications:

- The intersections of Delaware Avenue with Callowhill Street, Noble Street, Spring Garden Street and N. Penn Street will operate 110-second cycle length.

- Different signal timing will be required for the weekday evening and Saturday evening peak hours at the study intersections.

- There will be the following changes in lane configuration and signal timing as part of the proposed improvements:

  - At the intersection of ***Delaware Avenue and Spring Garden Street***:
    - Two eastbound (Spring Garden Street) left turn lane bays will be provided.
    - Two northbound (Delaware Avenue) left turn lane bays will be provided.
    - Three through lanes will be maintained along Delaware Avenue.
    - The access to the Riverwalk Casino (Valet Parking Access) will require a dedicated right turn lane and a shared through and left turn lane. This configuration is based on the estimated pattern and volume of site-generated traffic.
    - Signal timing and phasing at this intersection will be adjusted accordingly.

  - At the intersection of ***Delaware Avenue and Noble Street***:
    - A left turn lane bay will be provided for the southbound approach on Delaware Avenue into the site. An existing northbound left turn lane bay is already provided. The left turn lane bays will be positioned to maximize visibility to the opposing traffic due to the permitted/permitted-protected phasing. The northbound left turn lane will require partial removal of concrete median. The southbound left turn lane will require modification of the pavement marking.
    - A dedicated northbound right turn lane bay into the site will be provided.
    - Three through lanes will be maintained along Delaware Avenue in each direction.

- The access to the Riverwalk Casino (Self-Park Access) will require a dedicated right turn lane and a shared through and left turn lane. This configuration is based on the estimated pattern and volume of site-generated traffic.
- Installation of a new signal.

Based on the above, the results of the post-development evaluations indicate that movements at all study intersections will operate at overall LOS "D/d" or better during both weekday and Saturday evening peak hours, *except* for the following movements:

At the intersection of Delaware Avenue and Spring Garden Street the eastbound left turn movement and northbound through movement will be operating at LOS "E" during the weekday evening peak hour. The Synchro software classifies delay between 35 to 55 seconds as LOS "D", the eastbound left turn movement and the northbound through movements have quantifiable delay of 56 seconds and 58 seconds, respectively.

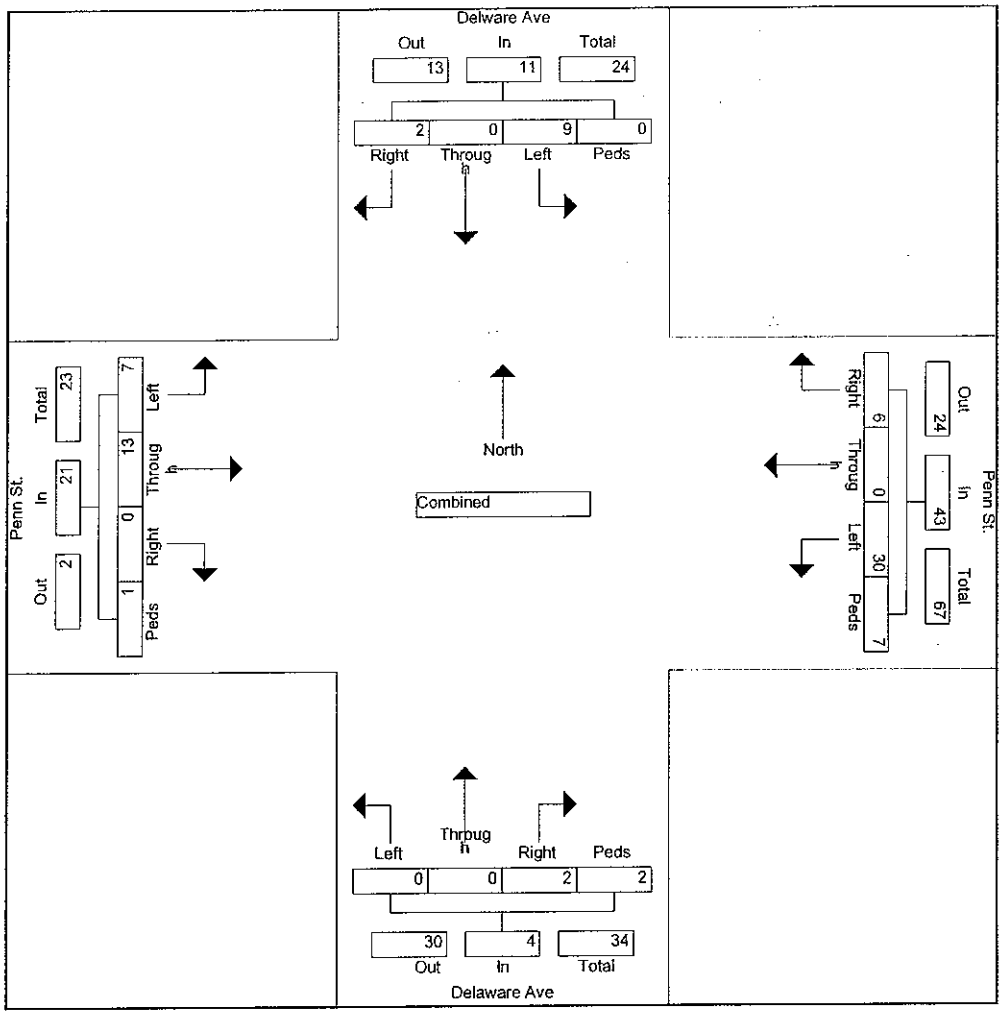
In conclusion, while there will be added delay time imposed by the additional traffic generated by the proposed Riverwalk Casino development, mitigations efforts listed above will be undertaken to ensure that the increase in traffic volumes will not significantly affect the operations of the subject intersections. As such, the proposed improvements ensure that the development is in compliance with the City of Philadelphia Zoning Code, Chapter 14-1803(3)(a)(.1).

APPENDIX A

TRAFFIC COUNTS

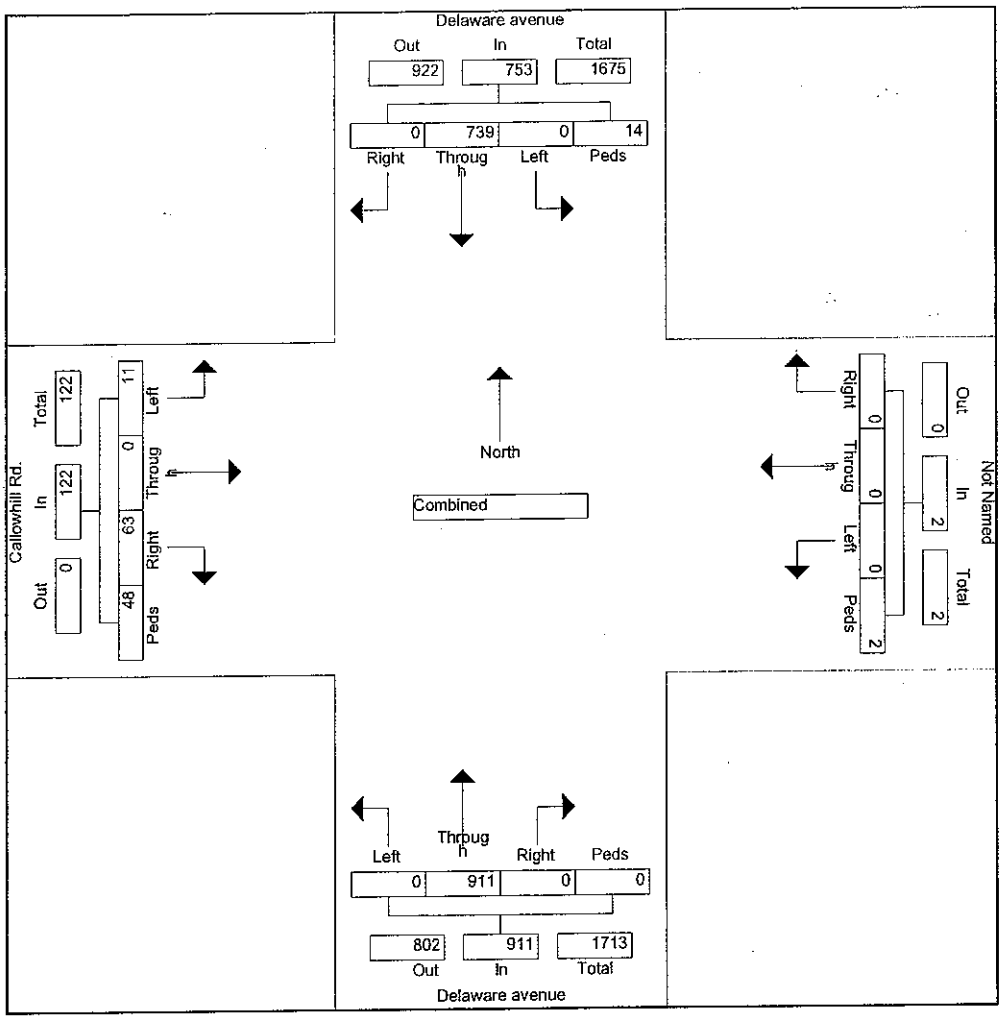
File Name : N. Delaware Ave. & Penn St.
Site Code : 00000000
Start Date : 11/19/2005 Sat
Page : 2

	Delware Ave Southbound					Penn St. Westbound					Delaware Ave Northbound					Penn St. Eastbound					
Start Time	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Int. Total
Peak Hour From 16:00 to 18:45 - Peak 1 of 1																					
Intersection	16:30																				
Volume	9	0	2	0	11	30	0	6	7	43	0	0	2	2	4	7	13	0	1	21	79
Percent	81.8	0.0	18.2	0.0		69.8	0.0	14.0	16.3		0.0	0.0	50.0	50.0		33.3	61.9	0.0	4.8		
High Int.	16:30					16:45					17:00					16:30					16:30
Volume	4	0	1	0	4	10	0	2	6	12	0	0	1	2	3	3	6	0	1	7	22
Peak Factor					0.688					0.896					0.333					0.750	0.898



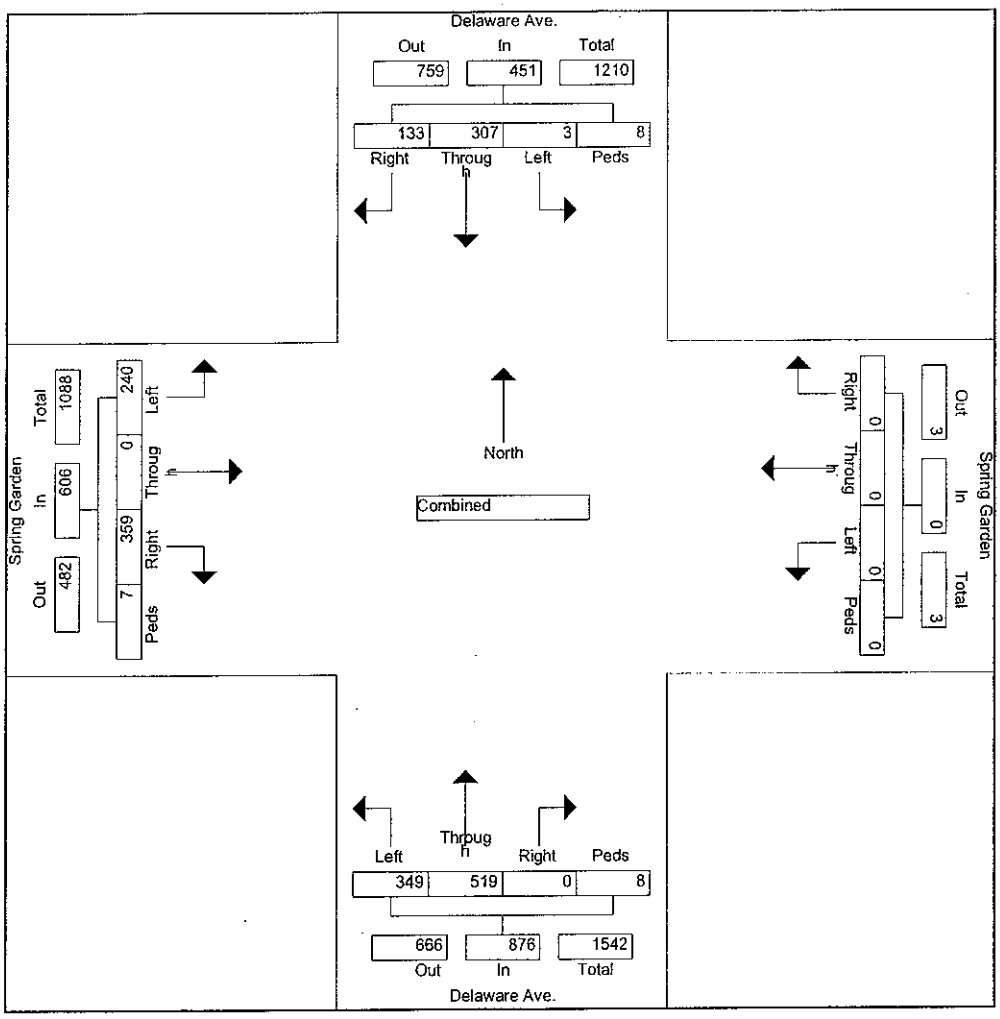
File Name : N. Columbus Blvd. & Callowhill Rd.
Site Code : 00000000
Start Date : 11/19/2005 Sat
Page : 2

	Delaware avenue Southbound					Westbound					Delaware avenue Northbound					Callowhill Rd. Eastbound					
Start Time	Left	Thr oug h	Rig ht	Ped s	App. Total	Left	Thr oug h	Rig ht	Ped s	App. Total	Left	Thr oug h	Rig ht	Ped s	App. Total	Left	Thr oug h	Rig ht	Ped s	App. Total	Int. Total
Peak Hour From 16:00 to 18:45 - Peak 1 of 1																					
Intersection	16:45																				
Volume	0	739	0	14	753	0	0	0	2	2	0	911	0	0	911	11	0	63	48	122	1788
Percent	0.0	98.1	0.0	1.9		0.0	0.0	0.0	100.0		0.0	100.0	0.0	0.0		9.0	0.0	51.6	39.3		
High Int.	17:00					17:30					16:45					17:00					16:45
Volume	0	209	0	10	219	0	0	0	2	2	0	254	0	0	254	4	0	20	17	37	477
Peak Factor					0.860					0.250					0.897					0.824	0.937



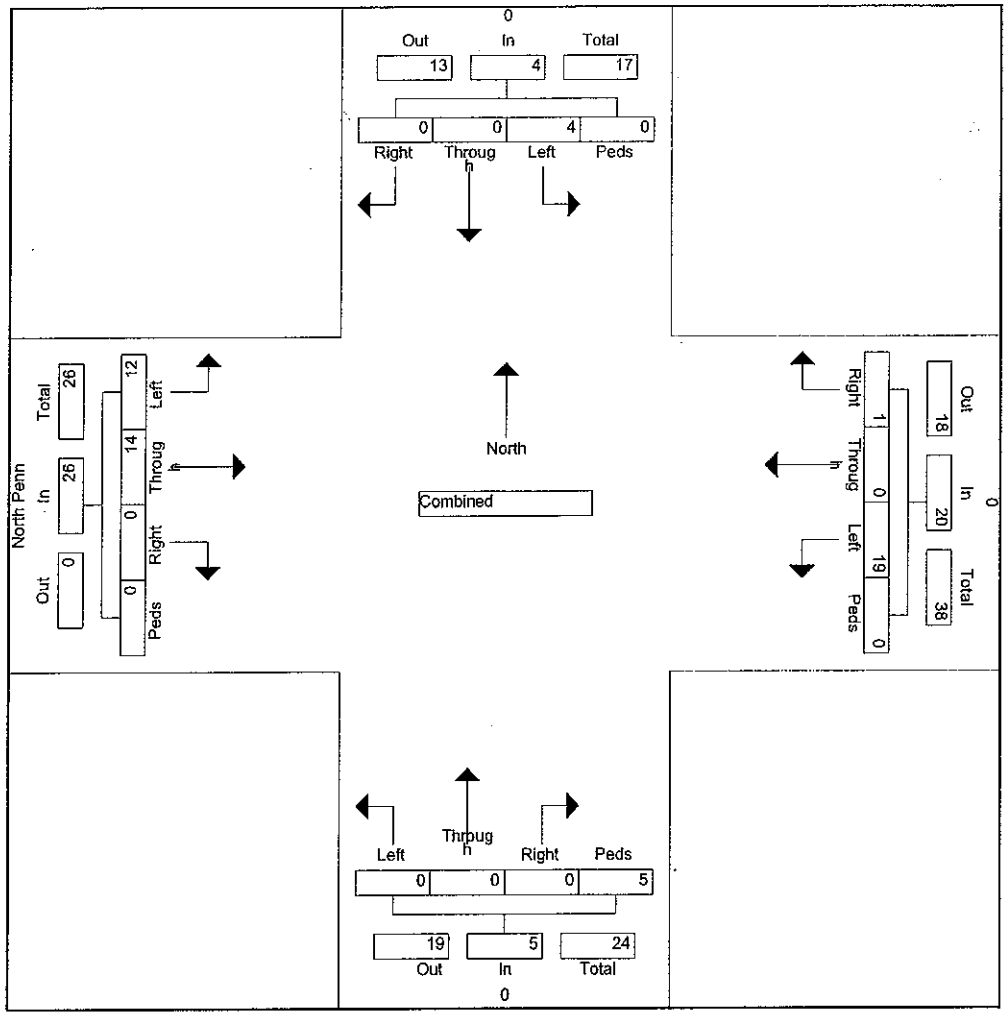
File Name : Spring Garden and Delaware Ave.
Site Code : 00000000
Start Date : 11/19/2005 Sat
Page : 2

	Delaware Ave. Southbound					Spring Garden Westbound					Delaware Ave. Northbound					Spring Garden Eastbound					
Start Time	Left	Thr oug h	Rig ht	Ped s	App. Total	Left	Thr oug h	Rig ht	Ped s	App. Total	Left	Thr oug h	Rig ht	Ped s	App. Total	Left	Thr oug h	Rig ht	Ped s	App. Total	Int. Total
Peak Hour From 16:00 to 19:00 - Peak 1 of 1																					
Intersection	16:15																				
Volume	3	307	133	8	451	0	0	0	0	0	349	519	0	8	876	240	0	359	7	606	1933
Percent	0.7	68.1	29.5	1.8		0.0	0.0	0.0	0.0		39.8	59.2	0.0	0.9		39.6	0.0	59.2	1.2		
High Int.	17:00					3:45:00 PM					16:15					16:15					17:00
Volume	2	94	37	6	132	0	0	0	0	0	92	140	0	4	232	71	0	103	7	163	517
Peak Factor					0.854										0.944					0.929	0.935



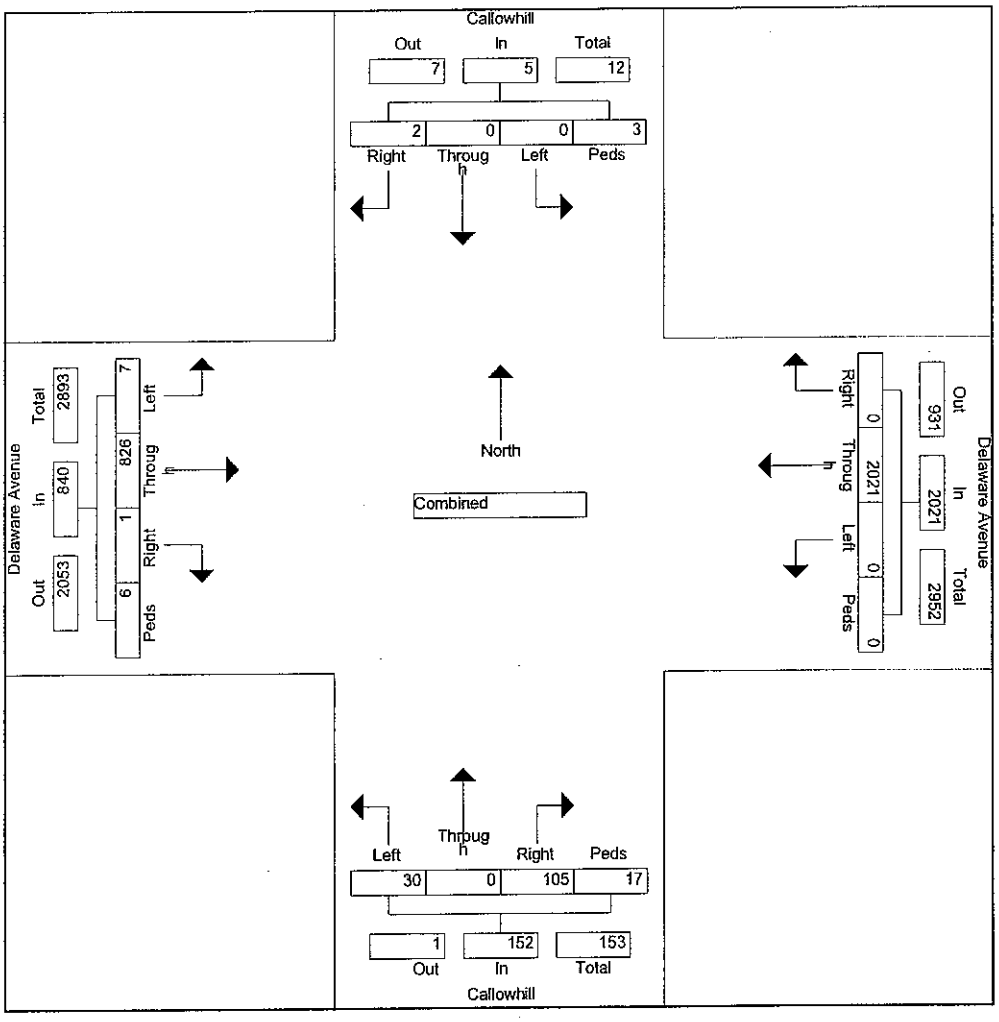
File Name : Delaware and North Penn
Site Code : 00000000
Start Date : 12/08/2005 Thu
Page : 2

	0 Southbound					0 Westbound					0 Northbound					North Penn Eastbound					
Start Time	Left from Delaware onto N. Penn	Through	Right	Peds	App. Total	Left from N. Penn To Delaware	Through	Right from N. Penn To Delaware	Peds	App. Total	Left	Through	Right from Delaware onto N. Penn	Peds	App. Total	Left	Through	Right	Peds	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																					
Intersection	17:00																				
Volume	4	0	0	0	4	19	0	1	0	20	0	0	0	5	5	12	14	0	0	26	55
Percent	100.0	0.0	0.0	0.0		95.0	0.0	5.0	0.0		0.0	0.0	0.0	100.0		46.2	53.8	0.0	0.0		
High Int.	17:45					17:00					17:15					17:15					17:15
Volume	3	0	0	0	3	6	0	1	0	6	0	0	0	2	2	5	6	0	0	9	18
Peak Factor					0.333					0.833					0.625					0.722	0.764



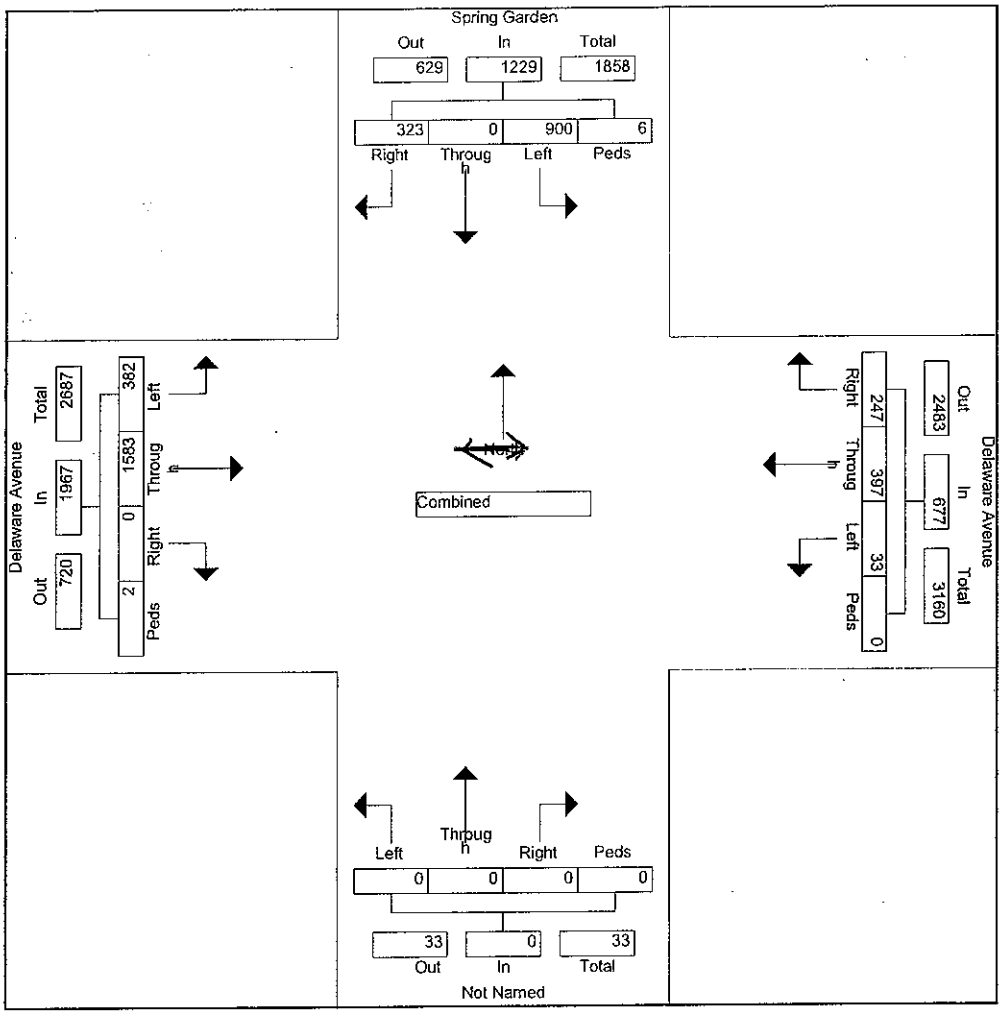
File Name : Delaware and Callowhill
Site Code : 00000000
Start Date : 12/08/2005 Thur
Page : 2

	Callowhill Southbound					Delaware Avenue Westbound					Callowhill Northbound					Delaware Avenue Eastbound					
Start Time	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																					
Intersection	16:15																				
Volume	0	0	2	3	5	0	2021	0	0	2021	30	0	105	17	152	7	826	1	6	840	3018
Percent	0.0	0.0	40.0	60.0		0.0	100.0	0.0	0.0		19.7	0.0	69.1	11.2		0.8	98.3	0.1	0.7		
High Int.	16:15					16:15					16:45					17:00					16:15
Volume	0	0	2	3	3	0	564	0	0	564	10	0	28	11	49	7	233	1	2	243	797
Peak Factor					0.417					0.896					0.776					0.864	0.947



File Name : Delaware and Spring Garden
Site Code : 00007686
Start Date : 12/08/2005 Thu
Page : 2

	Spring Garden Southbound					Delaware Avenue Westbound					Northbound					Delaware Avenue Eastbound					
Start Time	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Int. Total
Peak Hour From 16:00 to 17:45 - Peak 1 of 1																					
Intersection	16:00																				
Volume	900	0	323	6	1229	33	397	247	0	677	0	0	0	0	0	382	1583	0	2	1967	3873
Percent	73.2	0.0	26.3	0.5		4.9	58.6	36.5	0.0		0.0	0.0	0.0	0.0		19.4	80.5	0.0	0.1		
High Int.	16:45					16:15					3:45:00 PM					16:30					16:45
Volume	254	0	92	6	325	20	106	86	0	184	0	0	0	0	0	106	430	0	2	536	1022
Peak Factor					0.945					0.920										0.917	0.947



APPENDIX B

LEVEL OF SERVICE DEFINITIONS

LEVEL OF SERVICE

Level of Service is a term used to describe vehicle operator satisfaction with the driving experience. Research has determined that operator satisfaction is based primarily on travel speed and delay. In urban environments these factors, travel speed and delay, are primarily controlled by the operation of intersections.

By utilizing models to simulate the flow of traffic at intersections, the average delay experienced by vehicles can be estimated. These models consider such factors as traffic volumes, roadway geometry, traffic control, and driver behavior. Levels of Service designations based on a comparison of the average delays calculated by the models with perceived acceptable delays.

The following tables illustrate the guidelines used for designating Levels of Service at Intersections:

Level of Service Criteria
for Signalized Intersections[1]

Level of Service	Control Delay (seconds per vehicle)
A	< 10
B	> 10 and ≤ 20
C	> 20 and ≤ 35
D	> 35 and ≤ 55
E	> 55 and ≤ 80
F	> 80

[1] Table 6-3, Level of Service from Control Delay (2000 HCM)

Level of Service Criteria
for Unsignalized Intersections[2]

Level of Service	Intersection Delay (seconds per vehicle)
a	< 10
b	> 10 and ≤ 15
c	> 15 and ≤ 25
d	> 25 and ≤ 35
e	> 35 and ≤ 40
f	> 50

[1] Table 6-4, Level of Service Criteria for TWSC and AWSC intersections (2000 HCM)

APPENDIX C

EXISTING CONDITIONS LEVEL OF SERVICE ANALYSES

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.91	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		5085	5085	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		5085	5085	
Volume (vph)	30	105	0	2021	826	0
Peak-hour factor, PHF	0.78	0.78	0.90	0.90	0.86	0.86
Adj. Flow (vph)	38	135	0	2246	960	0
RTOR Reduction (vph)	0	121	0	0	0	0
Lane Group Flow (vph)	38	14	0	2246	960	0
Turn Type		custom				
Protected Phases	4	4		2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	7.6	7.6		71.4	71.4	
Effective Green, g (s)	9.6	9.6		72.4	72.4	
Actuated g/C Ratio	0.11	0.11		0.80	0.80	
Clearance Time (s)	6.0	6.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	189	169		4091	4091	
v/s Ratio Prot	c0.02	0.01		c0.44	0.19	
v/s Ratio Perm						
v/c Ratio	0.20	0.09		0.55	0.23	
Uniform Delay, d1	36.7	36.2		3.1	2.1	
Progression Factor	1.00	1.00		1.00	2.08	
Incremental Delay, d2	0.5	0.2		0.5	0.1	
Delay (s)	37.2	36.5		3.6	4.5	
Level of Service	D	D		A	A	
Approach Delay (s)	36.6			3.6	4.5	
Approach LOS	D			A	A	

Intersection Summary			
HCM Average Control Delay	5.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	49.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97		1.00				1.00	0.91		1.00	0.91	
Frt	1.00		0.85				1.00	1.00		1.00	0.94	
Flt Protected	0.95		1.00				0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433		1583				1770	5085		1770	4793	
Flt Permitted	0.95		1.00				0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433		1583				1770	5085		1770	4793	
Volume (vph)	900	0	323	0	0	0	382	1583	0	33	397	247
Peak-hour factor, PHF	0.95	0.95	0.95	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	947	0	340	0	0	0	415	1721	0	36	432	268
RTOR Reduction (vph)	0	0	128	0	0	0	0	0	0	0	125	0
Lane Group Flow (vph)	947	0	212	0	0	0	415	1721	0	36	575	0
Turn Type	custom		custom				Prot			Prot		
Protected Phases			4 5				5	2		1	6	
Permitted Phases	4											
Actuated Green, G (s)	17.0		37.0				13.0	47.1		4.9	39.0	
Effective Green, g (s)	20.0		40.0				16.0	50.1		7.9	42.0	
Actuated g/C Ratio	0.22		0.44				0.18	0.56		0.09	0.47	
Clearance Time (s)	7.0						7.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0						3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	763		704				315	2831		155	2237	
v/s Ratio Prot			0.13				c0.23	c0.34		0.02	0.12	
v/s Ratio Perm	c0.28											
v/c Ratio	1.24		0.30				1.32	0.61		0.23	0.26	
Uniform Delay, d1	35.0		16.0				37.0	13.4		38.2	14.5	
Progression Factor	1.00		1.00				1.05	0.77		0.98	0.96	
Incremental Delay, d2	119.5		0.2				160.7	0.8		0.8	0.3	
Delay (s)	154.5		16.3				199.7	11.2		38.1	14.3	
Level of Service	F		B				F	B		D	B	
Approach Delay (s)		118.0			0.0			47.8			15.4	
Approach LOS		F			A			D			B	

Intersection Summary			
HCM Average Control Delay	63.8	HCM Level of Service	E
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	70.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations	↑↑↑		↰	↑↑↑	↰	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frt	1.00		1.00	1.00	0.99	
Flt Protected	1.00		0.95	1.00	0.95	
Satd. Flow (prot)	5085		1770	5085	1767	
Flt Permitted	1.00		0.05	1.00	0.95	
Satd. Flow (perm)	5085		97	5085	1767	
Volume (vph)	2483	0	4	658	19	1
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2699	0	4	715	21	1
RTOR Reduction (vph)	0	0	0	0	1	0
Lane Group Flow (vph)	2699	0	4	715	21	0
Turn Type			Perm			
Protected Phases	2			6	8	
Permitted Phases			6			
Actuated Green, G (s)	75.9		75.9	75.9	3.1	
Effective Green, g (s)	76.9		76.9	76.9	5.1	
Actuated g/C Ratio	0.85		0.85	0.85	0.06	
Clearance Time (s)	5.0		5.0	5.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	4345		83	4345	100	
v/s Ratio Prot	c0.53			0.14	c0.01	
v/s Ratio Perm			0.04			
v/c Ratio	0.62		0.05	0.16	0.21	
Uniform Delay, d1	2.0		1.0	1.1	40.5	
Progression Factor	0.07		1.00	1.00	1.00	
Incremental Delay, d2	0.4		1.1	0.1	1.1	
Delay (s)	0.5		2.1	1.2	41.6	
Level of Service	A		A	A	D	
Approach Delay (s)	0.5			1.2	41.6	
Approach LOS	A			A	D	

Intersection Summary			
HCM Average Control Delay	0.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	58.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.91	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		5085	5085	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		5085	5085	
Volume (vph)	11	63	0	911	739	0
Peak-hour factor, PHF	0.82	0.82	0.90	0.90	0.92	0.92
Adj. Flow (vph)	13	77	0	1012	803	0
RTOR Reduction (vph)	0	70	0	0	0	0
Lane Group Flow (vph)	13	7	0	1012	803	0
Turn Type		custom				
Protected Phases	4	4		2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	5.6	5.6		73.4	73.4	
Effective Green, g (s)	7.6	7.6		74.4	74.4	
Actuated g/C Ratio	0.08	0.08		0.83	0.83	
Clearance Time (s)	6.0	6.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	149	134		4204	4204	
v/s Ratio Prot	c0.01	0.00		c0.20	0.16	
v/s Ratio Perm						
v/c Ratio	0.09	0.05		0.24	0.19	
Uniform Delay, d1	38.0	37.9		1.7	1.6	
Progression Factor	1.00	1.00		1.00	2.21	
Incremental Delay, d2	0.3	0.2		0.1	0.1	
Delay (s)	38.3	38.0		1.8	3.6	
Level of Service	D	D		A	A	
Approach Delay (s)	38.1			1.8	3.6	
Approach LOS	D			A	A	

Intersection Summary			
HCM Average Control Delay	4.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.23		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	27.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97		1.00				1.00	0.91		1.00	0.91	
Frt	1.00		0.85				1.00	1.00		1.00	0.95	
Flt Protected	0.95		1.00				0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433		1583				1770	5085		1770	4854	
Flt Permitted	0.95		1.00				0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433		1583				1770	5085		1770	4854	
Volume (vph)	240	0	359	0	0	0	349	519	0	3	307	133
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	261	0	390	0	0	0	379	564	0	3	334	145
RTOR Reduction (vph)	0	0	217	0	0	0	0	0	0	0	77	0
Lane Group Flow (vph)	261	0	173	0	0	0	379	564	0	3	402	0
Turn Type	custom		custom				Prot			Prot		
Protected Phases			4 5				5	2		1	6	
Permitted Phases	4											
Actuated Green, G (s)	12.6		37.0				17.4	55.2		1.2	39.0	
Effective Green, g (s)	15.6		40.0				20.4	58.2		4.2	42.0	
Actuated g/C Ratio	0.17		0.44				0.23	0.65		0.05	0.47	
Clearance Time (s)	7.0						7.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0						3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	595		704				401	3288		83	2265	
v/s Ratio Prot			0.11				c0.21	c0.11		0.00	0.08	
v/s Ratio Perm	c0.08											
v/c Ratio	0.44		0.25				0.95	0.17		0.04	0.18	
Uniform Delay, d1	33.3		15.6				34.2	6.3		41.0	14.0	
Progression Factor	1.00		1.00				0.94	0.82		0.97	0.93	
Incremental Delay, d2	0.5		0.2				30.7	0.1		0.2	0.2	
Delay (s)	33.8		15.8				63.0	5.3		39.7	13.1	
Level of Service	C		B				E	A		D	B	
Approach Delay (s)		23.0			0.0			28.5			13.3	
Approach LOS		C			A			C			B	

Intersection Summary			
HCM Average Control Delay	23.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations	↑↑↑		↰	↑↑↑	↰	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frt	1.00		1.00	1.00	0.98	
Flt Protected	1.00		0.95	1.00	0.96	
Satd. Flow (prot)	5085		1770	5085	1747	
Flt Permitted	1.00		0.33	1.00	0.96	
Satd. Flow (perm)	5085		613	5085	1747	
Volume (vph)	759	0	9	413	30	6
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	825	0	10	449	33	7
RTOR Reduction (vph)	0	0	0	0	6	0
Lane Group Flow (vph)	825	0	10	449	34	0
Turn Type			Perm			
Protected Phases	2			6	8	
Permitted Phases			6			
Actuated Green, G (s)	74.1		74.1	74.1	4.9	
Effective Green, g (s)	75.1		75.1	75.1	6.9	
Actuated g/C Ratio	0.83		0.83	0.83	0.08	
Clearance Time (s)	5.0		5.0	5.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	4243		512	4243	134	
v/s Ratio Prot	c0.16			0.09	c0.02	
v/s Ratio Perm			0.02			
v/c Ratio	0.19		0.02	0.11	0.25	
Uniform Delay, d1	1.5		1.3	1.4	39.1	
Progression Factor	1.12		1.00	1.00	1.00	
Incremental Delay, d2	0.1		0.1	0.1	1.0	
Delay (s)	1.7		1.3	1.4	40.1	
Level of Service	A		A	A	D	
Approach Delay (s)	1.7			1.4	40.1	
Approach LOS	A			A	D	

Intersection Summary			
HCM Average Control Delay	2.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.20		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	24.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX D

TRIP GENERATION AND FUTURE VOLUME WORKSHEETS

Trip Generation Calculations
Casino at Old Incinerator Site

0.358 trips per gaming position during the **weekday evening** peak hour (52% entering and 48% exiting); and
0.477 trips per gaming position during the **Saturday evening** peak hour (53% entering and 47% exiting)

Land Use	Size	Weekday	PM	Enter	Exit	Saturday	Sat Evening	Enter	Exit
			Rate[1]/ Daily Ratio[2]	7.8%	7%		Rate[1]/ Daily Ratio[2]	7.8%	6.9%
Casino	3,000	gaming positior	0.358	52%	48%		0.477	53%	47%
	rate	**14,525.00**	**1,074**	558	516	**19,472.00**	**1,431**	758	673
				7,153.85	7,371.43			9,717.95	9,753.62
			Daily Driveway Volume (Weekday) =		**14,525**		Daily Driveway Volume (Saturday) =		**19,472**

Land Use	Size	Weekday	PM	Enter	Exit	Saturday	Sat Evening	Enter	Exit
			Rate[1]/ Daily Ratio[2]	7.8%	7%		Rate[1]/ Daily Ratio[2]	7.8%	6.9%
Casino	2,000	gaming positior	0.358	52%	48%		0.477	53%	47%
	rate	**9,684.00**	**716**	372	*344*	**12,980.00**	**954**	506	448
				4,769.23	4,914.29			6,487.18	6,492.75
			Daily Driveway Volume (Weekday) =		**9,684**		Daily Driveway Volume (Saturday) =		**12,980**

Land Use	Size	Weekday	PM	Enter	Exit	Saturday	Sat Evening	Enter	Exit
			Rate[1]/ Daily Ratio[2]	7.8%	7%		Rate[1]/ Daily Ratio[2]	7.8%	6.9%
Casino	5,000	gaming positior	0.358	52%	48%		0.477	53%	47%
	rate	**24,207.00**	**1,790**	931	*859*	**32,452.00**	**2,385**	1,264	1,121
				11,935.90	12,271.43			16,205.13	16,246.38
			Daily Driveway Volume (Weekday) =		**24,207**		Daily Driveway Volume (Saturday) =		**32,452**

Total Generated Traffic (After Reduction due to Modal Split) = ***80%***

No. of Units	Weekday Evening Peak Hour	Weekday Daily	Sat. Evening Peak Hour	Saturday Daily
3,000	**859**	**11,620**	**1,145**	**15,578**
2,000	**573**	**7,747**	**763**	**10,384**
5,000	**1,432**	**19,366**	**1,908**	**25,962**

[1] PM Rate based on traffic count data at the Delaware Park Facility, Delaware

[2] Daily Ratio based on the Paul C. Box and William Bunte ITE Journal Article, Gaming Casino Traffic, March 1998: (Table 2)

		PM SATURDAY 2005 Existing	2.1% Growth 2	Neighboring Condo Development Enter 68 Distrib	Exit 37 Assign	PM SATURDAY 2007 Pre-Dev 2	Riverwalk Casino Enter 1,010 Distrib	Exit 900 Assign	PM SATURDAY 2007 Post-Dev
Callowhill	EB L	**11**				**11**	33%	333	**344**
Callowhill	EB T								
Callowhill	EB R	**63**	3			**66**			**66**
Callowhill	WB L								
Callowhill	WB T								
Callowhill	WB R								
Delaware	NB L								
Delaware	NB T	**911**	38	75%	51	**1000**	29%	293	**1293**
Delaware	NB R								
Delaware	SB L								
Delaware	SB T	**739**	31	-25%	9	**779**	-15%	135	**914**
Delaware	SB R								
Spring Garden	EB L	**240**	10			**250**			**250**
Spring Garden	EB T						5%	51	**51**
Spring Garden	EB R	**359**	15			**374**	25%	253	**627**
Driveway 1	**WB L**						**-2%**	**18**	**18**
Driveway 1	**WB T**						**-6%**	**54**	**54**
Driveway 1	**WB R**						**-7%**	**63**	**63**
Delaware	NB L	**349**	15			**364**	-24%	216	**580**
Delaware	NB T	**519**	22	75%	51	**592**	-48%	432	**1024**
Delaware	NB R						9%	91	**91**
Delaware	SB L	**3**				**3**	1%	10	**13**
Delaware	SB T	**307**	13	-25%	9	**329**	9%	91	**420**
Delaware	SB R	**133**	6			**139**			**139**
Penn	EB L								
Penn	EB T								
Penn	EB R								
Penn	WB L	**30**	1	-25%	9	**40**			**40**
Penn	WB T								
Penn	WB R	**6**		-75%	28	**34**			**34**
Delaware	NB L								
Delaware	NB T	**759**	32			**791**	-55%	495	**1286**
Delaware	NB R	**2**		75%	51	**53**			**53**
Delaware	SB L	**9**		25%	17	**26**			**26**
Delaware	SB T	**413**	17			**430**	8%	81	**511**
Delaware	SB R								
Alley	EB L								
Alley	EB T								
Alley	EB R								
Driveway 2	**WB L**						**-13%**	**117**	**117**
Driveway 2	**WB T**								
Driveway 2	**WB R**						**-72%**	**648**	**648**
Delaware	NB L								
Delaware	*NB T*	***868***	*36*	*75%*	*51*	***955***	*9%*	*91*	***1695***
Delaware	NB R						51%	515	**515**
Delaware	SB L						34%	343	**343**
Delaware	*SB T*	***666***	*28*	*-25%*	*9*	***703***	*-2%*	*18*	***1065***
Delaware	SB R								

		PM WEEKDAY 2005 Existing	2.1% Growth 2	Neighboring Condo Development Enter 68 Distrib	Exit 37 Assign	PM WEEKDAY 2007 Pre-Dev 2	Riverwalk Casino Enter 740 Distrib	Exit 690 Assign	PM WEEKDAY 2007 Post-Dev
Callowhill	EB L	30	1			31	33%	244	275
Callowhill	EB T								
Callowhill	EB R	105	4			109			109
Callowhill	WB L								
Callowhill	WB T								
Callowhill	WB R								
Delaware	NB L								
Delaware	NB T	2021	85	75%	51	2157	29%	215	2372
Delaware	NB R								
Delaware	SB L								
Delaware	SB T	826	35	-25%	9	870	-15%	104	974
Delaware	SB R								
Spring Garden	EB L	900	38			938			938
Spring Garden	EB T						5%	37	37
Spring Garden	EB R	323	14			337	25%	185	522
Driveway 1	**WB L**						**-2%**	**14**	**14**
Driveway 1	**WB T**						**-6%**	**41**	**41**
Driveway 1	**WB R**						**-7%**	**48**	**48**
Delaware	NB L	382	16			398	-24%	166	564
Delaware	NB T	1583	66	75%	51	1700	-48%	331	2031
Delaware	NB R						9%	67	67
Delaware	SB L	33	1			34	1%	7	41
Delaware	SB T	397	17	-25%	9	423	9%	67	490
Delaware	SB R	247	10			257			257
Penn	EB L								
Penn	EB T								
Penn	EB R								
Penn	WB L	19	1	-25%	9	29			29
Penn	WB T								
Penn	WB R	1		-75%	28	29			29
Delaware	NB L								
Delaware	NB T	2483	104			2587	-55%	380	2967
Delaware	NB R			75%	51	51			51
Delaware	SB L	4		25%	17	21			21
Delaware	SB T	658	28			686	8%	59	745
Delaware	SB R								
Alley	EB L								
Alley	EB T								
Alley	EB R								
Driveway 2	**WB L**						**-13%**	**90**	90
Driveway 2	**WB T**								
Driveway 2	**WB R**						**-72%**	**497**	**497**
Delaware	NB L								
Delaware	*NB T*	***1965***	*83*	*75%*	*51*	***2099***	*9%*	*67*	***2662***
Delaware	NB R						51%	377	377
Delaware	SB L						34%	252	252
Delaware	*SB T*	***720***	*30*	*-25%*	*9*	***759***	*-2%*	*14*	***1026***
Delaware	SB R								

Gaming Casino Traffic

THE AUTHORS SUMMARIZE RESULTS FROM TRAFFIC VOLUME STUDIES OF TWO GAMING CASINOS—THE CASINO ST. CHARLES AND THE CASINO QUEEN.

BY PAUL C. BOX AND WILLIAM BUNTE

GAMING CASINOS GENERATE significant volumes of traffic—especially during the evening peak hour. Two studies of existing operations were made in the St. Louis, Mo., USA, metropolitan area, including hourly vehicular volumes and daily variations. Also, the projections from an economic report for a proposed casino were utilized to provide multiplication factors for traffic counted in any given month, to that expected during the peak summer months.

Gaming casinos have three general types of positions—individual, such as slots and video poker; table, such as blackjack and poker; and audience, such as Keno or racing. For riverboat type facilities, a land-side staging area is used. Other customary services include bar and restaurant.

The Casino St. Charles is located in the metropolitan area, west of the Missouri River. It is reported to have about 2,500 gaming positions, about 80 percent of which are slots or video poker machines.

In January 1995, counts of entering and leaving traffic were taken across weekdays, Saturday and Sunday.[1] For the peak hours, the counts were converted into rates of flow in and out of the facility per gaming position and were expanded to the summer peak conditions (see Table 1). The highest weekday traffic occurs on Friday, while the absolute peak hour occurs on Saturday evening.

From the counts, it also was possible to calculate the hourly variation by the days of the week during which counts

Table 1. Casino St. Charles peak hour rates of vehicular flow per gaming position.

Day	Hour*	Rate*
Thursday facility peak	18:00 to 19:00	
IN		0.25
OUT		0.23
Thursday street peak	16:30 to 17:30	
IN		0.19
OUT		0.23
Friday facility peak	18:00 to 19:00	
IN		0.29
OUT		0.25
Friday street peak	16:30 to 17:30	
IN		0.19
OUT		0.24
Saturday facility peak	18:00 to 19:00	
IN		0.34
OUT		0.30
Sunday facility peak		
IN	13:00 to 14:00	0.25
OUT	16:00 to 17:00	0.25

*Expanded to summer peaks.
Source: Ref. 1

were taken. These data are given in Table 2. It should be noted that the facility is quite busy from 09:00 through 22:00 hours. Unlike residential, office or industrial developments, gaming casinos have no significant AM peak hour loading.

A second study was taken at the Casino Queen, a land-based facility on the north side of the Mississippi River in East St. Louis, Ill., USA. Table 3 gives the rates of flow in the PM peak hour per gaming position for customer traffic and separately for employee/service vehicles. The counts have been expanded to peak summer month activity. Only one truck entered or left the casino during the PM peak, which was from 16:30 to 17:30. This is a much smaller facility than the Casino St. Charles, with only 1,200 gaming positions. About 80 percent are slots or video poker. Furthermore, this casino is only open 22 hours per day (09:00 through 07:00). Pickup/dropoff traffic also was observed at the Casino Queen, and amounted to about 10 vehicles during the PM peak. Data on various characteristics of the casinos, such as floor area and employees, are given in Table 4.

The peak gaming months are reported as May, July and August. These may be considered as the "design" condition. The percent of average months and the monthly variation in expected casino traffic, provided in the form of a multiplier for counts taken in a given month to those projected during the peak months, is given in Table 5. For example, a February count would be expanded by 30 percent (1.3 times the count) to reach peak month volumes. The data are taken from an economic study,[3] prepared in connection with a gaming facility zoning application to St. Louis County.

Additional studies of casino traffic are warranted because of widely varying characteristics. For example, the St. Louis casinos had similar rates of peak flow per gaming position. However, the St. Charles facility continued to experience significant flow and had a weekday peak just after the PM peak, while the Casino Queen traffic dropped abruptly at the end of the rush hour. The count was discontinued at this point, because

Table 2. Hourly variation by day of week.

Hour Begin	Percent of Daily Vehicular Traffic					
	IN			OUT		
	Weekday*	Sat.	Sun.	Weekday*	Sat.	Sun.
00	2.5	3.0	3.9	4.3	5.9	7.3
01	1.8	2.7	3.7	3.9	4.4	6.2
02	1.2	1.3	1.9	3.3	4.2	5.4
03	0.7	0.8	1.0	3.2	4.7	5.2
04	1.0	0.6	0.9	3.3	3.7	3.9
05	0.7	0.6	0.9	1.6	2.0	2.5
06	1.0	0.7	0.8	0.6	0.7	0.8
07	1.6	1.1	1.3	0.6	0.5	0.4
08	3.9	3.3	4.4	1.2	0.9	0.8
09	5.6	4.7	6.1	1.3	0.9	0.9
10	5.2	4.3	5.6	2.1	1.7	1.9
11	5.5	4.9	5.7	3.0	2.6	2.9
12	5.8	4.8	6.6	4.1	2.8	3.8
13	6.0	5.2	7.2	5.2	3.5	4.4
14	5.4	5.6	6.5	6.1	4.1	5.5
15	5.2	5.6	6.1	6.4	5.8	6.5
16	5.3	5.7	5.8	7.1	6.3	6.6
17	5.9	6.7	6.2	6.6	6.8	6.0
18	7.8	7.8	5.8	7.0	6.9	6.4
19	7.4	7.7	4.0	5.7	6.4	5.8
20	6.3	6.5	3.9	5.3	6.7	4.3
21	5.3	6.1	5.0	5.7	6.1	4.3
22	4.7	5.7	3.4	6.3	6.0	4.6
23	4.0	4.6	3.3	6.1	6.4	3.6

*Average Monday AM, Thursday PM plus Friday.
Source: Ref. 1.

Table 3. Evening peak hour Casino Queen vehicular traffic.

Type of Traffic	Rate per Gaming Position*	
	IN	OUT
Customer	0.27	0.26
Employee/Service	0.02	0.02
TOTAL	0.29	0.28

*Expanded to peak months per Ref. 3.
Source: Ref. 2.

Table 4. Site characteristics.

	St. Charles	Casino Queen
Floor area (gaming and staging), square feet*	47,000	65,000
Employees	—	1,200
Employees at peak time	700	450
Capacity (gamblers)	4,200	—
*Conversion: One square foot = 0.093 square meter.		

Table 5. Monthly variation.

Month of Count	Percent of Average Month	Multiplier to Expand to Seasonal Peak
January	111%	1.1
February	90%	1.3
March	111%	1.1
April	108%	1.1
May	116%	1.0
June	108%	1.1
July	121%	1.0
August	121%	1.0
September	113%	1.1
October	105%	1.2
November	98%	1.2
December	105%	1.2

Source: Ref. 3.

the scope of study was intended to analyze only the PM street peak hour generation.

The two sites studied have provided useful information on hourly and monthly variation. These data should guide studies of other sites. Separate counts of customer and employee vehicular traffic, plus trucks, should be taken on busy weekdays and perhaps on a Saturday evening, if a street capacity problem is likely. At some locations, large numbers of patrons may arrive by bus, which relates to geometric design of driveways.

Other studies of gaming facilities needed include parking generation, which represents a major factor. The development of gaming on Native American tribal lands is often away from or at the fringe of metropolitan areas. Traffic and parking characteristics of these facilities may differ from those

within a metropolitan area. Busing may represent a more significant factor—especially relative to parking layout. ■

References

1. *Traffic Impact Study for the Ultimate Development of St. Charles Riverfront Station,* Final Report. Crawford, Bunte, Brammeier, August 1995, unpublished.

2. *Study of Casino Queen.* Paul C. Box and Associates Inc., November 1996, unpublished.

3. *Horseshoe Gaming, St. Louis County Project.* Economics Research Associates, as presented to County Plan Commission about September 1996, unpublished.

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APPENDIX E

PRE-DEVELOPMENT CONDITIONS LEVEL OF SERVICE ANALYSES

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.91	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		5085	5085	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		5085	5085	
Volume (vph)	11	66	0	1000	779	0
Peak-hour factor, PHF	0.82	0.82	0.90	0.90	0.92	0.92
Adj. Flow (vph)	13	80	0	1111	847	0
RTOR Reduction (vph)	0	73	0	0	0	0
Lane Group Flow (vph)	13	7	0	1111	847	0
Turn Type		custom				
Protected Phases	4	4		2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	5.6	5.6		73.4	73.4	
Effective Green, g (s)	7.6	7.6		74.4	74.4	
Actuated g/C Ratio	0.08	0.08		0.83	0.83	
Clearance Time (s)	6.0	6.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	149	134		4204	4204	
v/s Ratio Prot	c0.01	0.00		c0.22	0.17	
v/s Ratio Perm						
v/c Ratio	0.09	0.05		0.26	0.20	
Uniform Delay, d1	38.0	37.9		1.7	1.6	
Progression Factor	1.00	1.00		1.00	2.30	
Incremental Delay, d2	0.3	0.2		0.2	0.1	
Delay (s)	38.3	38.0		1.9	3.8	
Level of Service	D	D		A	A	
Approach Delay (s)	38.1			1.9	3.8	
Approach LOS	D			A	A	

Intersection Summary			
HCM Average Control Delay	4.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	29.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97		1.00				1.00	0.91		1.00	0.91	
Frt	1.00		0.85				1.00	1.00		1.00	0.96	
Flt Protected	0.95		1.00				0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433		1583				1770	5085		1770	4858	
Flt Permitted	0.95		1.00				0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433		1583				1770	5085		1770	4858	
Volume (vph)	250	0	374	0	0	0	364	592	0	3	329	139
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.94	0.94	0.94	0.85	0.85	0.85
Adj. Flow (vph)	269	0	402	0	0	0	387	630	0	4	387	164
RTOR Reduction (vph)	0	0	208	0	0	0	0	0	0	0	85	0
Lane Group Flow (vph)	269	0	194	0	0	0	387	630	0	4	466	0
Turn Type	custom		custom				Prot			Prot		
Protected Phases			4 5				5	2		1	6	
Permitted Phases	4											
Actuated Green, G (s)	12.7		37.0				17.3	55.0		1.3	39.0	
Effective Green, g (s)	15.7		40.0				20.3	58.0		4.3	42.0	
Actuated g/C Ratio	0.17		0.44				0.23	0.64		0.05	0.47	
Clearance Time (s)	7.0						7.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0						3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	599		704				399	3277		85	2267	
v/s Ratio Prot			0.12				c0.22	0.12		0.00	c0.10	
v/s Ratio Perm	c0.08											
v/c Ratio	0.45		0.28				0.97	0.19		0.05	0.21	
Uniform Delay, d1	33.3		15.8				34.5	6.5		40.9	14.2	
Progression Factor	1.00		1.00				0.94	0.81		0.97	0.95	
Incremental Delay, d2	0.5		0.2				36.3	0.1		0.2	0.2	
Delay (s)	33.8		16.0				68.9	5.4		39.9	13.6	
Level of Service	C		B				E	A		D	B	
Approach Delay (s)		23.2			0.0			29.6			13.8	
Approach LOS		C			A			C			B	

Intersection Summary			
HCM Average Control Delay	23.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	46.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations	↑↑↑		↰	↑↑↑	↰	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frt	0.99		1.00	1.00	0.94	
Flt Protected	1.00		0.95	1.00	0.97	
Satd. Flow (prot)	5037		1770	5085	1701	
Flt Permitted	1.00		0.30	1.00	0.97	
Satd. Flow (perm)	5037		556	5085	1701	
Volume (vph)	791	53	26	430	40	34
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	860	58	28	467	43	37
RTOR Reduction (vph)	5	0	0	0	33	0
Lane Group Flow (vph)	913	0	28	467	47	0
Turn Type			Perm			
Protected Phases	2			6	8	
Permitted Phases			6			
Actuated Green, G (s)	72.2		72.2	72.2	6.8	
Effective Green, g (s)	73.2		73.2	73.2	8.8	
Actuated g/C Ratio	0.81		0.81	0.81	0.10	
Clearance Time (s)	5.0		5.0	5.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	4097		452	4136	166	
v/s Ratio Prot	c0.18			0.09	c0.03	
v/s Ratio Perm			0.05			
v/c Ratio	0.22		0.06	0.11	0.28	
Uniform Delay, d1	1.9		1.7	1.7	37.7	
Progression Factor	1.12		1.00	1.00	1.00	
Incremental Delay, d2	0.1		0.3	0.1	0.9	
Delay (s)	2.3		1.9	1.8	38.6	
Level of Service	A		A	A	D	
Approach Delay (s)	2.3			1.8	38.6	
Approach LOS	A			A	D	

Intersection Summary

HCM Average Control Delay	4.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.23		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	32.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Pre-Development Weekday Evening
1: Catlowhill St. & Delaware Avenue — HCM Signalized Intersection Capacity Analysis

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.91	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		5085	5085	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		5085	5085	
Volume (vph)	31	109	0	2157	870	0
Peak-hour factor, PHF	0.78	0.78	0.90	0.90	0.86	0.86
Adj. Flow (vph)	40	140	0	2397	1012	0
RTOR Reduction (vph)	0	125	0	0	0	0
Lane Group Flow (vph)	40	15	0	2397	1012	0
Turn Type		custom				
Protected Phases	4	4		2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	7.7	7.7		71.3	71.3	
Effective Green, g (s)	9.7	9.7		72.3	72.3	
Actuated g/C Ratio	0.11	0.11		0.80	0.80	
Clearance Time (s)	6.0	6.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	191	171		4085	4085	
v/s Ratio Prot	c0.02	0.01		c0.47	0.20	
v/s Ratio Perm						
v/c Ratio	0.21	0.09		0.59	0.25	
Uniform Delay, d1	36.6	36.2		3.3	2.2	
Progression Factor	1.00	1.00		1.00	1.99	
Incremental Delay, d2	0.5	0.2		0.6	0.1	
Delay (s)	37.2	36.4		3.9	4.5	
Level of Service	D	D		A	A	
Approach Delay (s)	36.6			3.9	4.5	
Approach LOS	D			A	A	

Intersection Summary			
HCM Average Control Delay	5.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Pre-Development Weekday Evening
2: Spring Garden St. & Delaware Avenue — HCM Signalized Intersection Capacity Analysis

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97		1.00				1.00	0.91		1.00	0.91	
Frt	1.00		0.85				1.00	1.00		1.00	0.94	
Flt Protected	0.95		1.00				0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433		1583				1770	5085		1770	4797	
Flt Permitted	0.95		1.00				0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433		1583				1770	5085		1770	4797	
Volume (vph)	938	0	337	0	0	0	398	1700	0	34	423	257
Peak-hour factor, PHF	0.95	0.95	0.95	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	987	0	355	0	0	0	433	1848	0	37	460	279
RTOR Reduction (vph)	0	0	128	0	0	0	0	0	0	0	121	0
Lane Group Flow (vph)	987	0	227	0	0	0	433	1848	0	37	618	0
Turn Type	custom		custom				Prot			Prot		
Protected Phases			4 5				5	2		1	6	
Permitted Phases	4											
Actuated Green, G (s)	17.0		37.0				13.0	47.0		5.0	39.0	
Effective Green, g (s)	20.0		40.0				16.0	50.0		8.0	42.0	
Actuated g/C Ratio	0.22		0.44				0.18	0.56		0.09	0.47	
Clearance Time (s)	7.0						7.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0						3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	763		704				315	2825		157	2239	
v/s Ratio Prot			0.14				c0.24	c0.36		0.02	0.13	
v/s Ratio Perm	c0.29											
v/c Ratio	1.29		0.32				1.37	0.65		0.24	0.28	
Uniform Delay, d1	35.0		16.2				37.0	14.0		38.2	14.7	
Progression Factor	1.00		1.00				1.08	0.76		0.95	0.95	
Incremental Delay, d2	141.8		0.3				184.3	1.0		0.8	0.3	
Delay (s)	176.8		16.5				224.2	11.7		37.1	14.3	
Level of Service	F		B				F	B		D	B	
Approach Delay (s)		134.4			0.0			52.0			15.3	
Approach LOS		F			A			D			B	

Intersection Summary			
HCM Average Control Delay	70.7	HCM Level of Service	E
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	72.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations	↑↑↑		↰	↑↑↑	↰	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frt	1.00		1.00	1.00	0.93	
Flt Protected	1.00		0.95	1.00	0.98	
Satd. Flow (prot)	5071		1770	5085	1695	
Flt Permitted	1.00		0.06	1.00	0.98	
Satd. Flow (perm)	5071		103	5085	1695	
Volume (vph)	2587	51	21	686	29	29
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2812	55	23	746	32	32
RTOR Reduction (vph)	1	0	0	0	3	0
Lane Group Flow (vph)	2866	0	23	746	61	0
Turn Type			Perm			
Protected Phases	2			6	8	
Permitted Phases			6			
Actuated Green, G (s)	71.6		71.6	71.6	7.4	
Effective Green, g (s)	72.6		72.6	72.6	9.4	
Actuated g/C Ratio	0.81		0.81	0.81	0.10	
Clearance Time (s)	5.0		5.0	5.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	4091		83	4102	177	
v/s Ratio Prot	c0.57			0.15	c0.04	
v/s Ratio Perm			0.22			
v/c Ratio	0.70		0.28	0.18	0.35	
Uniform Delay, d1	3.9		2.2	2.0	37.4	
Progression Factor	0.34		1.00	1.00	1.00	
Incremental Delay, d2	0.5		8.1	0.1	1.2	
Delay (s)	1.8		10.3	2.1	38.6	
Level of Service	A		B	A	D	
Approach Delay (s)	1.8			2.3	38.6	
Approach LOS	A			A	D	

Intersection Summary			
HCM Average Control Delay	2.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX F

POST-DEVELOPMENT CONDITIONS LEVEL OF SERVICE ANALYSES

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.91	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		5085	5085	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		5085	5085	
Volume (vph)	344	66	0	1293	914	0
Peak-hour factor, PHF	0.82	0.82	0.90	0.90	0.92	0.92
Adj. Flow (vph)	420	80	0	1437	993	0
RTOR Reduction (vph)	0	60	0	0	0	0
Lane Group Flow (vph)	420	20	0	1437	993	0
Turn Type		custom				
Protected Phases	4	4		2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	20.0	20.0		59.0	59.0	
Effective Green, g (s)	22.0	22.0		60.0	60.0	
Actuated g/C Ratio	0.24	0.24		0.67	0.67	
Clearance Time (s)	6.0	6.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	433	387		3390	3390	
v/s Ratio Prot	c0.24	0.01		c0.28	0.20	
v/s Ratio Perm						
v/c Ratio	0.97	0.05		0.42	0.29	
Uniform Delay, d1	33.7	26.0		7.0	6.2	
Progression Factor	1.00	1.00		1.00	1.14	
Incremental Delay, d2	35.0	0.1		0.4	0.2	
Delay (s)	68.7	26.1		7.4	7.3	
Level of Service	E	C		A	A	
Approach Delay (s)	61.9			7.4	7.3	
Approach LOS	E			A	A	

Intersection Summary			
HCM Average Control Delay	16.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	0.91		1.00	0.91	
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.99		1.00	0.96	
Flt Protected	0.95	1.00	1.00		0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583		1839	1583	1770	5023		1770	4895	
Flt Permitted	0.71	1.00	1.00		0.93	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1314	1863	1583		1730	1583	1770	5023		1770	4895	
Volume (vph)	250	51	627	18	54	63	580	1024	91	13	420	139
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.94	0.94	0.94	0.85	0.85	0.85
Adj. Flow (vph)	269	55	674	20	59	68	617	1089	97	15	494	164
RTOR Reduction (vph)	0	0	153	0	0	53	0	9	0	0	67	0
Lane Group Flow (vph)	269	55	521	0	79	15	617	1177	0	15	591	0
Turn Type	Perm		pt+ov	Perm		Perm	Prot			Prot		
Protected Phases		4	4 5		8		5	2		1	6	
Permitted Phases	4			8		8						
Actuated Green, G (s)	18.0	18.0	38.0		18.0	18.0	14.0	52.5		1.5	40.0	
Effective Green, g (s)	20.0	20.0	40.0		20.0	20.0	16.0	54.5		3.5	42.0	
Actuated g/C Ratio	0.22	0.22	0.44		0.22	0.22	0.18	0.61		0.04	0.47	
Clearance Time (s)	6.0	6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	292	414	704		384	352	315	3042		69	2284	
v/s Ratio Prot		0.03	0.33				c0.35	c0.23		0.01	0.12	
v/s Ratio Perm	c0.20				0.05	0.01						
v/c Ratio	0.92	0.13	0.74		0.21	0.04	1.96	0.39		0.22	0.26	
Uniform Delay, d1	34.2	28.1	20.7		28.5	27.5	37.0	9.1		41.9	14.6	
Progression Factor	1.00	1.00	1.00		1.00	1.00	0.93	0.65		0.97	0.96	
Incremental Delay, d2	32.7	0.1	4.2		0.3	0.1	436.5	0.2		1.6	0.3	
Delay (s)	66.9	28.2	24.9		28.8	27.5	470.9	6.1		42.0	14.2	
Level of Service	E	C	C		C	C	F	A		D	B	
Approach Delay (s)		36.4			28.2			165.1			14.8	
Approach LOS		D			C			F			B	

Intersection Summary			
HCM Average Control Delay	96.2	HCM Level of Service	F
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frt	0.99		1.00	1.00	0.94	
Flt Protected	1.00		0.95	1.00	0.97	
Satd. Flow (prot)	5055		1770	5085	1701	
Flt Permitted	1.00		0.16	1.00	0.97	
Satd. Flow (perm)	5055		303	5085	1701	
Volume (vph)	1286	53	26	511	40	34
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1398	58	28	555	43	37
RTOR Reduction (vph)	3	0	0	0	33	0
Lane Group Flow (vph)	1453	0	28	555	47	0
Turn Type			Perm			
Protected Phases	2			6	8	
Permitted Phases			6			
Actuated Green, G (s)	72.2		72.2	72.2	6.8	
Effective Green, g (s)	73.2		73.2	73.2	8.8	
Actuated g/C Ratio	0.81		0.81	0.81	0.10	
Clearance Time (s)	5.0		5.0	5.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	4111		246	4136	166	
v/s Ratio Prot	c0.29			0.11	c0.03	
v/s Ratio Perm			0.09			
v/c Ratio	0.35		0.11	0.13	0.28	
Uniform Delay, d1	2.2		1.7	1.8	37.7	
Progression Factor	1.57		1.00	1.00	1.00	
Incremental Delay, d2	0.2		0.9	0.1	0.9	
Delay (s)	3.7		2.7	1.8	38.6	
Level of Service	A		A	A	D	
Approach Delay (s)	3.7			1.9	38.6	
Approach LOS	A			A	D	

Intersection Summary			
HCM Average Control Delay	4.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	37.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.91	1.00	1.00	0.91	
Frt		0.94			1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.98			0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1718			1770	1583	1770	5085	1583	1770	5085	
Flt Permitted		0.89			0.75	1.00	0.23	1.00	1.00	0.10	1.00	
Satd. Flow (perm)		1570			1403	1583	433	5085	1583	184	5085	
Volume (vph)	3	1	3	117	0	648	3	1695	515	343	1065	1
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	1	3	127	0	704	3	1842	560	373	1158	1
RTOR Reduction (vph)	0	3	0	0	0	1	0	0	332	0	0	0
Lane Group Flow (vph)	0	5	0	0	127	703	3	1842	228	373	1159	0
Turn Type	Perm			Perm		pm+ov	Perm		Perm	pm+pt		
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		13.0			13.0	37.4	34.6	34.6	34.6	65.0	65.0	
Effective Green, g (s)		15.0			15.0	41.4	36.6	36.6	36.6	67.0	67.0	
Actuated g/C Ratio		0.17			0.17	0.46	0.41	0.41	0.41	0.74	0.74	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		262			234	799	176	2068	644	602	3786	
v/s Ratio Prot						c0.26		c0.36		0.18	0.23	
v/s Ratio Perm		0.00			0.09	0.19	0.01		0.14	0.28		
v/c Ratio		0.02			0.54	0.88	0.02	0.89	0.35	0.62	0.31	
Uniform Delay, d1		31.3			34.4	22.0	16.0	24.8	18.5	19.2	3.8	
Progression Factor		1.00			1.00	1.00	0.84	0.76	0.27	1.11	1.14	
Incremental Delay, d2		0.0			2.6	10.9	0.2	5.9	1.4	1.7	0.2	
Delay (s)		31.4			36.9	32.9	13.5	24.7	6.5	23.1	4.5	
Level of Service		C			D	C	B	C	A	C	A	
Approach Delay (s)		31.4			33.5			20.4			9.0	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM Average Control Delay	19.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Post-Development Weekday Evening without Improvements
1: Callowhill St. & Delaware Avenue — HCM Signalized Intersection Capacity Analysis

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.91	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		5085	5085	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		5085	5085	
Volume (vph)	275	109	0	2372	974	0
Peak-hour factor, PHF	0.78	0.78	0.90	0.90	0.86	0.86
Adj. Flow (vph)	353	140	0	2636	1133	0
RTOR Reduction (vph)	0	88	0	0	0	0
Lane Group Flow (vph)	353	52	0	2636	1133	0
Turn Type		custom				
Protected Phases	4	4		2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	19.2	19.2		59.8	59.8	
Effective Green, g (s)	21.2	21.2		60.8	60.8	
Actuated g/C Ratio	0.24	0.24		0.68	0.68	
Clearance Time (s)	6.0	6.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	417	373		3435	3435	
v/s Ratio Prot	c0.20	0.03		c0.52	0.22	
v/s Ratio Perm						
v/c Ratio	0.85	0.14		0.77	0.33	
Uniform Delay, d1	32.8	27.2		9.8	6.1	
Progression Factor	1.00	1.00		1.00	1.07	
Incremental Delay, d2	14.6	0.2		1.7	0.3	
Delay (s)	47.5	27.4		11.5	6.8	
Level of Service	D	C		B	A	
Approach Delay (s)	41.8			11.5	6.8	
Approach LOS	D			B	A	

Intersection Summary			
HCM Average Control Delay	13.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Post-Development Weekday Evening without Improvements
2: Spring Garden St. & Delaware Avenue — HCM Signalized Intersection Capacity Analysis

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	0.91		1.00	0.91	
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	0.95	
Flt Protected	0.95	1.00	1.00		0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583		1840	1583	1770	5061		1770	4823	
Flt Permitted	0.72	1.00	1.00		0.94	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1342	1863	1583		1750	1583	1770	5061		1770	4823	
Volume (vph)	938	37	522	14	41	48	564	2031	67	41	491	257
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	957	38	533	14	42	49	576	2072	68	42	501	262
RTOR Reduction (vph)	0	0	150	0	0	38	0	3	0	0	105	0
Lane Group Flow (vph)	957	38	383	0	56	11	576	2137	0	42	658	0
Turn Type	Perm		pt+ov	Perm		Perm	Prot			Prot		
Protected Phases		4	4 5		8		5	2		1	6	
Permitted Phases	4			8		8						
Actuated Green, G (s)	18.0	18.0	38.0		18.0	18.0	14.0	48.9		5.1	40.0	
Effective Green, g (s)	20.0	20.0	40.0		20.0	20.0	16.0	50.9		7.1	42.0	
Actuated g/C Ratio	0.22	0.22	0.44		0.22	0.22	0.18	0.57		0.08	0.47	
Clearance Time (s)	6.0	6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	298	414	704		389	352	315	2862		140	2251	
v/s Ratio Prot		0.02	0.24				c0.33	c0.42		0.02	0.14	
v/s Ratio Perm	c0.71				0.03	0.01						
v/c Ratio	3.21	0.09	0.54		0.14	0.03	1.83	0.75		0.30	0.29	
Uniform Delay, d1	35.0	27.8	18.3		28.1	27.4	37.0	14.7		39.1	14.8	
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.08	0.75		0.95	0.95	
Incremental Delay, d2	1003.8	0.1	0.9		0.2	0.0	374.0	0.2		1.2	0.3	
Delay (s)	1038.8	27.9	19.2		28.3	27.4	413.9	11.3		38.2	14.4	
Level of Service	F	C	B		C	C	F	B		D	B	
Approach Delay (s)		658.0			27.9			96.7			15.7	
Approach LOS		F			C			F			B	

Intersection Summary			
HCM Average Control Delay	249.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.55		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	115.1%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frt	1.00		1.00	1.00	0.93	
Flt Protected	1.00		0.95	1.00	0.98	
Satd. Flow (prot)	5073		1770	5085	1695	
Flt Permitted	1.00		0.06	1.00	0.98	
Satd. Flow (perm)	5073		103	5085	1695	
Volume (vph)	2967	51	21	745	29	29
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3225	55	23	810	32	32
RTOR Reduction (vph)	1	0	0	0	1	0
Lane Group Flow (vph)	3279	0	23	810	63	0
Turn Type			Perm			
Protected Phases	2			6	8	
Permitted Phases			6			
Actuated Green, G (s)	71.6		71.6	71.6	7.4	
Effective Green, g (s)	72.6		72.6	72.6	9.4	
Actuated g/C Ratio	0.81		0.81	0.81	0.10	
Clearance Time (s)	5.0		5.0	5.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	4092		83	4102	177	
v/s Ratio Prot	c0.65			0.16	c0.04	
v/s Ratio Perm			0.22			
v/c Ratio	0.80		0.28	0.20	0.36	
Uniform Delay, d1	4.8		2.2	2.0	37.5	
Progression Factor	0.49		1.00	1.00	1.00	
Incremental Delay, d2	0.2		8.1	0.1	1.2	
Delay (s)	2.5		10.3	2.1	38.7	
Level of Service	A		B	A	D	
Approach Delay (s)	2.5			2.3	38.7	
Approach LOS	A			A	D	

Intersection Summary			
HCM Average Control Delay	3.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.91	1.00	1.00	0.91	
Frt		0.94			1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.98			0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1718			1775	1583	1770	5085	1583	1770	5083	
Flt Permitted		0.89			0.72	1.00	0.24	1.00	1.00	0.08	1.00	
Satd. Flow (perm)		1556			1348	1583	452	5085	1583	144	5083	
Volume (vph)	3	1	3	90	1	497	3	2662	377	252	1026	3
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	1	3	98	1	540	3	2893	410	274	1115	3
RTOR Reduction (vph)	0	3	0	0	0	1	0	0	175	0	0	0
Lane Group Flow (vph)	0	4	0	0	99	539	3	2893	235	274	1118	0
Turn Type	Perm			Perm		pm+ov	Perm		Perm	pm+pt		
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		10.4			10.4	26.2	45.8	45.8	45.8	67.6	67.6	
Effective Green, g (s)		12.4			12.4	30.2	47.8	47.8	47.8	69.6	69.6	
Actuated g/C Ratio		0.14			0.14	0.34	0.53	0.53	0.53	0.77	0.77	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		214			186	602	240	2701	841	433	3931	
v/s Ratio Prot						c0.18		c0.57		0.13	0.22	
v/s Ratio Perm		0.00			0.07	0.16	0.01		0.15	0.36		
v/c Ratio		0.02			0.53	0.90	0.01	1.07	0.28	0.63	0.28	
Uniform Delay, d1		33.5			36.1	28.4	10.0	21.1	11.6	34.3	3.0	
Progression Factor		1.00			1.00	1.00	1.13	0.79	1.47	1.03	1.10	
Incremental Delay, d2		0.0			2.9	15.8	0.1	37.9	0.6	2.9	0.2	
Delay (s)		33.6			39.0	44.3	11.4	54.6	17.6	38.2	3.4	
Level of Service		C			D	D	B	D	B	D	A	
Approach Delay (s)		33.6			43.4			50.0			10.3	
Approach LOS		C			D			D			B	

Intersection Summary			
HCM Average Control Delay	38.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	95.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX G

POST-DEVELOPMENT CONDITIONS ANALYSES AFTER IMPROVEMENTS

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.91	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		5085	5085	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		5085	5085	
Volume (vph)	275	109	0	2372	974	0
Peak-hour factor, PHF	0.78	0.78	0.90	0.90	0.86	0.86
Adj. Flow (vph)	353	140	0	2636	1133	0
RTOR Reduction (vph)	0	75	0	0	0	0
Lane Group Flow (vph)	353	65	0	2636	1133	0
Turn Type		custom				
Protected Phases	4	4		2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	25.6	25.6		73.4	73.4	
Effective Green, g (s)	27.6	27.6		74.4	74.4	
Actuated g/C Ratio	0.25	0.25		0.68	0.68	
Clearance Time (s)	6.0	6.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	444	397		3439	3439	
v/s Ratio Prot	c0.20	0.04		c0.52	0.22	
v/s Ratio Perm						
v/c Ratio	0.80	0.16		0.77	0.33	
Uniform Delay, d1	38.6	32.2		12.0	7.4	
Progression Factor	1.00	1.00		1.00	1.07	
Incremental Delay, d2	9.5	0.2		1.7	0.2	
Delay (s)	48.0	32.4		13.7	8.2	
Level of Service	D	C		B	A	
Approach Delay (s)	43.6			13.7	8.2	
Approach LOS	D			B	A	

Intersection Summary			
HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00	1.00		1.00	1.00	0.97	0.91		1.00	0.91	
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	0.95	
Flt Protected	0.95	1.00	1.00		0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	1863	1583		1840	1583	3433	5061		1770	4824	
Flt Permitted	0.95	1.00	1.00		0.90	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	1863	1583		1680	1583	3433	5061		1770	4824	
Volume (vph)	938	37	522	14	41	48	564	2031	67	41	491	257
Peak-hour factor, PHF	0.95	0.95	0.95	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	987	39	549	15	45	52	613	2208	73	45	534	279
RTOR Reduction (vph)	0	0	23	0	0	48	0	3	0	0	84	0
Lane Group Flow (vph)	987	39	526	0	60	4	613	2278	0	45	729	0
Turn Type	Prot		pt+ov	Perm		Perm	Prot			Prot		
Protected Phases	7	4	4 5		8		5	2		1	6	
Permitted Phases				8		8						
Actuated Green, G (s)	31.0	42.6	70.0		5.6	5.6	21.4	43.8		5.6	28.0	
Effective Green, g (s)	33.0	44.6	72.0		7.6	7.6	23.4	45.8		7.6	30.0	
Actuated g/C Ratio	0.30	0.41	0.65		0.07	0.07	0.21	0.42		0.07	0.27	
Clearance Time (s)	6.0	6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	1030	755	1036		116	109	730	2107		122	1316	
v/s Ratio Prot	c0.29	0.02	c0.33				c0.18	c0.45		0.03	0.15	
v/s Ratio Perm					0.04	0.00						
v/c Ratio	0.96	0.05	0.51		0.52	0.03	0.84	1.08		0.37	0.55	
Uniform Delay, d1	37.8	19.9	9.8		49.4	47.8	41.5	32.1		48.9	34.3	
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.17	0.63		1.00	0.96	
Incremental Delay, d2	18.6	0.0	0.4		3.9	0.1	0.8	37.5		1.9	1.7	
Delay (s)	56.4	19.9	10.2		53.3	47.9	49.2	57.8		50.6	34.6	
Level of Service	E	B	B		D	D	D	E		D	C	
Approach Delay (s)		39.4			50.8			56.0			35.4	
Approach LOS		D			D			E			D	

Intersection Summary			
HCM Average Control Delay	47.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	87.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations	↑↑↑		↰	↑↑↑	↰	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frt	1.00		1.00	1.00	0.99	
Flt Protected	1.00		0.95	1.00	0.95	
Satd. Flow (prot)	5085		1770	5085	1767	
Flt Permitted	1.00		0.04	1.00	0.95	
Satd. Flow (perm)	5085		77	5085	1767	
Volume (vph)	3018	0	4	754	20	1
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3280	0	4	820	22	1
RTOR Reduction (vph)	0	0	0	0	1	0
Lane Group Flow (vph)	3280	0	4	820	22	0
Turn Type			Perm			
Protected Phases	2			6	8	
Permitted Phases			6			
Actuated Green, G (s)	95.8		95.8	95.8	3.2	
Effective Green, g (s)	96.8		96.8	96.8	5.2	
Actuated g/C Ratio	0.88		0.88	0.88	0.05	
Clearance Time (s)	5.0		5.0	5.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	4475		68	4475	84	
v/s Ratio Prot	c0.64			0.16	c0.01	
v/s Ratio Perm			0.05			
v/c Ratio	0.73		0.06	0.18	0.26	
Uniform Delay, d1	2.2		0.8	0.9	50.6	
Progression Factor	1.07		1.00	1.00	1.00	
Incremental Delay, d2	0.3		1.6	0.1	1.7	
Delay (s)	2.7		2.5	1.0	52.2	
Level of Service	A		A	A	D	
Approach Delay (s)	2.7			1.0	52.2	
Approach LOS	A			A	D	

Intersection Summary			
HCM Average Control Delay	2.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↰	↱	↰	↑↑↑	↱	↰	↑↑↑	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.91	1.00	1.00	0.91	
Frt		0.94			1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.98			0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1718			1775	1583	1770	5085	1583	1770	5083	
Flt Permitted		0.90			0.72	1.00	0.24	1.00	1.00	0.06	1.00	
Satd. Flow (perm)		1575			1348	1583	452	5085	1583	116	5083	
Volume (vph)	3	1	3	90	1	497	3	2662	377	252	1026	3
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	1	3	98	1	540	3	2893	410	274	1115	3
RTOR Reduction (vph)	0	3	0	0	0	1	0	0	142	0	0	0
Lane Group Flow (vph)	0	4	0	0	99	539	3	2893	268	274	1118	0
Turn Type	Perm			Perm		pm+ov	Perm		Perm	pm+pt		
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		11.7			11.7	35.9	59.1	59.1	59.1	88.3	88.3	
Effective Green, g (s)		12.7			12.7	37.9	60.1	60.1	60.1	89.3	89.3	
Actuated g/C Ratio		0.12			0.12	0.34	0.55	0.55	0.55	0.81	0.81	
Clearance Time (s)		5.0			5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		182			156	603	247	2778	865	473	4126	
v/s Ratio Prot						c0.20		c0.57		0.13	0.22	
v/s Ratio Perm		0.00			0.07	0.14	0.01		0.17	0.34		
v/c Ratio		0.02			0.63	0.89	0.01	1.04	0.31	0.58	0.27	
Uniform Delay, d1		43.2			46.4	34.2	11.4	25.0	13.6	38.7	2.5	
Progression Factor		1.00			1.00	1.00	0.56	0.71	0.07	0.83	0.96	
Incremental Delay, d2		0.1			8.2	15.7	0.1	26.7	0.7	1.6	0.1	
Delay (s)		43.2			54.6	49.8	6.4	44.3	1.6	33.5	2.6	
Level of Service		D			D	D	A	D	A	C	A	
Approach Delay (s)		43.2			50.6			39.0			8.6	
Approach LOS		D			D			D			A	

Intersection Summary			
HCM Average Control Delay	32.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	95.5%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		0.91	0.91	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1770	1583		5085	5085	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	1770	1583		5085	5085	
Volume (vph)	344	66	0	1293	914	0
Peak-hour factor, PHF	0.82	0.82	0.90	0.90	0.92	0.92
Adj. Flow (vph)	420	80	0	1437	993	0
RTOR Reduction (vph)	0	44	0	0	0	0
Lane Group Flow (vph)	420	36	0	1437	993	0
Turn Type		custom				
Protected Phases	4	4		2	6	
Permitted Phases	4	4				
Actuated Green, G (s)	29.2	29.2		69.8	69.8	
Effective Green, g (s)	31.2	31.2		70.8	70.8	
Actuated g/C Ratio	0.28	0.28		0.64	0.64	
Clearance Time (s)	6.0	6.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	502	449		3273	3273	
v/s Ratio Prot	c0.24	0.02		c0.28	0.20	
v/s Ratio Perm						
v/c Ratio	0.84	0.08		0.44	0.30	
Uniform Delay, d1	37.0	28.9		9.7	8.7	
Progression Factor	1.00	1.00		1.00	0.90	
Incremental Delay, d2	11.6	0.1		0.4	0.2	
Delay (s)	48.6	28.9		10.2	8.0	
Level of Service	D	C		B	A	
Approach Delay (s)	45.4			10.2	8.0	
Approach LOS	D			B	A	

Intersection Summary			
HCM Average Control Delay	15.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00	1.00		1.00	1.00	0.97	0.91		1.00	0.91	
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.99		1.00	0.96	
Flt Protected	0.95	1.00	1.00		0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	1863	1583		1839	1583	3433	5023		1770	4895	
Flt Permitted	0.95	1.00	1.00		0.92	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	1863	1583		1711	1583	3433	5023		1770	4895	
Volume (vph)	250	51	627	18	54	63	580	1024	91	13	420	139
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.94	0.94	0.94	0.85	0.85	0.85
Adj. Flow (vph)	269	55	674	20	59	68	617	1089	97	15	494	164
RTOR Reduction (vph)	0	0	33	0	0	59	0	8	0	0	53	0
Lane Group Flow (vph)	269	55	641	0	79	9	617	1178	0	15	605	0
Turn Type	Prot		pt+ov	Perm		Perm	Prot			Prot		
Protected Phases	7	4	4 5		8		5	2		1	6	
Permitted Phases				8		8						
Actuated Green, G (s)	17.0	34.3	68.5		13.3	13.3	28.2	54.9		2.8	29.5	
Effective Green, g (s)	18.0	36.3	70.5		14.3	14.3	30.2	56.9		4.8	31.5	
Actuated g/C Ratio	0.16	0.33	0.64		0.13	0.13	0.27	0.52		0.04	0.29	
Clearance Time (s)	5.0	6.0			5.0	5.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	562	615	1015		222	206	943	2598		77	1402	
v/s Ratio Prot	0.08	0.03	c0.41				c0.18	c0.23		0.01	0.12	
v/s Ratio Perm					0.05	0.01						
v/c Ratio	0.48	0.09	0.63		0.36	0.04	0.65	0.45		0.19	0.43	
Uniform Delay, d1	41.7	25.4	11.9		43.6	41.9	35.3	16.7		50.7	32.0	
Progression Factor	1.00	1.00	1.00		1.00	1.00	0.64	0.78		1.04	0.96	
Incremental Delay, d2	0.6	0.1	1.3		1.0	0.1	0.9	0.3		1.2	1.0	
Delay (s)	42.4	25.5	13.2		44.6	41.9	23.4	13.3		54.2	31.6	
Level of Service	D	C	B		D	D	C	B		D	C	
Approach Delay (s)		21.8			43.4			16.7			32.1	
Approach LOS		C			D			B			C	

Intersection Summary			
HCM Average Control Delay	22.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	63.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations	↑↑↑		↰	↑↑↑	↰	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	4.0	4.0	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frt	1.00		1.00	1.00	0.98	
Flt Protected	1.00		0.95	1.00	0.96	
Satd. Flow (prot)	5085		1770	5085	1747	
Flt Permitted	1.00		0.17	1.00	0.96	
Satd. Flow (perm)	5085		310	5085	1747	
Volume (vph)	1337	0	9	520	31	6
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1453	0	10	565	34	7
RTOR Reduction (vph)	0	0	0	0	7	0
Lane Group Flow (vph)	1453	0	10	565	34	0
Turn Type			Perm			
Protected Phases	2			6	8	
Permitted Phases			6			
Actuated Green, G (s)	93.9		93.9	93.9	5.1	
Effective Green, g (s)	94.9		94.9	94.9	7.1	
Actuated g/C Ratio	0.86		0.86	0.86	0.06	
Clearance Time (s)	5.0		5.0	5.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	4387		267	4387	113	
v/s Ratio Prot	c0.29			0.11	c0.02	
v/s Ratio Perm			0.03			
v/c Ratio	0.33		0.04	0.13	0.30	
Uniform Delay, d1	1.5		1.1	1.2	49.1	
Progression Factor	0.12		1.00	1.00	1.00	
Incremental Delay, d2	0.2		0.3	0.1	1.5	
Delay (s)	0.4		1.3	1.2	50.6	
Level of Service	A		A	A	D	
Approach Delay (s)	0.4			1.2	50.6	
Approach LOS	A			A	D	

Intersection Summary			
HCM Average Control Delay	1.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	35.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↰	↱	↰	↑↑↑	↱	↰	↑↑↑	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.91	1.00	1.00	0.91	
Frt		0.94			1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.98			0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1718			1770	1583	1770	5085	1583	1770	5085	
Flt Permitted		0.90			0.75	1.00	0.23	1.00	1.00	0.07	1.00	
Satd. Flow (perm)		1587			1403	1583	433	5085	1583	135	5085	
Volume (vph)	3	1	3	117	0	648	3	1695	515	343	1065	1
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	1	3	127	0	704	3	1842	560	373	1158	1
RTOR Reduction (vph)	0	3	0	0	0	2	0	0	299	0	0	0
Lane Group Flow (vph)	0	4	0	0	127	702	3	1842	261	373	1159	0
Turn Type	Perm			Perm		pm+ov	Perm		Perm	pm+pt		
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		14.6			14.6	45.0	50.0	50.0	50.0	85.4	85.4	
Effective Green, g (s)		15.6			15.6	47.0	51.0	51.0	51.0	86.4	86.4	
Actuated g/C Ratio		0.14			0.14	0.43	0.46	0.46	0.46	0.79	0.79	
Clearance Time (s)		5.0			5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		225			199	734	201	2358	734	573	3994	
v/s Ratio Prot						c0.27		c0.36		0.19	0.23	
v/s Ratio Perm		0.00			0.09	0.17	0.01		0.16	0.32		
v/c Ratio		0.02			0.64	0.96	0.01	0.78	0.36	0.65	0.29	
Uniform Delay, d1		40.6			44.5	30.5	15.9	24.8	18.9	26.2	3.3	
Progression Factor		1.00			1.00	1.00	0.81	0.79	0.05	1.02	1.36	
Incremental Delay, d2		0.0			6.6	22.8	0.1	2.5	1.3	2.4	0.2	
Delay (s)		40.7			51.1	53.3	13.0	22.1	2.3	29.1	4.6	
Level of Service		D			D	D	B	C	A	C	A	
Approach Delay (s)		40.7			53.0			17.4			10.6	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM Average Control Delay	21.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group