

Traffic Impact Analysis

NASA Town Center Mixed Use Development
Nassau Bay, Texas

Prepared for



Prepared by

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November 2007

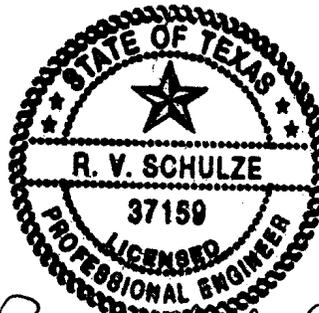
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R. V. Schulze

11/12/2007

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Introduction

Griffin Partners intends to develop a mixed-use project consisting of office, hotel, retail and residential land uses in Nassau Bay, Texas. The purpose of this study is to determine the potential impacts of the proposed development on the traffic in the surrounding area.

Existing Conditions

The study area is located to the south of NASA Road 1, east of Point Lookout Drive and west of Upper Bay Road in the City of Nassau Bay. It is in the immediate vicinity of Space Center Houston and NASA's Johnson Space Center.

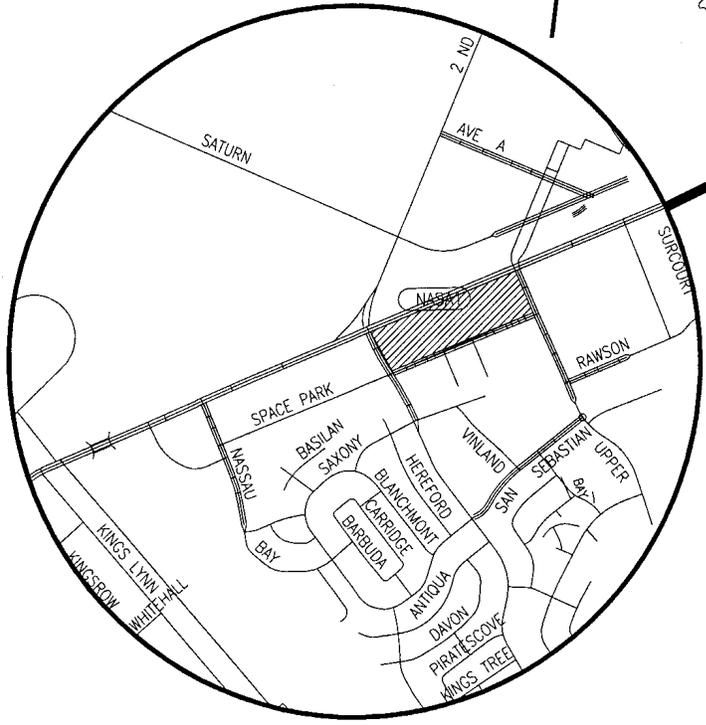
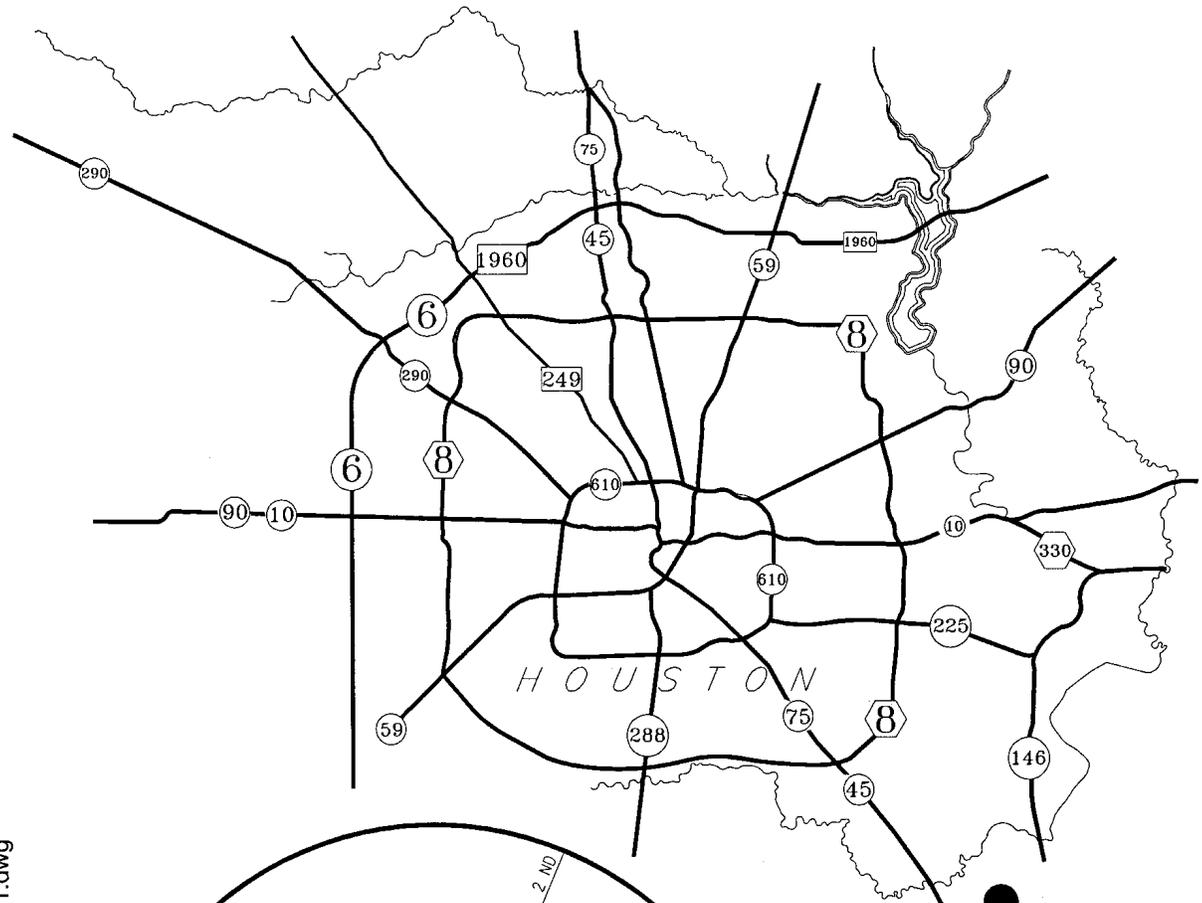
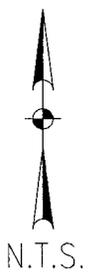
The site currently has twelve buildings, five of which are unoccupied. Out of the total leasable area of 437,406 square feet, only 42.9% is actually leased and is mainly occupied by real estate companies and IBM (1). Key streets providing access to the site are NASA Road 1, Point Lookout Drive, Upper Bay Road, Space Park Drive, and Saturn Lane. Following are the critical intersections considered as part of this study:

- NASA Road 1 at Point Lookout Drive
- NASA Road 1 at Saturn Lane
- NASA Road 1 at Upper Bay Road
- Point Lookout Drive at Space Park Drive
- Upper Bay Road at Space Park Drive

A site location map showing the general location of the study area with respect to major Houston area roadways is provided in **Figure 1**.

Area Roadways

Proposed development will affect the traffic conditions on NASA Road 1, Point Lookout Drive, Upper Bay Road, Saturn Lane, and Space Park Drive. These roadways are described in the following paragraphs.



SITE
LOCATION

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Sheet Title: **SITE LOCATION MAP**

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FIGURE 1

NASA Road 1 is the major thoroughfare in the study area running east-west. In the study area it intersects with Point Lookout Drive, Saturn Lane, and Upper Bay Road; and has four lanes in each direction separated by a median. Currently there are two driveways on NASA Road 1 entering the site.

Point Lookout Drive is a two-way street running north-south in the study area. It has two lanes in each direction separated by a median. It becomes Second Street on the north side of its intersection with NASA Road 1 and serves as an entrance and exit to Space Center Houston. Point Lookout Drive intersects with Space Park Drive on the south side of its intersection with NASA Road 1.

Saturn Lane is a two-way street traveling north-south in the study area that runs from NASA Road 1 to Ramada Drive.

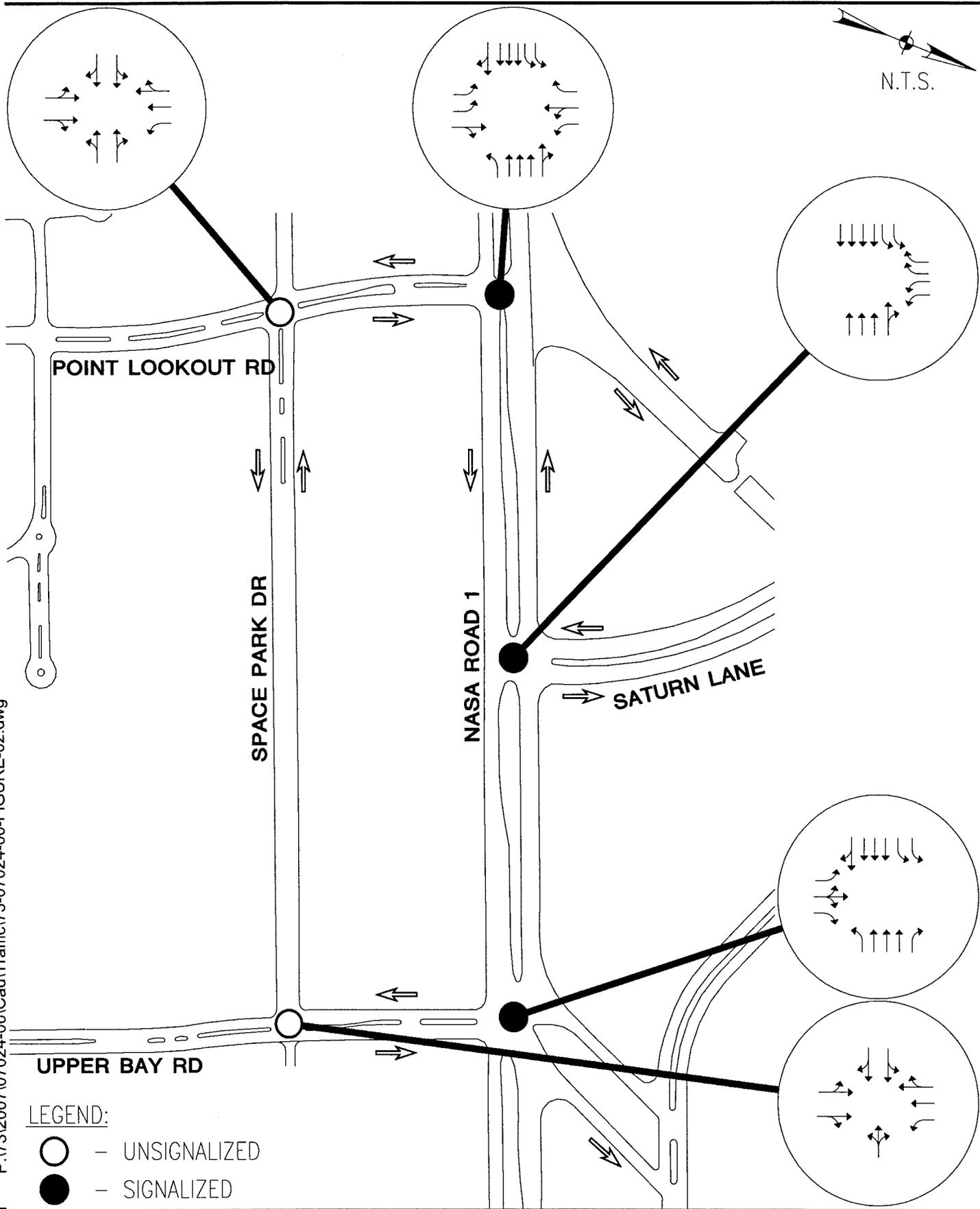
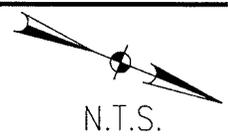
Upper Bay Road is a two-way street running north-south in the study area. It has two lanes in each direction separated by a median. Upper Bay Road intersects with Space Park Drive on the south side of its intersection with NASA Road 1. It becomes Third Street on the north side of its intersection with NASA Road 1 and serves as an entrance to NASA's Johnson Space Center in AM peak hour. This entrance is closed in the PM peak hour.

Space Park Drive runs east-west and parallel to NASA Road 1 in the study area. It forms intersections with Point Lookout Drive and Upper Bay Road which serve as key access points to the site. Space Park Drive has two lanes in each direction and it provides traffic circulation within the site.

Critical Intersections

Existing operations at selected intersections were examined closely. **Figure 2** shows the existing lane configuration and traffic control at these intersections.

NASA Road 1 at Point Lookout Drive – The intersection of NASA Road 1 and Point Lookout Drive is a four-legged intersection controlled by an actuated signal. The eastbound approach to the intersection has two left turn lanes, three through lanes and a through-right turn lane. The



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FIGURE 2

westbound approach has one left turn lane, three through lanes and a through-right turn lane. The northbound approach to the intersection has two left turn lanes and a through-right turn lane. The southbound approach to the intersection has a left turn lane, a through-left turn lane and a right turn lane.

NASA Road 1 at Saturn Lane – The intersection of NASA Road 1 and Saturn Lane is a three-legged intersection controlled by an actuated signal. NASA Road 1 forms the eastbound and westbound approaches to the intersection and Saturn Lane forms the southbound approach to the intersection. The eastbound approach has four through lanes and two left turn lanes whereas the westbound approach has three through lanes and a through-right turn lane. Saturn Lane on the southbound approach has two left turn lanes and two right turn lanes.

NASA Road 1 at Upper Bay Road – The intersection of NASA Road 1 and Upper Bay Road is a four-legged intersection controlled by an actuated signal. The eastbound approach to the intersection has two left turn lanes, three through lanes and a through-right turn lane whereas the westbound approach has one left turn lane, three through lanes and a right turn lane. Upper Bay Road has a left turn lane, a left turn-through-right turn lane and a right turn only lane on its northbound approach to the intersection. The southbound approach is not currently open to traffic.

Point Lookout Drive at Space Park Drive – This is a four-legged intersection controlled by a four-way stop. The southbound approach to the intersection has a left turn lane, a through lane and a through-right turn lane whereas northbound approach has a through-left and a through-right turn lane. Both eastbound and westbound approaches to the intersection have a through-left and a through-right turn lane each.

Upper Bay Road at Space Park Drive – This is a four-legged intersection controlled by a four-way stop. The southbound approach to the intersection has a left turn lane, a through lane and a through-right turn lane. Northbound approach has a through-left and a through-right turn lane. Eastbound approach to the intersection has a through-left and a through-right turn lane. Westbound approach, which is a driveway out of parking lot, has a left turn-through-right turn lane.

Traffic Volume Counts

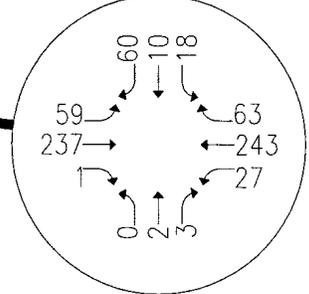
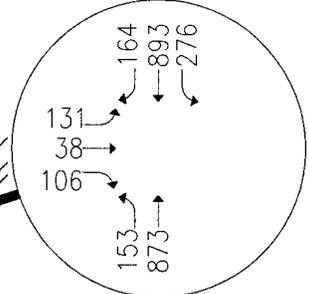
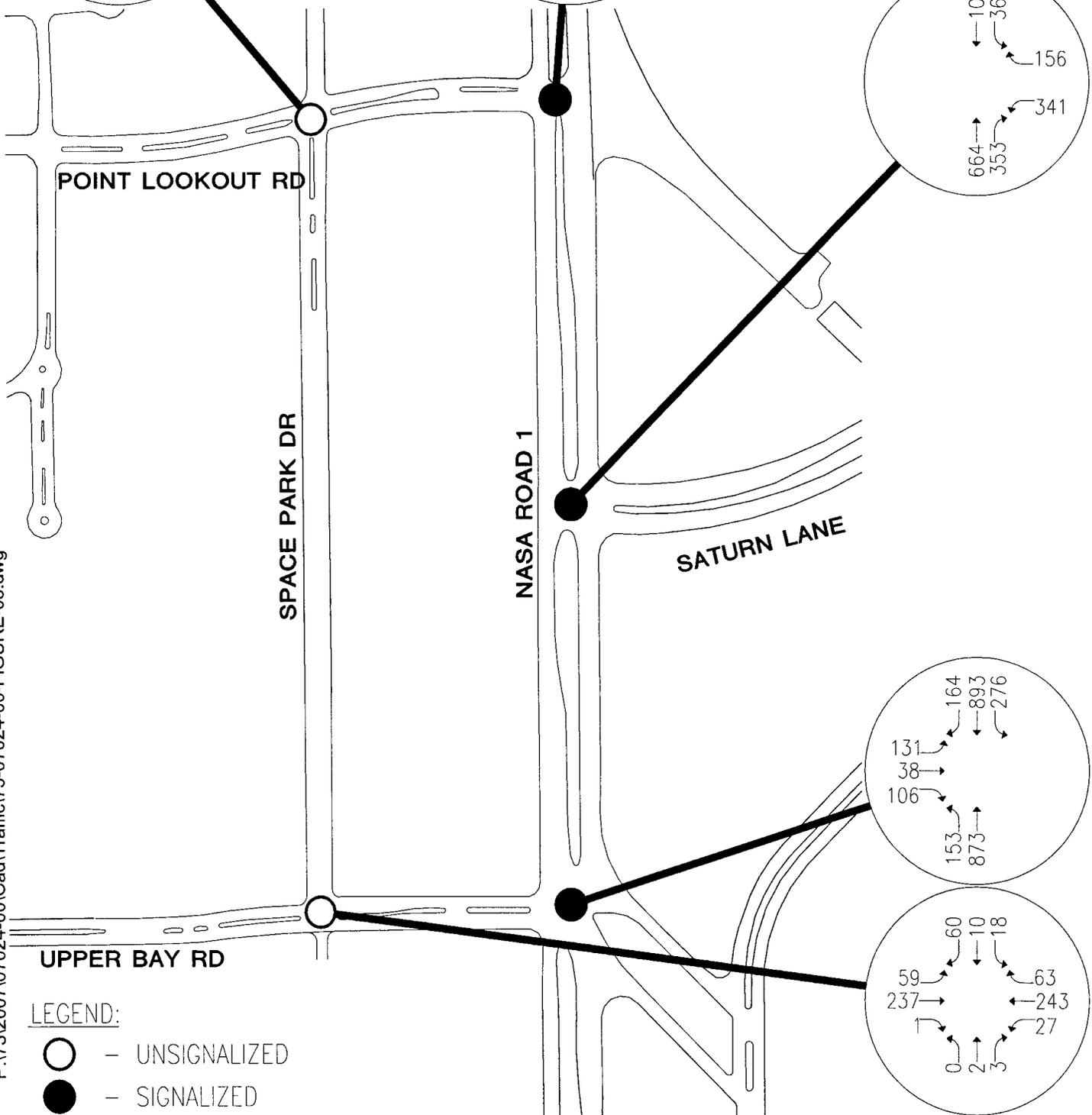
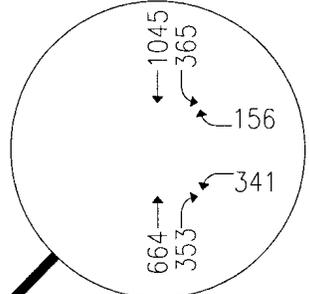
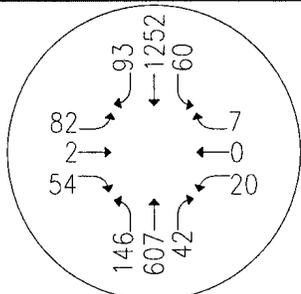
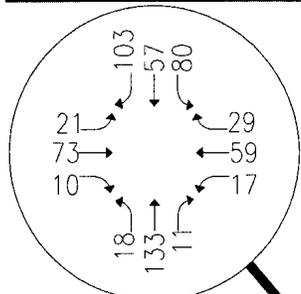
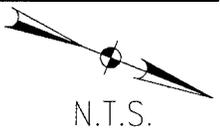
Peak period intersection turning movement volumes at all the critical intersections mentioned in the previous section were collected in August, 2007.

The data were collected from 7:00 AM to 9:00 AM and from 4:00 PM to 6:00 PM Peak hour turning movement volume data were used to establish intersection and turning movement levels of service for the existing conditions and for comparison with projected traffic volumes. Level of service is discussed further in a following section under the heading "Capacity Analysis". AM peak hour and PM peak hour turning movement volumes are shown in **Figure 3** and **Figure 4**. The peak period turning movement count data can be found under **Tab One**.

Capacity Analysis

Existing conditions capacity analyses were conducted for AM and PM peak traffic hours using turning movement counts for all of the intersections listed in the previous section. Unsignalized and signalized intersection operations were analyzed using software developed to automate procedures found in the *Highway Capacity Manual*. Unsignalized intersections and signalized intersections were analyzed using *Synchro 6.0*.

Results of the capacity analyses are reported in standard level-of-service (LOS) format, with the most favorable conditions being designated as LOS A and the poorest conditions indicated by LOS F. Intersection level of service is based on the amount of delay that each vehicle encounters at a given intersection. The level of service criteria for unsignalized and signalized intersections, along with a brief description of the conditions experienced for each level of service grade, can be seen in **Table 1** and **Table 2** respectively.



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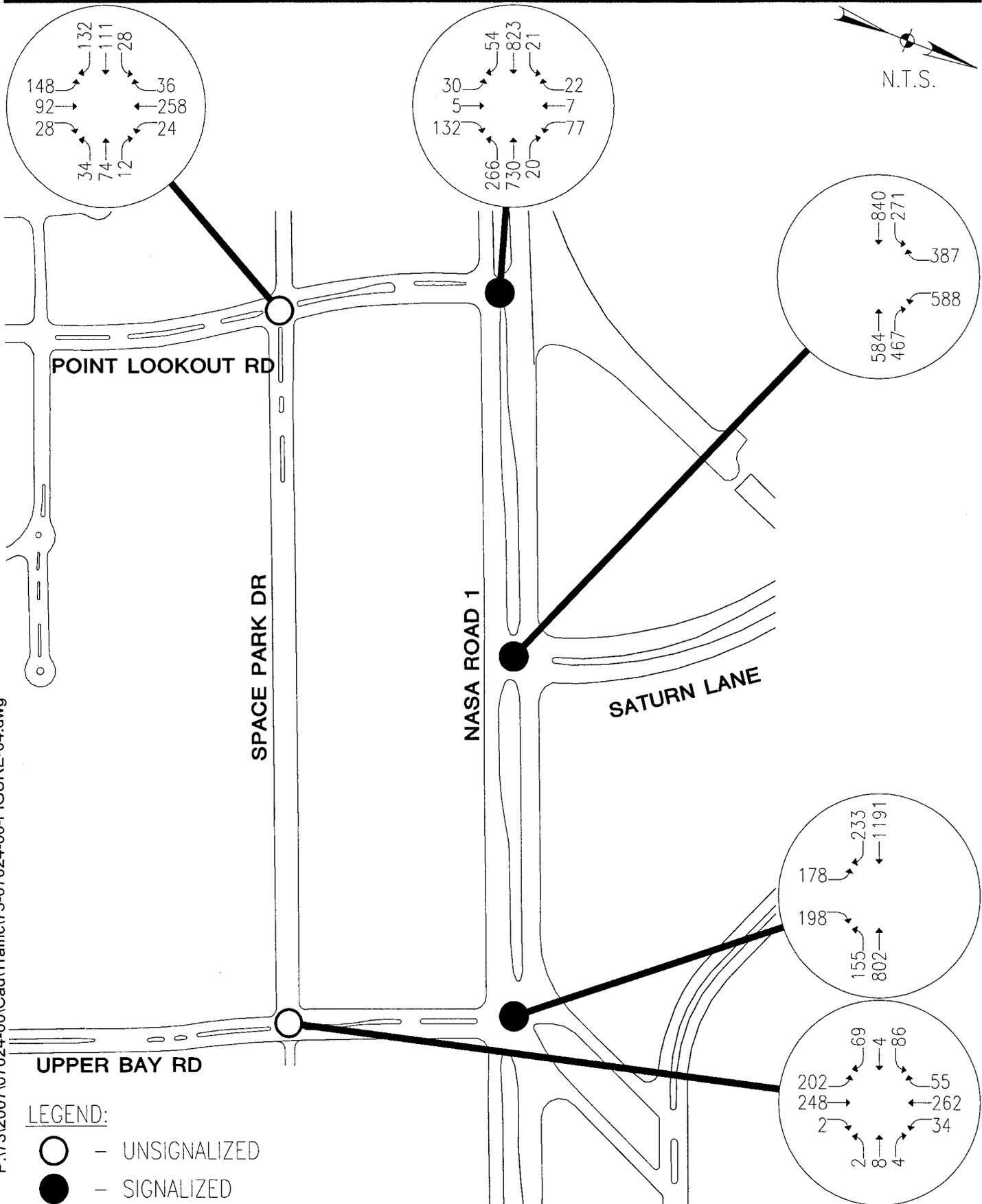
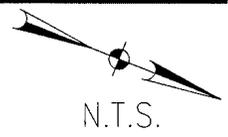
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FIGURE 3



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FIGURE 4

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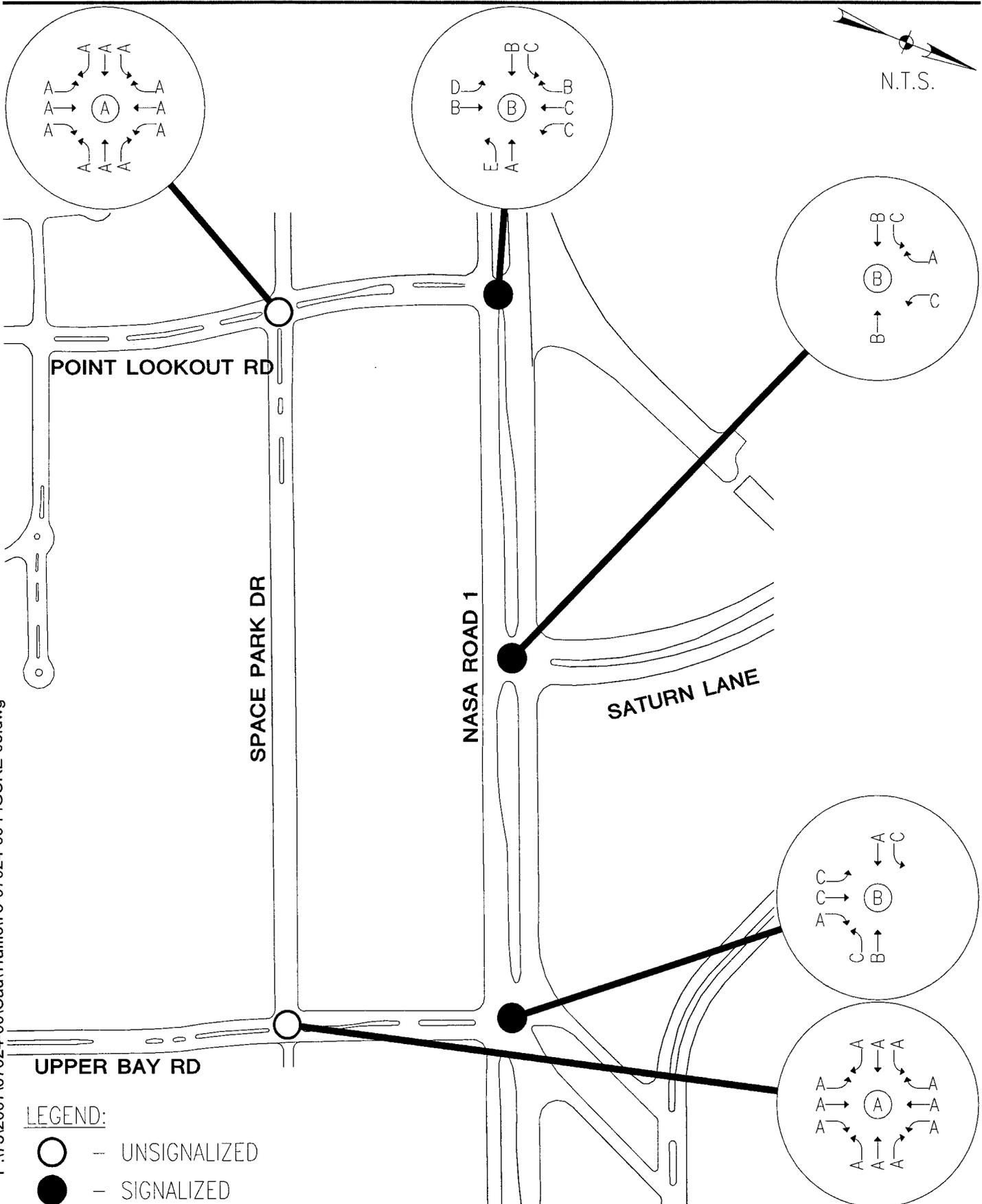
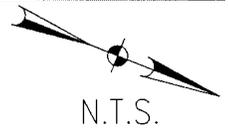
<p style="text-align: center;">TABLE 1 Level of Service Criteria for Unsignalized Intersections NASA Town Center Nassau Bay, Texas</p>		
Level of Service	Avg. Total Delay (sec/vehicle)	Description
A	≤ 10	At most, one vehicle is waiting to move through the intersection when the driver reaches the stop sign. Most often, the driver pulls up to the stop sign and is immediately free to proceed through the intersection.
B	> 10 and ≤ 15	When the driver reaches the intersection, one or two vehicles are in front of him. Once those vehicles proceed through the intersection, the driver is able to continue without opposition.
C	> 15 and ≤ 25	At this level, several vehicles may be in front of the driver at a two-way stop-controlled intersection. At an all-way stop-controlled intersection, there may be two or more vehicles at each approach that the driver has to wait for before getting his turn.
D	> 25 and ≤ 35	At this level, there are at least four vehicles in front of the driver and several vehicles at the other approaches. Also, for two-way stop-controlled conditions, the volume of traffic on the uncontrolled street may be high.
E	> 35 and ≤ 50	When the driver reaches the intersection, there are between five and eight vehicles in front of him and many vehicles at the other approaches that must also proceed through the intersection before the driver may continue.
F	> 50	At this level, the driver must wait for eight to ten cars at his approach to move through the intersection along with at least five vehicles at the other approaches. This level can also occur at two-way stop-controlled intersections when the uncontrolled street has such a high volume that no gaps are available in the traffic stream for the vehicles at the cross street to continue.

<p style="text-align: center;">TABLE 2 Level of Service Criteria for Signalized Intersections NASA Town Center Nassau Bay, Texas</p>		
Level of Service	Stopped Delay (sec/vehicle)	Description
A	≤ 10	At a single intersection most vehicles do not stop at all. When linked with other signals, vehicles progress through intersections without stopping.
B	> 10 and ≤ 20	At a single intersection some vehicles stop before getting a green signal. When linked with other signals, some cars may have to stop but most progress through the intersection without stopping.
C	> 20 and ≤ 35	At a single intersection, a significant number of vehicles must stop and wait for a green signal. Some vehicles may have to wait through one full signal cycle before being able to move through the intersection.
D	> 35 and ≤ 55	At this level, congestion is noticeable. Many vehicles have to stop while waiting for a green signal. A noticeable number of vehicles have to wait through one full cycle before being able to continue through the intersection.
E	> 55 and ≤ 80	At this level, almost all vehicles have to wait through one or more full signal cycles before moving through the intersection. When linked with other signals, progression is slow.
F	> 80	At this level, the number of vehicles entering the intersection exceeds its capacity. Vehicles have to wait through multiple full signal cycles before moving through the intersection.

Transportation agencies generally consider operations at or above LOS C to be acceptable. Depending upon the location, operations at or above LOS D may also be considered acceptable during peak traffic hours.

Printouts of the signalized and unsignalized intersection capacity analyses for existing conditions may be found under **Tab Two** in the Appendix. It can be seen in **Figure 5** and **Figure 6** that intersections in the study area are currently operating at a level of service of B or better.

The intersection of NASA Road 1 and Point Lookout Drive operates at LOS B both in AM and PM peak hour. However, in the AM peak hour the westbound left turn movement operates at LOS E and the northbound left turn movement operates at LOS D. Also, the westbound left turn,



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A.M. PEAK HOUR EXISTING LOS

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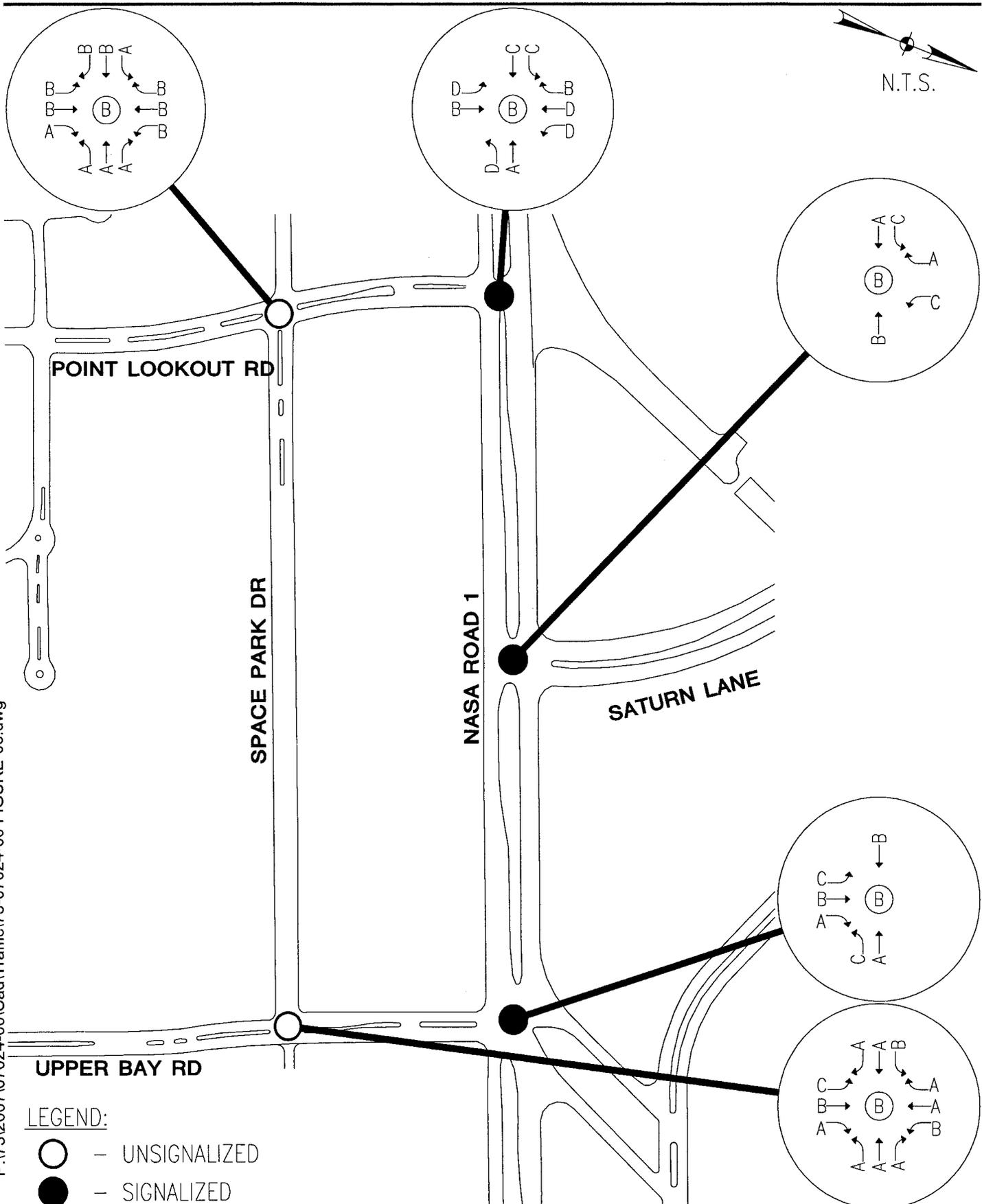
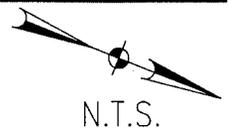
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FIGURE 5



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Copyright © 2007 WALTER P. MOORE AND ASSOCIATES, INC.		FIGURE 6

northbound left turn, southbound left turn and southbound through movements operate at LOS D in the PM peak hour. All other movements are performing at an acceptable LOS during both the AM and PM peak hours.

The intersection of NASA Road 1 and Saturn Lane operates at LOS B both in the AM and PM peak hours. All movements at this intersection are performing at LOS C or better.

The intersection of NASA Road 1 and Upper Bay Road is performing at LOS B both in the AM and PM peak hours. All movements at this intersection are performing at LOS C or better.

The intersection of Point Lookout Drive and Space Park Drive is performing at a LOS A in the AM peak and LOS B in the PM peak.

Similarly, the intersection of Upper Bay Road and Space Park Drive is performing at LOS of A in the AM peak and B in the PM peak.

Proposed Conditions

The analysis of proposed conditions consists of generating trips associated with each land use, assigning trips to different routes based on engineering judgment, and projecting the LOS at critical intersections in the study area.

Proposed Development

This report considers the development of a mixed use project in the City of Nassau Bay, Texas. The project site is located south of NASA Road 1, east of Point Lookout Drive and west of Upper Bay Road, and is approximately 27 acres in area. The project will consist of office, retail, hotel and residential land uses and will have parking provisions associated with each land use in the form of a garage or surface parking. The intersection of Saturn Lane and NASA Road 1 will have a new approach connecting the intersection to the site. Due to this added approach on the south, the existing signal operation at the intersection will have to be modified to allow for the added movements. The developer understands that he is required to construct a left turn bay at the new approach and provide for the required signal modifications. There will also be a driveway connecting

Space Park Drive to the Apartment Complex (Driveway 1) and two new driveways (Driveway 2 and Driveway 3 from west to east) connecting NASA Road 1 to the site. **Figure 7** shows the proposed site plan.

Trip Generation

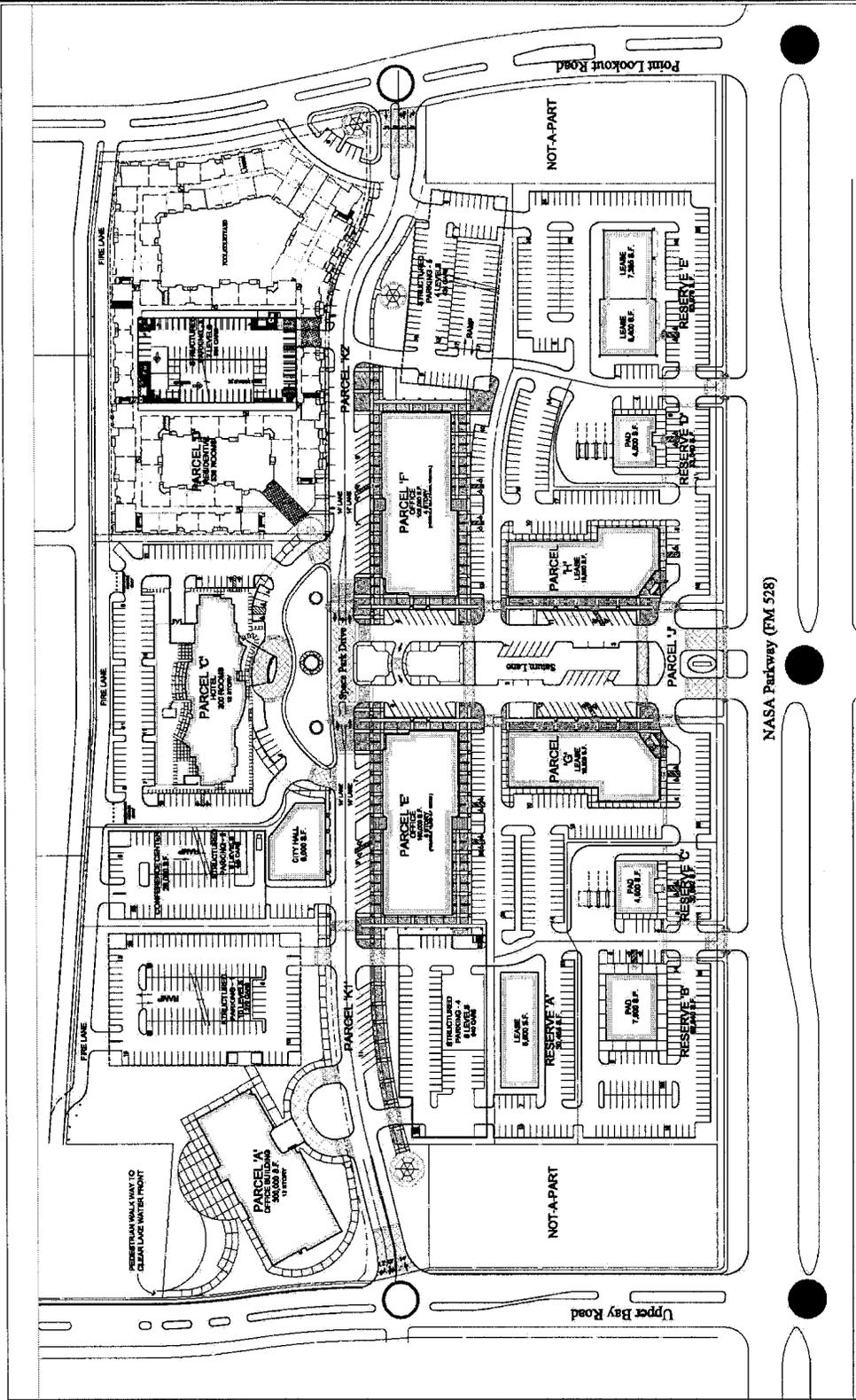
To complete a study for a proposed development, the number of trips expected to be generated by the planned facilities needs to be determined.

The number of trips generated during an average weekday and for weekday peak hours by a General Office Building, a Shopping Center, a Hotel and an Apartment Complex were calculated using trip generation rates from the ITE Manual "Trip Generation" (2). City Hall, which falls under the category of Government Office Building, was considered as General Office Building for the purpose of trip generation because the ITE Trip Generation Manual lacks substantial data on trips generated due to that land use. **Table 3** summarizes the number of expected trips to be generated by the new mixed use development during AM peak hour, PM peak hour, and weekday for each proposed land use.

Code	Land Use	Size	Weekday Traffic (vehicles per day)	Trip Generation (vehicles per day)		Trip Generation (vehicles per hour)			
				Weekday Traffic		Weekday Peak Hour			
				Entering	Exiting	A.M.		P.M.	
				Enter	Exit	Enter	Exit		
710	Office	574,000 (square feet)	5,123	2,562	2,562	668	91	123	599
820	Lease	70,685 (square feet)	5,420	2,710	2,710	78	50	239	259
310	Hotel	300 (rooms)	2312	1,156	1,156	97	62	94	83
220	Apartment	336 (units)	2170	1,085	1,085	34	135	123	66

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FIGURE 7

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Trip Distribution

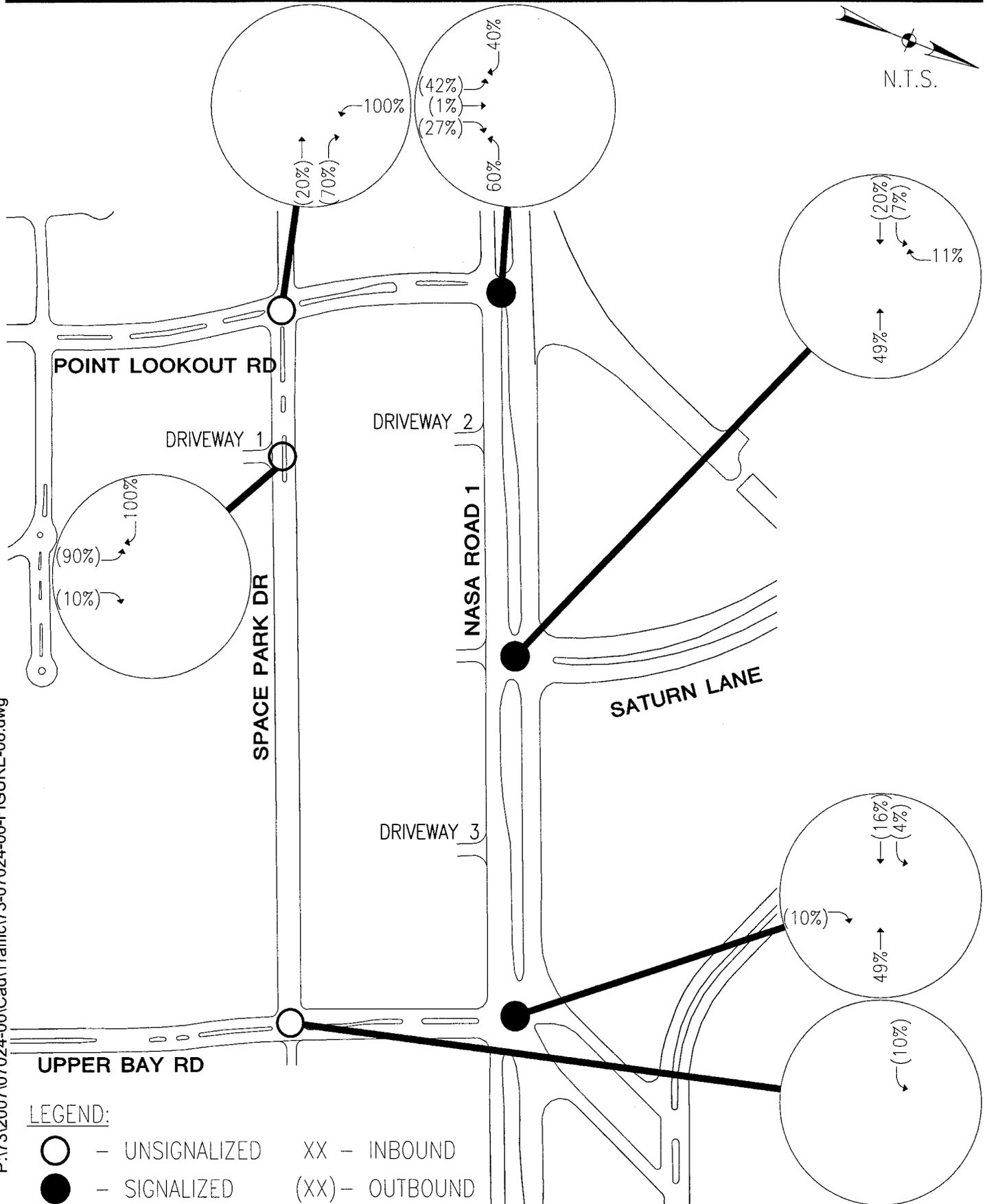
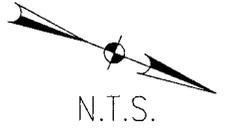
Site-generated traffic was assigned to the surrounding street network using a combination of existing and expected travel patterns. This process involves examining the roadway network and the expected travel patterns between the site and other trip ends. Turning movements at the various driveways are assigned based on the arrival and departure route, the location of site parking, and the internal circulation configuration. All traffic assignments were made over the most reasonable routes for each direction, and then the volumes were analyzed.

Traffic traveling to the apartment complex will have a different travel pattern compared to the traffic traveling to office, retail and hotel part of the project; therefore trip distribution for traffic traveling to the apartment complex was done separately. The trip assignment percentages for inbound and outbound traffic are illustrated in **Figure 8** and **Figure 9**.

Capacity Analyses

The proposed site currently has 12 office buildings on about a 27-acre area. As per the information provided by the client, out of the total leasable area of 437,406 square feet, only 42.9% is currently leased. Also, the client plans to demolish the existing construction on the site and develop the new mixed use development on it. To account for the reduction in traffic in the absence of current development, existing trips visiting the site were calculated for 42.9% of the trips generated by 437,406 square feet of floor area. These trips were then subtracted from the existing intersection turning movement counts to come up with base turning movement counts which remain in the absence of the existing development. These volumes were called base volumes and are shown in **Figure 10** and **Figure 11**. New site generated traffic was then added to these base turning movement volumes to come up with proposed traffic. The proposed peak hour turning movement volumes for AM and PM traffic can be seen in **Figure 12** and **Figure 13** respectively.

Unsignalized intersections and signalized intersections were analyzed for proposed traffic using *Synchro 6.0*. Signal timings were modified for the three signalized intersections in the study area to better suit proposed conditions. A comparison between the existing and the proposed conditions analyses are discussed in the next section. Printouts of the signalized and unsignalized intersection capacity analyses using proposed conditions may be found under **TAB THREE** in the Appendix.



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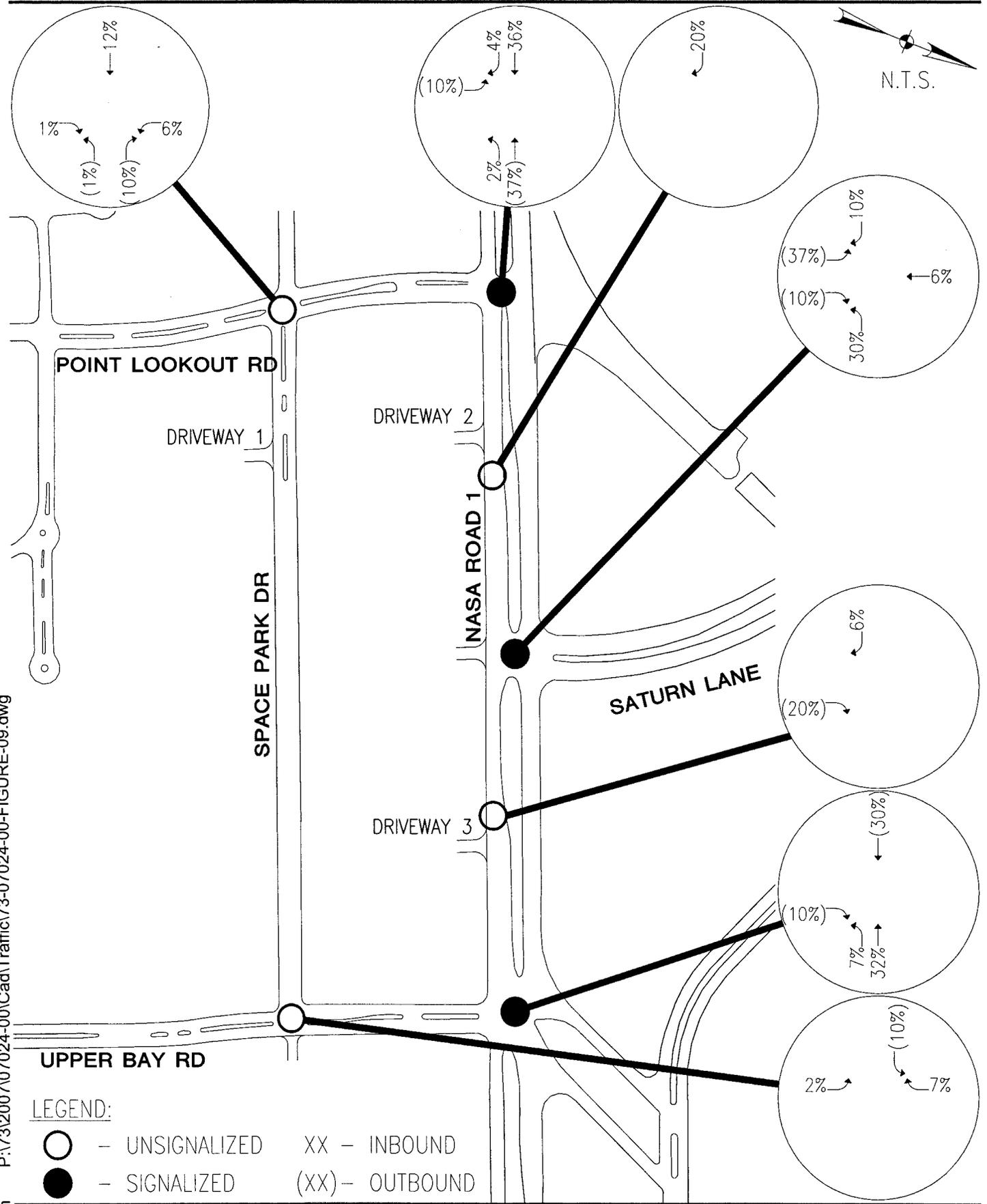
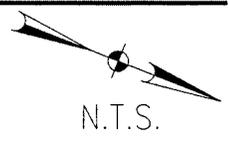
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FIGURE 8



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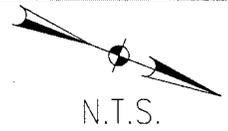
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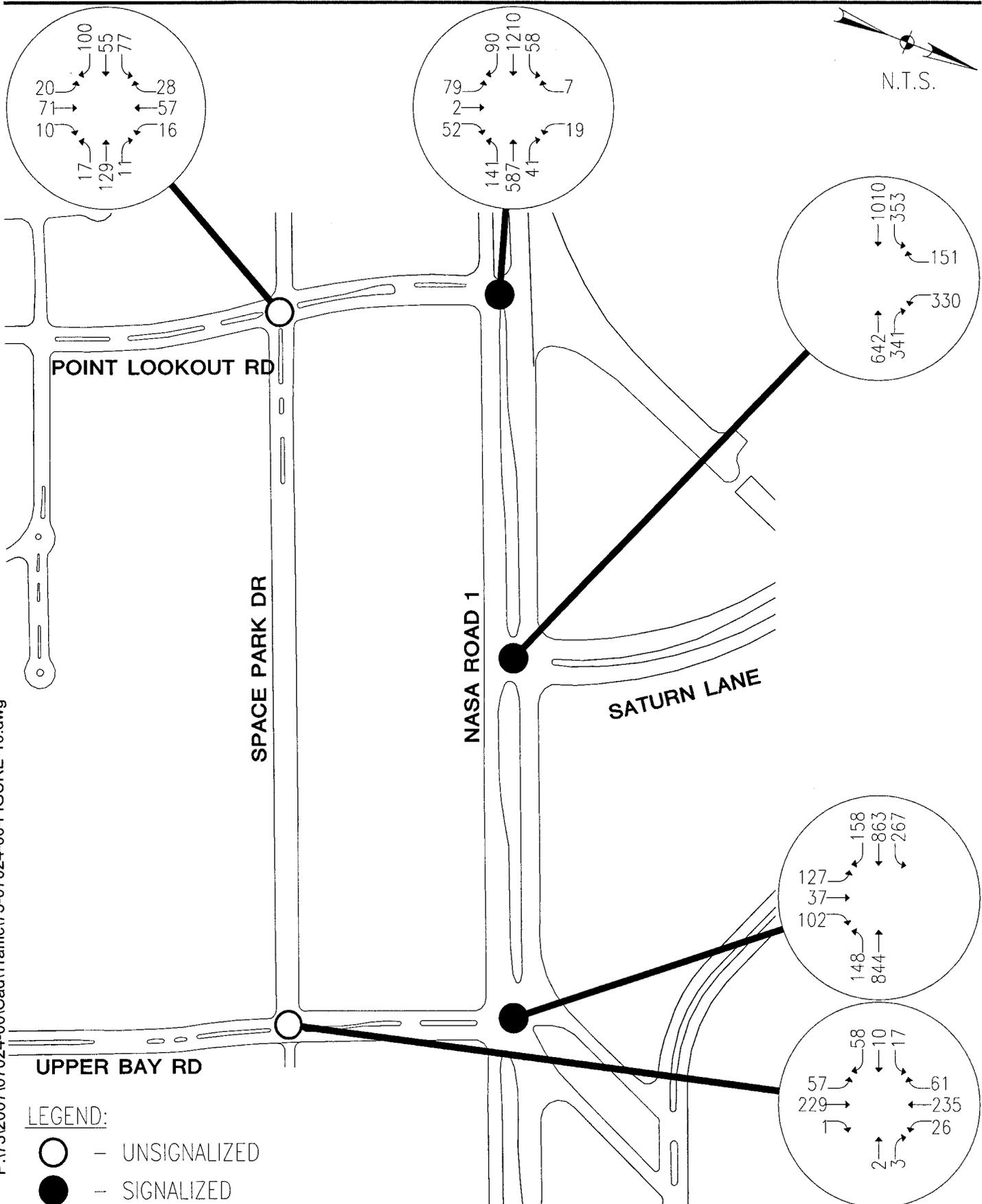
Project Name: **NASA TOWN CENTER MIXED USE DEVELOPMENT**
 Sheet Title: **TRIP DISTRIBUTION PERCENTAGES-NON-RESIDENTIAL**

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FIGURE 9



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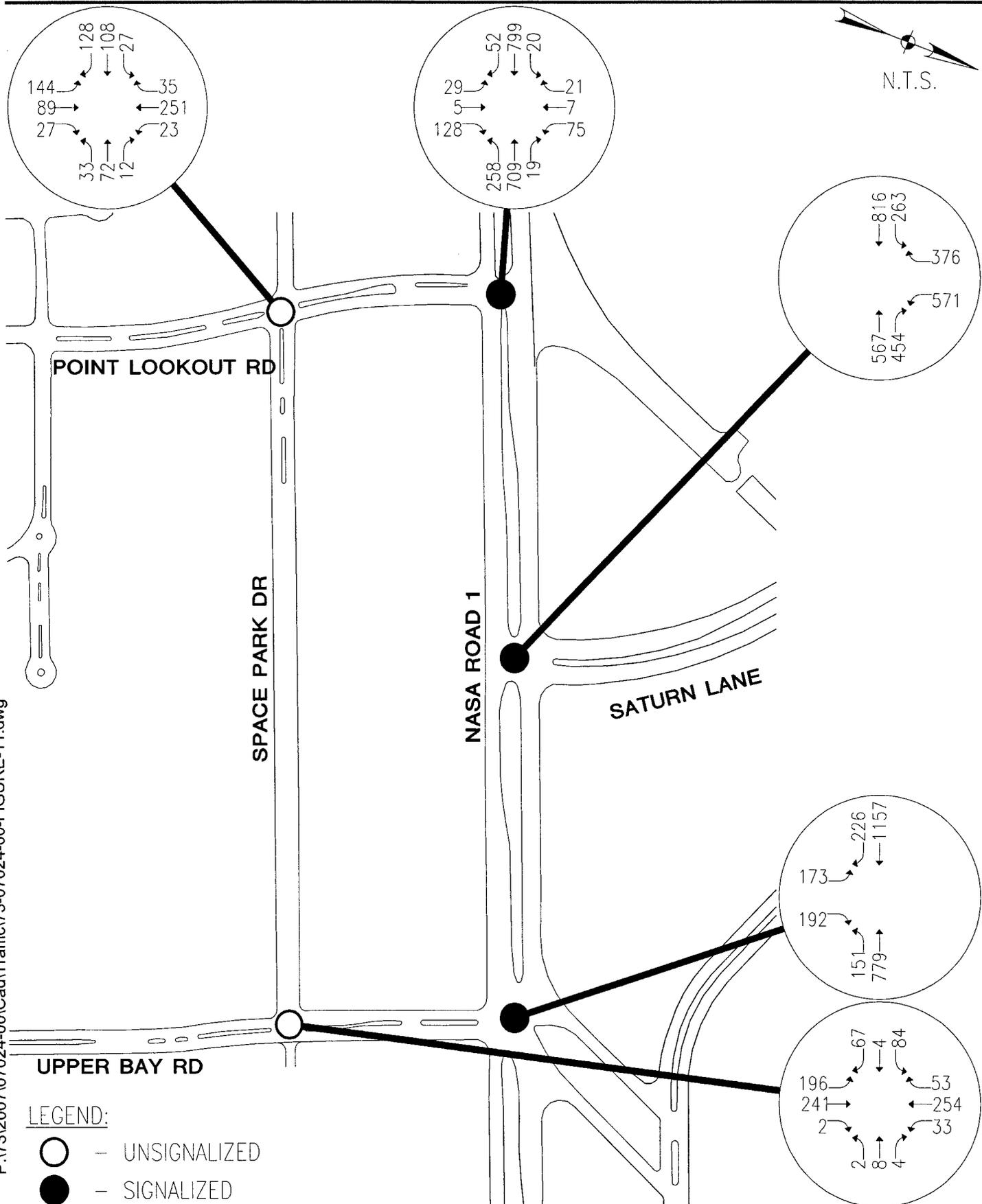
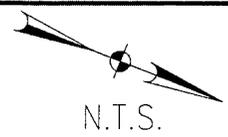
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Sheet Title: **BASE A.M. PEAK HOUR VOLUMES**

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FIGURE 10



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Sheet Title: **BASE P.M. PEAK HOUR VOLUMES**

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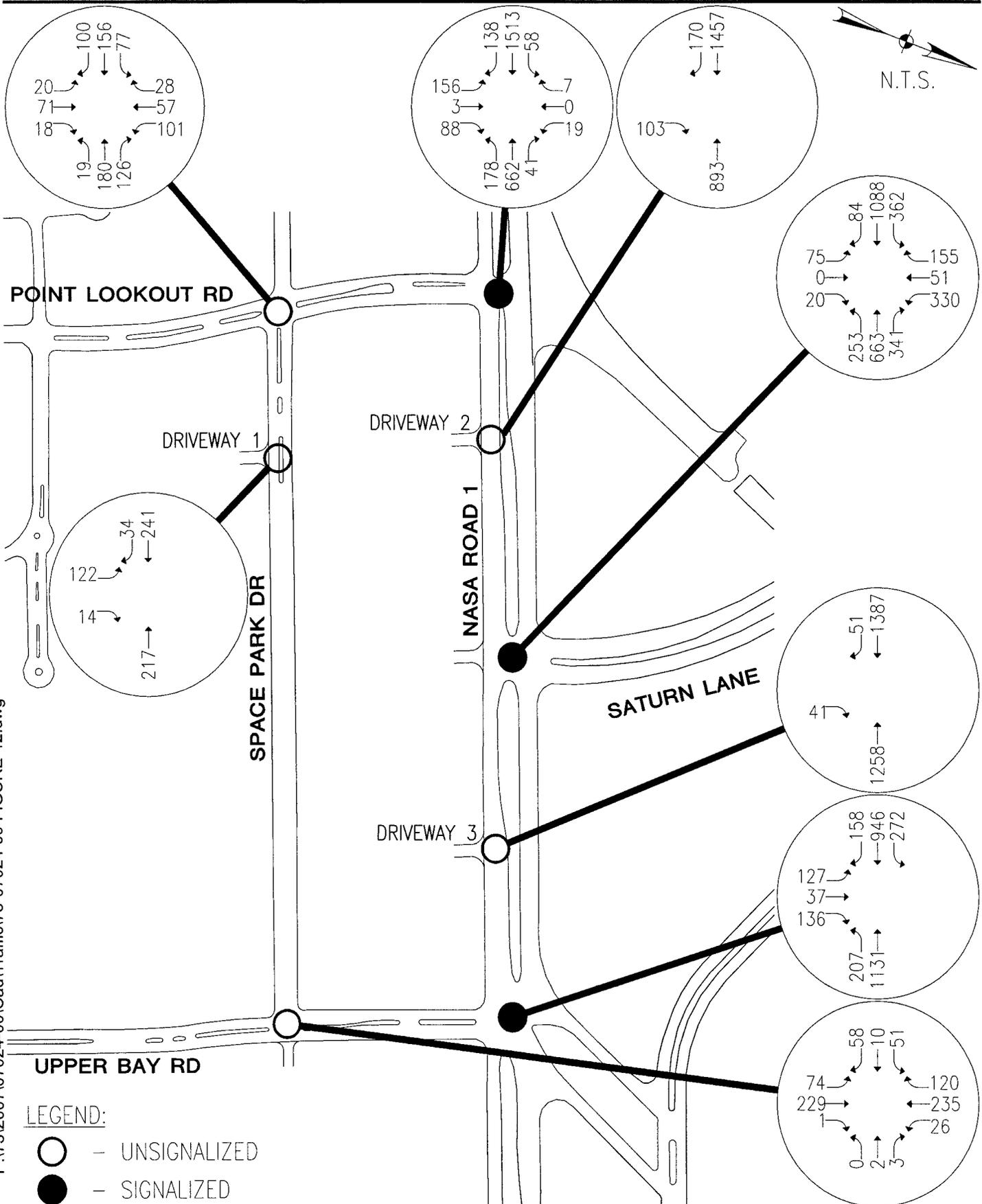
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FIGURE 11

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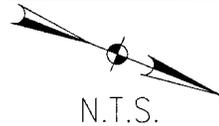
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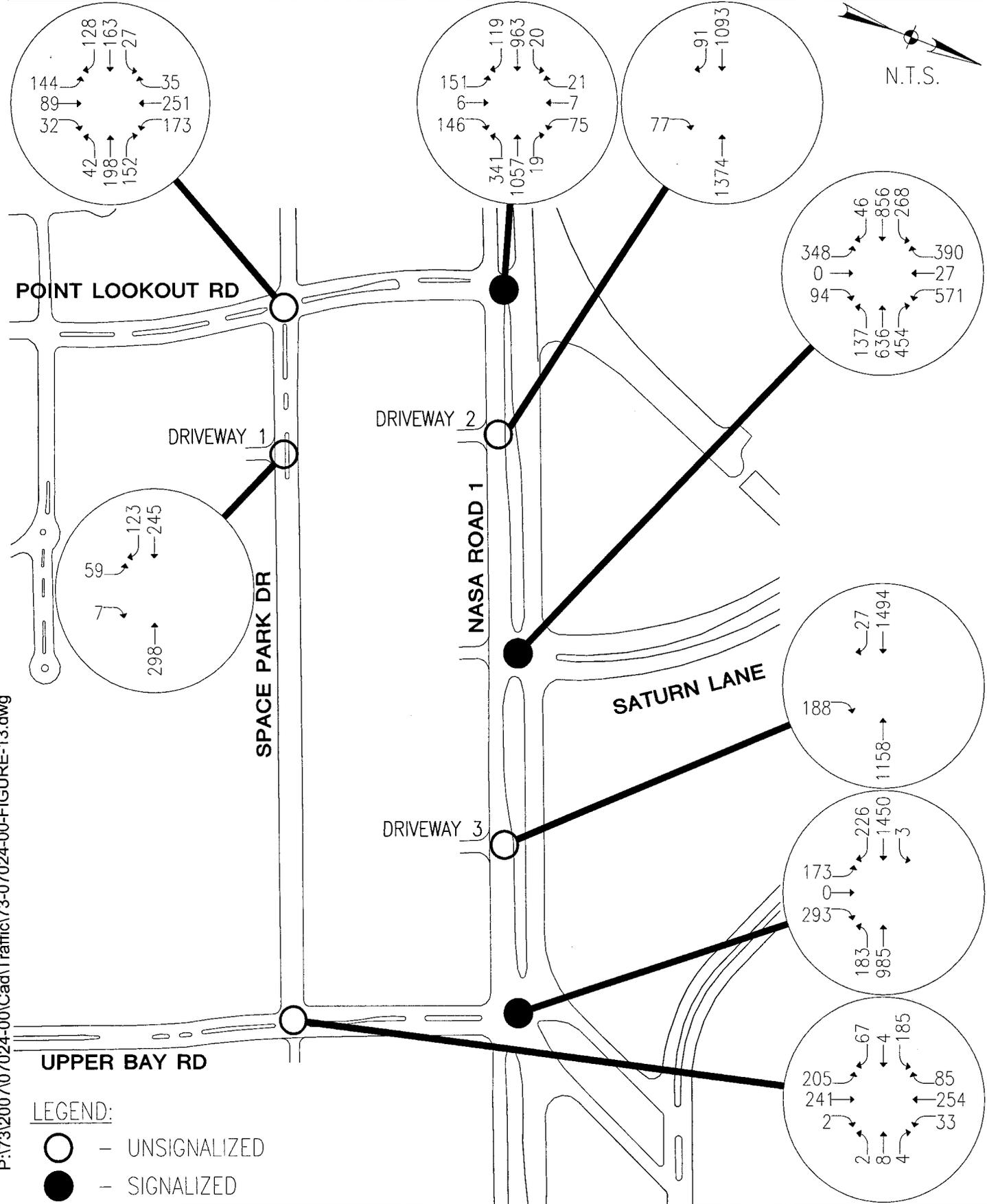
Project Name: **NASA TOWN CENTER MIXED USE DEVELOPMENT**
 Sheet Title: **PROPOSED A.M. PEAK HOUR VOLUMES**
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FIGURE 12

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Sheet Title: **PROPOSED P.M. PEAK HOUR VOLUMES**

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FIGURE 13

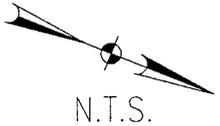
Intersection LOS Comparison

Table 4 and Table 5 provide a movement-by-movement comparison of existing and proposed levels of service at the intersections analyzed for this study.

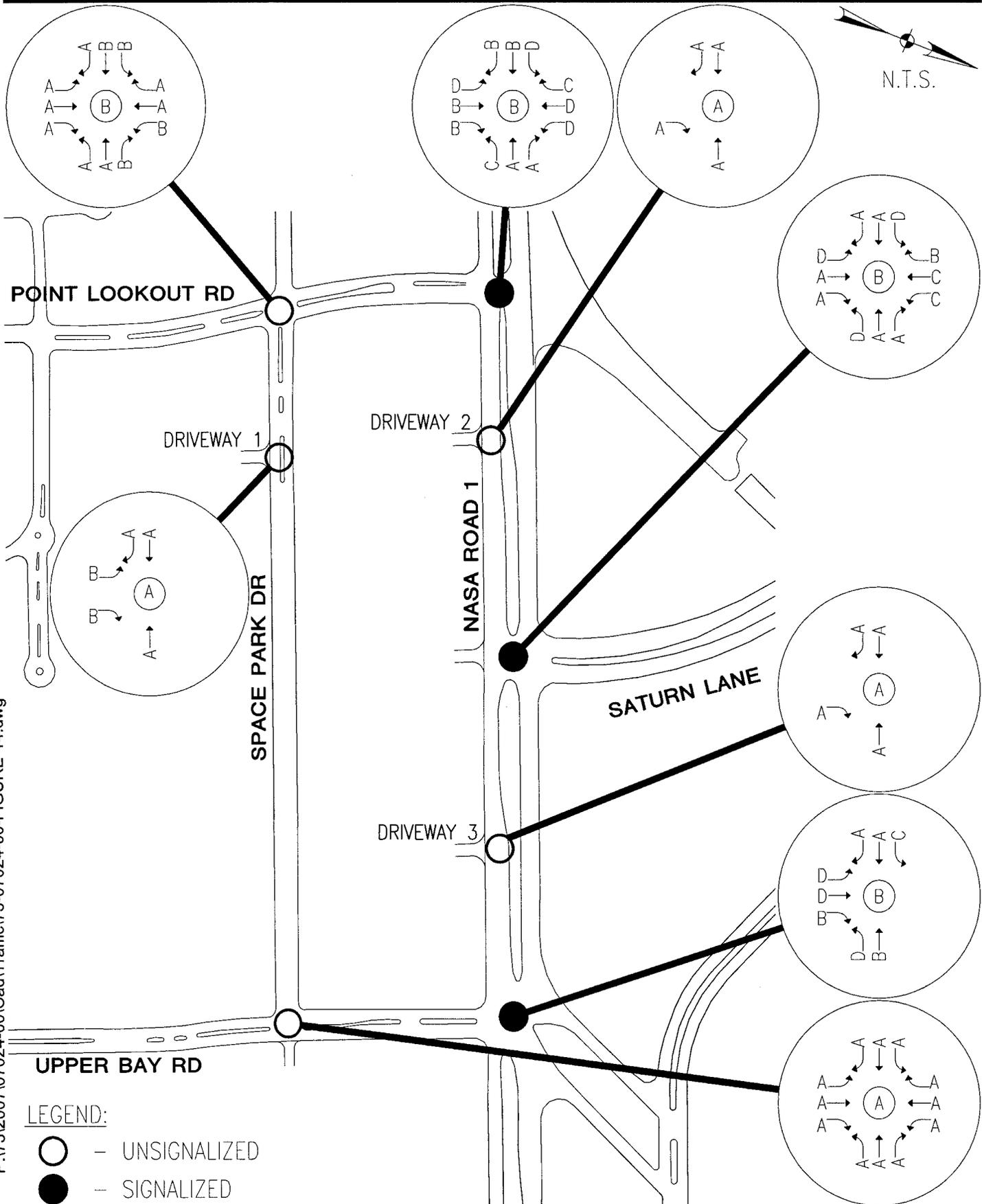
It can be seen in Table 4 and Figure 14 that all critical intersections are performing at a satisfactory LOS B or better in both existing and proposed conditions for the AM peak hour. However, the northbound left, southbound left and through, and eastbound left turn movement at the intersection of NASA Road 1 and Point Lookout Drive are performing at LOS D. Also the northbound, eastbound and westbound left turn movements at the intersection of NASA Road 1 and Saturn Lane are performing at LOS D. Finally, the northbound left and through and the westbound left turn movements are performing at LOS D at the intersection of NASA Road 1 and Upper Bay Road.

TABLE 4
A.M. Peak Hour Movement Level-of-Service Comparison
NASA Town Center
Nassau Bay, Texas

Intersection Location	Overall LOS	Level of Service by Approach and Movement											
		Northbound			Southbound			Eastbound			Westbound		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
NASA Road 1 at Point Lookout Drive													
Existing Conditions	B	D	B	B	C	C	B	C	B	B	E	A	A
Proposed Condition	B	D	B	B	D	D	C	D	B	B	C	A	A
NASA Road 1 at Saturn Lane													
Existing Conditions	B	-	-	-	C	-	A	C	B	-	-	B	B
Proposed Condition	B	D	A	A	C	C	B	D	A	A	D	A	A
NASA Road 1 at Upper Bay Road													
Existing Conditions	B	C	C	A	-	-	-	C	A	A	C	B	-
Proposed Condition	B	D	D	B	-	-	-	C	A	A	D	B	-
Point Lookout Drive at Space Park Drive													
Existing Conditions	A	A	A	A	A	A	A	A	A	A	A	A	A
Proposed Condition	B	A	A	A	B	A	A	B	B	A	A	A	B
Upper Bay Road at Space Park Drive													
Existing Conditions	A	A	A	A	A	A	A	A	A	A	-	A	A
Proposed Condition	A	A	A	A	A	A	A	A	A	A	-	A	A
Space Park Drive at Driveway 1													
Existing Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-
Proposed Condition	A	B	-	B	-	-	-	-	A	A	A	A	-
NASA Road 1 at Driveway 2													
Existing Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-
Proposed Condition	A	-	-	A	-	-	-	-	A	A	-	A	-
NASA Road 1 at Driveway 3													
Existing Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-
Proposed Condition	A	-	-	A	-	-	-	-	A	A	-	A	-



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 Sheet Title: **PROPOSED AM PEAK LOS**

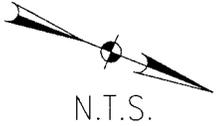
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FIGURE 14

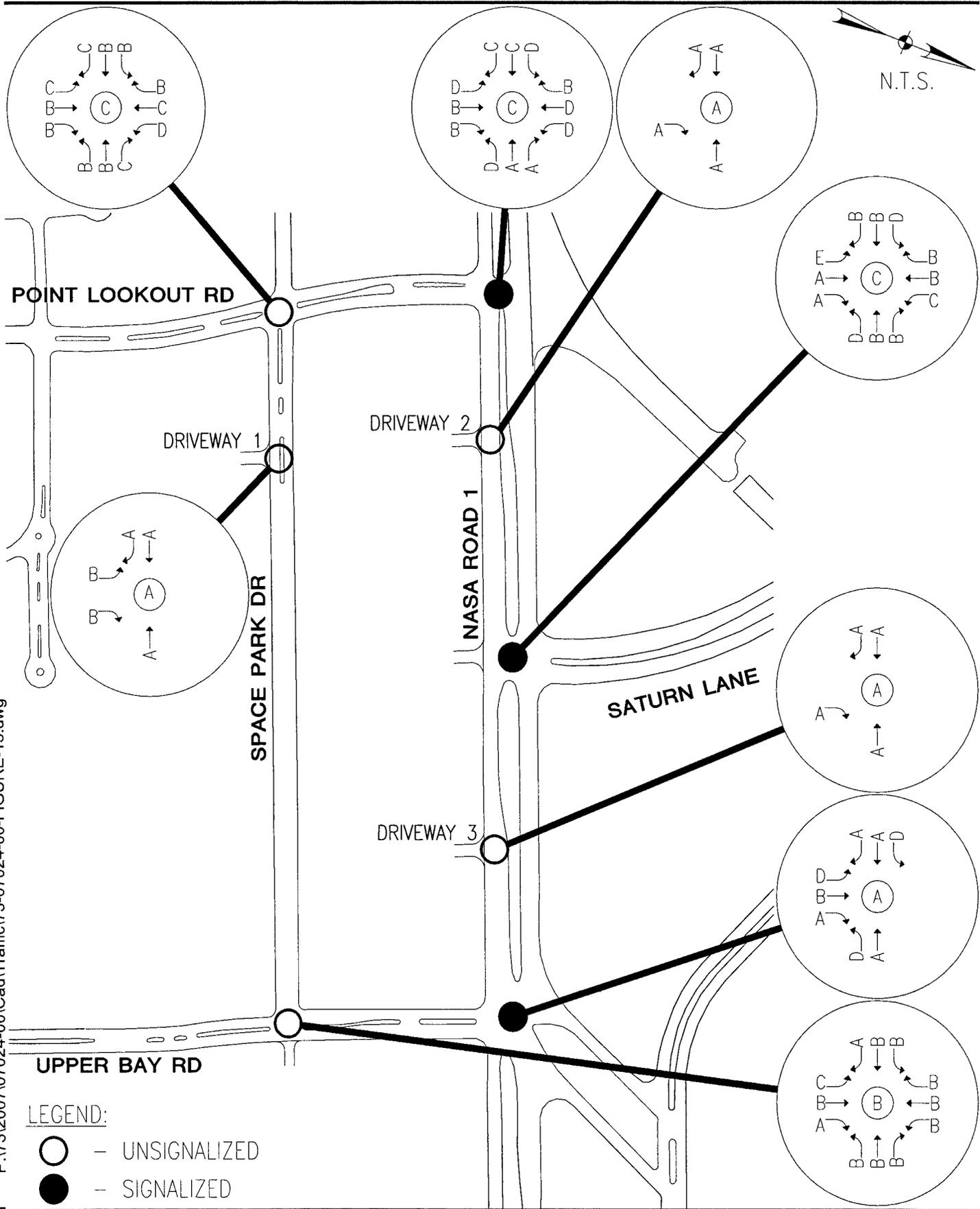
It can be seen in **Table 5** and **Figure 15** that all critical intersections are performing at a satisfactory LOS C or better in both existing and proposed conditions for the PM peak hour. However, all the left turn movements and the southbound through movement at the intersection of NASA Road 1 and Point Lookout Drive are performing at LOS D in proposed conditions. Also, the eastbound and westbound left turn movements at the intersection of NASA Road 1 and Saturn Lane are performing at LOS D and the northbound left turning movement is performing at LOS E. Finally, at the intersection of NASA Road 1 and Upper Bay Road, the northbound, eastbound and westbound left turn movements are performing at LOS D.

TABLE 5
P.M. Peak Hour Movement Level-of-Service Comparison
 NASA Town Center
 Nassau Bay, Texas

Intersection Location	Overall LOS	Level of Service by Approach and Movement											
		Northbound			Southbound			Eastbound			Westbound		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
NASA Road 1 at Point Lookout Drive													
Existing Conditions	B	D	B	B	D	D	B	C	C	C	D	A	A
Proposed Condition	C	D	B	B	D	D	B	D	C	C	D	A	A
NASA Road 1 at Saturn Lane													
Existing Conditions	B	-	-	-	C	-	A	C	A	-	-	B	B
Proposed Condition	C	E	A	A	C	B	B	D	B	B	D	B	B
NASA Road 1 at Upper Bay Road													
Existing Conditions	B	C	B	A	-	-	-	-	B	B	C	A	-
Proposed Condition	A	D	B	A	-	-	-	D	A	A	D	A	-
Point Lookout Drive at Space Park Drive													
Existing Conditions	B	B	B	A	B	B	B	A	B	B	A	A	A
Proposed Condition	C	C	B	B	D	C	B	B	B	C	B	C	C
Upper Bay Road at Space Park Drive													
Existing Conditions	B	C	B	A	B	A	A	B	A	A	A	A	A
Proposed Condition	B	C	B	A	B	B	B	B	B	A	B	B	B
Space Park Drive at Driveway 1													
Existing Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-
Proposed Condition	A	B	-	B	-	-	-	-	A	A	A	A	-
NASA Road 1 at Driveway 2													
Existing Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-
Proposed Condition	A	-	-	A	-	-	-	-	A	A	-	A	-
NASA Road 1 at Driveway 3													
Existing Conditions	-	-	-	-	-	-	-	-	-	-	-	-	-
Proposed Condition	A	-	-	A	-	-	-	-	A	A	-	A	-



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FIGURE 15

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Conclusion

Based on the results of the analysis, the proposed multiuse development will have a minor effect on the traffic operations in the study area. However, as part of the proposed condition analysis, signal timings at all the three signalized intersections in the study area were optimized to better suite the proposed condition traffic. Retiming of the signals in the field will be required to achieve the levels of service discussed in this report.

References

1. Griffin Partners Inc. <http://www.griffinpartners.com/news.html>
2. *Trip Generation Manual, 7th Edition*. Institute of Transportation Engineers, Washington, D.C., 2003.