



728 134th Street SW, Suite 200  
Everett, WA 98204  
Ph: 425/741-3800; Fax: 425/741-3900

**TECHNICAL MEMORANDUM**

To: Jeff Brauns  
From: Patrick McGrady  
Date: January 2005  
File No.: 252004.013  
Subject: SE 43rd Way/East Lake Sammamish Parkway Intersection  
Improvement Technical Memorandum

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**BACKGROUND**

The Mallard Bay development on the northeast and southeast quadrants of the East Lake Sammamish Parkway (ELSP)/SE 43rd Way intersection is required to mitigate traffic impacts on the intersection. The development was initially approved under King County but now is under the jurisdiction of the City of Issaquah (details of this transition can be obtained from the City). The City of Issaquah requested analysis to determine if improvements to the existing traffic signal system or a roundabout would provide the public the most efficient intersection control. In support of the intersection improvements the City of Sammamish contracted with Reid Middleton for this analysis.

Reid Middleton has completed a conceptual analysis to evaluate the appropriateness of a roundabout at the East Lake Sammamish Parkway/SE 43rd Way intersection. This process involved analysis to compare a traffic signal installation to a roundabout installation.

To support the analysis Lee Haro furnished the following information:

- Roundabout layout by Entranco (Developer's engineer)
- aaSIDRA analysis by Entranco
- Existing peak hour traffic volumes
- 2022 peak hour traffic volumes
- Development peak hour trip generation and distribution
- 2022 Synchro/SimTraffic analysis by the City of Issaquah
- Most current three-year collision data

For the purpose of this analysis, ELSP is referred to as northbound and southbound and SE 43rd Way is referred to as eastbound and westbound.

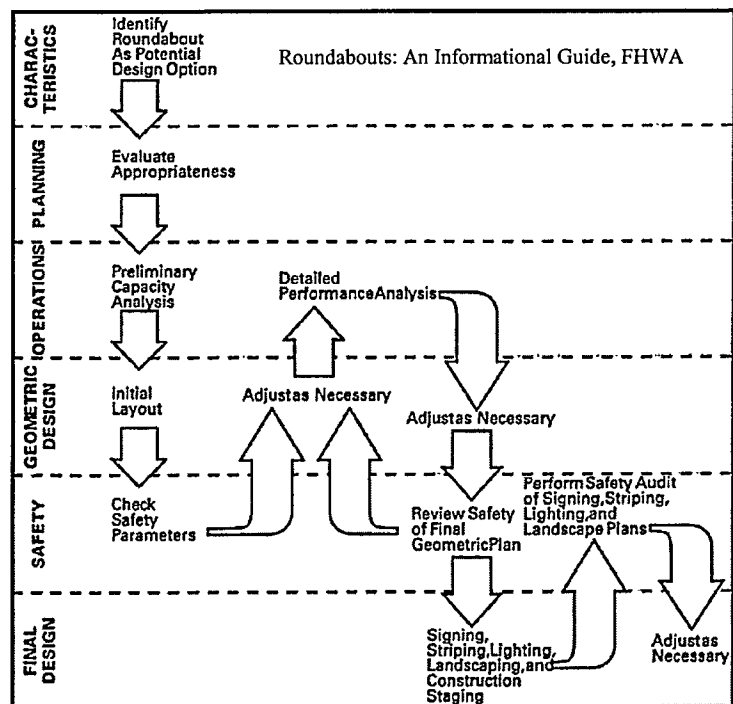
Existing peak hour traffic volumes were provided by the City of Issaquah. The 2022 forecast peak hour traffic volumes were provided by the City of Issaquah and the City of Sammamish. These forecasted traffic volumes are produced by their traffic models which are based on their Comprehensive Plans and projects included in their Transportation Improvements Plans. The forecasted traffic volumes were reviewed and approved by both City's. 2022 AM and PM peak hour forecasted volumes are presented on attached Figures 1 and 2. These figures include traffic from the Mallard Bay development to the east of the intersection.

**Discussion**

Like traffic signal controlled intersections, roundabout analysis is a process of examining traffic operations and safety. But more than other forms of intersection control, roundabouts may require numerous iterations of the geometrics to quantify their resultant intersection performance. This iterative process provides the basis for the detailed traffic analysis and conceptual design of the roundabout. See Figure 3.

Sound roundabout design is the application of geometric criteria that results in the desired driver behavior.

The strength of a roundabout is entry speed reduction and speed consistency through the intersection. Speed consistency for all movements and minimizing differential speeds helps to minimize collision rates and severity of collisions between conflicting vehicles.

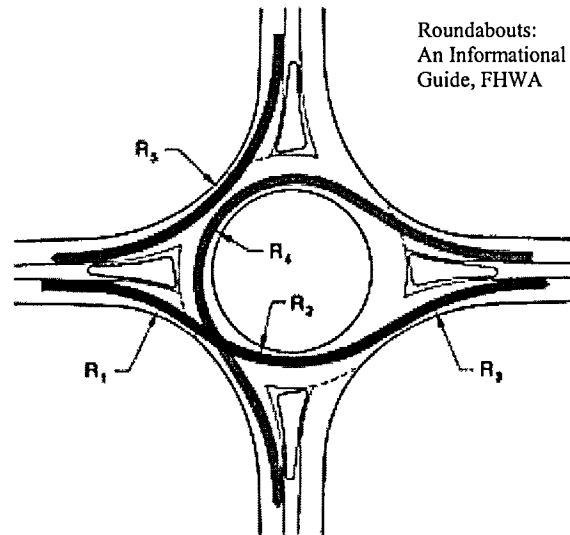


**Figure 3 – Roundabout Design Process**

Roundabout vehicle speeds are quantified by examining the five critical path radii:  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ , and  $R_5$  curves. These are the radii of the entering, circulating, exiting, left-turn, and right-turn movements, respectively. Refer to Figure 4.

$R_1$  must be less than or equal to  $R_2$ , and  $R_2$  less than or equal to  $R_3$ . Speeds must be reduced to their lowest level at  $R_1$ , the entry to the roundabout. Once a vehicle enters the circulating lane it

should not have to brake to negotiate the center island. Properly reducing the entering vehicle speed reduces rear end collisions on the approach legs and loss-of-control crashes in the circulating lane. This also reduces the differential speed between entering and circulating traffic and collision severity. All conflicting vehicle movement speeds must be no greater than 12 mph per the FHWA guidelines.



Roundabouts:  
An Informational  
Guide, FHWA

Figure 4 – Vehicle Path Analysis

### FOUR-LEG ROUNDABOUT DESIGN

Reid Middleton was furnished a conceptual roundabout design prepared by Entranco for the subject intersection. This layout portrayed a 150-foot inscribed circle diameter (ICD) roundabout with a fourth leg added to access the development on the northeast quadrant of the intersection. This layout did not meet criteria for speed consistency or for differential speeds between conflicting movements on any approach. For these reasons, this conceptual design needed further review and refinement.

With the existing site constraints, Reid Middleton was directed to develop a conceptual roundabout design that would:

- Minimize impacts on the development property on the northeast quadrant
- Minimize impacts on the wetland on the southeast quadrant
- Not allow the roadway to encroach on the trail property west of the intersection, however, the sidewalk and associated landscaping on the west side of the roundabout may encroach on the trail property pending Parks approval. If the sidewalk and associated landscaping must be moved into the roadway right of way, the roundabout will need to be shifted approximately twenty-feet toward SE 43rd Way.

Analysis using aaSIDRA software shows the following approach lanes are needed to accommodate the ELSP and SE 43rd Way traffic peak hour traffic:

- 2-NB lanes
- 3-SB lanes
- 2-WB lanes

The Entranco design ICD was increased in increments to 220-feet to gain separation between the north, development, and east legs. The larger roundabout failed to produce speed continuity or sufficiently reduce differential speeds between conflicting movements while having

increasingly negative impacts on the adjacent development property and wetland. It was concluded that a 4-leg roundabout was not appropriate for this location.

### **THREE-LEG ROUNDABOUT DESIGN**

A conceptual roundabout layout was achieved using a 3-leg, 160-foot ICD design. This layout meets the goals to provide for a safe and efficient roundabout intersection control. See attached Figure 5.

#### **AM Peak Hour**

The AM peak hour traffic posed two challenges:

1. Conflicts between two dominate movements: 1,000 southbound through vehicles conflicting 1,400 westbound left-turn vehicles.
2. Sufficient deflection and speed reduction for the third southbound through lane. This speed reduction is required to meet differential speed criteria between the southbound  $R_1$  movement and the westbound  $R_4$  movement and to slow motor vehicle traffic conflicting with pedestrian/bicycle movements.

Both these challenges were mitigated by providing a serpentine southbound slip-lane for southbound through traffic. The slip-lane reduces the number of southbound through vehicles conflicting with the westbound left-turn vehicles, reducing delays and queue lengths. The serpentine shape, combined with a landscaping buffer strip, will slow vehicles as they approach the pedestrian crossings.

#### **PM Peak Hour**

The dominant PM peak hour movements are 900 northbound through, 1,000 northbound right-turns, and 700 westbound vehicles. Providing a northbound right-turn slip-lane and not routing these vehicles through the circulating lane provided two benefits:

1. The northbound right-turn vehicles are not delayed by circulating lane traffic.
2. The northbound right-turn vehicles do not add delay to the westbound traffic entering the circulating lane.

Due to the low volume of southbound left-turn vehicles, a single northbound lane through the roundabout sufficiently supports this movement.

#### **Summary**

The 3-leg roundabout conceptual design provides for smooth and fluid drive paths, resulting in speed continuity for a safe and efficient roundabout. The 3-leg roundabout design minimizes encroachment onto the developer property, wetland and trail right-of-way, while providing U-turn capability for vehicles entering and exiting the proposed development to the east.

## 2022 TRAFFIC OPERATIONS

### ELSP/SE 43rd Way

The City Issaquah used Synchro Version 6.0 software to perform 2022 analysis for traffic signal control at the intersection. Reid Middleton used aaSIDRA to perform 2022 analysis for roundabout control at the intersection. Criteria for traffic signal and roundabouts level of service (LOS) are shown in Table 1.

**Table 1 – Traffic Signal & Roundabout Level of Service Criteria**

Level of Service	Signalized Intersection Delay Per Vehicle (seconds)
A	$\leq 10$
B	$> 10$ and $\leq 20$
C	$> 20$ and $\leq 35$
D	$> 35$ and $\leq 55$
E	$> 55$ and $\leq 80$
F	$> 80$

Highway Capacity Manual, 2000

The roundabout allows vehicles to enter the circulating lane at the first available gap. Thus it has the potential for vehicles to simultaneously enter and exit the intersection on every leg. In contrast, traffic signals operate on a predetermined phase sequence. When a phase or phases have a green ball or arrow the other phases wait and that traffic must be stored. The traffic signal phasing also includes clearance intervals between phases when no vehicles are supposed to enter the intersection.

In most cases the roundabout will out perform a traffic signal in applications like ELSP and SE 43rd Way if the proper geometrics can be fit to meet the site constraints. An exception is when traffic patterns are too dominant on an approach. This is not the case for this intersection and the given traffic volumes. Table 2 illustrates how a 3-leg roundabout design decidedly out performs a traffic signal for the ELSP and SE 43<sup>rd</sup> Way intersection.

**Table 2 – 2022 Average Delay & Level of Service**

Time of Day	Average Delay (sec/veh) – LOS	
	Traffic Signal	Roundabout
AM Peak Hour		
NB Approach	25 – C	10 – A
SB Approach	37 – D	19 – B
WB Approach	50 – D	15 – B
Total Intersection	41 – D	14 – B
PM Peak Hour		
NB Approach	66 – E	10 – A
SB Approach	18 – B	13 – B
WB Approach	55 – E	26 – C
Total Intersection	55 – E	13 – B

Less delay results in shorter queues and fewer stored vehicles. Reduction in delay also reduces vehicle emissions and concentrated stormwater pollutants. Roundabouts typically requires less new impervious area than a traffic signal (with associated lane additions), which would reduce stormwater discharges to Lake Sammamish, while the associated landscaping will capture and retain higher volumes of precipitation than new pavement.

**ELSP/Peregrine Point Way SE**

The ELSP/Peregrine Point Way SE intersection is located between two signalized intersections SE 43rd Way (750 feet to the south) and 212th Way SE (1,700 feet to the north). This stop-sign controlled T-intersection is the sole access to a residential neighborhood on the east side of ELSP. Residents have noted their concern regarding a need for sufficient gaps in northbound traffic to adequately egress Peregrine Way if a roundabout was installed at SE 43rd Way, versus the existing traffic signal.

Vehicles released from a traffic signal lose their platooning by the time they travel approximately 1/4 mile and therefore traffic modeling assumes a random arrival rate. Because the 212th Way SE intersection is greater than 1/4 mile to the north, the southbound traffic is modeled at a random arrival rate. Peak hour field observations confirm this condition for southbound traffic at Peregrine Point Way SE.

The City of Sammamish provided existing peak hour counts at the intersection and stated that, if all available property is developed under existing land use and zoning, AM and PM peak hour traffic volumes would increase by 43 and 38 percent, respectively. For 2022 analysis it is assumed that all available property on Peregrine Point Way SE is developed. See attached Figure 6 for existing and 2022 peak hour volumes. Criteria for stop-control level of service are shown in Table 3.

**Table 3 – Stop Control Level of Service Criteria**

Level of Service	Stop Control Intersection Delay Per Vehicle (seconds)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

Highway Capacity Manual, 2000

Peregrine Point Way SE delay calculations were performed using SimTraffic 6.0 and VISSIM traffic modeling software. SimTraffic was used when modeling a traffic signal at ELSP and SE 43rd Way while VISSIM was used when modeling a roundabout at ELSP and SE 43rd Way. Because both models are microscopic models and will not produce the same results with every run, the delays shown in Table 4 represent the average of multiple runs.

With the traffic signal alternative at SE 43rd Way, Peregrine Point Way SE fails during the 2022 AM peak hour because the southbound traffic queues from the SE 43rd Way traffic signal block Peregrine Point Way SE. The traffic signal at SE 43rd Way offers both an advantage and disadvantage to the Peregrine Point Way SE traffic. The advantage is that the traffic signal will create a gap in the northbound traffic between traffic signal phases. This works well when there is a short cycle length. The disadvantage is that when the cycle length is long and the queued northbound traffic is released by the traffic signal, the Peregrine Point Way SE traffic must wait until the entire queue passes before the next gap arrives. The SE 43rd Way traffic signal operates on a 150 second cycle during the PM peak hour with a maximum green phase of 75 seconds. This results in long delays on Peregrine Point Way SE for vehicles arriving at the beginning of the northbound through phase.

The roundabout releases traffic at a more random rate than the traffic signal. However, the VISSIM traffic model shows that there is sufficient hesitation by the northbound traffic entering the roundabout that the gaps presented to the Peregrine Point Way SE traffic are greater than with the traffic signal.

**Table 4 – Peregrine Point Way SE Average Delay & Level of Service**

Time of Day	2004		2022	
	Average Delay – LOS		Average Delay (sec/veh) – LOS	
	Traffic Signal at 43rd		Traffic Signal at 43rd	Roundabout at 43rd
AM Peak Hour	19 – C		> 500 – F	4 – A
PM Peak Hour	10 – A		14 – B	4 – A

## COLLISION HISTORY

The City of Sammamish provided the number of collisions (by type) for the vicinity of the ELSP/SE 43rd Way intersection from January 2001 to January 2004. See attached Figure 7. Table 5 summarizes the collision data.

**Table 7 – ELSP/SE 43rd Way Collision History**

Type	Number
Rear End	10
Side Swipe	1
Right Angle	5
Other	1

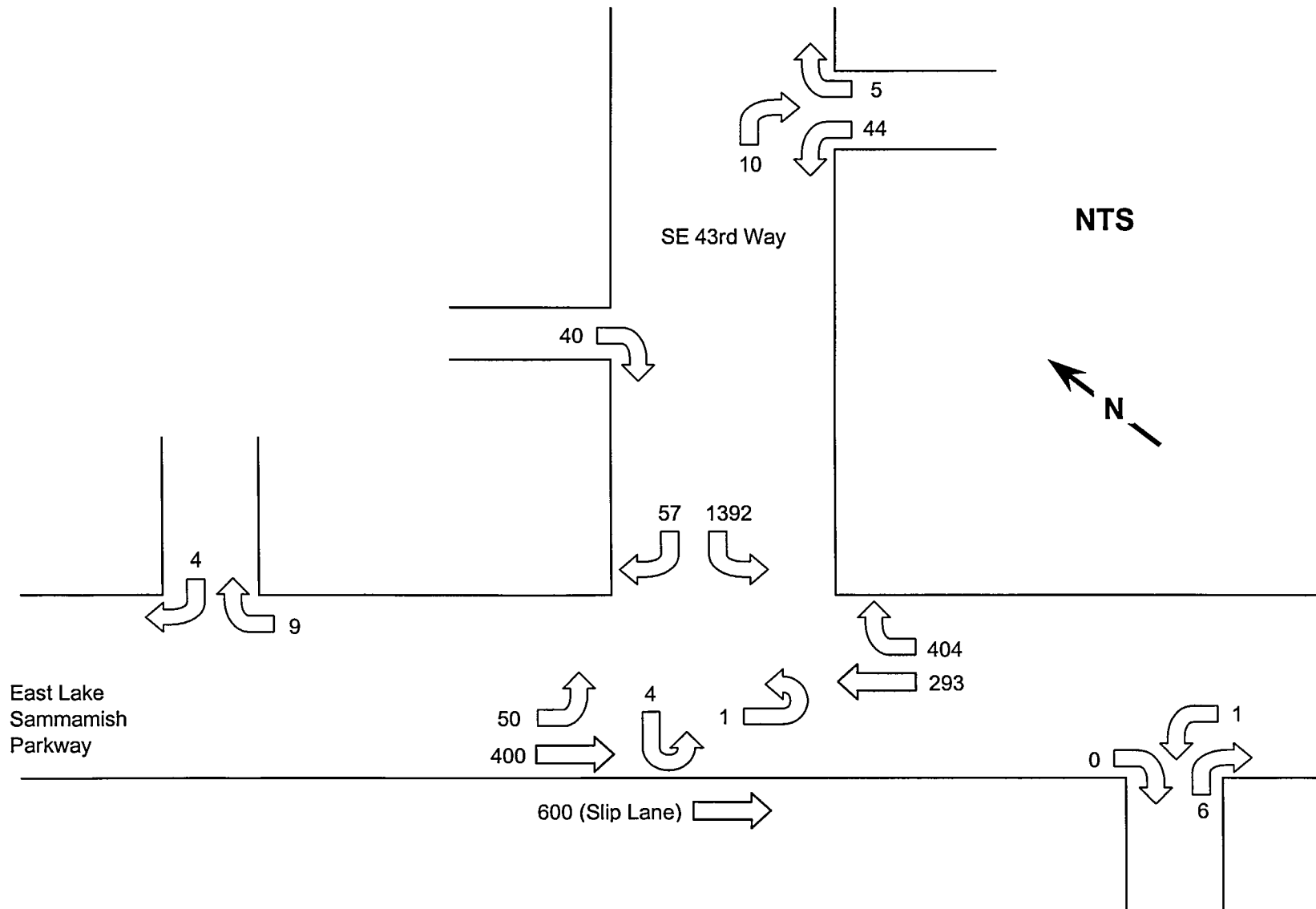
Eight of the rear end collisions occurred entering the intersection and two occurred exiting the intersection. Well-designed geometrics and landscaping on the roundabout approaches reduce the vehicle speeds gradually to the desired entering speed,  $R_1$ . The gradual reduction of approach speeds will mitigate many of the entering rear end collisions.

The geometrics of the roundabout mitigate all right angle collisions.

## CONCLUSION

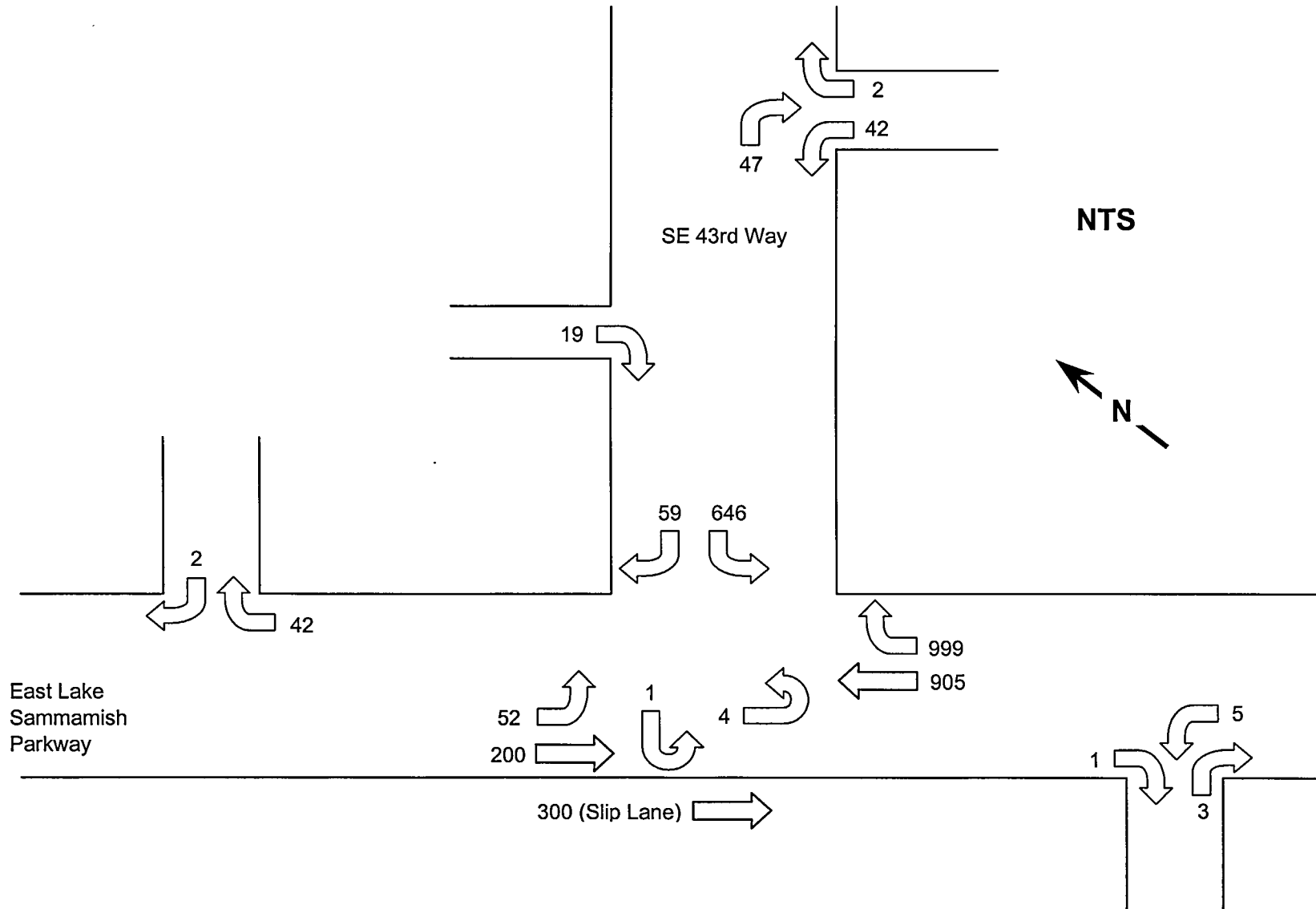
Based on the analysis, for the given site constraints and forecast traffic volumes, the 3-leg roundabout will control traffic more efficiently and safer than a traffic signal and provides better gaps for Peregrine Point Way SE traffic than a traffic signal. The roundabout will also present environmental benefits and provides an opportunity to embellish the intersection aesthetics with landscaping, forming a gateway feature for the ELSP and SE 43rd Way corridors.

# 2022 AM Peak Hour Traffic Volumes



**FIGURE 1**

## 2022 PM Peak Hour Traffic Volumes



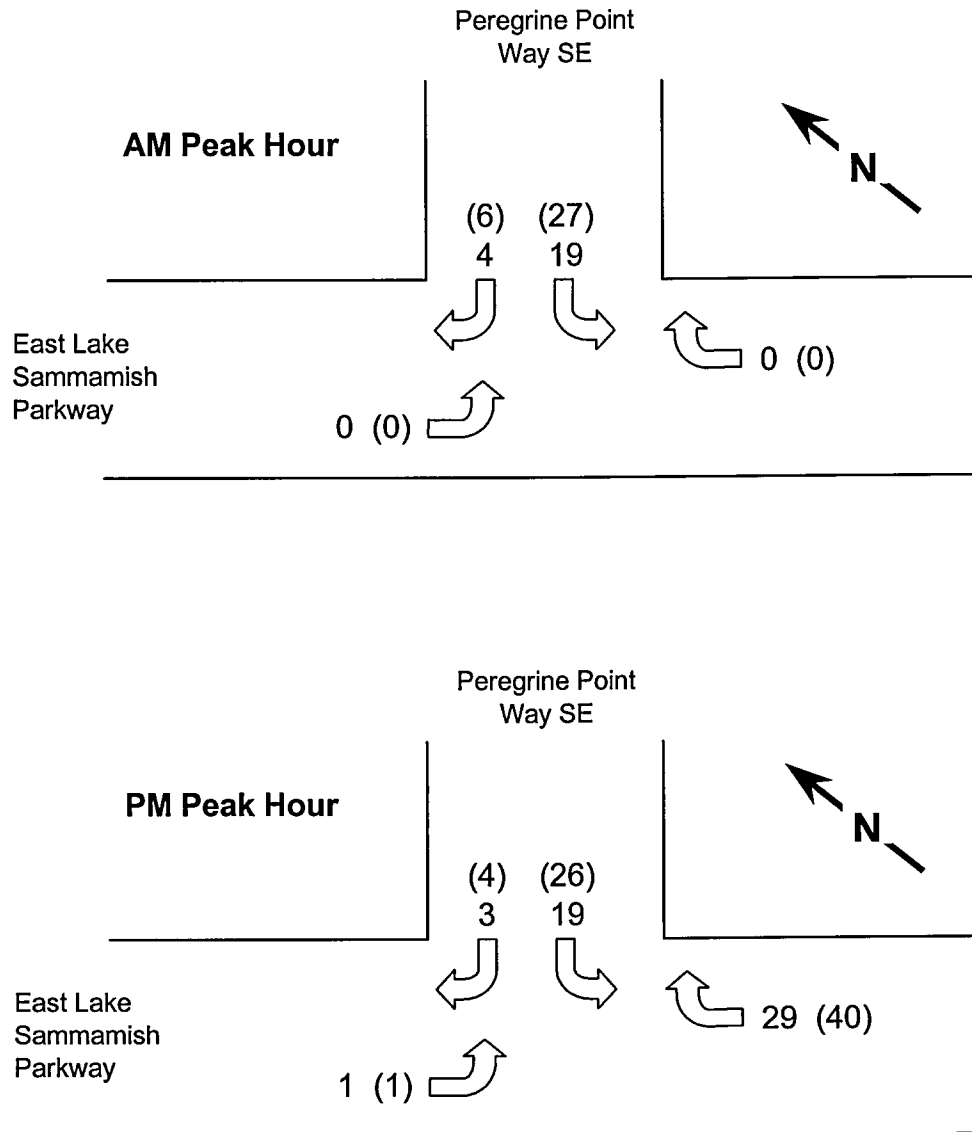
**FIGURE 2**



**FIGURE 5**

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# Peregrine Point Way SE Peak Hour Traffic Volumes



**LEGEND**  
 29 2004  
 (26) Full Buildout

**FIGURE 6**

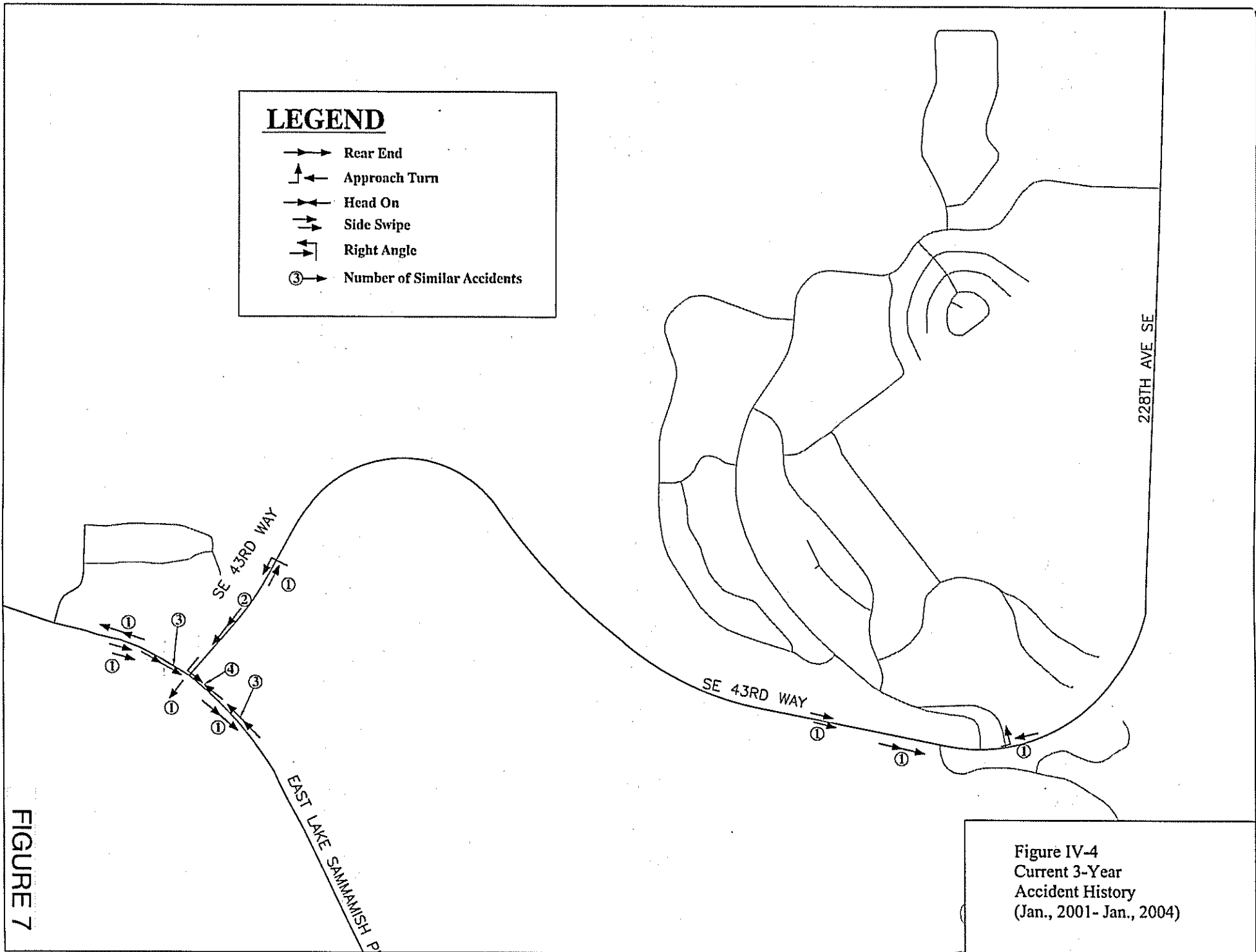


FIGURE 7

Figure IV-4  
 Current 3-Year  
 Accident History  
 (Jan., 2001- Jan., 2004)