A DIVISION OF HALEY WARD, INC.

Traffic Management Plan and Queuing Report

APPLICANT:
TMT Properties, Inc
PO Box 970354 | Coconut Creek, FL 33097

This document has been digitally signed and sealed by Steven G. Frink, PE #95595, on March 18, 2025.

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STEVEN GARY FRINK LICENSE 95595 STATE OF FLORIDA PROFESSIONAL ENGINEER

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Steven Frink, P.E. Date

PE #95595

March 5, 2025
JN: 24-276

REPORT PREPARED BY: Steven Frink, PE
Haley Ward, Inc.
10250 VILLAGE PKWY, STE 201, PORT ST. LUCIE, FL 34987

Contents

1.0 – Project Description

Located approximately 1/2 mile north of the intersection of SW Becker Rd and SW Darwin Blvd, on the east side, is a 6.28-acre (ac) vacant property with an associated property ID of 4432-500-0001-000-1. The project proposes the construction of a single-story daycare and educational facility that will be constructed in 3 phases. The first phase of the project will consist of the pre-kindergarten (pre-k) and educational grades K-5, the second phase is proposed to consist of grades 6-12, and the final phase will be determined at a later date.

Table 1: Proposed Student Population

Grades	Student Population
Daycare	40
K-5	120
6-8	160

The purpose of this report is to analyze the length and the average time in the queue for Phases I & II. The Traffic Management Plan & Queuing Analysis will need to be reevaluated once the third phase of the property begins the permitting process. To begin the analysis, the pre-k was assigned a first-in, first-out (FIFO), single queue multi-server model and the remainder of the grades analyzed used a FIFO single queue single server approach.

2.0 – Operational Hours

Darwin Autism School is proposing operational hours beginning at 7:30 AM and ending at 5:30 PM. Drop-off and pick-up times for pre-k and grade schools will be staggard to reduce unnecessary vehicle accumulation.

Table 2: Proposed Drop-off and Pick-up Times

Grade	Morning Drop-Off	Afternoon Pick-up
Pre-K	8:40 AM - 9:00 AM	1:35 PM - 2:00 PM
K-12	8:05 AM - 8:30 AM	2:15 PM - 2:40 PM

3.0 – Pre-Kindergarten

The pre-k portion of the project was analyzed using a FIFO, single queue multi-server methodology. This approach was selected as a single queue will form for any server, or parking space, to become available. The analysis looked for the average time in the queue is and the average number of vehicles in the queue.

3.1 – Vehicle Accumulation

The number of parking spaces allocated for drop-off and pick-up determined the number of parking spaces in the system. It is assumed that 14 parking spaces will be available during drop-off and pick-up and will be able to accommodate 7 vehicles per hour (vph). It is further assumed that all 40 students will arrive within a one-hour time period and that each vehicle will transport one student. Using these assumptions, the utilization factor (ρ) was then determined and is based on the probability that the parking space will be occupied. As demonstrated in Equation 1, the utilization factor is a quotient of the arrival rate (λ), the number of parking spaces (s), and the service rate (μ).

$$\rho = \frac{\lambda}{s\mu}$$
$$= \frac{40}{14(7)}$$
$$= 0.41$$

Equation 1: Utilization Factor

To determine the average number of vehicles that would be waiting in the queue, the probability that the entire system would be empty (ρ_0) needed to be evaluated first. Using Equation 2, this probability was determined to be 0.33%. Inserting this probability into Equation 3, the average number of vehicles waiting in the queue (L_q)is zero, indicating that there will always be a parking space available for the next vehicle to arrive. As there are no vehicles waiting for a parking space, the average time in the queue (W_q) is also zero, as shown in Equation 4.

$$p_0 = \left\{ \sum_{n=0}^{s-1} \left[\frac{\left(\lambda/\mu\right)^n}{n!} \right] + \frac{\left(\lambda/\mu\right)^s}{s!} \left(\frac{1}{1-\rho} \right) \right\}^{-1}$$

$$= 0.0033$$

$$= 0.33\%$$

Equation 2: Probability the System is Empty

$$L_q = \frac{p_0 \left(\lambda/\mu\right)^s \rho}{s!\,(1-\rho)^2}$$

$$= \frac{0.0033 \left(40/7\right)^{14} (0.41)}{14!\,(1-0.41)^2}$$

$$= 0.0017\ vehicles$$

$$\approx 0\ vehicles$$

Equation 3: Average Number of Vehicles Waiting in Queue

$$W_q = \frac{L_q}{\lambda}$$

$$= \frac{0.0017}{40}$$

$$= 0.00004\ hours$$

$$= 0.00262\ minutes$$

Equation 4: Average Queue Waiting Time

The next two variables that need to be determined are the average time spent in the queue and in a parking space (W) and the average number of vehicles in the system (L). This accomplished by summing the average queue waiting time to the mean service time, as demonstrated in Equation 5, and produce an average time of 8.57 minutes. This was then multiplied by the arrival rate, Equation 6, to determine the average number of vehicles in the system.

$$W = W_q + \frac{1}{\mu}$$
$$= 0 + \frac{1}{7}$$
$$= 0.14\ hours$$
$$\approx 8.57\ minutes$$

Equation 5: Average Time in System

$$L = \lambda W$$
$$= 40(0.14)$$
$$= 5.72\ vehicles$$
$$= 6\ vehicles$$

Equation 6: Average Number in the System

Finally, the probability that *n* number of vehicles that are in the system at any given time. The probability utilize can be seen as Equation 7. A graphical representation has been provided as Figure 1. From the figure, it is shown that the greatest chance of vehicles in the system occurs when the number of vehicles reaches 5.

$$P_n = \begin{cases} \frac{\left(\lambda/\mu\right)^n}{n!} p_0\ when\ n \leq s \\ \frac{\left(\lambda/\mu\right)^n}{s!\ s^{n-1}} p_0\ when\ n > s \end{cases}$$

Equation 7: Probability of n Vehicles in System

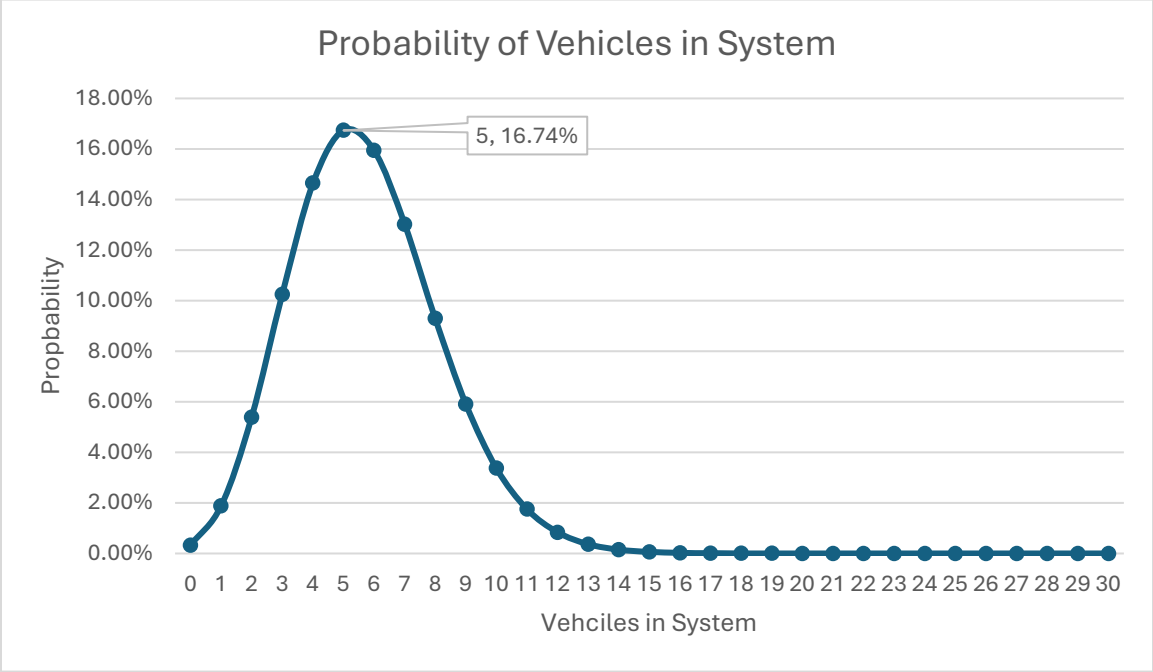

Figure 1: Probability of Vehicles in System at a Given Time

4.0 – Grade School

The grade school will consist of grade K-12 and be constructed in 2 phases. The first phase will consist of grades K-5 and is anticipating a population of 120 students, and the second phase will add grades 6-12, adding an additional 160 students, for a total of 280. The analysis for the grade school portion of the development used a FIFO singles server approach. To begin the analysis, the following assumptions were made:

- Each vehicle occupies 25 feet (ft);
- Each vehicle would arrive in a 30-minute time frame;
- Each vehicle would transport only one child;
- Each vehicle would take approximately one minute to load and unload; and
- 30% of the K-5 student population would be enrolled in before- and/or after-care.

The before- and/or after-care enrollment would reduce the K-5 arrival and dismissal by 36 students, resulting in 84 students arriving for the first phase and 244 students for the second phase.

4.1 – Personnel

The proposed on-site queuing plan was developed to accommodate the arrival and departure of vehicles in a smooth and effective manner. The school will assign trained staff members to critical areas for traffic management and safety, as well as utilize a traffic control office, police officer, or Florida state-certified crossing guard for operation in the SW Darwin Blvd right-of-way (ROW). At pick-up time, staff members will transmit a student identifier to the interior of the school where the child will be placed in a line for pick-up. The included appendixes depict the suggested location of each member and the following description outlines the responsibility of each member.

1) Drop-off/Pick-up Release Director – A trained staff member will release vehicles following the loading and unloading of the students. The staff member will also assist students and parents during the drop-off and pick-up process as needed.

2) Unloading and Loading of Students at Drop-Off/Pick-Up Area(s) – Staff will be positioned within the designated drop-off and pick-up area(s) and at key locations on the site. Depending on the initial process and observed operations, up to 4 teachers and/or administrators will be directly involved in the process of directing students, cars, and traffic.

3) Traffic Control Personnel – A trained staff member will direct in coming vehicles to the proper lane to ensure that there is no congestion in the SW Darwin Blvd right-of-way.

4) Traffic Control Officer/Police Officer/Crossing Guard – A Florida state-certified crossing guard, traffic control officer, or police officer will be located at the entrance to the site along SW Darwin Blvd. The officer or crossing guard can stop traffic along SW Darwin Blvd, at their discretion, to allow vehicles to leave the property and improve on-site operations. The personnel at this location can also impede the flow of traffic onto and out of the property to allow people to cross the driveway safely.

4.2 – Phase I On-site Queueing Plan

The on-site queuing plan was developed to reduce impacts to the SW Darwin Blvd ROW and minimize the time spent dropping off or picking up the 84-student population. To accomplish this goal, parents will be instructed to remain in their vehicles and proceed through the designated drop-off/pick-up lane. The designated drop-off/pick-up lane has a length of 675 ft allowing for a maximum of 27 vehicles to queue before impacts to the SW Darwin Blvd ROW occur.

Vehicles will enter the property using the existing driveway connection provided by The Life Shift Church. After dropping off or picking up the student(s), the vehicle can then depart through the newly constructed driveway or the existing connection provided by the Church. Appendix A: Phase I Vehicle Queue depicts the maximum anticipated queue length for Phase I.

4.3 – Phase I On-site Queueing Contingency Plan

While it is anticipated that the proposed ingress/egress has sufficient capacity to allow the vehicles to queue, it is important to have a contingency plan in place for any unforeseen issue. The contingency plan as shown in Appendix B: Phase I Vehicle Queue Contingency Plan consists of using the second and third drive aisle at 225 ft each as storage for additional stacking. This will allow for an additional 18 vehicles to wait on-site should the need arise. This plan is not anticipated to be utilized and is provided to demonstrate the flexibility that the site has to increase the queueing length in the unlikely event that it is needed.

4.4 – Phase II On-site Queueing Plan

Phase II will operate in much of the same capacity as Phase I. The on-site queuing plan was developed to reduce impacts to the SW Darwin Blvd ROW and minimize the time spent dropping off or picking up the 244-student population. Parents will again be instructed to remain in their vehicles during the pick-up and drop-off process and proceed to the designated pick-up/drop-off lane. The designated drop-off/pick-up lane has a length of 850 ft allowing for a maximum of 34 vehicles to queue before impacting the SW Darwin Blvd ROW.

Vehicles will enter the property using the existing driveway connection provided by the Church. After dropping off or picking up the student(s), the vehicle can then depart through the newly constructed driveway or the existing connection provided by the Church. Appendix C: Phase II Vehicle Queue depicts the maximum anticipated queue length for Phase II.

4.5 – Phase II On-site Queuing Contingency Plan

A contingency plan was also developed for Phase II. The contingency plan as shown in Appendix D: Phase II Vehicle Queue Contingency Plan consists of using the second and third drive aisle at 400 ft each as storage for additional stacking. This will allow for an additional 32 vehicles to wait on-site should the need arise. This plan is not anticipated to be utilized and is provided to demonstrate the flexibility that the site has to increase the queueing length in the unlikely event that it is needed.

4.6 – Vehicle Accumulation

As previously mentioned, the first phase of the development is anticipated to have a population of 84 students in grades K-5 arriving by vehicle with 36 in before/aftercare, for a total student body of 120 people. An additional 160 students will be added in the second phase resulting in a total student population of 280, with 244 arriving by vehicle and 36 in before/aftercare.

To determine the average number of vehicles that would queue for Phase I, the utilization factor (ρ) needed to be calculated, this time using Equation 8. As before the utilization factor is the probability that the drop-off and pick-up areas is occupied and is a ratio of the arrival rate (λ) and the rate at which the drop-off/pick-up area will be used (μ).

$$\rho = \frac{\lambda}{\mu}$$
$$= \frac{168}{360}$$
$$= 0.4\bar{6}$$
$$\approx 0.47$$

Equation 8: Phase I Utilization Factor

As the equation is based on the number of vehicles per hour, the number of vehicles was doubled to 168 and services as the arrival rate. For Phase I it is assumed that there will be six active areas to complete the drop-off and pick-up process, resulting in 360 services being completed per hour. The ratio of the arrival rate and the service rate produced a utilization factor of 0.47.

To find the average number of vehicles in the system (L), the difference between the service rate and the arrival would need to be determined. This difference was then used as a divisor with the arrival rate that produces the average number of vehicles in the queue, Equation 9. The utilization factor was then multiplied with the average number of vehicles in the queue to produce the average number of vehicles waiting in the queue (L_q),Equation 10.

$$L = \frac{\lambda}{\mu - \lambda}$$

Equation 9: Average Number of Vehicles in the System

$$L_q = \rho L$$

Equation 10: Average number of Vehicles Waiting in the Queue

With 168 vehicles arriving at the Darwin Autism School every hour, and with the potential of 360 drop-offs/pick-ups occurring every hour, the average number of vehicles in the system is approximately one. This would lead to the average number of vehicles waiting in the queue at one. Recalling that every vehicle will occupy 25 ft, results in 25 ft used for both the average number of vehicles in the system and waiting in the queue. The queue would then be reduced by 6 vehicles per minute (vpm) until no vehicles remained in the queue.

The results of the vehicle accumulation analysis mean that 2 vehicles would be added to the queue every minute until all of the vehicles have arrived. This created a maximum queue length of 20 vehicles, and occupy 500 ft, after 10 minutes have passed, as shown in Table 3

Table 3: Phase I Maximum Queue Length per Minute

Time (t, min)	Vehicles Arrived	Vehicles Serviced	Vehicles in Queue	Vehicles Remaining To Be Serviced
0	0	0	0	84
1	8	6	2	78
2	16	12	4	72
3	24	18	6	66
4	32	24	8	60
5	40	30	10	54
6	48	36	12	48
7	56	42	14	42
8	64	48	16	36
9	72	54	18	30
10	80	60	20	24
12	84	72	12	12
13	84	78	6	6
14	84	84	0	0

The process was then repeated for Phase II and increasing the number of available drop-off/pick-up areas to 13. This resulted in a utilization factor (ρ) of 0.63, an average number of vehicles in the system (L) at two, an average number of vehicles in the queue at one, and occupy 25 ft. The queue would then be reduced by 13 once all vehicles have arrived until no vehicles remain.

The results of the vehicle accumulation analysis mean that 2 vehicles would be added to the queue every minute until all of the vehicles have arrived. This created a maximum queue length of 32 vehicles, and occupy 800 ft, after 16 minutes have passed, as shown in Table 4

Table 4: Phase II Maximum Queue Length per Minute

Time (t, min)	Vehicles Arrived	Vehicles Serviced	Vehicles in Queue	Vehicles Remaining To Be Serviced
0	0	0	0	244
1	15	13	2	231
2	30	26	4	218
3	45	39	6	205
4	60	52	8	192
5	75	65	10	179
6	90	78	12	166
7	105	91	14	153
8	120	104	16	140
9	135	117	18	127
10	150	130	20	114
11	165	143	22	101
12	180	156	24	88
13	195	169	26	75
14	210	182	28	62
15	225	195	30	49
16	240	208	32	36
17	244	221	23	23
18	244	234	10	10
19	244	247	0	0

4.0 – Summary

Darwin Autism School is projecting a student body of 40 pre-k students, 120 K-5 grade students, and 160 6-12 grade students, in a phased development. Of the 120 K-5 grade students, 30% were assumed to be in before/aftercare, resulting in 84 students in grades K-5 and 244 students in all grades upon completion of the second phase. The drop-off and pick-up times for the pre-k and grade school will be staggered in an effort to reduce vehicle accumulation.

Phase I can accommodate 27 vehicles through the use of the 675 ft drop-off/pick-up lane, while Phase II can accommodate 34 vehicles. Two additional lanes at 225 ft for the first phase and 400 ft for the second phase can be placed into operation, for both phases, should the need arise. This will allow an additional 18 vehicles and 32 vehicles to queue for phases I and II, respectively.

Appendix A: Phase I Vehicle Queue

VICINITY MAP
SCALE: 1:1,000

PROPOSED DETENTION AREA
49,575 S.F.

POTENTIAL FUTURE DEVELOPMENT

Phase II

Proposed Pre-K Parking (14 Spaces)

PROPOSED DETENTION AREA
4,764 S.F.

PROPOSED TRAFFIC CONES

PHASE I
PROPOSED
2 STORY BUILDING
12,556 S.F.
MIN FFE.: 21.56'

PHASE II
PROPOSED
2 STORY BUILDING
12,556 S.F.
MIN FFE.:21.56'

PROPOSED PLAYGROUND AREA
9,109 S.F.

GRAPHIC SCALE
100 0 50 100 200 300
(IN FEET)
1 inch = 100 ft.

REV.	DATE	DESCRIPTION	BY	CHK.

DRAWING ISSUE STATUS

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PROJECT
DARWIN AUTISM CHARTER SCHOOL
PORT ST. LUCIE, FLORIDA

TITLE
QUEUING PLAN
PHASE I

LEGEND

EXISTING METER		EXISTING UTILITY POLE	
PROPOSED SIGN		PROPOSED DRAINAGE INLET	
PROPOSED MITERED END SECTION		EXIST. DRAINAGE INLET	
HANDICAP PARKING SYMBOL		EXISTING STREET LIGHT	
EXISTING CONCRETE		PROPOSED LIGHT POLE (SINGLE)	
EXISTING PAVEMENT		DRAINAGE FLOW ARROW	
PROPOSED CONCRETE		PROPOSED LIGHT POLE (DOUBLE)	
PROPOSED PAVEMENT	(#)	PARKING STALL COUNT	
PROPOSED TRAFFIC CONE		EXISTING DRAINAGE	
PERSONNEL LOCATION		PROPOSED DRAINAGE PIPE	

DATE 3/17/2025 | SCALE AS SHOWN
DRAWN BY JJL | DESIGNED BY JJL | CHECKED BY JRH
PROJECT No. 24-276 R6 QUEUING REPORT.DWG

J.R. HARRISON, P.E. (DATE)
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DRAWING No. **Q-101** REV.

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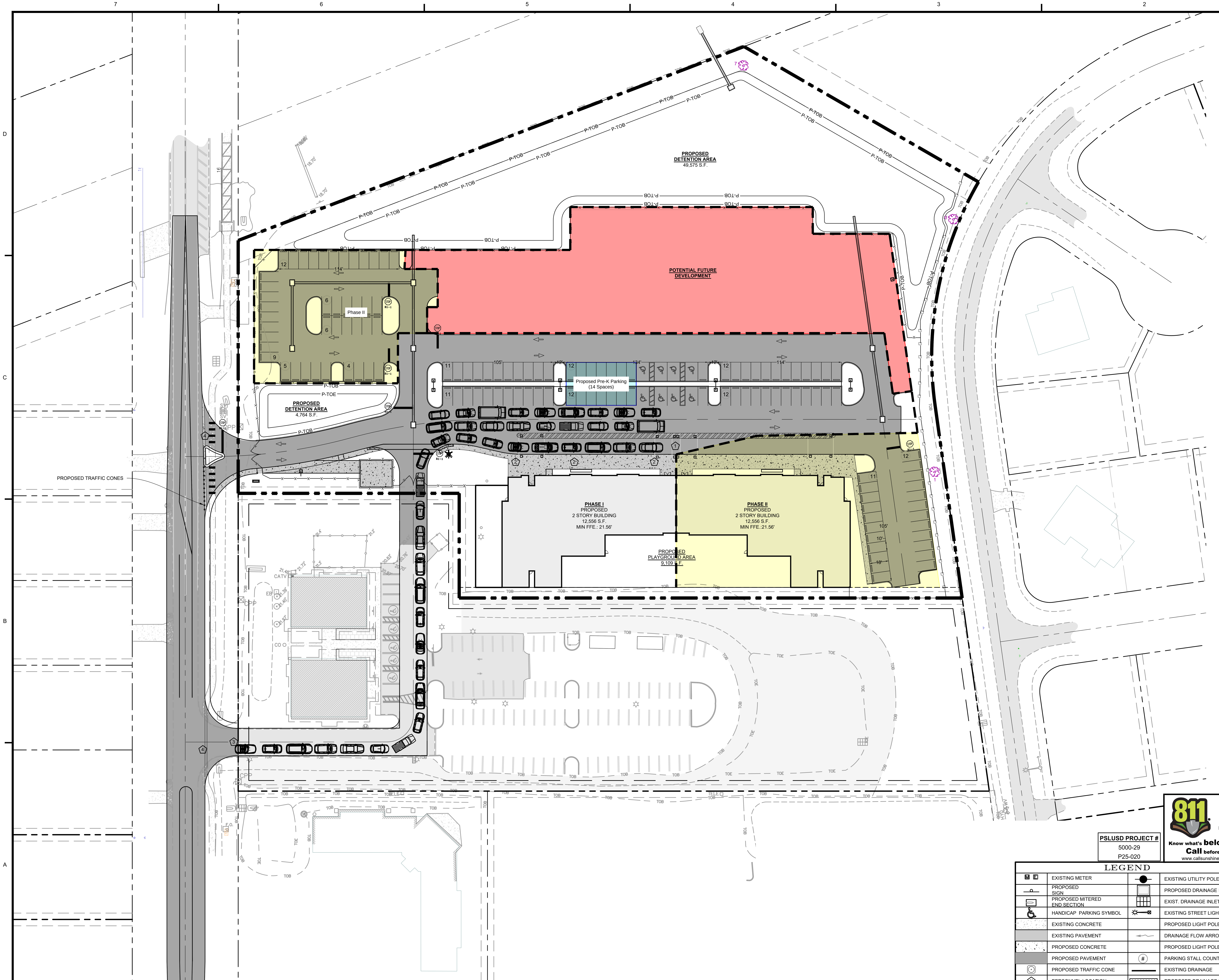
Appendix B: Phase I Vehicle Queue Contingency Plan



VICINITY MAP
SCALE: 1:1,000

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	PROPOSED MITERED END SECTION		EXIST. DRAINAGE INLET
	HANDICAP PARKING SYMBOL		EXISTING STREET LIGHT
	EXISTING CONCRETE		PROPOSED LIGHT POLE (SINGLE)
	EXISTING PAVEMENT		DRAINAGE FLOW ARROW
	PROPOSED CONCRETE		PROPOSED LIGHT POLE (DOUBLE)
	PROPOSED PAVEMENT	#	PARKING STALL COUNT
	PROPOSED TRAFFIC CONE		EXISTING DRAINAGE
	PERSONNEL LOCATION		PROPOSED DRAINAGE PIPE

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PROJECT
DARWIN AUTISM CHARTER SCHOOL
PORT ST. LUCIE, FLORIDA

TITLE
QUEUING PLAN
PHASE I - CONTINGENCY

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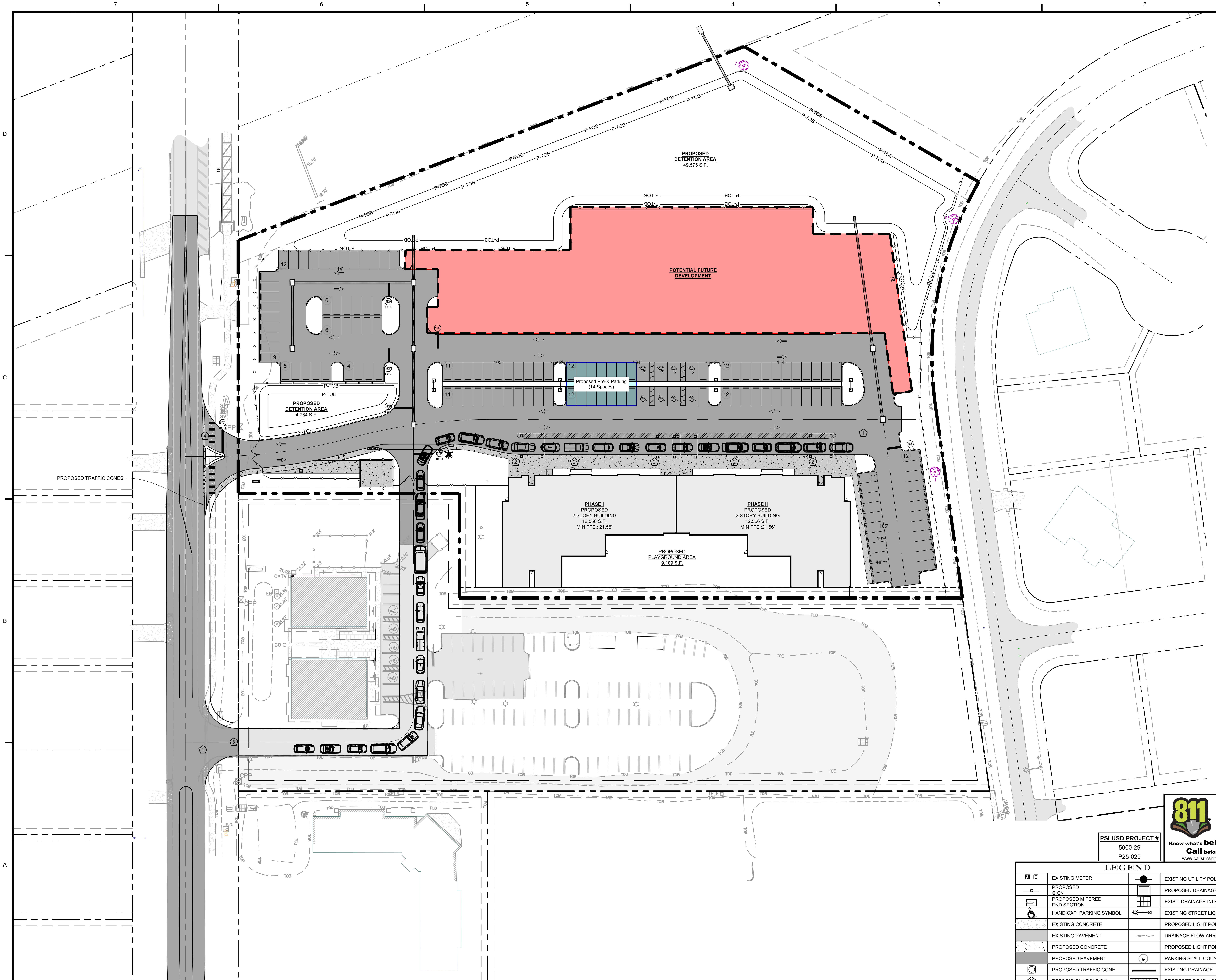
Appendix C: Phase II Vehicle Queue



VICINITY MAP
SCALE: 1:1,000

GRAPHIC SCALE
100 0 50 100 200 300
(IN FEET)
1 inch = 100 ft.

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PROJECT
DARWIN AUTISM CHARTER SCHOOL
PORT ST. LUCIE, FLORIDA

TITLE
QUEUING PLAN
PHASE II

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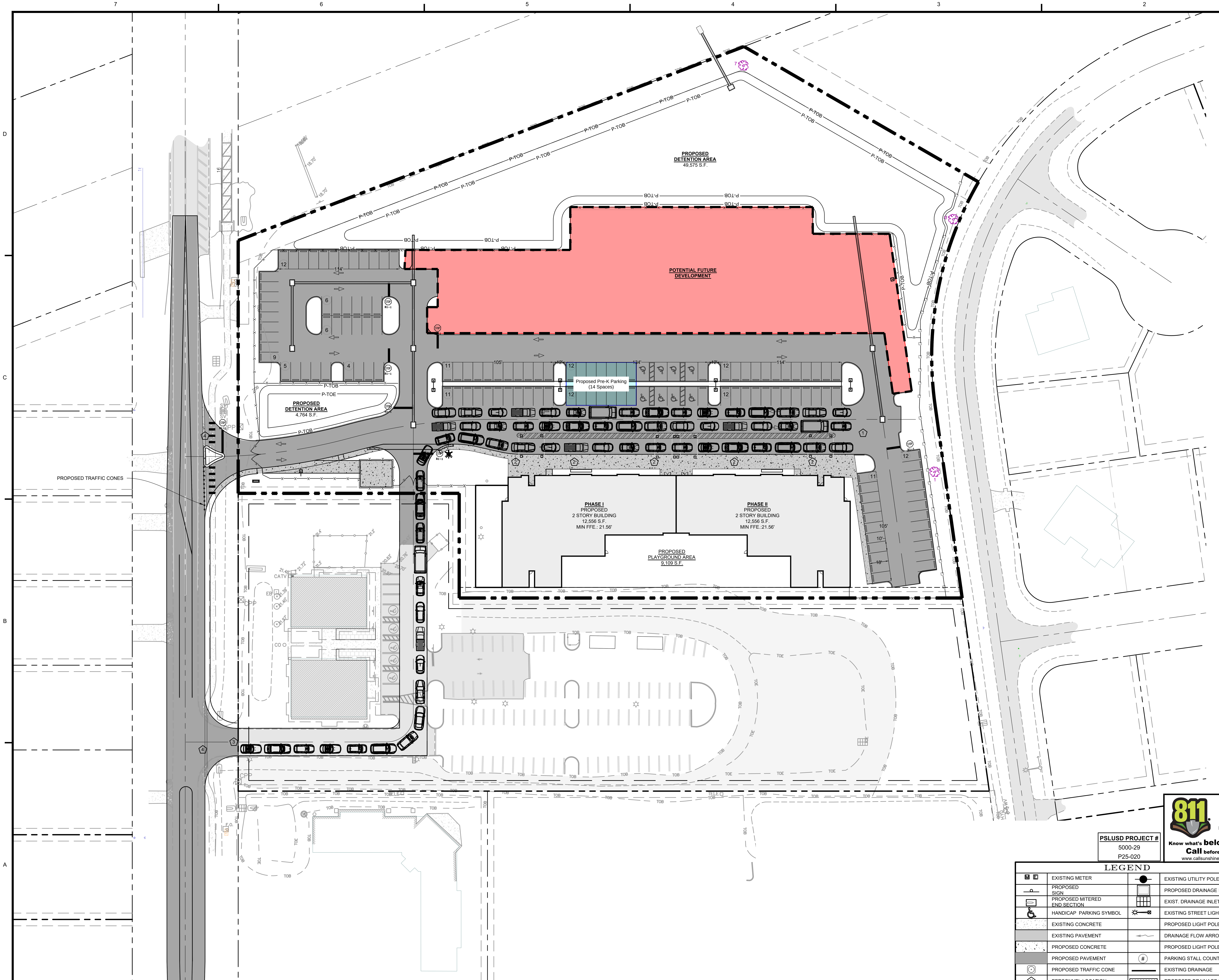
PROPOSED MITERED END SECTION	EXIST. DRAINAGE INLET
HANDICAP PARKING SYMBOL	EXISTING STREET LIGHT
EXISTING CONCRETE	PROPOSED LIGHT POLE (SINGLE)
EXISTING PAVEMENT	DRAINAGE FLOW ARROW
PROPOSED CONCRETE	PROPOSED LIGHT POLE (DOUBLE)
PROPOSED PAVEMENT	PARKING STALL COUNT
PROPOSED TRAFFIC CONE	EXISTING DRAINAGE
PERSONNEL LOCATION	PROPOSED DRAINAGE PIPE

Appendix D: Phase II Vehicle Queue Contingency Plan



VICINITY MAP

SCALE: 1:1,000

GRAPHIC SCALE

100 0 50 100 200 300

(IN FEET)
1 inch = 100 ft.

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	EXISTING PAVEMENT		DRAINAGE FLOW ARROW
	PROPOSED CONCRETE		PROPOSED LIGHT POLE (DOUBLE)
	PROPOSED PAVEMENT	#	PARKING STALL COUNT
	PROPOSED TRAFFIC CONE		EXISTING DRAINAGE
X	PERSONNEL LOCATION		PROPOSED DRAINAGE PIPE

REV.	DATE	DESCRIPTION	BY	CHK.

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PROJECT

DARWIN AUTISM CHARTER SCHOOL

PORT ST. LUCIE, FLORIDA

TITLE

QUEUING PLAN
PHASE II - CONTINGENCY

J.R. HARRISON, P.E. (DATE)
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10250 SW VILLAGE PARKWAY - SUITE 201
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