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The Gardens at North Carefree
ESAL Calculation Memorandum
PCD File No. SF-19
(LSC #204240)
April 1, 2020

Traffic Engineer's Statement

This traffic report and supporting information were prepared under my responsible charge and they comport with the standard of care. So far as is consistent with the standard of care, said report was prepared in general conformance with the criteria established by the County for traffic reports.

Developer's Statement

I, the Developer, have read and will comply with all commitments made on my behalf within this report.

4-2-2020
Date

LSC TRANSPORTATION CONSULTANTS, INC.
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April 1, 2020

Mr. Grace Covington
Covington Properties
13725 Struthers Road, Suite 201
Colorado Springs, CO 80921

RE: The Gardens at North Carefree
El Paso County, Colorado
ESAL Calculation Memorandum
LSC #204240

Dear Ms. Covington:

In response to your request, LSC Transportation Consultants, Inc. has prepared this transportation memorandum for The Gardens at North Carefree in El Paso County, Colorado. The site is located south and east of the intersection of North Carefree Circle/Akers Drive in El Paso County. LSC completed a traffic impact analysis for The Gardens at North Carefree dated October 16, 2018. This memorandum contains the projected buildout weekday traffic volumes and segment-specific Equivalent Single Axle Load (ESAL) values for use in pavement design for the Urban Local streets within the site. This memo accompanies a deviation request form.

TOTAL TRAFFIC

Figure 1 shows the projected average weekday traffic volumes on the interior streets of The Gardens at North Carefree. These volumes are based on the trip generation estimates, directional distribution, and trip routing estimates shown in the October 2018 traffic impact study.

ESAL CALCULATIONS

LSC has calculated street-segment-specific equivalent single axle load (ESAL) values based on the projected ADTs. These calculated ESALs and direction from El Paso County PCD staff on prior deviation requests have been used to develop recommended design ESALs for use in the pavement design of the streets within The Gardens at North Carefree.

All streets within The Gardens at North Carefree are planned to be classified Urban Local. For purposes of this ESAL calculation report, the Urban Local category has been divided into ADT (average daily traffic) ranges. The recommended design ESALs determined using this procedure are intended for use by the geotechnical engineer in the design of the pavement section(s). In some cases, this may require slightly less base course depth, thereby saving on material costs while at the same time providing an appropriate design. The design average daily traffic volume range for Urban Local streets (300 up to 3,000 ADT) has been split into two ranges as shown in the attached Table 1. As presented in the table, these ranges are from 300-1,120 and 1,120-3,000 vehicles per day. The purpose of grouping the traffic volumes in this way was to provide a means of comparing the calculated and proposed design ESAL values for each street segment to the minimum design ESAL

values listed in Table D-2 of the El Paso County Engineering Criteria Manual (ECM) (attached for reference). A previous version of the ECM included separate ESAL and pavement section values for lower- and higher-volume Urban Local streets. The applicable page has also been attached for reference.

The ECM outlines procedures for calculating ESAL values and determining the corresponding depth of asphalt pavement required, based on the street classification. For Urban Local streets, the ECM requires a truck percentage of four percent to be used. The ECM does not specify the vehicle mix of multi-unit and single-unit trucks. The ECM only indicates the total truck percentage. A vehicle mix of 2.33 percent single-unit trucks, 1.67 percent multi-unit trucks, and 96 percent cars/pickups was assumed for a total truck percentage of four percent.

Table 2 shows the ESAL calculations for each street segment. The table then shows the recommended design ESALs. As shown in Table 2, LSC recommends a design ESAL of 109,500 be used for all street segments within the Gardens at North Carefree.

Please contact me if you have any questions or need further assistance.

Respectfully Submitted,

LSC TRANSPORTATION CONSULTANTS, INC.

By: Jeffrey C. Hodsdon, P.E.
Principal

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Enclosures: Tables 1-2
Figure 1
Table D-2 of the Previous ECM
Table D-2 of the Current ECM

Tables and Figures

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Table 1
The Gardens at North Carefree
Street Classifications (for pavement design) with ADT Ranges and ESAL Values

Urban Street Functional Classification (from ECM Table D-2)	ADT Volume Range	ECM ESAL (from ECM Table D-2) Version prior to 2011	LSC-Proposed Design ESAL
Used in Table 2 Calculations			
Local (pavement only)	>300-1,120 (1)	109,500	109,500
Not Applicable To This Project			
Local (pavement only)	>1,120-3,000	292,000	292,000

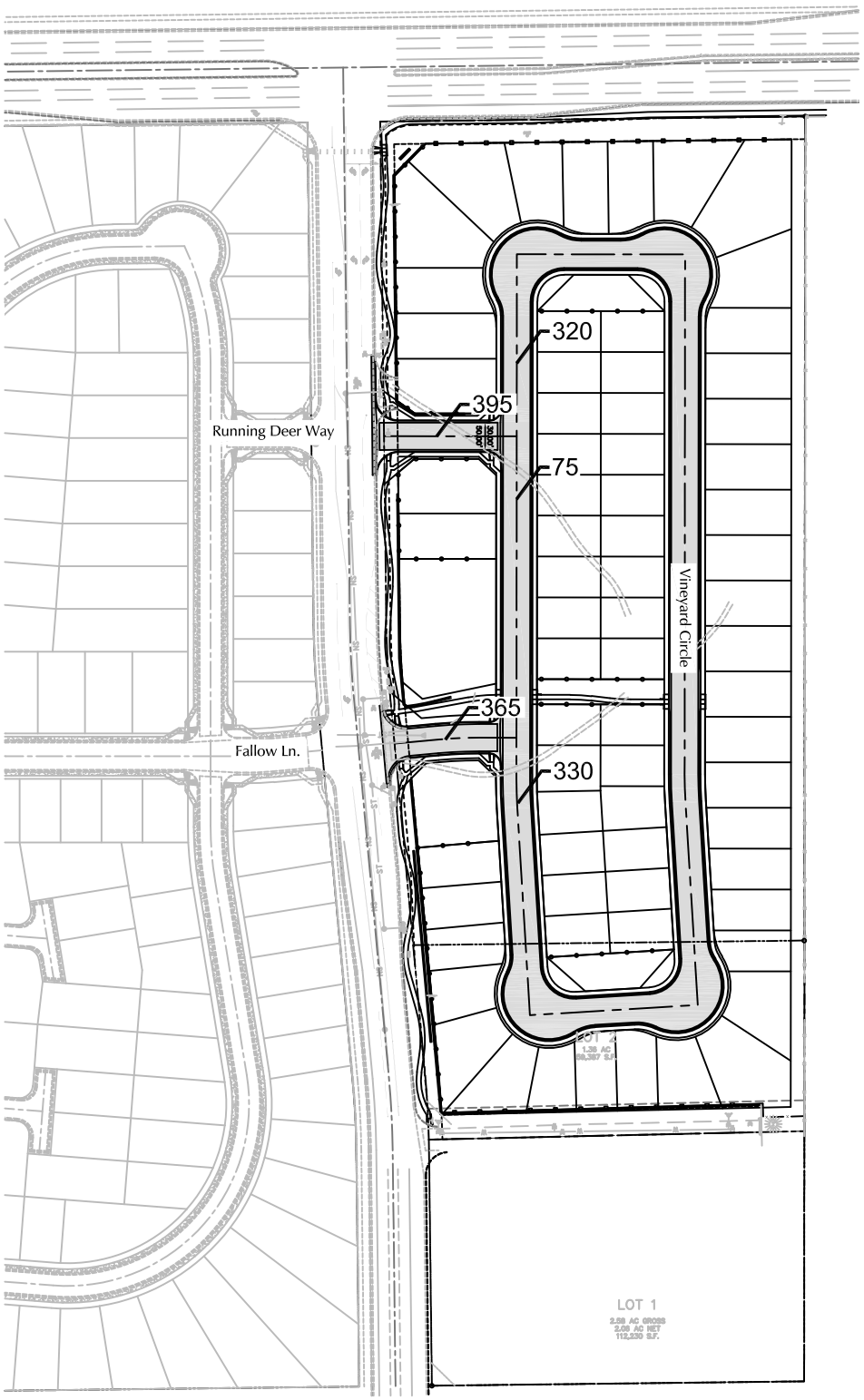
(1) 1,120 ADT not specifically quoted in ECM for Local (pavement only) streets, but resulting ESAL matches Table D-2 of the ECM when assuming 4% trucks. The 2011 ECM has been revised to remove the Local (pavement only line in the table. This was due to confusion over its use rather than removal because of inaccuracy).

Source: LSC Transportation Consultants, Inc. - 1 April 2020

Table 2
The Gardens at North Carefree
ESAL Calculation Table

Segment	Classification	Vehicle Type	Total Percent of One-Way ADT	Design Lane Percent of One-Way ADT	ADT (Vehicles Per Day)	Directional ADT (Vehicles Per Day)	Vehicles in Single Lane	CDOT Factor	EDLA	Calculated 20-Year 18-Kip ESAL	Recommended Design ESAL
Fallow Ln	Urban Local (Pavement Only)	Multi-Unit Trucks	1.67%	1.67%	395	198	3	1.087	3.59		
		Single-Unit Trucks	2.33%	2.33%			5	0.249	1.15		
		Passenger Cars/Pickup Trucks	96.00%	96.00%			190	0.003	0.57		
		Total							**5.30**	**38,689**	**109,500**
Running Deer Way	Urban Local (Pavement Only)	Multi-Unit Trucks	1.67%	1.67%	365	183	3	1.087	3.31		
		Single-Unit Trucks	2.33%	2.33%			4	0.249	1.06		
		Passenger Cars/Pickup Trucks	96.00%	96.00%			175	0.003	0.53		
		Total							**4.90**	**35,750**	**109,500**
Vineyard Circle N/O Fallow Ln	Urban Local (Pavement Only)	Multi-Unit Trucks	1.67%	1.67%	320	160	3	1.087	2.90		
		Single-Unit Trucks	2.33%	2.33%			4	0.249	0.93		
		Passenger Cars/Pickup Trucks	96.00%	96.00%			154	0.003	0.46		
		Total							**4.29**	**31,343**	**109,500**
Vineyard Circle S/O Fallow Ln	Urban Local (Pavement Only)	Multi-Unit Trucks	1.67%	1.67%	75	38	1	1.087	0.68		
		Single-Unit Trucks	2.33%	2.33%			1	0.249	0.22		
		Passenger Cars/Pickup Trucks	96.00%	96.00%			36	0.003	0.11		
		Total							**1.01**	**7,346**	**109,500**
Vineyard Circle S/O Running Deer Way	Urban Local (Pavement Only)	Multi-Unit Trucks	1.67%	1.67%	330	165	3	1.087	3.00		
		Single-Unit Trucks	2.33%	2.33%			4	0.249	0.96		
		Passenger Cars/Pickup Trucks	96.00%	96.00%			158	0.003	0.48		
		Total							**4.43**	**32,322**	**109,500**

Source: LSC Transportation Consultants, Inc. - 1 April 2020



Approximate Scale
Scale: NTS

LEGEND:

XXX = Average Weekday Traffic (vehicles per day)

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Figure 1

Average Weekday Traffic Volumes

Gardens at North Carefree (LSC #204240)

Table D-2 of the Previous ECM

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Previous ECM Version

Table D-2. Minimum Pavement Sections

Roadway Functional Classification	EDLA	ESAL	Composite Sections[1] Asphalt (in)	Composite Sections[1] Base (in)	Full Depth Asphalt (in)	Portland Cement Concrete (in)
Rural						
Local	5.0	32,850	3.0	4.0	4.0	5.0
Minor Collector	15.0	109,500	3.0	6.0	4.5	5.0
Major Collector	38.0	273,750	3.0	8.0	5.0	6.0
Minor Arterial	95.0	689,850	4.0	8.0	6.0	6.0
Principal Arterial, 4-lane	360.0	2,628,000	5.0	8.0	7.0	6.0
Principal Arterial, 6-lane	1,260.0	9,198,000	6.5	8.0	8.5	6.0
Expressway, 4-lane	540.0	3,942,000	6.5	10.0	7.5	6.0
Expressway, 6-lane	1,680.0	12,264,000	6.5	10.0	9.0	7.0
Urban						
Local (low volume)	5.0	32,850	3.0	4.0	4.0	5.0
Local (pavement only)[2]	15.0	109,500	3.0	6.0	4.5	5.0
Local	40.0	292,000	3.0	8.0	5.0	5.0
Residential Collector	113.0	821,000	4.0	8.0	6.0	6.0
Nonresidential Collector	113.0	821,000	4.0	8.0	6.0	6.0
Minor Arterial	270.0	1,971,000	5.0	8.0	7.0	6.0
Principal Arterial, 4-lane	720.0	5,256,000	5.0	8.0	8.0	6.0
Principal Arterial, 6-lane	1,120.0	8,176,000	6.5	8.0	8.5	6.0
Expressway, 4-lane	1,080.0	7,884,000	6.5	8.0	8.5	6.0
Expressway, 6-lane	1,344.0	9,811,000	6.5	10.0	9.0	7.0

[1] A composite section can only be used where the R-value of the subgrade soil is 30 or lower; or the CBR value is 5 or lower

[2] Section is for pavement design purposes only. All other design related requirements shall follow those designated under the Urban Local.

D.3.4 Flexible Pavement Strength Coefficients

The standard design coefficients for pavement materials are provided in Table D-1. Design values shall be verified by predesign mix test data and supported by daily construction tests.

D.3.5 Portland Cement Concrete Working Stress (ft)

The working stress (ft) shall be 75% of that provided by third-point beam loading which shall have minimum laboratory 28-day strength of 600 psi based on actual tests of materials to be used.

D.3.6 Gravel Roads

A minimum thickness of 6-inches shall be used on all newly constructed gravel roads meeting material specifications presented in Table D-11.

Table D-2 of the Current ECM

TRANSPORTATION
CONSULTANTS, INC.

Table D-2. Minimum Pavement Sections

Roadway Functional Classification	ESAL	Composite Sections[1]		Portland Cement Concrete (in)
		Asphalt (in)	Base (in)	
Rural				
Local	36,500	3.0	4.0	5.0
Minor Collector	109,500	3.0	6.0	5.0
Major Collector	273,750	3.0	8.0	6.0
Minor Arterial	689,850	4.0	8.0	6.0
Principal Arterial, 4-lane	2,628,000	5.0	8.0	6.0
Principal Arterial, 6-lane	9,198,000	6.5	8.0	6.0
Expressway, 4-lane	3,942,000	6.5	10.0	6.0
Expressway, 6-lane	12,264,000	6.5	10.0	7.0
Urban				
Local (low volume)	36,500	3.0	4.0	5.0
Local	292,000	3.0	8.0	5.0
Residential Collector	821,000	4.0	8.0	6.0
Nonresidential Collector	821,000	4.0	8.0	6.0
Minor Arterial	1,971,000	5.0	8.0	6.0
Principal Arterial, 4-lane	5,256,000	5.0	8.0	6.0
Principal Arterial, 6-lane	8,176,000	6.5	8.0	6.0
Expressway, 4-lane	7,884,000	6.5	8.0	6.0
Expressway, 6-lane	9,811,000	6.5	10.0	7.0

D.3.4 Flexible Pavement Strength Coefficients

The standard design coefficients for pavement materials are provided in Table D-3. Design values shall be verified by predesign mix test data and supported by daily construction tests.

D.3.5 Portland Cement Concrete Working Stress (f_t)

The working stress (f_t) shall be 75% of that provided by third-point beam loading which shall have minimum laboratory 28-day strength of 650 psi based on actual tests of materials to be used.

D.3.6 Gravel Roads

A minimum thickness of 6-inches shall be used on all newly constructed gravel roads meeting material specifications presented in Table D-7.

D.4 PAVEMENT DESIGN PROCEDURE

D.4.1 Flexible Pavements

The following procedure shall be used in determining the Structural Number (SN) and thickness of the pavement being designed.