STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

TRANSPORTATION MOBILITY AND SAFETY DIVISION
TRAFFIC MANAGEMENT UNIT

Project Numbers: SCH-F-2019-028 and SCH-F-2019-029

Mountain View Intermediate School
And
Macon County Middle School
Macon County

TRAFFIC OPERATIONS STUDY

Prepared by:

Municipal and School

Transportation Assistance

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NOTICE

The following report was prepared using information provided by Officials of the North Carolina Department of Transportation, and data by Municipal & School Transportation Assistance.

The methodology used to complete the evaluation is believed to be consistent with the current traffic engineering practice and principals. The recommendations presented herein are based on a comprehensive review and analysis of the available data and the application of engineering judgment. Any figures included in this report are Concept Plans and Not For Construction.

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Mountain View Intermediate School
And
Macon County Middle School
Traffic Operations Study

September 3, 2020

Prepared For:

Macon County School System
and
Municipal & School Transportation Assistance
Traffic Management Unit
North Carolina Department of Transportation

Prepared By:

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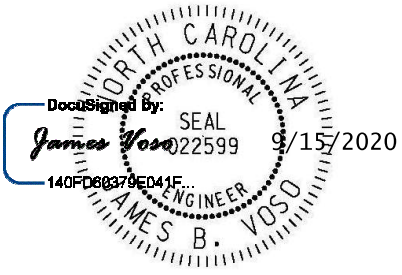

Analysis ……. Donald Lance Hartland, PE
Reviewed/Sealed .. James Voso, PE
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EXISTING CONDITIONS

The Macon County School System contacted the NCDOT Division 14 office regarding concerns involving school related traffic backing up and blocking the through lanes along both directions of Clark's Chapel Road (SR 1653) in front of Mountain View Intermediate School and along Wells Grove Road (SR 1667) in front of Macon County Middle School (See **Figure 1**). NCDOT Municipal School Transportation Assistance (MSTA) was asked to review these schools and provide comments. MSTA performs studies that address the safety concerns with the overall pedestrian activities and traffic operations on a school campus and how this school related traffic will affect adjacent state roadways. Mattern and Craig, under contract and in coordination with NCDOT MSTA, performed the analyses and developed a recommendation contained within this report.

Mattern and Craig performed field investigations at the two existing school campuses to assess current volumes of parent drop-off/pick-up traffic. This report is based on data provided by Mattern and Craig and reviewed by MSTA staff. Comments and recommendations are based on aerial photos, Annual Average Daily Traffic (AADT) maps, an off-site intersection traffic count and information provided by Macon County Schools and MSTA.

Existing Mountain View Intermediate School

Mountain View Intermediate (grades 5 and 6) is located on SR 1653 (Clark's Chapel Road/Bellview Road), which is a two-lane facility that is considered a secondary road in the area. The 2018 AADT volume of 2,200 vehicles south of Wells Grove Road and 1,300 vehicles north of Wells Grove Road. The posted speed limit is 45 MPH to the south and 30 MPH to the north with a Reduced School Speed Zone of 25 MPH. According to Macon County School data, Mountain View Intermediate has 645 students enrolled and 12 buses. The existing hours of operation are a starting time of 8:00am and a finish time of 2:55pm.

Existing Macon County Middle School

Macon County Middle (grades 7 and 8) is located on SR 1667 (Wells Grove Road), which is a two-lane facility that is considered a secondary road in the area. The 2018 AADT volume of 1,500 vehicles east of the school and 3,500 vehicles west of the schools. The posted speed limit is 35 MPH with a Reduced School Speed Zone of 25 MPH. According to Macon County School data, Macon County Middle has 643 students enrolled and 12 buses. The existing hours of operation are a starting time of 8:05am and a finish time of 2:55pm.

CAMPUS FEATURES

The existing campus features are described below and shown on **Figures 2a and 2b**:

CONCEPT PLAN
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Figure 1
Mountain View Intermediate & Macon Middle Site Locations

Division 14	Macon County	Franklin
SCALE: NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE: 9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
PREPARED BY: DLH		

NOTES

1. **Existing geometry provides two stacking lanes with a merge area before the loading zone. Currently the parents do not use the second lane.**
2. **Visitor and ADA parking exists in the same lot as staff parking and are designated along the loading zone. Crosswalks are provided across the travelway for the loading zone.**

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Figure 2a
Mountain View Intermediate
Existing Lane Geometry

Division 14	Macon County	Franklin
SCALE: NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE: 9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
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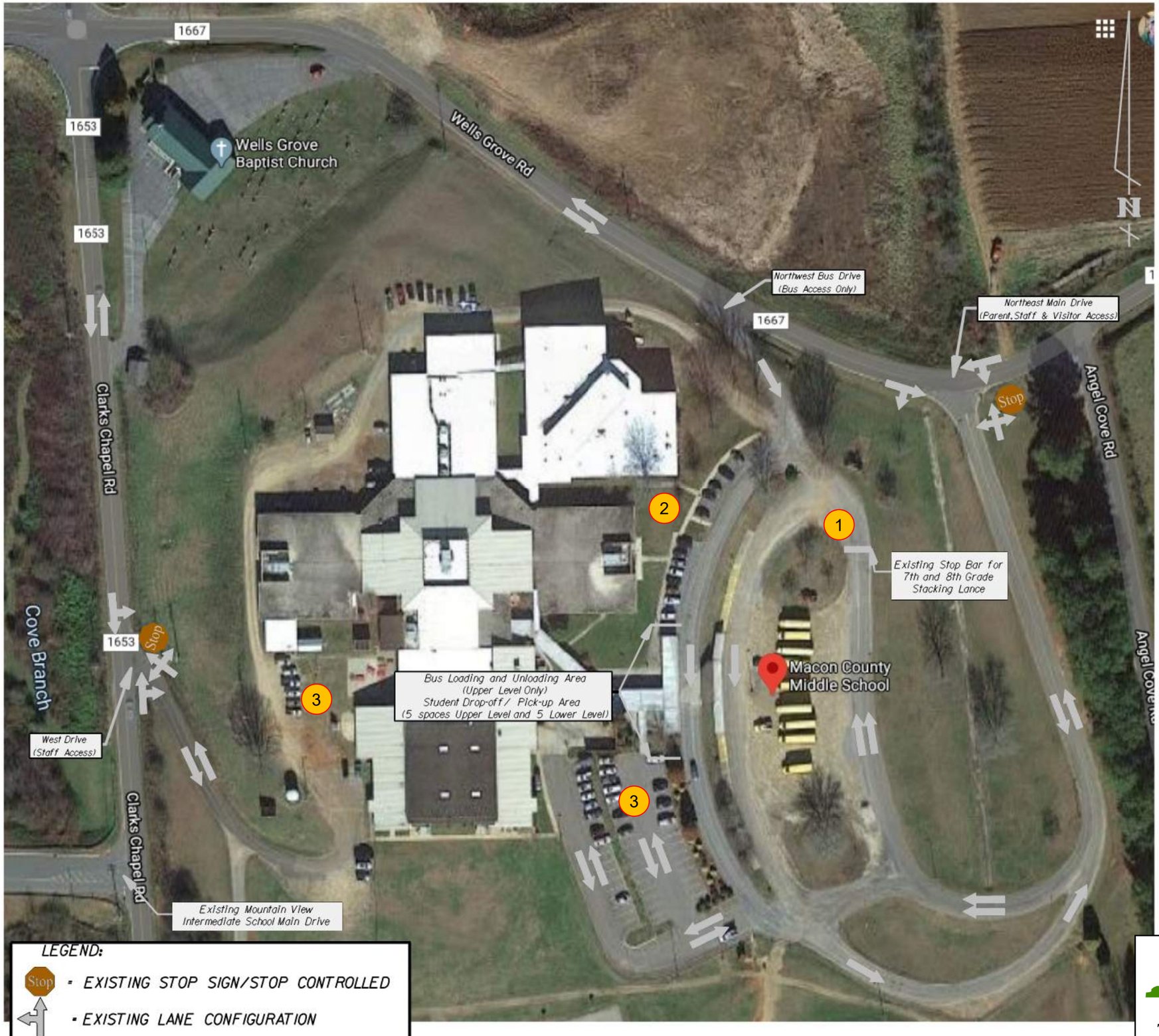

NOTES

1. **Existing geometry provides two stacking lanes with a stop bar then the lanes diverge to two loading zone. The parents utilize the upper loading zone after buses have departed.**
2. **Visitor parking exist along the travelway for the upper loading zone.**
3. **Staff parking is provided in two locations: 1) at the south end of the building; 2) in the back of the building. ADA parking is provided in the south end staff lot.**

CONCEPT PLAN
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Figure 2b
Macon County Middle
Existing Lane Geometry

Division 14	Macon County	Franklin
SCALE: NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE: 9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
PREPARED BY: DLH		

Driveways

The **Mountain View Intermediate School** has two access drives with one to the east off of SR 1653 (Clark's Chapel Road) and one to the north off of SR 1667 (Wells Grove Road):

Mountain View Bus Drive Looking North

Mountain View Main Drive Looking East

North Bus Drive is a two-way two-lane access for buses only located on the north side of the campus along SR 1667 (Wells Grove Road).

East Main Drive is a two-way two-lane access for parents, staff, and visitors located on the southeast side of the campus along SR 1653 (Clark's Chapel Road).

Student Loading Zone is located along the front (east side) of main school building along SR 1653 (Clark's Chapel Road).

Bus Loading Zone is located along the north side of campus and is separate from the student loading zone.

The **Macon County Middle School** has three access drives with one off of SR 1653 (Clark's Chapel Road) to the east and two off of SR 1667 (Wells Grove Road) to the north:

Northwest Bus Drive is a one-way one-lane access for buses only located on the north side of the campus along SR 1667 (Wells Grove Road).

Northeast Main Drive is a two-way two-lane access for parents, staff, and visitors located on the northeast side of the campus along SR 1667 (Wells Grove Road).

Macon Middle Main Drive Looking North

West Staff Drive is a two-way two-lane access for staff only located on the west side of the campus along SR 1653 (Clark's Chapel Road).

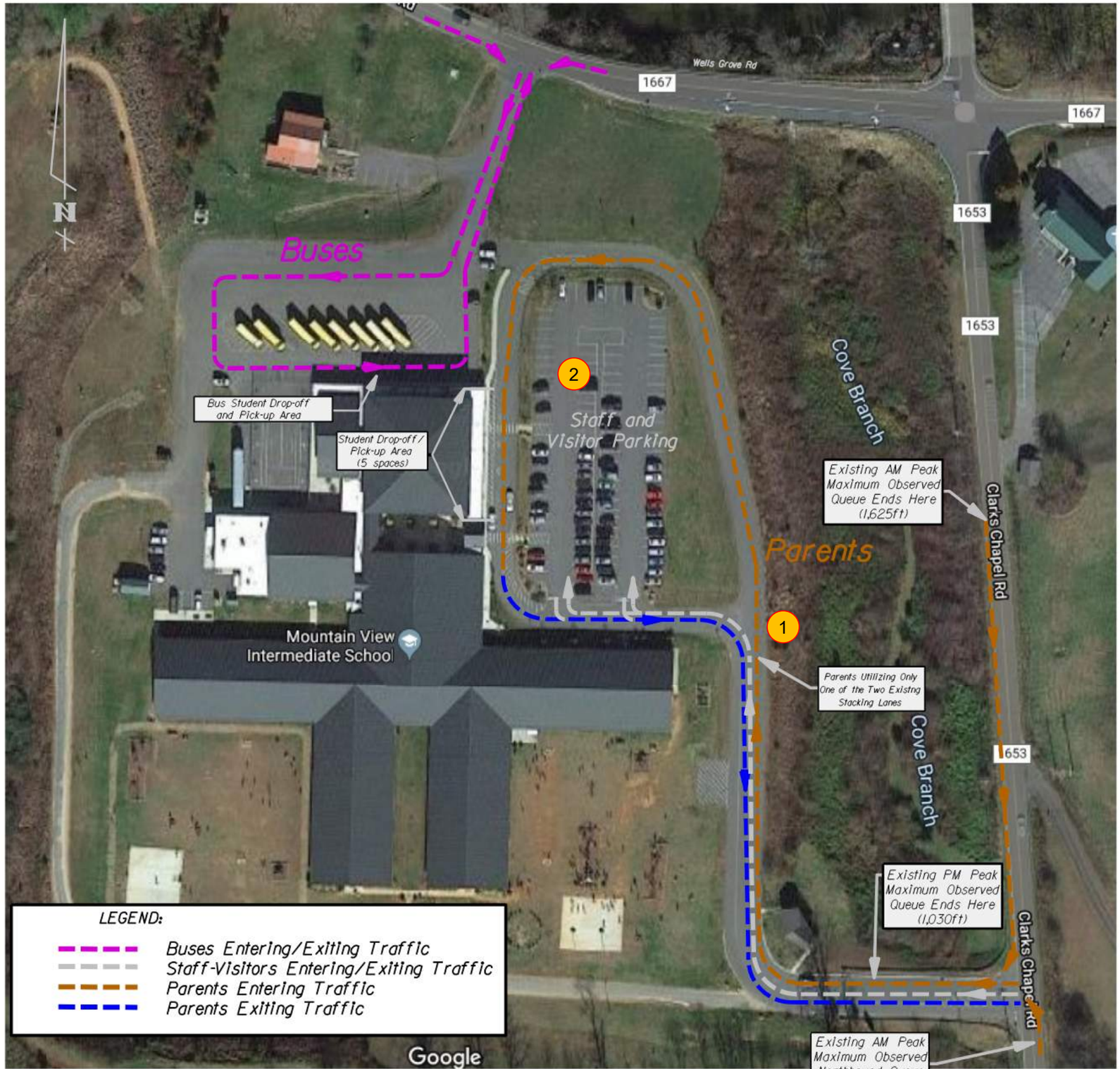
Student Loading Zone is located along the front of the main school building which is the east side of the building. This zone is split into two areas for pickup, an upper (7th graders) and a lower (8th graders), which has a grade-separated access to the school. The 7th grade zone is shared with the bus loading zone.

Bus Loading Zone is located along the east side of campus. It shares the loading zone with the 7th grade student pick-up area. Buses load first and once the buses leave the parents of the 7th graders use the zone.

LOADING OPERATIONS

The Mountain View Intermediate school currently provides approximately 1,050 feet of double lane queue length and 100 feet of single queue lane for the student loading operation for a total of 2,200 feet. However, based on the school's direction, the parents are only using one of the lanes for stacking (**See Figure 3a**).

The Macon County Middle school currently provides approximately 480 feet of double lane queue length, and 490 feet of single queue length for a total of 1,480 feet from the stop bar (**See Figure 3b**).



NOTES

1. **Existing geometry provides two stacking lanes with a merge area before the loading zone. Currently parents do not use the second lane.**
2. **Visitor and ADA parking exists in the same lot as staff parking and are designated along the loading zone. Crosswalks are provided across the travelway for the loading zone.**

Mountain View Intermediate

Existing 645 Student Population

Calculated Queue

1072 Feet Average Queue (1.66 ft/stud)
322 Feet 30% High Demand
1394 Feet Total Desired Queue

Provided Queue

100 Feet Single Queue
2100 Feet Double Queue
2200 Feet Total Queue

Observed Queue

1625 Feet Single Queue (2.52 ft/stud)
1625 Feet Total Queue

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Figure 3a
Mountain View Intermediate
Existing Loading Operations

Division 14	Macon County	Franklin
SCALE: NONE	N.C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE: 9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
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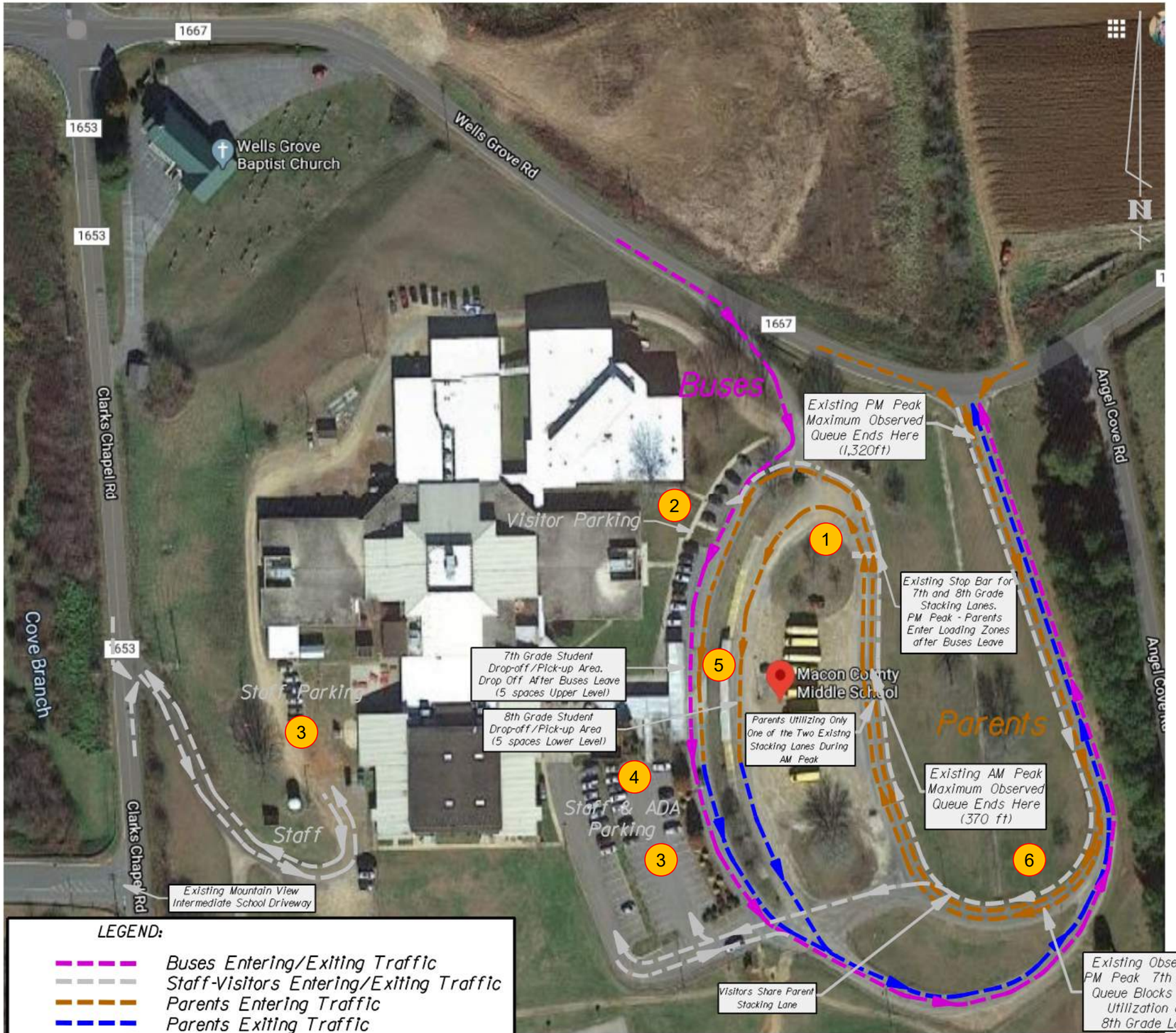

NOTES

1. Existing geometry provides two stacking lanes with a stop bar then the lanes diverge to two loading zone. The parents utilize the upper loading zone after buses have departed.
2. Visitor parking exists along the travelway for the upper loading zone. Visitors share the parent stacking lane to access the visitor parking. Visitors exit past the loading zone and follow the parent exit pattern.
3. Staff parking is provided in two locations: 1) at the south end of the building; 2) in the back of the building.
4. ADA parking is provided in the staff parking lot on the south end of the building.
5. Students that are dropped-off or picked-up on the lower level have access to the building via a graded-separated walkway under the upper loading zone.
6. Provided stacking is not being fully utilized because of 7th grade queue (inside lane) extends beyond the double lane section and block traffic from accessing the 8th grade lane (outside lane).

Macon County Middle School

Existing 643 Student Population

Calculated Queue

1072 Feet Average Queue (1.67 ft/stud)
322 Feet 30% High Demand
1394 Feet Total Desired Queue

Provided Queue (from stop bar)

490 Feet Single Queue
990 Feet Double Queue
1480 Feet Total Queue

Observed Queue (from stop bar)

445 Feet Single Queue
875 Feet Double Queue
1320 Feet Total Queue (2.05 ft/stud)

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Figure 3b
Macon County Middle
Existing Loading Operations

Division 14	Macon County	Franklin
SCALE: NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE: 9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
PREPARED BY: DLH		

OFF-SITE INTERSECTION & ROADWAY CONDITIONS

The local intersection that is directly impacted by both schools is the two-way unsignalized SR 1667 (Wells Grove Road) and SR 1653 (Clark's Chapel Road/Bellview Road) intersection. This intersection is in the northeast corner of Mountain View Intermediate and is northwest of Macon County Middle. The northbound approach on Clark's Chapel Road and southbound approach on Bellview Road are single lane approaches with stop sign control. The westbound approach is a single lane approach with no control. The eastbound approach has two lanes including a separate right-turn lane and has no control (**See Figure 4**).

Wells Grove Rd Looking East from Clark's Chapel Rd

Wells Grove Rd Looking West from Clark's Chapel Rd

Bellview Rd Looking North from Wells Grove Rd

Clark's Chapel Rd Looking South from Wells Grove Rd

SR 1667 (Wells Grove Road)

- Wells Grove Road is two-lane road that is classified as a Minor Collector both east and west of Clark's Chapel Road.
- Wells Grove Road runs east-west and connects downtown Franklin, NC to the west with SR 1668 (Fulton Road) to the east.
- Wells Grove Road provides the main access for the schools to downtown Franklin and US 23.

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Figure 4
Mountain View Intermediate & Macon Middle
2020 Existing Lane Geometry

Division 14	Macon County	Franklin
SCALE: NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE: 9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
PREPARED BY: DLH		

- The speed limit on Wells Grove Road in the study area is 35 MPH with a Reduced School Speed Zone of 25 MPH.

SR 1653 (Clark's Chapel Road)

- Clark's Chapel Road is two-lane road that is classified as a Minor Collector south of Wells Grove Road.
- Clark's Chapel Road runs north-south and connects to Wells Grove Road on the north end to SR 1643 (Hickory Knoll Road) to the south.
- The speed limit on Clark's Chapel Road in the study area is 35 MPH with a Reduced School Speed Zone of 25 MPH.

SR 1653 (Bellview Road)

- Bellview Road is two-lane road that is classified as a Minor Collector north of Wells Grove Road.
- Bellview Road runs north-south and connects to Wells Grove Road on the south end to US 64 to the north.
- The speed limit on Bellview Road in the study area is 30 MPH with a Reduced School Speed Zone of 25 MPH.

ANALYSIS

ESTIMATED SCHOOL TRAFFIC CALCULATIONS

For comparing the estimated and observed queues, the MSTA School Traffic Calculator was utilized to calculate school traffic data for this report assuming the current populations. This calculator provides a theoretical estimate of the traffic generated, on an average school day, based on the existing and maximum build out of the school student population. Calculations reflect the minimum number of vehicles expected and does not take into consideration high traffic demand days and/or special events. To provide maximum safety for pedestrians and motorists during peak demands, the school is expected to have an alternative traffic flow plan that will prevent school related vehicles from presenting a hazard along nearby public streets. The Traffic Calculators for each school are included in ***Appendix A***. The theoretical traffic calculations for the existing enrollment for each school are shown on **Tables 1a and 1b**:

Table 1a - MSTA School Calculator for Mountain View Intermediate (Existing)

MSTA School Queue Input				Calculations				
Type School	Student Population	Number of Buses	Staff Members	PM Total Vehicles	PM Peak Vehicles	Average Queue Length	Total AM Trips	Total PM Trips
Middle	645	12	60	91	47	1072	**518**	**194**
	AM Trips Generated				PM Trips Generated			
	Parents	Buses	Staff	Trips	Parents	Buses	Staff	Trips
IN	223	12	60	295	91			91
OUT	223			223	91	12		103
		Total AM Trips		**518**		Total PM Trips		**194**
NOTE:	Volumes reflect peak traffic for school operations, normally taking place in approximately 30 minutes.							

Table 1b - MSTA School Calculator for Macon County Middle (Existing)

MSTA School Queue Input				Calculations				
Type School	Student Population	Number of Buses	Staff Members	PM Total Vehicles	PM Peak Vehicles	Average Queue Length	Total AM Trips	Total PM Trips
Middle	643	12	40	91	47	1072	**497**	**194**

	AM Trips Generated				PM Trips Generated			
	Parents	Buses	Staff	Trips	Parents	Buses	Staff	Trips
IN	222	12	40	274	91			91
OUT	222			222	91	12		103
		Total AM Trips		**497**		Total PM Trips		**194**

NOTE: Volumes reflect peak traffic for school operations, normally taking place in approximately 30 minutes.

Using the current population of 645 students for Mountain View Intermediate, calculations indicate that the parent vehicles, during the school peak traffic periods, are expected to be 223 during the AM and 91 during the PM. The theoretical average queue length is expected to be around 1,072 feet; however, this does not include needs for high traffic demand days (1,394 feet). The current traffic geometry provides approximately 2,200 feet.

Using the current population of 643 students for Macon County Middle, calculations indicate that the parent vehicles, during the school peak traffic periods, are expected to be 222 during the AM and 91 during the PM. The theoretical average queue length is expected to be around 1,072 feet; however, this does not include needs for high traffic demand days (1,394 feet). The current traffic geometry provides approximately 1,480 feet after the stop bar.

ON-SITE FIELD QUEUE AND CIRCULATION OBSERVATIONS

On-Site Field observations were conducted on January 22-23, 2020. The on-site school trips and queues have been counted for both peak periods. The AM and PM count sheets for both schools are provided in ***Appendix B.***

Mountain View Intermediate Queue at 7:44am

The current operation at Mountain View Intermediate is not utilizing the second stacking lane; therefore, the existing morning drop-off queue totals of 1,625 feet which extends onto SR 1653 (Clark's Chapel Road) approximately 425 feet (See **Figure 3a).** The observed total is about 553 feet more than the theoretical average queue length total. The school has indicated the reason that the second stacking lane is not being used is that the merge area of the two lanes created conflicts between parents, resulting in undesirable behavior and potential safety concerns.

Macon County Middle Queue at 3:05pm

The current operation at Macon County Middle incorporates the provided stacking lanes, which accommodates total queues for both the pick-up and drop-off times. The maximum queue of 1,320 feet occurs during the pick-up time (See **Figure 3b**). The 8th grade stacking lane did not fill up

along the dual lane section. The vehicles oriented to that lane were blocked by the 7th grade vehicles and were then stacking together in the single lane section. Therefore, the available stacking area was not being fully utilized. The overall observed queue came to about 30 feet from Wells Grove Road during the PM peak. The observed total is about 248 feet more than the theoretical average queue length total.

OFF-SITE OBSERVATIONS AND ANALYSIS

In conjunction with the on-site field observations, the off-site field observations were conducted on January 22-23, 2020. During the school drop-off time period, the SR 1667 (Wells Grove Road) and SR 1653 (Clark's Chapel Road) intersection is controlled by a police officer. The northbound maximum queues on SR 1653 (Clark's Chapel Road) during both peaks extend south 610 feet to the Macon County Middle staff driveway. The maximum queue for the westbound approach on SR 1667 (Wells Grove Road) extends past the main driveway for the Macon County Middle for a total of about 1,095 feet during the morning peak. This in turn, caused backup queues for the vehicles exiting Macon County Middle. During the morning peak period, the eastbound approach on Wells Grove Road experiences a maximum queue of about 740 feet. This queue extended past the Mountain View Intermediate Bus driveway but the vehicles did not block the driveway. The southbound approach on SR 1653 (Clark's Chapel Road) experiences a maximum queue of approximately 340 feet during the morning peak period.

Wells Grove Rd and Clark's Chapel Rd at 7:52am

MSTA provided turning movement counts at the Wells Grove Road and Clark's Chapel Road intersection. The counts were conducted on November 19, 2019, and the AM and PM peak hours occurred between 7:10am - 8:10am and 2:45pm – 3:45pm. Counts were also provided at each of the schools' main drives. These counts were conducted on March 10, 2020, and the AM peak and PM peaks occurred between 7:10am - 8:15am and 2:30pm – 3:40pm. **Figure 4** illustrates the existing lane geometry and traffic control. Count data was compiled in five-minute bins to precisely correlate with the actual school peak hours. Raw traffic count data is shown in ***Appendix C***. **Figure 5a** shows the existing balanced AM and PM hour volumes. **Table 2** illustrates the actual AM and PM peak hour inbound and outbound volumes at the Main Drive of each school. The resulting trip generation rates based on the Main Drive counts were determined for the AM and PM peak hours are also shown in **Table 2**.

Table 2: Existing AM and PM Peak Hour Volumes and Rates

School	Students	AM Peak Hour*			PM Peak Hour*		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Mountain View Intermediate	645	287	240	527	69	109	178
		0.44	*0.37*	*0.82*	*0.11*	*0.17*	*0.28*
Macon County Middle	643	237	257**	494	87	108**	195
		0.37	*0.40*	*0.77*	*0.14*	*0.17*	*0.30*

* *Based on intersection counts. Main Drive intersection only (parent, staff and visitors), does not include Bus Drive.*

** *Outbound total reduced by 12 (buses) to only include parent, staff and visitors.*

LEGEND:

AM(PM)= EXISTING AM & PM PEAK HOUR VOLUMES

= EXISTING TURNING MOVEMENT

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Figure 5a
Mountain View Intermediate & Macon Middle
2020 Existing Peak Hour Volumes

Division 14	Macon County	Franklin
SCALE: NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE: 9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
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LEGEND:

AM(PM) = STAGGERED START AM & PM PEAK HOUR VOLUMES

= EXISTING TURNING MOVEMENT

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Figure 5b
Mountain View Intermediate & Macon Middle
2020 Staggered Start Peak Hour Volumes

Division 14	Macon County	Franklin
SCALE: NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
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The observed trip generation from both schools (**Table 2**) is greater that the theoretical totals provided in **Tables 1a and 1b**. This occurrence is consistent when comparing the observed and estimated queues.

The traffic data was coded into Synchro 10.1 capacity analysis software and accompanying SimTraffic 10.3 traffic microsimulation software. ***Appendix D*** contains the detailed Synchro and SimTraffic output information for the current condition. All standards for inputs into the Synchro capacity analysis software and SimTraffic microsimulation runs adhere to NCDOT Congestion Management Unit and MSTA Guidelines. **Table 3** provides the capacity analysis output summary for intersection Level-of-Service, vehicular delay, and peak hour queue measures for the 2020 Existing and 2021 Future Conditions assuming multiple improvement option scenarios.

When the calculated SimTraffic maximum queues or Synchro 95% queues (whichever is greater) are compared to the field observations, it shows that during the AM peak, the use of a police officer to direct the traffic does improve the northbound and southbound queues to provide a more balanced operation. However, the eastbound and westbound queues are longer than predicted when the intersection is under police officer control.

OFF-SITE IMPROVEMENT ANALYSIS

For the ***2020 Existing Condition***, the first step in improving the operation of the SR 1667 (Wells Grove Road) and SR 1653 (Clark's Chapel Road) intersection was to determine if the installation of a traffic signal would provide the acceptable Levels of Service. A warrant analysis was conducted using the existing 12-hour counts. According the results of the analysis, warrant 3 (Peak Hour) is satisfied. The warrant analysis report and the detail Synchro and SimTraffic reports for Scenarios 1-4 are included in ***Appendix E*****.** Scenarios 1-4 assume that the circulation and access to the schools do not change. Scenario 1 is the installation of a four-way stop control. Scenario 2 is the installation of a traffic signal. Scenario 3a is the installation of a traffic signal with the construction of a northbound 200-foot left turn lane, eastbound 200-foot left turn lane, and westbound 200-foot left turn and right turn lanes. Scenario 3b includes the signal and improvements mentioned for Scenario 3a plus the recommended on-site improvements shown in **Figures 7a and 7b**. Scenario 4 is the construction of a single-lane roundabout. Scenario 13 analyzes the impacts of staggering the school starting time by 45 minutes. **Table 3** identifies the details of these reconfiguration options. Scenarios 5-12 assume various circulation reconfiguration options of the Mountain View School, but only the AM peak hour was analyzed because it was the critical peak. ***Appendix F*** includes the physical improvements indicated for each Mountain View Reconfiguration (MVR) option (scenarios 5-12), and the detailed Synchro and SimTraffic reports for the various scenarios. For the analysis of the roundabout, the existing traffic data was coded into SIDRA Intersection 8.0 roundabout capacity analysis software. **Table 3** also illustrates the resulting approach level of service, delay, and maximum queues for each improvement Scenario assuming the existing traffic volumes. ***Appendix G*** contains the detailed SIDRA output information.

Table 3: 2020 Existing and 2021 Future Conditons: Improvement Scenario Level of Service, Delay and Queues

Intersection #4: Wells Grove Rd and Clarks Chapel Rd

Approach	Scenario >	Existing Condition: 2-Way Stop			1: 4-Way Stop			2: Signal			3a: 2020 Signal plus Improvements[2]			3b: 2020 On-Site and Intersection Improvements[3]			4: Roundabout[1]			13: Signal plus 45 Minute Start Stagger[4]		
	Peak Hour	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)
Eastbound	AM	A	1.0	229	F	137	374	E	77.1	379	C	24.3	369	C	24.3	227	E	40.5	907	D	42.5	368
	PM	A	1.0	113	C	17.4	98	B	14.5	371	B	12.3	128	B	11.4	155				B	14.0	135
Westbound	AM	A	0.2	214	F	388.4	911	E	78	532	C	23.4	398	C	23.4	208	F	197.1	1841	C	22.5	133
	PM	A	0.5	52	C	22.8	180	B	17.0	639	B	12.6	112	B	11.8	172				B	12.5	97
Northbound	AM	F	-	781	F	449.1	780	F	138.1	771	B	19.7	559	B	19.7	198	F	111.3	1278	D	38.7	393
	PM	F	161.3	270	C	22.9	160	B	17.6	320	B	11.7	176	B	11.1	138				B	14.1	176
Southbound	AM	F	-	660	F	187.5	684	C	29.4	462	C	25.3	666	C	25.3	401	D	51.1	236	A	9.1	193
	PM	E	35.9	203	C	18.1	115	B	13.2	222	B	12.1	158	B	11.4	176				B	10.0	120
Overall	AM	N/A	N/A	N/A	N/A	N/A	N/A	F	84.8	N/A	C	23.1	N/A	C	23.1	N/A	F	95.3	N/A	C	32.4	
	PM							B	15.6		B	12.2		B	11.4					B	13.0	

Intersection #1: Mountain View Main Dr and Clarks Chapel Rd

Approach	Scenario >	Existing Condition: 2-Way Stop			1: 4-Way Stop			2: Signal			3a: 2020 Signal plus Improvements[2]			3b: 2020 On-Site and Intersection Improvements[3]			4: Roundabout[1]			13: Signal plus 45 Minute Start Stagger[4]		
	Peak Hour	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)
Eastbound	AM	F	250.8	584	F	250.8	579	F	250.8	567	F	250.8	287	F	250.8	299	F	250.8	579	F	239.4	372
	PM	B	13.7	96	B	13.7	114	B	13.7	206	B	13.7	139	B	13.7	144				B	13.3	159
Northbound	AM	A	2.5	378	A	2.5	412	A	2.5	208	A	2.5	396	A	2.5	97	A	2.5	420	A	2.5	396
	PM	A	1.1	31	A	1.1	53	A	1.1	184	A	1.1	54	A	1.1	31				A	1.2	0
Southbound	AM	A	0	19	A	0	22	A	0	0	A	0	768	A	0	0	A	0	22	A	0	384
	PM	A	0	0	A	0	0	A	0	181	A	0	0	A	0	0				A	0	0
Overall	AM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	PM																					

Intersection #2: Macon Middle Main Dr and Wells Grove Rd

Approach	Scenario >	Existing Condition: 2-Way Stop			1: 4-Way Stop			2: Signal			3a: 2020 Signal plus Improvements[2]			3b: 2020 On-Site and Intersection Improvements[3]			4: Roundabout[1]			13: Signal plus 45 Minute Start Stagger[4]		
	Peak Hour	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)
Eastbound	AM	A	0.0	22	A	0.0	22	A	0.0	56	A	0.0	32	A	0.0	0	A	0.0	22	A	0.0	0
	PM	A	0.0	0	A	0.0	0	A	0.0	0	A	0.0	0	A	0.0	22				A	0.0	0
Westbound	AM	A	1.6	138	A	1.6	94	A	1.6	91	A	1.6	48	A	1.6	29	A	1.6	75	A	0	0
	PM	A	0.6	31	A	0.6	31	A	0.6	51	A	0.6	0	A	0.6	0				A	0	0
Northbound	AM	F	86.4	441	F	86.4	441	F	86.4	251	F	86.4	250	F	86.4	247	F	86.4	441	A	0	0
	PM	B	14.3	132	B	14.3	103	B	14.3	472	B	14.3	152	B	14.3	364				A	0	0
Overall	AM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	PM																					

Intersection #3: Mountain View Bus Dr and Wells Grove Rd

Approach	Scenario >	Existing Condition: 2-Way Stop			1: 4-Way Stop			2: Signal			3a: 2020 Signal plus Improvements[2]			3b: 2020 On-Site and Intersection Improvements[3]			4: Roundabout[1]			13: Signal plus 45 Minute Start Stagger[4]		
	Peak Hour	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)	LOS	Delay (sec)	Queue (ft)
Eastbound	AM	A	0.0	0	A	0.0	835	A	0.0	846	A	0.0	98	A	0.0	0	A	0.0	835	A	0.0	94
	PM	A	0.0	0	A	0.0	0	A	0.0	97	A	0.0	0	A	0.0	70				A	0.0	0
Westbound	AM	A	0.2	178	A	0.2	31	A	0.2	345	A	0.2	326	A	0.2	158	A	0.2	55	A	0.2	189
	PM	A	0.3	145	A	0.3	79	A	0.3	141	A	0.3	96	A	0.3	162				A	0.4	53
Northbound	AM	F	59.2	158	F	59.2	196	F	59.2	180	F	59.2	110	F	59.2	192	F	59.2	176	C	21.6	107
	PM	C	20.9	95	C	20.9	95	C	20.9	97	C	20.9	174	C	20.9	115				C	16.1	110
Overall	AM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	PM																					

Notes:

= Level of Service F

= Queue Extends to Adjacent Intersection

Scenarios 4-12: Only the critical Peak Hour (AM Peak) was analyzed.

1. Scenario 4: Roudabout Scenarios include Sidra analysis, which calculates total queues that may extend pass adjacent intersections.
2. Scenario 3a: Includes Off-Site Intersection Improvements Only. Assumes Upper Loading Area for Macon Middle is Utilized by Parents in AM peak.
3. Scenarion 3b: Assumes Recommended On-Site Improvements at both Schools plus Signal and Intersection Improvements. Assumes Upper Loading Area for Macon Middle is Utilized by Parents in AM peak.
4. Scenarion 13: Assumes Recommended On-Site Improvements at both Schools plus Signal Improvements. Assumes 45 minute start offset for Macon Middle.

The ***2020 Existing Condition*** analysis was performed with both schools operating at the same time period. The intersections were analyzed with the improvement option scenarios to determine the improvements required to provide acceptable approach Levels of Service. As the table indicates, the four-way stop (Scenario 1) and signal only scenario (Scenario 2) are not sufficient. Even though the current condition is a two-way stop control, the Wells Grove Road/Clark's Chapel Road intersection is controlled by a policeman in the AM peak hour. This manually directed control is a unique situation and is best modeled as signal controlled, so Scenario 2 best represents current the AM peak hour condition.

The next step was to determine if additional turn lanes (Scenarios 3a and 3b) would improve the operation. The results of the Scenario 3 analysis indicate that the addition of a northbound left-turn lane and westbound right-turn lane will provide Levels of Service that are an improvement over the existing condition (Scenario 2).

The ***2020 Staggered Start Condition*** (Scenario 13) analysis was performed assuming that Macon Middle School would start at least 45 minutes after Mountain View Intermediate. According to NCDOT policy, staggering one school's start time by a minimum of 45 minutes allows for the removal of the staggered school's traffic from the network peak hour volumes. Based on our engineering judgement, we have concluded that the off-site operation would be similar if the staggered school was reversed. The resulting 2020 peak hour volumes are shown in **Figure 5b**.

In addition to obtaining acceptable Levels of Service, the objective was to provide a scenario that would improve the queueing at the intersections at a worthwhile cost. Scenario 3 provided acceptable Levels of Service, and does provide some improvement to the overall queuing issues; however, with its large scale of construction and geometric constraints, it was deemed infeasible. Scenario 4 failed to achieve acceptable Levels of Service. Multiple additional scenarios that modified the Mountain View School's circulation and access were also conducted (Scenarios 5-12). The evaluation of improvement scenarios 4-12 has shown that there may be a minor improvement in one area of the network, but another area may get worse. In conclusion, the cost versus benefit of Scenarios 3-12 does not warrant them for further consideration.

ON-SITE IMPROVEMENT ANALYSIS

The observed queue at Mountain View Intermediate for the current 645 students equates to a queue (feet) per student ratio of 2.52 ft/student as compared to 1.66 ft/student (theoretical). **Figure 6a** illustrates Scenario 3b, which is the recommended lane geometry to alleviate the existing queuing issues. **Figure 7a** identifies the recommended loading operations that works in conjunction with the lane geometry shown in **Figure 6a**. The recommended lane geometry and loading operation should provide efficient loading and unloading of students and contain the queues within the school property.

The observed queue at Macon County Middle for the current 643 students equates to queue (feet) per student ratio of 2.05 ft/student as compared to 1.67 ft/student (theoretical). **Figure 6b** illustrates Scenario 3b, which is the recommended lane geometry to alleviate the existing queuing issues. **Figure 7b** identifies the recommended loading operations that works in conjunction with the lane geometry shown in **Figure 6b**. The recommended lane geometry and loading operation should provide efficient loading and unloading of students and contain the queues within the school property.

These on-site improvements were analyzed in Scenario 3b. This scenario also included the recommended off-site improvements at the Wells Grove Road and Clarks Chapel Road intersection.

NOTES

1. **Install a Stop Line** at the Parent Loading Zone, 10-feet before the first loading bay. “Stop Here” sign(s) may need to be installed, at the stop line to help indicate that traffic should stop and wait for the next five vehicles for the loading bay. School Staff or Police to direct alternating groups of six vehicles to proceed to loading area.
2. **Implement Double Queue Process** to meet the desired queue. Utilize existing stacking lanes.
3. Visitor and ADA parking exists in the same lot as staff parking and are designated along the loading zone. Crosswalks are provided across the travelway for the loading zone.

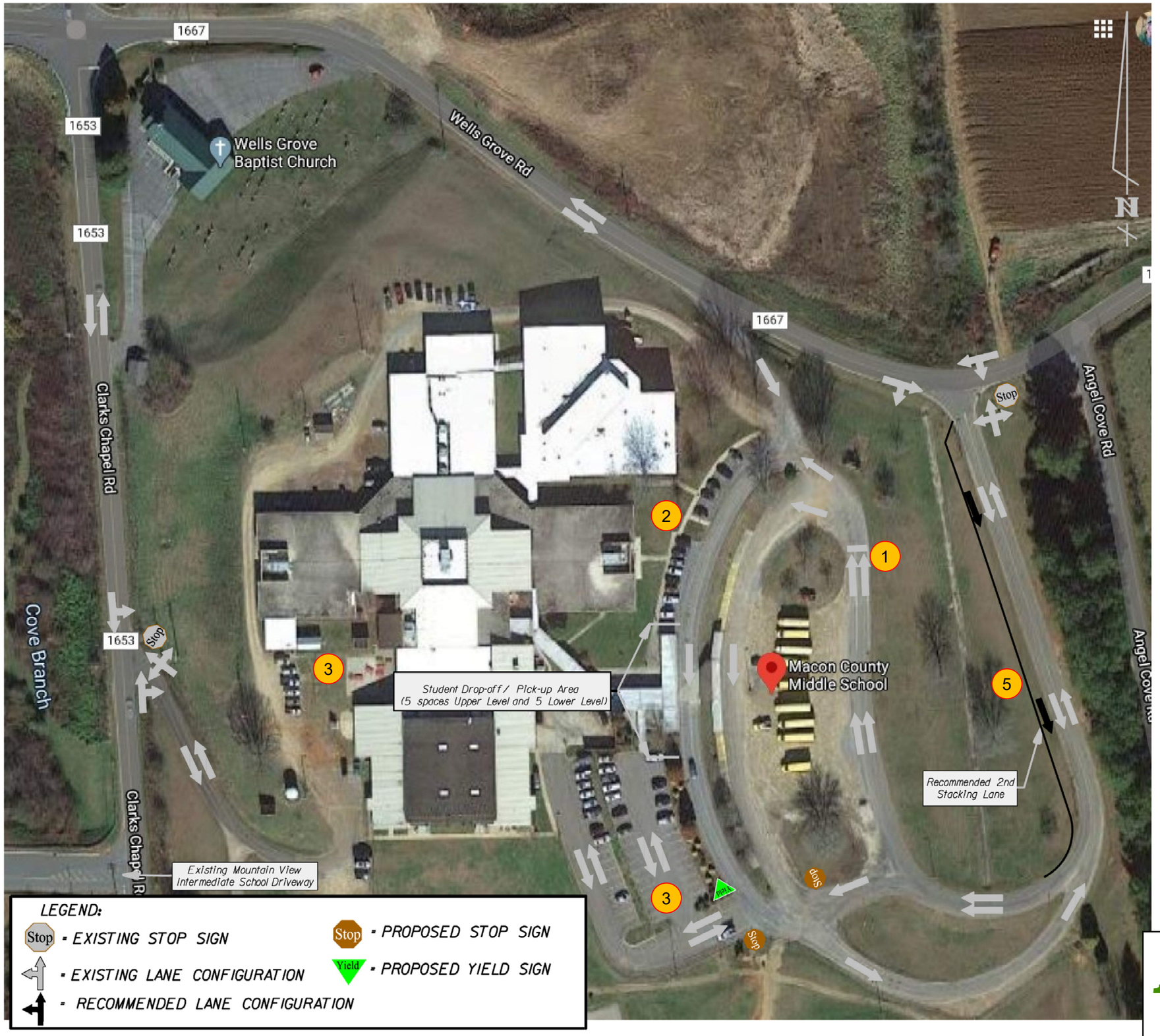
CONCEPT PLAN
NOT FOR CONSTRUCTION

Municipal & School Transportation Assistance

Figure 6a
Mountain View Intermediate
Recommended Lane Geometry

Division 14 | Macon County | Franklin

SCALE:	NONE	N. C. DEPARTMENT OF TRANSPORTATION TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVIEWED BY: DLH
DATE:	9/3/2020		REVISIONS:
PREPARED BY:	DLH		



NOTES

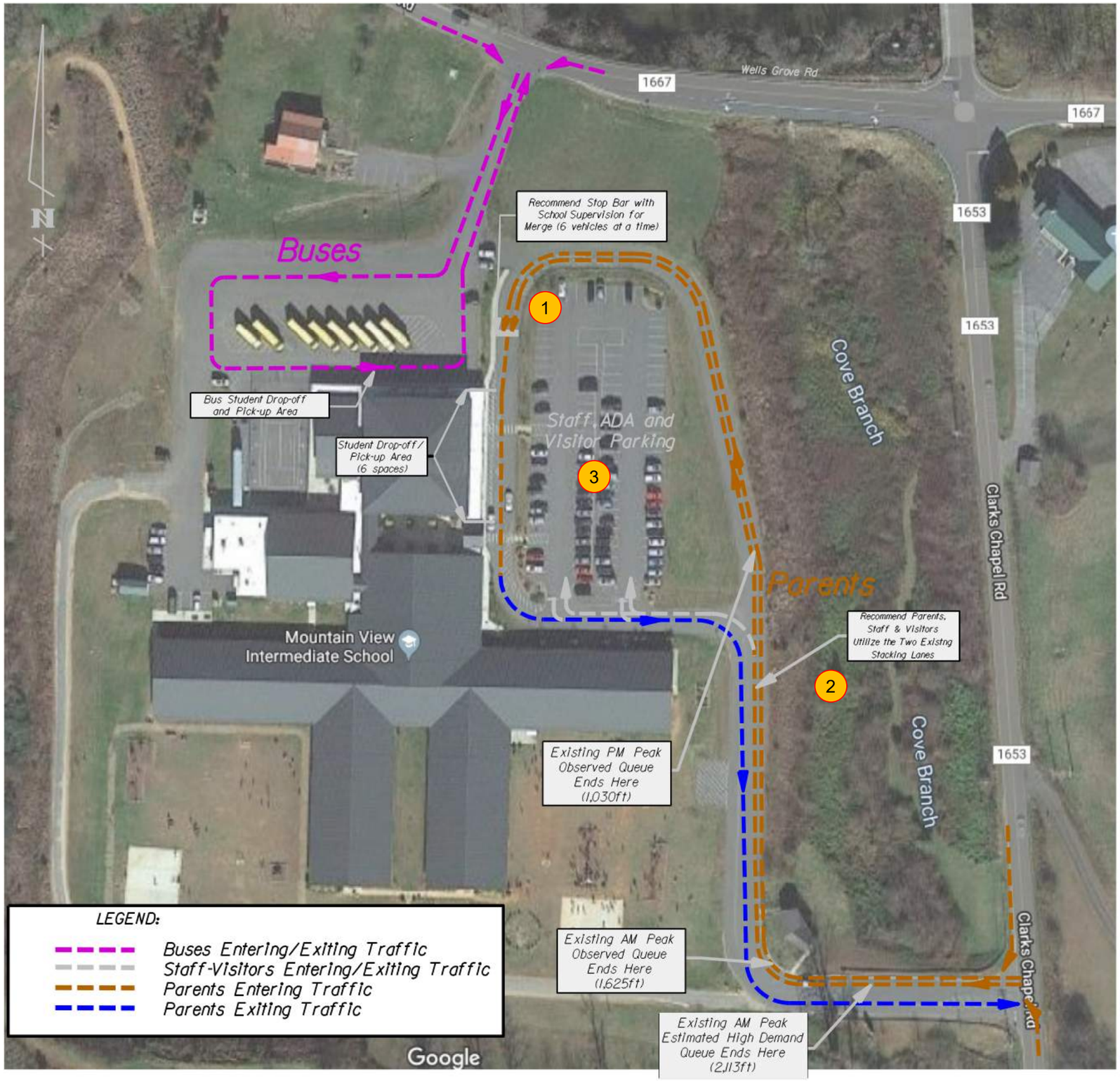
1. **Existing geometry provides two stacking lanes with a stop bar then the lanes diverge to two loading zone. The parents utilize the upper loading zone after buses have departed. Remove existing stop bar.**
2. **Visitor parking exist along the travelway for the upper loading zone.**
3. **Staff parking is provided in two locations: 1) at the south end of the building; 2) in the back of the building. ADA parking is provided in the south end staff lot.**
4. **No modifications are recommended, the existing circulation is functioning adequately assuming the current student enrollment of 643 students.**
5. **Construct the extension of the 2nd stacking lane between the existing 2nd lane and Wells Grove Rd. The new lane would extend approximately 490 feet to accommodate the High Demand of the existing student population.**

CONCEPT PLAN
NOT FOR CONSTRUCTION

Municipal & School
Transportation Assistance

Figure 6b
Macon County Middle
Recommended Lane Geometry

Division 14	Macon County	Franklin
SCALE: NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE: 9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
PREPARED BY: DLH		



NOTES

1. **Install a Stop Line** at the Parent Loading Zone, 10-feet before the first loading bay. "Stop Here" sign(s) may need to be installed, at the stop line to help indicate that traffic should stop and wait for the next six vehicles for the loading bay. School Staff or Police to direct alternating groups of five vehicles to proceed to loading area.
2. **Implement Double Queue Process** to meet the desired queue. Utilize existing stacking lanes. Distances shown reflect total queue. The queue end locations are half the total length and measured from the proposed stop bar. Staff and Visitors will share Parent stacking lane to access the Staff and Visitor Parking lot.
3. Staff, Visitor and ADA parking is provided in the same lot adjacent to the student loading zone. Crosswalks are provided through the loading area to access the building.

Mountain View Intermediate

Current 645 Student Population

Provided Queue

100 Feet Single Queue
2100 Feet Double Queue
2200 Feet Total Queue

Observed Queue

1625 Feet Single Queue
1625 Feet Total Queue (2.52ft/stud)
488 Feet 30% High Demand
2113 Feet Total Queue

Recommend Queue

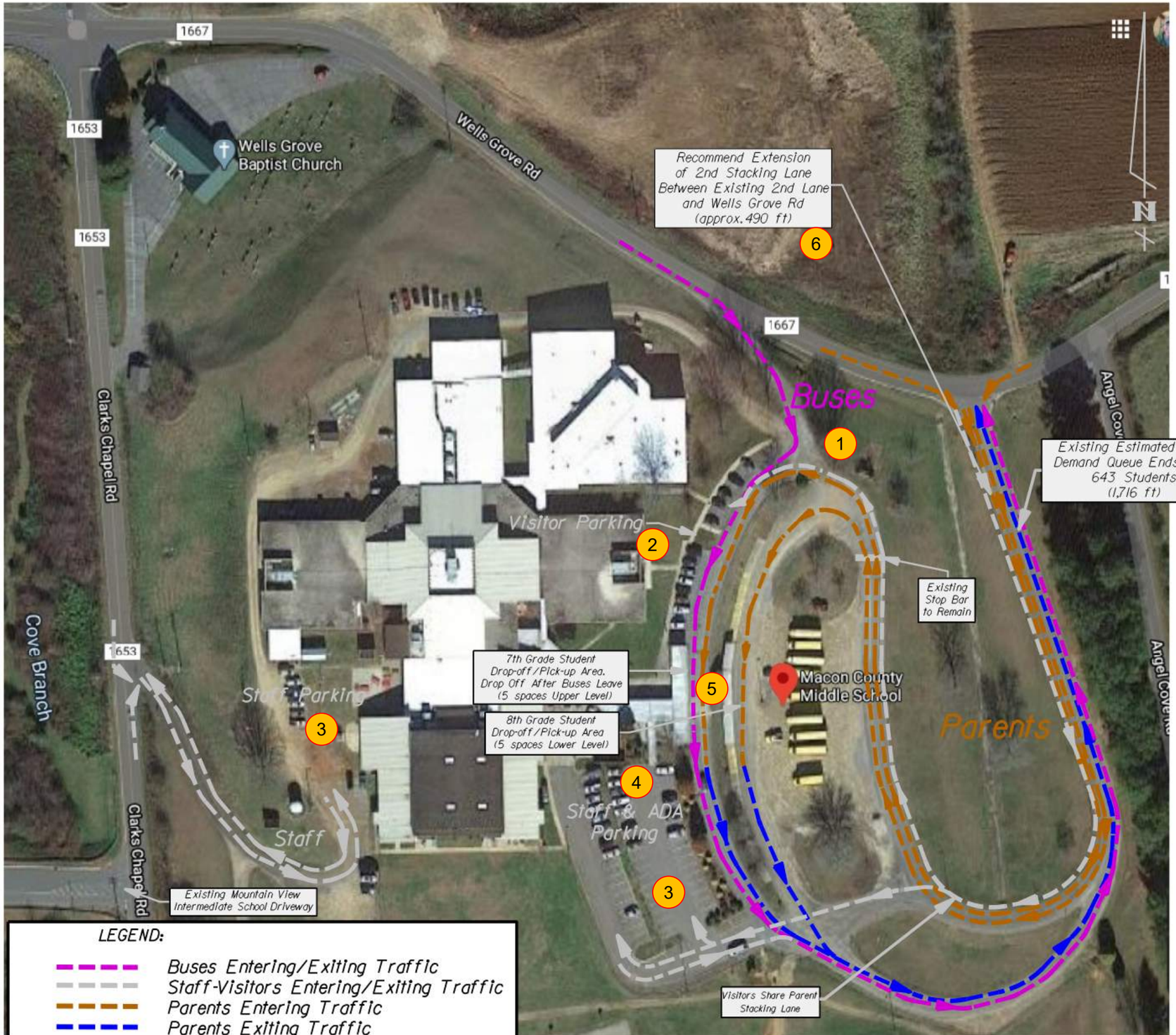
2135 Feet Double Queue
2135 Feet Total Queue

CONCEPT PLAN
NOT FOR CONSTRUCTION

Municipal & School Transportation Assistance

Figure 7a
Mountain View Intermediate
Recommended Loading Operations

Division 14	Macon County	Franklin
SCALE: NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE: 9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
PREPARED BY: DLH		



NOTES

1. Existing geometry provides two stacking lanes with a stop bar then the lanes diverge to two loading zone. The parents utilize the upper loading zone after buses have departed. Keep existing stop bar location.
2. Visitor parking exists along the travelway for the upper loading zone. Visitors share the parent stacking lane to access the visitor parking. Visitors exit past the loading zone and follow the parent exit pattern.
3. Staff parking is provided in two locations: 1) at the south end of the building; 2) in the back of the building.
4. ADA parking is provided in the staff parking lot on the south end of the building.
5. Students that are dropped-off or picked-up on the lower level have access to the building via a graded-separated walkway under the upper loading zone.
6. Construct the extension of the 2nd stacking lane between the existing 2nd lane and Wells Grove Rd. The new lane would extend approximately 490 feet to accommodate the High Demand of the existing student population.

Macon County Middle School

Existing 643 Student Population

Provided Queue

490 Feet Single Queue
960 Feet Double Queue
1450 Feet Total Queue

Observed Queue (from stop bar)

460 Feet Single Queue
860 Feet Double Queue
1320 Feet Total Queue (2.05ft/stud)
396 Feet 30% High Demand
1716 Feet Total Queue

Recommend Queue

1940 Feet Total Queue

CONCEPT PLAN
NOT FOR CONSTRUCTION

Municipal & School Transportation Assistance

Figure 7b
Macon County Middle
Recommended Loading Operations

Division 14	Macon County	Franklin

SCALE:	NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE:	9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
PREPARED BY:	DLH		

RECOMMENDATIONS

Recommendations were provided for the AM and PM student loading operations for Mountain View Intermediate and Macon County Middle. This report addresses the departmental goals and identifies traffic safety concerns on the Mountain View Intermediate and Macon County Middle campuses and at the SR 1667 (Wells Grove Road) and SR 1653 (Clark's Chapel Road) intersection by offering the recommendations described below and shown on **Figure 6a and 7a** for Mountain View Intermediate, **Figure 6b and 7b** for Macon County Middle, and **Figure 8** for the off-site intersection.

The intent of this report is to offer solutions to help the schools provide safer, better-organized, and more efficient student loading operations, also allowing the traffic on SR 1667 (Wells Grove Road) and SR 1653 (Clark's Chapel Road) to operate safely and efficiently.

ON-SITE CIRCULATION

Mountain View Intermediate

- Require the parents to utilize both of the existing stacking lanes to accommodate the maximum observed queue. Provide new pavement markings to accommodate the two stacking lanes.
- Remove the striping at the existing merge area, and install a stop bar at the location shown in **Figures 6a and 7a**. Place school personnel at stop bar to direct vehicles from each lane to proceed to student drop-off/loading zone. The lanes would alternate with six vehicles at a time move forward to the drop-off/loading zone.
- Implement the included Traffic Management Plan (page 27) for Mountain View Intermediate School.

Macon County Middle

- The existing lane geometry and circulation is sufficient to provide the appropriate flow and required queue area to accommodate the current average demand; however, it will not accommodate the high demand condition (30% increase). Therefore, the construction of an additional stacking lane (approximately 490 feet) adjacent to the existing single lane is recommended. This will provide two stacking lanes in the whole queueing area (See **Figures 6b and 7b**). Provide new pavement markings to accommodate the two stacking lanes along the existing and widened travelways.
- Parents utilize the upper loading/unloading area (7^{th} grade) during AM unloading time. This may require buses to arrive earlier to not hinder parents from using upper area.
- Install a Yield sign along the upper lane at the merge of the two parent/bus lanes south of the loading area. Also install a Stop signs at same intersection at both of the staff drive approaches (See **Figures 6b and 7b**).
- Implement the included Traffic Management Plan (page 27) for Macon County Middle School.

OFF-SITE OPERATION

SR 1667 (Wells Grove Road) and SR 1653 (Clark's Chapel Road)

- Implementation of a staggered start of a minimum of 45 minutes between schools. In addition, this scenario will require the installation of a traffic signal at this intersection (See **Figure 8**). Based on our engineering judgement, we have concluded that this recommendation is not contingent on a specific stagger arrangement.

CLOSING

This study identified that the intersection of SR 1667 (Wells Grove Road) and SR 1653 (Clark's Chapel Road) is experiencing excessive traffic delays and congestion especially for traffic exiting from and entering to Mountain View Intermediate and Macon County Middle schools. Modifying the inbound queuing configuration at Mountain View Intermediate and Macon County Middle as stated above should provide the necessary stacking area on-site and alleviate the queueing issues that occur on SR 1653 (Clark's Chapel Road), and potentially occur on SR 1667 (Wells Grove Road). The morning traffic generated by both schools is causing significant queues and delays at all approaches of the SR 1667 (Wells Grove Road) and SR 1653 (Clark's Chapel Road) intersection. The installation of a traffic signal and the schools implementing a 45-minute minimum staggered start are recommended to alleviate the congestion and provide the capacity required to improve the overall intersection operation.

The recommendations and findings of this report should not be thought of as mandates for action. It is and will be the responsibility of Mountain View Intermediate or Macon County Middle to implement and/or construct any of the recommendations located within their property boundaries. The recommendations or improvements located within the Department of Transportation roadway right-of-way will require the consultation of the Division Engineer. If participation needs to be considered, the following factors will be taken into account before any action is taken: jurisdictional responsibility, availability of funds, and the priority placed on the improvements by the Department of Transportation relative to all other planned and programmed improvements in the area.

LEGEND:

Stop = EXISTING STOP SIGN TO BE REMOVED

= EXISTING LANE CONFIGURATION

= PROPOSED TRAFFIC SIGNAL

CONCEPT PLAN
NOT FOR CONSTRUCTION

Municipal & School Transportation Assistance

Figure 8
Wells Grove Rd and Clark's Chapel Rd
Recommended Intersection Improvements

Division 14 | Macon County | Franklin

SCALE: NONE	N. C. DEPARTMENT OF TRANSPORTATION	REVIEWED BY: DLH
DATE: 9/3/2020	TRANSPORTATION MOBILITY AND SAFETY DIVISION	REVISIONS:
PREPARED BY: DLH		

TRANSPORTATION MANAGEMENT PLANS

The Transportation Management Plan (TMP) advises staff, parents, and visitors how to participate in the most efficient school traffic operations. It may also be shared with neighboring businesses for informational purposes. It provides a traffic flow patterns that accommodate the average as well as the high demand days. Each school is to provide the following Traffic Management Plans to the parents.

Mountain View Intermediate School

- Parents should enter and exit the main driveway on SR 1653 (Clark's Chapel Road).
- Parents should stack in a double queue from Clark's Chapel Road until reaching the stop bar, where they are to wait until the school official directs them to pull forward into one single lane at the loading zone.
- A school official will direct the first five or six vehicles in the stacking lane closest to the building to pull up and park in the loading zone. The school official will alternate the lanes.
- A school official will supervise loading to ensure the students safety and help make this loading process perform as quickly as possible.
- If a student needs extended time to load or the student is to be picked up early, then the parents are encouraged to use the short-term visitor parking spaces.
- Parents should enter the campus no more than 30 minutes prior to the AM or PM bell.
- Staff and Visitors should enter from Clark's Chapel Road, and Staff should arrive more than 30 minutes before the bell.
- For students requiring ADA accessibility, parents are to use the left stacking lane along with other parents and then turn at the staff and visitor parking lot. Within that lot, ADA spaces are provided along the loading and unloading area. Students are to use the crosswalks to access the school building.
- Pedestrians should use sidewalks and crosswalks where provided.
- Buses should enter and exit the bus driveway on SR 1667 (Wells Grove Road).

Macon County Middle School

- Parents should enter and exit the main driveway on SR 1667 (Wells Grove Road).
- Parents should stack in a double queue from Wells Grove Road until reaching the stop bars, where they are to wait until the school official directs them to pull forward into the upper and lower loading zones. The upper loading zone is for 7th grade students and the lower zone is for 8th grade students.
- A school official will direct the first five vehicles in the stacking lane closest to the building to pull up and park within the loading zones, both upper and lower.
- A school official will supervise loading to ensure the students safety and help make this loading process perform as quick as possible.
- If a student needs extended time to load or the student is to be picked up early, then the parents are encouraged to use the visitor parking spaces along the upper drive.
- Parents should enter the campus no more than 30 minutes prior to the AM or PM bell.
- Visitors should enter from Wells Grove Road, and follow the stacking lane for the upper loading area and park in the Visitor spaces provided next to the building.
- Staff should enter from the main driveway on Wells Grove Road or the staff-only driveway on Clark's Chapel Road. Staff should arrive more than 30 minutes prior to the AM bell.
- For students requiring ADA accessibility, parents are to use the stacking lane for the lower loading area and turn off to the staff parking lot on the southside of the building. Within that lot, ADA spaces are provided along the loading and unloading area. Students are to use the crosswalks to access the school building.
- Pedestrians should use sidewalks and crosswalks where provided.
- Buses should enter from the west via the bus driveway on Wells Grove Road, and from the east via the main driveway on Wells Grove Road. All buses should exit via the main driveway on Wells Grove Road. Buses should have first access to the loading/unloading zones and once the buses are finished then the parents are to access both loading zones.