TRAFFIC STUDY

Concord Middle School

Concord, New Hampshire

PREPARED FOR

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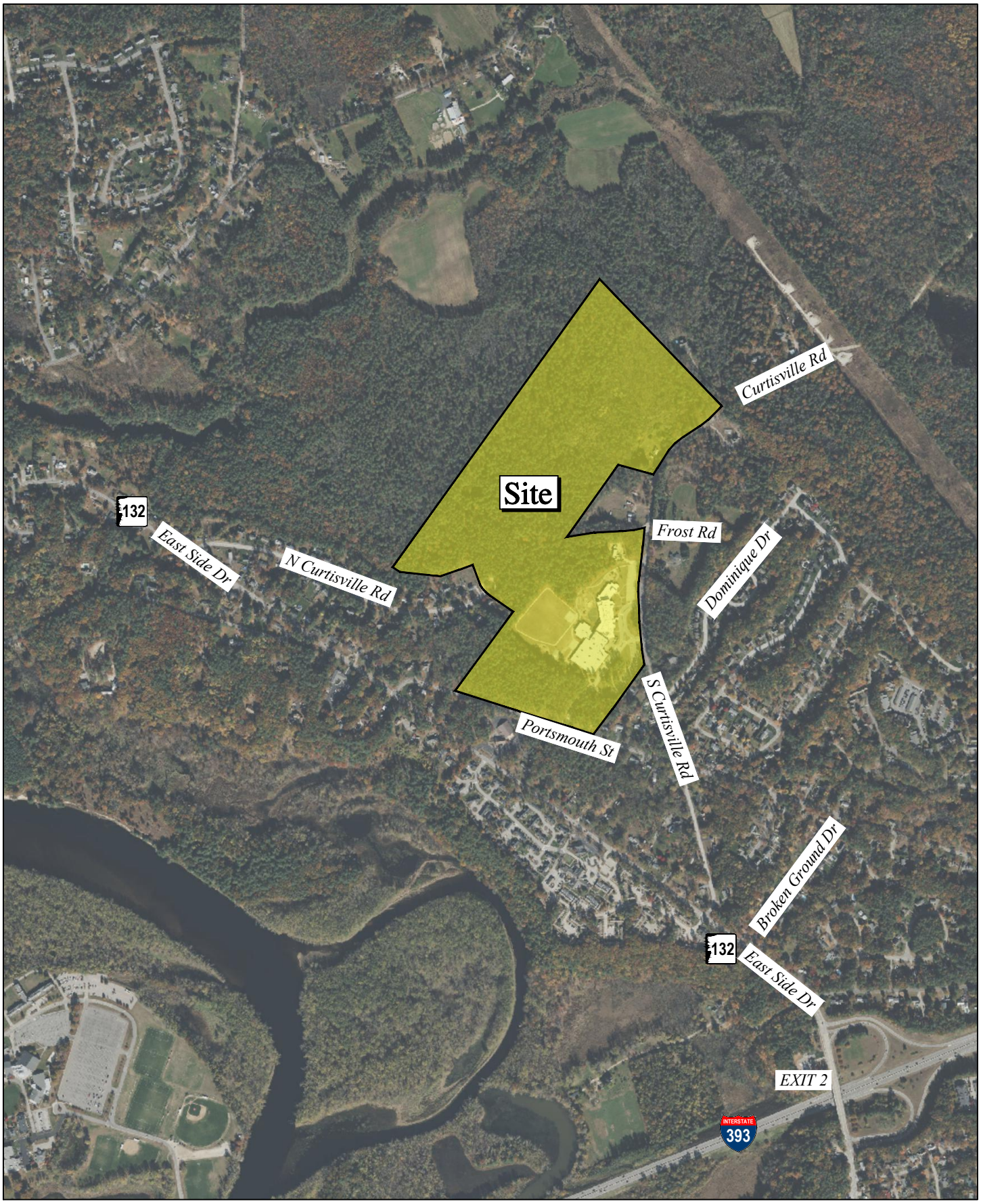
Introduction

Vanasse Hangen Brustlin, Inc. (VHB) has prepared this Traffic Study to summarize the anticipated transportation impacts associated with the proposed Concord Middle School to be located on the vacant lot at 11 Curtisville Road near Mill Brook School and Broken Ground School in Concord, New Hampshire. The project consists of constructing a new middle school with access to be provided along Portsmouth Street for parents/guardians to drop off and pick up students and access along South Curtisville Road for school buses and other authorized vehicles. The site location in relation to the surrounding roadway network is shown on Figure 1. A copy of the preliminary site plan prepared by Nobis Group is provided under a separate cover.

Based on a review of the New Hampshire Department of Transportation (NHDOT) Roads and Projects database,[1] the adjacent roadway system is under City of Concord jurisdiction. Accordingly, VHB attended a scoping session with City of Concord officials on October 6, 2023 to define the parameters and methodology of a traffic study for the proposed middle school project. The scope of this traffic study was developed in conformance with applicable City of Concord and NHDOT guidelines, standards, and requirements.

1 granitweb.sr.unh.edu/Geocortex/WebViewer/?app=9ec207d1970d4ddab771dce0d57f82aa



Site Location Image

Figure 1

0 500 1000 Feet

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Existing Conditions

Existing conditions were developed by conducting field reconnaissance and collecting traffic counts within the vicinity of the site. In preparing this study for the proposed middle school project, the following intersections have been analyzed:

- South Curtisville Road and Mill Brook School/Broken Ground School north driveway
- South Curtisville Road and Mill Brook School/Broken Ground School center driveway
- South Curtisville Road and Mill Brook School/Broken Ground School south (main) driveway
- South Curtisville Road and Portsmouth Street
- East Side Drive (NH Route 132) and Portsmouth Street
- East Side Drive (NH Route 132) and South Curtisville Road
- East Side Drive (NH Route 132) and Broken Ground Drive

Since NHDOT and McFarland-Johnson, Inc. are working on a bridge preservation project along East Side Drive over Interstate 393 (I-393), a qualitative evaluation was conducted at the following state-maintained intersections:

- East Side Drive (NH Route 132) and Interstate 393 (I-393) westbound ramps
- East Side Drive (NH Route 132) and I-393 eastbound ramps

Intersection Inventories

In September and November 2023, VHB visited the study area intersections to conduct a field inventory of the transportation facilities. The following summarizes these findings.

South Curtisville Road and Mill Brook School/Broken Ground School North Driveway

South Curtisville Road and the northern driveway for Mill Brook School and Broken Ground School intersect to form a three-legged unsignalized intersection. South Curtisville Road is aligned in a north-south layout, is approximately 30 feet in width, has no pavement markings to separate directional flows, and the northbound and southbound approaches are unrestricted (i.e., free flow). South Curtisville Road is legislatively categorized as a Class V Local Road, functionally classified as a Local Road, and under City of Concord jurisdiction.

The school driveway intersects South Curtisville Road from the west, is approximately 26-feet wide, has no pavement markings to separate directional flows, and the eastbound approach is under STOP sign control. The school driveway is legislatively categorized as a Class 0 Private Road, does not have a functional classification, and is under private jurisdiction.

There is a sidewalk along the west side of South Curtisville Road and a striped crosswalk across the school driveway with tactile curb ramps. The crosswalk is striped with a series of closely spaced white lines parallel to the direction of travel (aka, longitudinal bar striping). Utility poles are present along the east side of South Curtisville Road. There is an overhead light located on the southern side of the driveway to the west of the crosswalk. There are "School Bus Parking Only between 7:00 AM to 4:00 PM September through June" signs posted along the east side of South Curtisville Road and "No Parking between 7:00 AM to 4:00 PM September through June" signs posted along the west side of South Curtisville Road. There is a mailbox for 55 South Curtisville Road located on the northwestern side of the intersection.

South Curtisville Road and Mill Brook School/Broken Ground School Center Driveway

South Curtisville Road and the center driveway for Mill Brook School and Broken Ground School intersect to form a three-legged unsignalized intersection. South Curtisville Road is approximately 30 feet in width, has no pavement markings to separate directional flows, and the northbound and southbound approaches are unrestricted (i.e., free flow). The school driveway intersects South Curtisville Road from the west, is approximately 26-feet wide, has a striped double solid line yellow (DSLY) centerline to separate directional flows (one 13-foot wide entering lane and one 13-foot exiting lane), and the eastbound approach is under STOP sign control.

The school driveway is for Mill Brook School entering buses and for exiting parents/guardians from the Mill Brook School drop off/pick up area. There are "Do Not Enter" signs and "Bus Only" signs posted at the end of parents from drop off/pick up area and the beginning of the bus lane. Upon entering the school driveway, there are pavement markings to signify that motorists should turn right into the Mill Brook School parking lot while only buses can continue to the front of the school. The school driveway is legislatively categorized as a Class 0 Private Road, does not have a functional classification, and is under private jurisdiction.

There are sidewalks along the west side of South Curtisville Road and the north side of the school driveway with a striped crosswalk across the school driveway and tactile curb ramps. The crosswalk is defined with longitudinal bar striping. Utility poles are present along the east side of South Curtisville Road. There is an overhead light located on the northern side of the driveway to

the west of the crosswalk. There are "School Bus Parking Only between 7:00 AM to 4:00 PM September through June" signs posted along the east side of South Curtisville Road and "No Parking between 7:00 AM to 4:00 PM September through June" signs posted along the west side of South Curtisville Road.

South Curtisville Road and Mill Brook School/Broken Ground School South Driveway

South Curtisville Road and the southern driveway for Mill Brook School and Broken Ground School intersect to form a three-legged unsignalized intersection. South Curtisville Road is approximately 30 feet in width, has no pavement markings to separate directional flows, and the northbound and southbound approaches are unrestricted (i.e., free flow). The school driveway intersects South Curtisville Road from the west, is approximately 34-feet wide, is striped to provide two entering lanes and one exiting lane, had has a striped DSLY centerline to separate directional flows. The rightmost (northern) lane provides one-way parent/guardian vehicle flow to the front of Mill Book School for student drop off and pick up. The leftmost (middle) entering lane provides access to the Broken Ground School parking lot and for parent/guardian vehicles to the front of Broken Ground School for student drop off and pick up. The exiting (southern) lane is under STOP sign control at South Curtisville Road. The bus lane in front of Mill Brook School continues southerly to Broken Ground School without conflict with other vehicles since it is physically separated from and runs parallel with the parent drop off and pick up lane. The school driveway is legislatively categorized as a Class 0 Private Road, does not have a functional classification, and is under private jurisdiction.

There are sidewalks along the west side of South Curtisville Road and the south side of the school driveway with a striped crosswalk across the school driveway and tactile curb ramps. The crosswalk is defined with longitudinal bar striping. Utility poles are present along the east side of South Curtisville Road. There is an overhead light located on the northern side of the driveway to the west of the crosswalk. There are "School Bus Parking Only between 7:00 AM to 4:00 PM September through June" signs posted along the east side of South Curtisville Road and "No Parking between 7:00 AM to 4:00 PM September through June" signs posted along the west side of South Curtisville Road.

South Curtisville Road and Portsmouth Street

South Curtisville Road and Portsmouth Street intersect to form a four-legged unsignalized intersection that is under All-Way Stop control (AWSC) with STOP signs and All Way plaques. South Curtisville Road is aligned in a north-south layout and Portsmouth Street is an east-west roadway. The South Curtisville Road north and south legs are approximately 26 feet in width, have no pavement markings to separate directional flows, and have solid white STOP lines striped on the approaches to Portsmouth Street. The South Curtisville Road speed limit is posted at 25 miles per hour (mph) south of Portsmouth Street. The Portsmouth Street east and west legs are approximately 23 feet in width, have DSLY centerlines to separate directional flows (two 11.5-foot wide travel lanes), have single solid line white (SSLW) edge lines, and have solid white STOP lines striped on the approaches to South Curtisville Road. Portsmouth Street is legislatively categorized as a Class V Local Road, functionally classified as a Local Road, and under City of Concord jurisdiction.

Facing Portsmouth Street westbound motorists east of South Curtisville Road, there is a STOP Ahead sign and a School sign assembly with a posted speed limit of 20 mph when the beacon is flashing. Facing Portsmouth Street eastbound motorists east of 92 Portsmouth Street, there is a School sign assembly with a posted speed limit of 20 mph when the beacon is flashing. In addition, there is a STOP Ahead sign facing Portsmouth Street westbound motorists west of South Curtisville Road.

There are sidewalks along the west side of South Curtisville Road and the north side of Portsmouth Street with striped crosswalks across the South Curtisville Road north leg and the Portsmouth Street west leg. The crosswalks are defined with longitudinal bar striping. There is a School pedestrian crosswalk sign posted on the northwest corner of the intersection facing motorists departing the intersection destined for Portsmouth Street west. Utility poles are present along the north side of Portsmouth Street and along the east side of the South Curtisville Road north leg that cross at the intersection and continue along the west side of the South Curtisville Road south leg. There is an overhead light and a fire hydrant located on the northwest corner of the intersection.

East Side Drive (NH Route 132) and Portsmouth Street

East Side Drive, Portsmouth Street, and a driveway for the residence at 195 East Side Drive intersect to form a four-legged unsignalized intersection. East Side Drive is aligned in a northwest-southeast layout, is approximately 26-feet wide, has DSLY centerlines to separate directional flows (two 10-foot wide travel lanes), and has SSLW edge lines. The speed limit along East Side Drive is posted at 30 mph and the northbound and southbound approaches are unrestricted (i.e., free flow). East Side Drive is legislatively categorized as a Class IV Compact Road, functionally classified as a Major Collector, and under City of Concord jurisdiction.

Portsmouth Street is aligned in an east-west layout for approximately 130 feet from East Side Drive that transitions to a northwest-southeast horizontal layout. Portsmouth Street is approximately 28-feet wide, has DSLY centerlines to separate directional flows (two 11-foot wide travel lanes), has SSLW edge lines, and is posted at 30 mph. The Portsmouth Street approach to East Side Drive is under STOP sign control and has a solid white STOP line striped at the intersection. The northern driveway for the residence at 195 East Side Drive represents the western leg of the intersection and is approximately 11-feet wide. The residential driveway does not have pavement markings or signage.

There are “No Thru Trucking” signs posted on the Portsmouth Street leg facing motorists entering from the East Side Drive intersection (departing the intersection). There is a “STOP Ahead” sign posted facing Portsmouth Street westbound (approaching) motorists. Utility poles are present along the east side of East Side Drive, the north side of Portsmouth Street, and south of the 195 East Side Drive residential driveway. There is an overhead light on the southeast corner of the intersection. There are sidewalks along the west side of East Side Drive and the north side of Portsmouth Street with a longitudinal bar striped crosswalk across the East Side Drive north leg, a tactile ramp only on the eastern end of the crosswalk, and School pedestrian crosswalk signs posted on both sides of the crosswalk. The west side of the crosswalk leads pedestrians into a raised curb (see Photo 1). Since all pedestrian street crossings must be accessible to pedestrians with disabilities, the existing pedestrian crossings may need to be upgraded to Americans with Disabilities Act (ADA) and Federal Highway Administration (FHWA) compliancy.

Photo 1: West Side of East Side Drive Crosswalk at Portsmouth Street Intersection

East Side Drive (NH Route 132) and South Curtisville Road

East Side Drive, South Curtisville Road, and the southern driveway for Heritage Heights retirement community at 149 East Side Drive intersect to form a four-legged unsignalized intersection. East Side Drive is aligned in a northwest-southeast layout, is approximately 45-feet wide, provides a 10-foot wide exclusive left-turn lane and a 10-foot wide shared through/right-turn lane in each direction, has DSLY centerlines to separate directional flows, and has SSLW edge lines. The East Side Drive northbound and southbound approaches are unrestricted (i.e., free flow). South Curtisville Road is aligned in an east-west layout for approximately 115 feet from East Side Drive that transitions to a north-south horizontal layout. South Curtisville Road is approximately 30-feet wide and neither has centerline nor edge line pavement markings. The South Curtisville Road approach to East Side Drive is under STOP sign control and has a solid white STOP line striped at the intersection. The Heritage Heights retirement community driveway represents the western leg of the intersection, is under STOP sign control, and has a solid white STOP line striped at the intersection. The driveway is approximately 22-feet wide and neither has centerline nor edge line pavement markings. Approximately 100 feet to the west of East Side Drive, the Heritage Heights retirement community driveway westbound approach (departing the intersection) is under STOP control at an internal intersection.

The speed limit along East Side Drive is posted at 30 mph and the speed limit along South Curtisville Road is posted at 25 mph. Facing South Curtisville Road north-eastbound motorists (departing the intersection) approximately 380 feet north-east of East Side Drive, there is a School sign assembly with a posted speed limit of 15 mph when the beacon is flashing. Utility poles are present along the east side of East Side Drive and along both sides of South Curtisville Road to the driveway for 12 South Curtisville Road and then only on the east side until Portsmouth Street. There is an overhead light on the southeast corner of the intersection and on the north side of the Heritage Heights retirement community driveway. There are sidewalks along the west side of East Side Drive and the north side of Portsmouth Street with a longitudinal bar striped crosswalk across the East Side Drive north leg and tactile ramps. There are School pedestrian crosswalk signs posted on both sides of the crosswalk.

East Side Drive (NH Route 132) and Broken Ground Drive

East Side Drive and Broken Ground Drive intersect to form a three-legged unsignalized intersection. East Side Drive is aligned in a northwest-southeast layout, is approximately 45-feet wide, provides a southbound 10-foot wide exclusive left-turn lane and a 10-foot wide through lane, includes a northbound 10-foot wide shared through/right-turn lane, has DSLY centerlines to separate directional flows, and has SSLW edge lines. The East Side Drive northbound and southbound approaches are unrestricted (i.e., free flow). Broken Ground Drive is aligned in a southwest-northeast layout that is approximately 25-feet wide and neither has centerline nor edge line pavement markings. The Broken Ground Drive approach to East Side Drive is under STOP sign control and has a solid white STOP line striped at the intersection. Broken Ground Drive is legislatively categorized as a Class V Local Road, functionally classified as a Local Road, and under City of Concord jurisdiction.

The speed limit along East Side Drive is posted at 30 mph and the speed limit along Broken Ground Drive is posted at 25 mph. Utility poles are present along the east side of East Side Drive north of the intersection that cross to the west side of the roadway at the intersection. There is an overhead light on the west side of East Side Drive south of the intersection. There is a sidewalk along the west side of East Side Drive with a longitudinal bar striped crosswalk across the East Side Drive north leg. There are no pedestrian landing areas, curb ramps, or posted pedestrian crosswalk signs. The crosswalk leads pedestrians to a grassed area before accessing the sidewalk on the west side of East Side Drive and there are no sidewalks on the east side of the intersection for pedestrian connectivity. There is a pedestrian pathway provided on the west of the East Side Drive sidewalk to access Heritage Heights retirement community. There is a fire hydrant located on the west of the East Side Drive north of the crosswalk.

Photo 2: Looking West Across East Side Drive from Broken Ground Drive

East Side Drive (NH Route 132) and I-393 Westbound Ramps

East Side Drive, the I-393 westbound ramps, and a residential driveway for 79 East Side Drive intersect to form a four-legged unsignalized intersection. East Side Drive is aligned in a north-south layout and is approximately 52 feet in width. The East Side Drive northbound approach provides an 11-foot wide shared left-turn/through lane and an 11-foot wide channelized right-

turn lane that is under YIELD sign control to the east of the intersection (i.e., prior to the conflict point with East Side Drive southbound left turns within the I-393 westbound on-ramp). The East Side Drive southbound approach consists of an 11-foot wide left-turn lane and an 11-foot wide shared through/right-turn lane. East Side Drive has DSLY centerlines to separate directional flows as well as SSLW edge lines. The driveway for the residence at 79 East Side Drive represents the western leg of the intersection and is approximately 11.5-feet wide. The residential driveway does not have pavement markings or signage.

The I-393 westbound ramps are aligned in an east-west layout and are legislatively categorized as a Class I Primary Highways, functionally classified as Interstates, and under NHDOT jurisdiction. The I-393 westbound ramps leg of the intersection provides for approaching (off-ramp) and departing (on-ramp) vehicles with directional flows separated by a curbed grassed area. The I-393 westbound off-ramp approach consists of approximately 28 feet of pavement width, includes an 11.5-foot wide left-turn lane and an 11.5-foot wide right-turn lane, and has a SSLW edge line on the north side of the off-ramp and a single solid line yellow (SSLY) edge line along the south side. The I-393 westbound off-ramp approach to East Side Drive is under STOP sign control and has a solid white STOP line striped at the intersection. The I-393 westbound on-ramp provides one 22-foot wide travel lane for motorists departing the intersection east of the East Side Drive southbound left turn and East Side Drive northbound right turn conflict area. There is a SSLY edge line along the north side of the off-ramp and a SSLW edge line along the south side.

To the north of the intersection, there is a lane designation sign (left turn only lane and through lane) and a Destination Guide sign (for motorists destined for US Routes 4 and 202 west to turn left) posted on the west side of East Side Drive facing southbound motorists. To the south of the intersection, there is a Signal Ahead sign posted on the west side of East Side Drive facing southbound motorists (i.e., the sign is associated with the East Side Drive and I-393 eastbound ramps downstream signalized intersection). At the intersection, there is a No Parking sign posted on the west side of East Side Drive facing southbound motorists and a Destination Guide sign (for motorists destined for I-393 and I-93 west to turn left) located within the raised island for the channelized right-turns onto I-393 westbound.

To the south of the intersection, there is a Destination Guide sign (for motorists to turn right onto US Routes 4 and 202) posted on the east side of East Side Drive facing northbound motorists. At the intersection, there is a Destination Guide sign (for motorists destined for I-393 and I-93 west to turn right) facing northbound motorists located within the raised island for the channelized right-turns onto I-393 westbound. To the north of the intersection, there is a No Trucks sign and a NH Route 132 North sign posted on the east side of East Side Drive facing northbound motorists.

Posted on the I-393 westbound off-ramp, there is a 30 mph Advisory Ramp Speed sign, a Stop Ahead sign, Designation Signs (left and right for East Side Drive, left for Concord Heights, right for East Concord, and left for Hazen Drive State Offices), a NH Route 132 south sign for left turns, a NH Route 132 North sign for right turns, and an Airport sign for left turns. There are Do Not Enter and One Way signs posted at the I-393 off-ramp facing motorists on East Side Drive, as well as Wrong Way signs posted on the off-ramp to the east of the intersection. There is a No Pedestrians, Bicycles, Horses, Mopeds, Motor Scooters sign posted on the I-393 on-ramp facing motorists departing the intersection east of the East Side Drive southbound left turn and East Side Drive northbound right turn conflict area. Within the median separating the I-393

westbound on-ramp and off-ramp, there is an Object Marker sign and a Keep Right sign facing motorists on East Side Drive.

There is a sidewalk provided along the west side of East Side Drive. Utility poles are present along the east and west sides of East Side Drive. There are overhead lights on the west side of East Side Drive south of the 79 East Side Drive residential driveway (to the west of the sidewalk), on the east side of East Side Drive south of the East Side Drive northbound channelized right-turn lane, and on the south side of the I-393 westbound on-ramp east of the East Side Drive southbound left turn and East Side Drive northbound right turn conflict area. There is a mailbox for 79 East Side Drive located on the west side of East Side Drive south of the residential driveway.

East Side Drive (NH Route 132) Overpass

Between the I-393 westbound and eastbound ramps, David E. Powelson Memorial Bridge represents an overpass for East Side Drive for northbound and southbound travel over I-393. This section of East Side Drive provides approximately 52 feet of pavement width, two 11-foot wide northbound travel lanes (the outside travel lane transitions into the right-turn lane for continuation to the I-393 westbound on-ramp), an 11-foot wide southbound travel lane, DSLY centerlines to separate directional flows, and SSLW edge lines. Sidewalks are provided along both sides of the overpass with guardrail and fencing along the sides. Utility poles are present along the east and west sides of East Side Drive to the north of David E. Powelson Memorial Bridge and along the west side of East Side Drive to the south of the bridge.

To the north of David E. Powelson Memorial Bridge, there is a Destination Guide sign (for motorists destined for US Route 4, US Route 202, and I-393 east to use the next left) posted on the west side of East Side Drive facing southbound motorists. To the south of David E. Powelson Memorial Bridge, there is a Destination Guide sign (for motorists destined for US Route 4, US Route 202, and I-393 west to use the right lane) posted on the east side of East Side Drive facing northbound motorists.

East Side Drive (NH Route 132) and I-393 Eastbound Ramps

East Side Drive and the I-393 eastbound ramps intersect to form a three-legged signalized intersection. East Side Drive is aligned in a north-south layout and is approximately 50 feet in width. The East Side Drive northbound approach provides a 12-foot wide through lane and a 12-foot wide shared through/right-turn lane. The East Side Drive southbound approach consists of an 11-foot wide left-turn lane and an 11-foot wide through lane. East Side Drive has DSLY centerlines to separate directional flows as well as SSLW edge lines and Stop lines at the signalized intersection to show where the lead motorists should stop under red signal indication.

The I-393 eastbound ramps are aligned in an east-west layout and are legislatively categorized as a Class I Primary Highways, functionally classified as Interstates, and under NHDOT jurisdiction. The I-393 eastbound ramps leg of the intersection provides for approaching (off-ramp) and departing (on-ramp) vehicles with directional flows separated by a curbed grassed area. The I-393 eastbound off-ramp approach consists of approximately 28 feet of pavement width, includes an 11.5-foot wide left-turn lane and an 11.5-foot wide right-turn lane, and has a SSLW edge line on the north side of the off-ramp and a SSLY edge line along the south side. The I-393 eastbound off-ramp approach has a Stop line striped at the signalized intersection to show

where the lead vehicle should stop under red signal indication. The I-393 eastbound on-ramp provides one 21-foot wide travel lane for motorists departing the intersection. There is a SSLY edge line along the north side of the off-ramp and a SSLW edge line along the south side.

To the south of the intersection, there is a Destination Guide sign (for motorists to turn right onto US Route 4, US Route 202, and I-393 east) posted on the east side of East Side Drive facing northbound motorists. There is a Right Turn on Red After Stop sign posted on the traffic signal mast arm on the east side of East Side Drive (within the median island separating the I-393 eastbound on-ramp and off-ramp) facing east Side Drive northbound motorists. On the southwest corner of the intersection, there is a Destination Guide sign (for motorists to turn left onto US Route 4, US Route 202, and I-393 east) facing East Side Drive southbound motorists. Posted on the I-393 eastbound off-ramp, there is a 30 mph Advisory Ramp Speed sign, a Signal Ahead sign, Designation Signs (left for NH Route 132 South, right for NH Route 132 North, left and right for East Side Drive, left for Heights Business District, right for East Concord, left for Hazen Drive/State Offices, and left for Concord Heights), a NH Route 132 south sign for left turns, and a NH Route 132 North sign for right turns. There are Do Not Enter and One Way signs posted at the I-393 off-ramp facing motorists on East Side Drive, as well as Wrong Way signs posted on the off-ramp to the east of the intersection. There is a No Pedestrians, Bicycles, Horses, Mopeds, Motor Scooters sign posted on the I-393 on-ramp facing motorists departing the intersection. Within the median separating the I-393 westbound on-ramp and off-ramp, there is an Object Marker sign and a Keep Right sign facing motorists on East Side Drive.

The signalized intersection operates on a three phase system with an East Side Drive southbound lead phase, an East Side Drive northbound/southbound permissive phase (with a flashing yellow arrow facing the East Side Drive southbound left turns), and an I-393 eastbound off-ramp phase. The traffic signal cabinet is located on the southeast corner of the intersection. This signalized intersection is contained within a traffic signal system with the East Side Drive and Hazen Drive intersection. There is a sidewalk provided along the west side of East Side Drive. Utility poles are present along the east side of East Side Drive and a utility pole is located on the west side of East Side Drive north of the residential driveway for 65 East Side Drive. There are overhead lights on the west side of East Side Drive on the traffic signal mast arm and on the south side of the I-393 eastbound on-ramp. There is a mailbox for 65 East Side Drive located on the west side of East Side Drive north of the residential driveway.

Field Observations

In September 2023, VHB visited the existing Broken Ground and Mill Brook Schools campus and surrounding area to observe the general vehicular and pedestrian operations during the student arrival and dismissal periods when public schools are in regular session. The following field notes document the observed transportation issues.

South Curtisville Road and Mill Brook School/Broken Ground School Driveways

During the field observations, the school hours for students at Mill Brook School and Broken Ground School were between 7:45 AM-2:30 PM. At the times of the morning student drop-off period and the afternoon student pick-up period, motorists queued back from the school

campus' southern driveway onto South Curtisville Road and stopped along the east side of South Curtisville Road with the vehicles extending past Dominique Drive.

- Buses and faculty destined for Mill Brook School and residents to the north of the schools were observed to bypass the standing queue by traveling along the west side of South Curtisville Road into oncoming vehicles.
- Parents/guardians destined for Broken Ground School were observed turning into the exiting lane of the southern driveway into oncoming vehicles.

In addition, vehicles entering the southern driveway were observed to stop and idle within the striped crosswalk during the afternoon student pick-up period.

- Pedestrians were forced to cross the southern driveway within South Curtisville Road and not within the crosswalk.
- The sightlines were restricted to the north of the South Curtisville Road southern driveway for motorists exiting from this driveway due to the entering vehicles queueing back from the campus.
- Since Mill Brook School parent/guardian and faculty vehicles exit via the South Curtisville Road northern and center driveways, the South Curtisville Road southbound vehicle demand was high at the southern driveway which exacerbated the safety concern of the limited sightlines (i.e., available sight distances were blocked by vehicles queuing back from the south driveway onto South Curtisville Road).

Photo 3: Traveling on Incorrect Side of South Curtisville Road Northbound and Interaction with Pedestrian

Photo 4: Entering on Incorrect Side of Shared Driveway

Photo 5: Traveling on Incorrect Side of South Curtisville Road

Photo 6: Traveling on Incorrect Side of South Curtisville Road South of School Southern Driveway

Photo 7: Traveling on Incorrect Side of South Curtisville Road South of School Shared Driveway

Photo 8: South Curtisville Road Motorist off Pavement near Pedestrian to Avoid Opposing Vehicle

› Consideration may be provided in the following measures:
  - Improving on-campus operations to alleviate the frequency of vehicles queueing back from the south driveway onto South Curtisville Road.
  - Providing a northbound left-turn lane along South Curtisville Road in which motorists can wait prior to entering the elementary schools' south driveway.
  - Striping a centerline along South Curtisville Road between Frost Road (north of the schools' north driveway) and East Side Drive (southern terminus of the roadway).

South Curtisville Road and Portsmouth Street

During the student drop-off and pick-up time periods for Broken Ground School and Mill Brook School, motorists were observed to come to complete stops at the South Curtisville Road and Portsmouth Street multi-way stop controlled intersection. During off peak periods, motorists were seen to slow when approaching the intersection but not come to complete stops before proceeding through the intersection. Consideration may be given in the following measures:

› As previously identified, striping a centerline along South Curtisville Road between Frost Road (north of the schools' north driveway) and East Side Drive (southern terminus of the roadway).

› In compliance with Section 2A.11: Enhanced Conspicuity for Standard Signs of the Manual on Uniform Control Devices (MUTCD), adding light-emitting diode (LED) units within the border of the STOP signs to enhance the visibility of the regulatory sign.[2]

Sight Distances

In accordance with Section 3.28.08(6) of the City's Site Plan Regulations, sight distances have been evaluated at the study area intersections to determine if the available sightlines for vehicles exiting the minor street approach meet or exceed minimum distances required for approaching vehicles to safely stop. The available sightlines were compared with the minimum as established by the American Association of State Highway and Transportation Officials (AASHTO).[3]

2 Federal Highway Administration. Manual on Uniform Traffic Control Devices for Streets and Highways. 11th ed. Washington, DC. Dec. 2023.

3 American Association of State Highway and Transportation Officials. A policy on Geometric Design of Highway and Streets, 7th ed. Washington, D.C. 2018.

Sight distance is the length of roadway ahead visible to the driver and consideration is provided in two categories: Stopping Sight Distance (SSD) and Intersection Sight Distance (ISD). The SSD is the distance required for a vehicle approaching an intersection from either direction to perceive, react and come to a complete stop to avoid colliding with an object in the road. In this respect, SSD can be considered as the minimum visibility criterion for the safe operation of an unsignalized intersection with the minor street approach(es) under stop control.

The ISD is based on the time required for perception, reaction, and completion of the desired critical exiting maneuver (typically, a left turn) once the driver on a minor street approach (or a driveway) decides to execute the maneuver. In accordance with the AASHTO manual, the ISD must be equal to or greater than the minimum required SSD in order to provide safe operations at an intersection to anticipate and avoid potential collisions (i.e., minimum ISD).[4] Calculations for ISD include the time to (1) turn left and clear the near half of the intersection without conflicting with the vehicles approaching from the left; and (2) upon turning left, to accelerate to the operating speed on the major roadway without causing approaching motorists on the mainline to unduly reduce their speed. In this context, ISD can be considered as a desirable visibility criterion for the safe operation of an unsignalized intersection.

For intersections with traffic signal control or AWSC, AASHTO sight distance methodologies require the first stopped vehicle on one approach to be visible to the drivers of the first stopped vehicles on each of the other approaches.[5] Based on coordination efforts with NHDOT officials, the general guidelines for minimum sight distance requirements with these types of traffic control are similar to AASHTO guidelines. The measured SSD and ISD for each intersection are shown in Table 1.

4 AASHTO, page 9-35.

5 AASHTO, page 9-55 (Case D – Intersections with Traffic Signal Control) and page 9-56 (Case E – Intersections with All-Way Stop Control).

Table 1 Sight Distance Summary – Existing Study Area Intersections

Intersection/ Location/Condition	Stopping Sight Distance (feet)		Intersection Sight Distance (feet)			
			To/From North/East		To/From South/West	
	To/From North/East	To/From South/West	Minimum	Desirable	Minimum	Desirable
South Curtisville Road and Existing School North Driveway						
Eastbound Approach						
Measured	>300	>300	>300	>300	>300	>300
Minimum Required	155 [a]	155 [a]	155 [b]	280 [a]	155 [b]	280 [a]
South Curtisville Road and Existing School Center Driveway						
Eastbound Approach						
Measured	>300	>300	>300	>300	>300	>300
Minimum Required	155 [a]	155 [a]	155 [b]	280 [a]	155 [b]	280 [a]
South Curtisville Road and Existing School South Driveway						
Eastbound Approach						
Measured	>300	>300	>300	>300	>300	>300
Minimum Required	155 [a]	155 [a]	155 [b]	280 [a]	155 [b]	280 [a]

a Based on AASHTO Table 9-7 for posted speed limit of 25 mph along South Curtisville Road and 30 mph along East Side Drive.

b Minimum ISD same distance as SSD.

c Minimum required sight distance for signalized and AWSC intersections based on the distance from the first stopped vehicle on one approach to the first stopped vehicle on each of the other approaches. For signalized and AWSC intersections: XXX = to north, (XXX) = to east, [XXX] = to south, {XXX} = to west.

Table 1 Sight Distance Summary – Existing Study Area Intersections (continued)

Intersection/ Location/Condition	Stopping Sight Distance (feet)		Intersection Sight Distance (feet)	
	To/From North/East	To/From South/West	To/From North/East	To/From South/West
South Curtisville Road and Portsmouth Street [c]				
Northbound Approach				
Measured	>100 (>65)	{>100}	>100 (>65)	{>100}
Minimum Required	--	--	86 (30)	{75}
Eastbound Approach				
Measured	>100 (>100)	[>95]	>100 (>100)	[>95]
Minimum Required	--	--	45 (75)	[75]
Southbound Approach				
Measured	(>100)	[>100] {65}	(>100)	[>100] {65}
Minimum Required	--	--	(65)	[85] {45}
Westbound Approach				
Measured	>100	[>100] {>100}	>100	[>100] {>100}
Minimum Required	--	--	65	[30] {75}

a Based on AASHTO Table 9-7 for posted speed limit of 25 mph along South Curtisville Road and 30 mph along East Side Drive.

b Minimum ISD same distance as SSD.

c Minimum required sight distance for signalized and AWSC intersections based on the distance from the first stopped vehicle on one approach to the first stopped vehicle on each of the other approaches. For signalized and AWSC intersections: XXX = to north, (XXX) = to east, [XXX] = to south, {XXX} = to west.

Table 1 Sight Distance Summary – Existing Study Area Intersections (continued)

Intersection/ Location/Condition	Stopping Sight Distance (feet)		Intersection Sight Distance (feet)			
			To/From North/East		To/From South/West	
	To/From North/East	To/From South/West	Minimum	Desirable	Minimum	Desirable
East Side Drive and Portsmouth Street						
Eastbound Approach						
Measured	>350	>350	>350	>350	>350	>350
Minimum Required	200 [a]	200 [a]	200 [b]	335 [a]	200 [b]	335 [a]
Westbound Approach						
Measured	200	120	200	200	120	120
Minimum Required	200 [a]	200 [a]	200 [b]	335 [a]	200 [b]	335 [a]
East Side Drive and South Curtisville Road						
Eastbound Approach						
Measured	>350	>350	>350	>350	>350	>350
Minimum Required	200 [a]	200 [a]	200 [b]	335 [a]	200 [b]	335 [a]
Westbound Approach						
Measured	300	150	300	300	150	150
Minimum Required	200 [a]	200 [a]	200 [b]	335 [a]	200 [b]	335 [a]
East Side Drive and Broken Ground Drive						
Westbound Approach						
Measured	>350	>350	>350	>350	>350	>350
Minimum Required	200 [a]	200 [a]	200 [b]	335 [a]	200 [b]	335 [a]
East Side Drive and I-393 Westbound Ramps						
Westbound Approach						
Measured	>350	>350	>350	>350	>350	>350
Minimum Required	200 [a]	200 [a]	200 [b]	335 [a]	200 [b]	335 [a]

a Based on AASHTO Table 9-7 for posted speed limit of 25 mph along South Curtisville Road and 30 mph along East Side Drive.

b Minimum ISD same distance as SSD.

c Minimum required sight distance for signalized and AWSC intersections based on the distance from the first stopped vehicle on one approach to the first stopped vehicle on each of the other approaches. For signalized and AWSC intersections: XXX = to north, (XXX) = to east, [XXX] = to south, {XXX} = to west.

Table 1 Sight Distance Summary – Existing Study Area Intersections (continued)

Intersection/ Location/Condition	Stopping Sight Distance (feet)		Intersection Sight Distance (feet)	
	To/From North/East	To/From South/West	To/From North/East	To/From South/West
East Curtisville Road and I-393 Eastbound Ramps [c]				
Northbound Approach				
Measured	>200 (>200)	--	>200 (>200)	--
Minimum Required	--	--	115 (70)	--
Southbound Approach				
Measured	(>200)	[>200]	(>200)	[>200]
Minimum Required	--	--	(65)	[115]
Westbound Approach				
Measured	>200	[>100]	>200	[>100]
Minimum Required	--	--	65	[70]

a Based on AASHTO Table 9-7 for posted speed limit of 25 mph along South Curtisville Road and 30 mph along East Side Drive.

b Minimum ISD same distance as SSD.

c Minimum required sight distance for signalized and AWSC intersections based on the distance from the first stopped vehicle on one approach to the first stopped vehicle on each of the other approaches. For signalized and AWSC intersections: XXX = to north, (XXX) = to east, [XXX] = to south, {XXX} = to west.

South Curtisville Road and Existing School Driveways

Available sightlines at the existing Mill Brook School and Broken Ground School driveways on South Curtisville Road meet the AASHTO minimum and desirable guidelines.

South Curtisville Road and Portsmouth Street

The available sightlines on each approach of this AWSC intersection meet the AASHTO minimum guidelines in which the first vehicle stopped on each approach should be visible to the first motorists on the other approaches.

East Side Drive and Portsmouth Street

During field reconnaissance, available sightlines were limited from the Portsmouth Street westbound approach at East Side Drive due to overgrown vegetation on the northeast and southeast corners of the unsignalized intersection. To help enhance sightlines to and from Portsmouth Street, trimming and clearing of vegetation should occur on the northeast and southeast corners of the intersection. Further consideration may need to be given by City of Concord officials in obtaining sightline easements depending on the location of property lines on these corners of the intersection.

Photo 9: From Portsmouth Street Looking to the North on East Side Drive

Photo 10: From Portsmouth Street Looking to the South on East Side Drive

East Side Drive and South Curtisville Road

During field reconnaissance, available sightlines were limited from the South Curtisville Road westbound approach at East Side Drive due to overgrown vegetation on the northeast and southeast corners of the unsignalized intersection. To help enhance sightlines to and from South Curtisville Road, trimming and clearing of vegetation should occur on the northeast and southeast corners of the intersection. Further consideration may need to be given by City of Concord officials in obtaining sightline easements depending on the location of property lines within these corners of the intersection.

Photo 11: From South Curtisville Road Looking to the North on East Side Drive

Photo 12: From South Curtisville Road Looking to the South on East Side Drive

East Side Drive and Broken Ground Drive

During field reconnaissance, available sightlines at the East Side Drive and Broken Ground Drive unsignalized intersection were found to meet the AASHTO minimum and desirable guidelines. Based on historical imagery, the vegetation on the northeast and southeast corners of the intersection may have limited sightlines to and from Broken Ground Drive. The vegetation should continue to be maintained at this intersection so as not to limit sightlines.

East Side Drive and I-393 Westbound Ramps

Available sightlines at the existing East Side Drive and I-393 westbound ramps meet the AASHTO minimum and desirable guidelines.

East Side Drive and I-393 Eastbound Ramps

Available sightlines on each approach of the East Side Drive and I-393 eastbound ramps signalized intersection meet the AASHTO and NHDOT minimum guidelines in which the first vehicle stopped on each approach should be visible to the first motorists on the other approaches. Should the signalized intersection be under flash control or inoperable, the vegetation on the southeast corner of the intersection may need to be trimmed or cleared in order to enhance sightlines to and from the I-393 eastbound off-ramp.

Traffic Volumes

Traffic Counts

Base traffic conditions at the study area intersections were developed by conducting turning movement counts (TMCs) and vehicle classification counts.[6] The traffic counts were collected on

6 Highway Capacity Manual: "A heavy vehicle is defined as any vehicle with more than four tires touching the pavement. Local buses that stop within the intersection area are not included in the count of heavy vehicles."

Wednesday, November 8, 2023, for the weekday AM peak period (7:00-9:00 AM) and the weekday PM peak period (1:30-6:00 PM). In addition, automatic traffic recorder (ATR) counts were conducted to collect daily traffic volumes and vehicle speed measurements along South Curtisville Road, Portsmouth Street, and East Side Drive within the study area. The traffic count data are provided in the Appendix.

The school hours for the proposed middle school are anticipated to be consistent with the existing Rundlett Middle School operations. At the existing middle school, the doors open at 8:10 AM for students to enter and students are dismissed at 3:30 PM. For planning purposes, the 8:00-9:00 AM and 3:00-4:00 PM time periods were used in representing the weekday AM and PM peak hour conditions, respectively, to evaluate the time periods that result in the higher transportation impacts of the proposed site trips within the study area. These time periods are offset from the existing peaks for students at Mill Brook School and Broken Ground School (the elementary schools start at 7:45 AM and end at 2:30 PM).

Pandemic Adjustment

Due to the current coronavirus disease 2019 (COVID-19) pandemic, traffic volumes may not represent normal travel conditions along New Hampshire roadways. Based on current NHDOT preferences, traffic volumes from a nearby permanent count station should be compared during pandemic (valid full month of traffic counts) and pre-pandemic (same month of traffic counts in 2019) conditions. Accordingly, historical traffic counts were reviewed from the permanent count station along US Route 3 (Fisherville Road) in Concord to determine whether a pandemic adjustment should be made to the traffic counts.[7]

Based on a comparison of the November 2023 and the November 2019 data, traffic volumes decreased in 2023 by 3.6 percent on a weekday, decreased by 3.8 percent during the weekday AM peak hour, and were higher than the November 2019 during the weekday PM peak hour. Therefore, the 2023 traffic counts were increased by 3.6 percent for the weekday condition, increased by 3.8 percent for the weekday AM peak hour, and used as collected (i.e., without a decrease) during the weekday PM peak hour to reflect pre-pandemic traffic volumes. These adjustment factors were applied to all movements within the study area other than along South Curtisville Road from Portsmouth Street to the Broken Ground School and Mill Brook School northern driveway as these traffic volumes are not anticipated to be impacted by the pandemic. The traffic volume comparison is provided in the Appendix.

Seasonal Adjustment

Traffic on a given roadway typically fluctuates throughout the year depending on the area and the type of roadway. Based on NHDOT guidelines for the preparation of a land development traffic study, existing traffic volumes must represent peak monthly conditions. To determine if the traffic count data needed to be adjusted to account for this fluctuation, seasonal adjustment and historical count data provided by NHDOT were reviewed.

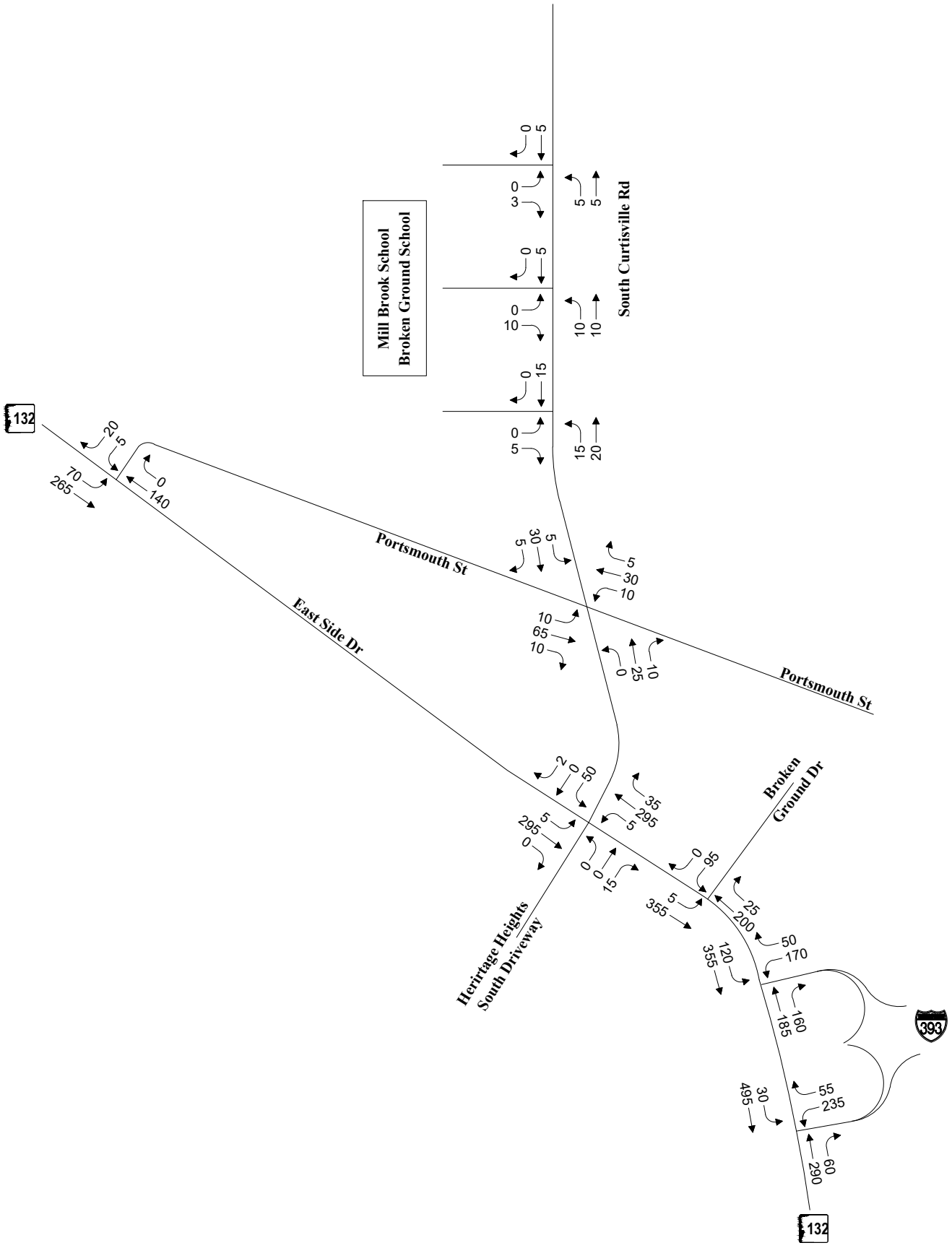
Based on a review of seasonal factors for the US Route 3 (Fisherville Road) permanent count station in Concord, traffic volumes in the month of November were 8 percent below peak-month volumes. Therefore, the pandemic-adjusted traffic volumes within the study area were increased

7 New Hampshire Department of Transportation Permanent Count Station 72099278, US 3 (Fisherville Rd) north of Sewalls Falls Rd, in Concord.

by an additional 8 percent to represent 2023 peak-hour traffic volumes during peak-month conditions. These seasonal adjustment factors were applied to all movements within the study area other than along South Curtisville Road from Portsmouth Street to the Broken Ground School and Mill Brook School northern driveway as these traffic volumes are not anticipated to be seasonally impacted. The weather during the counts in November 2023 was raining and overcast which may have resulted in more school-related vehicular traffic than on non-inclement school days. The NHDOT seasonal adjustment data are provided in the Appendix.

Existing Traffic Volume Summary

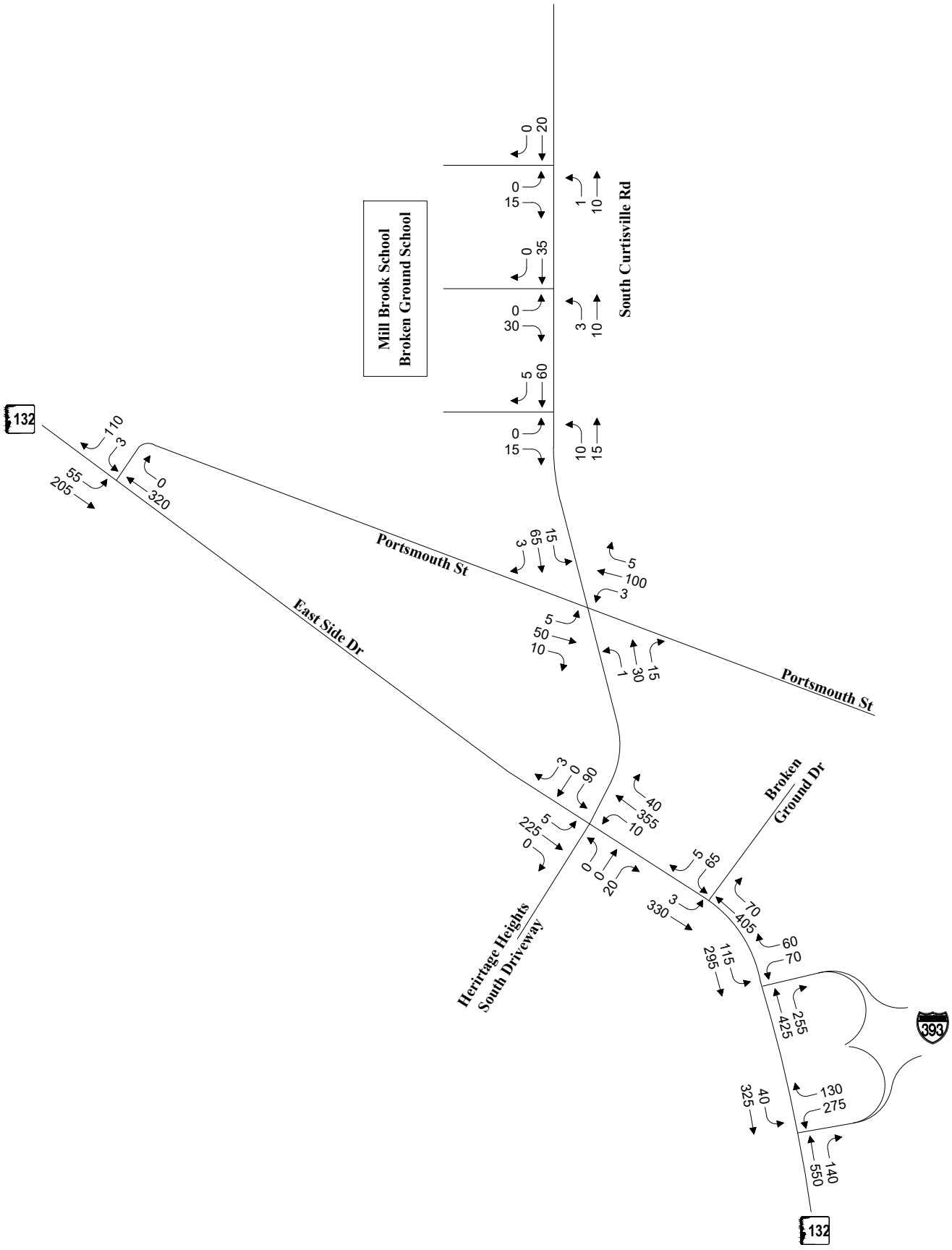
Figures 2 and 3 graphically depict the 2023 Existing peak-month, pre-pandemic weekday AM and PM peak hour traffic volumes, respectively. Table 2 provides a summary of the traffic volumes along South Curtisville Road, Portsmouth Street, and East Side Drive within the study area.



Not to Scale

2023 Existing Weekday AM
Middle School Student Arrival
Peak Hour Traffic Volumes

Figure 2



Not to Scale

2023 Existing Weekday PM
Middle School Student Dismissal
Peak Hour Traffic Volumes

Figure 3

Table 2 Existing Traffic Volume Summary

Location/Time Period [a]	Daily Traffic Volume (vpd) [b]	Peak Hour Traffic Volume (vph) [c]	K-Factor (percent) [d]	Directional Distribution [e]
South Curtisville Road north of Portsmouth Street				
Weekday Daily	1,565	--	--	--
Weekday AM Peak	--	80	5.1	50% NB/SB
Weekday PM Peak	--	125	8.0	68% SB
South Curtisville Road south of Portsmouth Street				
Weekday Daily	1,655	--	--	--
Weekday AM Peak	--	85	5.1	59% NB
Weekday PM Peak	--	125	7.6	64% SB
Portsmouth Street west of Broken Ground School Driveway				
Weekday Daily	2,180	--	--	--
Weekday AM Peak	--	120	5.5	71% EB
Weekday PM Peak	--	170	7.8	62% WB
Portsmouth Street west of Lady Bug Lane				
Weekday Daily	2,905	--	--	--
Weekday AM Peak	--	145	5.0	66% EB
Weekday PM Peak	--	230	7.9	58% WB
East Side Drive north of South Curtisville Road				
Weekday Daily	6,635	--	--	--
Weekday AM Peak	--	595	9.0	51% SB
Weekday PM Peak	--	590	8.9	61% NB

a Weekday AM Peak between 8:00-9:00 AM represents middle school student arrival periods and Weekday PM Peak between 3:00-4:00 PM represents the middle school student dismissal period.

b In vehicles per day. No pandemic or seasonal adjustments were applied to South Curtisville Road north of Portsmouth Street. Along other roadway segments, weekday daily traffic counts pandemically adjusted by 3.6% and seasonally increased by 8.0%.

c In vehicles per hour. No pandemic or seasonal adjustments were applied to South Curtisville Road north of Portsmouth Street. Along other roadway segments, weekday AM traffic counts pandemically adjusted by 3.8% and seasonally increased by 8.0%, and weekday PM traffic counts seasonally increased by 8.0% (no pandemic adjustment).

d Percent of average daily traffic occurring during the peak hour.

e Predominant traffic flow, with NB = northbound, SB = southbound, EB = eastbound, and WB = westbound.

Many rural and urban roadways experience a K-factor that falls between 9.0 and 10.0 percent. The K-factor may exceed 10.0 percent for roadways with heavy peak traffic demand.[8] As shown in Table 2, the K-factors for the weekday AM and PM peak hours are 9.0 or less. These K-factors indicate the traffic volumes along these roadway segments do not peak during the proposed middle school student arrival and dismissal periods. In addition, the traffic patterns suggest heavier directional flows toward the I-393 interchange and state offices in the morning and away from those areas along East Side Drive south in the afternoon.

8 Dowling, Richard, et al. Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual. National Cooperative Highway Research Program Report 825, Washington, DC: National Academy of Sciences, 2016.

Intersection Operational Analyses

Level of Service Methodology

Intersection operational analyses were performed for the study area intersections with the 2023 Existing weekday AM and PM peak hour traffic volumes based on the concepts and procedures in the Highway Capacity Manual (HCM) using the Trafficware Synchro Software computer program. This software program is a NHDOT approved traffic analysis tools for determining intersection operations and the intersection operational analyses were developed in conformance with NHDOT's Synchro Inputs Checklist.[9] Based on NHDOT guidelines, the HCM 2000 format[10] is preferred for signalized intersection (East Side Drive and I-393 eastbound ramps) and HCM 6th edition methodologies and procedures[11] are accepted for unsignalized intersections.

The analysis results are categorized in terms of Level of Service (LOS), which describes the qualitative intersection operational conditions based on the calculated average delay per vehicle. The criteria for signalized intersections are different than for unsignalized intersections because drivers expect different performance levels from each type of intersection. The volume-to-capacity (v/c) ratio represents a comparison of how an intersection can accommodate the vehicular demand. A v/c ratio greater than 1.00 indicates that more vehicles demand to use the roadway, lane group, or intersection than can be accommodated. Therefore, HCM methodologies assign a LOS F to those mainline critical movements and minor street approaches at an unsignalized intersection that experience a v/c ratio greater than 1.00. The relationship between LOS and delay is summarized in Table 3.

Table 3 Level of Service Criteria

LOS	Signalized Intersection Criteria: Average Total Delay (seconds/vehicle)	Unsignalized Intersection Criteria: Control Delay (seconds/vehicle) [a]
A	< 10.0	< 10.0
B	10.1 to 20.0	10.1 to 15.0
C	20.1 to 35.0	15.1 to 25.0
D	35.1 to 55.0	25.1 to 35.0
E	55.1 to 80.0	35.1 to 50.0
F	> 80.0	> 50.0

Source: Highway Capacity Manual.

a LOS F is assigned to a movement if its volume-to-capacity ratio exceeds 1.00 regardless of the control delay.

9 New Hampshire Department of Transportation Bureau of Traffic. Synchro Inputs Checklist, rev 5. 16 Aug. 2021.

10 Transportation Research Board. Highway Capacity Manual 2000. Washington, DC. 2000.

11 Transportation Research Board. Highway Capacity Manual 6th Edition: A Guide for Multimodal Mobility Analysis. Washington, DC. 2016.

Queue Length Methodology

The study area intersections were also evaluated with respect to vehicle queuing. For signalized intersections, the quantitative measures of vehicle queue length are defined as the 50th and the 95th percentile queues. The 50th percentile queue represents the average queue length during the peak hour and the 95th percentile queue represents the calculated maximum back of queue that has a probability of 5 percent or less of being exceeded during the peak hour.

For unsignalized intersections, the quantitative measure of vehicle queue length is defined as the 95th percentile queue. The 95th percentile queue represents the percent of time during the peak period being analyzed that the calculated maximum back of queue would be equal to or less than the percentile estimate (i.e., the maximum queue length that would be exceeded only 5 percent of the time). HCM 6th edition methodologies produce queue results in number of vehicles. Therefore, queue data presented for unsignalized analyses have been converted from vehicles to feet based on standard vehicle spacing of 25 feet per vehicle (front bumper to front bumper).[12]

Intersection Operational Results

The intersection operational analysis results are summarized in Table 4 for the 2023 Existing traffic volume conditions. The computer-generated analysis reports are provided in the Appendix.

During the Mill Brook School and Broken Ground School student arrival and dismissal periods, the intersection operations at the existing school driveways queue back onto South Curtisville Road due to on-site congestion that limits vehicles from entering the campus. These operations are not reflected in the intersection operational analyses in Table 4 because the arrival and dismissal times for the elementary schools will be different than those planned for the new middle school.

12 Institute of Transportation Engineers. Traffic Engineering Handbook, 7th ed. John Wiley & Sons, Inc. Hoboken, NJ. Jan. 2016.

Table 4 Intersection Operational Analysis Summary: 2023 Existing Conditions

Intersection/Peak Hour/ Critical Movement or Lane Group	v/c	Delay	LOS	Average Queue	95th % Queue
South Curtisville Road and Existing School North Driveway					
Weekday AM					
South Curtisville Rd NB Left	0.01	7.2	A	--	0
School Driveway EB Approach	0.00	8.4	A	--	0
Weekday PM					
South Curtisville Rd NB Left	0.00	7.3	A	--	0
School Driveway EB Approach	0.04	8.6	A	--	2
South Curtisville Road and Existing School Center Driveway					
Weekday AM					
South Curtisville Rd NB Left	0.01	7.3	A	--	0
School Driveway EB Approach	0.03	8.4	A	--	2
Weekday PM					
South Curtisville Rd NB Left	0.00	7.4	A	--	0
School Driveway EB Approach	0.08	8.9	A	--	5
South Curtisville Road and Existing School South Driveway					
Weekday AM					
South Curtisville Rd NB Left	0.02	7.3	A	--	2
School Driveway EB Approach	0.01	8.5	A	--	0
Weekday PM					
South Curtisville Rd NB Left	0.01	7.5	A	--	0
School Driveway EB Approach	0.03	9.1	A	--	2
South Curtisville Road and Portsmouth Street					
Weekday AM					
South Curtisville Rd NB Approach	0.07	7.7	A	--	5
South Curtisville Rd SB Approach	0.09	7.7	A	--	8
Portsmouth St EB Approach	0.13	7.9	A	--	10
Portsmouth St WB Approach	0.08	7.7	A	--	5
Weekday PM					
South Curtisville Rd NB Approach	0.07	7.7	A	--	5
South Curtisville Rd SB Approach	0.20	7.9	A	--	18
Portsmouth St EB Approach	0.08	8.3	A	--	8
Portsmouth St WB Approach	0.16	8.5	A	--	12

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

Table 4 Intersection Operational Analysis Summary: 2023 Existing Conditions (continued)

Intersection/Peak Hour/ Critical Movement or Lane Group	v/c	Delay	LOS	Average Queue	95th % Queue
East Side Drive and Portsmouth Street					
Weekday AM					
East Side Dr NB Left [a]	--	--	--	--	--
East Side Dr SB Left	0.06	7.7	A	--	5
Residential Driveway EB Approach [a]	--	--	--	--	--
Portsmouth St WB Approach	0.08	10.9	B	--	5
Weekday PM					
East Side Dr NB Left	--	--	--	--	--
East Side Dr SB Left	0.05	8.1	A	--	5
Residential Driveway EB Approach	--	--	--	--	--
Portsmouth St WB Approach	0.22	11.9	B	--	20
East Side Drive and South Curtisville Road					
Weekday AM					
East Side Dr NB Left	0.01	8.0	A	--	0
East Side Dr SB Left	0.01	8.2	A	--	0
Heritage Heights Driveway EB Approach	0.03	10.5	B	--	2
South Curtisville Rd WB Approach	0.32	23.6	C	--	32
Weekday PM					
East Side Dr NB Left	0.01	7.7	A	--	0
East Side Dr SB Left	0.01	8.2	A	--	0
Heritage Heights Driveway EB Approach	0.04	9.6	A	--	2
South Curtisville Rd WB Approach	0.44	23.6	C	--	52
East Side Drive and Broken Ground Drive					
Weekday AM					
East Side Dr SB Left	0.01	7.8	A	--	0
Broken Ground Dr WB Approach	0.29	17.5	C	--	30
Weekday PM					
East Side Dr SB Left	0.00	8.5	A	--	0
Broken Ground Dr WB Approach	0.27	19.9	C	--	28

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

a No vehicles counted on this movement.

Crash Analysis

In compliance with Section 32.08(13) of the City's Site Plan Regulations, crash data for the study area intersections were obtained from the Concord Police Department for the most recent complete three-year period available (2021 through 2023). The reported crash data are summarized below and do not appear to result in a safety issue that require engineering countermeasures.

South Curtisville Road and Mill Brook School/Broken Ground School Driveways

The South Curtisville Road intersections with the Mill Brook School and Broken Ground School driveways experienced a total of two reported collisions over the three-year period. Both of these incidents resulted in property damage only, and occurred when the roadway was dry, the weather was clear, and during the weekday AM commuter peak period (7:00-9:00 AM). One of the crashes did not occur at the intersection.

South Curtisville Road and Portsmouth Street

The South Curtisville Road and Portsmouth Street unsignalized intersection has experienced three reported collisions over the three-year period. Of these collisions, one resulted in personal injury, two occurred on a wet roadway surface, one when it was raining, and one during the weekday AM commuter peak period (7:00-9:00 AM). Two motorists were issued citations for running a STOP sign.

East Side Drive and Portsmouth Street

The East Side Drive and Portsmouth Street unsignalized intersection has experienced three reported collisions over the three-year period. One of these collisions resulted in personal injury, one occurred on a wet roadway surface, one when it was raining, and one during the weekday PM commuter peak period (4:00-6:00 PM). One motorist was issued a citation for failing to yield right of way and one for following too closely and distracted driving when using an electronic device.

East Side Drive and South Curtisville Road

The East Side Drive and South Curtisville Road unsignalized intersection has experienced one reported collision over the three-year period. The collision resulted in property damage only when colliding with a fixed object (barrier/fence). The incident occurred on a dry roadway surface, when the weather was clear, and during the weekday AM commuter peak period (7:00-9:00 AM).

East Side Drive and Broken Ground Drive

The East Side Drive and Broken Ground Drive unsignalized intersection has experienced four reported collisions over the three-year period. Of these collisions, one resulted in personal injury, all four occurred on a dry roadway surface, one when it was cloudy, and one during the weekday AM commuter peak period (7:00-9:00 AM). One motorist was issued a citation for

operating a motor vehicle in an inattentive, careless manner while using an electronic communication device. Two of the four incidents were identified not the be at an intersection (one not on the road and one on a non-traffic travel way).

East Side Drive and I-393 Westbound Ramps

The East Side Drive and the I-393 westbound ramps unsignalized intersection has experienced one reported collision over the three-year period. The collision resulted in property damage only on a dry roadway surface, when the weather was clear, and during the weekday PM commuter peak period (4:00-6:00 AM). Sun glare may have been an attributing visual factor in the incident.

East Side Drive and I-393 Eastbound Ramps

The East Side Drive and the I-393 westbound ramps signalized intersection has experienced four reported collisions over the three-year period. Of these collisions, two resulted in personal injury, one on a wet roadway surface, one when the roadway was covered in slush, one when it was raining, one during the weekday AM commuter peak period (7:00-9:00 AM), and one during the weekday PM commuter peak period (4:00-6:00 AM). One motorist was issued a citation for improper backing and one for failing to yield right of way. Sun glare may have been an attributing visual factor in one of the incidents.

Vehicle Speeds

A vehicle speed study was conducted along South Curtisville Road, Portsmouth Street, and East Side Drive within the study area and the statistical data summarized below and in Table 5. The average vehicular speed is calculated as the arithmetic mean of the observed vehicle speeds (i.e., the sum of the speeds divided by the number of observations). The 85th percentile speed generally indicates the speed that most drivers consider safe and reasonable under ideal conditions. The pace speed is the 10-mph range with the greatest number of observations. In general, the observed vehicle speeds may not be indicative of a safety concern if the posted speed limit falls within the 10 mph pace speed range. The speed statistics are provided in the Appendix.

Table 5 Vehicle Speed Summary

Location/Direction	Speed Limit (mph)	Average Speed (mph)	85th Percentile Speed (mph)	10 mph Pace (mph)
South Curtisville Road north of Portsmouth Street				
Northbound	25	23	29	20-29
Southbound	25	25	29	20-29
South Curtisville Road south of Portsmouth Street				
Northbound [a]	15/25	26	30	20-29
Southbound	25	31	34	24-33
Portsmouth Street west of Broken Ground School Driveway [b]				
Eastbound	20/30	32	37	30-39
Westbound	20/30	32	37	30-39
Portsmouth Street west of Lady Bug Lane				
Eastbound	30	35	39	30-39
Westbound	30	34	38	30-39
East Side Drive north of South Curtisville Road				
Northbound	30	35	39	30-39
Southbound	30	35	40	30-39

a The speed limit is 15 mph within the School Zones (when beacon is flashing) along South Curtisville Street northbound between East Side Drive and Portsmouth Street. During other time periods, the posted speed limit along South Curtisville Road is 25 mph.

b The speed limit is 20 mph within the School Zones (when beacons are flashing) along Portsmouth Street east and west of South Curtisville Road. During other time periods, the posted speed limit along Portsmouth Street is 30 mph.

- South Curtisville Road north of Portsmouth Street:
  - The average vehicle speeds were at or below the posted speed limit.
  - The 85th percentile speeds were slightly higher than the posted speed limit.
  - The posted speed limit fell within the 10 mph pace speed range.
- South Curtisville Road south of Portsmouth Street:
  - The average vehicle speeds were slightly higher than the posted speed limit.
  - The 85th percentile speeds were higher than the posted speed limit.
  - The posted speed limit fell within the 10 mph pace speed range.
- Portsmouth Street west of Broken Ground School Exit Driveway:
  - The average and 85th percentile vehicle speeds were higher than the posted speed limit.
  - Depending on the time of day, the posted speed limit may not fall within the 10 mph pace speed range.
- Portsmouth Street west of Lady Bug Lane:
  - The average and 85th percentile vehicle speeds were higher than the posted speed limit.
  - The posted speed limit fell within the lower end of the 10 mph pace speed range.

› East Side Drive north of South Curtisville Road:
  - The average and 85th percentile vehicle speeds were higher than the posted speed limit.
  - The posted speed limit fell within the lower end of the 10 mph pace speed range.

Due to the sensitive environment of the roadway system in relation to the existing Mill Brook School and Broken Ground School, a further speed evaluation was conducted with the peak hour data along each of the roadway segments in proximity to the schools (South Curtisville Road north of Portsmouth Street, South Curtisville Road south of Portsmouth Street, and Portsmouth Street west of Broken Ground School driveway). The peak hour vehicle speed summary is provided in Table 6 and the calculation worksheets are provided in the Appendix.

Table 6 Peak Hour Vehicle Speed Summary

Location/ Peak Hour/Direction	Peak Hour	Speed Limit (mph)	Average Speed (mph)	85th Percentile Speed (mph)
South Curtisville Road north of Portsmouth Street				
Weekday AM				
Northbound	7-8 AM	25	18	24
Southbound	7-8 AM	25	21	24
Weekday PM				
Northbound	2-3 PM	25	23	27
Southbound	2-3 PM	25	24	27
South Curtisville Road south of Portsmouth Street				
Weekday AM				
Northbound	7-8 AM	15	21	25
Southbound	7-8 AM	25	27	31
Weekday PM				
Northbound	2-3 PM	15	24	28
Southbound	2-3 PM	25	27	31
Portsmouth Street west of Broken Ground School Driveway				
Weekday AM				
Eastbound	7-8 AM	20	25	30
Westbound	7-8 AM	20	25	30
Weekday PM				
Eastbound	4-5 PM	30	30	35
Westbound	4-5 PM	30	28	35

› South Curtisville Road north of Portsmouth Street:
  - During the student arrival peak hour, the average and 85th percentile speeds vehicle speeds were below the posted speed limit.
  - During the student dismissal peak hour, the average vehicle speeds were below the posted speed limit and the 85th percentile speeds were slightly higher than the posted speed limit.
  - These observed vehicle speeds are controlled by the heavy volume of school traffic along this roadway segment during the student arrival and dismissal periods.

- South Curtisville Road south of Portsmouth Street:
  - During the student arrival and the student dismissal peak hours, the average and 85th percentile speeds vehicle speeds were slightly higher than posted speed limits.
  - These speeds may be a result of northbound motorists exiting from the faster speed limit along East Side Drive (30 mph) or southbound motorists departing the slower School Zone area destined for the higher speed limit roadway (East Side Drive).
- Portsmouth Street west of Broken Ground School Exit Driveway:
  - During the student arrival and weekday AM commuter peak hour, the average and 85th percentile speeds vehicle speeds were higher than posted speed limit.
  - During the weekday PM commuter peak hour, the average vehicle speeds were below the posted speed limit and the 85th percentile speeds were slightly higher than the posted speed limit.
  - Vehicle speeds along this segment may be more controlled and in line with the posted speed limit when the new driveway for the proposed middle school is constructed along the north side of Portsmouth Street due to the additional vehicles on the roadway system.

3

Future Conditions

The impact of site-generated traffic within the study area has been evaluated under two design horizons: 2028 and 2038 traffic volume conditions. Traffic volumes on the roadway network would include existing traffic, new traffic due to normal traffic growth, and traffic related to significant development by others that are expected to be completed within the design horizons. The five-year design horizon (2028) represents opening conditions for the proposed middle school development that can determine the project's traffic impacts, whereas the opening year conditions plus 10 years (2038) is typically used for planning purposes. Consideration of these factors resulted in the development of 2028 and 2038 No-Build traffic volumes, which assume the proposed project is not built. The incremental impacts of the proposed development may then be determined by adding site-generated traffic volumes (Build conditions) and making comparisons to the baseline (No-Build) conditions.

No-Build Conditions

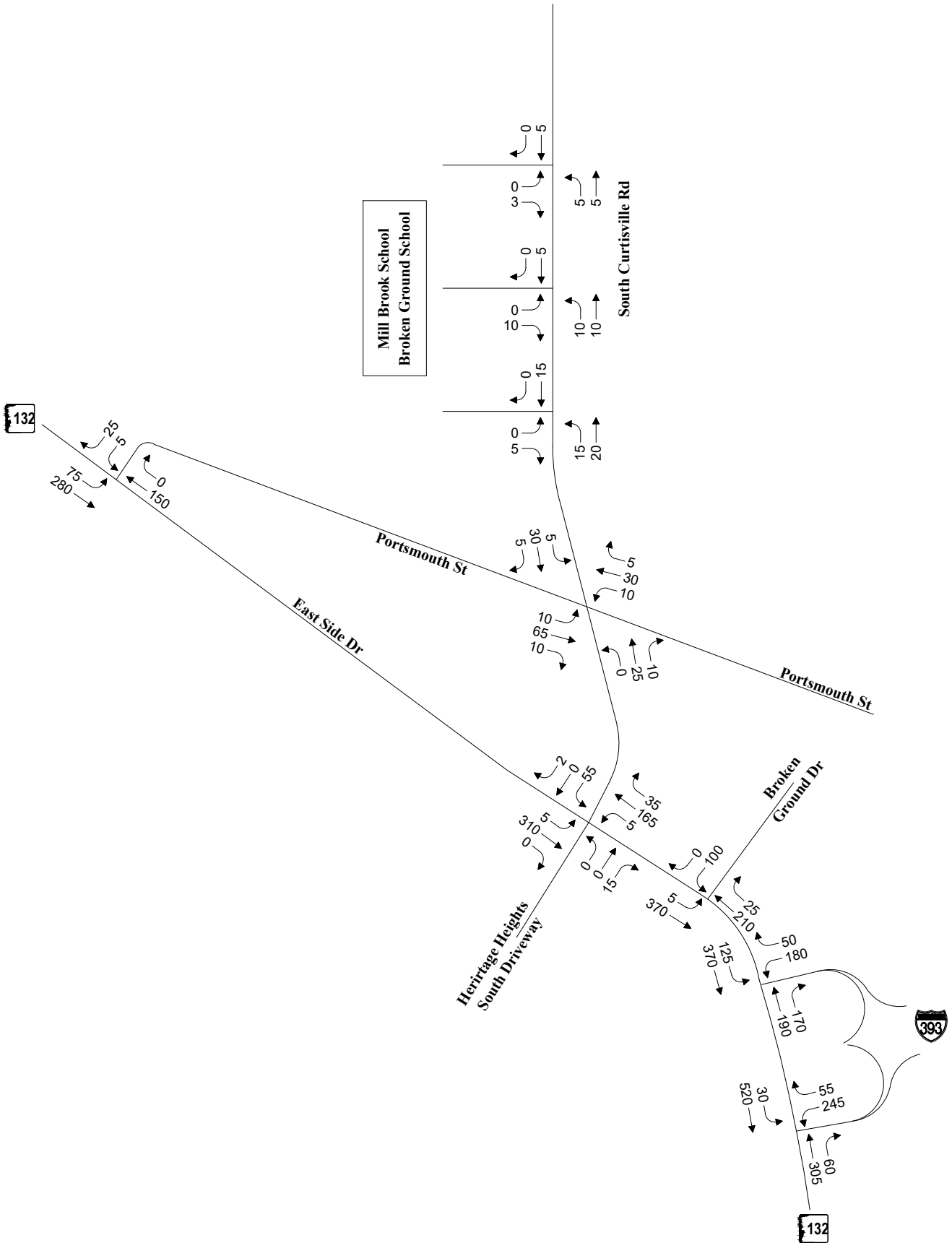
Traffic growth is a function of the expected land development in a region. A historical growth rate was used in forecasting future traffic volumes in the area. Based on a review of NHDOT historical traffic volume data for the Group E – Southeast Growth Region in which includes the Town of Hollis, traffic volumes experienced an annual increase of 0.67 percent between 1999 and 2019 as well as an annual increase of 0.97 percent between 2009 and 2019.[13] Consistent with NHDOT preference, a minimum of a 1.00 percent compounded annual growth rate was used to

13 NHDOT Bureau of Traffic – Historic Traffic Data. Group E: Southeast Growth Region. www.dot.nh.gov/about-nh-dot/divisions-bureaus-districts/traffic/traffic-data-and-information

account for general population growth and traffic generated by smaller area developments. No specific background developments were identified by City of Concord officials to be included within the future traffic volume projections. This annual growth rate was not applied to the movements along South Curtisville Road from Portsmouth Street to the Mill Brook School/ Broken Ground School northern driveway or at the driveway movements within the study area as these traffic volumes are not anticipated to increase by general population growth. The NHDOT historical data are provided in the Appendix.

The 2028 No-Build peak hour traffic volumes were accordingly developed by applying a 1.0 percent compounded annual traffic growth rate (or 5.1 percent over 5 years) to the 2023 Existing volumes. The 2028 No-Build weekday AM and PM peak hour traffic volumes are shown graphically for the study area intersections on Figures 4 and 5, respectively.

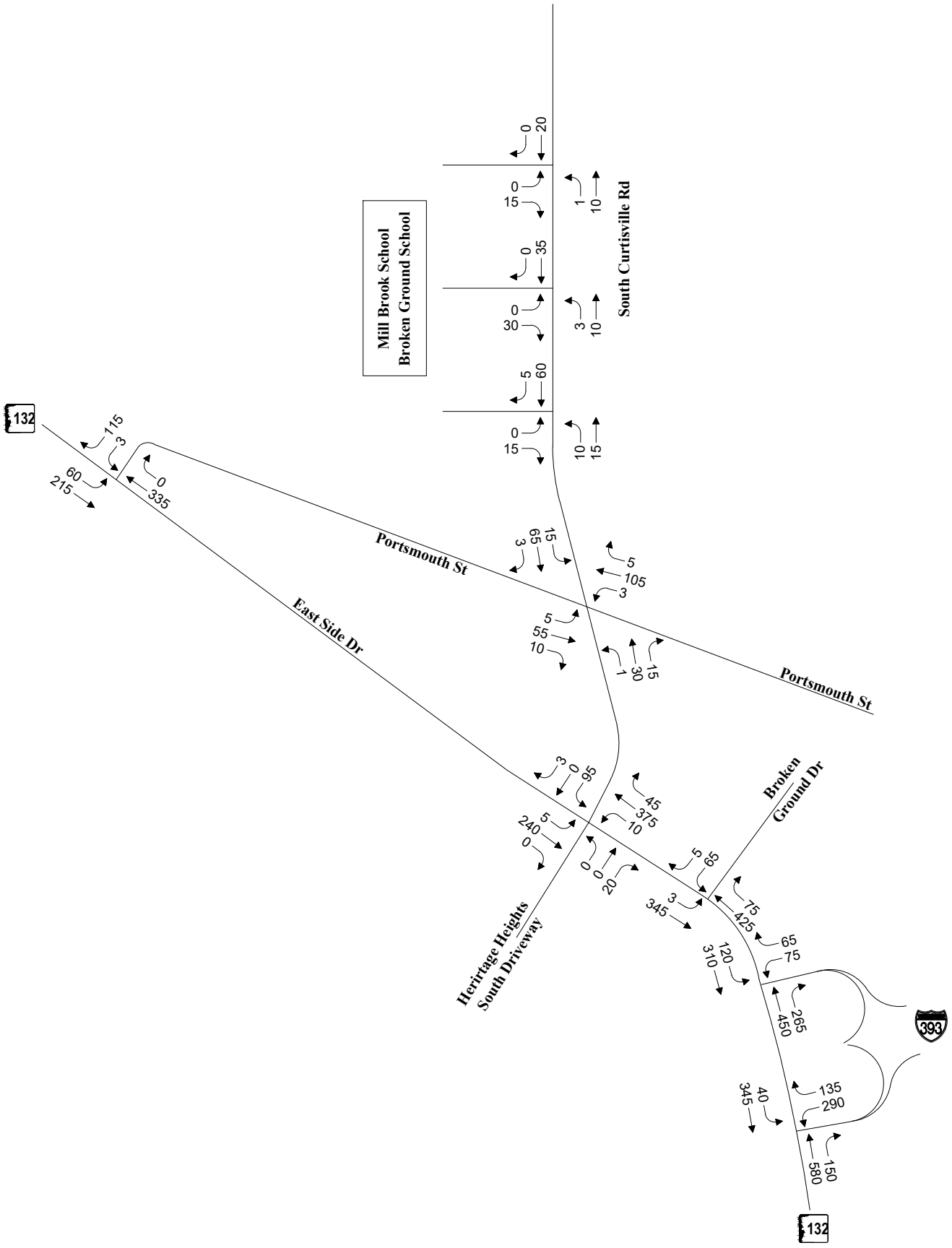
The 2038 No-Build peak-hour traffic volumes were accordingly developed by applying a 1.0 percent compounded annual traffic growth rate (or 16.1 percent over 15 years) to the 2023 Existing volumes. The 2038 No-Build weekday AM and PM peak hour traffic volumes are shown graphically for the study area intersections on Figures 6 and 7, respectively.



Not to Scale

2028 No-Build Weekday AM
Middle School Student Arrival
Peak Hour Traffic Volumes

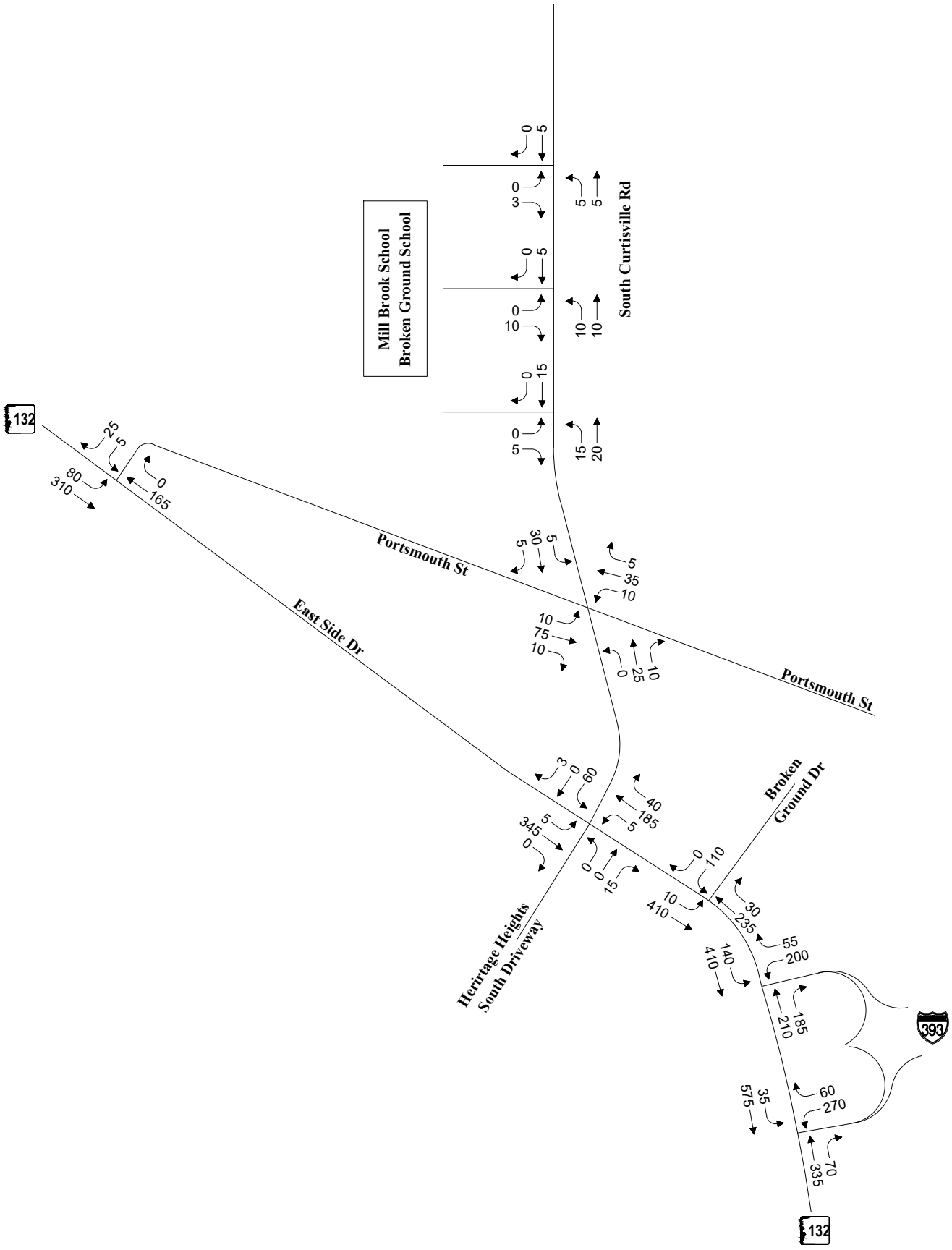
Figure 4



Not to Scale

2028 No-Build Weekday PM
Middle School Student Dismissal
Peak Hour Traffic Volumes

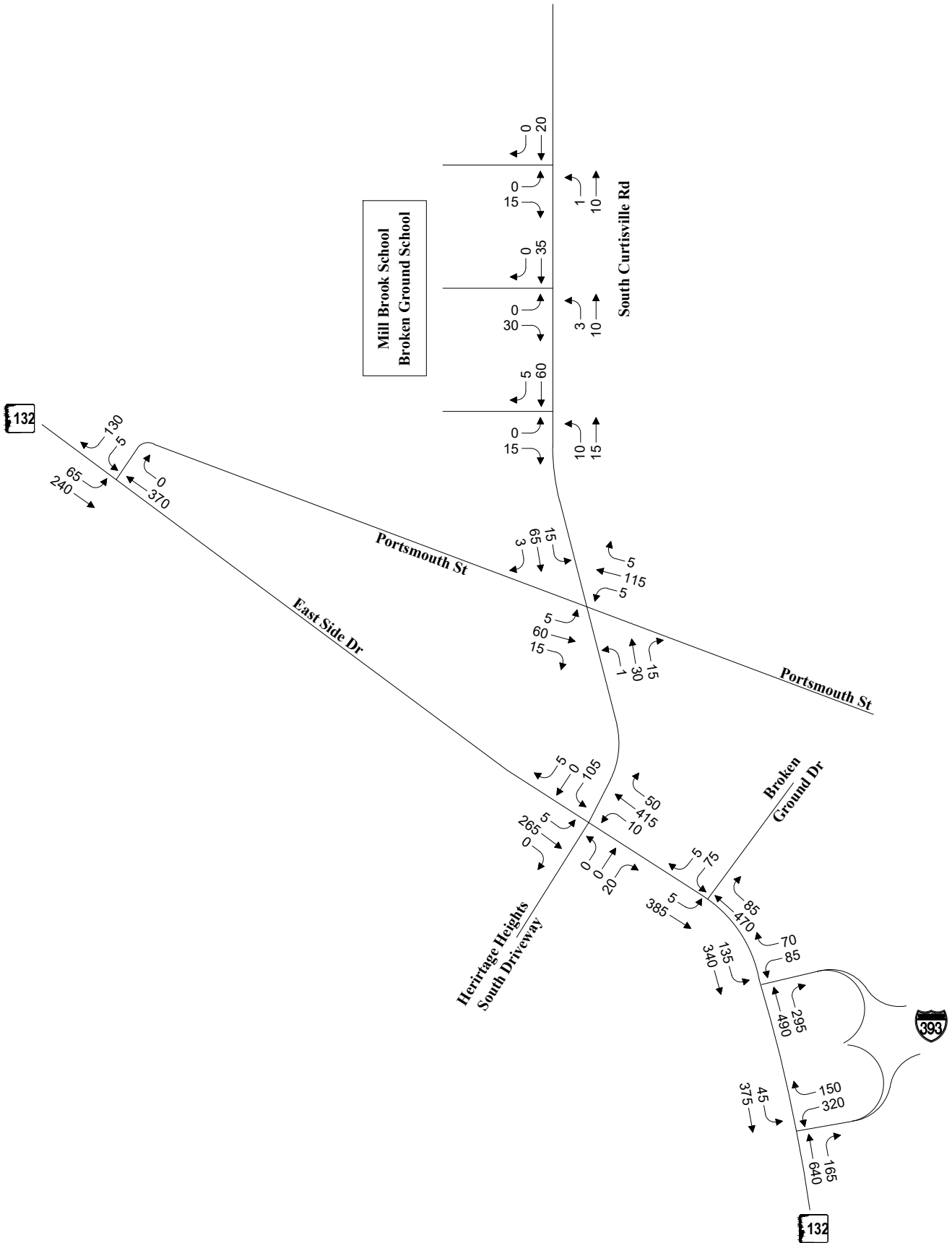
Figure 5



Not to Scale

2038 No-Build Weekday AM
Middle School Student Arrival
Peak Hour Traffic Volumes

Figure 6



Not to Scale

2038 No-Build Weekday PM
Middle School Student Dismissal
Peak Hour Traffic Volumes

Figure 7

Build Conditions

The development consists of constructing the Concord Middle School on the vacant lot at 11 Curtisville Road near Mill Brook School and Broken Ground School. As proposed, the new middle school will accommodate up to 900 students. Access is proposed to be provided along Portsmouth Street for parents/guardians to drop off and pick up students and access along South Curtisville Road for school buses and other authorized vehicles.

Sight Distance

Sight distances have been evaluated at the proposed site driveway locations to determine if the available sightlines for vehicles exiting the site meet or exceed the minimum distances required for approaching vehicles to safely stop. Consistent with the sight distance methodologies used in evaluating the existing study area intersections, available sightlines were compared with AASHTO minimum requirements for the proposed site driveways. The sight distance evaluation for the proposed site driveway locations is summarized in Table 7.

As indicated in Table 7, available sight distances at the proposed site driveways exceed the AASHTO SSD and ISD requirements. To encourage safe and efficient flow of traffic to and from the site, proposed plantings, vegetation, landscaping, and signing along the site frontage and at the site driveway are recommended to be kept low to the ground or set back sufficiently from the edge of the roadways so as not to inhibit the available sightlines.

Table 7 Sight Distance Summary – Proposed Site Driveways

Intersection/ Location/Condition	Stopping Sight Distance (feet)		Intersection Sight Distance (feet)			
			To/From North/East		To/From South/West	
	To/From North/East	To/From South/West	Minimum	Desirable	Minimum	Desirable
South Curtisville Road Site Driveway *Eastbound Approach*						
Measured	>300	>300	>300	>300	>300	>300
Minimum Required	155 [a]	155 [a]	155 [b]	280 [a]	155 [b]	280 [a]
Portsmouth Street Site Driveway *Southbound Approach*						
Measured	>350	>350	>350	>350	>350	>350
Minimum Required	155 [a]	155 [a]	155 [b]	335 [a]	155 [b]	335 [a]

a Based on AASHTO Table 9-7 for posted speed limit of 25 mph along South Curtisville Road and 30 mph along Portsmouth Street (non-school times).

b Minimum ISD same distance as SSD.

Trip Generation

To estimate the volume of traffic to be generated by the proposed project, Institute of Transportation Engineers (ITE) trip rates were reviewed.[14] In addition, traffic counts were collected at the existing Rundlett Middle School driveways on November 8, 2023 when the weather was overcast and raining which may have resulted in more school-related vehicular traffic than would be typically experienced on non-inclement school days when there may be more students walking and bicycling to and from school. Rundlett Middle School provides an enter-only driveway on South Street, one-way westbound traffic flow through the campus, and an exit-only driveway on Conant Drive. The traffic counts were collected at the Rundlett Middle School enter-only driveway on South Street and the exit-only driveway on Conant Drive. On the day of these traffic counts, there were 773 total students enrolled and 731 students who attended classes at Rundlett Middle School.

Rundlett Middle School and Abbott-Downing Elementary School are located within the same campus. During observations in September 2023, Abbott-Downing Elementary School staff and parents/guardians were observed parking within the marked spaces along the Rundlett Middle School enter-only driveway. In addition, there is an Abbott-Downing Elementary School driveway located approximately 50 feet to the west of South Street within the Rundlett Middle School enter-only driveway that is signed for accessible parking only between 7:30-7:50 AM and between 2:25-2:45 PM. Abbott-Downing Elementary School also has a driveway off South Street approximately 430 feet south of the Rundlett Middle School enter-only driveway, and ties in with the Rundlett Middle School driveway exit-only driveway prior to Conant Drive. The school day for Rundlett Middle School students is between 8:30 AM and 3:30 PM, while the school day for students at Abbott-Downing Elementary School is between 7:45 AM and 2:30 PM.

To minimize the capturing of traffic associated with Abbott-Downing Elementary School, the traffic counts associated with Rundlett Middle School focused on the hours between 7:45-8:45 AM (Rundlett Middle School doors opened at 8:10 AM) and between 3:00-4:00 PM (students dismissed at 3:30 PM). Table 8 summarizes a comparison of the ITE trip-generation estimates and the November 2023 traffic counts for the existing middle school. The trip-generation calculations and traffic counts are provided in the Appendix.

14 Institute of Transportation Engineers. Trip Generation Manual, 11th ed. Washington, DC, Sept. 2021.

Table 8 Existing Middle School Trip-Generation Comparison

Peak Hour/Direction	ITE Trip Estimates [a]	Traffic Counts [b]
Weekday AM		
Enter	298	228
Exit	243	228
Total	541	456
Weekday PM		
Enter	121	69
Exit	142	174
Total	263	243

a ITE Land Use Code 522 (Middle School/Junior High School) for 731 students in determining site trips during the weekday AM and PM peak hours of the generator.

b Based on traffic counts collected in November 2023 at the Rundlett Middle School driveways on South Street and Conant Drive.

As shown in Table 8, the traffic counts collected at the existing Rundlett Middle School driveways produce lower vehicle trips than estimated using ITE trip-generation methodologies. To provide a conservative (worse-case) analysis scenario, the ITE methodology was used within this traffic study to present higher estimations of the vehicular site trips. Table 9 summarizes the projected site trips for the proposed middle school development during the weekday AM and PM peak hours of the generator to demonstrate the largest traffic impacts of the development.

Table 9 Peak Hour Trip-Generation Summary

Peak Hour/Direction	Site Trips [a]
Weekday AM Peak Hour of Generator	
Enter	366
Exit	301
Total	667
Weekday PM Peak Hour of Generator	
Enter	149
Exit	175
Total	324

a ITE Land Use Code 522 (Middle School/Junior High School) for 900 students.

As shown in Table 9, the proposed middle school development is estimated to generate 667 trips (366 entering and 301 exiting during the student arrival peak hour (the weekday AM peak hour of the generator), and 324 trips (149 entering and 175 exiting) during the student dismissal peak hour (the weekday PM peak hour of the generator). As currently envisioned, there will be between 126 and 137 school faculty and 22 school buses for the proposed middle school. Since parent/guardian and bus entering and exiting trips typically occur during the same hour (i.e., a vehicle enters the school campus, drops off or picks up a student, and then exits the school campus), this Traffic Study used the following trip characteristics for planning purposes:

- During the weekday AM peak hour:
  - There would be 301 estimated entering and exiting parent/guardian and bus site trips.

    - This estimation was based on the premise that these vehicles would primarily be the only ones exiting the middle school during the student drop-off period (i.e., school staff would not typically exit the campus when students are arriving).
    - Therefore, none of the exiting trips were associated with school faculty vehicles.
  - The remaining 65 entering trips (366 total entering trips – 301 combined parent/guardian and bus entering trips) were considered to be associated with school faculty vehicles.
    - Not all of the school faculty entering trips would occur at the same time as the parent/guardian and bus trips because school staff typically arrive before the students in the morning.
- During the weekday PM peak hour:
  - There would be 149 entering and exiting parent/guardian and bus site trips.
    - This estimation was based on the premise that these vehicles would primarily be the only ones entering the middle school during the student pick-off period (i.e., school staff would typically already be on the campus when students are dismissed).
    - Therefore, none of the entering trips were associated with school faculty vehicles.
  - The remaining 26 exiting trips (175 total exiting – 149 combined parent/guardian and bus exiting trips) were considered to be associated with school faculty vehicles.
    - Not all of the school faculty exiting trips would occur at the same time as the parent/guardian and bus trips because school staff typically depart after the students are dismissed in the afternoon.

The student arrival and dismissal schedules for the existing Rundlett Middle School and Abbott-Downing Elementary School operations would be expected to be similar to those of the proposed middle school and the existing Mill Brook School/Broken Ground School operations. That is, elementary school students would arrive and depart at different (staggered) times than middle school students. Therefore, the addition of the middle school site trips to the adjacent roadway system may result in an expanded peak period of school traffic in the morning and afternoon but would not be expected to result in all elementary school and middle school vehicles proceeding through the study area intersections simultaneously.

Trip Distribution

The directional distribution of the middle school traffic at the proposed site was based on the existing vehicle patterns as that of Mill Brook School and Broken Ground School and then evenly distributed at the I-393 ramps. Although not identified to be part of the intersection analyses during the October 6, 2023 City scoping session, traffic counts were collected at the Portsmouth Street and Mill Brook School/Broken Ground School exit-only driveway for the purposes of the directional distribution evaluation. Accordingly, the middle school site generated traffic volumes were distributed at the study area intersections using the following travel patterns:

- Weekday AM Peak Hour:
  - East Side Drive North = 25 percent
  - East Side Drive South = 15 percent
  - I-393 West = 30 percent
  - I-393 East = 30 percent
- Weekday PM Peak Hour:
  - East Side Drive North = 20 percent
  - East Side Drive South = 20 percent
  - I-393 West = 30 percent
  - I-393 East = 30 percent

Within the vicinity of the proposed school, the site trips were distributed based on the vehicle user and the designated driveway for the different users. As proposed, the driveway along Portsmouth Street will be for parents/guardians to drop off and pick up students. In addition, the proposed driveway along South Curtisville Road will be for school buses and other authorized vehicles (school faculty). Accordingly, the following distribution characteristics were used for planning purposes:

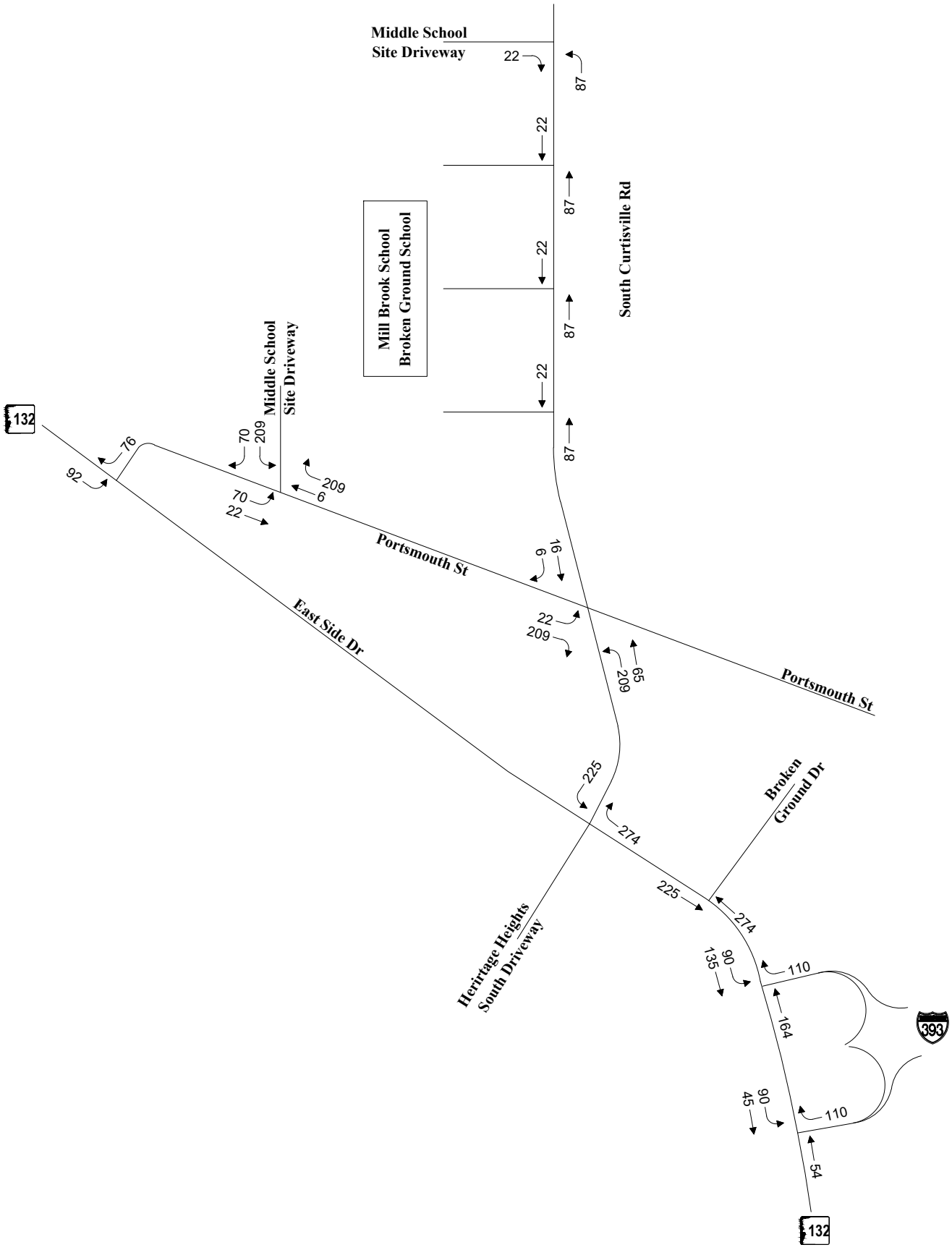
- The parent/guardian vehicles were distributed to and from the proposed Portsmouth Street site driveway,
- The school buses were distributed to and from the proposed South Curtisville Road site driveway, and
- The school faculty vehicles were assigned to and from the proposed South Curtisville Road site driveway.

The proposed middle school project site trips were added to the adjacent roadway network based on the traffic-generation and distribution estimates. The project-generated traffic volumes are shown on Figures 8 and 9 for the weekday AM and PM peak hours, respectively. In compliance with Section 3.28.08(17) of the City's Site Plan Regulations and as discussed at the October 6, 2023 scoping session with City of Concord officials, Table 10 has been prepared to summarize the increased daily travel volumes and percentages on specific roadway segments within the study area.

As shown in Table 10, the largest weekday daily traffic volume and percentage increases are expected along Portsmouth Street west of the mill Brook School/Broken Ground School driveway. The reasoning for these higher increases is that the majority of middle school site trips (i.e., parent/guardian vehicles) are anticipated to use the proposed Portsmouth Street middle school driveway to drop off and pick up students. This roadway segment also would include the middle school site trips associated with buses and staff originating from/destined to East Side Drive north of Portsmouth Street.

Build Traffic Volumes

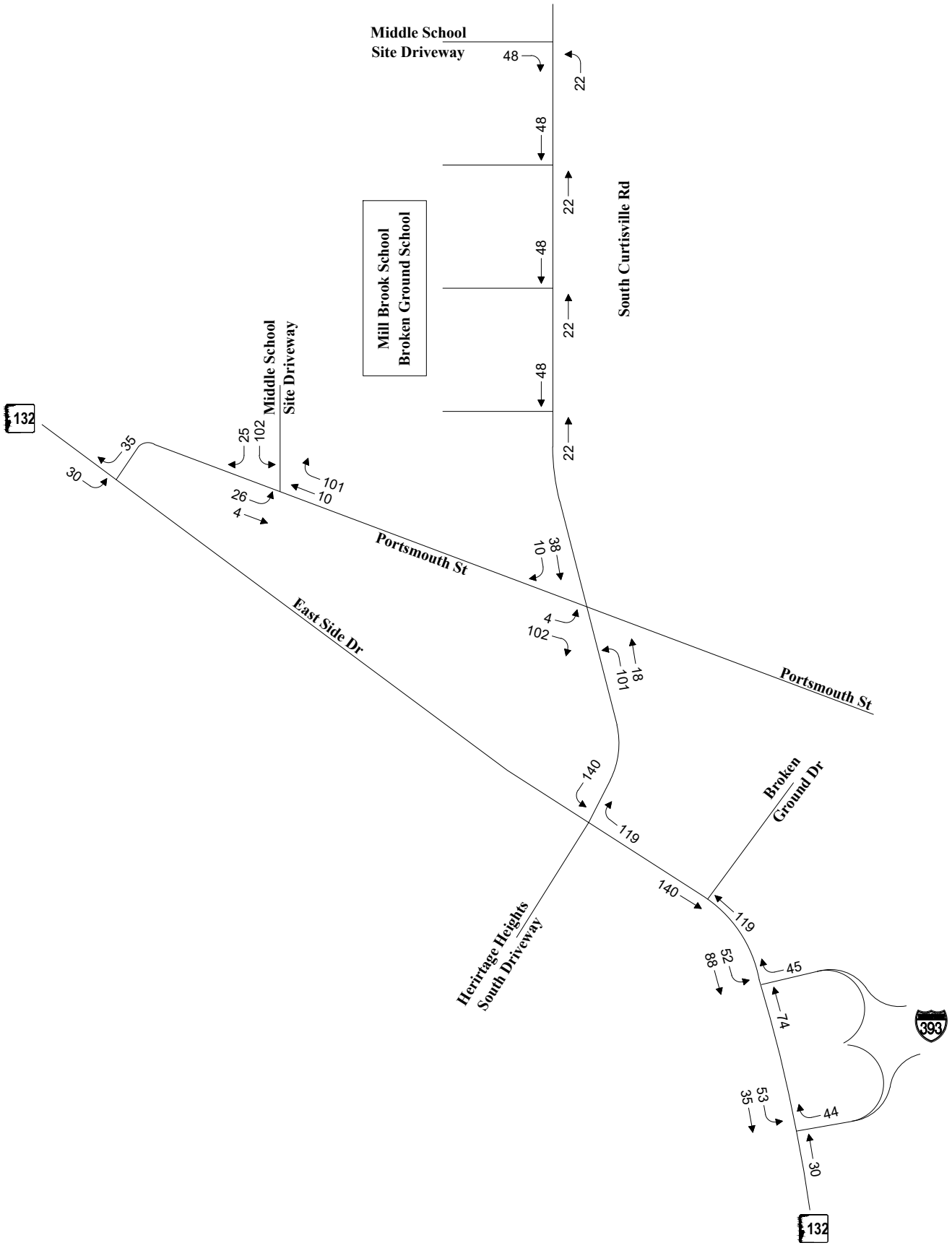
The project-generated traffic volumes were combined with the No-Build traffic volumes to develop the Build peak-hour traffic-volume networks. The 2028 Build weekday AM and PM peak hour traffic volumes are illustrated on Figures 10 and 11. The 2038 Build weekday AM and PM peak hour traffic volumes are illustrated on Figures 12 and 13.



Not to Scale

Site Generated Weekday AM
Middle School Student Arrival
Peak Hour Traffic Volumes

Figure 8



Not to Scale

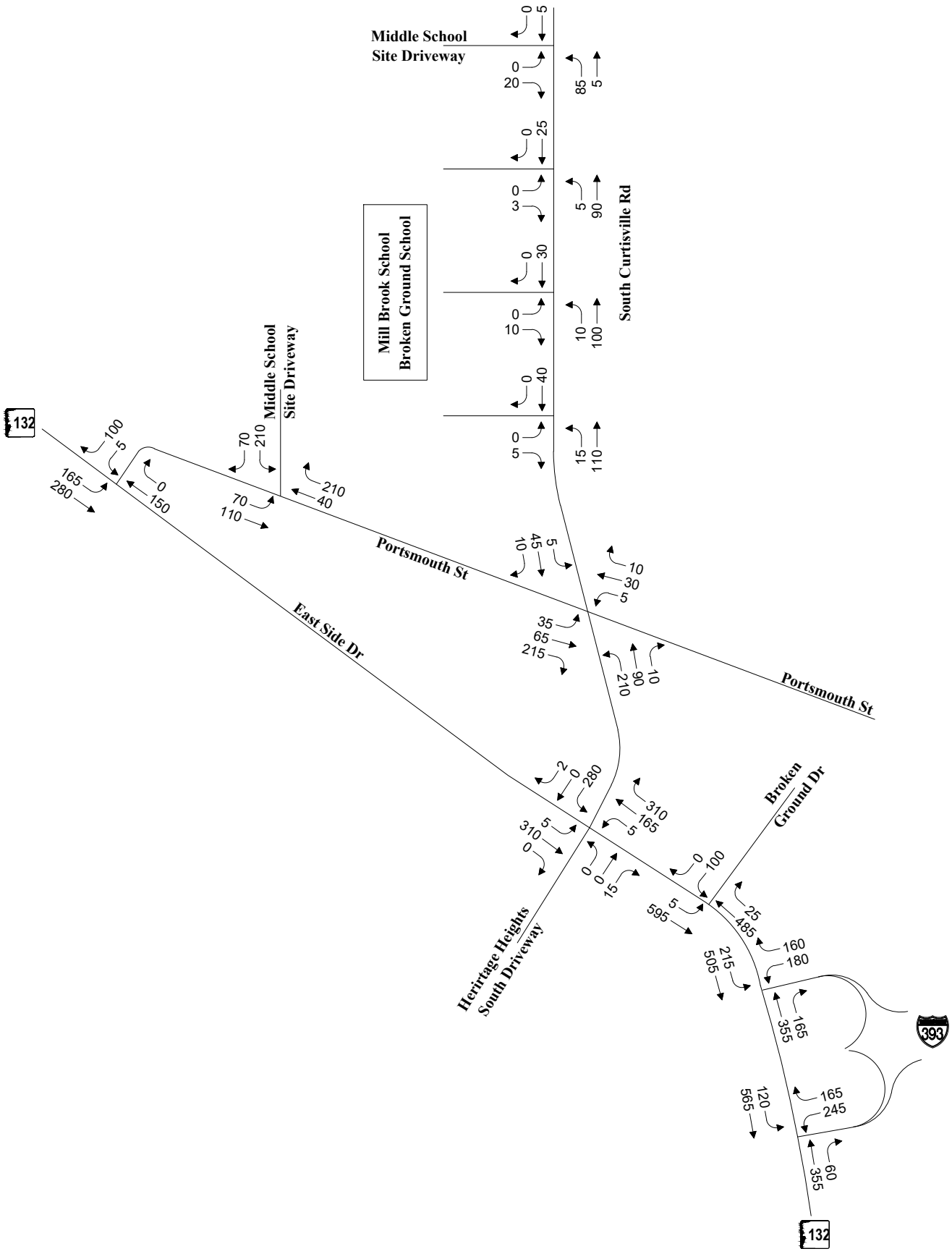
Site Generated Weekday PM
Middle School Student Dismissal
Peak Hour Traffic Volumes

Figure 9

Table 10 Weekday Daily Traffic Volume Increases

Location/Time Period	Existing Traffic Volumes [a]	Peak Hour Site Trips [b]	K-Factor (percent) [a]	Daily Increases	
				Volume [c]	Percent [d]
South Curtisville Road north of Portsmouth Street					
Weekday Daily	1,565	--	--	875	55.9%
Weekday PM Peak Hour	125	70	8.0	--	--
Portsmouth Street west of Broken Ground School Driveway					
Weekday Daily	2,180	--	--	3,320	152.3%
Weekday PM Peak Hour	170	259	7.8	--	--
Portsmouth Street west of Lady Bug Lane					
Weekday Daily	2,905	--	--	0	0%
Weekday PM Peak Hour	230	0	7.9	--	--
East Side Drive north of South Curtisville Road					
Weekday Daily	6,635	--	--	0	0%
Weekday PM Peak Hour	590	0	8.9	--	--

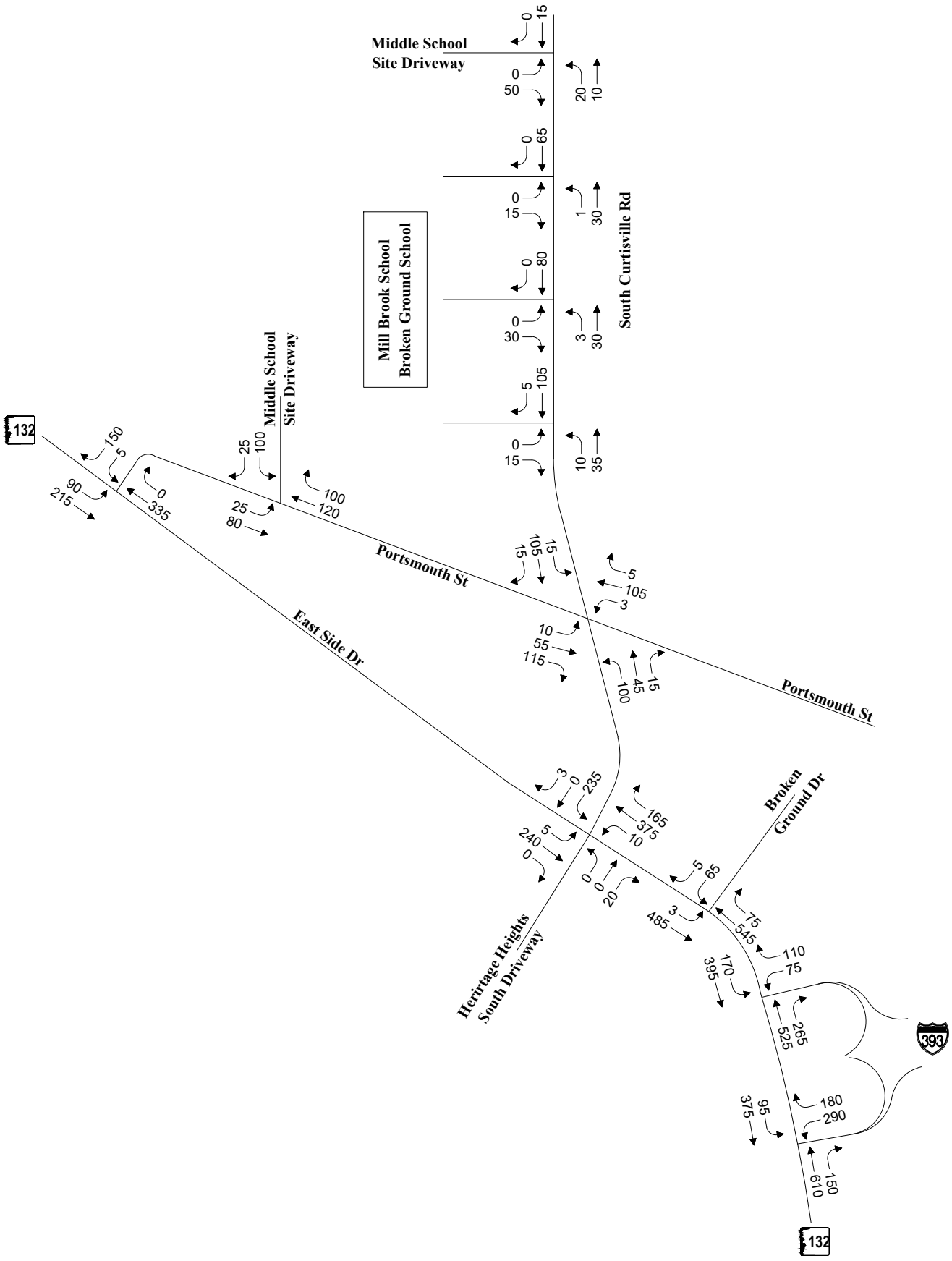
a From Table 2.
b From Figure 8.
c Weekday PM Peak Hour Site Trips divided by K-Factor.
d (Daily Volume Increases plus Existing Traffic Volumes) divided by Existing Traffic Volumes.



Not to Scale

2028 Build Weekday AM
Middle School Student Arrival
Peak Hour Traffic Volumes

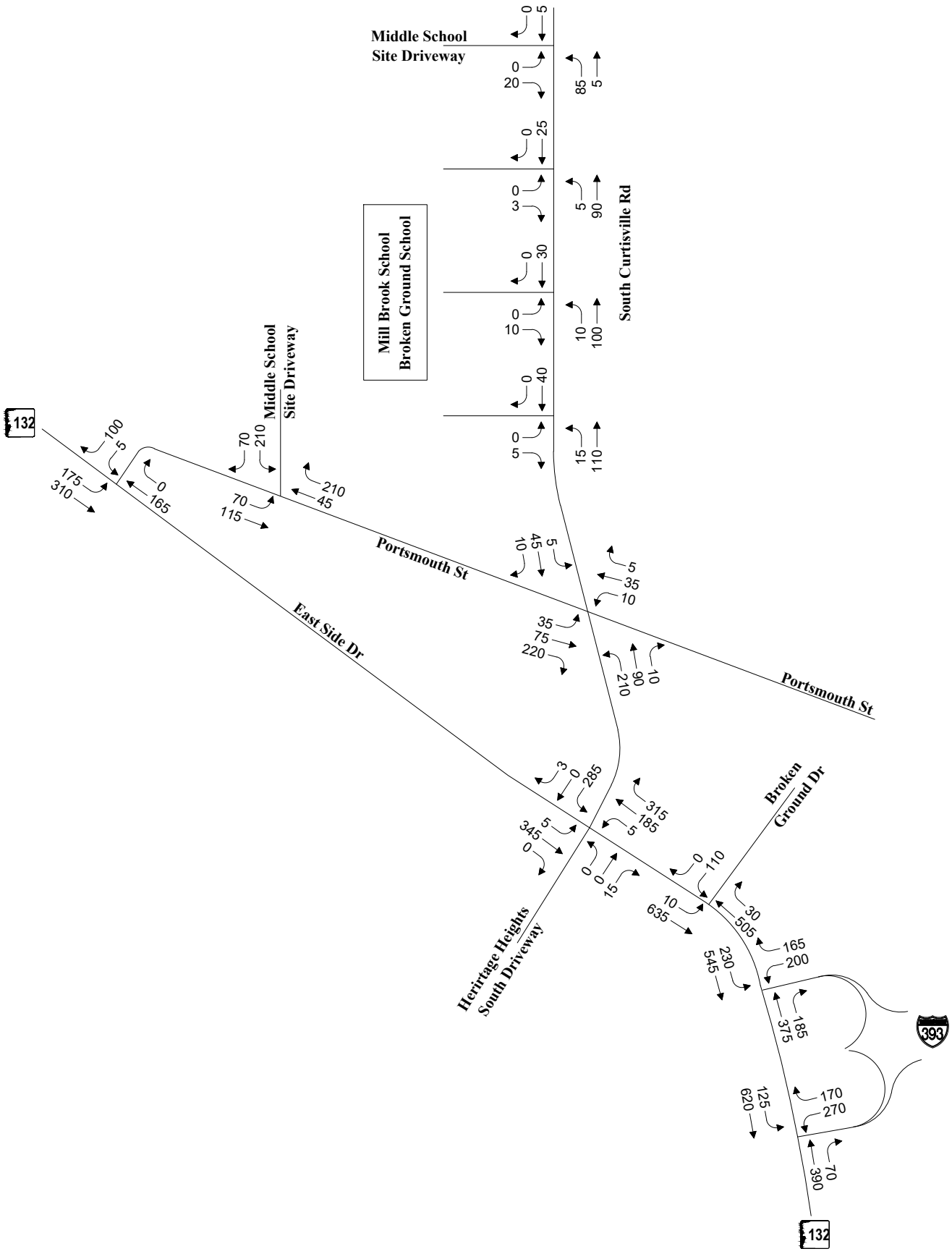
Figure 10



Not to Scale

2028 Build Weekday PM
Middle School Student Dismissal
Peak Hour Traffic Volumes

Figure 11



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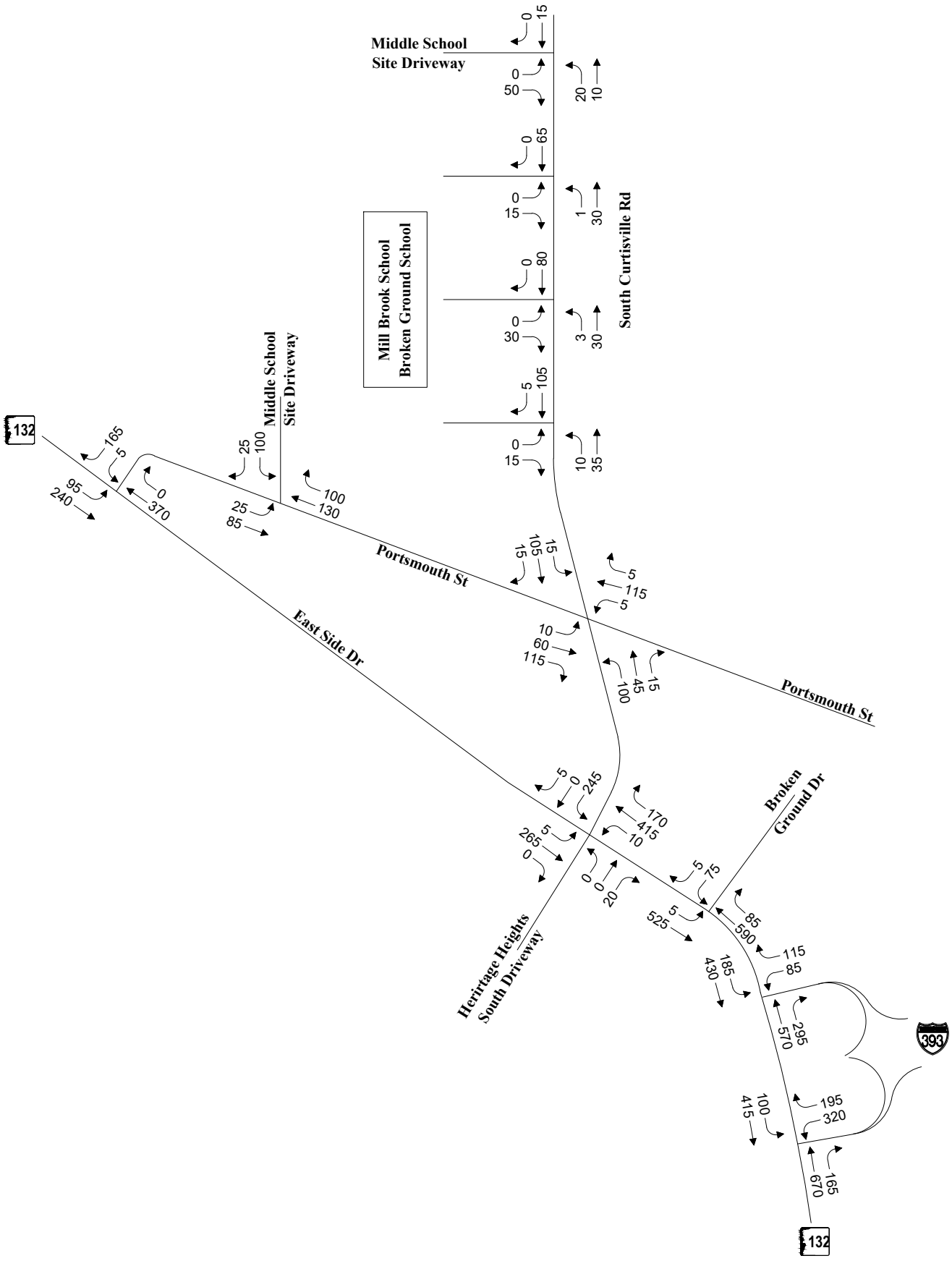
2038 Build Weekday AM
Middle School Student Arrival
Peak Hour Traffic Volumes

Figure 12



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2038 Build Weekday PM
Middle School Student Dismissal
Peak Hour Traffic Volumes

Figure 13

Intersection Operational Analyses

Intersection operational analyses were performed for the study area intersections to examine operations under future traffic volume conditions without the development (2028 and 2038 No-Build) and with the development (2028 and 2038 Build) during the weekday AM and PM peak hours. A summary of the 2028 traffic volume operations is reflected in Table 11 and the 2038 analyses are summarized in Table 12. The intersection operational analysis worksheets are provided in the Appendix.

Of importance to note, the intersection analysis results may produce worse operating conditions (longer delays and queues) than may be experienced due to the inclusion of seasonal, pandemic, and historical growth adjustments applied to the traffic counts. In addition, the intersection operations may reflect worse operating conditions as compared to other evaluations conducted as part of roadway projects or other planning studies in the area due to different parameters required in developing traffic volumes. For example, transportation studies supporting public roadway improvement projects typically use average-month factors, may not apply pre-pandemic adjustment factors, and include calculated historical growth percentages. In comparison, land development traffic studies in New Hampshire are required to analyze peak-month, pre-pandemic conditions and use no less than a 1 percent compounded annual growth rate in developing future traffic volumes which can result in higher traffic volumes and produce worse intersection operating results.

The peak hour factor (PHF) is a measure of traffic demand fluctuations within the peak hour. As traffic volumes and patterns change within the design horizons, the concentration of traffic volumes is not anticipated to remain stagnant. Based on standard traffic engineering practice, existing PHFs are generally increased to 0.90 under conditions with noticeable changes in traffic patterns. Accordingly, the following methodologies were used in determining where the PHF adjustment was applied:

- For those approaches where existing PHFs were observed to be above 0.90, the PHFs were used as observed without a reduction.
- No changes were made to the 2028 No-Build PHFs (i.e., same as observed).
- With the 2038 No-Build conditions, this PHF adjustment was only applied to the East Side Drive study area intersections because the traffic volumes along South Curtisville Road and Portsmouth Street in the vicinity of the existing elementary schools would not be anticipated to experience the same noticeable growth.
- Under the 2028 and 2038 Build conditions, this PHF adjustment was applied to all study area intersections other than the vehicles exiting the Mill Brook School and Broken Ground School driveways as these volumes would not experience noticeable traffic volume changes with the addition of the middle school site trips.

Table 11 Intersection Operational Analysis Summary 2028 Opening Year Conditions

Intersection/Peak Hour/ Critical Movement or Lane Group	2028 No-Build					2028 Build				
	v/c	Delay	LOS	Average Queue	95th % Queue	v/c	Delay	LOS	Average Queue	95th % Queue
South Curtisville Road and Existing Schools North Driveway										
Weekday AM										
South Curtisville Rd NB Left	0.01	7.2	A	--	0	0.00	7.3	A	--	0
School Driveway EB Approach	0.01	8.4	A	--	0	0.01	8.5	A	--	0
Weekday PM										
South Curtisville Rd NB Left	0.00	7.3	A	--	0	0.00	7.3	A	--	0
School Driveway EB Approach	0.04	8.6	A	--	2	0.04	8.8	A	--	2
South Curtisville Road and Existing Schools Center Driveway										
Weekday AM										
South Curtisville Rd NB Left	0.01	7.3	A	--	0	0.01	7.3	A	--	0
School Driveway EB Approach	0.03	8.5	B	--	2	0.03	8.6	A	--	2
Weekday PM										
South Curtisville Rd NB Left	0.00	7.3	A	--	0	0.00	7.4	A	--	0
School Driveway EB Approach	0.08	8.9	A	--	5	0.08	9.0	A	--	8
South Curtisville Road and Existing Schools South Driveway										
Weekday AM										
South Curtisville Rd NB Left	0.02	7.3	A	--	2	0.01	7.3	A	--	0
School Driveway EB Approach	0.01	8.5	A	--	0	0.01	8.5	A	--	0
Weekday PM										
South Curtisville Rd NB Left	0.01	7.5	A	--	0	0.01	7.5	A	--	0
School Driveway EB Approach	0.03	9.1	A	--	2	0.03	9.0	A	--	2

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

Table 11 Intersection Operational Analysis Summary 2028 Opening Year Conditions (continued)

Intersection/Peak Hour/ Critical Movement or Lane Group	2028 No-Build					2028 Build				
	v/c	Delay	LOS	Average Queue	95th % Queue	v/c	Delay	LOS	Average Queue	95th % Queue
South Curtisville Road and Portsmouth Street										
Weekday AM										
South Curtisville Rd NB Approach	0.07	7.7	A	--	5	0.49	12.8	B	--	65
South Curtisville Rd SB Approach	0.09	7.7	A	--	8	0.10	8.9	A	--	8
Portsmouth St EB Approach	0.13	7.9	A	--	10	0.46	11.5	B	--	58
Portsmouth St WB Approach	0.08	7.7	A	--	5	0.08	8.8	A	--	5
Weekday PM										
South Curtisville Rd NB Approach	0.07	7.7	A	--	5	0.24	9.5	A	--	22
South Curtisville Rd SB Approach	0.20	8.6	A	--	18	0.20	9.1	A	--	1
Portsmouth St EB Approach	0.09	7.9	A	--	8	0.24	8.9	A	--	22
Portsmouth St WB Approach	0.16	8.3	A	--	15	0.18	9.0	A	--	15
East Side Drive and Portsmouth Street										
Weekday AM										
East Side Dr NB Left [a]	--	--	--	--	--	--	--	--	--	--
East Side Dr SB Left	0.07	7.8	A	--	5	0.13	7.9	A	--	10
Residential Dwy EB Approach [a]	--	--	--	--	--	--	--	--	--	--
Portsmouth St WB Approach	0.09	10.9	B	--	8	0.15	10.4	B	--	12
Weekday PM										
East Side Dr NB Left [a]	--	--	--	--	--	--	--	--	--	--
East Side Dr SB Left	0.06	8.2	A	--	5	0.08	8.3	A	--	8
Residential Dwy EB Approach [a]	--	--	--	--	--	--	--	--	--	--
Portsmouth St WB Approach	0.24	12.2	B	--	22	0.27	12.6	B	--	28

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

a No vehicles counted on this movement.

Table 11 Intersection Operational Analysis Summary 2028 Opening Year Conditions (continued)

Intersection/Peak Hour/ Critical Movement or Lane Group	2028 No-Build					2028 Build				
	v/c	Delay	LOS	Average Queue	95th % Queue	v/c	Delay	LOS	Average Queue	95th % Queue
East Side Drive and South Curtisville Road										
Weekday AM										
East Side Dr NB Left	0.01	8.1	A	--	0	0.01	8.0	A	--	0
East Side Dr SB Left	0.01	7.8	A	--	0	0.01	8.4	A	--	0
Heritage Heights Dwy EB Approach	0.03	10.6	B	--	2	0.04	10.3	B	--	2
South Curtisville Rd WB Approach	0.28	18.7	C	--	28	0.98	82.1	F	--	260
Weekday PM										
East Side Dr NB Left	0.01	7.7	A	--	0	0.01	7.7	A	--	0
East Side Dr SB Left	0.01	8.3	A	--	0	0.01	8.7	A	--	0
Heritage Heights Dwy EB Approach	0.04	9.7	A	--	2	0.04	9.7	A	--	2
South Curtisville Rd WB Approach	0.49	26.7	D	--	65	0.92	73.2	F	--	215
East Side Drive and Broken Ground Drive										
Weekday AM										
East Side Dr SB Left	0.01	7.8	A	--	0	0.01	8.6	A	--	0
Broken Ground Dr WB Approach	0.32	18.5	C	--	32	0.56	44.2	E	--	75
Weekday PM										
East Side Dr SB Left	0.00	8.4	A	--	0	0.00	9.0	A	--	0
Broken Ground Dr WB Approach	0.28	20.8	C	--	28	0.36	30.8	D	--	38

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

Table 11 Intersection Operational Analysis Summary 2028 Opening Year Conditions (continued)

Intersection/Peak Hour/ Critical Movement or Lane Group	2028 No-Build					2028 Build				
	v/c	Delay	LOS	Average Queue	95th % Queue	v/c	Delay	LOS	Average Queue	95th % Queue
South Curtisville Road and Proposed Middle School Driveway										
Weekday AM										
South Curtisville Rd NB Left	--	--	--	--	--	0.06	7.3	A	--	5
School Driveway EB Approach	--	--	--	--	--	0.02	8.4	A	--	2
Weekday PM										
South Curtisville Rd NB Left	--	--	--	--	--	0.01	7.3	A	--	0
School Driveway EB Approach	--	--	--	--	--	0.05	8.6	A	--	5
Portsmouth Street and Proposed Middle School Driveway										
Weekday AM										
Portsmouth St EB Left	--	--	--	--	--	0.06	8.0	A	--	5
School Driveway SB Approach	--	--	--	--	--	0.52	17.2	C	--	75
Weekday PM										
Portsmouth St EB Left	--	--	--	--	--	0.02	7.8	A	--	2
School Driveway SB Approach	--	--	--	--	--	0.20	11.6	B	--	20

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

Table 12 Intersection Operational Analysis Summary 2038 Opening Year Conditions

Intersection/Peak Hour/ Critical Movement or Lane Group	2038 No-Build					2038 Build				
	v/c	Delay	LOS	Average Queue	95th % Queue	v/c	Delay	LOS	Average Queue	95th % Queue
South Curtisville Road and Existing Schools North Driveway										
Weekday AM										
South Curtisville Rd NB Left	0.01	7.2	A	--	0	0.00	7.3	A	--	0
School Driveway EB Approach	0.01	8.4	A	--	0	0.01	8.5	A	--	0
Weekday PM										
South Curtisville Rd NB Left	0.00	7.3	A	--	0	0.00	7.3	A	--	0
School Driveway EB Approach	0.04	8.6	A	--	2	0.04	8.8	A	--	2
South Curtisville Road and Existing Schools Center Driveway										
Weekday AM										
South Curtisville Rd NB Left	0.01	7.3	A	--	0	0.01	7.3	A	--	0
School Driveway EB Approach	0.03	8.5	A	--	2	0.03	8.6	A	--	2
Weekday PM										
South Curtisville Rd NB Left	0.00	7.4	A	--	0	0.00	7.4	A	--	0
School Driveway EB Approach	0.08	8.9	A	--	5	0.08	9.0	A	--	8
South Curtisville Road and Existing Schools South Driveway										
Weekday AM										
South Curtisville Rd NB Left	0.02	7.3	A	--	2	0.01	7.3	A	--	0
School Driveway EB Approach	0.01	8.5	A	--	0	0.01	8.5	A	--	0
Weekday PM										
South Curtisville Rd NB Left	0.01	7.5	A	--	0	0.01	7.5	A	--	0
School Driveway EB Approach	0.03	9.1	A	--	2	0.03	9.0	A	--	2

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

Table 12 Intersection Operational Analysis Summary 2038 Opening Year Conditions (continued)

Intersection/Peak Hour/ Critical Movement or Lane Group	2038 No-Build					2038 Build				
	v/c	Delay	LOS	Average Queue	95th % Queue	v/c	Delay	LOS	Average Queue	95th % Queue
South Curtisville Road and Portsmouth Street										
Weekday AM										
South Curtisville Rd NB Approach	0.07	7.7	A	--		0.49	13.2	B	--	70
South Curtisville Rd SB Approach	0.09	7.8	A	--	8	0.10	9.0	A	--	8
Portsmouth St EB Approach	0.15	8.0	A	--	12	0.48	12.0	B	--	65
Portsmouth St WB Approach	0.08	7.7	A	--	8	0.09	9.1	A	--	8
Weekday PM										
South Curtisville Rd NB Approach	0.07	7.8	A	--	5	0.25	9.6	A	--	22
South Curtisville Rd SB Approach	0.20	8.7	A	--	18	0.21	9.2	A	--	20
Portsmouth St EB Approach	0.10	8.0	A	--	8	0.24	9.0	A	--	22
Portsmouth St WB Approach	0.18	8.5	A	--	18	0.19	9.1	A	--	18
East Side Drive and Portsmouth Street										
Weekday AM										
East Side Dr NB Left [a]	--	--	--	--	--	--	--	--	--	--
East Side Dr SB Left	0.06	7.7	A	--	5	0.14	8.0	A	--	12
Residential Dwy EB Approach [a]	--	--	--	--	--	--	--	--	--	--
Portsmouth St WB Approach	0.05	10.6	B	--	5	0.15	10.6	B	--	12
Weekday PM										
East Side Dr NB Left [a]	--	--	--	--	--	--	--	--	--	--
East Side Dr SB Left	0.06	8.3	A	--	5	0.09	8.4	A	--	8
Residential Dwy EB Approach [a]	--	--	--	--	--	--	--	--	--	--
Portsmouth St WB Approach	0.24	12.7	B	--	25	0.31	13.4	B	--	32

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

a No vehicles counted on this movement.

Table 12 Intersection Operational Analysis Summary 2038 Opening Year Conditions (continued)

Intersection/Peak Hour/ Critical Movement or Lane Group	2038 No-Build					2038 Build				
	v/c	Delay	LOS	Average Queue	95th % Queue	v/c	Delay	LOS	Average Queue	95th % Queue
East Side Drive and South Curtisville Road										
Weekday AM										
East Side Dr NB Left	0.01	8.0	A	--	0	0.01	8.0	A	--	0
East Side Dr SB Left	0.00	7.7	A	--	0	0.01	8.5	A	--	0
Heritage Heights Dwy EB Approach	0.02	10.5	B	--	2	0.02	10.5	B	--	2
South Curtisville Rd WB Approach	0.18	16.6	C	--	18	1.07	111.9	F	--	310
Weekday PM										
East Side Dr NB Left	0.01	7.8	A	--	0	0.01	7.8	A	--	0
East Side Dr SB Left	0.01	8.4	A	--	0	0.01	8.8	A	--	0
Heritage Heights Dwy EB Approach	0.04	9.9	A	--	2	0.04	9.9	A	--	2
South Curtisville Rd WB Approach	0.42	26.2	D	--	50	1.08	120.2	F	--	288
East Side Drive and Broken Ground Drive										
Weekday AM										
East Side Dr SB Left	0.01	7.8	A	--	0	0.01	8.7	A	--	0
Broken Ground Dr WB Approach	0.32	19.1	C	--	35	0.69	62.1	F	--	105
Weekday PM										
East Side Dr SB Left	0.01	8.6	A	--	0	0.01	9.2	A	--	0
Broken Ground Dr WB Approach	0.32	23.5	C	--	32	0.48	40.9	E	--	58

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

Table 12 Intersection Operational Analysis Summary 2038 Opening Year Conditions (continued)

Intersection/Peak Hour/ Critical Movement or Lane Group	2038 No-Build					2038 Build				
	v/c	Delay	LOS	Average Queue	95th % Queue	v/c	Delay	LOS	Average Queue	95th % Queue
South Curtisville Road and Proposed Middle School Driveway										
Weekday AM										
South Curtisville Rd NB Left	--	--	--	--	--	0.06	7.3	A	--	5
School Driveway EB Approach	--	--	--	--	--	0.02	8.4	A	--	2
Weekday PM										
South Curtisville Rd NB Left	--	--	--	--	--	0.01	7.3	A	--	0
School Driveway EB Approach	--	--	--	--	--	0.05	8.6	A	--	5
Portsmouth Street and Proposed Middle School Driveway										
Weekday AM										
Portsmouth St EB Left	--	--	--	--	--	0.06	8.0	A	--	5
School Driveway SB Approach	--	--	--	--	--	0.53	17.6	C	--	78
Weekday PM										
Portsmouth St EB Left	--	--	--	--	--	0.02	7.8	A	--	2
School Driveway SB Approach	--	--	--	--	--	0.21	11.8	B	--	20

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

South Curtisville Road and Mill Brook School/Broken Ground School Driveways

During the middle school student arrival and dismissal time periods, the turning movements ay the South Curtisville Road intersections with the Mill Brook School and Broken Ground School driveways are projected to operate with minimal delays (LOS A) under 2028 and 2038 future traffic volume conditions. As previously noted, the intersection operations at the existing Mill Brook School and Broken Ground School driveways queue back onto South Curtisville Road due to on-site congestion that limits vehicles from entering the campus during the elementary school student arrival and dismissal time periods. Since the proposed middle school schedule is different (staggered) from the existing elementary school times, however, the peak site trips associated with the existing elementary schools and the proposed middle school would not occur at the same time along the South Curtisville Road corridor.

South Curtisville Road and Portsmouth Street

Under 2028 No-Build and Build traffic volume conditions, the critical movements at the South Curtisville Road and Portsmouth Street AWSC intersection are projected to operate at LOS B or better during the weekday AM and PM peak hours. Similarly, the approaches to this unsignalized intersection are projected to operate at LOS B or better during the 2038 No-Build and Build traffic volume conditions.

East Side Drive (NH Route 132) and Portsmouth Street

Under 2028 and 2038 No-Build and Build traffic volume conditions, the critical movements at the East Side Drive and Portsmouth Street unsignalized intersection are projected to operate at LOS B or better during the weekday AM and PM peak hours.

East Side Drive (NH Route 132) and South Curtisville Road

Under 2028 and 2038 Build traffic volume conditions, the South Curtisville Road approach to the unsignalized intersection with East Side Drive is projected to operate with long delays (LOS F) during both the middle school student arrival and dismissal periods. These operations are similar to those observed during the Mill Brook School and Broken Ground School student arrival and dismissal periods. Improvements have been identified for this intersection as detailed within the Potential Improvements section of this Traffic Study.

East Side Drive (NH Route 132) and Broken Ground Drive

Under 2028 Build traffic volume conditions, the Broken Ground Drive approach to the unsignalized intersection with East Side Drive is projected to operate at LOS E during the weekday AM peak hour. With the addition of future traffic growth in the area, the 2038 Build traffic volumes are projected to result in long delays during both the weekday AM and PM peak hours (LOS E/F). Although long delays are estimated on the Broken Ground Drive approach, ample capacity would be available as reflected by the low v/c ratios (≤0.69). Improvements have been identified for this intersection as detailed within the Potential Improvements section of this Traffic Study.

South Curtisville Road and Proposed Site Driveway

Under 2028 and 2038 Build traffic volume conditions, the critical movements at the South Curtisville Road and proposed middle school site driveway unsignalized intersection are projected to operate at LOS A during the weekday AM and PM peak hours. Ample capacity would be available as reflected by the low v/c ratios (≤0.06).

Portsmouth Road and Proposed Site Driveway

Under 2025 and 2035 Build traffic volume conditions, the proposed middle school site driveway approach to Portsmouth Street is projected to operate at LOS C or better during the weekday AM and PM peak hours. Ample capacity would be available as reflected by the low v/c ratios (≤0.53).

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Potential Improvements

The final component of a traffic study is the identification of improvement measures that are expected to be effective in eliminating or improving anticipated deficiencies resulting from the combination of existing, background, and project generated traffic. Based on Section 32.08(19) of the City's Site Plan Regulations, physical improvements or traffic control modifications need to be identified that are necessary in providing acceptable operating conditions (LOS D or better) at the study area intersections. In addition, Sections 32.08(20) and (21) of the City's Site Plan Regulations require physical improvements or traffic control modifications should be identified that would help improve safe operating conditions within the study area.

South Curtisville Road and Mill Brook School/ Broken Ground School Driveways

During field observations of the Mill Brook School and Broken Ground School student arrival and dismissal periods, motorists queued back from the schools' southern driveway onto South Curtisville Road and stopped along the east side of South Curtisville Road. South Curtisville Road northbound motorists were seen traveling along the west side of the roadway into oncoming vehicles to bypass the queued vehicles along the east side of the roadway. As previously identified (see Field Observations section of this Traffic Study), consideration may be provided in the following measures to help alleviate existing deficiencies independent of the proposed Concord Middle School project:

- Improving on-campus operations for the elementary schools to alleviate the frequency of vehicles queueing back from the south driveway onto South Curtisville Road.
- Providing a northbound left-turn lane along South Curtisville Road in which motorists can wait prior to entering the elementary schools' south driveway.

› Striping a centerline along South Curtisville Road between Frost Road (north of the elementary schools' north driveway) and East Side Drive (southern terminus of the roadway).

South Curtisville Road and Portsmouth Street

South Curtisville Road and Portsmouth Street intersect to form a four-way AWSC intersection. During off peak periods, motorists were observed slowing when approaching the intersection but not come to complete stops before proceeding through the intersection. As previously identified (see Field Observations section of this Traffic Study), consideration may be provided in the following measures independent of the proposed Concord Middle School project:

› Striping a centerline along South Curtisville Road between Frost Road (north of the elementary schools' north driveway) and East Side Drive (southern terminus of the roadway).

› Adding LED units within the border of the STOP signs on the Portsmouth Street approaches to enhance the visibility of the regulatory sign.

East Side Drive (NH Route 123) and Portsmouth Street

Pedestrian Facilities

East Side Drive, Portsmouth Street, and a driveway for the residence at 195 East Side Drive intersect to form a four-way unsignalized intersection. As described in the Intersection Inventories section of this Traffic Study, there are sidewalks along the west side of East Side Drive and the north side of Portsmouth Street with a crosswalk striped across the East Side Drive north leg, a tactile ramp only on the eastern end of the crosswalk, and School pedestrian crosswalk signs posted on both sides of the crosswalk. The west side of the crosswalk leads pedestrians into a raised curb. Independent of the proposed Concord Middle School project, City of Concord officials should upgrade existing pedestrian crossing to ADA and FHWA compliancy.

Sightlines

As noted in the field, available sightlines were limited from the Portsmouth Street westbound approach at East Side Drive due to overgrown vegetation on the northeast and southeast corners of this unsignalized intersection. Independent of the proposed Concord Middle School project, City of Concord officials should trim and clear vegetation in these areas of the intersection to achieve adequate sightlines per AASHTO standards. In addition, City of Concord officials should consider the need for obtaining sightline easements depending on the location of property lines within these corners of the intersection.

East Side Drive (NH Route 123) and South Curtisville Road

East Side Drive, South Curtisville Road, and the southern driveway for Heritage Heights retirement community at 149 East Side Drive intersect to form a four-legged unsignalized

intersection. The East Side Drive northbound and southbound approaches provide an exclusive left-turn lane and a shared through/right-turn lane. The South Curtisville Road westbound approach and the Heritage Heights driveway eastbound approach each consist of a single travel lane that is under STOP sign control.

Sightlines

As noted in the field, available sightlines were limited from the South Curtisville Road westbound approach at East Side Drive due to overgrown vegetation on the northeast and southeast corners of the intersection. Independent of the proposed Concord Middle School project, City of Concord officials should trim and clear vegetation in these areas of the intersection to achieve adequate sightlines per AASHTO standards. In addition, City of Concord officials should consider the need for obtaining sightline easements depending on the location of property lines within these corners of the intersection.

Traffic Control Improvements

Should City of Concord officials determine that operational improvements be considered in reducing the delays along the South Curtisville Road westbound approach to East Side Drive, consideration may be given to placing the intersection under traffic signal control. In compliance with MUTCD guidelines, a traffic signal warrant analysis has been conducted for the East Side Drive and South Curtisville Road intersection. A traffic control signal may be considered if at least one of the signal warrants is met; however, a number of factors are involved in determining if signal control should be installed, including intersection operations, safety, and engineering judgment. Agencies typically determine if the MUTCD eight-hour traffic volume warrant is met before deciding whether a traffic signal should be considered so as not to install such a traffic control device that would accommodate traffic demands during a short time span and disrupt vehicle progression throughout the remainder of the day.

For the purposes of this analysis, traffic counts were collected at the East Side Drive and South Curtisville Road intersection in September 2024 between 9:00 AM and 2:00 PM to supplement the TMCs collected in November 2023 (7:00-9:00 AM and 2:00-6:00 PM). As discussed further in this Traffic Study, NHDOT officials are evaluating the potential of placing the East Side Drive and I-393 westbound ramps under traffic signal control. With potential traffic signals to be installed at the East Side Drive intersections with South Curtisville Road and with the I-393 westbound ramps, consideration may be given to restricting left turns from Broken Ground Drive onto East Side Drive southbound. These left turns would be re-routed to turn left from South Curtisville Road onto East Side Drive. Therefore, traffic counts were also collected at the East Side Drive and Broken Ground Drive intersection in September 2024 to supplement the TMCs collected in November 2023.

Since traffic typically fluctuates throughout the year depending on the area and the type of roadway, MUTCD guidelines consider annual average traffic volume conditions. Based on a review of seasonal adjustment and historical count data provided by NHDOT, traffic volumes are approximately 3 percent lower than average-month volumes in the month of November and above average-month conditions in September. In addition, a comparison of November 2024 and November 2019 historical traffic volumes revealed that weekday daily traffic volumes have decreased by 2.7 percent and a comparison of the most recent full complete month of August 2024 and August 2019 (at the time of this evaluation) showed a decrease of 4.9 percent.

Therefore, the November 2024 traffic counts were increased by 6.6 percent and the September 2024 traffic counts were increased by 4.9 percent to represent Existing average-month, pre-pandemic traffic volumes for the traffic signal warrant analysis. The seasonal and pandemic adjustment worksheets are provided in the Appendix.

The 2038 No-Build traffic volumes were then developed by applying a 1 percent compounded annual growth rate to account for general population growth and traffic generated by smaller area developments (November 2023 traffic volumes increased over 15 years and September 2024 traffic volumes increased over 14 years). The left turns from Broken Ground Drive onto East Side Drive were then redistributed to turn left from Portsmouth Street onto South Curtisville Road and then left from South Curtisville Road onto East Side Drive.

Based on ITE trip-generation methodologies, the estimated middle school site trips were distributed over an hourly basis (provided in the Appendix). The site trips were then assigned to the East Side Dive and South Curtisville Road intersection with the weekday PM peak hour distribution patterns previously described within this Traffic Study (i.e., 30 percent to/from I-393 westbound ramps, and 50 percent combined to/from the south on East Side Drive and the I-393 eastbound ramps).[15] The project generated hourly traffic volumes were added to the 2038 No-Build traffic volumes to develop the 2038 Build traffic volumes. Based on the full 2038 Build traffic volumes at the intersection, the following MUTCD warrants are satisfied.

- Warrant 1C: Eight-Hour Vehicular Volume (Combination of Warrants 1A and 1B),
- Warrant 2: Four-Hour Vehicular Volume, and
- Warrant 3: Peak Hour.

In accordance with MUTCD guidelines, the intersection analyses indicate improved operations with the installation of a traffic signal (see Table 13).[16] Should City of Concord officials deem signalization to be desirable, then survey and traffic signal plans would need to be prepared for these traffic control improvements. The traffic signal warrant analysis data and supporting calculations are provided in the Appendix.

East Side Drive (NH Route 123) and Broken Ground Drive

East Side Drive and Broken Ground Drive intersect to form a three-way unsignalized intersection. The East Side Drive northbound approach consists of a single travel lane and the East Side Drive southbound approach includes an exclusive left-turn lane and a through lane. The Broken Ground Drive westbound approach consists of a single travel lane under STOP sign control.

Geometric Improvements

Should City of Concord officials determine signalization to be desirable at the East Side Drive and South Curtisville Road intersection, consideration may be given to restricting left turns from Broken Ground Drive at East Side Drive. The appropriate signage and treatment should be installed to support this change (e.g., signage at the Broken Ground Drive intersections with East

15 Site trips to/from the north along East Side Drive were assigned to the East Side Drive and Portsmouth Street intersection.

16 MUTCD, Section 4C.01.07.

Side Drive and with Portsmouth Street, raised half-delta [aka, porkchop] island on Broken Ground Drive at East Side Drive). In addition, consideration could be provided in striping a centerline along Broken Ground Drive from the East Side Drive intersection independent of the proposed Concord Middle School project.

Pedestrian Facilities

As previously described (see Intersection Inventories section of this Traffic Study), there is a sidewalk along the west side of East Side Drive with a crosswalk striped across the East Side Drive north leg, but there are no pedestrian landing areas, curb ramps, or posted pedestrian crosswalk signs. In addition, the crosswalk leads pedestrians to a grassed area before accessing the sidewalk on the west side of East Side Drive and there are no sidewalks on the east side of the intersection for pedestrian connectivity. Independent of the proposed Concord Middle School project, City officials should upgrade the existing pedestrian crossing to ADA and FHWA compliancy.

Sightlines

As previously documented within this Traffic Study, available sightlines may have been previously limited from the Broken Ground Drive westbound approach at East Side Drive due to overgrown vegetation on the northeast and southeast corners of the unsignalized intersection. At the time of the field inventories, the vegetation within these areas were maintained and available sightlines were not hindered. City of Concord officials should regularly provide maintenance of the vegetation at this intersection so as not to limit available safe sightlines.

East Side Drive (NH Route 123) and I-393 Westbound Ramps

NHDOT and McFarland-Johnson, Inc. are working on a bridge preservation project along East Side Drive over I-393. Those efforts include conducting an analysis to determine if a traffic signal will be warranted at the East Side Drive and I-393 westbound ramps. To assist NHDOT officials with this effort, the proposed Concord Middle School project collected 13-hour TMCs at the East Side Drive and I-393 westbound ramps intersection in March 2024 that were provided to McFarland Johnson, Inc. Since this intersection is under NHDOT jurisdiction, any improvements would need to be reviewed and approved by state officials.

Intersection Operational Analyses

Intersection analyses were performed for those study area intersections where operational improvements have been identified. Table 13 summarizes the intersection operational results with these improvements implemented under 2038 Build traffic volume conditions. The intersection operational analysis worksheets are provided in the Appendix.

Table 13 Intersection Operational Analysis Summary: 2038 Build with Improvements

Intersection/Peak Hour/ Critical Movement or Lane Group	v/c	Delay	LOS	Average Queue	95th % Queue
East Side Drive and South Curtisville Road					
Weekday AM					
East Side Dr NB Left	0.07	23.4	C	1	11
East Side Dr NB Through/Right	0.75	19.1	B	41	306
East Side Dr SB Left	0.07	23.4	C	1	11
East Side Dr SB Through/Right	0.55	13.5	B	37	192
Heritage Heights Driveway EB Approach	0.01	22.7	C	0	0
South Curtisville Rd WB Approach	0.61	23.1	C	30	198
Overall Intersection	0.68	18.9	B	--	--
Weekday PM					
East Side Dr NB Left	0.13	25.6	C	2	16
East Side Dr NB Through/Right	0.84	22.2	C	60	418
East Side Dr SB Left	0.06	24.7	C	1	10
East Side Dr SB Through/Right	0.35	10.3	B	20	126
Heritage Heights Driveway EB Approach	0.02	23.3	C	0	0
South Curtisville Rd WB Approach	0.47	24.0	C	16	141
Overall Intersection	0.71	20.3	C	--	--
East Side Drive and Broken Ground Drive					
Weekday AM					
East Side Dr SB Left	0.01	8.7	A	--	0
Broken Ground Dr WB Right	0.00	0.0	A	--	0
Weekday PM					
East Side Dr SB Left	0.01	9.2	A	--	0
Broken Ground Dr WB Right	0.01	13.3	B	--	0

v/c = volume-to-capacity ratio.

Delay in seconds.

Queue lengths in feet (unsignalized intersections produce number of vehicles multiplied by standard traffic engineering practice vehicle spacing of 25 feet/vehicle).

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Summary of Findings

Existing and future conditions in the study area have been described, analyzed, and evaluated with respect to traffic operations and impacts of the proposed Concord Middle School to be located vacant lot at 11 Curtisville Road near Mill Brook School and Broken Ground School. The project consists of constructing a new middle school with access along Portsmouth Street for parents/guardians to drop off and pick up students and along South Curtisville Road for school buses and other authorized vehicles. This Traffic Study has been prepared in compliance with the City of Concord's Site Plan Regulations and in conformance with the scoping session held with City officials.

Existing deficiencies have been detailed and improvements have been recommended to address concerns with limited sightlines, pedestrian facilities, safety, and operations. In addition, traffic signalization has been identified for the East Side Drive and South Curtisville Road intersection with the restriction of left turns from Broken Ground Drive at East Side Drive. Further, NHDOT may consider placing the East Side Drive and I-393 westbound ramps intersection under traffic signal control. In summary, traffic operational results in compliance with City of Concord requirements, NHDOT traffic guidelines, ITE methodologies, and standard traffic engineering practice indicate that the implementation of these potential improvements would help alleviate existing deficiencies and offset the traffic increases associated with the proposed Concord Middle School project.