SANRAL
SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD

Reg.No.1998/009584/30

BUILDING SOUTH AFRICA
THROUGH BETTER ROADS

SANRAL VALIDATION TEST ACCORDING TO TMH 3, TMH 8 AND TMH 14

OCTOBER 2020

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1. INTRODUCTION

The data management software specified by the Employer shall be used for the purposes of data verification and calibration. An overview of the tests that must be undertaken is provided in this document.
The software provides for three levels of verification tests and the Service Provider will be required to undertake all three levels of tests. The test levels are as follows:

a) First level tests undertaken on submission of data to the software.
b) Second level tests undertaken on a monthly basis (calendar months) or when the monitoring duration is shorter than one month.
c) Third level tests are usually undertaken on an annual basis (calendar years) but may be undertaken over a shorter period when data are not available for a whole year.

The following general procedure is followed during the three levels of verification tests:

a) Tests are first undertaken to verify that the data comply with the requirements of the South African Standard Traffic Data Collection Format. Tests will also be undertaken to authenticate the data. Should any data fail this test, then the whole file will be rejected and not processed further.

b) Tests are then undertaken with the purpose of identifying “suspect” and “bad” data. When such data are identified, a report will be created listing the data and made available. It will be the responsibility of the Service Provider to investigate the data and to identify possible causes or reasons why the data are suspect and to make recommendations whether the data should be accepted or rejected. Rejected data must be marked as “bad” data. Data may also be marked “uncertain” in situations where the monitoring services have been undertaken at sites that do not comply with the road geometry and pavement requirements of these specifications.

c) Tests will also be undertaken with the purpose of identifying periods with “missing” data. These are periods in which no or partial sets of data have been collected.

Please take note that the verification methods described in this document is by no means exhaustive. Verifications may be added or removed as specifications change over time. All changes will be communicated with Service Providers.

2. FIRST LEVEL TESTS

First level tests are undertaken on submission of data to the software. The following tests are required:

a) **Data format tests**. These tests are undertaken to determine whether data have been provided correctly according to the requirements of the South African Standard Traffic Data Collection Format. These tests include inter alia the following:

   i) Tests that individual data items comply with the specified format.
   ii) Tests that data items are within the minimum and maximum ranges specified in the format.
   iii) Tests that data separators (e.g. commas) comply with the format.
   iv) Tests for whether header data have been provided and whether this data are correct.

Data that do not comply with the format requirements will be rejected and not processed further.

b) **Lower and upper bound tests**. These tests are undertaken to determine whether individual vehicle data falls outside lower and upper bounds. Vehicles that fail these tests are marked as suspect. The tests are undertaken on data items such as the following:

i) Total vehicle length. This is the measurement from the front to rear bumpers of the vehicle, including any trailers.
ii) Number of trailers. This is the number of trailers counted per individual vehicle.
iii) Number of axles. This is the total number of axles counted per individual vehicle.
iv) Number of steering axles. An axle on a vehicle is considered to be a steering axle when the first group of axles are spaced less than 1.6 m apart.
v) Axle spacing. The axle spacing test is applied per axle. A vehicle fails a test if any of the axle spacing measurements exceed the thresholds.
vi) Average axle load (per axle). The average axle load is the total load of the vehicle divided by the number of axles.
vii) Individual axle load. This test is applied per individual axle. A vehicle fails the test if any of the axle loads exceed the thresholds.
viii) Axle load/average load ratios. These ratios are determined as the individual axle load divided by the average axle load of a vehicle.

2.1 DATA FORMAT TEST

Table 1: Data Format Tests (TMH14)

NO	DESCRIPTION	TEST	ACTION
1.	RSV Filename	SiteId-YYYYMMDD.RSV	Fail if format is incorrect
2.	**Header**		
2.1	H0	3.2	Fail if different
2.2	**S0**		
2.2.1	Site Number	Site numbers are allocated by SANRAL	Fail if site number is not allocated by SANRAL
2.2.2	GPS Format	Decimal degrees – 6 digits	Fail if format is incorrect
2.2.3	GPS Accuracy	File GPS does not differ with more than 50 m from RSS GPS	Fail if more than 50 m
2.3	I0: Logger Instrument Code	Once equipment is certified by a Certification Organisation, a code will be allocated by SANRAL. This code must then be used in all RSV files	Fail if a certified Service Provider is not using allocated code, otherwise 00000 or 00001 will be accepted.
2.4	**D0**		
2.4.1	Measurement Unit	“M”	Warn if something different
2.4.2	Drive Convention	“L”	Warn if something different
2.5	**D1 -Dates**	**Dates are used to determine the following:**	
2.5.1	Timeliness of submissions	24 hours after completion (unvalidated) 3 weeks after completion (validated	Warn if late Motivation required
2.5.2	Count Durations	According to specifications	Fail if not according to spec

NO	DESCRIPTION	TEST	ACTION
2.5.3	Partial Days	Only full days are valid	Excluded from submission
2.5.4	Abnormal Days	No counting permitted on these days	Excluded from submission
2.5.5	Equipment Setups		Warn if change occurs Motivation required
2.6	**L1**	**The following is tested against the SANRAL station information database**	
2.6.1	Lane Number		Fail if different
2.6.2	Direction Code	Only primary directions according to proclamation of road (N, S, E, W)	Fail if different
2.6.3	Lane Type Code	Only P and V permitted	Fail if different
2.6.4	Traffic Stream Number	See section 5 below	Fail if different
2.6.5	Traffic Stream Lane Position	See section 5 below	Fail if different
2.6.6	Vehicle Code	1 for counts done by SANRAL	Fail if different
2.6.7	Time Code	0, 1, 5	Fail if different
2.6.8	Length Code	System Types A, B, and C = 1 System Type M = 0	Fail if different
2.6.9	Speed Code	System Types A, B, C and E = 1 System Type D and M = 0	Fail if different
2.6.10	Trailer Code	System Types A, B, and E = 1 System Type C, D and M = 0	Fail if different
2.6.11	Axle Code	System Types A, B, and E = 1 System Type C, D and M = 0	Fail if different
2.6.12	Mass Code	Count Type W = 1 or 2 Anything Else = 0	Fail if different
2.6.13	Tyre Type	System Types A = 1 Anything Else = 0	Fail if different
2.6.14	Traffic Monitoring Type	According to specifications	Fail if not according to spec
2.6.15	HSWIM Class	Count Type W = According to specification Anything Else = 0	Fail if not according to spec
2.6.16	Vehicle Categorisation Scheme 1&2	According to specifications	Fail if not according to spec
2.7	**Type 10**		
2.7.1	Vehicle Classification Scheme 1	According to specifications	Fail if not according to spec
2.7.2	Vehicle Classification Scheme 2	According to specifications	Fail if not according to spec
3.	**Individual Vehicle Records**		

NO	DESCRIPTION	TEST	ACTION
3.1	Traffic Data Type Code*	10	Fail if different
3.2	Number of Fields*	According to specifications	Fail if not according to spec
3.3	Data Source Code	Unvalidated =1 Validated = 2 (if changes were made) or 1 (if no changes were made.	Fail if different
3.4	Edit Code*	0	Fail if different
3.5	Departure Date*	Format YYMMDD	Fail if wrong
		Must fall within D1 dates	Fail if date does not fall within D1 dates
3.6	Departure Time*	Format at least hhmm	Fail if wrong
		Must fall within D1 dates	Fail if date does not fall within D1 dates
3.7	Assigned Lane Number*	As indicated in L1 records	Fail if not according to L1
3.8	Physical Lane Number*	As indicated in L1 records	Fail if not according to L1
3.9	Forward/Reverse Code*	See section 5 below	Fail if different
3.10	Vehicle Category*	According to specifications	Fail if not according to spec
3.11	Vehicle Class Primary*	According to specifications	Fail if not according to spec
3.12	Vehicle Class Secondary*	According to specifications	Fail if not according to spec
3.13	Vehicle Speed	Compulsory for System Types A, B, C and D	Fail if different
3.14	Vehicle Length	Compulsory for System Type A, B, and C	Fail if different
3.15	Site Occupancy	Only defined values may be used	Fail if different
3.16	Chassis Height	Only defined values may be used	Fail if different
3.17	Vehicle Following*	Only defined values may be used	Fail if different
3.18	Vehicle Tag	Only defined values may be used	Fail if different
3.19	Trailer Count	Compulsory for System Type A, and B Others = 0	Fail if different
3.20	Axle count	Compulsory for System Type A, and B Others = 0	Fail if different
3.21	Bumper-to-first Axle		No validation
3.22	Tyre Type	Compulsory for System Type A Others = 0	Fail if different

NO	DESCRIPTION	TEST	ACTION
3.23	Vehicle Identification		No validation
3.24	**Axle Spacing**	**Compulsory for System Type A and B.**	
3.24.1	Sub-Data Type	Only defined values may be used	Fail if different
3.24.2	Number	Only defined values may be used	Fail if different
3.24.3	Spacing	Only defined values may be used	Fail if different
3.25	**Wheel Mass**	**Compulsory for Count Type W**	
3.25.1	Sub-Data Type	Only defined values may be used	Fail if different
3.25.2	Number	Only defined values may be used	Fail if different
3.25.3	Offset sensor	Only defined values may be used	Fail if different
3.25.4	Measurement Resolution	Only defined values may be used	Fail if different
3.25.5	Axle Mass	Only defined values may be used	Fail if different
3.25.6	Axle Group Mass	Only defined values may be used	Fail if different
3.25.7	Single/Dual Tyre	Only defined values may be used	Fail if different
3.25.8	Axle Group Config	Only defined values may be used	Fail if different
4.	**Additional Data**		
4.1	QF	As per TMH 14 format	Fail if wrong format
			Warning if QF records are present
			Warning if QF records = 0 - 5%
			Fail if QF records > 5%
4.2	QC	Compulsory for Count Type W	Fail if wrong format
4.3	QW	Compulsory for Count Type W	Fail if wrong format
4.4	QD		No validation

2.2 LOWER AND UPPER BOUND TEST

Table 2:Lower and Upper Bound Test (TMH8)

NO	DESCRIPTION	MINIMUM	MAXIMUM
1.	**Total vehicle length**		
1.1	All vehicles	1.5m	35m
1.2	Heavy – 2 axles	1.5m	25m
1.3	Heavy – 3 axles	2.5m	35m
1.4	Heavy – 4+ axles	2.5 – 4.5m	35m
2.	**Number of trailers**		
2.1	Light Vehicles	Not required	2
2.2	Heavy Vehicles	Not required	3
3.	**Number of axles**		
3.1	Light Vehicles	2	5
3.2	Heavy Vehicles	2	8
4.	**Number of steering axles**		
4.1	Light Vehicles	Not required	1
4.2	Heavy – 2 axles	Not required	1
4.3	Heavy – 3+ axles	Not required	2
5.	**Axle Spacing**		
5.1	All vehicles	0.5m	12m
5.2	Heavy Vehicles	0.5m	16m
6.	**Average axle loads - Heavy vehicles***		
6.1	2 – 4 axle vehicles	0.25ton	16ton
6.2	5+ axle vehicles	1.5ton	16ton
7.	**Individual axle loads - Heavy vehicles***		
7.1	Front Axle	0.25ton	15ton
7.2	Second Axle	0.25ton	20ton
7.3	Other Axles	N/A	20ton
8.	**Axle load ratio - Heavy vehicles**		
8.1	Front and second axles	0.3	N/A

NO	DESCRIPTION	MINIMUM	MAXIMUM
8.2	Other axles	N/A	N/A

(*) Axle loads adjusted using the systematic calibration factor

3. SECOND LEVEL TESTS

Second level tests are undertaken on a monthly basis, or when a full data set has been provided for a monitoring duration shorter than one month. The following tests are undertaken:

a) **Traffic pattern tests**. These tests are undertaken per traffic stream using hourly traffic counts for the different hours of the day. A pattern matching algorithm is used for these tests and will group the patterns in similar clusters. The tests are used for the identification of suspect or missing data as well as for the classification of the data as Normal, Abnormal, etc. The software will undertake the classification, but each classification must be confirmed manually.

b) **Daily traffic count tests**. These tests are undertaken per traffic stream using daily counts. Statistical methods are used for the identification of outliers and identified outliers will be marked as suspect for further investigation.

c) **Monthly failure rate tests**. Tests are undertaken of the percentage of vehicles that fail the lower and upper bound tests previously described. Should these percentages exceed the maximum allowable percentages, then the data are marked as suspect for the whole month. The tests are undertaken separately for each lane of traffic.

   The minimum sample size for the test is 500 vehicles. Where necessary, vehicles from a previous month(s) will be added to the sample to ensure this sample size.

d) **Systematic calibration tests**. These tests are performed as part of the systematic calibration of axle loads. The tests are only applied to trucks selected to form part of the calibration. The tests are undertaken separately for each load sensor. The following tests are undertaken:

   i) Allowable range for the calibration factors.
   ii) Maximum standard deviation for the total tractor load.
   iii) Allowable range for average front axle load.
   iv) Maximum standard deviation for the front axle load.
   v) Average axle spacing between 2nd and 3rd axles.
   vi) Standard deviation of axle spacing between 2nd and 3rd axles.
   vii) Recalibration tests. These tests are applied on a monthly basis to determine whether any changes may have occurred that may affect the system calibration. The tests are undertaken separately for each load sensor.

3.1 TRAFFIC PATTERN TEST

Not yet developed.

3.2 DAILY TRAFFIC COUNT TESTS

Not yet developed.

3.3 MONTHLY FAILURE RATE TESTS

Table 3: Thresholds for Failure Rate Tests (TMH8)

NO	DESCRIPTION	WARNING	FAIL
1.	**Vehicle Length**		
1.1	Light and heavy vehicles with any number of axles	0.50%	1.00%
1.2	Heavy vehicles with 2 to 8 axles	0.50%	1.00%
2.	Number of trailers	1.50%	2.50%
3.	Number of axles	1.50%	2.50%
4.	**Number of steering axles**		
4.1	Light vehicles with 2 to 5 axles	0.20%	0.50%
4.2	Heavy vehicles with 2 to 8 axles	0.50%	1.00%
5.	**Axle spacing**		
5.1	Light vehicles with 2 to 5 axles	0.10%	0.20%
5.2	Heavy vehicles with 2 to 8 axles	0.25%	0.50%
6.	**Axle load tests (heavy vehicles with 2 to 8 axles)**		
6.1	Average axle load – Lower bound	0.50%	0.75%
6.2	Average axle load – Upper bound	0.05%	0.10%
6.3	Individual axle loads – Lower bound	0.05%	0.10%
6.4	Individual axle loads – Upper bound	0.05%	0.10%
6.5	Axle load ratio	1.50%	2.50%
7.	**Other**		
7.1	Unknown or unclassified vehicles	1.00%	2.50%
7.2	Vehicles in Reverse Direction	3.00%	5.00%

3.4 SYSTEMATIC CALIBRATION TESTS

Table 4: Thresholds for Calibration Tests (TMH8)

NO	DESCRIPTION	WARNING	FAIL
1.	Allowable range of calibration factors	0.90 to 1.10	0.75 to 1.25
2.	Maximum standard deviation of total tractor load	2.2 t	2.5 t

NO	DESCRIPTION	WARNING	FAIL
3.	Average front axle load	5.5 to 6.5 t	5 to 7 t
4.	Standard deviation of front axle load	0.85t	1.0 t
5.	Average spacing between 2nd and 3rd axles	1.34 to 1.40 m	1.32 to 1.45 m
6.	Std Dev of spacing between 2nd and 3rd axles	0.07 m	0.13 m

4. THIRD LEVEL TESTS

Third level tests are undertaken on an annual basis (calendar years) but may be undertaken over a shorter period when data are not available for a whole year. The purpose of the tests is to determine whether possible changes have occurred over the long term. The tests are undertaken for each traffic stream at a long-term monitoring site.

Use is made of daily or monthly averages which are plotted over time to establish whether there are any unexpected changes or trends in the observations. Observations are usually required over a period of several months before it would be possible to identify such changes or trends.

The following characteristics are included in the tests:

a) **Traffic count tests** (daily and monthly). The traffic count tests are undertaken for daily traffic counts, as well as the average daily count for the month.

b) **Percentage composition** (monthly). The percentage composition test is used to check the consistency of the percentage of heavy vehicles classified as short, medium and long.

c) **Systematic calibration factor** (monthly). This factor should normally remain constant over time, but it could be affected by the recalibration of equipment in the field. It is also possible for the calibration of the equipment to “drift” over time. Any unexpected changes in the calibration factor should be investigated to establish the reasons for such changes.

d) **Average front axle load** (monthly). The average front axle load consistency check uses the average observed load of the front axle of the 6- and 7-axle trucks used in the calibration method, but without the application of the average axle load criterion of 6.5 to 8.5 tons. The front axle loads are adjusted using the calibration factor.

e) **Standard deviation in front axle load** (monthly). The front axle load standard deviation consistency check uses the same trucks and axles as for the average front axle load test.

f) **Average number of axles per vehicle** (monthly). The averages are determined for heavy vehicles classified as short, medium and long.

g) **Average number of E80’s per axle** (monthly). The tests are undertaken for each of the short, medium and long heavy vehicle classes.

h) **Average vehicle length** (monthly). The tests are undertaken for the short, medium and long heavy vehicle classes.

i) **Percentage unclassified vehicles** (monthly). Unclassified vehicles are those that could not be classified by the equipment.

4.1 TRAFFIC COUNT TESTS

Not yet developed.

4.2 PERCENTAGE COMPOSITION

Not yet developed.

4.3 SYSTEMATIC CALIBRATION FACTOR

Not yet developed.

4.4 AVERAGE FRONT AXLE LOAD

Not yet developed.

4.5 STANDARD DEVIATION IN FRONT AXLE LOAD

Not yet developed.

4.6 AVERAGE NUMBER OF AXLES PER VEHICLE

Not yet developed.

4.7 AVERAGE NUMBER OF E80'S PER AXLE

Not yet developed.

4.8 AVERAGE VEHICLE LENGTH

Not yet developed.

4.9 PERCENTAGE UNCLASSIFIED VEHICLES

See section 3.3 no 7.1.

5. COUNTING STATION DEFINITION

5.1 INTRODUCTION

In this chapter, a specification is given for the provision of counting station definition data. This data is not supplied as part of the traffic data file but must be supplied in a separate counting station definition data file. This data file must be provided when required by the data user.

The definition data is provided in a comma delimited format. Each line of the file contains all definition data for a counting station. The first line may contain column headings as defined below or may be empty; it is ignored by data processing software.

The data is provided in a single file with the following name and type:

Filename.RSS

where "filename" can be any name. The default name is "STATION".

5.2 DEFINITION FILE VERIFICATION

Table 5: Station Definition File (TMH14)

NO	DESCRIPTION	TEST	ACTION
1.	RSS Filename	Filename.RSS	Fail if format is incorrect
			Fail if station number does not exist
2.	RSS Format	All fields must be populated with defined options as per TMH14	Fail if not according to TMH14

5.3 COUNTING STATION IMAGE FILES

Table 6: Image File Verification (TMH14)

NO	DESCRIPTION	TEST	ACTION
1.	Photos	SiteId-Pnn-YYYYMMDD.Ext	Fail if format is incorrect
			Fail if photo is not geocoded.
2.	RSS Format	File GPS does not differ with more than 50 m from photo GPS or RSS GPS.	Fail if difference is more than 50m

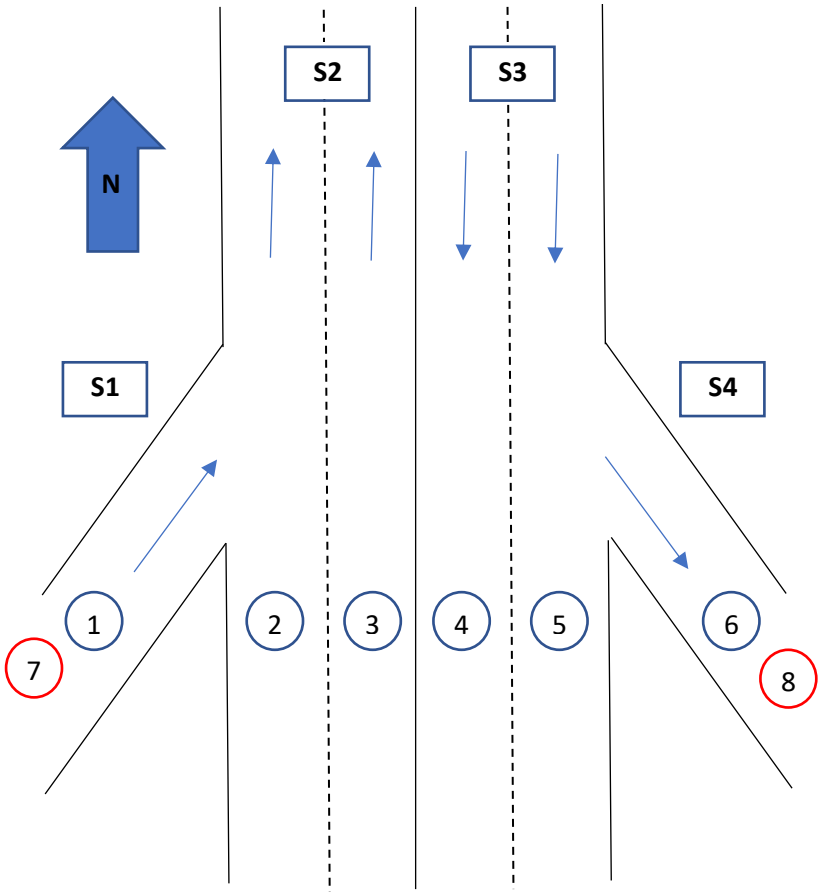
6. STATION LAYOUT GUIDELINE

6.1 LEGEND

	PRIMARY DIRECTION
	STREAM NUMBER
	DIRECTION OF TRAFFIC
	LANE NUMBER
	REVERSE LANE NUMBER

6.2 STREAM SETUP GUIDELINE FOR SITE WITH RAMPS

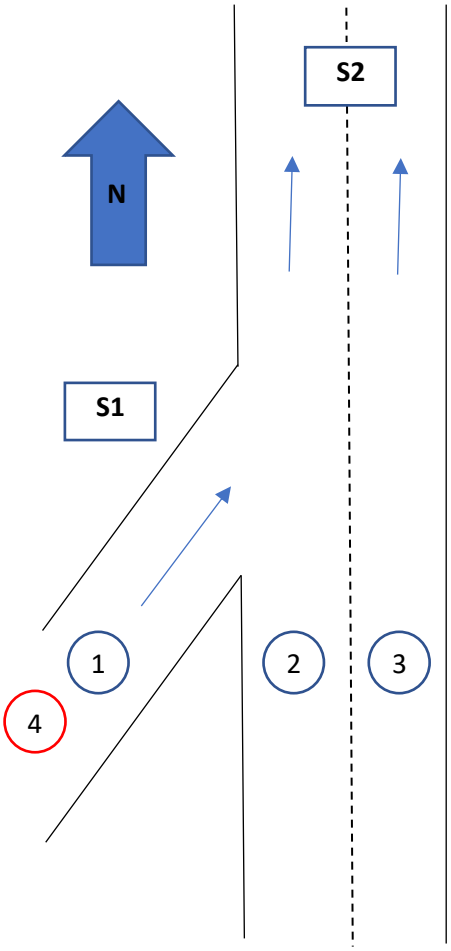
6.2.1 FULL SITE



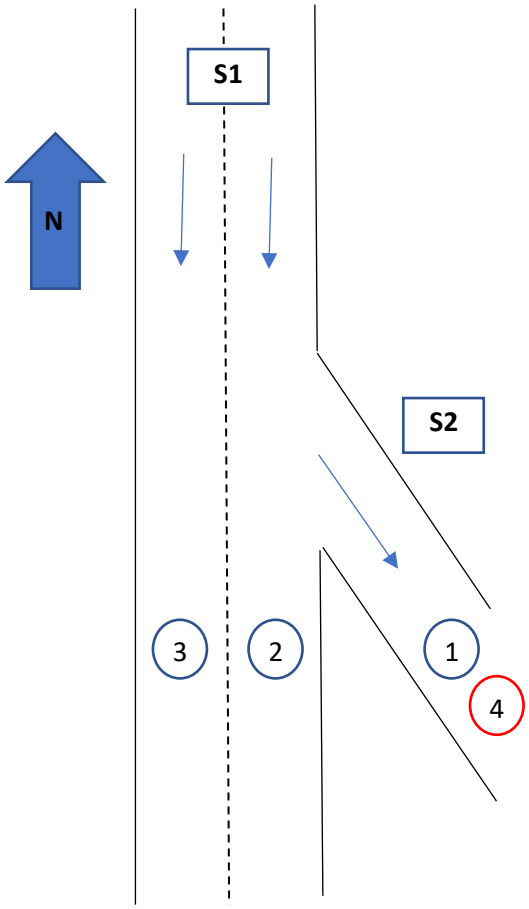
Notes:

Looking in the primary direction, number the lanes and streams from left to right, except for the reverse log lanes.

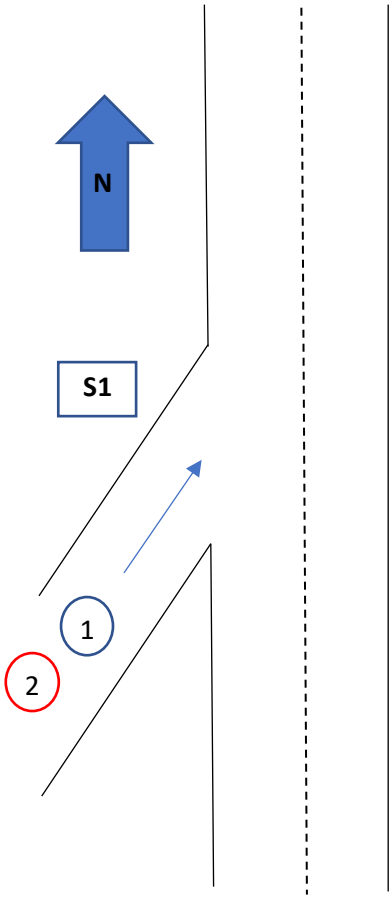
6.2.2 PARTIAL SITE: RAMP WITH MAINLINE - PRIMARY DIRECTION



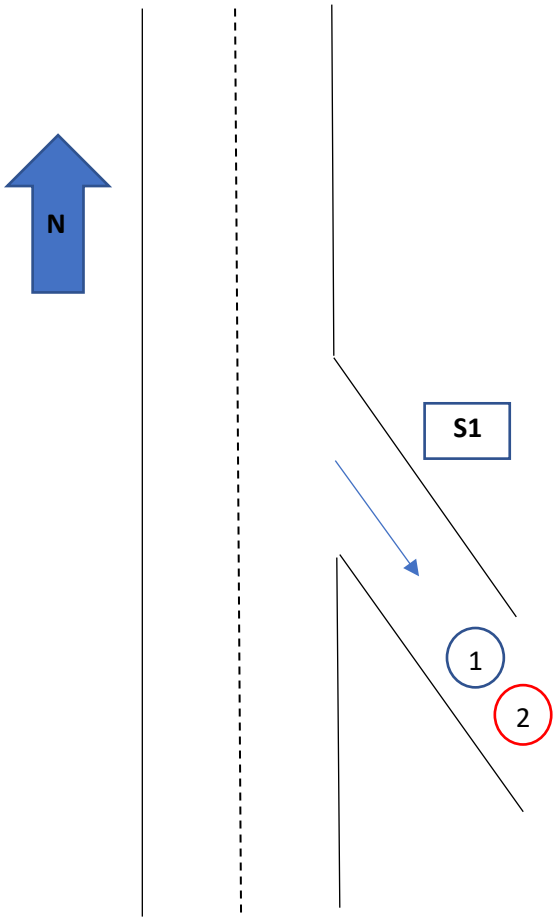
6.2.3 PARTIAL SITE: RAMP WITH MAINLINE - SECONDARY DIRECTION



6.2.4 PARTIAL SITE: RAMP ONLY - PRIMARY DIRECTION



6.2.5 PARTIAL SITE: RAMP ONLY - SECONDARY DIRECTION



6.3 REVERSE LOG RULES AT TOLL PLAZAS

a) All ramps on Toll stations must have dedicated reverse log lanes.
b) Reverse log lanes may not have a dedicated stream.
c) Assign the reverse log lane to the stream of the relative physical lane's stream
d) The reverse log lane will have the same direction as the physical lane.
e) Reverse log lanes will have no position, and no reverse lane number.
f) The flow of direction of a reverse log lane will be "Reverse".
g) The lane type will be "Virtual".