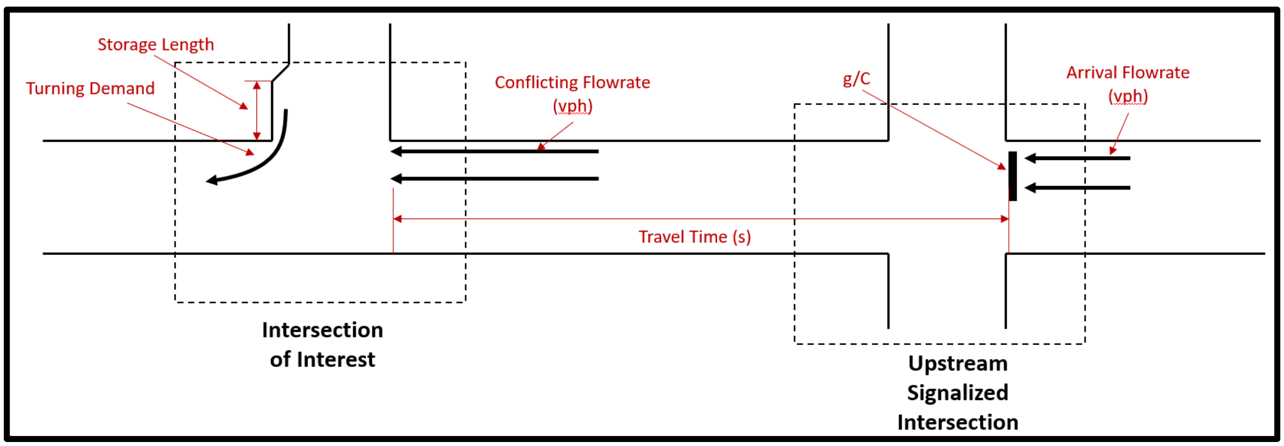
NCDOT Two or Three Leg Signalization Guidelines Charts

These guidelines have been developed for use in determining signalization needs at intersections with fewer than four legs. The intersections may have left turns, right turns, or u turns crossing or merging with two lanes of conflicting traffic. These movements are frequently, although not exclusively, found along four lane divided roadways with leftovers, T intersections, and median u turn openings.

Needed Information

To analyze an intersection using the provided charts, the following quantities must be known:

- Movement type (right, left, or u)
- Turning demand (vph)
- Conflicting volume (vph)
- Queue storage length (ft)
- Presence of an upstream signalized intersection; if yes:
    - Travel time from the upstream intersection to the intersection of interest (s)
    - Arrival rate of inbound, mainline vehicles at the upstream intersection (vph)
    - Approximate green-to-cycle length time of the upstream inbound mainline movement OR the number of critical phases at the intersection



Assumptions

The Conflicting Volume Adjustment Factor (CVAF) chart assumes a cycle length at the upstream intersection between 60 s and 120 s. It does not consider the impact of side street turning movements joining the inbound vehicles. It is intended to be used when it can be reasonably assumed all critical phases are called regularly.

The left turn queue length chart is intended for use under the following scenario

- The yielding movement is a left turn from the major to the minor,
- Two lanes of conflicting traffic,
- Conflicting traffic has a posted speed limit of 45 or 55 mph, and
- The target lane is not expected to experience queue spillback to the turning point

The right turn queue length chart is intended for use under the following scenario

- The yielding movement is a right turn from the minor to the major,
- Two lanes of conflicting traffic,
- Conflicting traffic has a posted speed limit of 45 or 55 mph, and
- The target lane is not expected to experience queue spillback to the turning point

The u turn queue length chart is intended for use under the following scenario

- The yielding movement is a u turn,
- Two lanes of conflicting traffic,
- Conflicting traffic has a posted speed limit of 45 or 55 mph, and
- The target lane is not expected to experience queue spillback to the turning point

Process

1. Using the STEP 1 chart that corresponds to the turning movement at the interesection of interest and green-to-cycle length ratio at the upstream intersection, determine the Conflicting Volume Adjustment Factor (CVAF). If there is no upstream signalized intersection, the CVAF = 1.0.
   a. Determine the green-to-cycle length ratio for the inbound mainline movement at the upstream intersection. Alternatively, the number of critical phases can be used. Care should be used in considering if all phases of the upstream intersection are regularly served.

      Example
      A two critical phase signal is located upstream to serve a mainline u turn. The u turn phase operates protected/permitted with a 15 second delay for the protected phase. The local engineer knows the protected phase is called approximately once per hour.

      The intersection of interest should be analyzed as an isolated intersection. Applying a Conflicting Volume Adjustment Factor (CVAF) other than 1.0 would inflate the capacity at the intersection of interest in a manner not typically observed in the field.

   b. Using the CVAF chart that corresponds to the turning movement at the intersection of interest, and the g/C at the upstream intersection, find the travel time between the intersections on the x-axis and move in the positive-y direction until reaching the line for the arrival flowrate* of the inbound mainline movement at the upstream intersection. Move to the left to find the CVAF.
2. Multiply the CVAF with the measured conflicting flowrate* at the intersection of interest to calculate the adjusted conflicting volume.
3. Using the STEP 3 chart that corresponds to the turning movement at the intersection of interest, find the intersection of the turning movement demand and the adjusted conflicting volume. Move in the positive-y direction to the next plotted line to determine the expected 95% queue length or the expected volume-to-capacity.

Analysis

It is recommended that two conditions would result in further investigation of a signal:

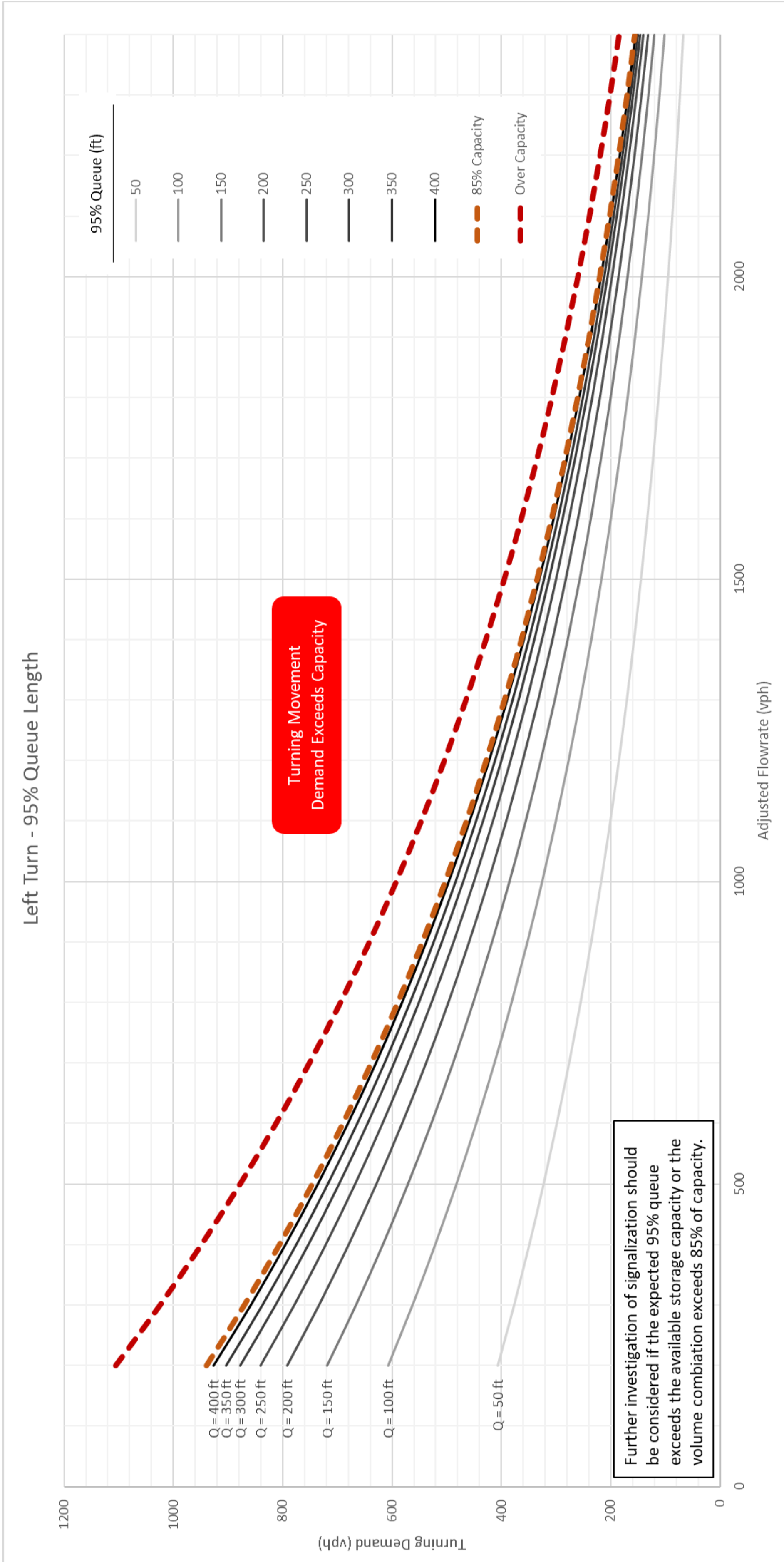
- The expected 95% queue length exceeds the available storage capacity, or
- The turning movement volume-to-capacity ratio exceeds 85%.

If only the first criterion is met, it would also be appropriate to consider extending the storage capacity in lieu of signalization.

* The arrival flowrate does not include vehicles which have turned onto the mainline from the upstream sidestreet. As such, the arrival flowrate may be slightly lower than the conflicting flowrate.

NCDOT Two or Three Leg Signalization Guidelines Charts - STEP 3 **Version 1**

STEP 3



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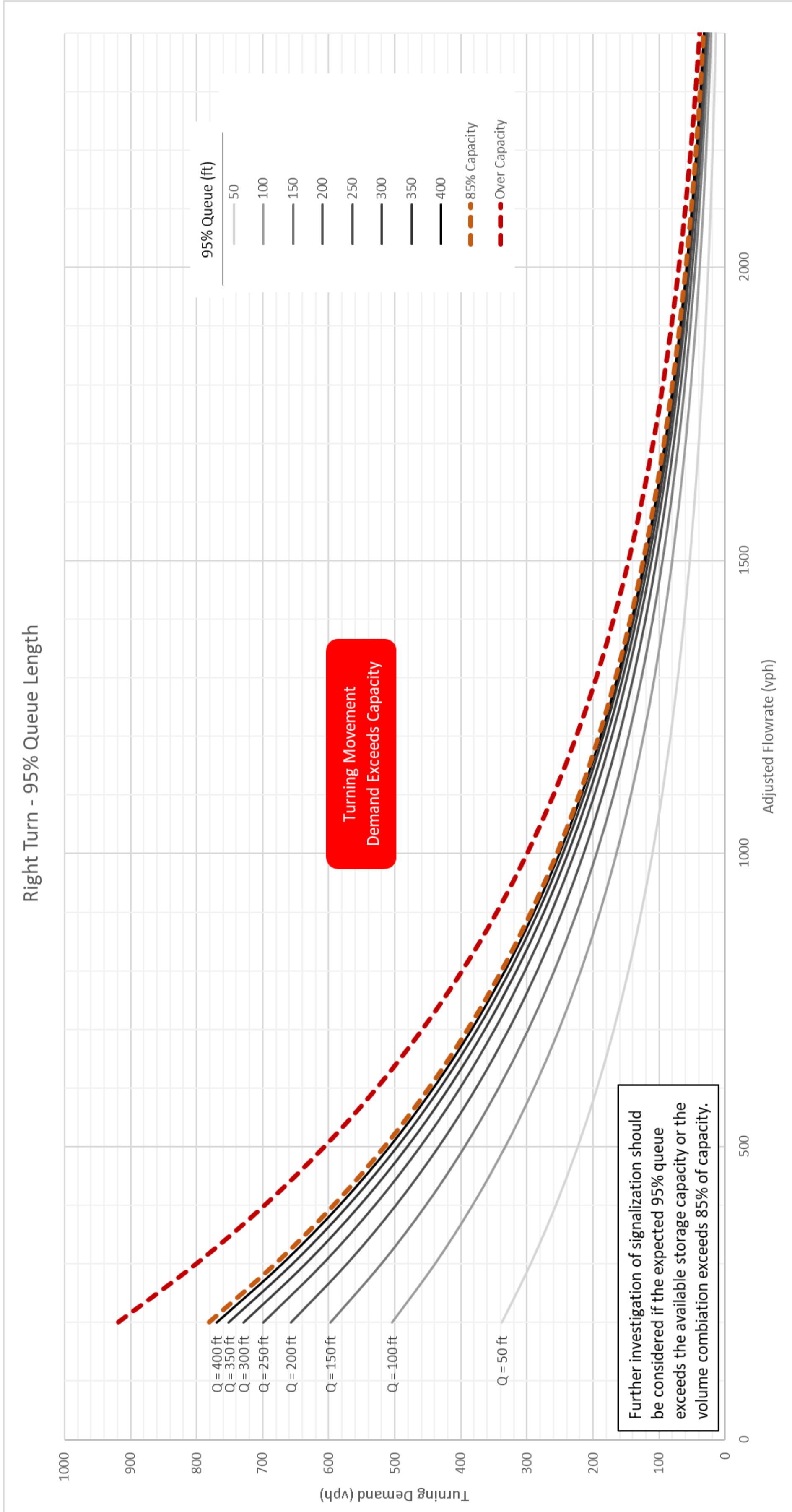
NCDOT Two or Three Leg Signalization Guidelines Charts - STEP 3

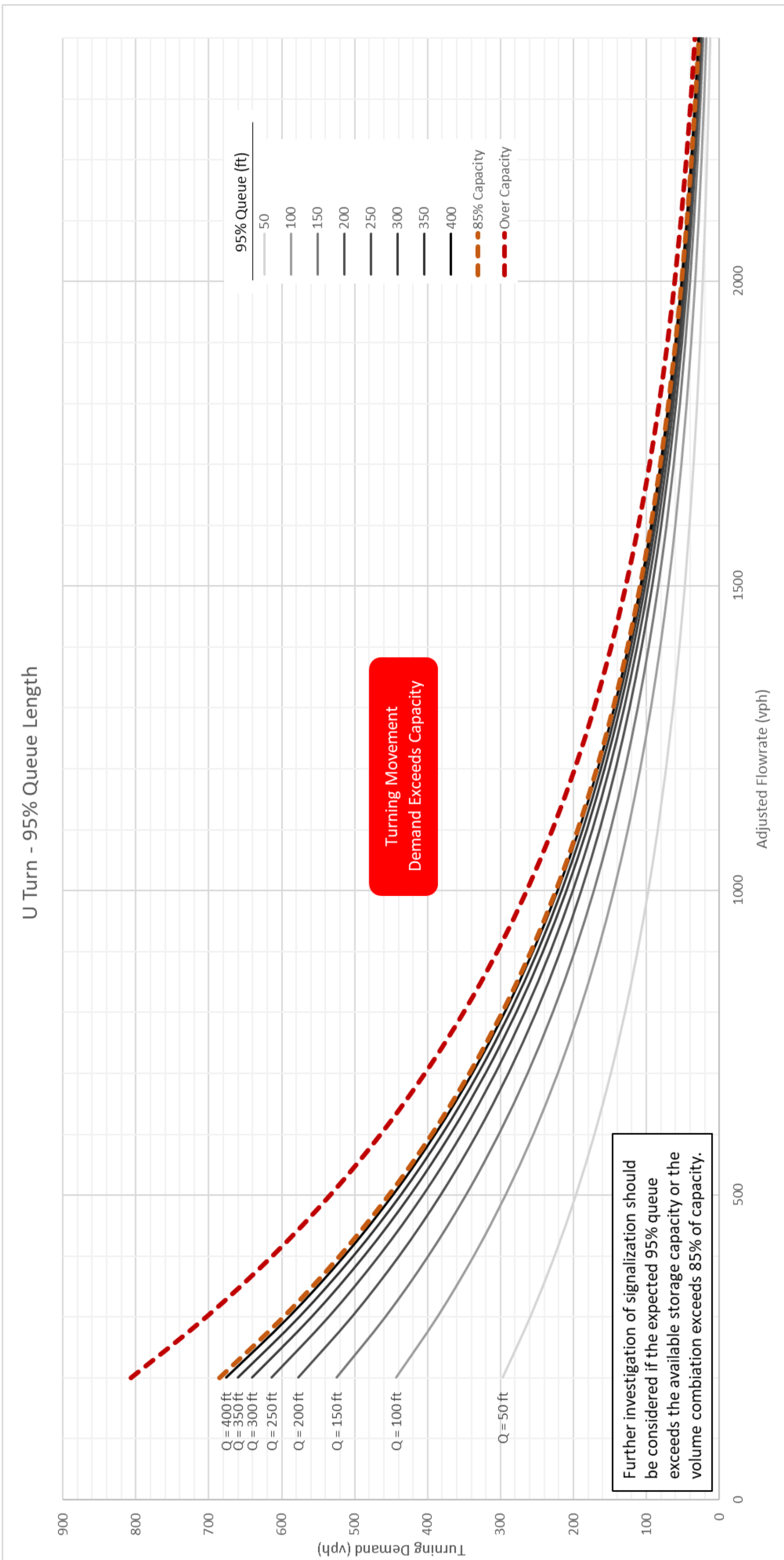
Version 1

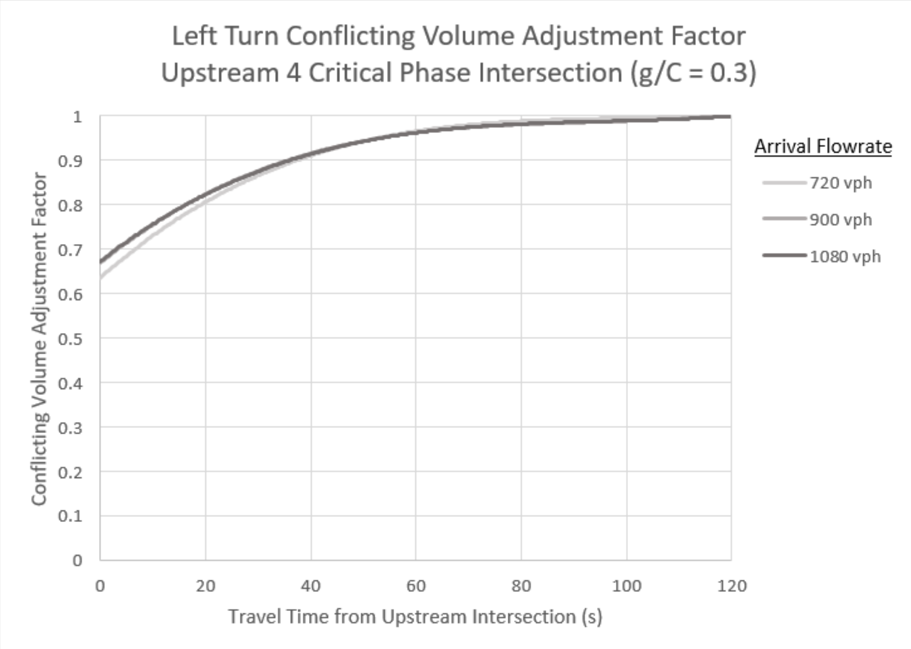
STEP 3

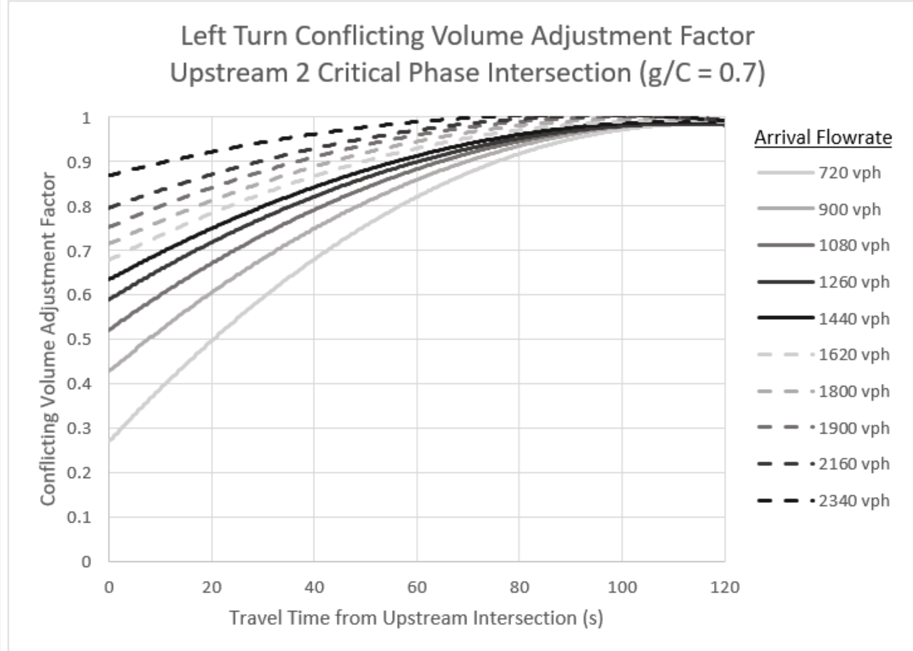


NCDOT Two or Three Leg Signalization Guidelines Charts - STEP 3 **Version 1**

STEP 3







The Conflicting Volume Adjustment Factor can also be determined mathematically wih the following equation, where t is the travel time from the upstream intersection in seconds.

$$CVAF = at^2 + bt + c$$

Upstream Mainline Arrival Rate (vph)	g/c	a	b	c
720	0.3	0.00004	0.0076	0.6590
720	0.7	0.00005	0.0124	0.2707
900	0.3	0.00004	0.0066	0.6930
900	0.7	0.00004	0.0097	0.4284
1080	0.3	0.00004	0.0066	0.6943
1080	0.7	0.00004	0.0082	0.5217
1260	0.7	0.00004	0.0070	0.5899
1440	0.7	0.00004	0.0063	0.6342
1620	0.7	0.00004	0.0058	0.6786
1800	0.7	0.00004	0.0054	0.7145
1980	0.7	0.00004	0.0049	0.7528
2160	0.7	0.00004	0.0042	0.7956
2340	0.7	0.00004	0.0030	0.8685

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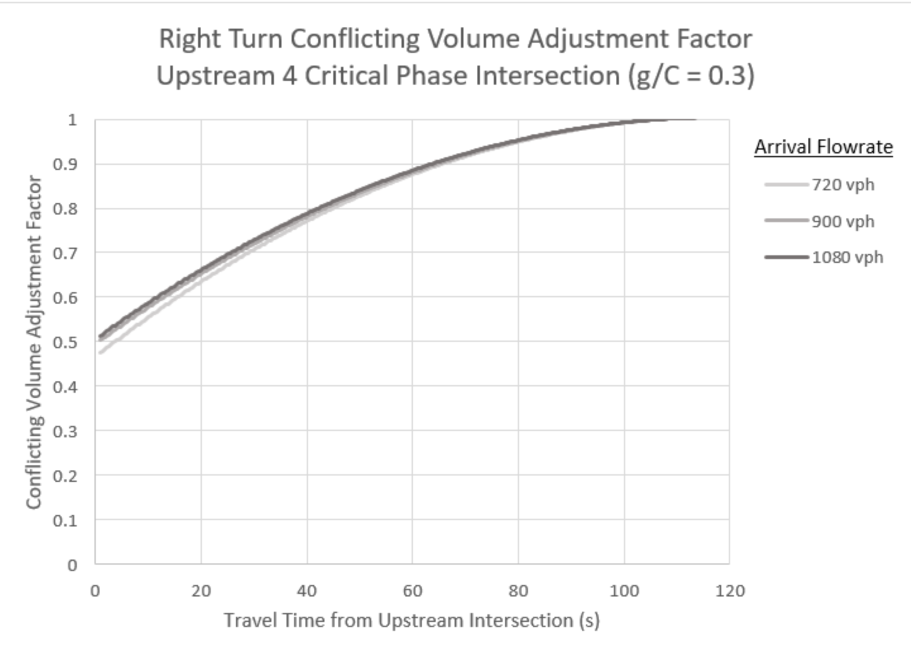
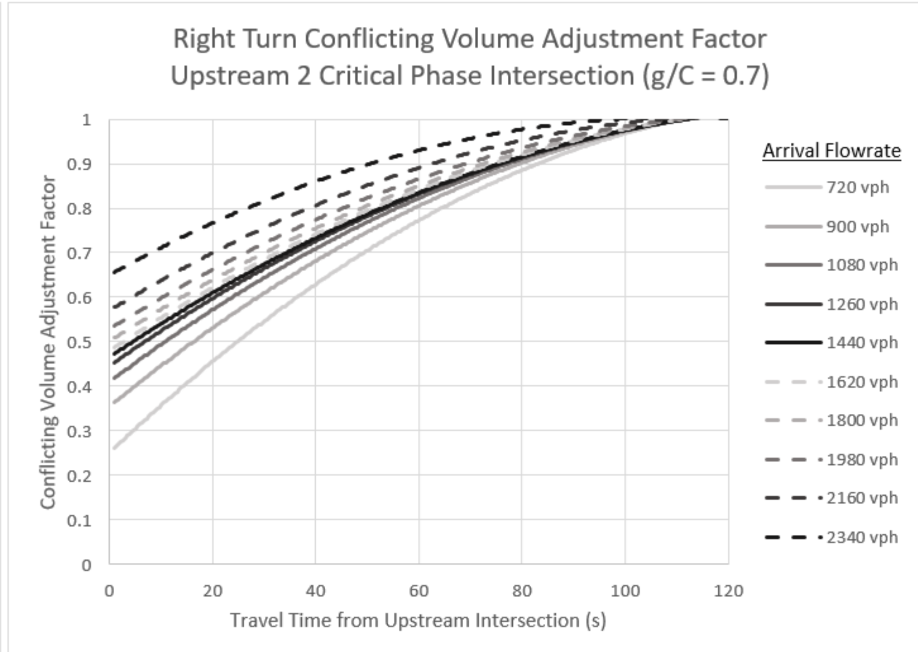
STEP 1





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$$CVAF = at^2 + bt + c$$

Upstream Mainline Arrival Rate (vph)	g/c	a	b	c
720	0.3	0.00004	0.0090	0.4736
720	0.7	0.00004	0.0108	0.2587
900	0.3	0.00004	0.0084	0.5010
900	0.7	0.00003	0.0093	0.3609
1080	0.3	0.00004	0.0083	0.5121
1080	0.7	0.00003	0.0085	0.4162
1260	0.7	0.00003	0.0080	0.4518
1440	0.7	0.00003	0.0076	0.4712
1620	0.7	0.00003	0.0075	0.4856
1800	0.7	0.00003	0.0072	0.5071
1980	0.7	0.00003	0.0070	0.5338
2160	0.7	0.00003	0.0069	0.5756
2340	0.7	0.00003	0.0063	0.6548

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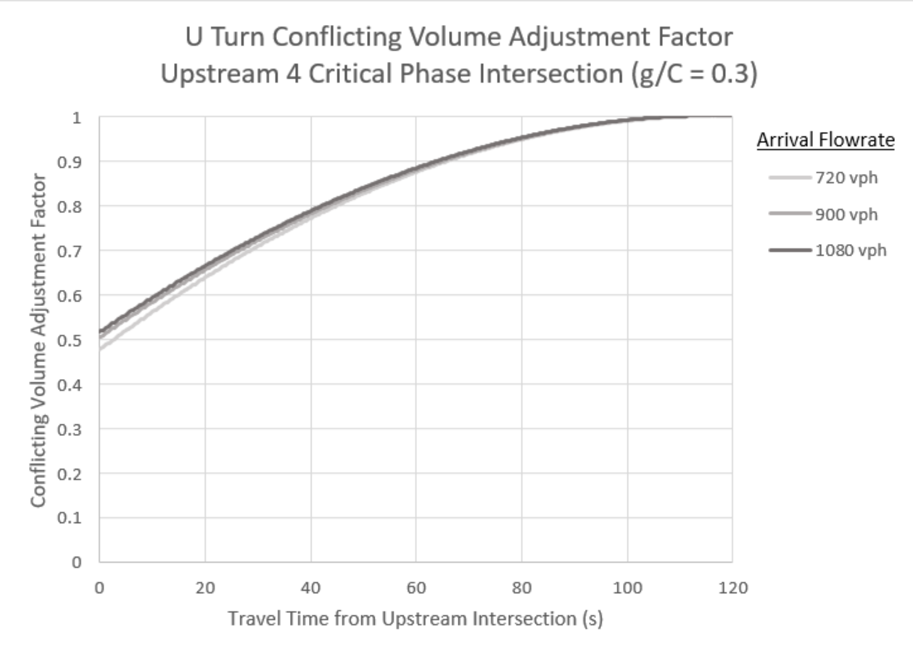
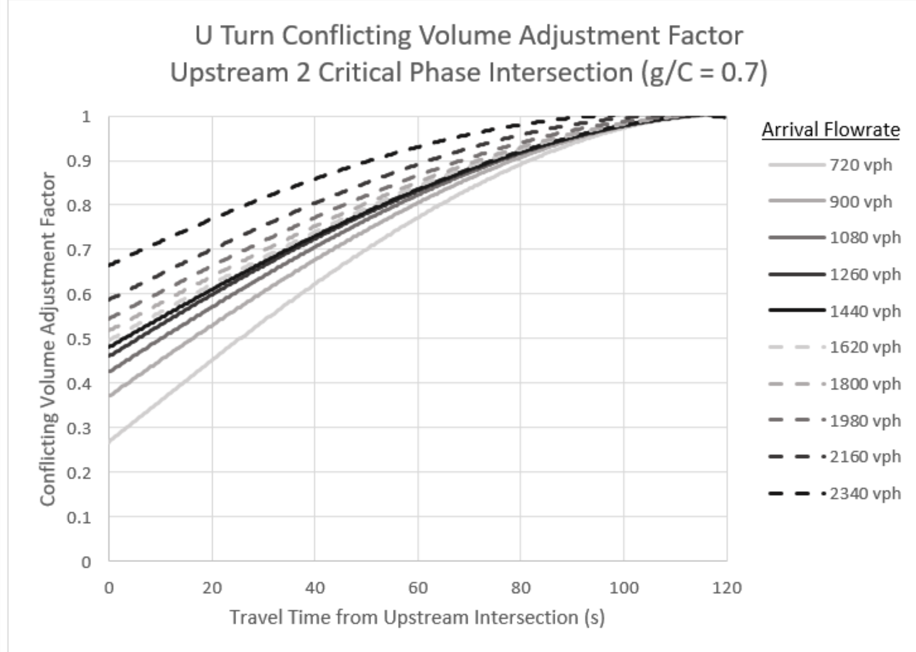
STEP 1





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$$CVAF = at^2 + bt + c$$

Upstream Mainline Arrival Rate (vph)	g/c	a	b	c
720	0.3	0.00004	0.0089	0.4765
720	0.7	0.00004	0.0108	0.2568
900	0.3	0.00004	0.0084	0.5035
900	0.7	0.00003	0.0093	0.3619
1080	0.3	0.00003	0.0083	0.5155
1080	0.7	0.00003	0.0085	0.4171
1260	0.7	0.00003	0.0079	0.4544
1440	0.7	0.00003	0.0076	0.4737
1620	0.7	0.00003	0.0074	0.4886
1800	0.7	0.00002	0.0072	0.5106
1980	0.7	0.00003	0.0070	0.5374
2160	0.7	0.00003	0.0068	0.5795
2340	0.7	0.00003	0.0062	0.6592

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STEP 1