

Content: Used to store notes regarding data

* NOTE: These items have NOT been maintained and are therefore unreliable!

B. VAOT Linear Reference System and Coding Standard

DUAL LINEAR REFERENCE SYSTEMS

There are two clear choices for VAOT Linear Reference Systems:

1. **Town-Based LRS**, based on the current route log milemarkers. These milemarkers are generally reset to zero at the town boundaries, such that U.S. Highway 2 in Richmond is a separate *route* from U.S. Highway 2 in Williston. Milemarkers for the interstates and for limited access U.S. 4 are not reset to zero at the town boundaries.
2. **End-to-End LRS**, an LRS with continuous milemarkers along the full length of each highway, without having the milemarkers reset to zero at town boundaries.

Several pros and cons of these two systems are listed in the table below.

Town-Based LRS

Pro: If a route's length changes (due to a road re-alignment) the milemarkers need only need be adjusted to the end of the highway within that town. This is primarily a logistical problem for maintaining route logs and milemarkers in the field.

Con: It's inconvenient to specify events which traverse town boundaries. For example, one High Accident Location on U.S. 2 spans 3 towns: Waterbury (4.784-4.900), Duxbury (0.0-0.082) and Moretown (0.0-0.100). This requires three separate database records for the HAL.

Con: There are about 757 Town-Based LRS routes (not counting urban collectors, ramps, approaches, etc.), due to the milemarkers being reset at the town boundaries. A town code (CT_CODE) is needed to specify most routes.

Con: Route symbology will start and stop at town boundaries (for most routes).

End-to-End LRS

Con: Re-alignments require milemarkers to be adjusted to the end of the highway (including in the field if adopted for field markers).

Pro: The same stretch of road could be specified as U.S. 2 from 65.540-65.722, in a single database record.

Pro: There are about 256 End-to-End LRS routes, which is easier to manage. Route identifiers don't require the CT_CODE. The Arc/Info route system is somewhat simpler.

Pro: Route symbology is continuous across town boundaries.

Recommendation: both LRSs have their pros and cons. Having two standard VAOT LRSs will complicate data management and sharing within the agency, but they are both practical and each meets the needs of different users. The two systems shall be allowed to coexist, unless and until such time as it is deemed impractical by VAOT.

END-TO-END LRS IDENTIFIER (LR_ETE_RTE)

A standard, unique identifier is needed for each highway so that database records can be easily linked to a GIS LRS for mapping or analysis. The following 11-character LR_ETE_RTE field is proposed. Note that for most highways, only the first 4 or 5 characters are required; characters 6-11 are used only when needed.

Field LR_ETE_RTE components (11 characters):

	Route Type	Route Number	Route # Modifier	Direction	Subtype	Numeric ID	Alpha ID
Number of Characters:	1	3	1	1	1	3	1

Most LR_ETE_RTEs will be 4 or 5 characters in length, as described below.

Component descriptions and examples:

Route Type (character 1):

- I = Interstate
- U = U.S. route
- V = VT signed route
- S = State highway (named, special cases, other routes)
- A = Alternate route
- B = Business route

Route Number (characters 2-4). The numeric portion of the highway number (3 digits), right justified in characters 2-4. For Named State Highways, Major Collectors and Urban Collectors, 4-digit codes are used (in characters 2-5).

Route # Modifier (character 5). Used for a letter or special modifier, if needed.

Named State Highways, Major Collectors and Urban Collectors retain their full, 4-digit codes in common usage. For these, the Highway Number and Modifier are combined to form a 4-digit highway number.

For the three separate sections of Alternate U.S. 5, the modifiers (1 to 3) are:

- A0051 = Alternate US 5, St. Johnsbury
- A0052 = Alternate US 5, Newport
- A0053 = Alternate US 5, Derby

Valid Highway # Modifier characters include:

- <letter> = Highway letter (e.g., the 'A' in Highway 2A)
- <digit> = Special cases (e.g., Alternate U.S. 5); digit for a Named State Highway, Major or Urban Collector
- ' ' = <blank>, if no modifier is needed and no subsequent components are needed for the LR_ETE_RTE
- = <dash>, if no modifier is needed but other LR_ETE_RTE components follow

The Route Type, Route Number and Route # Modifier format allows highways to be easily sorted in a common reference order.

Examples:	<u>LR_ETE_RTE</u>	<u>End-to-End Route</u>
	V100	= VT 100
	V100A	= VT 100A
	S9360	= Middlesex State Highway
	S0103	= Major Collector 0103
	S5222	= Urban Collector Spear St., S. Burlington
	A0052	= ALT US 5 in Newport

Direction (character 6). The direction character is included only if the highway is divided. To determine where highways divide, refer to official VAOT Route Logs or Appendix E. Valid direction characters include:

- ' ' = <blank>, if route is undivided and there are no subsequent LR_ETE_RTE components
- W = Westbound (for divided routes)
- S = Southbound (for divided routes)
- E = Eastbound (for divided routes)
- N = Northbound (for divided routes)



Examples:	<u>LR ETE RTE</u>	<u>End-to-End Route</u>
	I089-N	= I 89 Northbound lane
	I089-S	= I 89 Southbound lane
	U002	= US 2 undivided portions
	U002-W	= US 2 Westbound portions (where divided)
	V003-NA020	= VT 3, Approach 20

Approaches generally use the same direction as the parent road. A complete list of valid approach codes is included in Appendix D.

Subtype (character 7): This field describes sections of road that are not on the main line yet have defined lengths recognized by the Agency. Valid codes include:

' '	=	<blank>, no subtype
A	=	Approach
C	=	Connector
J	=	Jughandle
R	=	Ramp
S	=	Spur

Numeric ID (characters 8-10): The ID number represents different things according to the subtype.

Approaches and jughandles are numbered (initially) in ascending order from the start of the parent route in the primary direction. Numbers will increment by multiples of ten (ex:10,20,30,40,etc...). Gaps are left between numbers for future construction.

For ramps and spurs the number refers to the exit number for the parent route. A few ramps exit at locations that have no exit number. These have zeros in this field.

Where no ID is required in this field, blanks are used.

Alpha ID (character 11): This letter identifies ramps and spurs, as taken from the route logs except for two ramps at I 91, Exit 2, which were named A/B and C/D on the route logs. These have been renamed 'E' and 'F', respectively.

Where no ID is required in this field, a blank space is used.

Examples:	<u>LR ETE RTE</u>	<u>End-to-End Route</u>
	U004-E	= US 4 Eastbound Divided Highway
	U004-W	= US 4 Westbound Divided Highway
	V100-NA010	= VT 100 Approach #10
	B004-WJ010	= Business Route US 4 Westbound Jughandle #10
	I089-SR009A	= I 89 Southbound Exit 9 Ramp A

TOWN-BASED LRS IDENTIFIER (LR_TWN RTE)

The Town-Based LRS is identical to the End-to-End LRS with the addition of a town identifier. The VAOT County/Town code (CT_CODE) is added directly after the Route # Modifier. The standard town-based route identifier will be called LR_TWN RTE.

Field LR_TWN_RTE components (15 characters):

	Route Type	Route Number	Route # Modifier	Town Code	Direction	Subtype	Numeric ID	Alpha ID
Number of Characters:	1	3	1	4	1	1	3	1

Most LR_TWN_RTEs will be 9 characters in length. Characters 10-15 are used only as needed. The Town Code will always be coded, so that LR_TWN_RTE codes always differ from LR_ETE_RTE codes.

Special cases for the County/Town code:

For the Interstates, limited access portions of U.S. 4, VT 289 and ramps, the CT_CODE will equal '0000' (since the route log milemarkers for these routes are not reset at the town boundaries):

<u>LR_TWN_RTE</u>	<u>Route</u>
I089-0000N	Interstate 89 (North Bound)
I091-0000N	Interstate 91 (North Bound)
I093-0000N	Interstate 93 (North Bound)
I189-0000E	Interstate 189 (East Bound)
U004-0000E	US 4 (East Bound, limited access portion)
V289-0000E	VT 289 (Burlington circumferential highway East Bound)

Major Collectors 0199 and 0126 are reset to 0 at the Bristol Village and Bellows Falls Village boundaries, respectively, but VAOT has no CT_CODES for these villages. CT_CODES of 0199 and 1399 are thus used. Their LR_TWN_RTEs are as follows:

<u>LR_TWN_RTE</u>	<u>Area</u>
S01990103	Bristol Town
S01990199	Bristol Village
S01261314	Rockingham Town
S01261399	Bellows Falls Village

Town-Based LR_TWN_RTE examples:

<u>LR_TWN_RTE</u>	<u>Town-Based Route</u>
I089-0000N	= I 89, primary direction (Northbound)
I089-0000S	= I 89, Southbound lane
I089-0000NR08A	= I 89, Ramp A, Interchange 08
U002-0411	= US 2, Richmond (0411), undivided
U002-0311W	= US 2, St. Johnsbury (0311), Westbound portions (where divided)
V012A0909NA30	= VT 12A, Approach 30 in Randolph (0909)
U007-1103SR01B	= US 7, Castleton (1103), Southbound, Exit 01, Ramp B

SPECIAL ISSUES REGARDING THE LR_ETE_RTE AND LR_TWN_RTE CODES

Variable length codes.

The LR_ETE_RTE and LR_TWN_RTE codes are variable length (for example, LR_ETE_RTEs of 'V100' for VT Highway 100 and 'V100A' for VT Highway 100A. This scheme has the following advantages:

- enables simple coding of most highways, reserving more complex codes for approaches, ramps, etc.,
- enables simple sorting based on the route identifiers,
- eliminates confusion for route numbers with trailing zeros (e.g., when '0' is used as a default route # modifier, there's confusion as to whether '0030' is Highway 3 or Highway 30).

Variable length fields raise the potential problem of improper analyses or matching of records. For example, some software operators may consider 'V100A' to be 'equal' to 'V100', since the first 4 characters match. As a specific example, FoxPro considers 'V100A' = 'V100' to be true with SET EXACT OFF. Therefore, data manipulation of variable length fields must take place with care. *If, upon review, variable length codes are deemed impractical, the identifiers can automatically be right-filled with dashes as part of the data uploading process.*

Use of 4-digit highway numbers for special cases.

Most U.S. and State highways are based on numbers from 1 to 3 digits, with a letter 'modifier' in some cases (as for VT 100A). There are several exceptions where 4-digit highway numbers will be used:

- Urban Collectors all rely on 4 digits,
- Named State Highways (the '9000' series) traditionally use 4 digits, all of which end in '0' with the exception of 'S9998' (Kennedy Drive, S. Burlington),
- Major Collectors require only 3 digits (numbered from 103 to 319), but have traditionally been referenced with a leading zero (as on the Functional Class maps),
- Minor Collector numbers have not yet been assigned, but 4-digit codes will be consistent with the Major Collector codes (perhaps starting with '0500').

Use of <blank> for the direction component (undivided routes).

Most milemarker-based VAOT data is collected for 'main line' highways without regard to direction of travel (information applies to both directions). However, some VAOT data developers (such as pavement management), must specifically code the Northbound and Southbound (or Eastbound and Westbound) sections of divided highways. As a result, divided highways (or sections of highways) should be coded with directional information (N,S,E,W). Undivided highways (or sections of highways) should not include any directional information (<blank>). The beginning and ending milemarkers for divided highways (or sections of highways which are divided) can be obtained from VAOT Route Logs or in Appendix E (Complete Dual LRS Listing for Divided Highways).

Use of a separate Highway Type prefix for Alternate and Business routes.

The LR_ETE_RTE and LR_TWN_RTE codes use prefixes of 'A' and 'B' for Alternate and Business routes, respectively. As of December, 1995, all Alternate and Business routes are for U.S. Highways (Alt. 5, Alt. 7, B.R. 2 and B.R. 4). If an Alternate or Business Route were created for a Vermont Highway in the future, this coding scheme would not indicate to the user if the route were a U.S. or VT route. This is not considered to be a problem, since U.S. and VT routes are signed differently in the field, but are otherwise effectively treated the same within the Agency.

CONVERTING BETWEEN THE TWO LINEAR REFERENCE SYSTEMS

The pavement management division has developed a spreadsheet with cumulative milages for all highways in the state, by town. This spreadsheet provides the correspondence between the two LRSs, whereby the milemarkers can be converted from one system to the other. The spreadsheet has been converted into database LRS.DBF and modified accordingly (Appendix D).

Within Arc/Info, separate route systems will be developed for both the Town-Based and End-to-End Linear Reference Systems, so that data based on either system can be easily displayed. The TMIS Work Plan describes 'uploading' procedures consistent with this scenario.