

Pima Co. DOT
Linear Referencing System LRS

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Pima Co. DOT

Linear Referencing System LRS

- Topics Covering
 - LRS Basics & Uses
 - PC LRS Setup / Process
 - PC LRS applications
 - Street Network reconfiguration
 - Carriageways

LRS Overview

Linear Referencing System

A set of procedures and methods for specifying a location as a distance, or offset, along a linear feature, from a point with a known location.

Linear Referencing – Basic Concepts

Routes

Measures

Events

Dynamic segmentation

Linear referencing applications

Route features

Linear features – in a polyline feature class
Have an identifier and measurement system
Stored in a geodatabase, coverage, or shapefile

	OBJECTID*	Shape*	ROUTE
▶	1	Polyline M	7 11081
	2	Polyline M	9 11081
	3	Polyline M	9 11082
	4	Polyline M	9R11011
	5	Polyline M	9w11051

Linear feature Unique identifier



Measures

Measures or M values

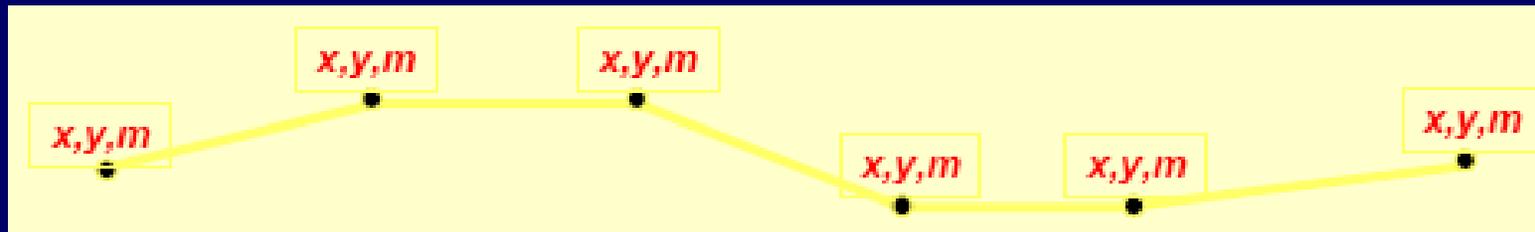
Distances along linear feature

Stored with X and Y coordinate

Measures start at route origin

Measure Units

Can be miles, meters, feet, time, etc.



Events

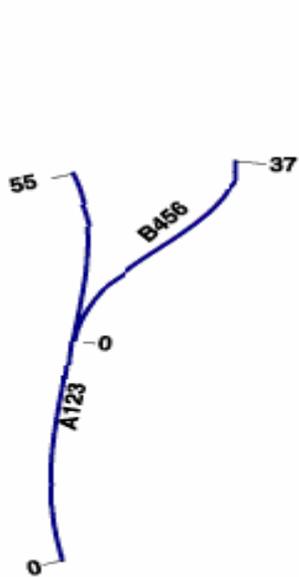
Geographic locations stored in tabular form

Route events are features occurring along the route

May be Point or Line events

May be stored in any ArcGIS supported table

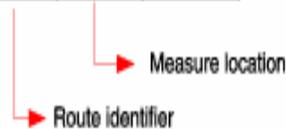
Route feature class



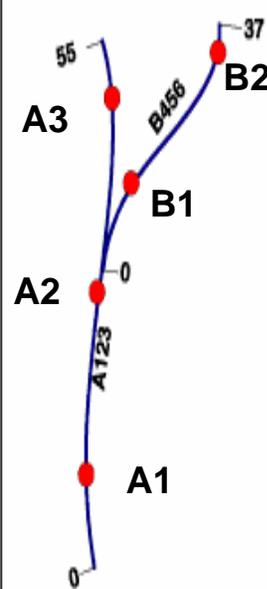
Point event table

GAUGES

REACH	MP	GAUGE_ID
A123	12	A1
A123	30	A2
A123	47	A3
B456	9	B1
B456	35	B2



DynSeg results



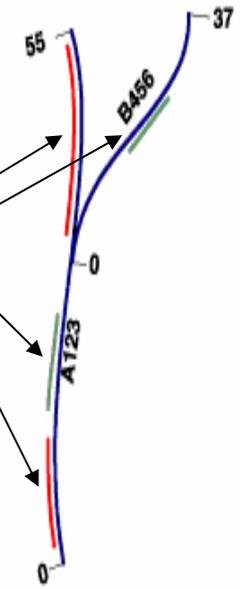
Line event table

HABITAT

REACH	FMP	TMP	SPECIES
A123	5	13	SALMON
A123	15	25	STEELHEAD
A123	30	52	SALMON
B456	17	25	STEELHEAD



DynSeg results



Dynamic Segmentation

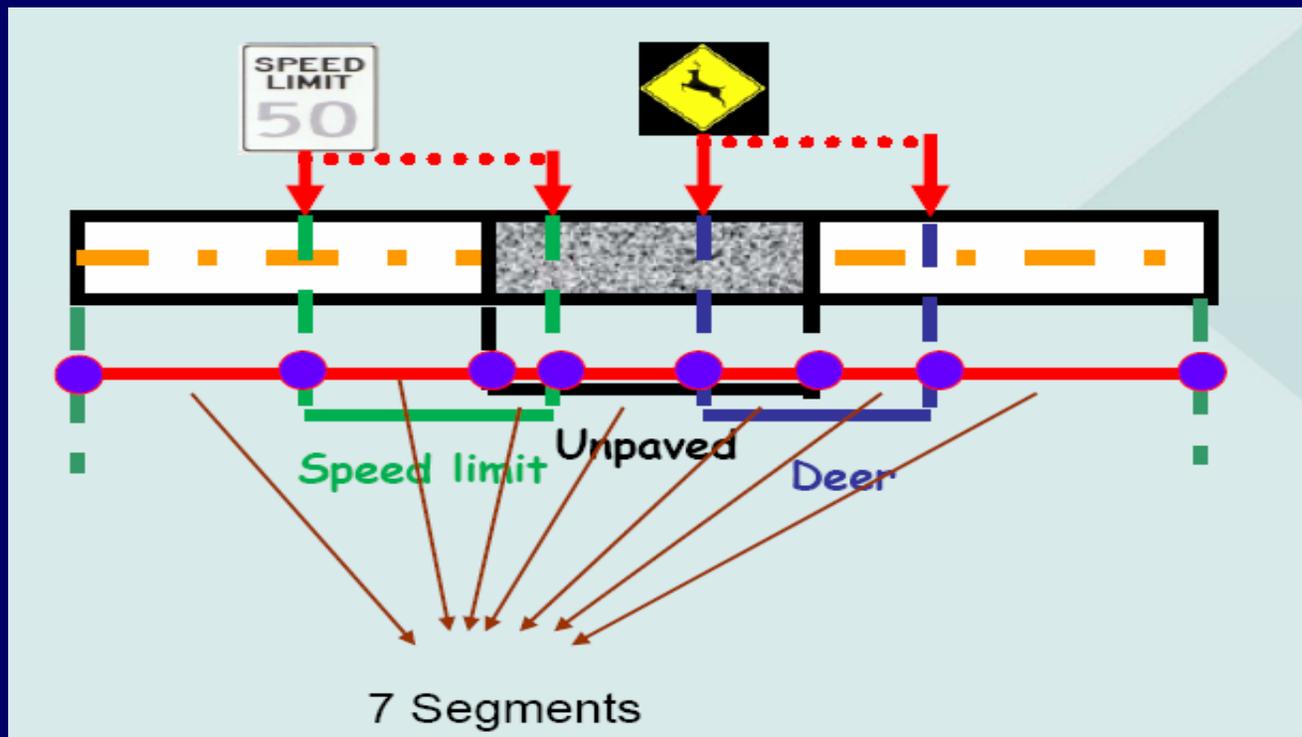
The process of computing the location of events on linear features at run time based on event tables for which distance measures are available.

- Events become features
- Underlying route is not broken apart

Linear Referencing Applications

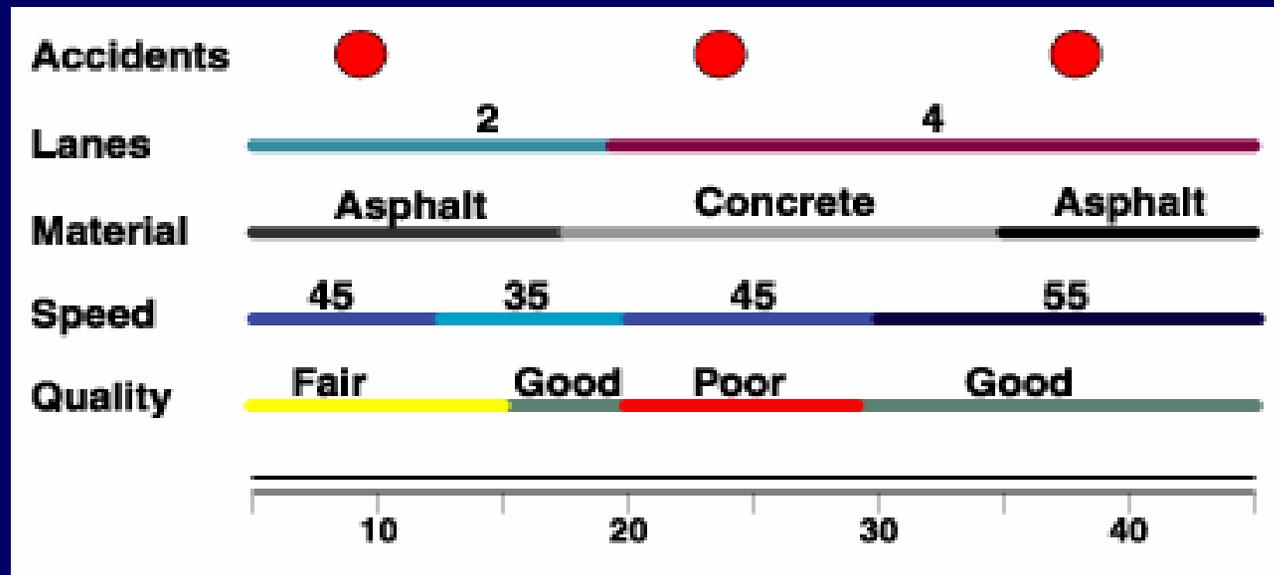
Modeling one to many (1:M) relationships

Used when two or more pieces of information are associated with the same location on a linear feature.



Linear Referencing Applications

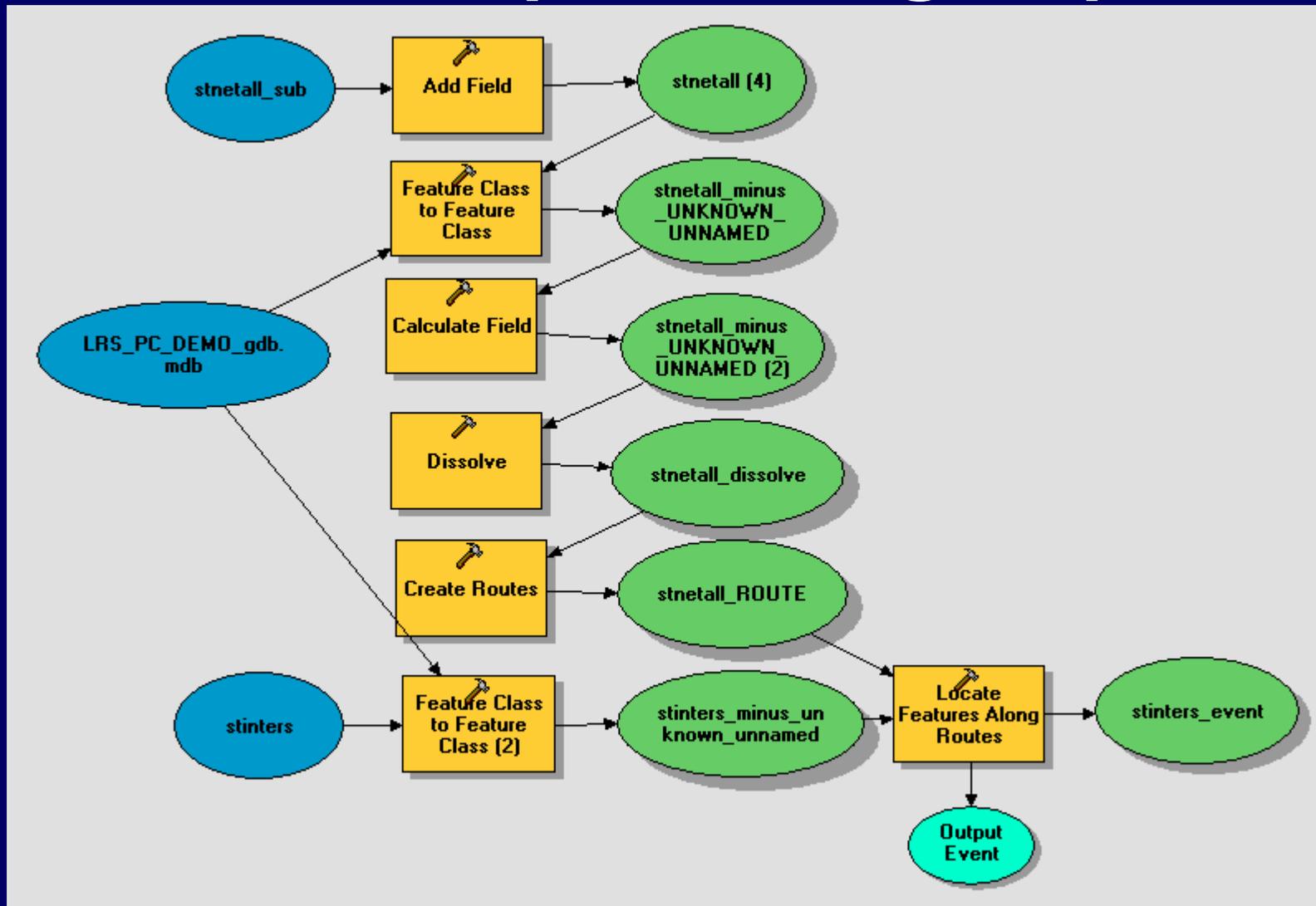
- Features with frequently segmented data
- Features location determined using a linear system of measures instead of using xy coordinates



PC Road Network Stats

- Total Road Segments ~ 57,000
- Total Length of Roads
 - ~ 41,644,000 Feet
 - ~ 7,900 Miles
- Total Routes ~ 15,700
- Total Intersections ~ 43,400
- Total Duplicate intersections ~ 5,000

PC LRS processing steps



PC LRS processing steps

UNPIVOT Stinters_Event Table

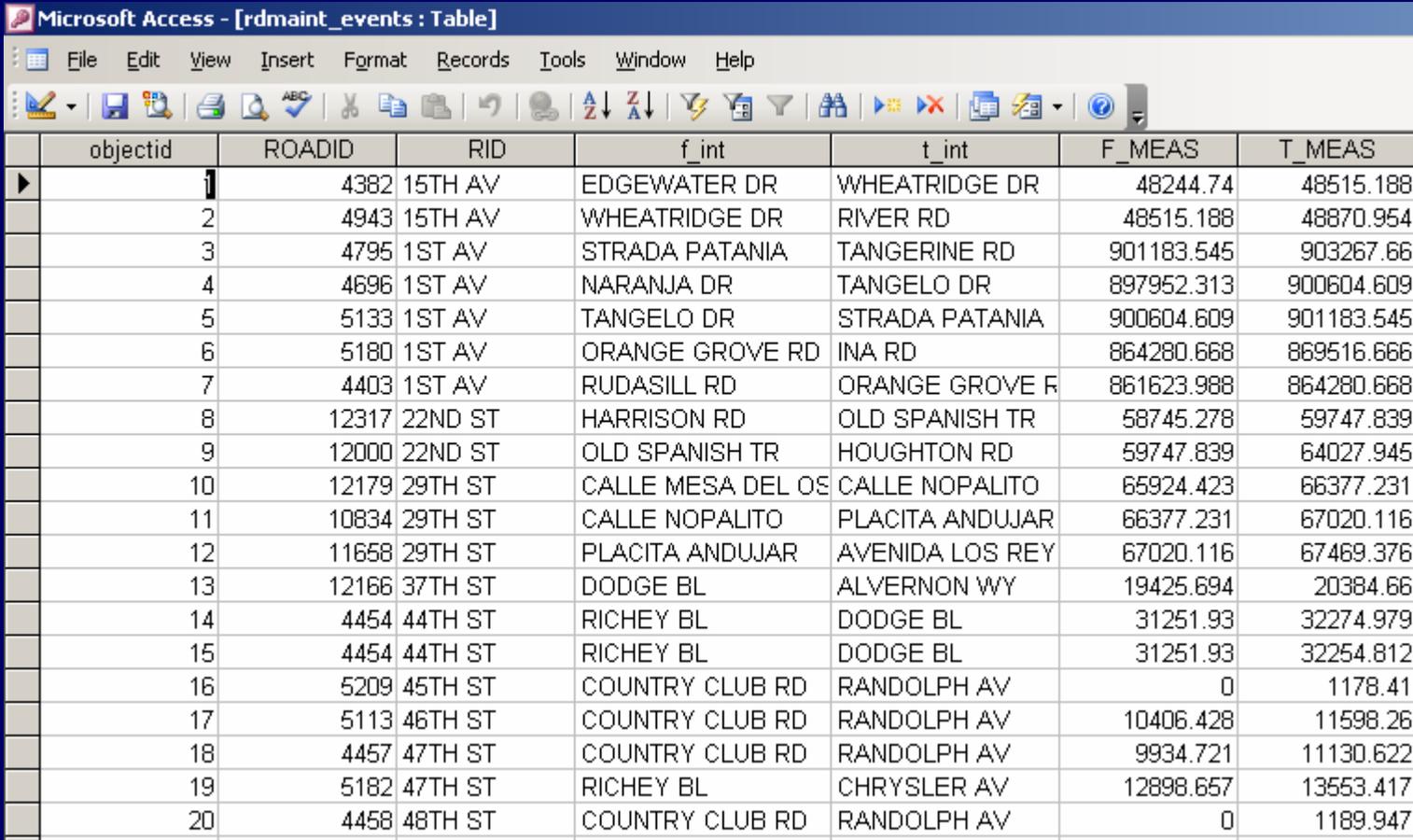
RID	MEAS	STREET1	STREET2
CALLE CAMPECHE	417	CALLE CAMPECHE	PLACITA ACAMBAY
CALLE CAMPECHE	1681	PLACITA ZACATECAS	CALLE CAMPECHE
CALLE CAMPECHE	0	CALLE DE MIRAR	CALLE CAMPECHE
CALLE CAMPECHE	1287	PLACITA ATIZA	CALLE CAMPECHE
CALLE CAMPECHE	2031	CALLE CAMPECHE	END OF ROAD

Result - Stinters_EventMeas

RID	CROSSSTREET	MEAS
CALLE CAMPECHE	PLACITA ACAMBAY	417
CALLE CAMPECHE	PLACITA ZACATECAS	1681
CALLE CAMPECHE	CALLE DE MIRAR	0
CALLE CAMPECHE	PLACITA ATIZA	1287
CALLE CAMPECHE	END OF ROAD	2031

PC LRS processing steps

Results of Query



The screenshot shows a Microsoft Access window titled "Microsoft Access - [rdmaint_events : Table]". The window contains a table with 8 columns: objectid, ROADID, RID, f_int, t_int, F_MEAS, and T_MEAS. The table lists 20 rows of road intersection data, including road names and associated measurements.

objectid	ROADID	RID	f_int	t_int	F_MEAS	T_MEAS
1	4382	15TH AV	EDGEWATER DR	WHEATRIDGE DR	48244.74	48515.188
2	4943	15TH AV	WHEATRIDGE DR	RIVER RD	48515.188	48870.954
3	4795	1ST AV	STRADA PATANIA	TANGERINE RD	901183.545	903267.66
4	4696	1ST AV	NARANJA DR	TANGELO DR	897952.313	900604.609
5	5133	1ST AV	TANGELO DR	STRADA PATANIA	900604.609	901183.545
6	5180	1ST AV	ORANGE GROVE RD	INA RD	864280.668	869516.666
7	4403	1ST AV	RUDASILL RD	ORANGE GROVE RD	861623.988	864280.668
8	12317	22ND ST	HARRISON RD	OLD SPANISH TR	58745.278	59747.839
9	12000	22ND ST	OLD SPANISH TR	HOUGHTON RD	59747.839	64027.945
10	12179	29TH ST	CALLE MESA DEL OS	CALLE NOPALITO	65924.423	66377.231
11	10834	29TH ST	CALLE NOPALITO	PLACITA ANDUJAR	66377.231	67020.116
12	11658	29TH ST	PLACITA ANDUJAR	AVENIDA LOS REY	67020.116	67469.376
13	12166	37TH ST	DODGE BL	ALVERNON WY	19425.694	20384.66
14	4454	44TH ST	RICHEY BL	DODGE BL	31251.93	32274.979
15	4454	44TH ST	RICHEY BL	DODGE BL	31251.93	32254.812
16	5209	45TH ST	COUNTRY CLUB RD	RANDOLPH AV	0	1178.41
17	5113	46TH ST	COUNTRY CLUB RD	RANDOLPH AV	10406.428	11598.26
18	4457	47TH ST	COUNTRY CLUB RD	RANDOLPH AV	9934.721	11130.622
19	5182	47TH ST	RICHEY BL	CHRYSLER AV	12898.657	13553.417
20	4458	48TH ST	COUNTRY CLUB RD	RANDOLPH AV	0	1189.947

Applications/Uses

- **Cartegraph (pavement management)**
- **HPMS (Highway Performance Monitoring System)**
- **Signage**
- **Mileposts**
- **Speed limits**
- **# of lanes**

How Cartegraph uses LRS

- Original pavement table joined with the stinter_EventMeas table and calculates the new F_OFF_CALC and T_OFF_CALC fields with the actual measure values of the route.
- This table is used in ArcMap to display route events.

cartegraph_example:Table					
	STREETNAME	from_offset	SegmentGoesFrom	SegmentGoesT	Length
▶	Pantano Rd	-295	Calle Barranco	Altez Vista	610
	Pantano Rd	-275	Knollwood Terrace	Calle Barranco	720
	Pantano Rd	-265	Fort Lowell Rd	Alvin St	1320

Issues / Problems / Challenges

Duplicate intersections

Knuckles off the main street

Unknown and Unnamed streets

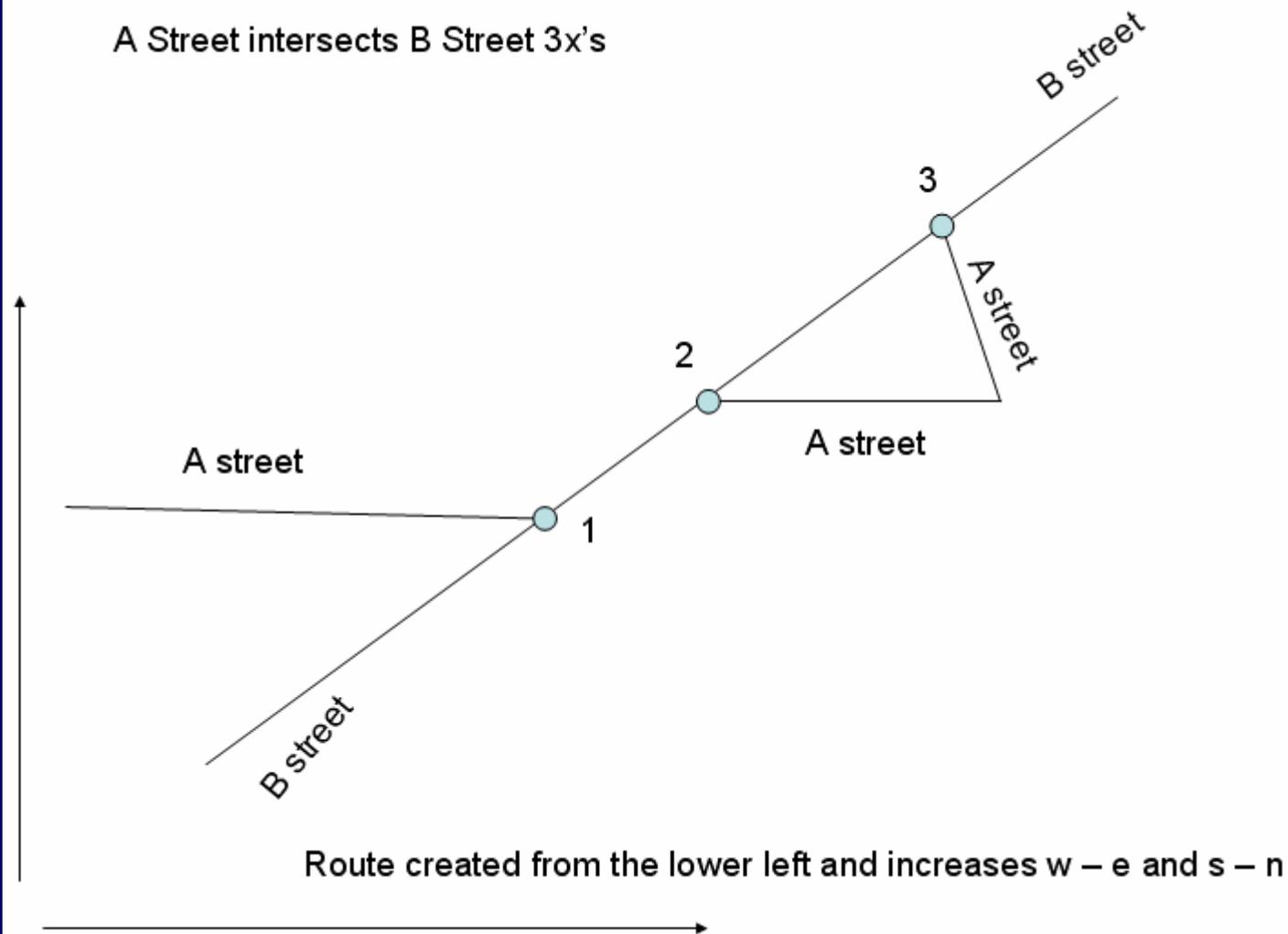
End of Roads

Crossing into and out of Jurisdictions

Circles

Side access roads

A Street intersects B Street 3x's



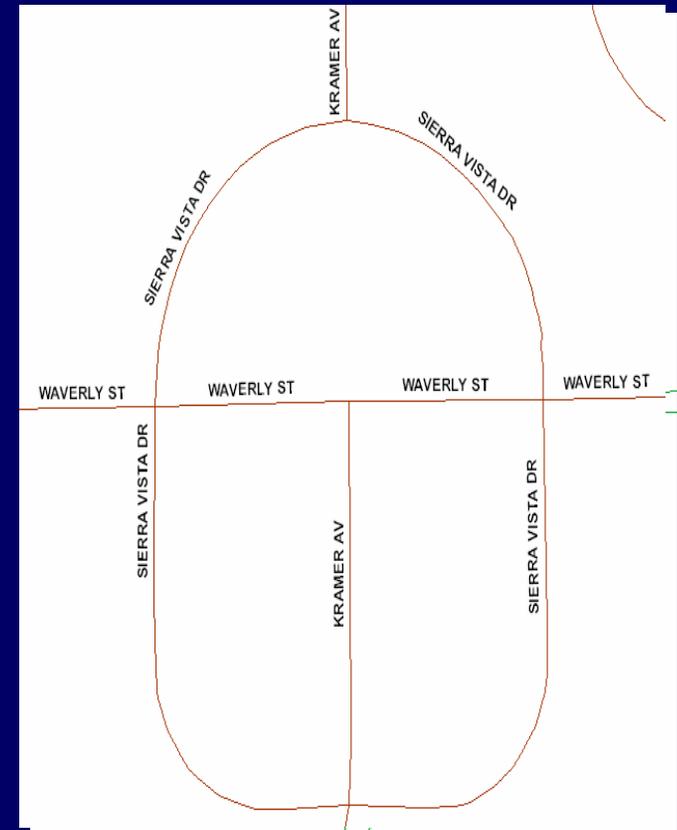
Route created from the lower left and increases w - e and s - n

Challenges

Problem: Duplicate Intersections & Roundabouts
Solution: Remove Roundabouts &
Added unique identifier to intersections

dbo_A_stinter_eventmeas_dups : Table					
	OBJECTID	RID	CROSSSTREET	MEAS	DUP
	75874	WAVERLY ST	SIERRA VISTA DR 1	20990.10600000	1
	75875	WAVERLY ST	SIERRA VISTA DR 2	21619.35000000	2
	75876	WAVERLY ST	SIERRA VISTA DR 3	21860.07100000	3
	75877	WAVERLY ST	SIERRA VISTA DR 4	21890.61500000	4

dbo_A_stinter_eventmeas_dups : Table					
	OBJECTID	RID	CROSSSTREET	MEAS	DUP
	40836	KRAMER AV	SIERRA VISTA DR 1	19842.85600000	1
	40837	KRAMER AV	SIERRA VISTA DR 2	20921.42900000	2
	40838	KRAMER AV	SIERRA VISTA DR 3	22798.94400000	3

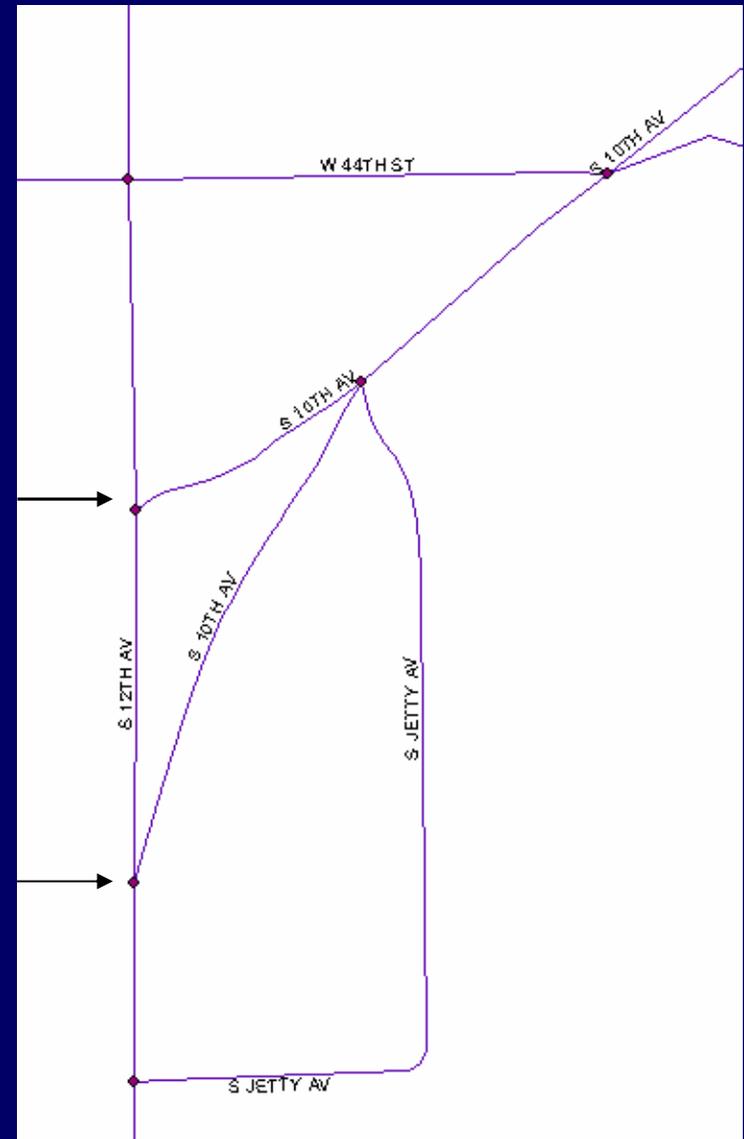


Challenges

Problem: Duplicate Intersections
Solution: concatenate unique integer to crossstreet

Old: RID=12th AV Crossstreet=10th AV
New: RID=12th AV Crossstreet=10th AV 2

Old: RID=12th AV Crossstreet=10th AV
New: RID=12th AV Crossstreet=10th AV 1

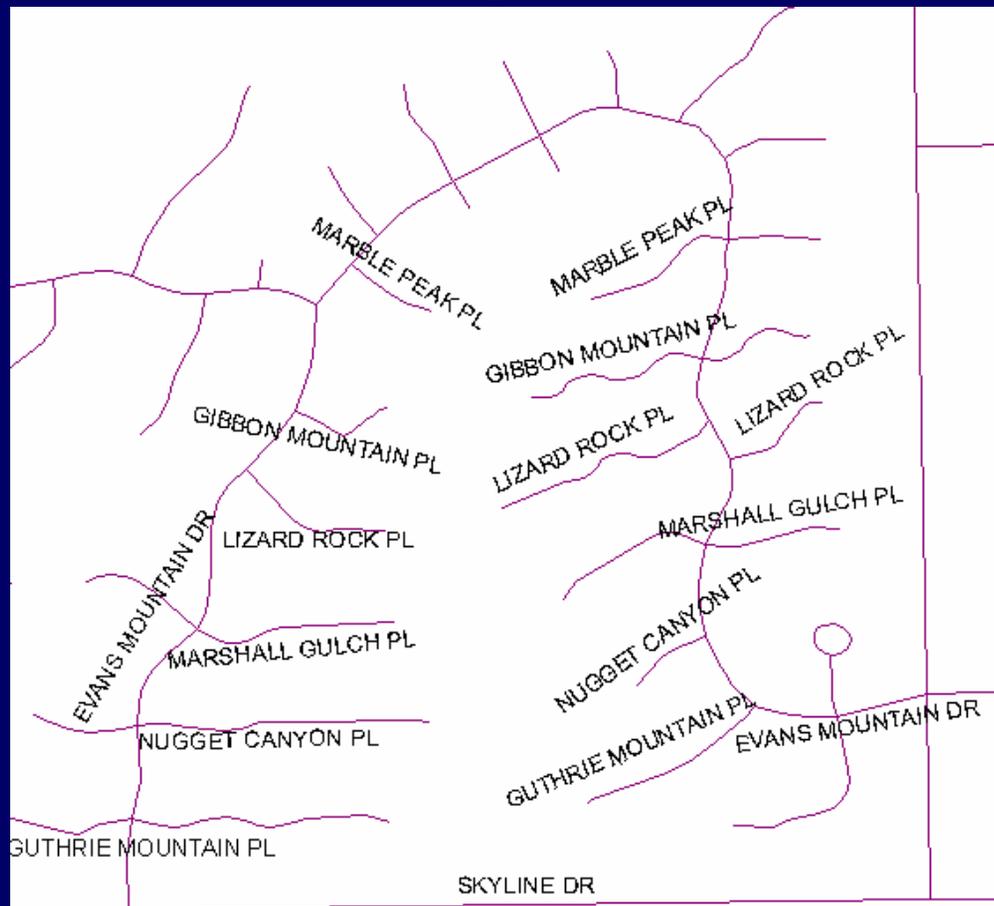


Challenges

EVANS MOUNTAIN DR route

6 Cross Streets that intersect it 2x's

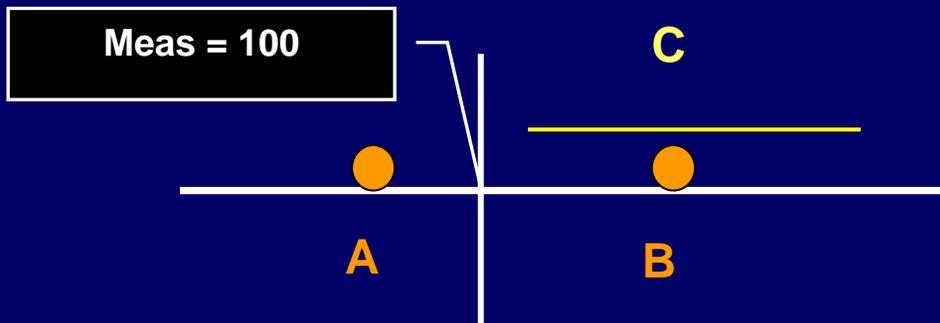
Each Cross Street has multiple end of roads



How can I store my tabular data to be displayed as Events?

- Reference segment – Route
- Reference location e.g. intersection, mile post
- Known Ref Location and Length
- Distance from Known Ref Location
- Distance from Known Ref Location and Length

Route – Broadway
Cross Street – Kolb

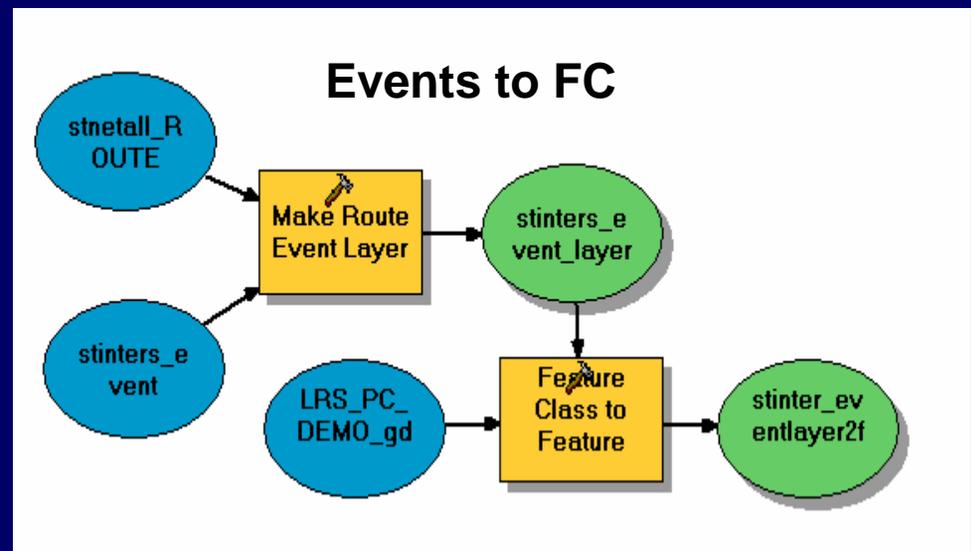
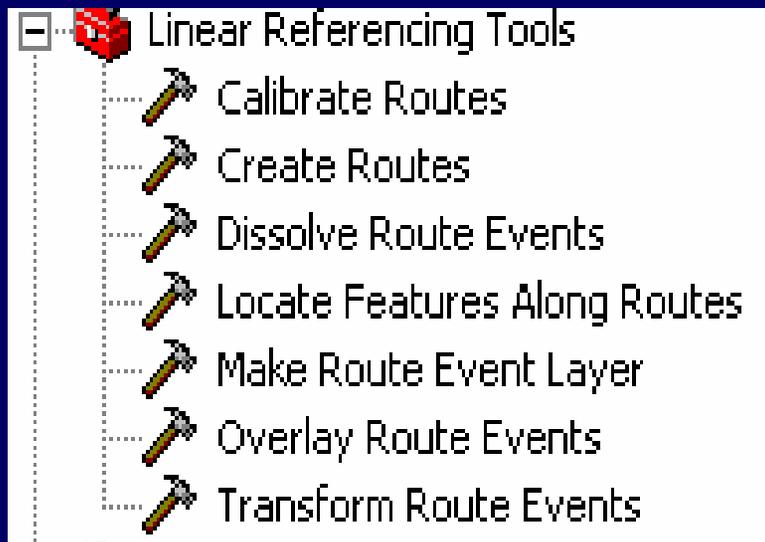


A is 10 units W from Intersection

B is 30 units E from Intersection

**C start 5 units E from Intersection
and goes 45 more units**

Toolbox & Toolbar



LRS Setup and Displaying Events Demo

Add table

Display route events

Symbology

Select by attribute / location

Edit Measures and see update

Export to FC

Pima Co. DOT LRS

QUESTIONS ???

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Current Street Network Configuration

Subtypes: Carriageway, Centerline, Combined

CARRIAGEWAY

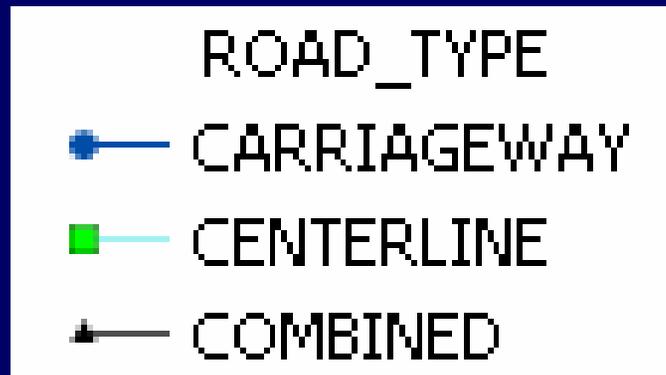
Dual line representation of street network.

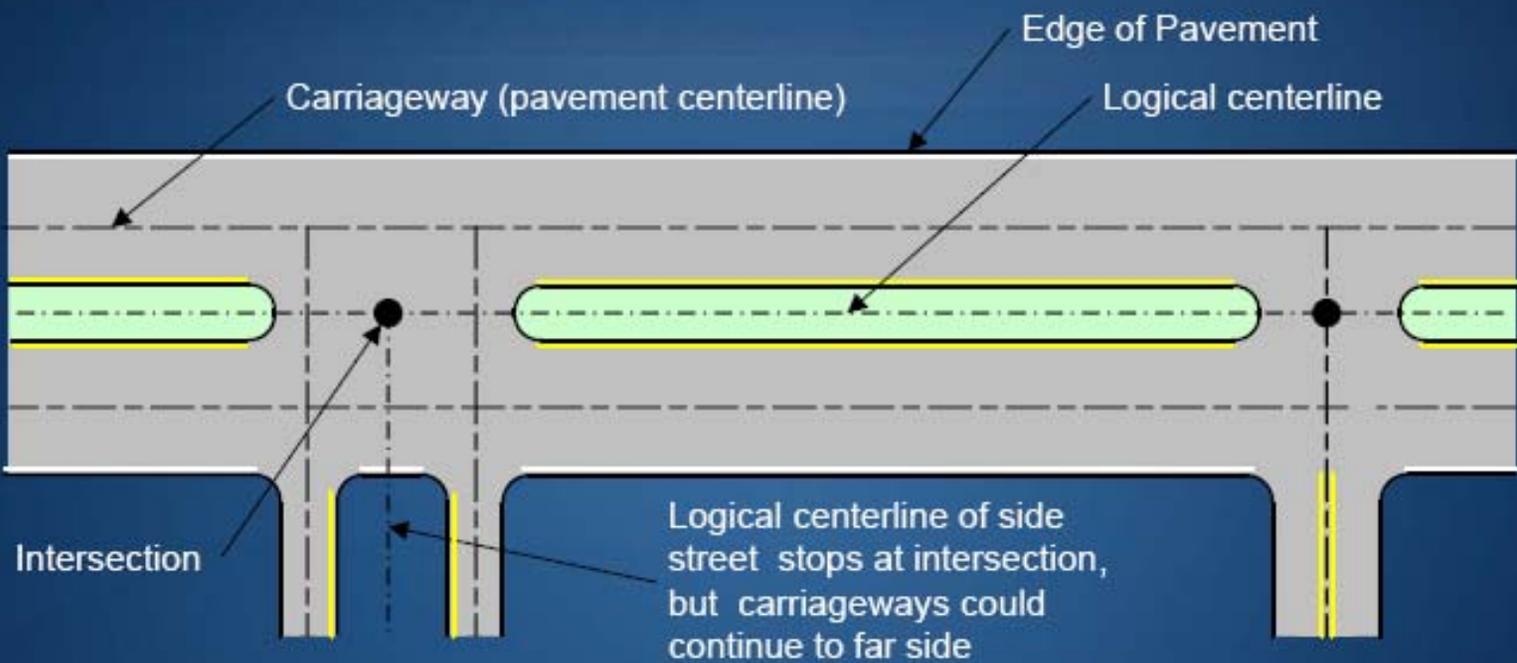
CENTERLINE

Segment represents the logical center of the roadway

COMBINED

Segment is both a CARRIAGEWAY and CENTERLINE





Roadways with Carriageways

2 Carriageway segments

Same ROADID

Left & Right Address Ranges

Centerline segment

Same ROADID

Both Left & Right Address Range

ROAD_TYPE

— CARRIAGEWAY

— CENTERLINE

— COMBINED

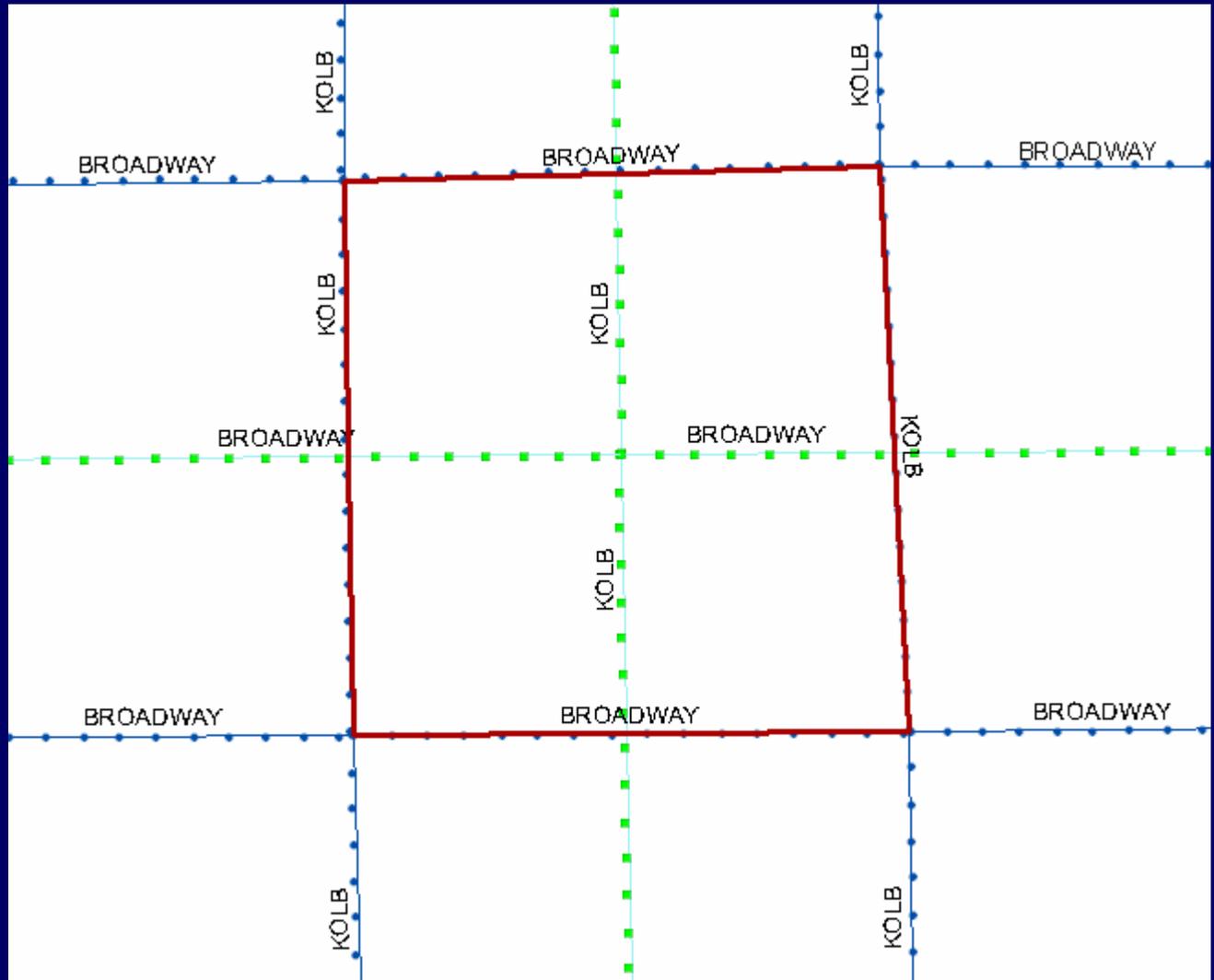


Intersections Segments on Carriageways

Intersection segments – flag a field and no address range

ROAD_TYPE

- CARRIAGEWAY
- CENTERLINE
- ← COMBINED



If Median then CL connects to CL and Carriageway connects to Carriageway

ROAD_TYPE
● CARRIAGEWAY
■ CENTERLINE
← COMBINED



- There are cases where two segments overlap and one is assigned
- ROAD_TYPE = CARRIAGEWAY and the other assigned
- ROAD_TYPE = CENTERLINE.
- The two overlapping segments have the same ROADID and Address ranges

The END