



Public Schools of North Carolina

# The Value of GIS Supporting our Public Schools

Derek Graham, Section Chief  
Transportation Services





Public Schools of North Carolina

# Routing and Scheduling School Buses



# A Bit of History

- Operations Research Program, NCSU
- Institute for Transportation Research and Education (ITRE), NCSU
- State Energy Office
- Transportation Information Management System (TIMS)



# 1990-1992 Required Implementation

§ 115C-240. Authority and duties of State Board of Education....

(d) ...The State Board shall also require local boards to implement the Transportation Information Management System or an equivalent system approved by the State Board of Education, no later than September 1, 1992.



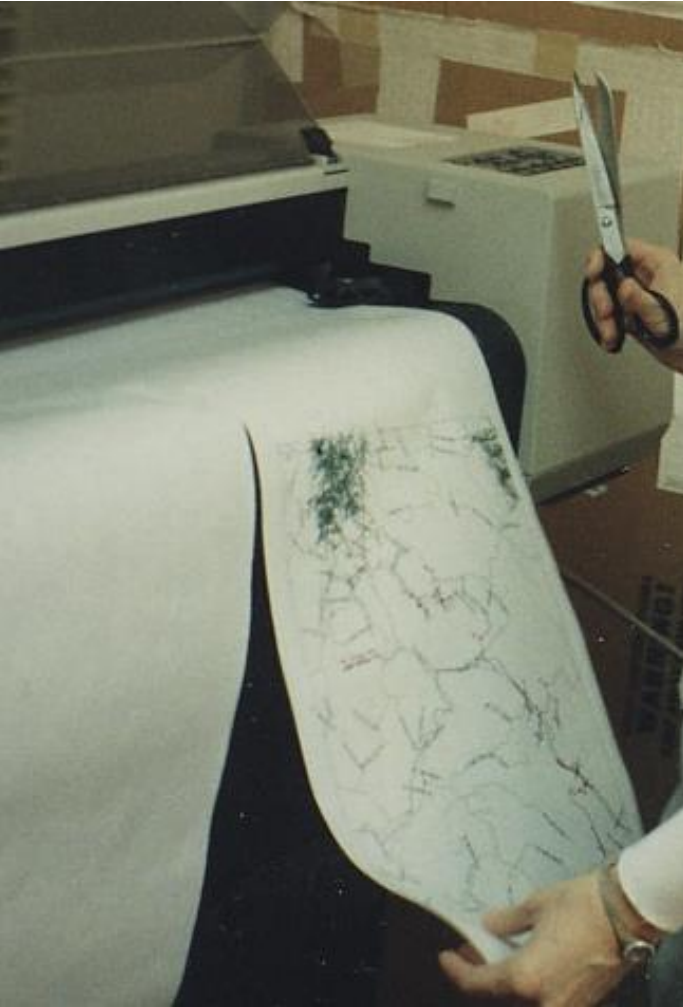
# Digitizing 100 County Centerlines

1985-1991

Pre-TIGER Sources: Paper DOT Maps; Paper Municipal Maps; Charlotte DIME file; WCPSS GIS; Riding roads/Manual address range entry

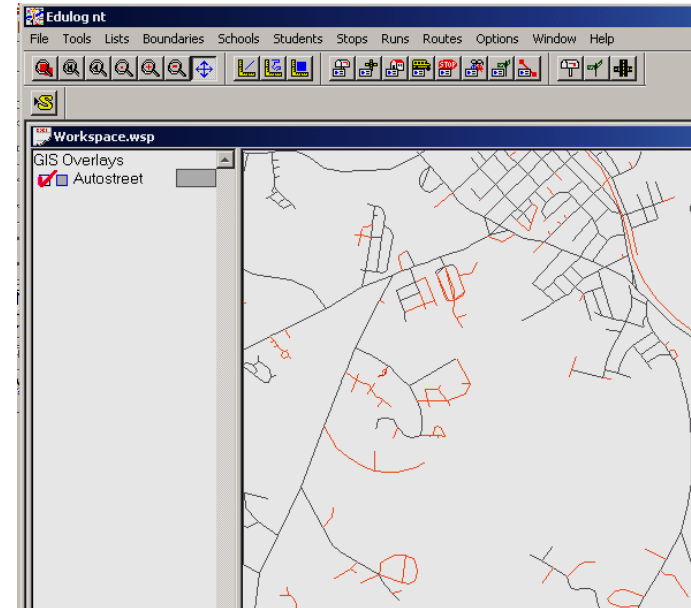


# Pen Plotters

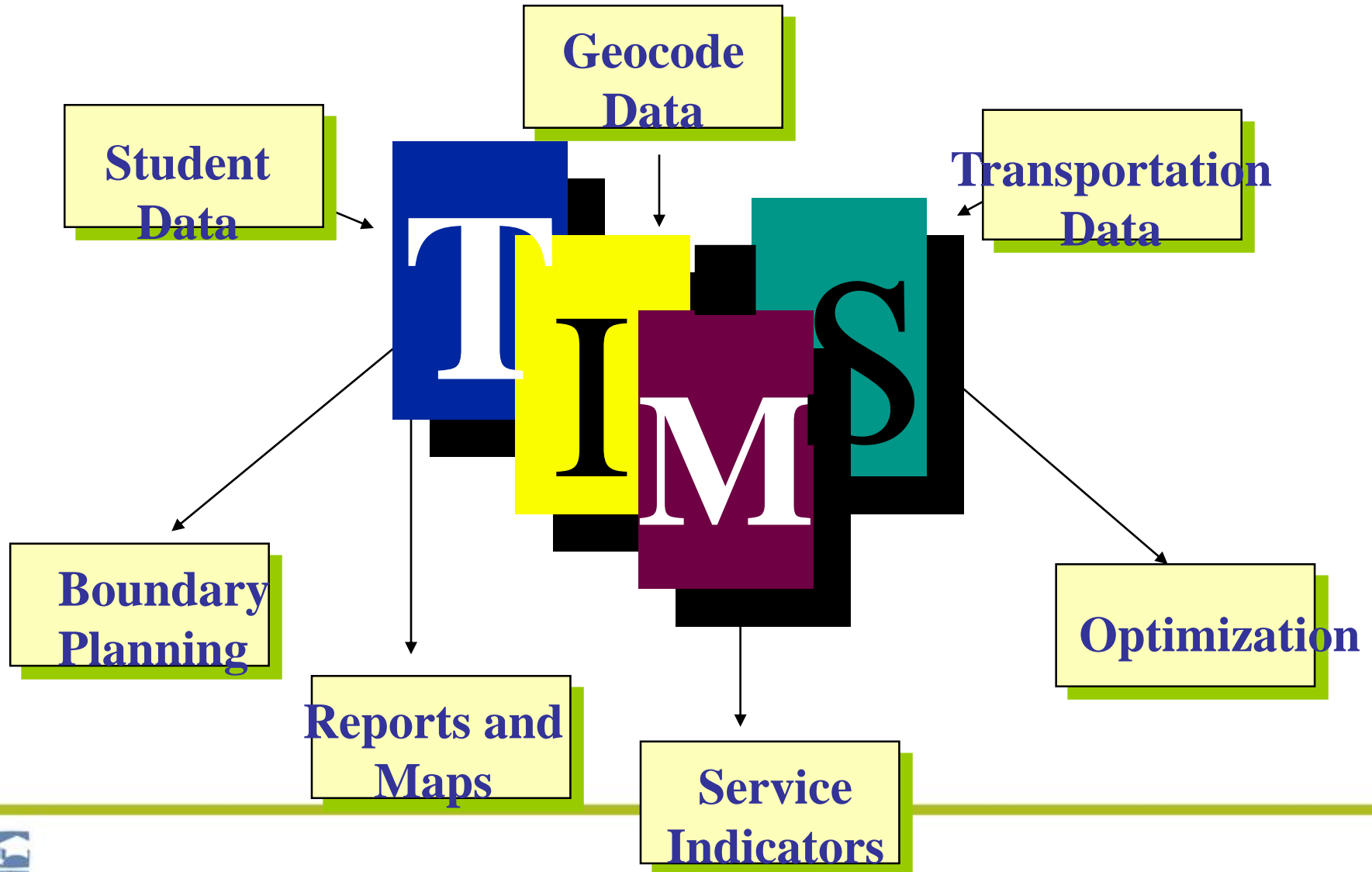


# Original maps nearly all replaced

- TIGER files
- Local government GIS files
- ATTRIBUTES:
  - Direction of Travel
  - Average Speed
  - Hazardous for Student Crossing
  - “No Travel”



# The TIMS System





# Student Data from PowerSchool

**Student data entry form**

Last Name: DOE School: 302 District ID: 000000123456 Elg: 0 U: 99  
 First Name: JOHN Grade: 06 Edulog ID: 3 Goto:   
 Date of Birth: 01/01/1997 Program:  Sch. Distance: 1.16 mi Copy Fields

Location: 447 CHANNEL DR  Home Stop  Home Stop  
 Res Addr: 447 CHANNEL DR Copy Special Needs  Special Ed  
 Special Needs  Other Needs

AM Transport Location  AM Shuttle   
 PM Transport Location  Copy PM Shuttle

Other Fields Att Endry Trips Picture Print School Path Quick Assign  
 Confirm Cancel Delete Previous Next Walk Path Discipline

I...	P/U Location	Stop Description	Run
1	=HOME	CHANNEL DR & WEDGEWOOD CI	MT\
2	=SCHOOL - 302	CHANNEL DR & WEDGEWOOD CI	MT\

AM Tm D >  AM Tm T >   
 PM Tm D >  PM Tm T >

Race: 1 City Code: 565  
 City: MAYBERRY Sex: R  
 Zip Code: 12345 Home Ph: 515-5555

Date modified 08-20-2010 Date created 08-20-2010

Confirm	CmnDst	Previous	Next	Spc Needs	Eligibility	Parent Info	CANCEL
Last Name: DOE	Edulog ID: 3	Cur	Home	Next	ADMIT Date: <input type="text"/>		
First Name: JOHN	District ID: 000000123456	School: 302	<input type="checkbox"/>	<input type="checkbox"/>	REGIS Date: <input type="text"/>		
Mid Name: <input type="text"/>	Home Ph: <input type="text"/>	Grade: 06	<input type="checkbox"/>	<input type="checkbox"/>	FRM: <input type="text"/>		
Counselor: <input type="text"/>	Race: 1 Sex: R	Program: <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	HR: <input type="text"/>		
	Yr Rnd: <input type="text"/> Tren Ex: <input type="text"/>						
Location: 447 CHANNEL DR	City: <input type="text"/>	Elg Code: 0					
Residence: 447 CHANNEL DR	State: <input type="text"/> Zip Code: <input type="text"/>	User Elg Code: 99					
Mail Add: <input type="text"/>		-SPECIAL NEEDS-					
Apt #: <input type="text"/>	Nd1 4995 Nd2 4966 X 2478589 Y 653142	EC Code: <input type="text"/>					
AM Tm T > <input type="checkbox"/>	AM Tm D > <input type="checkbox"/>	AM Bus D > <input type="checkbox"/>	OD-Bndy <input type="checkbox"/>	Local1 <input type="text"/>	Local3 <input type="text"/>	Loading: <input type="checkbox"/>	
PM Tm T > <input type="checkbox"/>	PM Tm D > <input type="checkbox"/>	PM Bus D > <input type="checkbox"/>	OD-Cnty <input type="checkbox"/>	Local2 <input type="text"/>	Local4 <input type="text"/>	Restraint: <input type="checkbox"/>	
						Monitor: <input type="checkbox"/>	
Father: JOHN DOE SR	Res: 515-5555	Work: 515-4444	Cell: <input type="text"/>				
Mother: JANE DOE	Res: 515-5555	Work: 515-3333	Cell: <input type="text"/>				
Emerg1: SARA JONES	Emerg1 Ph: 515-4545						
Emerg2: BOB SMITH	Emerg2 Ph: 515-6767						





# Bus Routing Information



REPORT CODE: BUSRUN- 5      USER:  
 TIME: 08:56 am  
 PAGE: 1

Run: 324005    Route: 122    Description: MS BRYANT  
 Bus: 122      Route Description: MS BRYANT

Description		Time	Stpld
Runld Stop			
School: WALLACE RO Check Point Record		7:14	
0 CHK PT			
Turn Right on HIGH SCHOOL RD	2535	1024	
Turn Left on S US 117 HWY	1018	3628	
Turn Right on E HALL ST	937	936	

**\*\*\*\*\* WARNING RRX - NO LIGHTS \*\*\*\*\***

Turn Left on S WEST RAILRO ST WA      2216      2207

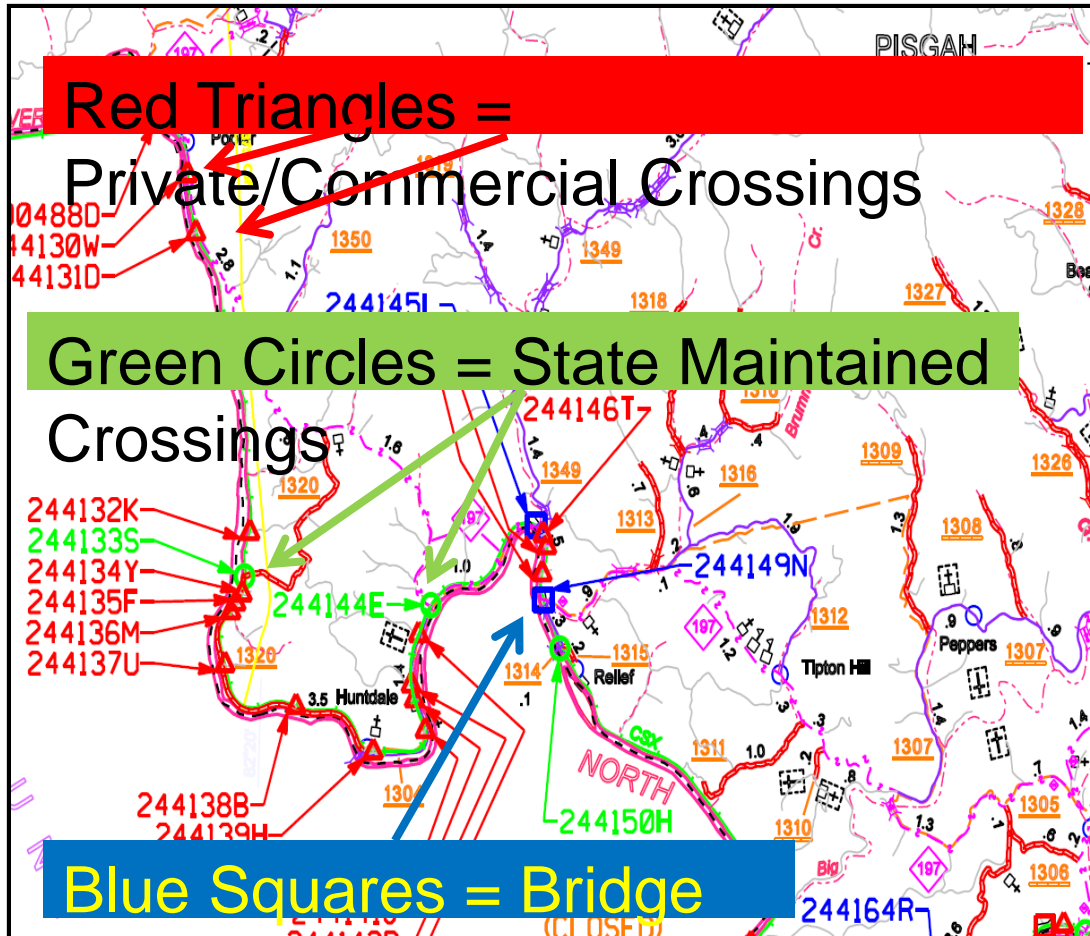
730 S WEST RAILRO ST WA

7:23

1



# NCDOT Railroad Crossing Report



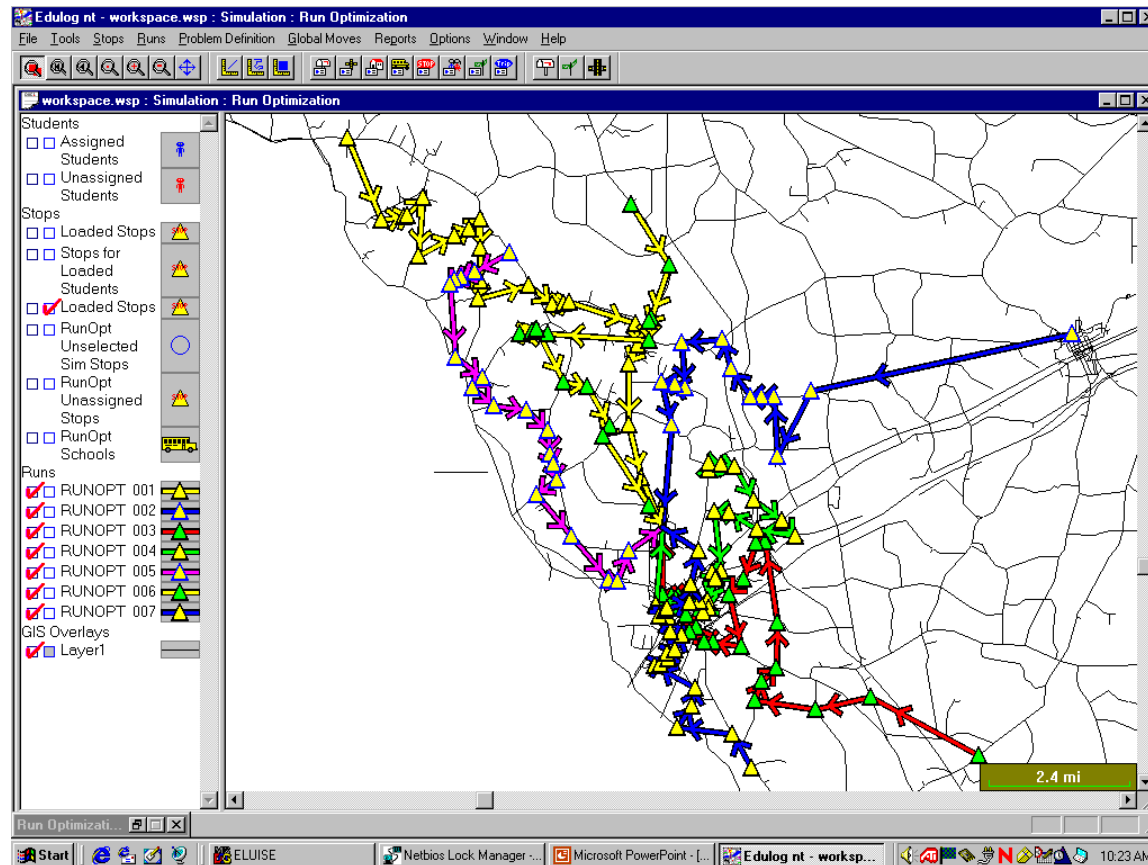
Railroads are added to TIMS as non-travel streets

Railroad warnings can be placed within driver directions generated from TIMS and can alert the driver to an upcoming stop.

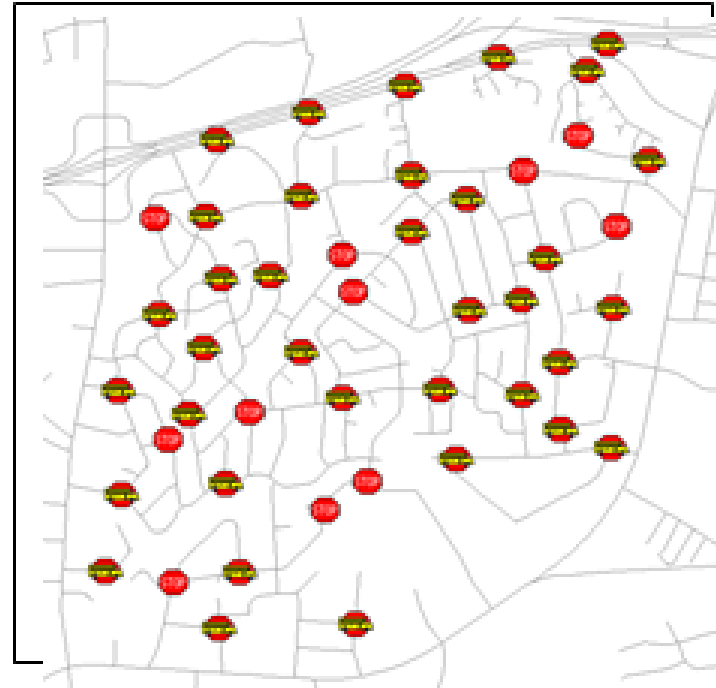
Load Counts used by NCDOT to prioritize signal enhancements



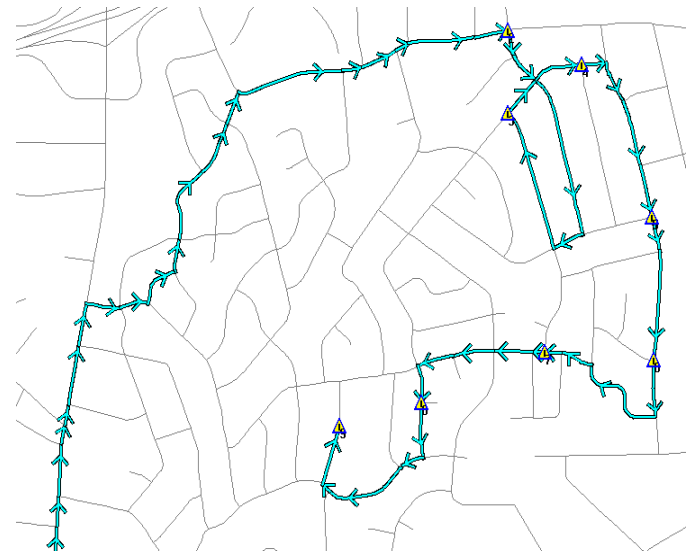
# Bus Run Optimization



# Case Study – Charlotte/Meck Bus Stop Consolidation



# Bus Routes Before/After Stop Consolidation



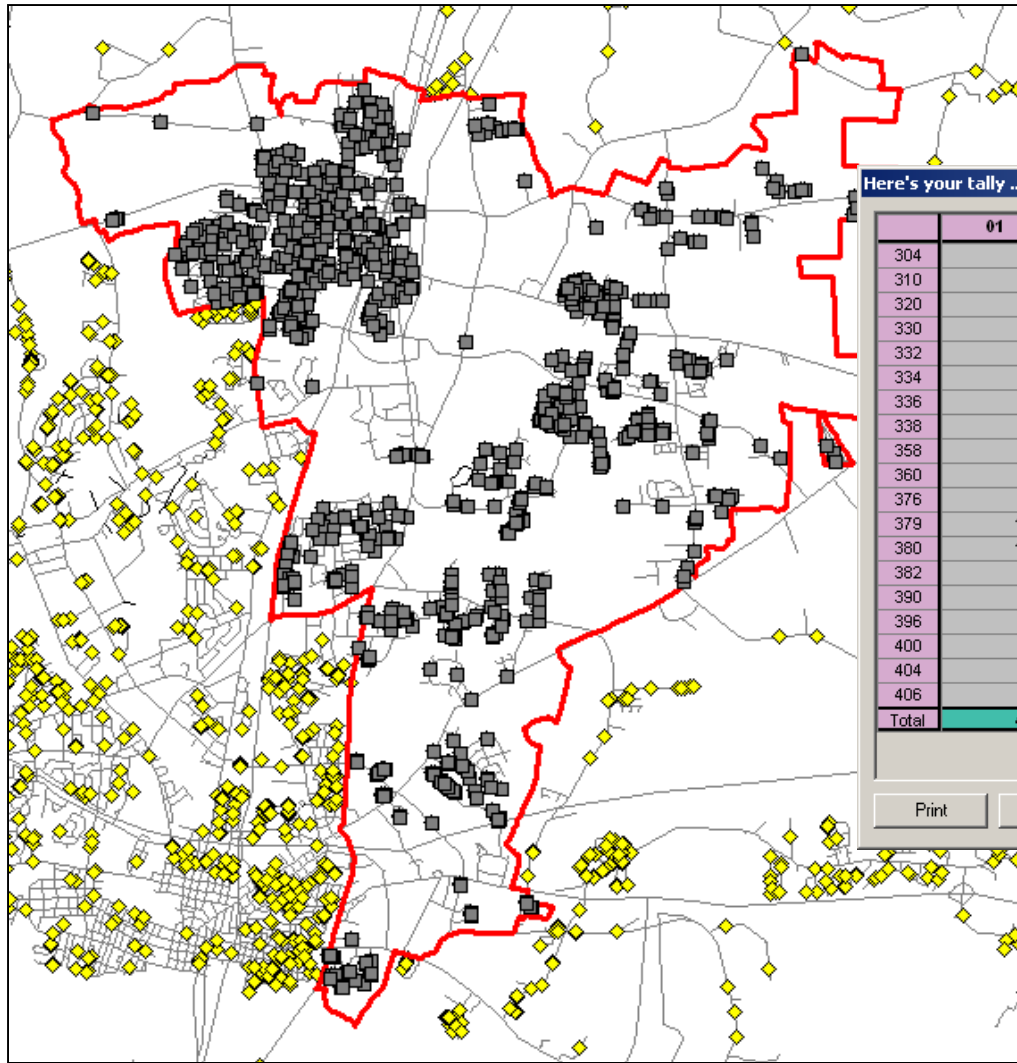
# Improvement from Stop Consolidation

<b>Comparison of Opening Day of School Assigned TIMS Data</b>			
	2008-09	2009-10*	Estimated Change
<b># Students Assigned to a Bus</b>	112,000	111,000	(1,000)
<b># Total Bus Stops</b>	37,000	26,000	(11,000)
<b># Total Bus Runs</b>	5,652	5,292	(360)
<b># Total Routes or Buses</b>	1,255	1,155	(100)
<b># Daily Miles</b>	140,000	129,000	(11,000)
<b>Average Walk Distance to Bus Stop (miles)</b>	0.07	0.12	0.05
<b>*2009-10 Data are projections and subject to change as the year progresses</b>			
<b>Numbers in ( ) are projected reductions; without ( ) represents an increase</b>			





# School Boundary Planning



Here's your tally ...

	01	02	03	04	05	Total
304	3	4	2	2	1	12
310	1	0	0	1	1	3
320	1	0	0	0	0	1
330	90	79	98	88	71	426
332	1	0	0	2	0	3
334	6	2	3	2	0	13
336	2	0	1	1	1	5
338	0	0	0	1	2	3
358	1	0	0	0	0	1
360	0	1	0	0	0	1
376	1	0	0	0	0	1
379	181	106	119	104	109	619
380	153	117	93	118	105	586
382	1	3	5	5	3	17
390	1	0	1	1	1	4
396	0	0	0	1	0	1
400	1	5	2	1	0	9
404	0	0	37	34	26	97
406	49	23	0	0	0	72
<b>Total</b>	<b>492</b>	<b>340</b>	<b>361</b>	<b>361</b>	<b>320</b>	<b>1874</b>

Tally view  
Down the side  
FIRSTNAME  
GRADE  
LAST NAME  
RACE  
RES ADDR  
SCHOOL  
CEV

Along the top  
FIRSTNAME  
GRADE  
LAST NAME  
RACE  
RES ADDR  
SCHOOL  
CEV

Switch side and top

Show %'s  
 Show Totals

Colors...

Print Export Close

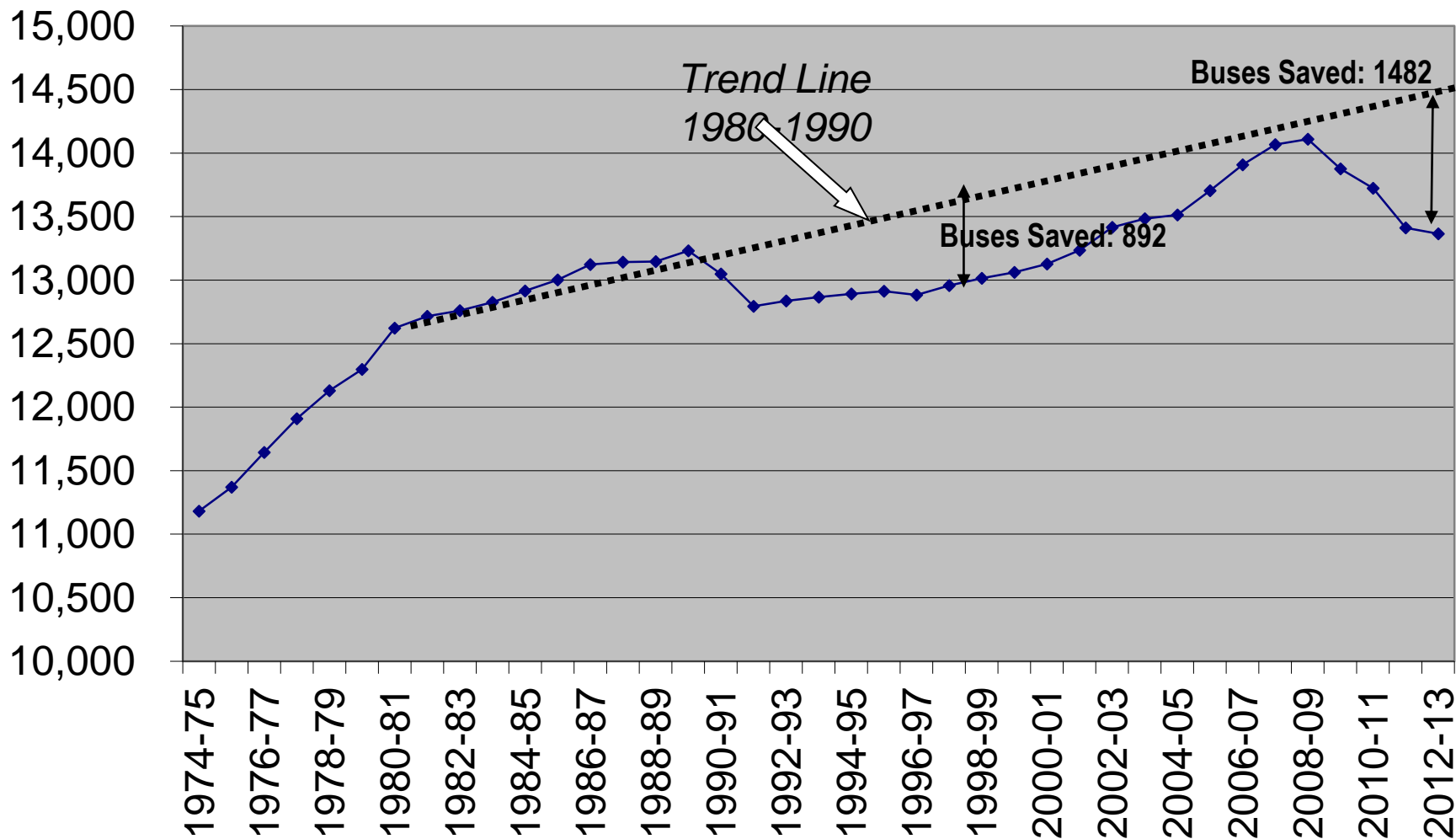


# State Funding for School Transportation

- School district transportation funding based in part on efficiency
- Efficiency:
  - Cost per student
  - Number of Buses Operated
- Leveling the Playing Field
  - Distance of student residence to school
  - Students per mile of roadway



## Public Schools of North Carolina Number of Buses Operated



# Other applications

- Service Indicators
- Local School District GPS / AVL
  - Monitors the driver
  - Defends the driver
- Stop Arm Violation Cameras



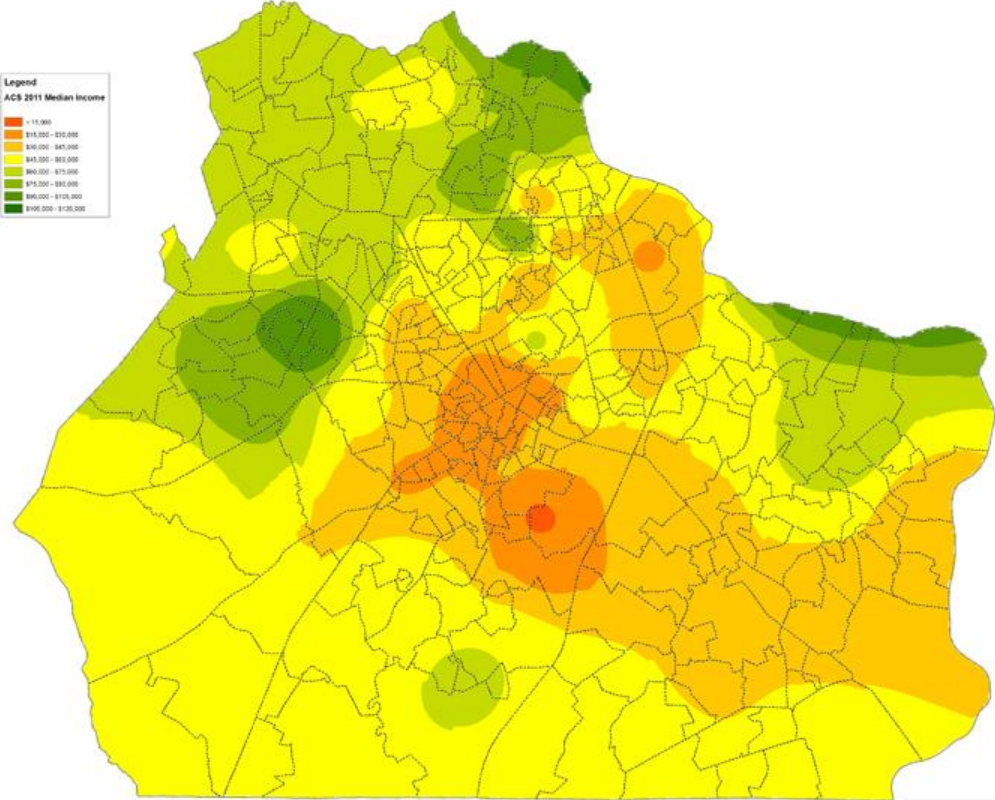
# Data for Growth Projections

- ITRE's OR/ED lab studies the best locations for future schools based on projected growth



# School Assignment – balancing equity based on median income

RHS - Household Median Income

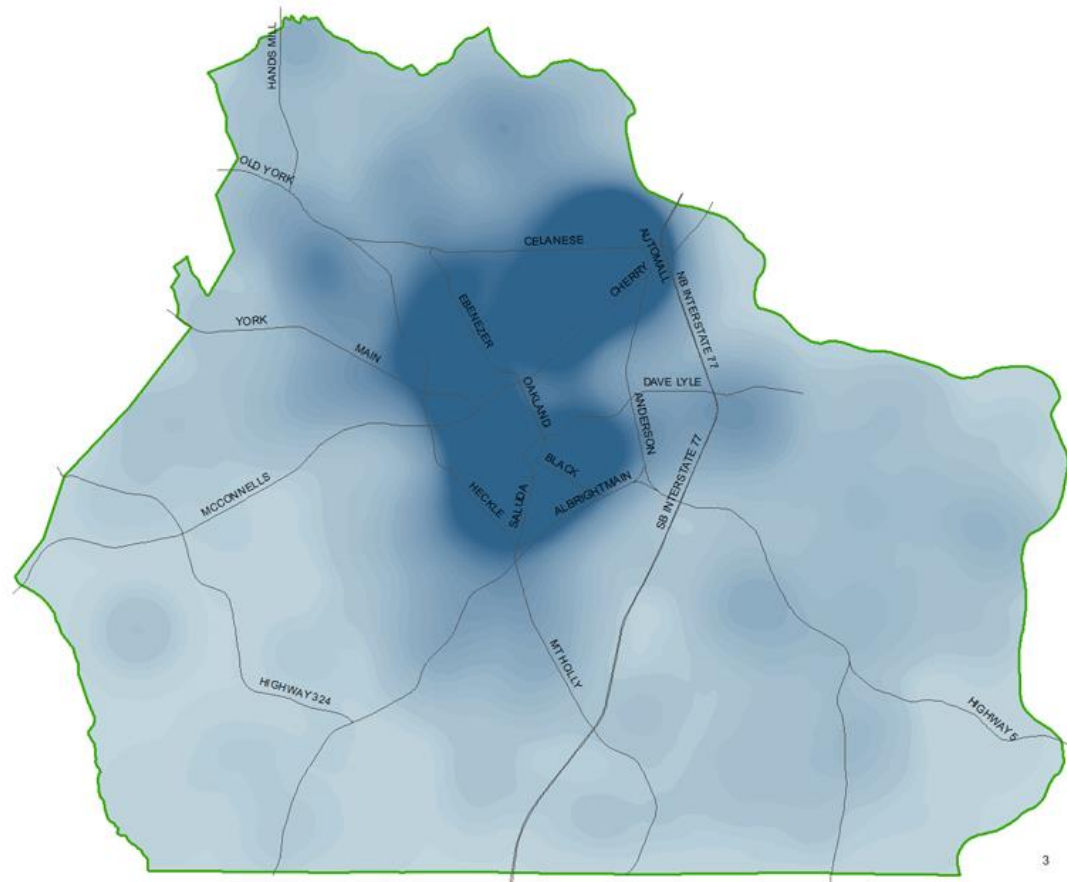


Data Source: Minnesota Population Center, National Historical Geographic Information System, Version 2.0, Minneapolis, MN, University of Minnesota 2011. <http://www.rhgs.org>

Map created by OREd,  
intended for planning purposes only  
November 4th, 2013



# Future Growth Maps – projecting likely hotspots of student growth





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