

Increasing School Transportation Efficiency Utilizing GIS and the Web

ArcView with the SmartR
extension and Lydia

Jake Sheets and Shane Steckelberg

Paper Abstract

The parents, teachers, administration, and students of Sioux City's schools deserve prompt and reliable service. The safety of the students depends on the Transportation Department's ability to organize all of the aspects involved in transporting students in varying situations. The goal of the Sioux City Transportation Department is to provide the safe, efficient, and reliable transport of the students to and from their school. With the integration of ArcView with the SmartR extension and a database with a web interface, this is possible. The Sioux City Schools in cooperation with the Dakota Valley Schools have developed a methodology to describe, collect and analyze the data items needed to be tracked for a complete transportation management system. The benefits of using a combination of GIS and web interface will be presented.

Sioux City Community School District

The Sioux City Community School District is comprised of 29 schools. There are four high schools, four middle schools and 21 elementary schools.

The District first applied the use of GIS and the ESRI products to accurately determine the external district boundary, that was written in 1965. Once this had been completed, the internal attendance boundaries could be created using the descriptions written in 1993. Having the boundaries graphically represented provided immediate problem area identification.

We have extended the use of GIS to our Transportation Department, who now use a product called SmartR. This provides routing and optimization to provide maximized efficiency and reporting.

Legend

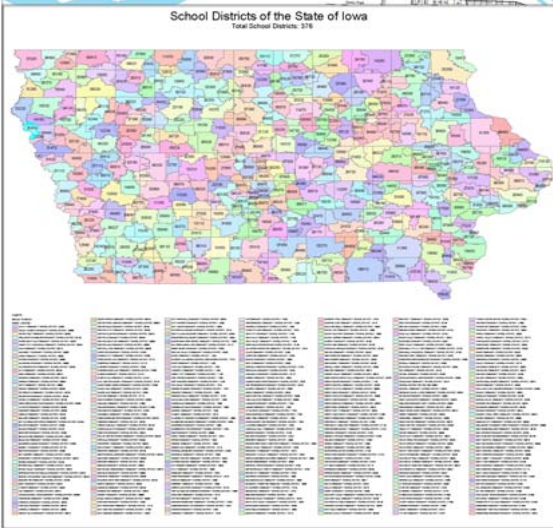
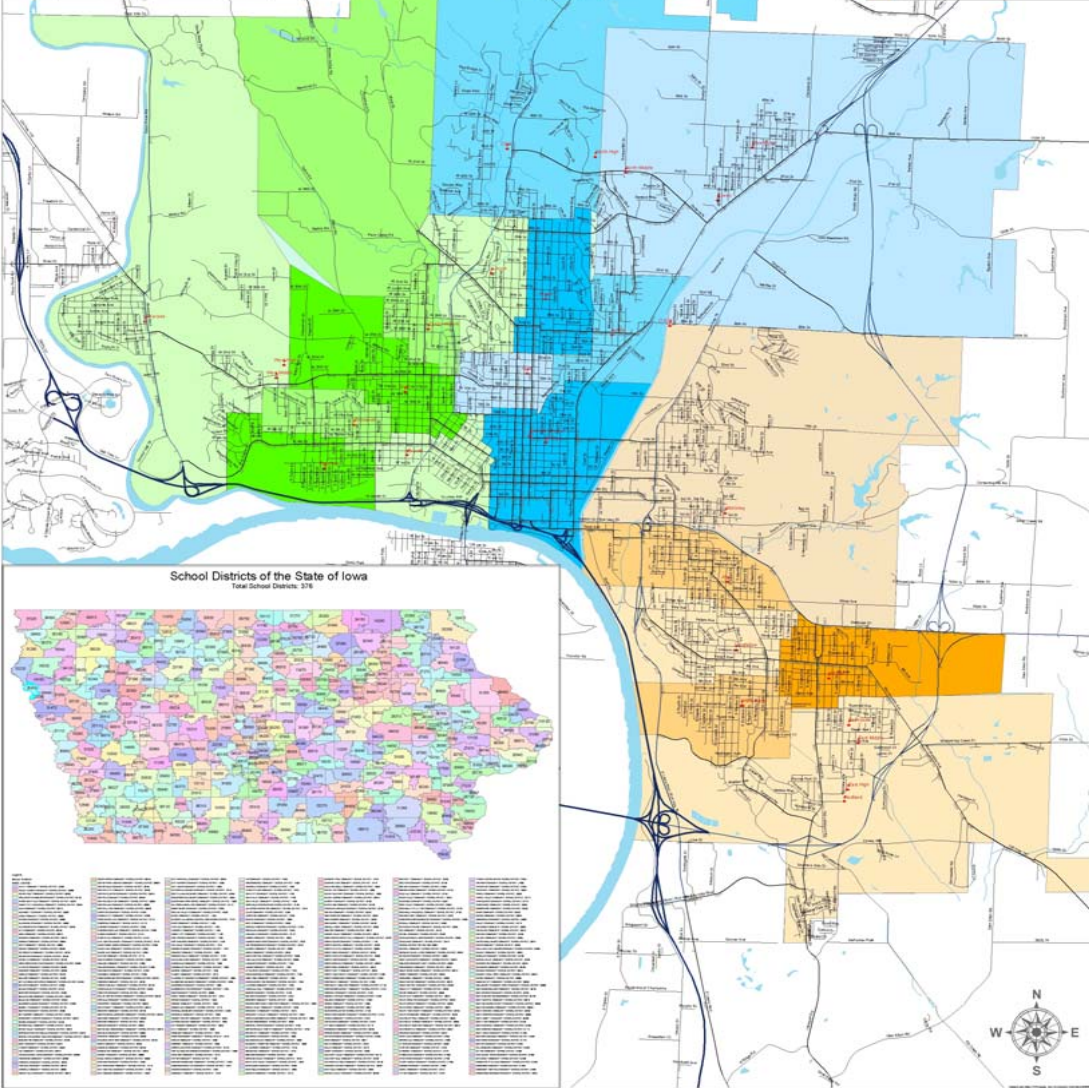
streets

- Collector
- Interstate
- Local
- Major Collector
- Minor Arterial
- Minor Collector
- Other Principal Arterial
- Private

FFC

- JOY
- LONGFELLOW
- MCKINLEY
- NODLAND
- SUNNYSIDE
- WASHINGTON
- WHITTIER

- BRYANT
- CLARK
- HAWTHORNE
- HUNT
- IRVING
- LEEDS
- LOWELL
- CRESCENTPARK
- EMERSON
- EVERETT
- LINCOLN
- SMITH
- RIVERSIDE
- ROOSEVELT



History

- The Sioux City Community School district has been doing routing and stop assignments using an Access database.
- Had an routing software, but map did not work, so it was no use.
- Multiple people using database lead to multiple copies and incorrect data

SmartR

- The district was awarded the SmartR/DDP grant
- SmartR training was done
- Map was repaired in ArcView by Jake Sheets
- SmartR was not fully implemented due to data issues and single user capabilities.

Data

- Student System had student demographic data and address information.
- Special Education Department had special transportation needs data.
- English as a Second Language Department had ESL student Rosters.
- School Nurses had emergency medical information.
- Parochial Schools had student information.

Data Issues

- Each department stored the student data differently.
- Merging different data into one location and file type.
- Many departments did not use the student ID or have a key unique field.
- All existing formats were single user accessible.

Tragedy Struck!

- The school year started with incorrect assignments due to data merging inconsistencies and data corruption.
- Incorrect bus passes.
- Incorrect bus rosters.
- Children dropped off at wrong locations.
- CHAOS!

The Super Data Guy!

- A concerned parent stepped forward to assist in the data issues.
- Had already been working on a transportation database for the school district he works for.
- Updated on technology and techniques the SCCSD uses in Transportation.

Lydia

- Utilizing Lydia, data corruption and inconsistency was resolved.
- Data then downloaded into SmartR.
- Assignments of students went swimmingly.
- Assignments then uploaded back to Lydia.
- Reports were extracted.
 - Route sheets, rosters with pictures, student assignment reports, bus passes, etc.

Lydia

A brief demonstration of
capabilities

Timeline

- Aug. 30th, 2004
 - The “last straw”
- Sept. 23rd, 2004
 - First meeting on specifications with SCCSD
- Sept. 24th, 2004
 - Build 18 based on specs/data released from SCCSD
- Sept. 30th, 2004
 - Initial end-user training begins; more requirements

Timeline

- October 10th, 2004
 - Special Route reports available. Version 0.45
- January 10th, 2005
 - Major version change to improve usability. Version 0.60
- March 28th, 2005 – May 17th, 2005
 - Another complete redesign of the User interface for “Quick Access” to data
- June 3rd, 2005
 - Final specifications laid out for Version 1.0 (release of July 10, 2005)

Why is Lydia Different

- Routing software independence.
- Scalable relational architecture.
- Student information is the core content.
- Data access, reporting and queries are the centerpiece.
- Web-based with multiple user security levels.

The First screen

The screenshot displays a web application interface. At the top left, there is a 'Filter By:' section with three tabs: 'None', 'Students' (which is selected), and 'Personnel'. Below this is a search filter form with the following fields: 'Last Name' (text input), 'First Name' (text input), 'SIS No.' (text input), 'Grade' (dropdown menu with 'Please Select'), 'Travel Code' (text input), 'Sex' (dropdown menu with 'Please Select'), 'Ethnicity' (dropdown menu with 'Please Select'), 'Language' (dropdown menu with 'Please Select'), and 'Inactive' (radio buttons for 'Yes' and 'No'). A 'Search' button is located below the filter form. To the right of the filter form is a vertical navigation menu with the following items: 'People', 'Routes', 'Vehicles', 'Places', 'Schools', 'Comm.', 'Reports', 'Admin', and 'Logout'. Red arrows point from the 'Filter By:' section to the first text block, from the 'Grade' dropdown to the second text block, and from the 'Reports' menu item to the third text block.

Simple filtered searches are available in order to find the individual based upon the criteria for that category.

Note the “student” specific filter criteria available to more quickly find the proper student.

A menu (to be redesigned) allows access to all areas of the program.

Student Record Screen

Lydia Transportation Management System v 0.67

Filter By: [None](#) [Students](#) [Personnel](#)

Search [Adv.](#)

[Search](#)

1 2 3 4 5 6 7 8 9 10 11-20

[Next](#)
Records 1 to 20 of 6884

Last Name, First Name SIS ID.

[ABARUS-PERRIN, JENNIFER](#) 4938

[AALFS, BRANDIE](#) 1220

[AALFS, MARIA](#) 1214

[ABARA, ARIES](#) 1202

[ABARA, AUDREY](#) 1201

[ABARA, MIRIAM](#) 1178

[ABELSON, ESTHER](#) 1167

[ABRAMO, ASHLEY](#) 1144

[ABREGO, LATSAMY](#) 1142

[ACEVEDO, AMANDA](#) 1133

[ACEVEDO, BRITTNEY](#) 1121

[ACEVEDO, EMILY](#) 1092

[ACEVEDO, JASMINE](#) 1090

[ACEVEDO, JEANNE](#) 1128

[ACEVEDO, KRISTAL](#) 1103

[ACEVEDO, MADDI](#) 1095

Personnel Records

Personnel Records Student Record **Person Record** Personnel Records

Pent ID.	Start Date	Grade	End Date	Grad Yr	Residency	Enrollment	Travel Code	Transient	Comments
1178		10		2007	RESIDENT-ENROLLED (1)	306		No	

STUDENT STOPS [Add](#)

School/Schedule	Route	Stop Type	Route No.	Stop No.	Stop Time	Location
-----------------	-------	-----------	-----------	----------	-----------	----------

SPECIAL EDUCATION [Add](#)

HEALTH INFORMATION [Add](#)

DISCIPLINE EVENTS [Add](#)

SCHOOLS [Add](#)

School/Schedule	In	Dist.
WEST HIGH, MS Schedule	Yes	No

Comment:

Distance Waiver [Add](#)

BUS PASSES [Add](#)

Date	Verified	Color	Code	Lost
------	----------	-------	------	------

BILLING [Add](#)

Date	Type	Rate	Quant	Comment	Reconcile
------	------	------	-------	---------	-----------

Tabs related to **Personal Info** (contact numbers, addresses), **Student Info** (health concerns, Sped Info, Routes, Schools)

Each category holds all relevant information on one screen.

Person Record Screen

Filter results even further with the search field.

Direct relationships created with locations/addresses and other individuals.

Lydia Transportation Management System v 0.67

Filter By: [None](#) [Student](#) [Personnel](#)

Search [Adv.](#)

Search

1 2 3 4 5 6 7 8 9 10 11-20

[Next](#)

Records 1 to 20 of 6884

Last Name, First Name	SIS ID.
AAKHUS-PERRIN, JENNIFER	4338
AALFS, BRANDIE	1220
AALFS, MARIA	1214
ABARA, ARIES	1202
ABARA, AUDREY	1201
ABARA, MIRIAM	1178
ABELSON, ESTHER	1167
ABRAMO, ASHLEY	1144

Personnel

Routes

Vehicles

Places

Schools

Comm.

Reports

Admin

Person Record [Student Records](#) [Personnel Records](#)

Person ID	Last Name	First Name	Mid Init	SSN	Sex	Ethnicity	Language	DOB	HID	Picture	Comments	Inactive
7540	ABELSON	ESTHER			F	HISPANIC	SPANISH	9/12/1988	No			<input type="checkbox"/>

PERSON CONTACTS [Add](#)

Contact Type	Person Contact	Comments
Home Phone	(712)758-7946	

PERSON LOCATIONS [Add](#)

Location	Person Org. Relation	Person Org. Comment

PERSON RELATIONS [Add non-student Relation](#) [Add student Relation](#)

PLEASE REPORT BUGS OR FEATURES REQUESTS [HERE](#). ©2004-2005, SHANE STECKELBERG. ALL RIGHTS RESERVED

Adding “relations” to others is easy

Lydia Transportation Management

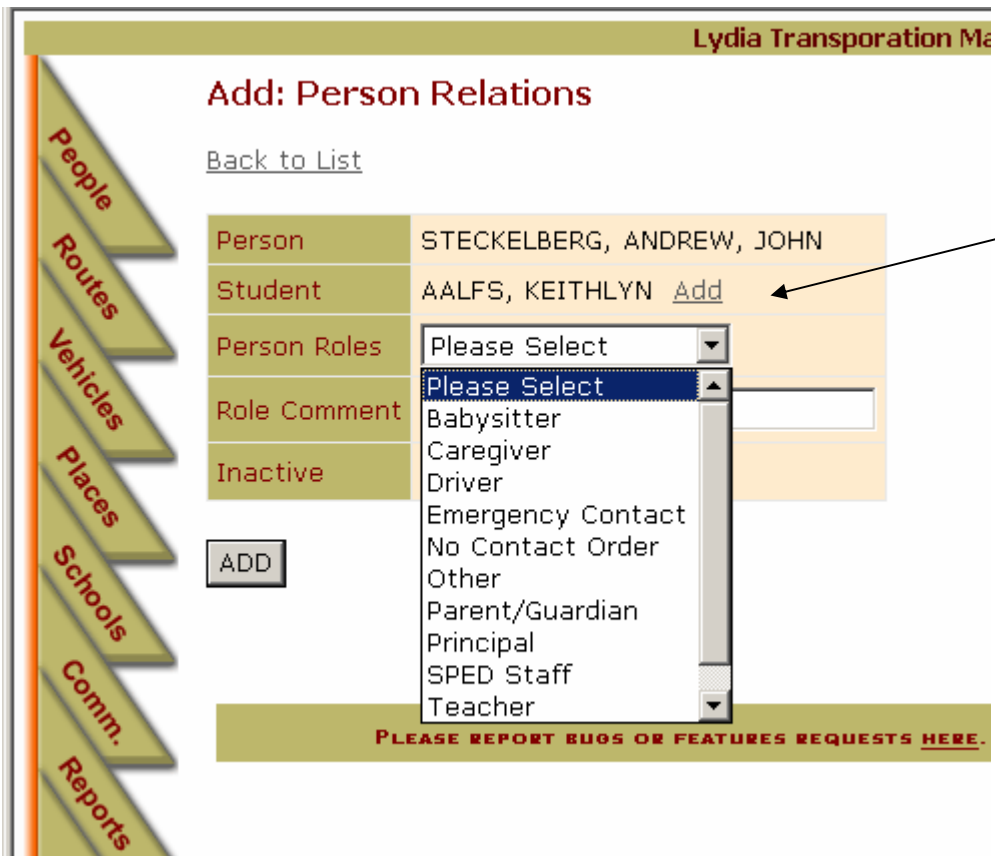
Add: Person Relations

[Back to List](#)

Person	STECKELBERG, ANDREW, JOHN
Student	AALFS, KEITHLYN Add
Person Roles	Please Select
Role Comment	Please Select
Inactive	<input type="checkbox"/>

- Babysitter
- Caregiver
- Driver
- Emergency Contact
- No Contact Order
- Other
- Parent/Guardian
- Principal
- SPED Staff
- Teacher

PLEASE REPORT BUGS OR FEATURES REQUESTS [HERE](#).



A sample of adding a student relationship to another individual.

Routes Screen

Bus Routes

 Search (*) [Show all](#)

Exact phrase All words Any word

Add

1 2 3 [Next](#)

Records 1 to 25 of 57

Records Per Page

Sub-categories related to the Route



Route No. (*)▲	Route Name (*)	Comments (*)							
01	01					Runs	Driver Report Times	Route Vehicles	Driver Assignments
02	02					Runs	Driver Report Times	Route Vehicles	Driver Assignments
03	03					Runs	Driver Report Times	Route Vehicles	Driver Assignments
04	04					Runs	Driver Report Times	Route Vehicles	Driver Assignments
05	05					Runs	Driver Report Times	Route Vehicles	Driver Assignments
06	06					Runs	Driver Report Times	Route Vehicles	Driver Assignments
07	07					Runs	Driver Report Times	Route Vehicles	Driver Assignments
08	08					Runs	Driver Report Times	Route Vehicles	Driver Assignments
09	09					Runs	Driver Report Times	Route Vehicles	Driver Assignments
10	10					Runs	Driver Report Times	Route Vehicles	Driver Assignments

- People
- Routes
- Vehicles
- Places
- Schools
- Comm.
- Reports
- Admin
- Log

Reviewing Routes

Lydia Transportation Management System v 0.67

Routes >> Route Runs

Route Number	Stop Type
01	AM Pickup

[Back to List](#)
















Route Stops    

Search (*) [Show all](#) [Advanced Search](#)

Exact phrase All words Any word

Add

Records 1 to 23 of 23 Records Per Page

Stop No. (*)	Stop Time (*)	Stop Location (*)	Student	Bus Stop Types				
	8:00AM	27th & Clark St	CRESCENT PARK, ES Schedule	Individual Stop				Student Stops
	8:08AM	1923 Ingleside Ave	CRESCENT PARK, ES Schedule	Individual Stop				Student Stops
	8:23AM	1622 Grandview Blvd	CRESCENT PARK, ES Schedule	Individual Stop				Student Stops
	8:25AM	1505 McDonald St	CRESCENT PARK, ES Schedule	Individual Stop				Student Stops
	8:21AM	1817 Grandview Blvd	CRESCENT PARK, ES Schedule	Group Stop				Student Stops

Export capabilities on every screen.

Simple and advanced filter queries available on most pages

People

Routes

Vehicles

Places

Schools

Comm.

Reports

Admin

Logout

Route Stops

Routes >> **Route Runs** >> **Route Stops**

Stop No.	Stop Time	Stop Location	Student	Bus Stop Types
	8:21AM	1817 Grandview Blvd	CRESCENT PARK, ES Schedule	Group Stop







[Back to List](#)

Student Stops    

[Show all](#) [Advanced Search](#)
 Exact phrase All words Any word

Add

Records 1 to 2 of 2 Records Per Page

<u>Student</u>	<u>Stop Type</u>	<u>Route Status</u>	<u>NO LS</u>	<u>NO EO</u>	<u>Stop Notes (*)</u>				
VILLANLUEVA, DAVID	AM Pickup	ADDED	<input type="checkbox"/>	<input type="checkbox"/>					Student Record
MCCUDDIN, KERRY	AM Pickup	ADDED	<input type="checkbox"/>	<input type="checkbox"/>					Student Record

Each page relates to other data that is similar in nature to speed access.



- People
- Routes
- Vehicles
- Places
- Schools
- Comm.
- Reports
- Admin
- Logout

Vehicles

Vehicle Size Categories >> **Vehicle Makes** >> **Vehicle Models**

Vehicle Model	Model Yr	Seat Cap
BigBertha	1972	66

[Back to List](#)





Vehicle Details    

[Show all](#) [Advanced Search](#)

Exact phrase All words Any word

Add

Records 1 to 1 of 1

Vehicle Status	Purchase Date	Vehicle No. (*)	Owner (*)	Odometer Start	License No. (*)	Engine Type	Engine Serial (*)	Fuel Type	VIN No. (*)	Lift				
	2/3/2005	rtrt	gr	123234	345345			Diesel	yy	<input checked="" type="checkbox"/>				

People

Routes

Vehicles

Places

Schools

Comm.

Reports

Admin


Logout

Sample “Add” Screen

Lydia Transportation Management System v 0.67

Add to: Vehicle Details

[Back to List](#)

Vehicle Model	1
Vehicle Status	Please Select ▾
Purchase Date	<input type="text"/> 
Vehicle No.	<input type="text"/>
Owner	<input type="text"/>
Odometer Start	<input type="text"/>
License No.	<input type="text"/>
Engine Type	Please Select ▾
Engine Serial	<input type="text"/>
Fuel Type	Please Select ▾
VIN No.	<input type="text"/>
Lift	<input type="checkbox"/>

ADD

Most of the screens have many standardized “lookup” values. These are customizable by an administrator. For instance, an administrator may choose to add a Vehicle Status of “Stolen” if one did not exist.

Locations/Addresses

Lydia Transportation Management System v 0.67

Organizations & Locations



Search (*)

[Show all](#)

[Advanced Search](#)

Exact phrase
 All words
 Any word

[Add](#)

Records 1 to 17 of 17

Records Per Page

25

Org. Name (*) ^Δ	Street No (*)	St. Dir (*)	St. Name (*)	St. Type (*)	Apt No (*)	City (*)	Zip (*)	State (*)	Org. Comments (*)				
1117 S PAXTON ST	1117	S	PAXTON	ST		FORESTBURG	51106	IA					Person Orgs.
1167 PAXTON ST	1167		PAXTON	ST		FORESTBURG	51105	IA					Person Orgs.
1169 S PAXTON ST	1169	S	PAXTON	ST		FORESTBURG	51106	IA					Person Orgs.
117 S PAXTON ST	117	S	PAXTON	ST		FORESTBURG	51105	IA					Person Orgs.
161 PAXTON ST	161		PAXTON	ST		FORESTBURG	51105	IA					Person Orgs.

Again, relating individuals to Particular addresses and then providing yet another view of the data.



- People
- Routes
- Vehicles
- Places
- Schools
- Comm.
- Reports
- Admin
- Logout

Drilling down from last page allows us to see even more information which is editable from anywhere in the program.

Organizations & Locations

[Back to List](#)

Org. Name	Street No	St. Dir	St. Name	St. Type	Apt No	City	Zip	State	Org. Comments
1117 S PAXTON ST	1117	S	PAXTON	ST		FORESTBURG	51106	IA	

Persons Related to Organization



[Add](#)

Records 1 to 1 of 1

Person	Person Org Relation	Person Org Comment						
Parcel, DUSTIN	Home						Person Contact Info.	Student Stops

- People
- Routes
- Vehicles
- Places
- Schools
- Comm.
- Reports
- Admin

Standard Reports/Queries

STANDARD REPORTS		
Bus Routes	Special Reports	Communications Reports
Route Details	Students with Special Transportation	Detailed Ticket Analysis
Active SPED Stops	Students with Special Medical Needs	Closed Tickets
Student Stops without SPED Records		User Tracking Log
AM Route Sheet with Pictures	Student Discipline Reports	
PM Route Sheet with Pictures	Out of Distance Students	
	In-Dist. Billable Students	
	Dist. Waived Students	
Changed Routes **	Special Routes Edit (Move/Copy Stops)	
	** not fully implemented yet	
School/Student Schedules	Cleanup/Exception Reports	Other Reports
School Schedule exceptions notice **	Student Requests Not Yet Assigned Stop	AM Actual VS Proposed Stops
Student Bus Schedule Exceptions **	Stops without Students	PM Actual VS Proposed Stops
	Student Duplicate AM Stops	AM Actual VS Proposed (Different Stops)
	Student Duplicate PM Stops	PM Actual VS Proposed (Different Stops)
	Incomplete/Undefined Bus Stops	
	Students without Addresses	
	Students with Incomplete/Missing Info.	

Although still incomplete, a variety of canned reports are available to assist in planning.

One of the Route Sheet reports actually includes pertinent student info and student picture!

Search: Detailed Route Search

[Back to List](#)

Last Name	START WITH	<input type="text"/>
First Name	START WITH	<input type="text"/>
Grade	=	<input type="text" value="Please Select"/>
School	=	<input type="text" value="Please Select"/>
Route Stop Type	=	<input type="text" value="Please Select"/>
Student Stop Type	=	<input type="text" value="Please Select"/>
Route No.	=	<input type="text" value="Please Select"/>
Stop No.	LIKE	<input type="text"/>
Stop Time	LIKE	<input type="text"/>
Stop Location	LIKE	<input type="text"/>
Stop Notes	LIKE	<input type="text"/>
School M	=	<input type="radio"/> Yes <input type="radio"/> No
School Tu	=	<input type="radio"/> Yes <input type="radio"/> No
School W	=	<input type="radio"/> Yes <input type="radio"/> No
School Th	=	<input type="radio"/> Yes <input type="radio"/> No
School F	=	<input type="radio"/> Yes <input type="radio"/> No
School S	=	<input type="radio"/> Yes <input type="radio"/> No
Stop LS	=	<input type="radio"/> Yes <input type="radio"/> No
Stop EO	=	<input type="radio"/> Yes <input type="radio"/> No

Search

This is a query from the “Detailed Route Search” report. A user might specify any of the particular items of interest such as Route Number and Stop Location.

Program Administration

View/Edit My Options:

[Change my Password](#)

View/Edit Global Table Lookup Values:

Person/Student Lookups

[Attendance Day Types](#)

[Billing Types](#)

[Bus Stop Days Types](#)

[Discipline Infractions](#)

[Discipline Types Given](#)

[Ethnicities](#)

[Grade Levels](#)

[Grade Level Groups](#)

[Health Issues](#)

[Languages](#)

[SPED Issues Types](#)

Communication Log Lookups

[Communication Types](#)

[Escalations-Priorities](#)

Vehicle Lookups

[Fuel Types](#)

[Vehicle Incident Roles](#)

[Vehicle Roles](#)

[Vehicle Engine Types](#)

[Vehicle Option Types](#)

[Vehicle Status Types](#)

Contact Lookups

[Organization Types](#)

[Person Contact Types](#)

[Person Role Types](#)

Route/Stops Lookups

[Bus Stop Types](#)

[Driver Report In-Out Types](#)

[Stop Types](#)

[Route Setup Status Types](#)

[Route Driver Types](#)

Personnel Lookups

[Personnel Employment Types](#)

[Personnel In-service Types](#)

[Personnel License Types](#)

[Personnel Test Results](#)

[Personnel Test Types](#)

[Personnel Union/Contractors](#)

Each and every lookup table may be modified by a program administrator. This allows for greater flexibility while maintaining data integrity.

View/Edit User Accounts:

[User Accounts](#)

What is in progress now?

- Finalization of Production Version 1 to include interface improvements and even more reports and query capabilities.
- Critical need for automated synchronization with other systems such as Student Information Systems and Routing software.
- Improved reports integration/complete automation of application to bus assignment process.

What is expected in the future?

- The schema already has the capabilities to:
 - Import/sync bus routing data from GPS devices.
 - Sync actual student drops/pickups as opposed to the “scheduled” drops/pickups
 - Allow a degree of parent/caregiver access to data.
 - Better Pocket PC capabilities
 - Online mapping
 - Ideas from others are always appreciated!

Questions?

Contact Information

Primary Author

Mr Jake Sheets
IT/GIS Analyst - Transportation
Sioux City Community Schools
1221 Pierce St
Sioux City, IA 51105
US
(712)277-6103
sheetsj@sioux-city.k12.ia.us

Co-Author

Mr Shane Steckelberg
Director of Technology
Dakota Valley Schools
1150 North Shore Dr
North Sioux City, SD 57049
US
605-232-3190
Shane.Steckelberg@k12.sd.us