Redneck's and Duct Tape GIS/GPS Method of Efficient School Bus Routing

Will Davis, GISP Lake County Schools

Friday, March 2, 2012





294 Buses Transporting 21,860 Students Twice Daily 30,670 Miles







Key West, FL to Deadhorse, AK -- Distance of 5,482 4 Days 15 Hours -- 30,670 Miles = 2.8 Round Trips 6.2 mpg = 4,950 gallons/day

















Situation

- Revenue/Budget Shortfall
 - Total Cost = \$16 Million
 - Cost to District = \$7.65 Million
 - State Reimbursement = \$8.35 Million
- Cost Cutting Measures
- State Statute & Board Policy





Key Project Points

- Efficient Routing
 - Travel Time/Distance
 - Depot Stops
- Reduce Ridership
 - State Guidelines
 - Board Policy
- Student Safety
 - Local Govt. Coordination
 - Public Involvement







Project Goals

- Reduce Cost to School District
 - Eliminate routes
 - Eliminate stops (initiate depot stops)
 - Reduce travel time/distance
 - Eliminate or reduce staff hours
 - Cut fuel consumption
 - Cut Maintenance







- Determine tasks & budget
- Data collections efforts
 - Students
 - Routes/Stops
 - Streets (networkable)
 - Cost
- Measuring success







- Determine operating cost
 - Minimize windshield time
 - Driver hours
 - Minimize travel distance
 - Fleet maintenance
 - Reduce fuel cost
- Load balancing of students
- Student travel time constraints
- Bell time constraints
- COLOR DOG
- Stop allocation





- Mapping what we KNOW
 - Geocoded students
 - Determine transportation
 - Routes
 - Stops
 - Networkable GIS layers
 - Walkability (Student)
 - Drivability (Bus)













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115	10	TEL-762		IN N	P	00040	03:30	TAVARES RIDGE E	SCHOOL	AFTER TURN		CONTTO R ON WOODLEAN R ON HWY 19, L ON LANE PARK, R INTO
115	511	TEL-762	7 OPE	EN	A	00000	07:41	LEAVE TAVARES	BUSLOT			R ON HWY 19, L WN DEAD RIVER.
115	512	TEL-762	7 OPE	EN	A	00005	07:51	DEAD RIVER: MAR	SH HARBOR			
115	513	TEL-762	7 OPE	EN	A	00010	07:53	DEAD RIVER: STO	P- COVE RD			PULL FORWARD AND BASK UP INTO COVE RD, R ON DEAD RIVER
115	514	TEL-762	27 OPE	EN	A	00015	07:57	DEAD RIVER RU.S	TOP-WAGNO	LA RIDGE		CROSS HWY 19, ONTO WELLS, L ON WELLS, CROSSOVER BRIDGE (WELLS TUR
115	15	TEL 762	17 OPE	EN EN	A	00020	08:00	RUBY SI:STOP-FR	ITADY SCHOOL	OUND		L ON BLOXHAM ST,R ON MAIN ST, ON SINCLAIR AVE,R ON GIVENS ST,L ON ME
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115	518	TEL-762	7 OPE	EN	Р	00005	03:14	RUBY ST:STOP-FR	ONT PLAYGR	OUND		L ON LAKE ST WHICH TURNS INTO WELLS AVE CROSS OVER BRIDGE R ON DEA
115	519	TEL-762	7 OPE	EN	P	00010	03:20	DEAD RIVER: STO	P- MARSH HA	RBOR		PULL DOWN ON DEAD RIVER PAST COVE RD, BACK UP INTO COVE RD THE DRC
115	520	TEL-762	7 OPE	EN	P	00015	03:25	COVE RD: STOP- [DEAD RIVER			R ON DEAD RIVER
115	21	TEL-762	27 OPE	EN	P	00020	03:30	DEAD RIVER:STOP	P- MAGNOLIA	RIDGE		R ON HWY 19, L ON LANE PARK CUT
115	22	TEL-762	1 IOANN H		P	00025	03:35	I FAVE TAVARES	BUSLOT			R ON HWY 19 R ON OLD HWY 441 L ON JANTHE ST L ON SINCLAIR R ON GIVEN
115	24	TEL-AFT	1 JOANN H	AVENS	P	00005	05:00	TAVARES ELEM S	CHOOL			L ON CLIFFORD, L ON ST, CLAIR ABRAMS, R ON CAROLINE
115	25	TEL-AFT	1 JOANN H	AVENS	P	00010	05:04	CAROLINE:STOP-I	ROCKINGHAM			L ON ROCKINGHAM, L ON OLD 441, R ON ST. CLAIR ABRAMS, L ON MAIN, CROSS
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115	27	TEL-AFT	1 JOANN H	AVENS	P	00020	05:19	BEXLEY: STOP- BA	ARNSLEY			R ON BARNSLEY, R ON BRACKNELL, L ON MERRY RD, R ON CARROLL COURT
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115	6	TEL	11509	TEL	762	26	C	PEN	P	00040	03:30	TAVARES RIDGE BLVD: STOP- AFTER TURN
115	30	TEL	11510	TEL	762	26	C	PEN	P	00045	03:35	TAVARES MIDDLE SCHOOL
115	539 540	TEL	11511	11 TEL-7627			C	PEN	A	00000	07:41	LEAVE TAVARES BUS LOT
115	641 642	TEL- TEL-	11512	TEL	762	27	C	PEN	A	00005	07:51	DEAD RIVER: MARSH HARBOR
115	643 644	TEL:	11513	TEL	-762	27	C	PEN	Α	00010	07:53	DEAD RIVER: STOP- COVE RD
115	545 546	TEL	11514	TEL	-762	27	C	PEN	Α	00015	07:57	DEAD RIVER RD.STOP- MAGNOLIA RIDGE
115	47	TAL	11515	TEL	-762	27	C	PEN	Α	00020	08:00	RUBY ST:STOP-FRONT PLAYGROUND
H -	↓	1	11516	TEL	-762	27	C	PEN	Α	00025	08:10	TAVARES ELEMENTARY SCHOOL
			11517	TEL	-762	27	C	PEN	P	00000	03:10	LEAVE TAVARES ELEMENTARY
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- Mapping existing details
 - AVL Tracking Systems
 - GPS "Geofence" detection
 - VRP Vehicle Routing Problem
 - EMC Ejection Chain Method
 - TSA Tabu Search Algorithm
 - Heuristic Method







Vendor Options

- Locating Bus Routes or Stops
 - Transfinder (Routefinder Pro)
 - Tyler Technologies (Versatrans TM)
 - Edulog (Edulog.nt)
 - − Route Solutions (*StreetSync*TM)
 - Trapeze Group (Trapeze MapNet)
 - Gecko Microsolutions, Inc. (T.O.M.)
 - Everday Solutions, Inc. (GEOREF)
 - Total Solutions Partners (BusOnePro)













How to Obtain Useful GIS Data







- Ernest P. Worrell GIS Method
 - Affordable GPS Tracking Key
 - Scripts to extract
 - Routes
 - Stops
 - Create GIS Layers
 - Arcs
 - Points









GPS Tracking

Key







<u>Tracking Key</u> <u>Pro</u>







SilverCloud



Browser Friendly



ShareSpot





Google Maps



3D Viewing



Activity Reports



Alerts



Preferred <u>Bus</u> Mounting















Data Reinforcement

Review Reports in Past TrackTM

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02:35:28pm 01m:42s 02:37:08pm 400 McCormack St, Leesburg, FL 34748, USA 0.1 48m:20s	



- Exporting flat file from Past-Track[™]
- Run BAT files with scripts for export
 - Arcs representing bus routes
 - Point representing estimate of bus stops









- Developed scripts for export
 - <u>ActivePerl</u>[®] by ActiveState Software, Inc.
 - Multipurpose Program Language
 - Free Community License
 - <u>**PostgreSQL</u>** by PostgreSQL Global Development Group</u>
 - Open source object-relational database system
 - Contains PostGIS geographic object support
 - Spatially enables "PostgreSQL for GIS applications







Assessing the Data



Assessing the Data





Data Format

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Route 7617

(Treadway Elementary, Tavares Middle & Tavares High School Runs)

Existing Bus Stops = 46 Existing Mileage = 44.4 <u>Proposed Bus Stops = 34 Proposed Mileage = 42.3</u> Number of Stops Saved = 12 Mileage Saved on Route = 2.1

<u>Calculation of Average Speed for Existing Route</u> Treadway Elementary = 10.0 miles in 41 minutes or 16.7 mph Tavares Middle = 11.8 miles in 42 minutes or 16.9 mph Tavares High = 22.6 miles in 55 minutes or 24.6 mph Average = 44.4 miles in 2 hours 18 minutes or 19.3 mph

Travel Time Saved = 2.1 miles/route @ 19.3 mph or 6.5 minutes/route or 13 minutes/day

12 stops/route @ 2 minutes/stop = 24 minutes/route or 48 minutes/day Daily time saved = 13 minutes + 48 minutes = 61 minutes/day







Daily Savings for Fuel & Maintenance = \$12.76/route Daily Savings in Personnel = \$15.48/route

Total Daily Savings = \$28.24/route

Total Annual Labor Time Saved = 36,600 hours or 5,228 average work days Or 29 equivalent employees/year (average work day is 7 hours/day)

Total Annual Travel Distance Saved = 151,200 miles

Annual Equivalent Daily Routes Eliminated = 1,338

(7.4 routes/day) (based on average of 113 miles/day/route)

Daily Savings = \$28.24/route @ 200 routes = \$5,648/day Annual Savings = \$5,648/day @ 180 day = \$1,016,640/year

























































