Analysis of A.M. Bus Routes for the White Settlement Independent School District's Elementary Campuses Using GIS

By Biatriz Chapa

Introduction

The White Settlement ISD is a growing suburban school district (see Figure 1) that serves more than 4,600 students. Located west of downtown Fort Worth, it includes four elementary campuses, an intermediate school, middle school and a high school. Plans are in the works for a fifth elementary school to be located north of the Blue Haze elementary school. Approximately 1,072 students ride the buses daily to each of the seven schools in the system. To accomplish this task, the Transportation Department uses 21 buses. The Transportation Department provides several types of routes, including regular, special education, and special programs routes. Of the 1,072 students, 160 students ride one of four buses to the four elementary schools. Figure 2 shows the boundaries for each of the elementary schools. Currently, the bus routes are in need of an update to verify if routes are well laid out with minimal overlap and have logical stop sequencing and street paths. Figure 3 shows the current bus routes for morning routes numbered 2, 3, 7 and 12 along with the bus stops and student locations of elementary school students. These are the routes to be analyzed in this study. A network analysis of the White Settlement ISD's current bus routes will be done using GIS. Only the A.M. routes for the four elementary schools will be analyzed for this project because of time constraints. The question to answer in this study is whether or not the district needs to revise their bus routes in order to accommodate the growing number of students in the district and to see if current bus routes and stops are

minimum cost paths. New route recommendations based on the analysis will be presented in this report if that is what the study finds needs to be done.

Literature review

There are many companies specializing in creating software for school districts to use for planning their bus routes according to where the students who ride the buses live. One such company is GIS/Trans who has developed GIS/T-School Bus, a simple to use, cost effective software based on the ESRI ArcView. The software requires the user to plug in busing information and will process the data and define routes that conveniently serve all the bus stops defined for the school. The software also generates reports from the data. Another company is Education Logistics, Inc. They provide routing software on-line for smaller ISD's who do not have the revenue to spend on purchasing bus routing software. The on-line access is available with on-line support. The WSISD is not currently using a software program for use in their busing routes.

Methodology

Map of study area (see Figure 4) showing the White Settlement Independent School District and its boundaries along with surrounding school districts within Tarrant County . The district covers all of the City of White Settlement, which borders the western boundary of Tarrant County, and the western part of the City of Fort Worth. Data sources for this project include: the White Settlement Independent School District, ESRI, and the North Central Texas Council of Governments. Available for the study are current bus routes (not supplied in digital format; will need to digitize information), Excel file of student addresses and bus numbers they ride, and the

street network of the WSISD boundary was downloaded from ESRI and NCTCOG. Attached also is the flowchart (see Table 1) for this project.

Scientific merits

The school district's bus routes are in need of updates considering the district is growing rapidly and needs to keep up with the demands for bus transportation. School officials want to look into getting the system into a routing/fleet software program. This is an important factor considering the district does not currently use bus routing software but collects data manually from the bus drivers. This system may have worked well for them in the past but with a growing district, using technology would be a good solution to keeping bus routes current for future planning.

Findings and Conclusion

From the start, there were data problems. The TIGER files downloaded from the U.S. Census Bureau did not have current streets therefore many of the existing streets in the City of White Settlement were not in the file. A current street file from ESRI was purchased but was found to be outdated even though the site states updates are within the last quarter of the year. Upon searching for more internet resources, none was found to have anything more current than the file from ESRI. Once the addresses were geocoded, all but six percent of students were geocoded successfully therefore this analysis still shows a good representation of the locations of elementary students who ride the buses. The accuracy of the routes material received by the ISD is questionable considering no date was given as to when the information had last been updated by each bus driver. Bus routes were not digital files but instead were received on paper handwritten or typed. Current routes were mapped using the directions received. For this study,

current routes on the maps included are shown in green (see Figure 3). A network analysis using paths was run on the stops and Figure 5 shows the proposed routes in different colors to identify each numbered route. Findings suggest that three of the four a.m. routes analyzed, route 2, 3, and route 12 could be modified to minimize paths. Route 7 is identified as a minimum cost path. Figure 6 clearly shows that of the four routes, route 12 is the only route that would require the most modifications. This conclusion may be questionable in that the data provided may be inaccurate. Some of these current routes appear inconsistent because no bus stop exists in areas where there is a path and/or no students exist where there is a bus stop. Notice on Figure 6 where the proposed route 12 overlays the current route 12 clearly showing that there are turns taken that do not coincide with stops and stops made where no bus student exists. In conclusion, it would benefit the school district to have all of their bus routes analyzed for minimum path. Right now, based on the information given, there seem to be enough buses for the number of students attending the elementary schools therefore the district would not need to revise those bus routes. Once the fifth school is built, then another route with stops will be created to accommodate the students in the new area. Whether or not a new bus is needed will be determined at that time. Although the district doesn't seem to need to revise the routes based on number of student, it should look into revising their bus routes for minimum path costs as shown in Figure 6 or at least look into the reason for the inconsistent paths and stops provided for this study. A recommendation that the school district purchase cost effective bus routing software or, if revenue is an issue, utilize the on-line software available to school districts.

References

Education Logistics, Inc. www.edulog.com

Stock Transportation Ltd., www.stock-transport.com/mapnet.html

GIS/Trans, www.gistrans.com

Maximus, Inc., www.managementservices.maximus.com

ESRI, www.esri.com

North Central Texas Council of Governments, www.dfwinfo.com

White Settlement Independent School District Boundary

Legend
— Streets
☐ White Settlement ISD

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April 2003
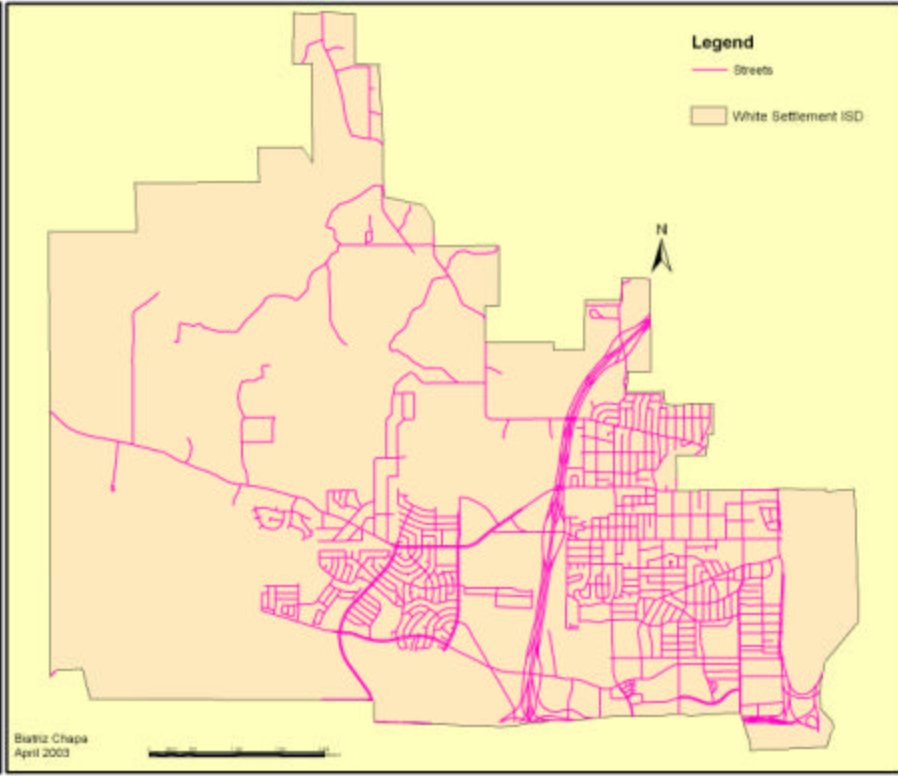
White Settlement Independent School District Elementary Schools Boundaries

Legend
🚩 Elementary Schools
— Streets
☐ West Elementary
☐ North Elementary
☐ Liberty Elementary
☐ Blue Haze Elementary

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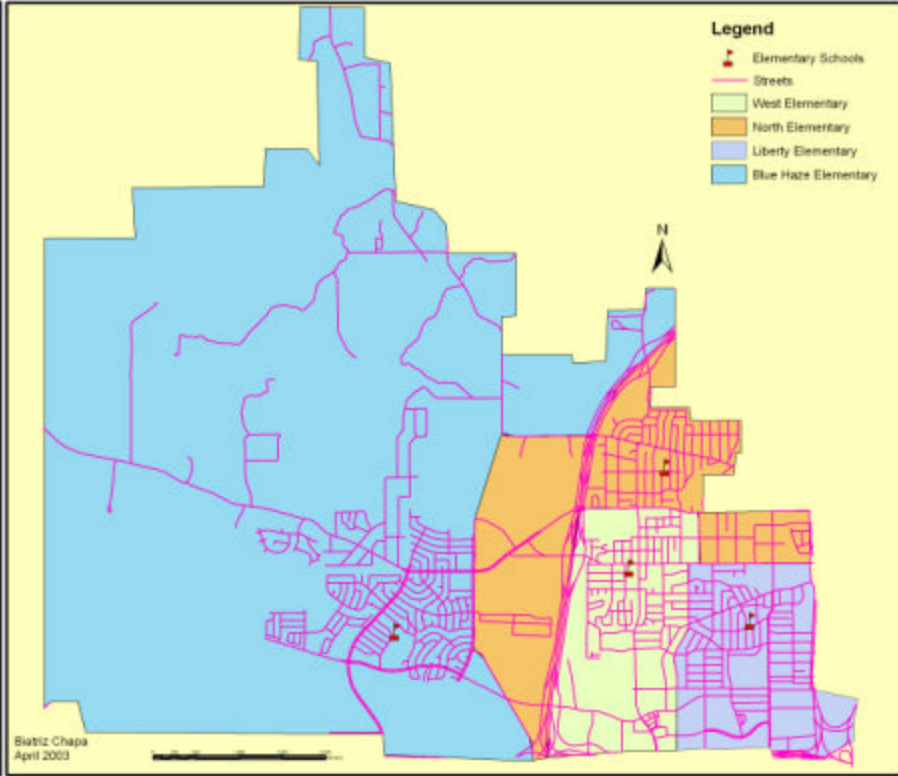
White Settlement Independent School District
Elementary Schools Current A.M. Bus Routes

Legend
- • Bus Students
- ⚑ Elementary Schools
- • Bus Stops
- ▬ Current Routes
- — Streets
- West Elementary
- North Elementary
- Liberty Elementary
- Blue Haze Elementary

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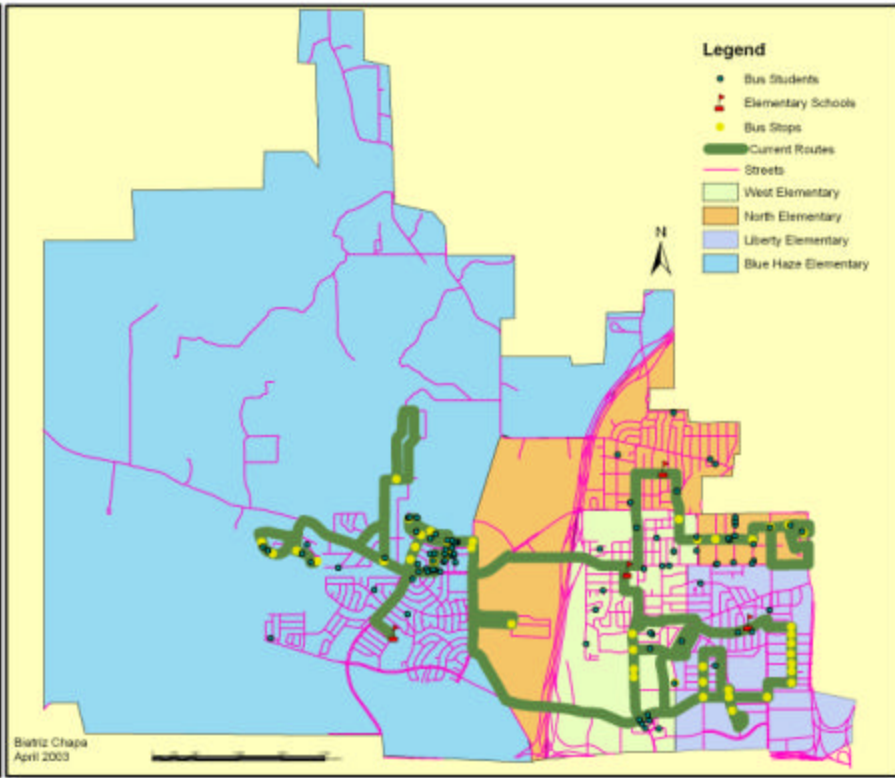
White Settlement Independent School District
and Surrounding School Districts in Tarrant County

EAGLE MT-SAGINAW INDEPENDENT SCHOOL DISTRICT

AZLE INDEPENDENT SCHOOL DISTRICT

LAKE WORTH INDEPENDENT SCHOOL DISTRICT

CASTLEBERRY INDEPENDENT SCHOOL DISTRICT

WHITE SETTLEMENT INDEPENDENT SCHOOL DISTRICT

FORT WORTH INDEPENDENT SCHOOL DISTRICT

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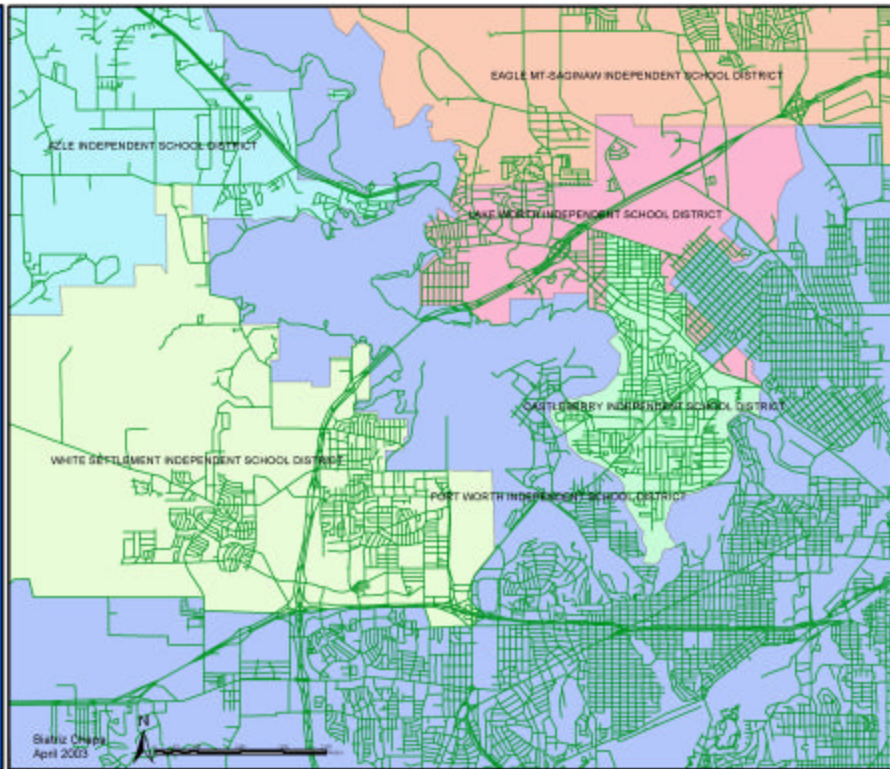
White Settlement Independent School District Elementary Schools Proposed A.M. Bus Routes

Legend
● Bus Students
♪ Elementary Schools
● Bus Stops
— Route 12
— Route 2
— Route 3
— Route 7
— Streets
West Elementary
North Elementary
Liberty Elementary
Blue Haze Elementary

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April 2003
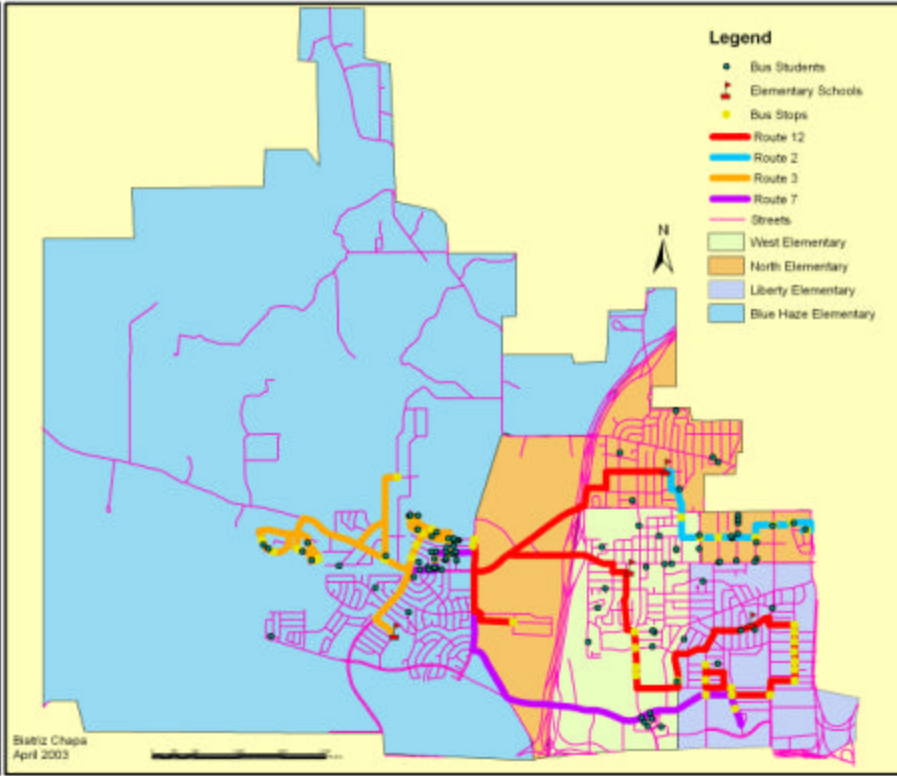
White Settlement Independent School District Elementary School Current and Proposed A.M. Bus Routes

Legend
● Bus Students
♪ Elementary Schools
● Bus Stops
— Route 12
— Route 2
— Route 3
— Route 7
— Current Routes
— Streets
West Elementary
North Elementary
Liberty Elementary
Blue Haze Elementary

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