Report #3 in the series

Transitway Impacts Research Program

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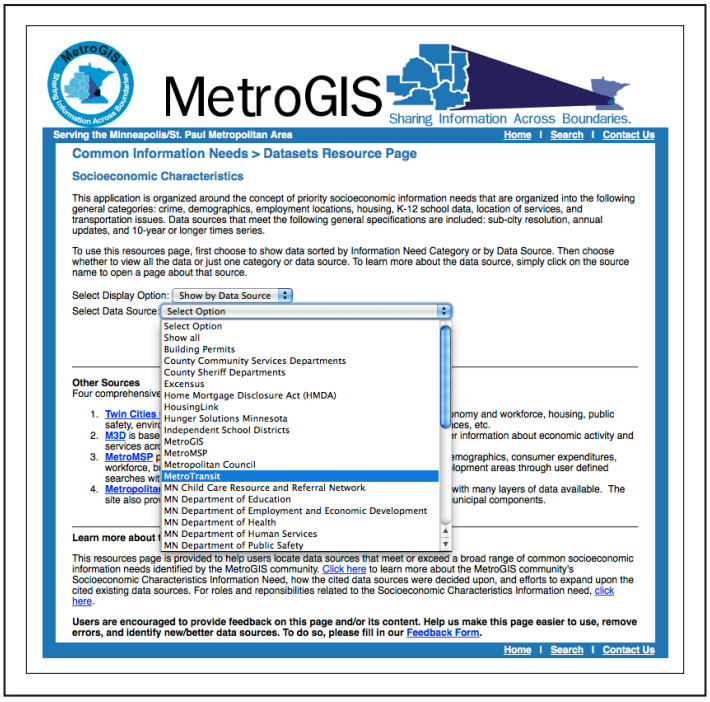
Transitway Data Management Project



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Transitway Data Management Project

Final Report

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Executive Summary

This project focuses on the data management issues of the Transitway Impact Research Program (TIRP) at the University of Minnesota. It has two basic goals: to help researchers find and access data to support their projects and to document and archive their research data files for subsequent use. The first goal was to include identifying and archiving a current version of ephemeral data, so it would be available if needed for subsequent analysis.

The project consisted of five tasks. Each is presented in a chapter of this report. The major products of the project, aside from this report, consist of an updated website directory to relevant data and the appendices found at the end of the report, especially Appendix C.

Task 1 was to work with the TIRP Technical Advisory Group (TAG) to understand MetroGIS DataFinder and its Socioeconomic Resources page as a way to direct researchers to available datasets. DataFinder already has over 200 datasets, each fully documented using a nationally compliant Metadata standard. In addition, the Socioeconomic Resources page directs people to data from 25 other data sources, such as the US Census, organized into seven distinct categories; e.g., housing, transportation.

Task 2 was to work with the TAG to look for new sources of data that should be added to this list. To do this we looked at two existing reports about transportation impacts, looking to identify key data types that were missing from DataFinder's Socioeconomic Resources page. As a result, 10 new data sources were identified, along with two new data categories. Perhaps the most notable outcome from this work was the addition of annual state Department of Revenue sales and income tax data starting in 2003 for areas as small as block groups. Many of the existing 25 data sources were expanded and updated as a result of the review. Several ideas for adding additional data were investigated and determined to be beyond the scope of this project. No critical ephemeral data sources were found.

Task 3 was to find appropriate methods for adding TIRP research project datasets to DataFinder. Two research projects had been completed by December 2009. This project helped clean their research data files, developed MetaData for them, and is adding that Metadata to DataFinder. In addition, MetaData was developed for the Department of Revenue sales and income tax data.

Task 4 was to work with the TAG to develop long term policies and procedures for providing access to TIRP research project datasets. Following discussions with this project team, the TAG adopted a policy making a final dataset and adequate MetaData part of the required deliverables for any TIRP project. The Metropolitan Council has agreed to make the data available from its FTP site. It has appropriate controls over access to licensed datasets.

Task 5 was to develop guidelines to help researchers document their data. To this end, a MetaData Tutorial was developed. This is found in Appendix C to the report.

Three appendices are included in the report:

A. An annotated extraction from a report on Transit Oriented Development, showing which of indicators are already available in DataFinder

B. An example of the data available from MetroMSP, one ephemeral data source.
C. The MetaData Tutorial to be used by future TIRP project investigators.

Chapter 1

1.0 Introduction

This project is intended to provide data to research studies measuring the impacts of new Transitways in the Twin Cities region. It also is intended to archive data from existing studies so they can be used again in future studies.

The project is funded by the Transitway Impacts Research Program (TIRP). TIRP intends to measure the economic, travel, and community impacts of new transitway corridors. Several studies have already been funded related to the Hiawatha Light Rail Transit (LRT) corridor. TIRP is an initiative of the Hennepin County-University of Minnesota Partnership. It is supported by the University's Center for Transportation Studies and the State and Local Policy Program (SLPP) at the Humphrey Institute of Public Affairs. Funding is being provided by Anoka, Dakota, Hennepin, Ramsey, and Washington counties; Metro Transit and the Metropolitan Council; and the Minnesota Department of Transportation. Additional partners include the cities of Minneapolis and St. Paul.

TIRP has a need to address three kinds of data issues to facilitate future research. First, it needs to document (and archive) data that have been collected and used as part of current research. Second, it needs to identify key data sources that should be used in transit research and will be available when needed, e.g., US Census. Third, it needs to identify more ephemeral data that needs to be collected, documented, and archived now, so that it is available to provide a "before" picture within the corridors.

This project is divided into five key objectives. These objectives and project deliverables are defined below.

- **TASK 1:** Work with the TIRP Technical Advisory Group (TAG) and Metropolitan Council representatives to better understand and document how DataFinder is used and how it could work to support TIRP research.
    - Deliverable: Report to TAG on how DataFinder is used and how it could work to support TIRP research.

- **TASK 2:** Work with the TIRP TAG to identify other datasets that might be added to DataFinder, including datasets used to create the Metropolitan Council's Before and After Study for the Hiawatha light rail line.
    - Deliverable: Report to TAG on datasets that should have metadata placed on DataFinder.

- **TASK 3:** Develop methods for adding TIRP datasets to the DataFinder catalog and create metadata on datasets of interest.
    - Deliverable: Metadata on DataFinder for datasets of interest to TIRP researchers.

- **TASK 4:** Work with the TIRP TAG to develop guidelines that will lead to datasets that better support TIRP research, including creating guidelines for the collection and storage of data. This task includes working with the TIRP TAG and Metropolitan Council representatives to determine how to archive data.
    - Deliverable: TAG policy for archiving future TIRP projects
    - Deliverable: Procedure for archiving data

- **TASK 5:** Document methods and procedures that will need to be maintained in order to ensure that relevant datasets are accessible to researchers.
    - Deliverable: User-friendly procedures manual.

Chapter 2

TASK 1: *Work with the TIRP TAG and Metropolitan Council representatives to better understand and document how DataFinder is used and how it could work to support TIRP research.*

2.0 Task One

2.1 Data Issues

TIRP has a need to address three kinds of data issues in order to facilitate future research. First, it needs to document (and archive) data that has been collected and used as part of current research. Second, it needs to identify key data sources that should be used in transit research and will be available when needed, e.g., US Census. Third, it needs to identify more ephemeral data that needs to be collected, documented, and archived now, so that it is available to provide a "before" picture within the corridors.

2.2 Metadata and DataFinder

The suggested tool for achieving these outcomes is DataFinder, a Web site developed by MetroGIS. DataFinder is a one-stop-shop for discovering geospatial data pertaining to the Minneapolis-St. Paul Metropolitan Area. Its primary function is to facilitate sharing of GIS (Geographic Information System) data. DataFinder is essentially an online catalog of datasets that supports data sharing. More than 200 datasets are available, all fully documented. These datasets are indexed in a catalog using 19 standard categories, but can be found using keyword searches and geographic extent tools. Those tools will make it easy for future TIRP researchers to identify and find what they need to support their projects. DataFinder often allows direct access to the data for download or as a Web Mapping Service. It always provides key contact information about the data custodian. See www.datafinder.org.

DataFinder is maintained by the GIS staff at the Metropolitan Council as part of its support for the MetroGIS data sharing collaborative. The Council has significant need for data developed by others, so this also help it meet its own business needs. Most of the data listed in DataFinder is also stored on the Council's computers, but other regional custodians host data too.

Each dataset is documented with formal Metadata. A metadata record is a file of information, usually presented as an XML document, which captures the basic characteristics of a data or information resource. It represents the who, what, when, where, why and how of the resource. Geospatial metadata are used to document geographic digital resources such as Geographic Information System (GIS) files, geospatial databases, and earth imagery. A geospatial metadata record includes core library catalog elements such as title, abstract, and publication data; geographic elements such as geographic extent and projection information; and database elements such as attribute label definitions and attribute domain values.

In Minnesota, people use the Minnesota Geographic Metadata Guidelines as documented at http://www.gis.state.mn.us/stds/metadata.htm. This guideline was adapted from the standard

developed by the Federal Geographic Data Committee by the Standards Committee of the Minnesota Governor's Council on Geographic Information to provide a streamlined implementation of that standard while retaining the essence of its original content. The Guidelines are an official state guideline adopted by the state Office of Enterprise Technology.

2.2.1 Socioeconomic Resources Guide

The Socioeconomic Resources section of DataFinder is an exception to the above rules. This page directs people to census and other data that is well documented using other approaches. It also directs people to organizations and offices that can provide useful socioeconomic data, but have not considered themselves GIS practitioners; an example is county sherriff offices that maintain records about housing foreclosures. To be complete, this section also directs people to well-documented datasets within MetroGIS and other data resource Web sites. See http://www.datafinder.org/mg/socioeconomic_resources/.

The Socioeconomics Resource section matches well with the needs of this TIRP project. It will form the base for archiving and documenting data resources useful to transit impact studies. It already contains much useful information. Data is organized into seven types of categories. Some 25 data providers are identified. In each instance data is either provided directly, or contact information is provided so users can request data and get answers to questions about the data.

Data Categories

- Crime
- Demographics (place of residence)
- Employment locations
- Housing
- K-12 school data
- Location of services
- Transportation issues

Data Sources

- County Community Services
- County Sheriff
- Home Mortgage Disclosure Act (HMDA)
- Hunger Solutions Minnesota
- Independent School Districts
- MetroGIS
- Metropolitan Council
- MN Child Care & Referral Network
- MN Dept. of Education
- MN DEED
- MN Dept of Health
- MN Dept of Human Services
- MN Dept of Public Safety
- MN Geospatial Information Office
- State Demographic Center
- National Center for Education Statistics
- Twin Cities Realtors
- US Bureau of Economic Analysis
- US Internal Revenue Service
- US Census Products
  - Census Transportation Planning Package
  - County Business Patterns
  - County-to-County Worker Flows
  - Current Population Survey
  - Economic Census
  - US Census of Population & Housing

Chapter 3

TASK 2: *Work with the TIRP TAG to identify other datasets that might be added to DataFinder, including datasets used to create the Metropolitan Council's Before and After Study for the Hiawatha light rail line.*

3.0 Task Two

3.1 What Data Does TIRP Need?

This question has two parts. One part is to identify the kind of data that could be useful in a transit impact study. Much of that work has already been done by the Humphrey Institute. The other part is to identify ephemeral data that must be captured now if it is going to be available when needed for a transit study. That work was done in the fall of 2009 in consultation with the TIRP TAG.

The 2006 report *Inventory of Data and Research on the Economic and Community Impacts of the Hiawatha LRT* identified 17 different categories. Those categories are listed here, but the report provides more detail. See Appendix D of http://www.hhh.umn.edu/centers/slp/pdf/reports_papers/data_research_hiawatha_lrt.pdf .

- Business (e.g. number of employees, retail sales)
- Commercial (e.g., square footage, rental rates, vacancies)
- Construction-Demolitions-Improvements
- Crime and Safety
- Demographics
- Industrial (same as Commercial)
- Land Use & Zoning
- Live-Work (e.g., tenure, quality of life. commute)
- Method of Payment (e.g., type of transit ticket, where purchased)
- Operations & Maintenance (e.g., train schedule delays, total miles, car usage)
- Parking (e.g., availability around stations)
- Property Values (e.g., valuations and sales prices)
- Quality of Transit Services
- Residential (e.g., vacancies, rents, owner occupied)
- Taxes
- Traffic Count
- Travel Behavior

3.2 What Data Should Be Added to DataFinder?

Much of the data detailed in the Humphrey Institute paper is already available in DataFinder and its Socioeconomic Resources pages. A few new data sources have been identified and are being added. Community surveys, parking surveys, and similar unique data collection efforts are not listed here because there is no organization with an ongoing commitment to collect and provide such data. We know that Xcel Energy could provide data on housing vacancy and turnover, but

the company is reluctant to do this both because of privacy concerns and because of lack of economic returns for producing such data.

Two new data categories (building permits and taxes) and 10 new data sources were added to DataFinder's Socioeconomic Resources page. Many other data source pages were updated and augment. The new data sources are:

- Minnesota Commercial Association of Realtors (for commercial and industrial properties)
- Local Employment Dynamics (for current information on place of work, place of residence, and interrelationship between the two)
- MetroMSP (for data on current property listings, local businesses, and employment)
- MetroTransit (for data on ridership, rider surveys, and crime on transit)
- Minnesota Department of Revenue (for new Block Group level data on income, income taxes, and sales taxes)
- Minnesota Department of Transportation (for new data on traffic counts on major roads, but reference to contact individual cities for counts on minor roads)
- US Postal Service (for vacancy rates)
- Building Permits (for improvements, new construction, and demolitions)
- Housing Link (for affordable housing)
- Excensus (for current household demographics derived from administrative data)

3.3 Additional TAG Recommended Tasks

In addition to the data sources outlined in section 3.2, the TIRP TAG made several recommendations for possible data sources. Five additional tasks were outlined at the June 25, 2009 TIRP TAG meeting and are detailed below. Each task was investigated as part of this project. Only one led to additional resources being listed in DataFinder. The other investigations found data already listed, data not of significant value, or data which will require significant additional resources to collect and document.

3.3.1 Data Issues Related to Transit Oriented Development

The first additional task identified was to look at data issues related to national work on Transit Oriented Development as it pertains to data sources of possible use to TIRP projects. By utilizing past research efforts, TIRP hoped to identify previously unconsidered data sources which may potentially be added to the DataFinder website.

This task was addressed through an internet search of published reports on the topic. One such report, published by the Transportation Research Board of the National Academies (TRB) in February 2005, synthesized TOD data sources identified as means of measuring or indicating success or failure of TOD. This report was used as a base for identifying types of data sources related to the Minneapolis-St. Paul Metropolitan area. Those types of data sources, identified in tables within the TRB report, were marked as being available in the DataFinder Catalog or somehow listed in the Socioeconomic Page within DataFinder. This report, with identifiers, is found in Appendix A.

Data source categories not marked were thus assumed to identify data sources of potential use to transit related research but not currently cataloged or otherwise identified by DataFinder or other data catalogs. This work was subsequently reviewed at the December 10th, 2009 TAG meeting. Many of those data source types identified as not being included in DataFinder, such as pedestrian counts and public perception, cannot be found in any ongoing program and will require individual data collection efforts. Others, such as air pollution data sources, could be included but given the scattered nature of the data (rather than along specific transitway corridors) the value of the data was deemed minimal for the focused scope of TIRP. The TAG saw no reason to further pursue this task.

3.3.2 Metro Transit Park and Ride Facilities

The second additional task identified was to add data created by Metro Transit regarding Park and Ride facilities to the DataFinder page. Given the key indicators discerned through data on Park and Ride lots (occupancy, vehicle registration origin, etc.), this data is of great use to research on transitway issues in the Twin Cities area.

Park and Ride Lots data was already available on DataFinder under the Transportation theme of the catalog. This data provides lot capacity and spaced used during an annual fall survey of the lots. It is updated annually, but only the most recent data is available online.

A conversation about the annual survey was held with Craig Lamothe, head of Facilities Planning for Metro Transit. He can provide access to data from earlier years. Besides the capacity and utilization information, data is also collected about individual vehicles in the lot. From the license plate, Metro Transit is able to learn the home address of those parking in each lot. The raw data from these annual surveys is available in varying degrees, depending on user and intentions. Information identifying home address of Park and Ride users is most sensitive and only available for appropriate government and academic research with strict requirements on mapping and publishing resolution.

3.3.3 Metropolitan Council LRT Impact Study

The third additional task identified by the TAG was to incorporate the Metropolitan Council Hiawatha LRT Impact Study and the sources of which it is comprised into DataFinder. This task was considered due to the presumably large number of diverse data sources of potential use in future TIRP research.

This task was approached by contacting Todd Graham at the Metropolitan Council who was the TAG member that defined this task. Todd Graham was unable to locate the aforementioned LRT Impact Study but recommended that the data sources used in the report be archived within DataFinder. Those data sources from the cities of Minneapolis and Bloomington were identified as including property value information, structure information, and look up tables for Transit Analysis Zones, and building permit information. Portions of these data sources have been previously archived, and other sources were deemed scattered and outside the scope of this project to organize, document, and archive. This task was therefore dropped from further consideration within this project.

3.3.4 Consultant Reports and Data

The fourth additional task identified was to investigate consultant reports done on Transitway issues within the Twin Cities area. Similar to the third task, as described in Section 2.3, the purposes of this request were based in the assumption that a large number of diverse data sources are used in the creation of consultant reports such as the Alternatives Analysis (AA), Environmental Impact Statement (EIS), or Preliminary Engineering (PE) for transit projects such as the Central Corridor LRT line or the Southwest LRT line in the Twin Cities area.

This task was approached first be reviewing the website for the Central Corridor LRT line and the Final EIS documents located on the site. Searching for potential data sources through more than one thousand pages of report and appendices, a number of potential data sources were discovered. Data related to historic sites and structures, tax incremental financing (TIF) districts, and Small Area Plans were the primary potential data sources identified.

This task was discussed at the October 22 TAG meeting and dropped because it was beyond the scope of the project.

3.3.5 Information about Public Investments

The fifth additional task identified was to add information on how to access public investment data. Data related to TIF, capital development, and community development investment is potentially important to TIRP research. The connection between transitways and new development is one often explored and providing information on the varied sources of investment related data could prove useful for TIRP researchers.

This task was approached through contact with Dr. Judith Martin who has investigated this topic. She identified this task as being exceedingly difficult as having found data to be scattered in many departments within any given jurisdiction and oftentimes missing completely. The resources necessary to organize and document this scattered collection of data was determined to outside the scope of this project and dropped from further consideration.

3.4 MetroMSP as a Data Source

This project identified a potentially important data source in a website of MetroMSP. While its purpose is primarily as a commercial real estate listing service (as detailed in DataFinder's Socioeconomic page), its mapping capabilities allow for locating business and demographic information for whatever area one chooses. By identifying an intersection of interest, one can create a buffer of any size around the area and extract current data for that site. Ephemeral information from within this buffer includes the numbers and types of businesses, as well as employment and demographic information. Appendix B provides an example of the current information available for a 1-mile buffer around the planned Snelling and University Avenues LRT station.

Data from this website is not archived, so any desire to document this information for a before and after study of a new transitway, for example, needs to be done prior to the transitway's creation.

This information was brought to the attention of the TAG during their December 10th, 2009 meeting. Committee members felt the data, while useful, was equal to data currently available from the Minnesota Department of Employee and Economic Development (DEED) which is archived. Given TAG feedback, this topic has been dropped from further consideration.

Chapter 4

TASK 3: *Develop methods for adding TIRP datasets to the DataFinder catalog and create metadata on datasets of interest.*

4.0 Task Three

4.1 Completed TIRP Metadata

This TIRP project, in addition to locating and documenting outside data sources, was charged with creating metadata records for a number of data sources. The primary task was writing metadata for two TIRP research projects being pursued at the same time of this project.

4.1.1 TIRP Research Project Data Files

Metadata for TIRP projects by Dr. Edward Goetz and Dr. Xinyu (Jason) Cao was completed as part of this project. Both the metadata and data itself will be uploaded onto the MetroGIS DataFinder website.

The project of Dr. Edward Goetz, entitled "Understanding the Impacts of Transitways - The Hiawatha Line: Impacts on Land Use and Residential Housing Value" was near completion as this project commenced in January of 2009 but due to delays in finalizing the report, metadata was not fully completed until January 2010.

The project of Dr. Xinyu (Jason) Cao, entitled "Understanding the Impacts of Transitways: Demographic and Behavioral Differences between Hiawatha Light-Rail and Other Transit Riders" was begun in April 2009 and fully completed in January 2010.

4.2 Additional Metadata

In addition to creating metadata for TIRP projects, the opportunity arose during the course of this project to author metadata for data sources owned by the Minnesota Department of Revenue. Tax data are valuable sources for future transitway studies and proper documentation is crucial. The two data sources provided by the Department of Revenue were Sales Tax and Income Tax figures for the state of Minnesota for the years 2003 through 2007. This detailed information, broken down by block group in the seven county Metro area and by county and city for greater Minnesota is an important addition to the DataFinder website.

Chapter 5

TASK 4: *Work with the TIRP TAG to develop guidelines that will lead to datasets that better support TIRP research, including creating guidelines for the collection and storage of data. This task includes working with the TIRP TAG and Metropolitan Council representatives to determine how to archive data.*

5.0 Task Four

5.1 Policy on Archiving Data

At its June 29, 2009 meeting, the TAG decided to require a final research data file, along with adequate Metadata, as part of the deliverables for future products.

5.2 Where and How to Archive Data

Clearly, the Metadata should go on the DataFinder website. The question is where to store the data. Besides CURA and the Center for Transportation Studies, two options were pursued: the University Libraries and the Metropolitan Council. The Metropolitan Council hosts the DataFinder website and was our first choice.

5.2.1 University of Minnesota Libraries

The possibility for archiving TIRP data at the University Libraries was one option. They have established a committee to look at archiving faculty research data, but do not have the resources to move forward. Kristi Jensen, Chief Map Librarian and chair of that committee, offered several suggestions:

- University Digital Conservancy (UDC - http://conservancy.umn.edu/). Could probably be adapted to act as a Geospatial Repository, one that could accept GIS files. The Conservancy has not made a commitment to preserve data by updating formats as needed for future use.

- Netfiles (http://www1.umn.edu/netfiles). Netfiles is an online file storage tool centrally managed by the University's Office of Information Technology providing storage to individuals and departments. The University's Map Library has an account and stores some of its files there. Kristi offered to include TIRP research files within her space.

- Dataverse Network (http://thedata.org). This is an open-source web application developed at Harvard to help scholars and others make their data available to others.

5.2.2 Metropolitan Council

Following discussion with Mark Kotz of the Metropolitan Council's GIS Office, the Metropolitan Council is willing to aid in posting the metadata on the DataFinder website in addition to housing the actual data source on its FTP site. This is the best option for TIRP due to the reliability of and current relationship with the Metropolitan Council. Through the services of the Metropolitan Council, both public data and licensed data can be appropriately handled, archived, and distributed.

Chapter 6

TASK 5: *Document methods and procedures that will need to be maintained in order to ensure that relevant datasets are accessible to researchers.*

6.0 Task Five

6.1 Metadata Tutorial

This project, as discussed, included a metadata authoring component. Metadata was written for the aforementioned projects, but future metadata responsibilities will fall onto the principal investigator and his or hers research team. Given the complex nature and exacting requirements and guidelines for metadata completed for TIRP projects, a tutorial was created to aid investigators in the prompt accurate documentation projects.

This tutorial, located in Appendix C, provides a clear understanding of the purpose and benefits of thorough documentation and metadata creation from the viewpoint of the principal investigator. Providing detailed information on all steps necessary to not only download and install the necessary software, but also to write the metadata is important to ensure that the data created during TIRP projects are properly documented in the future.

Chapter 7

7.0 Conclusions

This TIRP project has pursued and accomplished the five key tasks outlined in Chapter 1. The TIRP TAG has been familiarized with the MetroGIS DataFinder website and its virtues for TIRP projects. Numerous additional data sources have been documented on the Socioeconomic page of DataFinder through this research project.

Metadata for two TIRP research projects has been authored in addition metadata on valuable data of the Minnesota Department of Revenue. Ensuring TIRP metadata remains a priority for future TIRP projects, a tutorial for creating metadata was authored. This tutorial will aid both the PI and his or hers research team in understanding not only the technical details of creating metadata, but also the many merits of metadata.

Numerous avenues of potential data sources were pursued as recommended by the TIRP TAG. While not all recommended tasks led to additional documented data, several valuable pieces of data were documented as a result of the TIRP TAG recommendations.

This project has also led to an offer from the Metropolitan Council to aid in hosting TIRP data. While the current list of TIRP data is small, it will continually grow as research efforts and interest on transitways in the region escalate.

Appendix A
Transit Oriented Development Related Data Sources

This document is a summary of a complete TRB study which lists numerous types of data sources of relevance to transit oriented development (TOD). Those source types marked by either a plus sign or a star indicate a similar source type has already been included in MetroGIS DataFinder or, specifically, its Socioeconomic page.

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February 2005

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Subject Areas: I Planning, Administration, and Environment; VI Public Transit

Responsible Senior Program Officer: Christopher W. Jenks

Research Results Digest 294

TRANSIT-ORIENTED DEVELOPMENT: DEVELOPING A STRATEGY TO MEASURE SUCCESS

This digest summarizes key findings from NCHRP Project 20-65(5), "Transit-Oriented Development: Developing a Strategy to Measure Success," conducted by John L. Renne and Jan S. Wells of the Alan M. Voorhees Transportation Center, Edward J. Bloustein School of Planning and Public Policy, Rutgers University.

Available via DataFinder Catalog

Listed in Socioeconomic Page of DataFinder

CONTENTS

SUMMARY

This digest offers a strategy to systematically evaluate the potential success of transit-oriented development. The digest identifies and evaluates various indicators of the impacts of transit-oriented development, provides the results of a survey of transit-oriented development indicators, and identifies ten indicators that can be used to systematically monitor and measure impacts.

Over the past decade, transit-oriented development (TOD) has gained in popularity as a planning tool to promote smart growth. Many articles, books, reports, and plans have discussed the potential benefits of TOD, which vary broadly. But except for studies focusing on transit ridership and land value near stations, little empirical research has been conducted to holistically measure the outcomes of TOD. This study builds on a number of recent projects—namely, work at Rutgers University dealing with the New Jersey Transit Village Initiative and the recently published *TCRP Report 102: Transit Oriented Development in the United States: Experiences, Challenges, and Prospects* (Cervero et al., 2004).

This digest summarizes research conducted to determine the wide range of outcomes and benefits of TOD. The digest also look at who is evaluating TOD across the United States, what are the most useful indicators, how difficult it is to collect data, and how often progress should be monitored. It concludes with suggestions for developing a strategy to monitor the success of TOD.

In looking across the United States to determine what indicators exist, 56 benefits/indicators were identified and categorized into five groups: travel behavior, economic, environmental, built environment, and social diversity/quality. A survey was then conducted of transportation professionals from state departments of transportation, metropolitan planning organizations, county and local governments, and transit agencies concerning the usefulness of each indicator, the difficulty in obtaining the data for each indicator, and the frequency with which each indicator should be monitored.

Based on this research, the most useful indicators are transit ridership, density, quality of streetscape, quantity of mixed-use structures, pedestrian activity and safety, increase in property value and tax revenue, public perception, number of mode connections at the transit station, and parking. While data collection is relatively easy for

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TABLE 5 Travel Behavior Benefits/Indicators

Category	Benefit/Indicator	Measure	Sources
Parking	Number of parking spaces for shoppers only	Number	NJ Transit Village Evaluation[a]
	Number of parking spaces for commuters only	Number	NJDOT; Salt Lake City; NJ Transit Village Evaluation
	Number of parking spaces that are shared	Number	NJ Transit Village Evaluation; Northeast Illinois Commuter Railroad Corporation (METRA)
	Number of parking garages	Number	Puget Sound Regional Council; METRA
	Number of bicycle racks or lockers provided	Number	Puget Sound Regional Council; NJ Transit; Northeastern Illinois Planning Commission; METRA; NJ Transit Village Evaluation
Traffic Flow	Transit ridership	Number	NJ Transit; Los Angeles County Metropolitan Transportation Authority; Port Authority of Allegheny County; Metropolitan Atlanta Rapid Transit Authority; TRI-MET; BART; Santa Clara Valley Transportation Authority; Niagara Frontier Transportation Authority; Seattle Dept. of Transportation; Office of Planning, Washington, D.C.; Portland, Ore., Office of Transportation; San Mateo, Calif.; Mountain View, Calif. Community Development; Contra Costa County, Calif., Redevelopment Agency; Delaware Valley Regional Planning Commission (DVRPC); Atlanta Regional Planning Commission; Indianapolis MPO; Mid-Ohio Regional Planning Commission; Caltrans; NJDOT; Ore. DOT; Miami-Dade Transit Agency; Conn. Department of Transportation; Baltimore Department of City Planning; Salt Lake City; Capital District Transportation Committee, Albany, N.Y.; East-West Gateway Council of Governments; METRA; NJ Transit Village Evaluation
	Number of shuttle or jitney services provided to and from the transit station	Number	NJ Transit Village Evaluation; METRA
	Vehicle miles traveled (VMT) for residents/employees	Miles	Washington Metropolitan Area Transit Agency (WMATA); TRI-MET; North San Diego County Transit District; Seattle Dept. of Transportation; Sacramento; San Diego; San Mateo; Mid-Ohio Regional Planning Commission; Caltrans; Oregon DOT; Conn. Department of Transportation; Capital District Transportation Committee, Albany, N.Y.; East-West Gateway Council of Governments
	Number of single-occupancy-vehicle trips for residents/employees	Number	Seattle Dept. of Transportation; Indianapolis MPO; Greater Buffalo–Niagara Regional Transportation Council
	Bicycle activity counts	Number	San Diego
	Number of traffic control or flow improvements (including traffic calming devices)	Number	Metropolitan Atlanta Rapid Transit Authority; Northern Virginia Transportation Commission; Portland, Ore., Office of Transportation; Portland Metro; NJ Transit Village Evaluation
	Amount of bicycle lanes	Miles/feet	NJ Transit; Southeastern Pennsylvania Transportation Authority; Northeastern Illinois Planning Commission; METRA
	Pedestrian activity counts	Number	Santa Clara Valley Transportation Authority; Port Authority of Allegheny County

[a] The New Jersey Transit Village Evaluation was conducted by VTC on behalf of NJDOT, and the other participating state agencies including NJ Transit (see "Background on Indicators of TOD Success" for a summary of the evaluation of the New Jersey Transit Village Initiative).

TABLE 6 Economic Benefits/Indicators

Category	Benefit/Indicator	Measure	Sources
Public Investment	**Municipal Funds**	Dollars	NJ Transit Village Evaluation
	State funds (detail by source):		
	—Grants	Dollars	NJ Transit Village Evaluation
	—Loans	Dollars	NJ Transit Village Evaluation
	Federal funds (detail by source)		
	—Grants	Dollars	NJ Transit Village Evaluation
	—Loans	Dollars	NJ Transit Village Evaluation
	Tax abatements given	Dollars	NJ Transit Village Evaluation
	Total public investment	Dollars	NJ Transit Village Evaluation; METRA
Private Investment	**Commercial**		
	New or substantially rehabilitated retail/office space	Square footage	TRI-MET; BART; Office of Planning, Washington, D.C.; Boston Redevelopment Authority (BRA); DVRPC; Atlanta Regional Planning Commission; Greater Cleveland Regional Transit Authority; Miami-Dade Transit Agency; Colo. DOT; Baltimore Dept. of City Planning; Englewood, Colo.; Salt Lake City; Sacramento Economic Development Department; Capital District Transportation Committee, Albany, N.Y.; METRA; NJ Transit Village Evaluation
	Number of convenience retail establishments (e.g., dry cleaning, video rental)	Number	METRA
	Estimated private investment	Dollars	NJ Transit Village Evaluation; METRA
	Estimated new property taxes generated	Dollars	Niagara Frontier Transportation Authority; NJ Transit Village Evaluation
	Housing		
	New or substantially rehabilitated housing units	Number of units	TRI-MET; BART; Office of Planning, Washington, D.C.; BRA; DVRPC; Atlanta Regional Planning Commission; Miami-Dade Transit Agency; Baltimore Department of City Planning; Englewood, Colo.; Salt Lake City; Capital District Transportation Committee, Albany, N.Y.; NJ Transit Village Evaluation
	Minor housing improvements	Dollars	NJ Transit Village Evaluation
	Estimated private investment	Dollars	NJ Transit Village Evaluation
	Estimated new property taxes generated	Dollars	NJ Transit Village Evaluation; Englewood, Colo.
	Estimated increase in property value	Dollars	TRI-MET; DART; Contra Costa County Redevelopment Authority; Seattle; Englewood, Colo.; Salt Lake City; NJ Transit Village Evaluation

TABLE 6 (Continued)

Category	Benefit/Indicator	Measure	Sources
Private Investment *(continued)*	**Configuration**		
	Studio/one bedroom	Number of units	NJ Transit Village Evaluation
	Two bedrooms	Number of units	NJ Transit Village Evaluation
	Three or more bedrooms	Number of units	NJ Transit Village Evaluation
	Tenure		
	For sale	Number of units	NJ Transit Village Evaluation
	For rent	Number of units	NJ Transit Village Evaluation
	Subsidized units (with income income limits)	Number of units	NJ Transit Village Evaluation
	For sale	Number of units	NJ Transit Village Evaluation
	For rent	Number of units	NJ Transit Village Evaluation

TABLE 7 Environmental Benefits/Indicators

Category	Benefit/Indicator	Measure	Sources
Air Quality	Amount of air pollution (NO_x, CO_2, PM)	Air Pollution Index (API) reports	San Francisco Municipal Railway; North San Diego County Transit District; Sacramento; San Diego; Mountain View, Calif., Community Development; Portland Metro; Mid-Ohio Regional Planning Commission; Caltrans; Oregon DOT; Baltimore Department of City Planning; Englewood, Colo.; East-West Gateway Council of Governments
Energy Use	Consumer gasoline consumption	Gallons	Caltrans

TABLE 8 Built Environment Benefits/Indicators

Category	Benefit/Indicator	Measure	Sources
Design Quality	Presence of pedestrian-orientation/human scale	Subjective/width and height proportions	NJ Transit; Columbus Planning Division; Seattle; Charlotte Planning Division; Northeastern Illinois Planning Commission; Mountain View, Calif., Community Development; Salt Lake City Redevelopment Agency; BRA; North Central Texas Council of Governments; Greater Buffalo–Niagara Regional Transportation Council; Salt Lake City; Redwood City, Calif., Redevelopment Agency; East-West Gateway Council of Governments; METRA
Pedestrian Friendliness	Length of improved streetscape	Feet	NJ Transit Village Evaluation
	Number of improved intersections/street crossings for pedestrian safety	Number	NJ Transit Village Evaluation; METRA
	Length of façade improvement	Feet	NJ Transit Village Evaluation
	Amount of brownfield properties remediated under a DEP-approved plan	Acreage	NJ Transit Village Evaluation
	Number/size of vacant buildings rehabilitated or replaced	Number/square feet	NJ Transit Village Evaluation
	Number/amount of underutilized vacant lots reclaimed for construction or green/recreation space	Number/acreage	North San Diego County Transit District; NJ Transit Village Evaluation
	Number of new or improved park areas	Number	Southeastern Pennsylvania Transportation Authority; DART; Northern Virginia Transportation Commission; Mid-Ohio Regional Planning Commission; Caltrans; METRA; NJ Transit Village Evaluation
Land Use	Number of mixed-use structures	Number/square footage	NJ Transit; LA County Metropolitan Transportation Authority; Southeastern Pennsylvania Transportation Authority; WMATA; DART; Santa Clara Valley Transportation Authority; Niagara Frontier Transportation Authority; Sacramento Regional Transit District; Peninsula Corridor Joint Powers Board; Seattle DOT; Office of Planning, Washington, D.C.; Sacramento; Columbus Planning Division; Seattle; Charlotte Planning Department; San Mateo, Calif.; Northeastern Illinois Planning Commission;

TABLE 9 Social Diversity/Quality Benefits/Indicators

Category	Benefit/Indicator	Measure	Sources
Social	Amount of crime	Crime rate	WMATA; BART; Caltrans
	New cultural/artistic institutions or establishments	Number	Sacramento Regional Transit District; DART; NJDOT
	Number of neighborhood associations	Number	Northern Virginia Transportation Commission
	Public perception (administered survey)	Percentage in favor	Mountain View, Calif., Community Development Dept.
	Household diversity	Age/household income	Sacramento; San Diego; Columbus Planning Division; Mountain View, Calif., Community Development Dept.; Ore. DOT; METRA
	Increase in household disposable income	Dollars	Mid-Ohio Regional Planning Commission; Caltrans; Ore. DOT
	Number of affordable housing units	Units per acre	Portland Development Commission; Salt Lake City Redevelopment Agency; BRA; Miami-Dade Transit Agency

Appendix B
MetroMSP Data

This information is a sample of the type of data that can be acquired, in Word, Excel, or PDF format, for areas in the Twin Cities region from MetroMSP. This is ephemeral data, meaning it is not archived; rather, this data would need to be collected yearly to create a historical record of changes. The particular site chosen for this example, Snelling Avenue and University Avenue, was chosen due to it being identified as a station location for the planned Central Corridor Light Rail Transit line.

Central Corridor Station Area

University Avenue & Snelling Avenue

Example of Ephemeral Data Available Through MetroMSP

Data Acquired On November 12, 2009 From
www.mspprospector.com

One (1) Mile Buffer Placed Around Intersection Area Address of:

1600 University Avenue W St. Paul, MN 55104

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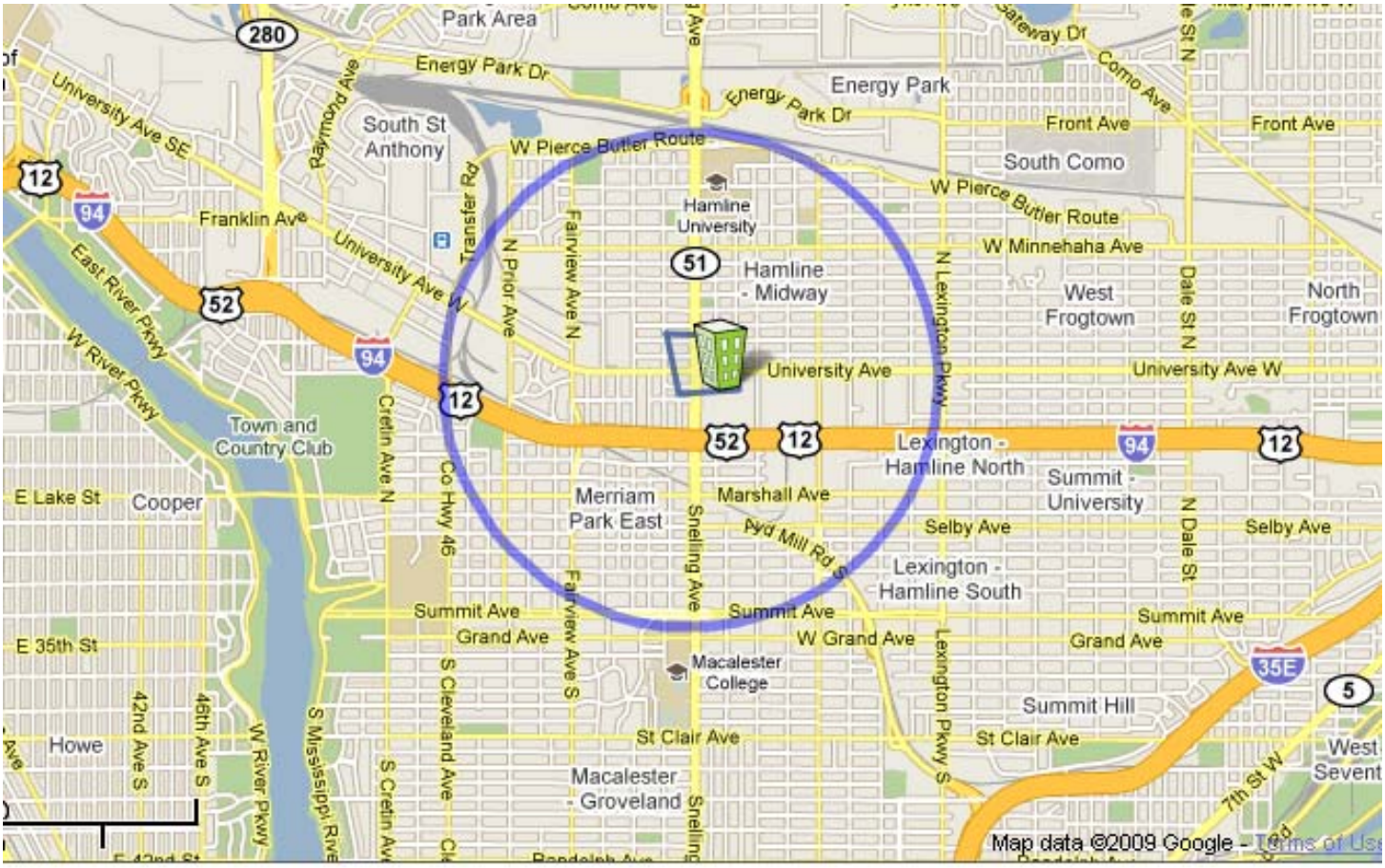
*Note: Maps are only available as screen shots taken during a given search.



Demographic Report

Report Center: 1600 University Ave W

Radius: 1 miles

Population (2009)			Population (2014)		
	Total	**%**		**Total**	**%**
2009 Population	20,105		**2014 Population**	20,027	
Sex (2009)			**Sex (2014)**		
	Total	**%**		**Total**	**%**
Male	9,725	48.4%	**Male**	9,724	48.6%
Female	10,380	51.6%	**Female**	10,303	51.4%
Age Distribution (2009)			**Age Distribution (2014)**		
	Total	**%**		**Total**	**%**
0-4	1,296	6.4%	**0-4**	1,424	7.1%
5-9	1,074	5.3%	**5-9**	1,078	5.4%
10-19	2,706	13.5%	**10-19**	2,505	12.5%

20-29	4,132	20.6%	**20-29**	4,196	21.0%
30-39	2,967	14.8%	**30-39**	2,762	13.8%
40-49	2,894	14.4%	**40-49**	2,725	13.6%
50-59	2,403	12.0%	**50-59**	2,358	11.8%
60-64	751	3.7%	**60-64**	917	4.6%
65+	1,882	9.4%	**65+**	2,062	10.3%
Race Distribution (2009)			**Race Distribution (2014)**		
	Total	**%**		**Total**	**%**
White	14,826	73.7%	**White**	15,646	78.1%
Black	2,611	13.0%	**Black**	1,468	7.3%
American Indian	212	1.1%	**American Indian**	306	1.5%
Asian	941	4.7%	**Asian**	1,196	6.0%
Pacific Islander	9	0.0%	**Pacific Islander**	14	0.1%
Other	441	2.2%	**Other**	456	2.3%
Multirace	1,065	5.3%	**Multirace**	941	4.7%
Hispanic	942	4.7%	**Hispanic**	1,027	5.1%
2009 Total Households			**2014 Total Households**		
	Total	**%**		**Total**	**%**
Households	8,406		**Households**	8,189	
Families	3,940	46.9%	**Families**	4,028	49.2%
2009 Household Income Distribution			**2014 Household Income Distribution**		
	Total	**%**		**Total**	**%**
	743	8.8%		672	8.2%
$10-$20K	934	11.1%	**$10-$20K**	872	10.6%
$20-$30K	940	11.2%	**$20-$30K**	814	9.9%
$30-$40K	958	11.4%	**$30-$40K**	897	11.0%
$40-$50K	867	10.3%	**$40-$50K**	804	9.8%
$50-$60K	707	8.4%	**$50-$60K**	702	8.6%
$60-$75K	827	9.8%	**$60-$75K**	805	9.8%
$75-$100K	1,054	12.5%	**$75-$100K**	1,014	12.4%
> $100K	1,376	16.4%	**> $100K**	1,609	19.6%
2009 Labor Force Status			**2014 Labor Force Status**		
	Total	**%**		**Total**	**%**

Labor Force	12,094		**Labor Force**	12,028	
Employed	11,148	92.2%	**Employed**	11,220	93.3%
Unemployed	944	7.8%	**Unemployed**	803	6.7%
In Armed Forces	2		**In Armed Forces**	5	
Not In Labor Force	4,328		**Not In Labor Force**	4,200	
2009 Total Number of Housing			**2014 Total Number of Housing**		
	Total	**%**		**Total**	**%**
Total Dwellings	8,927		**Total Dwellings**	8,464	
Owner-Occupied Dwellings	4,213	50.1%	**Owner-Occupied Dwellings**	3,525	43.0%
Renter-Occupied Dwellings	4,193	49.9%	**Renter-Occupied Dwellings**	4,664	57.0%
Housing Units Occupied	8,406	94.2%	**Housing Units Occupied**	8,189	96.8%
2009 Education Attainment			**2014 Education Attainment**		
	Total	**%**		**Total**	**%**
Population Age 25+	12,498		**Population Age 25+**	12,574	
< Grade 9	538	4.3%	**< Gr 9**	555	4.4%
Grade 9-12	488	3.9%	**Gr 9-12**	441	3.5%
High School	2,356	18.9%	**High School**	2,364	18.8%
Some College	2,322	18.6%	**Some College**	2,161	17.2%
Assoc Degree	1,013	8.1%	**Assoc Degree**	929	7.4%
Bach Degree	3,444	27.6%	**Bach Degree**	3,610	28.7%
Grad Degree	2,337	18.7%	**Grad Degree**	2,514	20.0%
2009 Size of Household			**2014 Size of Household**		
	Total	**%**		**Total**	**%**
1 Person	3,331	39.6%	**1 Person**	3,084	37.7%
2 Person	2,440	29.0%	**2 Person**	2,465	30.1%
3 Person	1,187	14.1%	**3 Person**	1,217	14.9%
4 Person	804	9.6%	**4 Person**	799	9.8%
5 Person	377	4.5%	**5 Person**	365	4.5%
6+ Person	157	1.9%	**6+ Person**	154	1.9%

Source: Applied Geographic Solutions, Thousand Oaks. CA, 2009

Consumer Expenditures

Report Center: 1600 University Ave W
Radius: 1 miles

Consumer Expenditures (2009)					
	$ Per Household	**Total $000s**		**$ Per Household**	**Total $000s**
Apparel	2,333	19,608	**Personal Care**	713	5,995
Men's Apparel	446	3,750	Hair Care	56	467
Boys' Apparel	111	932	Electric Personal Care Appliances	14	116
Women's Apparel	781	6,562	Personal Care Services	478	4,015
Girls' Apparel	151	1,266	Personal Care Products	166	1,397
Infants Apparel	103	864	**Reading**	162	1,358
Footwear	379	3,185	Newspapers	69	582
Apparel Services and Accessories	363	3,049	Magazines	33	279
Education	1,168	9,817	Books	59	497
Books And Supplies	162	1,358	**Tobacco**	330	2,773
Tuition	1,006	8,458	Cigarettes	297	2,495
Entertainment	2,710	22,782	Other Tobacco Products	33	278
Fees And Admissions	686	5,770	**Transportation**	9,744	81,912
Video And Audio Equipment	957	8,048	New Vehicle Purchase	2,478	20,831
Recreational Equipment And Supplies	1,066	8,963	Used Vehicle Purchase	1,572	13,214
Food and Beverages	7,535	63,342	Motorcycles (New And Used)	67	564
Food At Home	3,945	33,161	Vehicle Finance Charges	468	3,933
Food Away From Home	3,015	25,342	Gasoline And Oil	2,182	18,341
Alcoholic Beverages	576	4,839	Vehicle Repair And Maintenance	766	6,440
Health Care	3,045	25,598	Vehicle Insurance	1,117	9,393
Health Care Insurance	1,473	12,381	Public Transportation	552	4,638
Health Care Services	738	6,207	Other Transportation Costs	542	4,558

Health Care Supplies And Equipment	834	7,010	**Utilities**	3,491	29,346
Household Furnishings and Equipment	2,127	17,877	Natural Gas	486	4,088
Household Textiles	152	1,274	Electricity	1,280	10,759
Furniture	573	4,820	Fuel Oil And Other Fuels	127	1,068
Floor Coverings	72	602	Telephone Service	1,198	10,070
Major Appliances	245	2,058	Other Utilities	400	3,361
Housewares And Small Appliances	1,085	9,123	**Gifts**	1,276	10,723
Shelter	9,394	78,963	Gifts Of Apparel	254	2,137
Mortgage Interest	3,749	31,516	Gifts Of Apparel Accessories	33	279
Property Taxes	1,573	13,221	Gifts Of Education	257	2,164
Miscellaneous Owned Dwelling Costs	1,283	10,786	Gifts Of Recreation	88	738
Rental Costs	2,235	18,785	Gifts Of Food And Beverages	117	979
Other Lodging	554	4,656	Gifts Of Household Furnishings And Equipment	209	1,759
Household Operations	1,706	14,339	Gifts Of Household	55	466
Babysitting And Elderly Care	397	3,334	Gifts Of Transportation	65	550
Household Services	307	2,583	Gifts Elsewhere Unspecified	197	1,652
Alimony And Child Support	254	2,132	**Personal Insurance**	488	4,101
Household Supplies	748	6,290	**Contributions**	1,758	14,779
Miscellaneous Expenses	831	6,987			
Legal And Accounting	99	836			
Funeral And Cemetery	90	753			
Finance Charges Excluding Mortgage And Vehicle	538	4,526			
Other Miscellaneous Expenses	104	872			

Source: Applied Geographic Solutions, Thousand Oaks. CA, 2009

Business and Workforce

Report Center: 1600 University Ave W
Radius: 1 miles

Total Establishments	1,161		**Total Employees by Major SIC (2009)**		
Total Employees	15,614			**Total**	**%**
Total Establishments by Size (2009)			**Agricultural, Forestry, Fishing (SIC Range 01-09)**	73	0.5%
	Total	**%**	**Mining (SIC 10-14)**	2	0.0%
1-4 Employees	659	56.8%	**Construction (SIC 15-17)**	364	2.3%
5-9 Employees	236	20.3%	**Manufacturing (SIC 20-39)**	586	3.8%
10-19 Employees	137	11.8%	**Transportation and Communications (SIC 40-49)**	160	1.0%
20-49 Employees	87	7.5%	**Wholesale Trade (SIC 50-51)**	248	1.6%
50-99 Employees	21	1.8%	**Retail Trade (SIC 52-59)**	2,887	18.5%
100-249 Employees	14	1.2%	**Finance, Insurance And Real Estate (SIC 60-69)**	572	3.7%
250-499 Employees	4	0.3%	**Services (SIC 70-89)**	10,341	66.2%
500-999 Employees	2	0.2%	**Public Administration (SIC 90-98)**	259	1.7%
1000+ Employees	1	0.1%	**Unclassified (SIC 99)**	122	0.8%
Total Businesses by Establishment Type (2009)			**Total Employees by Establishment Type (2009)**		
	Total	**%**		**Total**	**%**
Agriculture, Forestry and Fishing	0	0.0%	**Agriculture, Forestry and Fishing**	0	0.0%
Agricultural Services	8	0.7%	**Agricultural Services**	73	0.5%
Coal and Ore Mining	1	0.1%	**Coal and Ore Mining**	2	0.0%
Oil and Gas	0	0.0%	**Oil and Gas**	0	0.0%
General Construction	19	1.6%	**General Construction**	163	1.0%

Heavy Construction	18	1.6%	**Heavy Construction**	201	1.3%
Food Manufacturing	0	0.0%	**Food Manufacturing**	0	0.0%
Tobacco Manufacturing	0	0.0%	**Tobacco Manufacturing**	0	0.0%
Textile Mills	0	0.0%	**Textile Mills**	0	0.0%
Apparel and Textile Manufacturing	0	0.0%	**Apparel and Textile Manufacturing**	0	0.0%
Lumber and Wood Production	0	0.0%	**Lumber and Wood Production**	0	0.0%
Furniture Manufacturing	1	0.1%	**Furniture Manufacturing**	6	0.0%
Paper Manufacturing	1	0.1%	**Paper Manufacturing**	40	0.3%
Printing and Publishing	17	1.5%	**Printing and Publishing**	181	1.2%
Chemicals	0	0.0%	**Chemicals**	0	0.0%
Petroleum Refining	0	0.0%	**Petroleum Refining**	0	0.0%
Rubber and Plastics	1	0.1%	**Rubber and Plastics**	15	0.1%
Leather Manufacturing	0	0.0%	**Leather Manufacturing**	0	0.0%
Stone, Glass, and Concrete	1	0.1%	**Stone, Glass, and Concrete**	7	0.0%
Metals Fabrication	7	0.6%	**Metals Fabrication**	293	1.9%
Machinery and Equipment Manufacturing	8	0.7%	**Machinery and Equipment Manufacturing**	44	0.3%
Transportation	16	1.4%	**Transportation**	122	0.8%
Travel Services	6	0.5%	**Travel Services**	12	0.1%
Transport Services	1	0.1%	**Transport Services**	6	0.0%
Communications	3	0.3%	**Communications**	20	0.1%
Utilities	0	0.0%	**Utilities**	0	0.0%

Durables Wholesale	34	2.9%	Durables Wholesale	220	1.4%
Non Durables Wholesale	5	0.4%	Non Durables Wholesale	28	0.2%
Total Businesses by Establishment Type (2009)			**Total Employees by Establishment Type (2009)**		
	Total	**%**		**Total**	**%**
Building Materials, Hardware and Garden	9	0.8%	Building Materials, Hardware and Garden	69	0.4%
General Merchandise Stores	8	0.7%	General Merchandise Stores	695	4.5%
Food Markets	7	0.6%	Food Markets	500	3.2%
Convenience Stores	6	0.5%	Convenience Stores	42	0.3%
Other Food Stores	6	0.5%	Other Food Stores	39	0.2%
Auto Dealers and Gas Stations	19	1.6%	Auto Dealers and Gas Stations	142	0.9%
Clothing Stores	20	1.7%	Clothing Stores	175	1.1%
Furniture Stores	5	0.4%	Furniture Stores	30	0.2%
Home Furnishings	6	0.5%	Home Furnishings	58	0.4%
Electronics and Computer Stores	5	0.4%	Electronics and Computer Stores	46	0.3%
Music Stores	7	0.6%	Music Stores	34	0.2%
Restaurants	30	2.6%	Restaurants	485	3.1%
Other Food Service	12	1.0%	Other Food Service	127	0.8%
Bars	5	0.4%	Bars	36	0.2%
Drug Stores	8	0.7%	Drug Stores	107	0.7%
Liquor Stores	3	0.3%	Liquor Stores	24	0.2%
Specialty Stores	52	4.5%	Specialty Stores	272	1.7%

Catalog and Direct Sales	1	0.1%	**Catalog and Direct Sales**	6	0.0%
Banks and Financial Institutions	29	2.5%	**Banks and Financial Institutions**	391	2.5%
Insurance Carriers	0	0.0%	**Insurance Carriers**	0	0.0%
Insurance Agents and Brokers	16	1.4%	**Insurance Agents and Brokers**	61	0.4%
Real Estate	28	2.4%	**Real Estate**	120	0.8%
Hotels and Lodging	2	0.2%	**Hotels and Lodging**	157	1.0%
Dry Cleaning and Laundry	3	0.3%	**Dry Cleaning and Laundry**	6	0.0%
Beauty and Barber Shops	30	2.6%	**Beauty and Barber Shops**	76	0.5%
Other Personal Service	27	2.3%	**Other Personal Service**	159	1.0%
Advertising	5	0.4%	**Advertising**	23	0.1%
Computer Services	4	0.3%	**Computer Services**	19	0.1%
Other Business Services	55	4.7%	**Other Business Services**	3,162	20.3 %
Auto Repair/Services	23	2.0%	**Auto Repair/Services**	171	1.1%
Miscellaneous Repair Services	13	1.1%	**Miscellaneous Repair Services**	44	0.3%
Motion Pictures	10	0.9%	**Motion Pictures**	28	0.2%
Entertainment and Recreation Services	19	1.6%	**Entertainment and Recreation Services**	166	1.1%
Health and Medical Services	166	14.3 %	**Health and Medical Services**	1,171	7.5%
Hospitals	22	1.9%	**Hospitals**	1,604	10.3 %
Legal Services	30	2.6%	**Legal Services**	89	0.6%
Primary and Secondary Education	19	1.6%	**Primary and Secondary Education**	771	4.9%
Colleges and Universities	4	0.3%	**Colleges and Universities**	725	4.6%

Social Services	92	7.9%	Social Services	1,044	6.7%
Child Care Services	13	1.1%	Child Care Services	163	1.0%
Museums and Zoos	2	0.2%	Museums and Zoos	22	0.1%
Membership Organizations	65	5.6%	Membership Organizations	322	2.1%
Professional Services	43	3.7%	Professional Services	262	1.7%
Government	16	1.4%	Government	259	1.7%
Unclassified Establishments	51	4.4%	Unclassified Establishments	122	0.8%

Total Employees by Occupation (2009)		
	Total	%
Executive, Managers, and Administrators	1,454	9.3%
Professional Specialty Occupations	2,604	16.7 %
Sales Professionals	280	1.8%
Technologies and Technicians	535	3.4%
Sales Workers and Clerks	1,297	8.3%
Administrative Support Workers	2,712	17.4 %
Technical, Sales, and Administrative: Field Occupations	42	0.3%
Private Household Service	1	0.0%
Protective Services	187	1.2%
Other Services: Site Based	3,154	20.2 %
Other Services: Field Based	267	1.7%
Farming, Forestry, and Fishing	224	1.4%
Precision, Craft, and Repair:	1,230	7.9%

Site Based		
Construction, Repair, and Mining: Field Based	323	2.1%
Machine Operators, Assemblers, and Inspectors	392	2.5%
Transportation and Materials Moving Workers	371	2.4%
Handlers, Helpers and Laborers	419	2.7%

Source: Applied Geographic Solutions, Thousand Oaks. CA, 2009

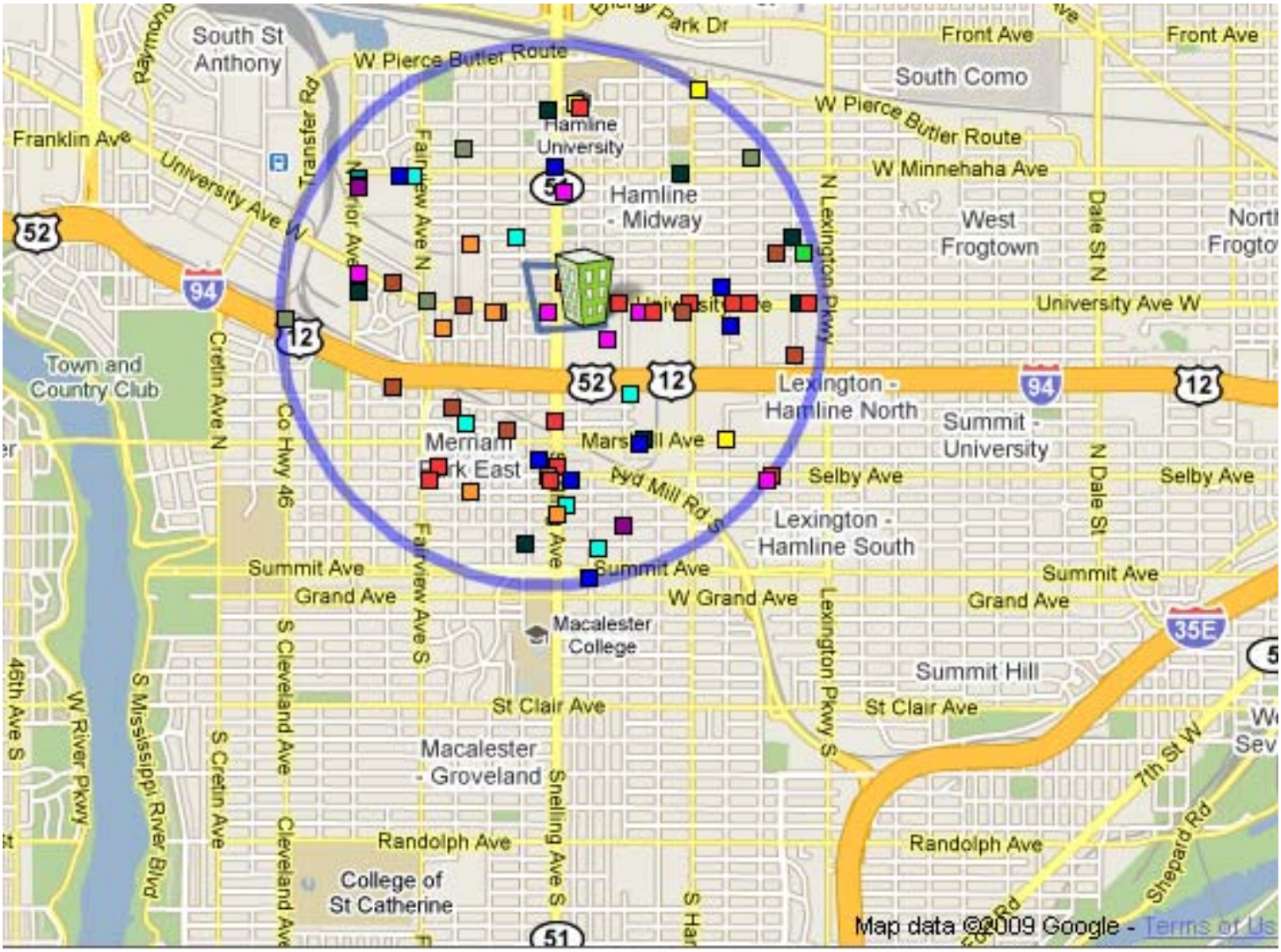
2005 Employee Wages for MSA
(showing 1st 2 pages of the 19 page complete report)

Report Center: 1600 University Ave W
Radius: 1 miles
MSA: Minneapolis-St. Paul-Bloomington, MN-WI

Occupation	Median Hourly Wage	Median Annual Wage
All Occupations	$18.32	$38,110
Management occupations	$47.26	$98,300
Chief executives	#	#
General and operations managers	$47.99	$99,820
Legislators	*	$15,120
Advertising and promotions managers	$51.82	$107,790
Marketing managers	$56.09	$116,660
Sales managers	$51.23	$106,560
Public relations managers	$48.65	$101,190
Administrative services managers	$38.14	$79,320
Computer and information systems managers	$54.61	$113,590
Financial managers	$52.98	$110,200
Compensation and benefits managers	$51.89	$107,930
Training and development managers	$49.22	$102,390
Human resources managers, all other	$49.00	$101,920
Industrial production managers	$44.40	$92,350
Purchasing managers	$48.17	$100,190
Transportation, storage, and distribution managers	$40.30	$83,820
Construction managers	$42.67	$88,750
Education administrators, preschool and child care center/program	$18.92	$39,350
Education administrators, elementary and secondary school	*	$97,410
Education administrators, postsecondary	$38.43	$79,930
Education administrators, all other	$39.79	$82,760
Engineering managers	$55.37	$115,170
Food service managers	$19.49	$40,530
Funeral directors	$32.65	$67,920
Gaming managers	$31.81	$66,160
Lodging managers	$21.56	$44,850

Medical and health services managers	$43.19	$89,830
Natural sciences managers	$55.87	$116,220
Postmasters and mail superintendents	$33.60	$69,880
Property, real estate, and community association managers	$23.50	$48,880
Social and community service managers	$31.58	$65,690
Managers, all other	$48.19	$100,240
Business and financial operations occupations	$27.59	$57,400
Agents and business managers of artists, performers, and athletes	$42.93	$89,300
Purchasing agents and buyers, farm products	$27.64	$57,480
Wholesale and retail buyers, except farm products	$26.93	$56,020
Purchasing agents, except wholesale, retail, and farm products	$27.70	$57,620
Claims adjusters, examiners, and investigators	$23.47	$48,810
Insurance appraisers, auto damage	$26.62	$55,370
Compliance officers, except agriculture, construction, health and safety, and transportation	$26.37	$54,850
Cost estimators	$27.82	$57,860
Emergency management specialists	$31.07	$64,620
Employment, recruitment, and placement specialists	$25.12	$52,240
Compensation, benefits, and job analysis specialists	$26.20	$54,490
Training and development specialists	$27.94	$58,100
Human resources, training, and labor relations specialists, all other	$29.20	$60,740
Logisticians	$32.69	$67,990
Management analysts	$38.45	$79,980
Meeting and convention planners	$21.56	$44,840
Business operations specialists, all other	$25.07	$52,150
Accountants and auditors	$28.47	$59,210
Appraisers and assessors of real estate	$24.10	$50,130
Budget analysts	$31.14	$64,780
Credit analysts	$27.15	$56,470

Financial analysts	$33.90	$70,510
Personal financial advisors	$28.50	$59,290



Business Report

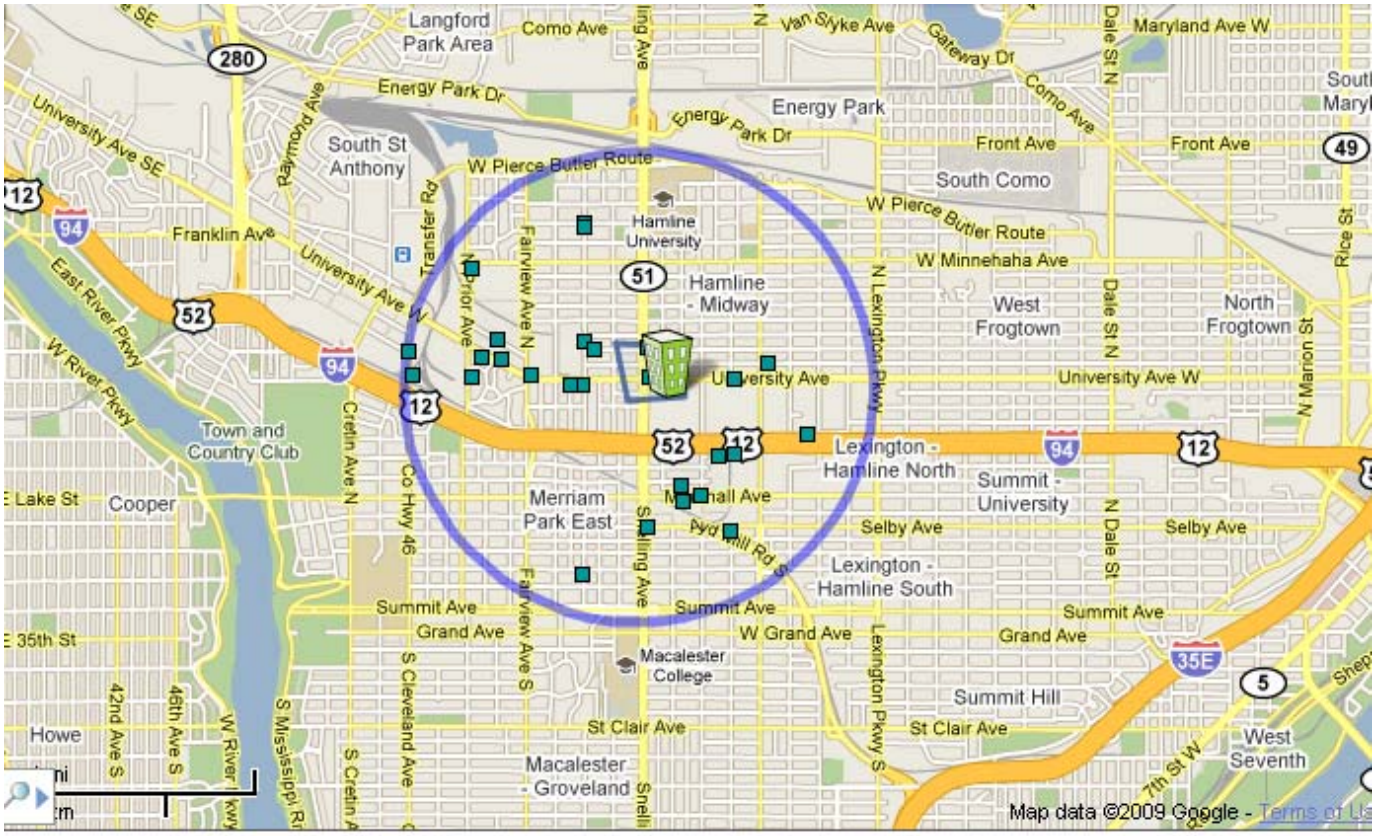
Report Center: 1600 University Ave W

Radius: 1 miles

Business Type	Total	%
TRANSPORTATION AND WAREHOUSING	31	2%
INFORMATION	41	3%
REAL ESTATE	56	4%
RETAIL TRADE	187	12%
CONSTRUCTION	89	6%
OTHER SERVICES	206	13%
PUBLIC ADMINSTRATION	13	1%
AGRICULTURE, FORESTRY, FISHING AND HUNTING	3	0%

PROFESSIONAL, SCIENTIFIC, AND TECHNICAL SERVICES	173	11%
MANAGEMENT OF COMPANIES AND ENTERPRISES	2	0%
EDUCATIONAL SERVICES	54	4%
MINING	1	0%
MANUFACTURING	71	5%
FINANCE AND INSURANCE	54	4%
ACCOMMODATION AND FOOD SERVICES	61	4%
ARTS, ENTERTAINMENT, AND RECREATION	22	1%
HEALTH CARE AND SOCIAL ASSISTANCE	267	17%
ADMINISTRATIVE AND SUPPORT AND WASTE MANAGEMENT AND REMEDIATION SERVICES	147	10%
WHOLESALE TRADE	66	4%

Source: Dun & Bradstreet, 2009



Business Report For "Transportation and Warehousing" Business Type

Report Center: 1600 University Ave W
Radius: 1 miles

Name	# of Employees	Name	# of Employees
AAA Midway Inside Storage	3	Demar Storage	2
Accessible Self Mini Stor Whse	2	Diamond Taxi Cab Corp	6
Airport Shuttle Service	10	Dukes Cars and Towing	3
All American Self Storage	2	Eagan Transportation Mm L	2
American Taxicab Service Corp	1	Express Shipping	3
Anderson Boat Docks & Acc	1	G Logan & Sons Hauling Inc	1
Bartusch Brokerage	1	Hospitech LLC	2
Chermak Trucking Joe	1	Judge Trucking Co	1
City Cab	2	Lemmy O Productions Towing	1
Container Logistics Inc	2	Mainstream Transportation Inc	5

Source: Dun & Bradstreet, 2009

Appendix C
Metadata Tutorial

This metadata tutorial provides a summary for both the Principal Investigator (PI) and his or her research assistant(s) on the purpose and benefits of metadata in addition to the correct methods for creating metadata for TIRP projects. It includes details on which software(s) is necessary, where to download it, appropriate options to select, as well as assistance in how to fill out specific metadata fields.

Tutorial for Metadata Creation

Transitway Impacts Research Program

January 2010

CURA
301 19th Avenue S
330 HHH Center
Minneapolis, MN 55455

- This tutorial was developed for Transitway Impact Research Program (TIRP) projects. Any TIRP project that develops a new dataset as part of its analysis is required to document and archive that data. Metadata is a standard way of documenting data. This tutorial is intended to guide researchers and their staff in developing their Metadata for spatial data used in GIS.

- There is no need to document single sources that are used in the research if it is standard data available to all; e.g. Census or MetroGIS parcel data. It becomes important to document and archive data that is a composite of multiple sources. It is critical when the data is unique or ephemeral.

- The archived dataset should be a clean version ready for use in subsequent studies. When possible, all data used in the study should be combined into a single file. The variables should be a basic set of essential measures, with temporary variables removed.

- Studies not using GIS are still required to document and archive their data.

- Completed metadata and components (map sample, etc.) will be turned over to the Metropolitan Council's GIS Office for final compilation and publishing on MetroGIS DataFinder.

To the Principal Researcher:

- **Identification**
  - Title, abstract, time frame, keywords.
    - *Housing sales along Hiawatha LRT. Study from 2002-2007*
- **Data Quality**
  - Accuracy and completeness of the data. Process of how data sources were compiled.
    - *Missing sales data in parcel layer. Filled in with information from Realtor organization.*
- **Spatial Data Organization**
  - Spatial object type and software used.
    - *Polygon objects using ArcGIS 9.3*
- **Spatial Reference**
  - Projection and coordinate system used.
    - *UTM Zone 15 , NAD 83*
- **Entity and Attribute**
  - Brief explanation of what the GIS information is for (Entity)
    - *Parcels in Minneapolis and Bloomington with a recorded sale between 2002 and 2007.*
  - List of each and every data field (Attribute) with a description.
    - *Prop_val06 = Assessed property value in 2006.*
- **Distribution**
  - Publisher, distribution liability, file transfer size
    - *CURA, Users accept this data as is and understand that no guarantee, written or implied, exists for this GIS data. , 1.2 mb zipped folder.*
- **Metadata Reference**
  - Contact information for person who writes the metadata.
    - *John Q. Gradstudent, Transitway Research Assistant.*

Metadata is data about data. The purpose of it is to document your GIS work to explain what you did, why you did it, and why it is important. While it is an additional step in your research project, the benefits are many. Future parties interested in your work will be able to maximize the usefulness of your research. Additionally, thorough documentation reduces the time you need to spend answering questions and repeatedly explaining what your research did and how it did it. Most importantly, however, is that it will help you if and when you revisit your research in the future. Research assistants who aided your research will most likely be gone, and it will be up to you to refamilarize yourself with the research. This is undoubtedly easier with the help of well documented metadata.

GIS Metadata consists of seven primary categories of information type. Shown on the left are the seven categories along with a few of the components required in each category, along with an example of the different components.

Please provide your research assistant this document to ensure the accurate and conforming creation of metadata for your research project. Please remember that while the metadata created for this project will benefit the general public and other interests, it is highly likely that *you* will be the primary beneficiary of this information. Hence, it is in your interest to be as accurate and thorough in creating the metadata in accordance to the TIRP guidelines.

In addition, while this document is intended primarily to aid in the creation of GIS metadata, metadata for non-spatial data sources (such as a large spreadsheet) can also be created following the links in either Step 1 or Step 2 and otherwise following the same basic guidelines and suggestions.

Thank You.

1. Minnesota has created a standardized metadata format modeled after a standard federal format. Creating metadata in the Minnesota format first requires downloading the Minnesota Geographic Metadata Guidelines (MGMG) Metadata Editor. Visit http://www.lmic.state.mn.us/chouse/arccatalog.html#install and follow the directions to download and install on the computer. This software extension requires ESRI ArcCatalog to function, but it can also be used to create non-GIS based metadata.

2. If you have ArcCatalog, please skip this step. If you do not have access to ArcCatalog and the data for which metadata is being written is not GIS based, visit http://www.lmic.state.mn.us/chouse/datalogr_download.html and download the DataLogr software. DataLogr follows a similar platform to the MGMG Metatdata Editor but is used to create non-GIS based metadata (a large spreadsheet of data, for example) when the ArcCatalog software is unavailable.

3. Having installed the MGMG Metadata Editor, it is imperative to set some settings within ArcCatalog to ensure accurate metadata creation. In ArcCatalog, under Tools>Options>Metadata, make sure to select MGMG as the default stylesheet in the 1st drop down box. Then, make sure the following 2 boxes are *not* checked. Finally, in the last drop down box, select MGMG Editor as the Metadata Editor. Press Apply then OK. Detailed, full color picture details of this step can be found in C:\arcgis\MGMG_Editor\tutorial\MGMG_ArcCatalog_tutorial.pdf, assuming the MGMG Metadata Editor was installed in its default location.

4. Before metadata creation can begin, it is first necessary to decide for which file metadata will be created. Ideally, each research project will have only one GIS shapefile or Excel spreadsheet for which metadata is necessary. Multiple files can be joined into one larger file to ensure all important fields or attributes are included. If secondary and tertiary files exist that cannot be combined together and the principal researcher believes said files will be valuable to the general public or future researchers, additional metadata files can be created.

5. Once the file(s) is chosen for metadata creation, create a blank XML document by going to File>New>XML Document. This can also be done by right clicking within the folder you wish to place the metadata and selecting New>XML Document. After the XML document is made and appropriately named, ensure that MGMG is selected as the stylesheet and then click the Edit Metadata icon. **DO NOT CREATE METADATA WITHIN THE ACTUAL SHAPEFILE FOR WHICH THE METADATA IS BEING CREATED!!** This is important as it allows the metadata to be moved around without having to move the shapefile and the numerous files which make it up. *(If using DataLogr, the file will be saved as a .lgr rather than a .xml.)*

6. Having clicked the Edit Metadata icon, the MGMG Metadata Editor is now open. Quickly navigating around, one sees seven tabs on top and numerous text fields within each tab to be filled out. Green boxes are those which can be expanded by double clicking while white boxes cannot be expanded. *Pressing F1 while the cursor is within a text box will give a description of the information to enter in that box.*

7. Additional information about each metadata text field can be had through http://www.gis.state.mn.us/pdf/Mgmg1_2.pdf

8. In addition to filling out the numerous metadata text fields, it is recommended that *simple* map be created to give potential users a visual representation of your dataset. The map should be exported to a web-quality jpeg.

9. When metadata is finished, the .xml *(or .lgr)* file needs to be converted to an .html file.

    a. Within C:\arcgis\MGMG_Editor\converter\ open an additional piece of software called Wmeta32.exe. *(If only using DataLogr, the Wmeta32.exe software is within the main downloaded folder.)*

    b. Run Wmeta32.exe and click the Open File button and browse to and select the .xml file you have created. You may need to change the file type option in the dropdown menu to see your file.

    c. Check the Create HTML radio button on the main screen.

    d. Click the Convert File button, and a window will pop up saying "Conversion successful".

    e. Do not bother attempting to convert to .html using the ArcCatalog export feature as it typically leads to a badly formatted document.

10. The linking of the sample map to the metadata, fields requiring a web address, and other last minute information (i.e. publication date) can be left blank and will be filled in by the Metropolitan Council's GIS Office.

11. Special considerations in metadata creation

    a. Several examples of metadata (both excellent and average) can be viewed at http://www.datafinder.org/ . This is the most valuable resource for seeing how others have completed particularly confusing metadata fields.

    b. The "Originator" should be listed as the Transitway Impacts Research Program (TIRP).

    c. The abstract should include a link to the webpage hosting information about the research (…cts.umn.edu for example).

    d. The "Publisher" should be listed as the Center for Urban and Regional Affairs (CURA).

To the Research Assistant: (3)

e. Metadata lists 3 different contact persons.
   i. Under Identification Information, the contact person is the principal researcher.

   ii. Under Distribution, the contact person is Jeff Matson of CURA at the University of Minnesota. His contact info is:
   330 HHH Center
   301 19th Ave S
   Minneapolis, MN 55455
   612-625-0081
   jmatson@umn.edu

   iii. Under Metadata Reference, the contact person is whoever is physically doing the metadata, even if it is a research assistant who is only a temporary employee.

f. If the dataset includes parcel level information or other proprietary data, limitations on its distribution exist under current licensure. A disclaimer limiting its use must be included. This should be placed within the Access Constraints text field with supporting information in the Use Constraints and Ordering Instructions. Example disclaimers can be viewed on the aforementioned DataFinder website.

g. In the Entity and Attribute Detailed Citation field, list each attribute in the dataset along with a brief description. Additional information such as field type, maximum character length, and other things are strictly optional. **FIELDS FOR WHICH NO LEGITMATE DESCRIPTION CAN BE PROVIDED SHOULD BE CONSIDERED UNNECESSARY AND COMPLETELY REMOVED FROM THE DATASET.** This most often will include fields created as a step in the process of reaching a desired result but not having value on their own to the finished dataset.

h. The “Transfer Size” may automatically be filled in, but this is incorrect as it is only considering the size of the XML file, rather than the actual shapefile dataset. Replace this figure with an approximate size of the dataset files.