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Environmental Reporting for the University of Michigan Ann Arbor Campus: the U-M Environmental Data Repository

Sarah Deslauriers, Colin McMillan, and David Spitzley

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Ann Arbor, MI

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Sarah Deslauriers, Colin McMillan, and David Spitzley
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The Environmental Task Force is chaired by Dean Rosina Bierbaum of the School of Natural Resources and Environment (SNRE) and Dean Douglas Kelbaugh of the Taubman College of Architecture and Urban Planning. The Advisory group for the EDR project included Professors Jonathan Bulkley and Gregory Keoleian from SNRE, and Terry Alexander (Director) and Andrew Berki (Coordinator for Environmental Services) from Occupational Safety and Environmental Health.

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1. Introduction

In April of 2004, The University of Michigan Environmental Task Force (ETF) issued their advisory report to President Mary Sue Coleman[1]. This report, included as Appendix A, proposed an environmental assessment and reporting system that would allow the University to evaluate its progress with respect to environmental performance. The proposed measurement framework included six general categories of environmental performance, eight key environmental performance indicators, and 46 specific operational performance metrics. The acceptance of the ETF recommendations and the growing interest in annual environmental performance reporting at the University of Michigan have created the need for an environmental data tracking and management system.

The ETF report implementation plan recognizes the need for "…an effective and efficient system…to manage the data throughout the reporting life cycle (i.e. collection, compilation, analysis, storage, reporting)." The ETF also identified "…central data compilation, data analysis, conversion to appropriate measurement units, [and] normalization…" as necessary components of environmental reporting. In response to these challenges, a team from the Center for Sustainable Systems has developed the University of Michigan Environmental Data Repository (EDR).

2. Background

2.1 Early Research in Environmental Reporting at U-M

In April of 2002, a Master's degree project thesis was completed in the School of Natural Resources and Environment. This thesis examined the opportunities for sustainability assessment and reporting at the University of Michigan's Ann Arbor campus[2]. Specific outcomes of the project included:

- A definition of sustainability and a operable reporting framework tailored to the UM Ann Arbor Campus
- Initial evaluation of a set of sustainability indicators
- Development of a prototype sustainability report for the University
- Recommendations for institutionalizing the reporting process

Research findings were presented to interim President Joseph B. White in June of 2002 and to President Mary Sue Coleman in December 2002. The 25 environmental performance indicators proposed in the thesis project provided the basis for the eight key environmental performance indicators and several operational metrics recommended by the ETF.

[1] Bierbaum, R.M., and D.S. Kelbaugh. 2004. University of Michigan Environmental Task Force Advisory Report to President Mary Sue Coleman. Ann Arbor, MI: Environmental Task Force.

[2] Rodríguez, S.I., M.S. Roman, S.C. Sturhahn, and E.H. Terry. 2002. Sustainability Assessment and Reporting for the University of Michigan's Ann Arbor Campus, School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI.

2.2 The Environmental Task Force

In 2003, the UM ETF was established by President Mary Sue Coleman as an advisory group to consider the questions surrounding environmental performance measurement at the University. Specifically the charge of the ETF was "…to identify ten to twelve indicators that best measure the University's progress with respect to environmental stewardship and to investigate how these indicators might best be measured and included in a periodic University report." The members of the ETF and the associated technical committee are shown in Table 2-1, below.

Table 2-1. Environmental Task Force Members, Technical Committee Members, and Supporting Staff

Task Force Members
Phil Abruzzi, Director, Purchasing and Stores
Peter Adriaens, Professor, Civil and Environmental Engineering
Terry Alexander, Director, Occupational Safety and Environmental Health
Catherine Badgley, Associate Research Scientist and Lecturer III, College of Literature, Science and Arts
John Beeson, Student, Taubman College of Architecture and Urban Planning
Rosina Bierbaum, Dean, School of Natural Resources and Environment (co-chair)
Horace Bomar, Director, Facilities Management and Planning, Medical School
Jonathan Bulkley, Professor, Civil and Environmental Engineering and Natural Resources and Environment
Susan Gott, University Planner
Marty Kaufman, Associate Professor and Chair, University of Michigan – Flint Earth and Resource Science
Douglas Kelbaugh, Dean, Taubman College of Architecture and Urban Planning (co-chair)
Greg Keoleian, Associate Professor, School of Natural Resources and Environment
Ellen Ring Kolasky, Student, College of Literature, Science and Arts
David Miller, Director, Parking and Transportation Services
Richard Robben, Director, Plant Operations
Brian Talbot, Professor, School of Business Administration
James Vincent, Professor and Chair, Environmental Health Sciences, School of Public Health
Technical Committee Members
Phil Abruzzi, Director, Purchasing and Stores
Peter Adriaens, Professor, Civil and Environmental Engineering
Terry Alexander, Director, Occupational Safety and Environmental Health
Andrew Berki, OSEH Coordinator
Rosina Bierbaum, Dean, School of Natural Resources and Environment (co-chair)
Douglas Kelbaugh, Dean, Taubman College of Architecture and Urban Planning (co-chair)
Greg Keoleian, Associate Professor, School of Natural Resources and Environment
David Miller, Director, Parking and Transportation Services
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Richard Robben, Director, Plant Operations
Marina Roelofs, Director, Plant Extension
Jeff Schroeder, Coordinator, Housing Management Systems
Liason to the President
Patrick Naswell, Assistant to the Counsels, Office of the President
Staff Support
Nancianna Girbach, Executive Secretary, Office of the President
Michael Sadowski, Research Associate, Center for Sustainable Systems
David Spitzley, Research Associate, Center for Sustainable Systems

The ETF developed a recommended framework for capturing the impact and progress of the University with respect to environmental issues. The framework, which is shown in Figure 2-1, is comprised of six General Categories for assessing environmental performance; a set of eight Environmental Performance Indicators for evaluating campus wide performance; and Operational Metrics to provide a more detailed assessment of specific operations and activities of the University. In addition, examples of existing Programs and Initiatives were identified by the ETF for enhancing environmental performance on campus.

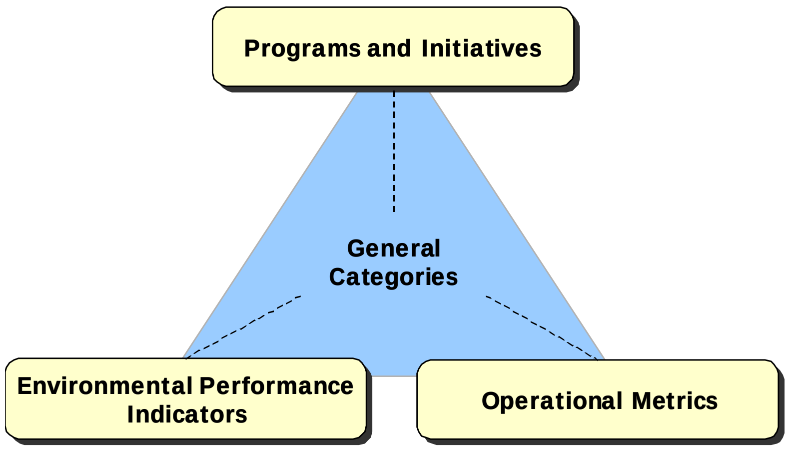


Figure 2-1. Environmental Reporting Framework for the University of Michigan as developed by the ETF

The ETF recommended a set of General Categories designed to capture the environmental footprint of the UM Ann Arbor campus. These six General Categories were chosen for their significance of impact, campus-wide applicability and availability of data. The recommended categories are:

1. Energy: Buildings and Transportation
2. Water Use
3. Land Use: Built and Natural Spaces
4. Emissions: Air and Water Pollutants
5. Material Use and Solid Waste
6. Cross-Cutting and Emerging Issues

The ETF report also identifies a set of eight key environmental performance indicators designed to provide an overview of performance in the general categories. The recommended key environmental performance indicators for the University of Michigan are:

- Total Energy Consumption
- Renewable Energy Contribution
- Total Water Use
- Impervious Surface Area
- Total Greenhouse Gas Emissions

- Total Solid Waste
- Percent of Solid Waste Recycled
- Building Utilization

Finally, a set of 3-15 operational metrics were proposed in each category. These metrics are discussed in greater detail in the section that follows.

3. Environmental Performance Measurement at the University of Michigan

3.1 Proposed Indicators and Metrics

The key performance indicators (KPIs) and operational metrics recommended by the ETF are shown in Table 3-1 on the following page. According to the ETF, certain indicators were normalized to better represent changes over time in facilities, the population of the University community and the core activities of the University. The base units for data reporting are shown in the table along with the normalization units. For each indicator and metric a check mark is shown when measurements were made as part of the SNRE thesis research project. The ETF expanded on the small number of environmental indicators examined by the student research project to propose a full set of 56 indicators and metrics. Every attempt was made to fully populate the EDR with the indicators and metrics recommended by the ETF. However, limitations on data currently available restricted reporting in some cases. In other cases, metrics were expanded to provide additional information or detail on campus environmental performance. Additional metrics address the following topics:

- *Generated vs. Purchased Electricity*. The ETF report recommended tracking total electricity consumption as an operational metric. The EDR subdivides this into purchased electricity and on-site generated electricity. Similarly, electricity from renewable sources is shown as a percentage of on-site generated electricity and as a percentage of purchased electricity.
- *Mobile Source Emissions*. While only CO_2 emissions are reported for mobile pollutant sources (i.e. the campus fleet), these emissions are distinguished between fossil based sources and bio-based sources. Bio-fuels are generally considered "carbon neutral" due to the balance between carbon uptake during the growing cycle and carbon release during combustion.
- *Regulated Materials Recycling*. Several products and materials containing potentially hazardous substances are recovered for recycling on campus. Many of these are tracked in terms of unit quantities or volumes and can not be combined into total waste values reported in mass units. Recycling of regulated materials on campus is reported in a series of metrics reflecting the range of product categories tracked.

The final column in Table 3-1 indicates metrics and indicators that were incorporated into the University of Michigan Environmental Data Repository (EDR). 2004 results for these indicators and metrics are included in Appendix B for reference.

Table 3-1. University of Michigan Environmental Performance Indicators and Metrics

General Category	Indicator/Metric	Units	Normalization	Indicator/Metric Type: KPI[a]	Indicator/Metric Type: Operational Metric	Proposed/Reported by: M.S. Thesis[b]	Proposed/Reported by: ETF	Proposed/Reported by: EDR
Energy – Buildings and Transportation								
	Total Energy Consumption	Btu Barrels oil eqv.	per person	√		√	√	√ [c]
	Renewable Energy Contribution	Percentage		√		√	√	√
	Building Energy Consumption	Btu	per ft^2 per person per ft^2/person		√		√	√ [c]
	Purchased Electricity Consumption	MWh			√		√ [d]	√
	Generated Electricity Consumption	MWh			√		√ [d]	√
	Purchased Electricity from Renewable Sources	Percentage			√		√ [d]	√
	Generated Electricity from Renewable Sources	Percentage			√		√ [d]	√
	Transportation Energy Consumption	Btu	per person		√	√	√	√
	Bus Energy Consumption	Btu	per passenger mile		√		√	√ [e]
	Fleet Vehicles Energy Consumption	Btu			√		√	√
	Fleet Fuel Economy	mpg by class			√	√	√	[f]
	Renewable Percentage for Transportation Energy	Percentage			√	√	√	√
	Campus Bus Ridership	Number of passengers Passenger miles			√		√	√ [g]
	Car/Van Pooling (UM pool vehicles only)	Vehicle miles Passenger miles[h]			√		√	√
	AATA Bus Passes	Number of passes			√		√	[f]
	AATA Bus Ridership	Number of rides			√		√	√
	Bicycle Ridership	Number of bike racks			√		√	√ [i]
	Vehicular Commuting[h]	Vehicle miles Passenger miles Btu			√		√	
	Air Travel[h]	Passenger miles Btu			√		√	

General Category	Indicator/Metric	Units	Normalization	Indicator/Metric Type		Proposed/Reported by:		
				KPI[a]	Operational Metric	M.S. Thesis[b]	ETF	EDR
Water Use								
	Total Water Use	Gallons	per person	√			√	√
	Total Purchased Water	Gallons	per person		√	√	√	√
	Total Discharged to Sewer	Gallons	per person		√		√	√ [c]
	Building Specific Water Use	Gallons	per person		√	√	√	√ [i]
	Total Irrigation Water	Gallons	per acre green space		√		√	√ [i]
Land Use – Built and Natural Spaces								
	Total Impervious Surface Area	Acres	percentage of campus area	√		√	√	√
	Total Green Space	Acres	percentage of campus area		√	√	√	√
	Maintained Green Space	Acres	percentage of campus area		√		√	√
	Unmaintained (natural) Green Space	Acres	percentage of campus area		√		√	√
	Tree Population	Number of trees			√	√	√	√
	Protected Natural Spaces	Acres	percentage of campus area		√		√	f
	Total Building Area	Sq. Ft.	per person		√	√	√	√
	LEED Certification	Number of buildings	percentage of buildings		√		√	√
	Deck Parking	Percentage of spaces			√		√	√

General Category	Indicator/Metric	Units	Normalization	Indicator/Metric Type		Proposed/Reported by:		
				KPI[a]	Operational Metric	M.S. Thesis[b]	ETF	EDR
Emissions – Air and Water Pollutants								
	Total Greenhouse Gas Emissions	Metric tons CO_2 eqv Metric tons C eqv.	per person	√		√	√	√ [c]
	Criteria Air Pollutants from Stationary Sources (VOC, PM_{10}, $PM_{2.5}$, CO, NO_x, SO_2, Pb)[j]	Lb (by pollutant)	per person		√	√	√	√
	Mobile Source Greenhouse Gas Emissions (fossil)	Lb	per person		√	√	√ [k]	√ [c,i]
	Mobile Source Greenhouse Gas Emissions (bio-based)	Lb	Per person		√			√
	Fertilizer Use	Lb	per person		√	√	√	f
	Salt Use	Lb	per person		√		√	√
	Sand Use	Lb	per person		√		√	√
	Pesticide Use	Lb (solids) Gallons (liquid)	per person		√	√	√	f
Material Use and Solid Waste								
	Total Solid Waste	Tons	per person	√		√	√	√
	Percent Recycled	Percentage		√		√	√	√
	Hospital Waste	Tons	per person		√	√	√	√
	Waste from Campus Buildings	Tons	per person		√	√	√	√
	Waste from Auxiliary Buildings	Tons	per person		√		√	f
	Paper Recycled	Tons	percentage of paper generation		√	√	√	√ [e]
	Glass Containers Recycled	Tons	percentage of glass generation		√		√	√ [c,e]
	Plastics Recycled	Tons	percentage of plastics generation		√		√	√ [c,e]
	Metal Containers Recycled	Tons	percentage of metal generation		√		√	√ [c,e]
	Consumer Electronics Recycled	Lb			√			√
	Batteries Recycled	Lb			√			√
	Fluorescent Light Bulbs Recycled	Number of bulbs			√			√
	Lamp Ballasts Recycled	Lb			√			√

General Category	Indicator/Metric	Units	Normalization	Indicator/Metric Type		Proposed/Reported by:		
				KPI[a]	Operational Metric	M.S. Thesis[b]	ETF	EDR
	Xylene Solvent Recycled	Gallons			√			√
	Acetone Solvent Recycled	Gallons			√			√
	Formalin Solvent Recycled	Gallons			√			√
	Latex Paint Recycled	Gallons			√			√
	Transportation Oils Recycled	Gallons			√			√
	Coolants Recycled	Gallons			√			√
	Construction In-house Waste Recycled	Tons	percentage of generation		√		√	√
	Composting	Tons	per person		√	√	√	√
	Reuse (PD or Ann Arbor recycling)	Tons	per person		√		√	√ [g]
	Materials Reuse (housing moveout)	Tons	per person		√		√	√
	Paper Purchases (included recycled and chlorine free)[h]	Tons	per person		√		√	
Cross Cutting and Emerging Issues								
	Building Utilization (conditioned buildings)	Sq. Ft.	per person	√			√	√
	Educational Programs and Initiatives	tbd[l]			√	√	√	f
	LEED Certification (by award level)	Number of buildings	percentage of buildings		√		√	√
	Aesthetics	Number of awards			√		√	√

---

[a] KPI = Key Performance Indicators
[b] ETF report categories have been applied to MS Thesis metrics.
[c] Incomplete or estimated data reported, see table X-3 for details
[d] Metric recommended by the ETF is reported as two separate metrics to provide additional detail
[e] One or more normalizations not reported, see table X-3 for details
[f] Metric proposed by ETF, but not tracked in EDR, see table X-3 for details
[g] Not tracked in the units of measurement recommended by the ETF, see table X-3 for details
[h] Recognized by the ETF as not yet collected
[i] Listed as "data not available" in ETF report, however, data are collected for this metric
[j] Pollutants originally listed in ETF report included O_3, PM, CO, NO_x, SO_2 and Pb. The list shown has been corrected to specifiy PM constituatns and repaces O_3 with VOC.
[k] Only CO_2 emissions are reported for mobile sources. Metrics recommended by ETF worded as "Air Pollutants from Mobile Sources."
[l] tbd = to be determined

3.2 Data Limitations

A series of telephone conversations, face-to-face meetings, and e-mail exchanges between the authors and the contacts listed in Appendix C served to identify data appropriate for the measurements recommended by the ETF. However, in some cases information required to fully evaluate the proposed indicators and metrics was not available. Indicators and metrics for which full data were unavailable are listed in Table 3-2 along with a discussion of data limitations[3]. Future updates to data tracking systems may enable additional reporting.

Table 3-2. Limitations on Evaluation of Indicators and Metrics

Indicator or Metric	***Current Challenges***	***Status***
Fleet Fuel Economy	Fuel economy of individual vehicles is not currently tracked in transportation services databases. In order to accurately track changes in fleet fuel economy over time individual vehicle fuel economy is required.	This metric will not be reported.
Bus Energy Consumption (per passenger mile)	Passenger mile data for campus bus operation are not available. See below.	Data normalized per passenger
Campus Bus Ridership (passenger miles)	Transportation services does not currently collect data on passenger miles of bus ridership. However, total ridership (number of passengers) is tracked.	Data will not be reported in terms of passenger miles.
AATA Bus Passes	As of August 2004, UM is no longer issuing AATA bus passes. This program has been replaced by the M-Ride program.	This metric will not be reported.
Total Discharged to Sewers	Currently sewer discharges are billed as a percentage of purchased water. Estimated building specific relationships exist and are used to estimate water discharged for each building, however, discharge is not metered. Marked as "not yet collected" in the ETF report.	Estimated data will be reported.
Protected Natural Spaces	No definitions for "protected spaces" are familiar to any grounds or facilities staff contacted. The intended meaning of this metric was unclear to staff contacted. Additional research is required to develop a clear definition to support evaluation.	This metric will not be reported.
Air Pollutants from Mobile Sources	Detailed data required to determine criteria pollutants from fleet vehicles would include EPA emissions test results as well as deterioration factors based on vehicle age. Such data are not currently available. However, CO_2 emissions can be estimated based on fuel consumption information.	Metric renamed "Mobile Source Greenhouse Gas Emissions." Only estimated CO_2 emissions associated with on-campus fueling are reported.

[3] In addition, three metrics and one unit of tracking were identified by the ETF as unavailable. These are indicated in Table 3-1. No data to support these measurements were identified during the development of the EDR.

Indicator or Metric	***Current Challenges***	***Status***
Fertilizer Use	Some data are tracked as operator reported application hard copy reports only, hundreds of pages of information would need to be compiled into a single source. Additionally, the suggestion has been made that data should only be reported in a categorized system (e.g. toxicity level, PAN status). Current tracking systems are inadequate for campus wide annual reporting.	This metric will not be reported.
Pesticide Use		This metric will not be reported.
Waste from Auxiliary Buildings	No data are available that would allow buildings on University property to be accurately distinguished from one another in terms of waste generation.	Two metrics (waste from auxiliary buildings and waste from campus buildings) combined into reporting of a single metric "waste from campus."
Paper Recycled	ETF Report recommended normalizing materials recycled as a percentage of total waste generated in a given category (e.g. % of total paper waste). However, no data are available on the generation of waste in specific categories. Additionally, container recycling values are based on Ann Arbor MRF annual averages for percentages in mixed container loads and are not specific to the University.	Reported as percentage of total waste generation.
Glass Containers Recycled		Reported as an estimated percentage of total waste generation.
Plastics Recycled		Reported as an estimated percentage of total waste generation.
Metals Containers Recycled		Reported as an estimated percentage of total waste generation.
Reuse	Property disposition activity tracked in dollar values only.	Reported as US$ of reuse.
Total Energy Consumption	When electricity is purchased from a utility company the energy, greenhouse gas emissions and criteria pollutant emissions must be reported for consistency with reporting practice for University run power plants. However, these factors are highly dependent on the mix of fuels and age of technologies used by the supplier utilities over the time period studied. Currently no specific data are available on the mix of fuels or specific technologies used by the utility power plants supplying the University with electricity. Regional grid (ECAR) average data are available for fuel mix and heat rate, but will limit the influence of changes in suppliers on reported performance. Data on greenhouse gas emissions can be estimated based on available regional grid data. However, no data on recent criteria air pollutant emissions from purchased electricity are available.	Purchased electricity data are incorporated in total energy consumption based on regional grid average values for fuel mix and heat rate.
Building Energy Consumption		Purchased electricity data are incorporated into building energy consumption based on regional grid average values for fuel mix and heat rate.
Total Greenhouse Gas Emissions		Purchased electricity data are incorporated in total greenhouse gas emissions results based on regional grid average values for fuel mix and estimated CO_2 emissions for each fuel type.
Criteria Air Pollutants from Stationary Sources		No criteria air pollutant data are reported for purchased electricity. Reported criteria air pollutant values reflect on-site generation of electricity and heat only.
Educational Programs and Initiatives	Data regarding environment related programs and initiatives on campus are not consistently tracked. Data that are available are based on occasional surveys. In the future it is expected that data on environmental education programs and courses will be incorporated into a University wide web portal.	This metric is not currently reported.

4. The University of Michigan Environmental Data Repository (U-M EDR)

4.1 Overview

The U-M EDR is a spreadsheet based software tool that facilitates the annual reporting of environmental data by compiling data from within the University, enabling entry of data from non-university sources, calculating required metrics, and presenting results in tables and graphs. This tool was built in Microsoft Excel using Visual Basic macros and forms. Complete Visual Basic code for the EDR is included in Appendix D. The components of the EDR are shown in Figure 4-1.

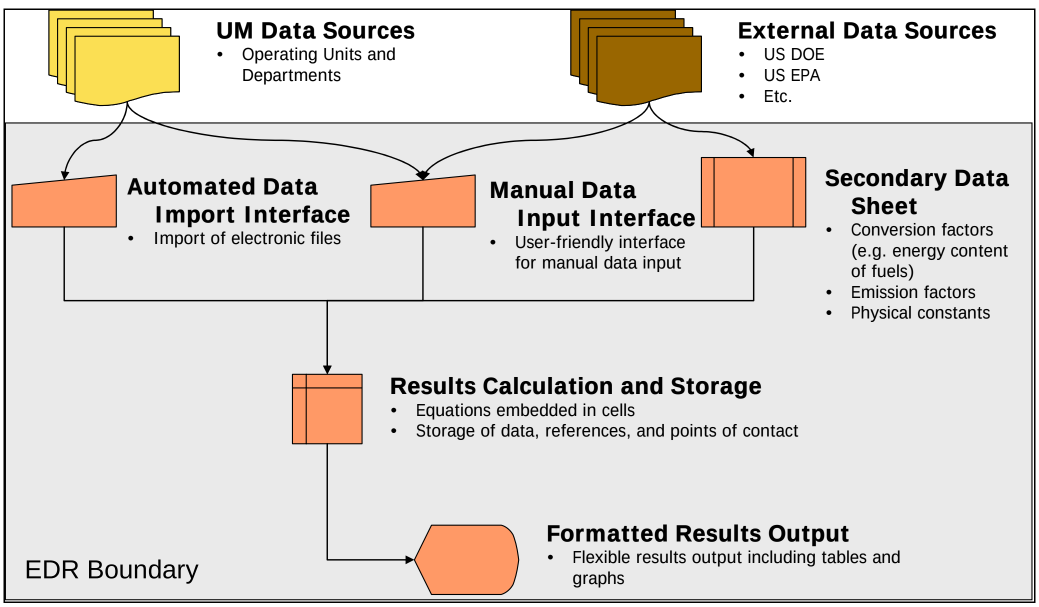


Figure 4-1. Overview of U-M EDR Components

The EDR tool is designed for use by a single centralized data manager (the user) who will be responsible for contacting data sources on campus and collecting data from external sources. This data is then input to the tool using one of three options:

1) **Automated Data Import.** Several data collection forms have been designed to mimic the format and data available from key electronic resources on campus, such as the *Annual Report of Utilities* and transportation services records. Data holders on campus can easily cut and paste data from these sources into the available forms. These forms are then imported directly into the EDR by the user. An example data import interface is shown in Figure 4-2 below.
2) **Manual Data Input (via form based interface).** Data sources with smaller quantities of information from within the University and key data sources from outside the University are input via a series of fields in the input interface.

Examples of data input in this manner include hospital waste data and regional electric grid data. An example manual data input form is shown in Figure 4-3 below.

3) **Manual Data Input (via direct entry into data sheet).** External data sources for which data may not change on an annual basis are entered directly into a secondary data sheet. This enables efficient copy and paste of previous year data in the event of no change in values. Examples of this type of data include heat content of fuels, and carbon emissions factors for vehicles. A portion of the secondary data sheet is shown in Figure 4-4 below. Some cells in the secondary data sheet are locked to prevent inadvertent data entry. These cells are shown with grey (or dotted) shading. The sheet can be unprotected by selecting "protection" from under the "tools" menu. This will allow data to be entered into one protected cell. After this data entry the sheet will automatically re-protect itself.

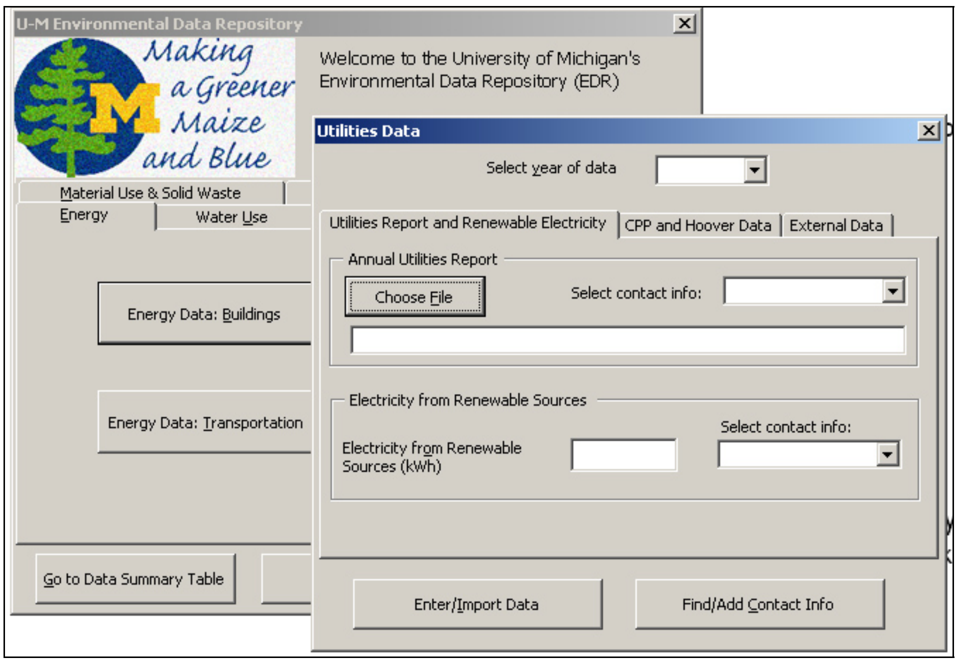


Figure 4-2. Example Data Import Interface

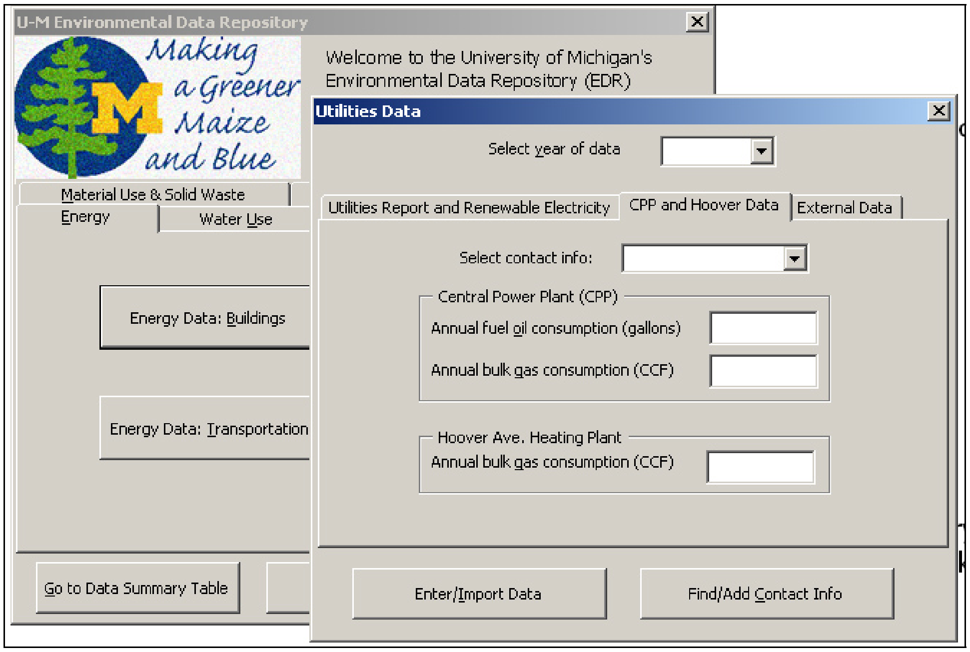


Figure 4-3. Example Manual Data Entry Interface

Instructions for entering data from external (secondary) sources:
The required data fields are identified by bold red text. When a required data field is empty, the cell in the worksheet appears highlighted and with a border. Once an empty field is completed, the highlight and border will be replaced with bold red text.
The sources of external data are indicated with worksheet cell comments. When a previously empty data field is completed, the user will right click on the cell and select "Insert Comment". Within this new comment, the user will enter the data source.

Category	Description	Unit	1990	1999	2000	2001	2002	2003	2004	2005	2006
Waste	Mulch Conversion	Lbs/cubic yard	170	170	170	170	170	170	170	170	170
Energy	Unleaded Fuel - HHV	Btu/gallon							125071		
Energy	Diesel Fuel - LHV	Btu/gallon							138690		
Energy	Biodiesel Fuel - LHV	Btu/gallon							135916		
Energy	ULSD Fuel - LHV	Btu/gallon							128000		
Energy	Ethanol Fuel - HHV	Btu/gallon							84262		
Emissions	Unleaded Fuel	kg C/gallon							2.42		
Emissions	Diesel Fuel	kg C/gallon							2.78		
Emissions	B20 Biodiesel Fuel	kg C/gallon							2.56		
Emissions	ULSD Fuel	kg C/gallon							2.78		
Emissions	Ethanol Fuel	kg C/gallon							1.52		
Emissions	Unleaded Fuel	kg CO_2/gallon							8.79		
Emissions	Diesel Fuel	kg CO_2/gallon							10.08		
Emissions	B20 Biodiesel Fuel	kg CO_2/gallon							9.29		
Emissions	ULSD Fuel	kg CO_2/gallon							10.08		
Emissions	Ethanol Fuel	kg CO_2/gallon							5.5		
Emissions	Electric utility (coal) carbon c	MMTC/Quad	25.95	25.97	25.98	25.98	25.98	25.98	25.98		
Emissions	Natural gas carbon coefficien	MMTC/Quad	14.47	14.47	14.47	14.47	14.47	14.47	14.47		
Emissions	Fuel oil carbon content	MMTC/Quad	19.95	19.95	19.95	19.95	19.95	19.95	19.95		
Emissions	Fuel Mix (% coal)	%							84.8%		95.0%
Emissions	Fuel Mix (% natural gas)	%							3.1%		2.0%
Emissions	Fuel Mix (% fuel oils)	%									

Figure 4-4. Secondary Data Input Sheet

The data entry interface is started automatically when the EDR is first opened. If the EDR interface is closed it may be re-opened by clicking the logo on the interface worksheet. Part of the data entry process is the specification of contact or source information for each data point. The entry of contact information is facilitated by the EDR user interface, which allows users to find or add a contact on any of the data entry screens. A button at the bottom of each input form allows users to add contact names (with phone, e-mail, and department name) to the existing list or find a contact listed for a previous year. This feature helps users identify points of contact for data collection and provides a historic record of data sources in the event that questions arise.

Once data are entered into the EDR, they are housed in a series of hidden data sheets. These sheets store the raw data and also perform the calculations necessary to convert input data into values appropriate for reporting the indicators and metrics discussed earlier. Complete details of data entry and calculations for each indicator and metric are included in Chapter 5.

Generally, it is not recommended that users manipulate the data contained in the hidden sheets, however, should this become necessary the sheets can be revealed by selecting "unhide" from the window menu. Some additional calculations are only accessible via the Visual Basic programming shown in Appendix D. Users familiar with the Visual Basic macro language can access the calculations by opening the Visual Basic editor.

To view final results of calculations select the "summary" worksheet, choose the category or categories of interest from the pull down menu, the year or years of interest from the "year" pull down and the specific indicators and metrics of interest from the "indicators or metrics" pull down (note: by default all indicators and metrics are shown). Then click the refresh button to view the data currently available. When data have not been entered an error code may appear in some of the cells.

Finally, the "graphing" worksheet may be used to view simple bar charts for any of the indicators or metrics. One graph at a time may be viewed by selecting the appropriate indicator or metric from the list. An example graph is shown in Figure 4-5. Note: data available for graphing are determined by the selections made on the summary worksheet. If you do not see the data you are interested in, make changes as described above to the summary sheet.

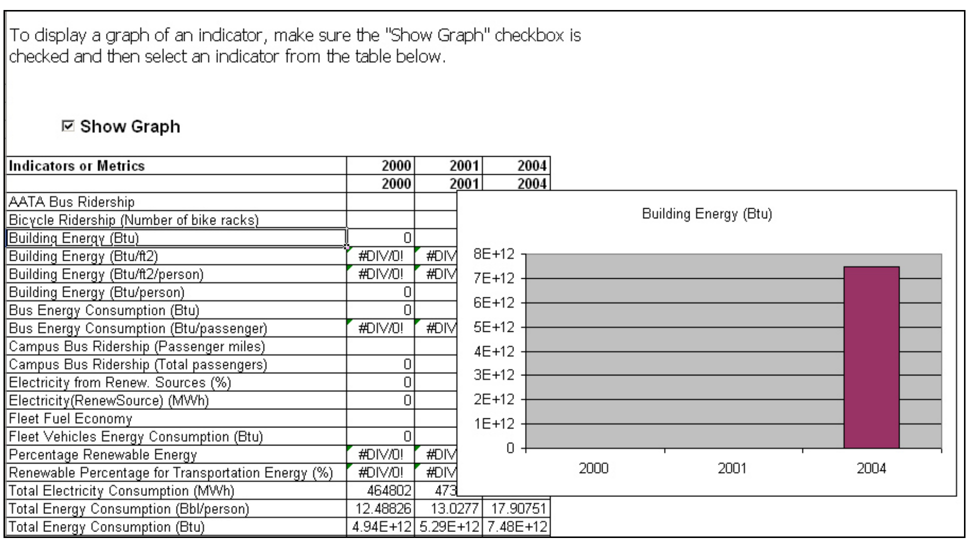


Figure 4-5. Example Graphical Output

4.2 Reporting Scope and Boundaries

The reporting boundaries for the EDR are taken as proposed by both the SNRE thesis and the ETF report and generally defined as properties and activities of the University within the city limits of Ann Arbor. Specifically, the Ann Arbor campus system boundary is defined as all University-owned and operated land and infrastructure within the city limits of Ann Arbor that is utilized mainly by University faculty, staff, or students, as well as Matthaei Botanical Gardens and Radrick Farms Golf Course. This definition also includes the athletic properties, Horner's Woods, Mud Lake Bog and Nichols Arboretum.

In order to maintain system boundaries some non-University run activities are included in the EDR data. The inclusion of non-University run activities is specific to energy use and the purchase of utility generated electricity. The production of utility electricity generally involves the combustion of fuels used either directly or indirectly to generate electricity in a turbine[4]. Energy use is evaluated based on the quantity of fuel input to this process for both campus power plants and utility power plants. This enables fuels used in the production of electricity to be combined with fuels used in the production of heat. However, this necessitates the inclusion of utility electricity generation operations not otherwise included in the system boundary. Additionally, for consistency the emissions from these operations must be reported as well. Unfortunately, accurate information on criteria air pollutant emissions from these facilities is not available so only CO_2 emissions from off-campus electricity generation are reported. This system boundary is shown in Figure 4-6.

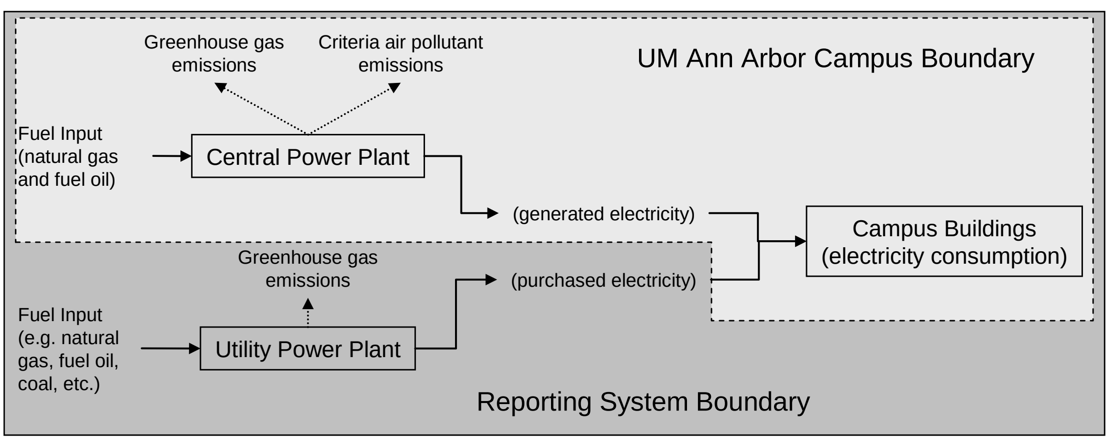


Figure 4-6. Reporting System Boundary for Purchased Electricity

Defining a temporal boundary for the U-M Ann Arbor campus system is problematic. Activities within the University observe one or more of calendar year boundaries, fiscal year boundaries (July – June), or academic semester boundaries (fall, winter, spring/summer). Unfortunately not all environmental data tracked within the University observe the same boundaries with respect to time. The ideal period for reporting would

[4] This is a simplification of the typical process for generating electricity from fossil fuels in boiler or turbine type systems. A number of variations from this arrangement exist, but the specific distinctions are not important for this discussion.

be the calendar year which is easily understood by both internal and external audiences. However, a majority of the metrics currently tracked are reported on a fiscal year basis only. The specific temporal period covered by each indicator and metric tracked in the EDR is shown in Table 4-1.

Table 4-1. Temporal Coverage of Metric and Indicator Data

Tracking Period	**Indicators and Metrics**
Calendar Year	Bicycle ridership[(b)], total irrigation water, total impervious surface area, total green space, maintained green space, un-maintained green space, tree population, protected natural spaces, LEED certification, deck parking, criteria air pollutants from stationary sources, hospital waste, building utilization[(b)], aesthetics
Fiscal Year	total energy consumption, renewable energy contribution, building energy consumption, purchased electricity consumption, generated electricity consumption, purchased electricity from renewable sources, generated electricity from renewable sources, transportation energy consumption, bus energy consumption, fleet vehicles energy consumption, renewable percentage for transportation energy, campus bus ridership, car/van pooling, AATA bus ridership, total purchased water, total discharged to sewer, building specific water use, total building area, mobile source greenhouse gas emissions, salt use, sand use, waste from campus buildings, paper recycled, consumer electronics recycled, batteries recycled, fluorescent light bulbs recycled, lamp ballasts recycled, xylene solvent recycled, acetone solvent recycled, formalin solvent recycled, latex paint recycled, transportation oils recycled, coolants recycled, construction in-house waste recycled, composting, reuse, materials reuse
Combined[(a)]	total water use, total greenhouse gas emissions, total solid waste, percent recycled, glass containers recycled, plastics recycled, metal containers recycled

(a) Indicators/metrics reflect the combination of data collected on a fiscal year basis with data collected on a calendar year basis
(b) Data reflect the state of campus at a particular point in time and not an annual total or average

In addition to the physical and temporal definition of the system, the population contributing to system performance must also be specified. Population data are entered into the EDR interface via the "population" tab. For the purposes of reporting in the EDR, the UM Ann Arbor campus population includes all faculty, staff and students. These values are taken as determined by the Office of Budget and Planning and published in the Electronic Fact Pages, All Campus Data[5]. Given the emphasis of fiscal year data in metrics tracking, the fall enrollment for the previous year is taken as the student population level for the purposes of reporting. For example, 2004 data would be normalized based on 2004 staff and faulty levels combined with fall 2003 student enrollment. Example population data are shown in Table 4-2.

[5] (http://www.umich.edu/~oapainfo/TABLES/PDF/UM_System.pdf)

Table 4-2. University of Michigan Ann Arbor Campus Population by Year

	2001	2002	2003	2004
Students[a]	38,103	38,248	38,972	39,031
Faculty and Staff[b]	21,726	22,191	22,450	22,576
Hospital Faculty and Staff[c]	10,036	10,406	11,226	11,738
Total Campus Population	69,865	70,845	72,648	73,345

[a] Student population is taken as enrollment in fall of the previous year, winter enrollment not reported.
[b] Total All Staff Headcount – Ann Arbor, includes faculty, regular staff and supplemental staff.
[c] Total All Staff Headcount – Hospital.

5. Data Collection and Calculation Procedure

5.2 Energy – Buildings and Transportation

Two key performance indicators and 13 operational metrics are reported in the category Energy – Buildings and Transportation. These measures combine data from various data sources to provide an indication of the movement of the University towards more sustainable energy use. According to the ETF "…energy consumption is arguably at the root of the University's most significant environmental impacts."

An example of data management for an energy metric is shown in Figure 5-1. This example examines the input parameters and calculations required to determine the buildings energy consumption metric. A detailed discussion of data sources and calculation procedures for all indicators and metrics in this category is included in the sections that follow.

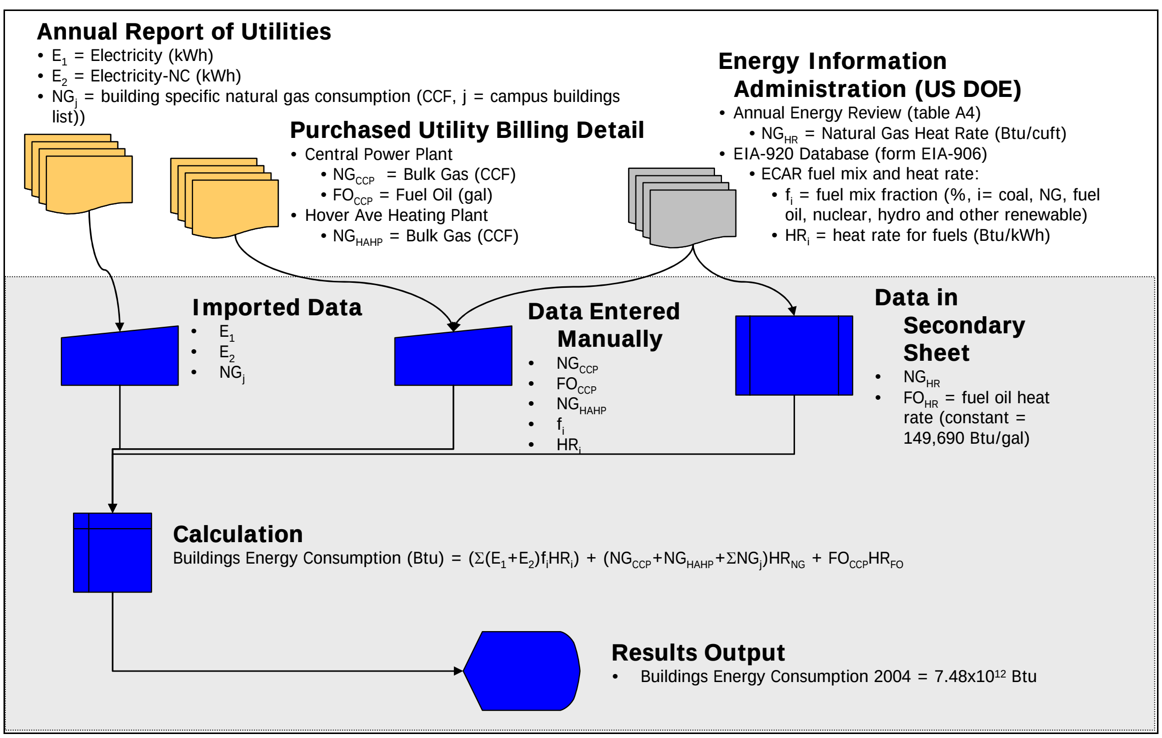


Figure 5-1. Buildings Energy Consumption Example Data Management Process

5.1.1 Total Energy Consumption (Btu, Btu/person, Barrels of oil equivalent/person)

The Total Energy Consumption indicator measures the total amount of energy consumed by U-M buildings, buses, and fleet vehicles. Included in this indicator is the energy consumption of the Central Power Plant (CPP) and the Hoover Boiler Plant.

5.1.1.1 Primary Data Sources
Please refer to Sections 5.1.3 and 5.1.8 for the primary data sources.

5.1.1.2 Secondary Data Sources
Please refer to Sections 5.1.3 and 5.1.8 for the secondary data sources.

5.1.1.3 Calculation Procedures
The Total Energy Consumption indicator is calculated in the "RawOutput" worksheet as the sum of the Building Energy Consumption and Transportation Energy Consumption metrics. Please refer to Sections 5.1.3 and 5.1.8 for detailed descriptions of the Building Energy Consumption metric and the Transportation Energy Consumption metric, respectively.

The "RawOutput" worksheet also calculates the normalizations of Btu/person and barrels of oil equivalent/person. The Btu/person normalization is calculated by dividing the Total Energy Consumption indicator (Btu) by the total U-M Ann Arbor campus population. The barrels of oil equivalent/person normalization is calculated by first dividing the Total Energy Consumption indicator (Btu) by the crude oil heat content (a constant 5,800,000 Btu/barrel). This calculation results in the number of barrels of oil equivalent. The number of barrels of oil equivalent is then dividing by the total campus population.

5.1.2 Renewable Energy Contribution (%)

The Renewable Energy Contribution indicator measures the percentage of total energy consumption, including U-M buildings, buses, and fleet vehicles, that is provided by renewable sources.

5.1.2.1 Primary Data Sources
Please refer to Sections 5.1.3, 5.1.8, and 5.1.11 for the primary data sources.

5.1.2.2 Secondary Data Sources
Please refer to Sections 5.1.3, 5.1.8, and 5.1.11 for the secondary data sources.

5.1.2.3 Calculation Procedures
The Renewable Energy Contribution indicator is calculated in the "RawOutput" worksheet by the following equation:

Renewable Energy Contribution (%) = [Transportation Energy Consumption (Btu) * Renewable Percentage for Transportation Energy (%) + Purchased Electricity from Renewable Sources (MWh) * (1,000 kWh/MWh) * Electricity Heat Content (3,412 Btu/kWh) + Generated Electricity from Renewable Sources (MWh) * (1,000 kWh/kWh) * Electricity Heat Content (3,412 Btu/kWh)] / Total Energy Consumption (Btu)

Please refer to the sections of the report dedicated to each individual metric listed above for detailed instructions and descriptions on how data are entered and how calculations are performed.

5.1.3 Building Energy Consumption (Btu, Btu/ft^2, Btu/person, Btu/ft^2/person)

The Building Energy Consumption metric measures the total energy consumption by all University-owned and leased buildings within Ann Arbor's city limits, including the Central Power Plant (CPP) and the Hoover Boiler Plant. Typically, these buildings consume energy in the form of electricity, natural gas, and to a smaller extent, fuel oil.

5.1.3.1 Primary Data Sources

Contact:
Carol Varney
Business Manager, Utilities
(734) 647-0963
cvarney@umich.edu

Building-related energy consumption data are obtained from the Utilities Annual Report. It is critical that the report be the version that is organized according to building number and not by fund. The source of this report is Carol Varney.

Contact:
Mike Swanson
Senior Engineer, Utilities
(734) 763-3011
mswaney@umich.edu

CPP and Hoover Boiler Plant data are tracked separately from the *Annual Report of Utilities*. These are obtained from Mike Swanson and are manually entered into the EDR.

Contact:
Andy Berki
OSEH Coordinator
(734) 647-3120
aberki@umich.edu

Andy Berki is the primary data source the amount of electricity generated from renewable sources. This value is entered manually into the EDR.

5.1.3.2 Secondary Data Sources

Thermal conversion factors and the fuel mix and average heat rate of purchased electricity must be collected from the U.S. Department of Energy's Energy Information Administration (EIA). The heat contents of natural gas and fuel oil are available from the *Annual Energy Review*, published by the EIA (http://www.eia.doe.gov/emeu/aer/pdf/pages/sec13_4.pdf and http://www.eia.doe.gov/emeu/aer/pdf/pages/sec13_1.pdf). The heat content of electricity generated from renewable sources is assumed to be constant (3,412 British thermal units/kilowatt-hour). All secondary data are entered to the "SecondaryInput" worksheet.

To convert the amount of purchased electricity from kilowatt-hours (kWh) to British thermal units (Btus), an average heat rate (measured in Btu/kWh) is required. Data relating to utility electricity generation and fuel consumption is obtained from the EIA's EIA-906/920 Monthly Time Series File (http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html). These data must then be analyzed according to the procedure described in the following section.

The square footage of campus buildings is required for normalizing the Building Energy Consumption metric. This value is calculated automatically by the EDR once the *Annual Report of Utilities* is imported.

5.1.3.3 Calculation Procedure

Calculating the Building Energy Consumption metric involves importing the *Annual Report of Utilities* and manually entering data from the U-M and external sources. The *Annual Report of Utilities* contains categories of energy consumption data on an individual building basis. The five energy categories that are applicable to the EDR are: electricity consumed from the CPP; electricity purchased for North Campus; other purchased electricity; recharge bulk gas; and natural gas.

To import the *Annual Report of Utilities*, begin by selecting the "Energy" tab in the main user interface. Next, click the "Energy Data: Buildings" button to display the "Utilities Data" form, shown as Figure 5-2. The form is comprised of three tabs: "Utilities Report and Renewable Electricity", "CPP and Hoover Data", and "External Data."

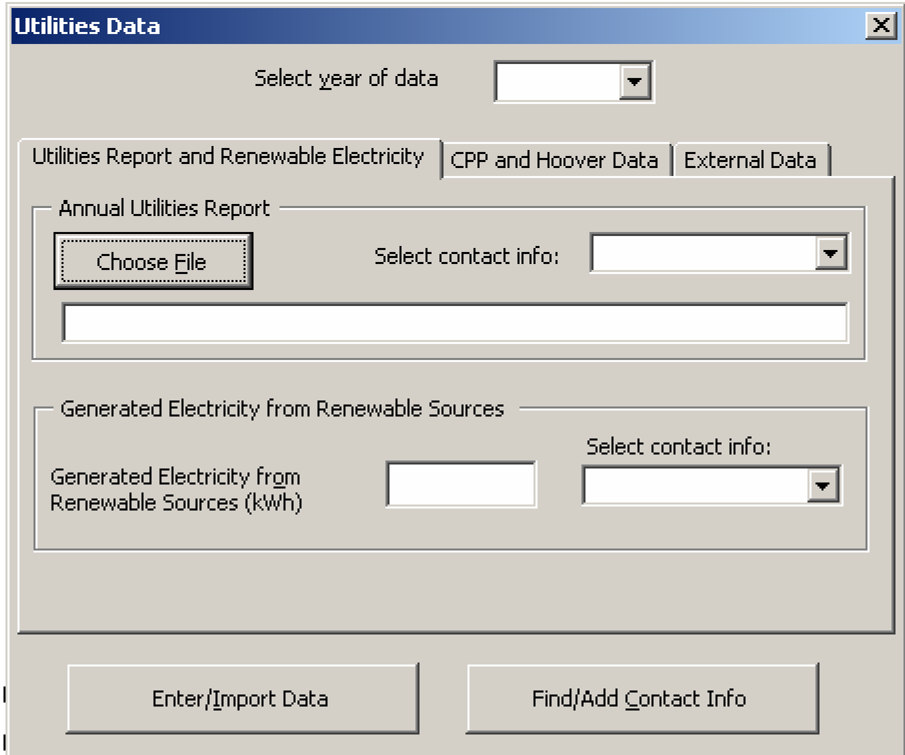


Figure 5-2. Utilities Data Entry Form

Choose the "Utilities Report and Renewable Electricity" tab and click the "Choose File" button. The path and file name will appear in the long text box below the button. Next, select the location of the *Annual Report of Utilities* file and click "OK." At this point, you can either click the "Enter/Import Data" button to import the file, or proceed with the manual data entry. Once the "Enter/Import Data" button is clicked, the EDR will import the *Annual Report of Utilities* to the "UtilCSV" temporary worksheet. The EDR then writes the data to the "BldgData" worksheet based on each building's unique building number. The "BldgData" worksheet serves as the repository for building energy data

The "BldgList" worksheet contains the list of U-M buildings that are included in the model analysis. When new buildings are built or purchased by the University, their building numbers and names should be inserted (either by right-clicking the mouse or selecting "insert" from the menu) into a new row in the table. Without inserting these data, the EDR will not import any information related to the new building.

Calculating the Building Energy Consumption metric also requires the manual entry of U-M and external data. In the "Utilities Report and Renewable Electricity" tab, enter the amount of electricity generated from renewable sources on campus. In the "CPP and Hoover Data" tab, enter the annual fuel oil and bulk gas consumption figures for the CPP and the Hoover Boiler Plant in the appropriate text boxes.

The "External Data" tab contains the data fields for the fuel mix and heat rates of purchased electricity. Ideally, fuel mix data is obtained directly from the providers of U-M's purchased electricity. At this time it is not possible to determine this information;

instead, the fuel mix of purchased electricity is approximated with regional data. These values are calculated in a separate file using Excel's PitvotTable feature with the EIA data set. The procedure for this calculation is as follows:

1. Download Data: The fuel mix and heat rate for purchased electricity must be calculated from the EIA-906/920 Monthly Time Series File data provided by the Energy Information Administration (http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html).

2. Begin PivotTable Wizard: The simplest way to process these data is to select the entire data set and utilize Excel's PivotTable feature, located under the "Data" menu. In the PivotTable Wizard, after the source data have been selected, choose the "Layout" option. An example of the PivotTable Wizard is shown as Figure 5-3.

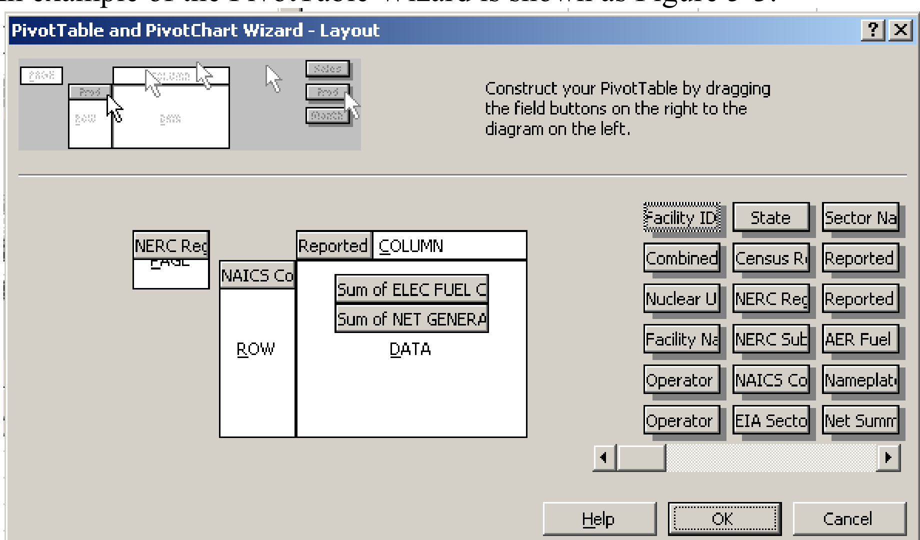


Figure 5-3. Construction of the PivotTable using the PivotTable Wizard

3. Completing the Wizard: Drag and drop the "NERC Region" field button into the "Page" area. Drag and drop the "NAICS Code" field button into the "Row" area and drag and drop the "Reported Fuel Type Code" field button into the "Column" area. Lastly, drag and drop the "Elec Fuel Consumption MMBtus" and "Net Generation (megawatthours)" field buttons into the "Data" area. Double-click each of these buttons and verify that "Sum" has been selected under the "Summarize by:" option, as shown in Figure 5-4.

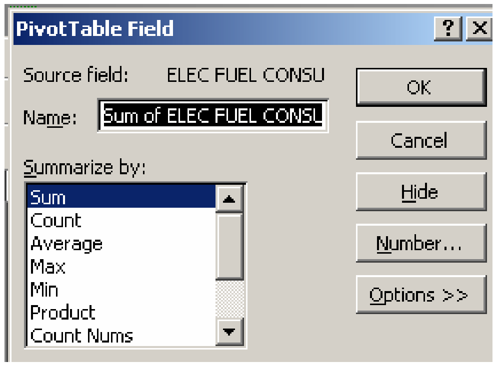


Figure 5-4. PivotTable Field Window

4. Select PivotTable Fields: Once the PivotTable Wizard completes, select only "ECAR" from the "NERC Region" field and "22" from the "NAICS Code" field

5. Verify PivotTable: Once these selections have been made, the PivotTable will display the total fuel consumed and total electricity produced from each of the Reported Fuel Types. The PivotTable should now resemble Figure 5-5.

	A	B	C	D	E	
1	NERC Region	ECAR				
2						
3			Reported Fuel Type Code			
4	NAICS Code	Data	BFG	BIT	DFO	LI
5	22	Sum of ELEC FUEL CONSUMPTION MMBTUS	1642850	4202297620	13392138	
6		Sum of NET GENERATION (megawatthous)	124083.95	418110009	1155846.6	6
7						

Figure 5-5. Example of the PivotTable used to Calculate Fuel Mix and Heat Rate

6. Identify Fuel Types: Calculating the fuel mix for purchased electricity begins by summing the "Net Generation (megawatt hours)" field. There are three main sources of electricity production that are a concern for U-M: coal, natural gas, and nuclear. To determine the percentage of coal-generated electricity, sum the generation fields of the Reported Fuel Types "BIT", "SC", "SUB", and "WC". These abbreviations stand for anthracite and bituminous coal, coal-based synfuel, subbituminous coal, and waste/other coal. Next, divide the sum of the generation fields by the total generation. Repeat this procedure for natural gas-generated electricity by using the Reported Fuel Type "NG". Lastly, repeat for nuclear-generated electricity by using the Reported Fuel Type "NUC". The resulting fuel mix should be in the range of approximately 80-85 percent coal, 2-7 percent natural gas, and 7-13 percent nuclear.

7. Calculate Heat Rate: In order to calculate the heat rate for coal, natural gas, and nuclear generated electricity, it is necessary to divide electric fuel consumption (MMBtus) by net generation (megawatt hours). For coal-generated electricity, multiply the sum of the electric fuel consumption by 1,000 and then divide by the total net generation for the Reported Fuel Types "BIT", "SC", "SUB", and "WC". To calculate the heat rate for natural gas, repeat the process using the Reported Fuel Type "NG". To calculate the heat rate for nuclear, repeat the process using the Reported Fuel Type "NUC". The heat rate for coal-generated electricity should be approximately 10,100

Btu/kWh. Natural gas and nuclear heat rates should be in the range of 8,700 to 9,500 Btu/kWh and 10,400 Btu/kWh, respectively.[6]

8. Enter Data: Once the fuel mix and heat rate values have been calculated, they are entered into the “External Data” tab of the “Utilities” form. Next, click the “Enter/Import Data” button. The EDR calculates the average heat rate of purchased electricity and writes the value to the “SecondaryInput” worksheet. The fuel mix percentages do not undergo any calculations and are written directly to the “SecondaryInput” worksheet. Also, because they are necessary for greenhouse gas emissions calculations, the individual heat rates for coal, natural gas, and fuel oil-fired power plants are written to the “SecondaryInput” worksheet.

The actual calculation of the Building Energy Consumption metric occurs in the “RawOutput” worksheet. Here, the energy consumption data are converted from their reported units to Btus. The amount of natural gas and bulk gas consumed is summed and multiplied by the natural gas heat content to convert from hundred cubic feet (CCF) to Btu. The volume of fuel oil consumed is summed and multiplied by the fuel oil heat content to convert from gallons to Btus. The amounts of electricity purchased for North Campus and from other off-site suppliers are summed and multiplied by the overall heat rate of purchased electricity to convert from kWh to Btus. Electricity purchases from the CPP are not included in the analysis, since the amount of natural gas combusted by the CPP during electricity generation is already accounted for. If electricity from renewable sources was purchased, this value is multiplied by the heat content of electricity to convert from kWh to Btus.

> Building Energy Consumption (Btus) = Σ [Bulk Gas, Natural Gas (CCF)] * 100 * Natural Gas Heat Content (Btu/cubic foot) + CPP Fuel Oil (Gallons) * Fuel Oil Heat Content (Btu/gallon) + Σ [Purchased North Campus Electricity, Other Purchased Electricity (kwh)] * Average Heat Rate of Purchased Electricity (Btu/kWh) + Purchased Electricity from Renewable Sources (kWh) * 3,412 (Btu/kWh)

The normalization Btu/ft^2 is calculated within the “RawOutput” worksheet by dividing the Building Energy Consumption in Btus by the total building square footage. The building area is calculated automatically by the EDR when the *Annual Report of Utilities* is imported and the result is written to the “SecondaryInput” worksheet. The normalization Btu/person is calculated within the “RawOutput” worksheet by dividing the Building Energy Consumption by the total U-M Ann Arbor campus population. Lastly, the normalization Btu/ft^2/person is calculated within the “RawOutput” worksheet by first dividing the Building Energy Consumption in Btu by the total building square footage and then by dividing by the total campus population.

[6] These heat rate ranges were observed from EIA-906/920 data for years 2001 – 2004.

5.1.4 Purchased Electricity Consumption (MWh)

The Purchased Electricity Consumption metric measures the amount of electricity purchased from off-site generators. Electricity purchases for U-M fall within two categories: purchased for North Campus and other purchased.

5.1.4.1 Primary Data Sources

The amount of purchased electricity by building is reported in the *Annual Report of Utilities*, which is obtained from Carol Varney. Please see Section 5.1.3.

5.1.4.2 Secondary Data Sources

There are no secondary data sources for the Purchased Electricity Consumption metric.

5.1.4.3 Calculation Procedure

In order to calculate the Purchased Electricity Consumption metric, it is necessary to import the *Annual Report of Utilities*. For instructions on how to import this file, please refer to Section 5.1.3. Once the file is imported, the "RawOutput" worksheet calculates the metric by summing the amounts of electricity purchased for North Campus and for general consumption for all buildings. This sum is then divided by 1000 to convert from kWh to MWh.

5.1.5 Generated Electricity Consumption (MWh)

In addition to electricity purchased from off-site generators, the U-M generates a large portion of its total electricity consumption at the CPP. The Generated Electricity Consumption metric measures the amount of CPP-generated electricity consumed by U-M buildings.

5.1.5.1 Primary Data Sources

The amount of CPP-generated electricity consumed by building is available in the *Annual Report of Utilities*, which is obtained from Carol Varney. Please see Section 5.1.3.

5.1.5.2 Secondary Data Sources

There are no secondary data sources for the Generated Electricity Consumption metric.

5.1.5.3 Calculation Procedure

In order to calculate the Generated Electricity Consumption metric, it is necessary to import the *Annual Report of Utilities*. For instructions on how to import this file, please refer to Section 5.1.3. Once the file is imported, the "RawOutput" worksheet calculates the metric by summing the amount of CPP-generated electricity consumed by all buildings. This sum is then divided by 1000 to convert from kWh to MWh.

5.1.6 Purchased Electricity from Renewable Sources (%)

The Purchased Electricity from Renewable Sources metric measures the consumption of purchased electricity from renewable sources. The metric calculates the percentage of purchased electricity reported in the *Annual Report of Utilities* that is generated using renewable sources.

5.1.6.1 Primary Data Sources
The amount of purchased electricity by building is contained in the *Annual Report of Utilities*, which is obtained from Carol Varney.

5.1.6.2 Secondary Data Sources
Data from the EIA's EIA-906/920 Monthly Time Series File are used to calculate the average fuel mix of purchased electricity. With the fuel mix, the percentage of purchased electricity generated from renewable sources is calculated. Please see Section 5.1.3.

5.1.6.3 Calculation Procedure
The average fuel mix of purchased electricity is calculated by the user based on data obtained from the EIA's EIA-906/920 Monthly Time Series File. The processes for calculating and entering these data into the EDR are described in Section 5.1.3. It is also necessary to import the *Annual Report of Utilities*. Please refer to Section 5.1.3 for instructions on how to import this file.

The Purchased Electricity from Renewable Sources metric is simply the sum of the purchased electricity fuel mix percentages of hydroelectric and other renewables. This calculation occurs in the "RawOutput" worksheet.

5.1.7 Generated Electricity from Renewable Sources (%)

The Generated Electricity from Renewable Sources metric measures the percentage of electricity that is generated on-site from renewable sources.

5.1.7.1 Primary Data Sources
Andy Berki is the primary data source for the Generated Electricity from Renewable Sources metric. Please see Section 5.1.3.

5.1.7.2 Secondary Data Sources
There are no secondary data sources for the Generated Electricity from Renewable Sources metric.

5.1.7.3 Calculation Procedure
The amount of electricity generated from renewable sources is entered directly to the Utilities Data form. To enter this value, begin by selecting the "Energy" tab in the main user interface and clicking the "Energy Data: Buildings" button. Next, choose the "Utilities Report and Renewable Electricity" tab and enter the value of direct purchases of electricity from renewable sources in the appropriate text box. Last, click the "Import/Enter Data" button to write the value to the "PrimaryInput" worksheet. In the "RawOutput" worksheet, the amount of electricity generated from renewable sources is divided by 1000 to convert from kWh to MWh. This value is then divided by the Generated Electricity Consumption metric.

5.1.8 Transportation Energy Consumption (Btu, Btu/person)

Transportation energy consumption results from fuel consumed by vehicles (including trucks, buses, vans, and various types of automobiles) owned and maintained by the University. The types of fuel consumed are unleaded gasoline, B20 (a mix of 80% conventional diesel with 20% biodiesel), a mix of 80% ultra low sulfur diesel (ULSD) with 20% biodiesel, and E85 (a mix of 85% ethanol with 15% unleaded gasoline). This indicator is per person – person here is defined as total U-M Ann Arbor campus population.

5.1.8.1 Primary Data Sources

Contact:
Renee Jordan
Administrative Associate I
Parking & Transportation Services
(734) 615-0527
reneej@umich.edu

University of Michigan Parking & Transportation Services (U-M PTS) prepares an annual statistics review at the end of each fiscal year (June 30th) summarizing the total volume of fuel consumed listed by type of fuel (e.g. unleaded gasoline, B20, ULSD/Biodiesel mix, and E85). The U-M PTS maintains statistics for fuel consumption by all vehicles on an on-going basis.

Renee Jordan enters the data necessary (total gallons of unleaded gasoline, B20, ULSD/Biodiesel mix, and E85 consumed) for calculating the total transportation energy consumption in British thermal units (Btu) into an Excel spreadsheet named "TransportationStats." This worksheet has been prepared to facilitate data entry and needs to be sent via email in order for the contact to enter data into the appropriate cells (see Figure below). This worksheet is designed to reflect the fields and data contained in the U-M PTS annual statistics review and will allow the contact to copy and paste data currently collected. The file contains an "Instructions" worksheet for ease of data entry.

In order for the model to access data from "TransportationStats" for use in calculations, the file must be imported. To import the file, one must select the Energy tab on the user interface and click the "Energy Data: Transportation" button. Be sure to select the year of data entry and the contact providing the data in order for the data to be successfully entered. Next click the "Import Fuel & Passenger Data" button, select the file "TransportationStats" and click OK. A message box will appear displaying the pathname of the file you selected. After clicking the OK button, the spreadsheet will automatically be imported to the "Transportation_Input" worksheet. At this point, the model takes the fuel consumption data in the spreadsheet and stores the values in the "PrimaryInput" worksheet under the year selected for data entry. A screenshot of the "TransportationStats" file is shown as Figure 5-6.

Microsoft Excel - TransportationStats

File Edit View Insert Format Tools Data Window Help

D1

	A	B	C	D
1	**Energy Consumption**	**Fuel Type (Gallons)**	**2004**	
2	Total	Unleaded	344165.7	
3	Total	B20 Biodiesel	79895.8	
4	Total	80% ULSD/20% Biodiesel	254405.9	
5	Total	85% Ethanol/15%Unleaded	130747.6	
6	Bus	Unleaded	0	
7	Bus	B20 Biodiesel	40047.2	
8	Bus	80% ULSD/20% Biodiesel	215723.9	
9	Bus	85% Ethanol/15%Unleaded	0	
10	Fleet (Auto/Truck)	Unleaded	344165.7	
11	Fleet (Auto/Truck)	B20 Biodiesel	39848.6	
12	Fleet (Auto/Truck)	80% ULSD/20% Biodiesel	38682	
13	Fleet (Auto/Truck)	85% Ethanol/15%Unleaded	130747.6	
14	**Campus Bus Ridership**			
15	Bus Ridership	Total Passengers	4702261	
16	Bus Ridership	Total Miles Traveled	1115037	
17	**Vanpooling (U-M vehicles only)**	**Location**	**# Passengers**	**VMT**
18	Vanpool	Adrian 1	7	23874
19	Vanpool	Blissfield 1	6	9803
20	Vanpool	Brighton 1	6	12632
21	Vanpool	Brighton 2	6	4910
22	Vanpool	Brighton 2	6	3538
23	Vanpool	Canton 1	6	15103
24	Vanpool	Clinton 1	7	15416
25	Vanpool	Clinton 2	7	16311
26	Vanpool	Fenton 1	7	24767
27	Vanpool	Grand Blanc 1	7	4521
28	Vanpool	Grass Lake 1	7	22961
29	Vanpool	Grass Lake 2	6	26942
30	Vanpool	Grass Lake 3	6	27806

Figure 5-6. Screenshot of TransportationStats MS Excel File, Showing Energy Consumption, Campus Bus Ridership, and Vanpooling Data

5.1.8.2 Secondary Data Sources

Additional data necessary to calculate the total transportation energy consumption and normalize per person are the heating values of each fuel and the total U-M Ann Arbor campus population (which includes students, faculty and staff on the U-M Ann Arbor campus, as well as those at the U-M Hospital). This data is stored in the "SecondaryInput" worksheet and should be input manually each year.

To enter the heating values for each fuel you must first exit from the user interface and then select the "SecondaryInput" worksheet. The higher heating value (HHV) for unleaded gasoline is to be in British thermal units (Btu) per gallon of fuel and input to row 16 "Unleaded Fuel – HHV" corresponding to the appropriate year of data entry. When you are ready to input this data, click on the cell the data belongs in, type in the value, and press Enter. The cell will no longer be highlighted, indicating that you have made an entry. You will then insert a comment in the cell indicating the data source (if necessary, click on a cell from a previous year for reference). When you have the source information ready, click on the cell one time, then right-click, and select Insert Comment.

Type the source information in the text box that appears and, if necessary, adjust the size of it to fit the text.

Following the same procedure described above for data entry, the HHV for conventional diesel is to be in British thermal units (Btu) per gallon of fuel and input to row 17 "Diesel Fuel – HHV" corresponding to the appropriate year of data entry; the HHV for B20 is to be in British thermal units (Btu) per gallon of fuel and input to row 18 "Biodiesel Fuel – HHV" corresponding to the appropriate year of data entry; the HHV for ULSD is to be in British thermal units (Btu) per gallon of fuel and input to row 19 "ULSD Fuel – HHV" corresponding to the appropriate year of data entry; the HHV for E85 is to be in British thermal units (Btu) per gallon of fuel and input to row 20 "Ethanol Fuel – HHV" corresponding to the appropriate year of data entry. The 2004 heating values are listed in Table 5-1 in Btu per gallon.

Table 5-1. Higher Heating Values of Transportation Fuels (2004)

Fuel Type	Heating Value (Btu/gallon)
Unleaded Gasoline[7]	125,071
Conventional Diesel[7]	138,690
Biodiesel[8]	135,916
Ultra Low Sulfur Diesel[9]	137,997
Ethanol[7]	84,262

A U.S. Environmental Protection Agency (EPA) document (Climate Leaders GHG Inventory Protocol Core Module Guidance: Direct Emissions from Mobile Combustion Sources) released in October 2004 contains the heating values for unleaded gasoline, conventional diesel and ethanol. In accordance with the Department of Energy (DOE), the heating value for biodiesel is 2% less on average than that for conventional diesel.[8] There is no regularly updated source for the heating value of ULSD however a recent publication by the Energy Information Administration (Transition to Ultra-Low Sulfur Diesel Fuel, 2001) reported that the energy content of ULSD is assumed to decrease by 0.5% due to the undercutting and severe desulfurization resulting in a lighter stream composition than for conventional diesel.[9]

The total U-M Ann Arbor campus population is necessary to normalize this metric and is described in Section 4.2. Input this data into the appropriate fields in the "Population" tab of the user interface and it will be stored in the "SecondaryInput" worksheet.

[7] U.S. Environmental Protection Agency. *Climate Leaders GHG Inventory Protocol Core Module Guidance: Direct Emissions from Mobile Combustion Sources.* October 2004.

[8] U.S. Department of Energy. Energy Efficiency and Renewable Energy. Alternative Fuels Data Center. http://www.eere.energy.gov/afdc/afv/bio_vehicles.html (last updated October 13, 2004).

[9] Energy Information Administration. Transition to ULSD Fuel: Effects on Prices and Supply (6. Mid-Term Analysis of ULSD Regulations). http://www.eia.doe.gov/oiaf/servicerpt/ulsd/chapter6.html 2001.

5.1.8.3 Calculation Procedure
After the "TransportationStats" file has been imported, the data from this file are stored in the "Transportation_Input" worksheet and the total fuel consumption (gallons) for unleaded gasoline, B20, ULSD/Biodiesel mix, and E85 is stored in the "PrimaryInput" worksheet. These values (gallons of fuel) are multiplied by the corresponding heating values (Btu/gallon of fuel) and are added together to get a new value representing the total transportation energy consumption (Btu) for the year. This new value is divided by the total U-M Ann Arbor population to calculate the desired metric in Btu per person. Both values are stored in the "RawOutput" worksheet in the Energy category for the corresponding year and can be viewed in the "Summary" and "Graphing" worksheets.

> Transportation Energy Consumption (Btu) =
> [Unleaded Fuel (gal) * Unleaded Fuel Heat Content (Btu/gal)] + [B20 Fuel (gal) * 0.8 * Conventional Diesel Heat Content (Btu/gal)] + [B20 Fuel (gal) * 0.2 * Biodiesel Heat Content (Btu/gal)] + [ULSD/Biodiesel Mix Fuel (gal) * 0.8 * ULSD Heat Content (Btu/gal)] + [ULSD/Biodiesel Mix Fuel (gal) * 0.2 * Biodiesel Heat Content (Btu/gal)] + [E85 Fuel (gal) * 0.85 * Ethanol Fuel Heat Content (Btu/gal)] + [E85 (gal) * 0.15 * Unleaded Fuel Heat Content (Btu/gal)]

5.1.9 Bus Energy Consumption (Btu, Btu/passenger)

Bus energy consumption results from fuel consumed by buses owned and maintained by the University. The types of fuel consumed by the buses at U-M are B20 and a mix of 80% ULSD with 20% biodiesel. This metric is normalized per passenger – the U-M PTS records the number of passengers riding U-M busses each year.

5.1.9.1 Primary Data Sources
Contact:
Renee Jordan
Administrative Associate I
Parking & Transportation Services
(734) 615-0527
reneej@umich.edu

The U-M PTS prepares annual statistics at the end of each fiscal year (June 30th) summarizing the volume of fuel consumed listed by fuel type (e.g. unleaded gasoline, B20, ULSD/Biodiesel mix, and E85) and bus passenger totals.

The data necessary for calculation of the Bus Energy Consumption metric are part of the "TransportationStats" import. The process for importing this file is described in Section 5.1.8 in addition to a figure to view for example values.

5.1.9.2 Secondary Data Sources
Additional data necessary to calculate the bus energy consumption per passenger are the heating values of each fuel (values are listed in Table 5-1). To enter the heating values for each fuel, one must first exit from the user interface and select the "SecondaryInput"

worksheet. If the values have not already been input, follow the process described in Section 5.1.8.

5.1.9.3 Calculation Procedure

After the "TransportationStats" file has been imported, the data from this file are stored in the "Transportation_Input" worksheet. The bus fuel consumption (gallons) for B20 and ULSD/Biodiesel and the number of bus passengers are stored in the "PrimaryInput" worksheet. These values (gallons of fuel) are multiplied by the corresponding heating values (Btu/gallon of fuel) and are added together to get a new value representing the total bus energy consumption (Btu) for the year. This new value is divided by the total number of bus passengers to normalize the metric giving British thermal units of bus energy consumption per passenger (Btu/passenger). Both values are stored in the "RawOutput" worksheet in the Energy category for the corresponding year and can be viewed in the "Summary" and "Graphing" worksheets.

5.1.10 Fleet Vehicle Energy Consumption (Btu)

Fleet vehicles energy consumption is a result of fuel consumed by fleet vehicles (including sedans, pickups, wagons, vans, minivans, SUVs, and trucks) owned and maintained by the University. The types of fuel consumed by these vehicles are unleaded gasoline, B20, a mix of 80% ULSD with 20% biodiesel, and E85.

5.1.10.1 Primary Data Sources

Contact:
Renee Jordan
Administrative Associate I
Parking & Transportation Services
(734) 615-0527
reneej@umich.edu

The U-M PTS prepares annual statistics at the end of each fiscal year (June 30th) summarizing the volume of fuel consumed listed by fuel type (e.g. unleaded gasoline, B20, ULSD/Biodiesel mix, and E85).

The data necessary for calculation of the Fleet Vehicle Energy Consumption metric are part of the "TransportationStats" import. The process for importing this file is described in Section 5.1.8 in addition to a figure to view for example values.

5.1.10.2 Secondary Data Sources

Additional data necessary to calculate the fleet vehicle energy consumption are the heating values of each fuel (values are listed in Table 5-1). To enter the heating values for each fuel, one must first exit from the user interface and select the "SecondaryInput" worksheet. If the values have not already been input, follow the process described in Section 5.1.8.

5.1.10.3 Calculation Procedure
After the "TransportationStats" file has been imported, the data from this file are stored in the "Transportation_Input" worksheet. The fleet vehicle fuel consumption (gallons) for unleaded gasoline, B20, ULSD/Biodiesel mix, and E85 are stored in the "PrimaryInput" worksheet. These values (gallons of fuel) are multiplied by the corresponding heat values (Btu/gallon of fuel) and are added together to get a new value representing the total fleet vehicle energy consumption (Btu) for the year. This value is stored in the "RawOutput" worksheet in the Energy category for the corresponding year and can be viewed in the "Summary" and "Graphing" worksheets.

5.1.11 Renewable Percentage for Transportation Energy (% of total transportation energy)

Transportation energy consumption is a result of fuel consumed by vehicles (including trucks, buses, vans, and various types of automobiles) owned and maintained by the University. The types of fuel consumed by these vehicles are unleaded gasoline, B20, a mix of 80% ultra low sulfur diesel (ULSD) with 20% biodiesel, and E85. This metric considers only the portion of fuel that is renewable (e.g. B20 contains 20% biodiesel by volume).

5.1.11.1 Primary Data Sources
Contact:
Renee Jordan
Administrative Associate I
Parking & Transportation Services
(734) 615-0527
reneej@umich.edu

The U-M PTS prepares annual statistics at the end of each fiscal year (June 30th) summarizing the volume of fuel consumed listed by fuel type (e.g. unleaded gasoline, B20, ULSD/Biodiesel mix, and E85).

The data necessary for calculating the Renewable Percentage for Transportation Energy metric are part of the "TransportationStats" import. The process for importing this file is described in Section 5.1.8.

5.1.11.2 Secondary Data Sources
Additional data necessary to calculate the renewable transportation energy consumption are the heating values of each fuel (values are listed in Table 5-1). To enter the heating values for each fuel, one must first exit from the user interface and select the "SecondaryInput" worksheet. If the values have not already been input, follow the process described in Section 5.1.8.

5.1.11.3 Calculation Procedure
After the "TransportationStats" file has been imported, the data from this file are stored in the "Transportation_Input" worksheet. The transportation fuel consumption (gallons) for unleaded gasoline, B20, ULSD/Biodiesel mix, and E85 are stored in the

"PrimaryInput" worksheet. These values (gallons of fuel) are multiplied by the fraction of renewable fuel by volume that is contained in the mix of fuel (e.g. the total B20 fuel consumption in gallons is multiplied by 0.2 to determine the volume of fuel that is renewable). If the fraction of renewable fuel by volume changes for any fuel type, this can be updated manually in the "RawOutput" worksheet. The "RawOutput" worksheet is hidden. The procedure for viewing hidden sheets is described in Section 4. Once the worksheet is in view, select the cell that contains the equation in need of updating and edit the equation.

After the fraction of renewable fuel is determined for each fuel mix, these values are multiplied by the corresponding heat values (Btu/gallon of fuel) and are added together to get a new value representing the total renewable transportation energy consumption (Btu) for the year. This value is then divided by the total transportation energy consumption (calculation described in Section 5.1.8) and is stored in the "RawOutput" worksheet in the Energy category for the year selected and can be viewed in the "Summary" and "Graphing" worksheets.

Renewable Percentage of Transportation Energy (%) =
{[B20 Fuel (gal) * 0.2 * Biodiesel Heat Content (Btu/gal) + ULSD/Biodiesel Mix Fuel (gal) * 0.2 * Biodiesel Heat Content (Btu/gal) + E85 Fuel (gal) * 0.85 * Ethanol Fuel Heat Content (Btu/gal)] / [Transportation Energy Consumption (Btu)]} * 100

5.1.12 Campus Bus Ridership (total passengers)

Campus bus ridership is represented by the total number of passengers riding U-M busses for the fiscal year being considered.

5.1.12.1 Primary Data Sources
Contact:
Renee Jordan
Administrative Associate I
Parking & Transportation Services
(734) 615-0527
reneej@umich.edu

The U-M PTS prepares annual statistics at the end of each fiscal year (June 30th) summarizing the bus passenger totals.

The data necessary for calculating the Campus Bus Ridership metric are part of the "TransportationStats" import. The process for importing this file is described in Section 5.1.8 in addition to a figure to view for example values.

5.1.12.2 Secondary Data Sources
No secondary data sources are necessary for this metric.

5.1.12.3 Calculation Procedure
After the "TransportationStats" file has been imported, the data from this file are stored in the "Transportation_Input" worksheet. The total number of passengers riding the U-M busses for the year selected is then stored in the "PrimaryInput" and "RawOutput" worksheets. The metric requires no additional calculation and can be viewed in the "Summary" worksheet.

5.1.13 Vanpooling (vehicle-miles traveled, passenger-miles traveled)

The U-M has sponsored vanpooling for faculty and staff since the 1970s. Up to six passengers and a driver meet each day in their community and ride in together, are dropped off near work, and the van is parked in a reserved parking place on campus. The vehicle-miles traveled metric requires the total number of miles traveled by each van for the fiscal year being considered, while the passenger-miles traveled metric requires the number of passengers riding in each van and the total number of miles traveled by each van for the fiscal year being considered.

5.1.13.1 Primary Data Sources
Contact:
Renee Jordan
Administrative Associate I
Parking & Transportation Services
(734) 615-0527
reneej@umich.edu

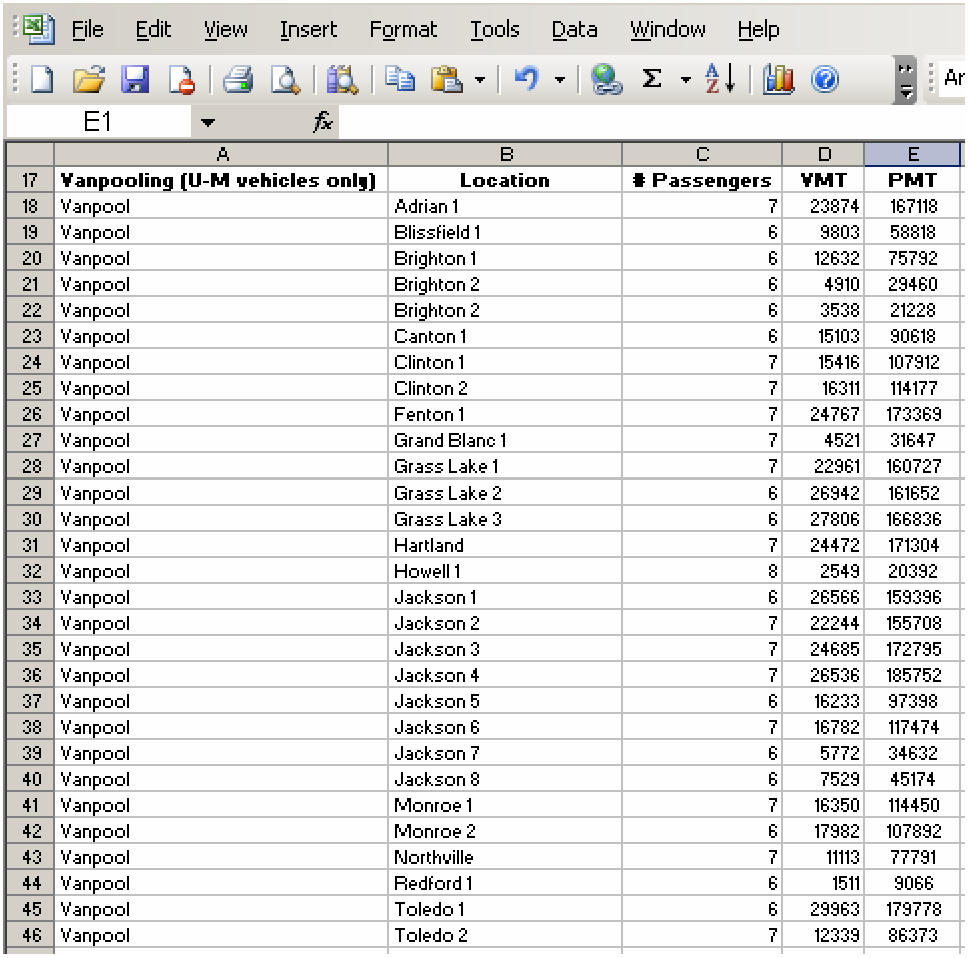
The U-M PTS prepares and maintains statistics summarizing the vanpooling information.

The data necessary for calculating both the vehicle-miles traveled and passenger-miles traveled metrics are part of the "TransportationStats" import. The process for importing this file is described in Section 5.1.8 in addition to a figure to view for example values.

5.1.13.2 Secondary Data Sources
No secondary data sources are necessary for this metric.

5.1.13.3 Calculation Procedure
After the "TransportationStats" file has been imported, the data from this file are stored in the "Transportation_Input" worksheet. The number of miles each van travels during the fiscal year being considered are added together resulting in the total number of miles traveled for U-M vanpooling. This new value is then stored in the "PrimaryInput" and "RawOutput" worksheets. The vehicle-miles traveled metric requires no additional calculation and can be viewed in the "Summary" and "Graphing" worksheets.

Within the "Transportation_Input" worksheet, the number of miles each van travels is multiplied by the number of passengers it carries resulting in the number of passenger-miles traveled by each van (see Figure 5-7 below for example values). The total number of passenger-miles driven is then calculated by summing the passenger-miles traveled for each van. This new value is then stored in the "PrimaryInput" and "RawOutput" worksheets. The passenger-miles traveled metric requires no additional calculation and can be viewed in the "Summary" and "Graphing" worksheets.



	A	B	C	D	E
17	Vanpooling (U-M vehicles only)	Location	# Passengers	VMT	PMT
18	Vanpool	Adrian 1	7	23874	167118
19	Vanpool	Blissfield 1	6	9803	58818
20	Vanpool	Brighton 1	6	12632	75792
21	Vanpool	Brighton 2	6	4910	29460
22	Vanpool	Brighton 2	6	3538	21228
23	Vanpool	Canton 1	6	15103	90618
24	Vanpool	Clinton 1	7	15416	107912
25	Vanpool	Clinton 2	7	16311	114177
26	Vanpool	Fenton 1	7	24767	173369
27	Vanpool	Grand Blanc 1	7	4521	31647
28	Vanpool	Grass Lake 1	7	22961	160727
29	Vanpool	Grass Lake 2	6	26942	161652
30	Vanpool	Grass Lake 3	6	27806	166836
31	Vanpool	Hartland	7	24472	171304
32	Vanpool	Howell 1	8	2549	20392
33	Vanpool	Jackson 1	6	26566	159396
34	Vanpool	Jackson 2	7	22244	155708
35	Vanpool	Jackson 3	7	24685	172795
36	Vanpool	Jackson 4	7	26536	185752
37	Vanpool	Jackson 5	6	16233	97398
38	Vanpool	Jackson 6	7	16782	117474
39	Vanpool	Jackson 7	6	5772	34632
40	Vanpool	Jackson 8	6	7529	45174
41	Vanpool	Monroe 1	7	16350	114450
42	Vanpool	Monroe 2	6	17982	107892
43	Vanpool	Northville	7	11113	77791
44	Vanpool	Redford 1	6	1511	9066
45	Vanpool	Toledo 1	6	29963	179778
46	Vanpool	Toledo 2	7	12339	86373

Figure 5-7. Screenshot of "TransportationStats" MS Excel File Showing Vanpooling Data

5.1.14 AATA Bus Ridership (total number of rides)

Ann Arbor Transportation Authority (AATA) bus ridership is represented by the total number of rides it provides for the year being considered.

5.1.14.1 Primary Data Sources

Contact:
Dave Miller
Director
Parking & Transportation Services
(734) 647-0948
dvmiller@umich.edu

The U-M PTS prepares an annual statistics review at the end of each fiscal year summarizing the total number of AATA rides in an Excel spreadsheet. Upon request, Dave will share the total number of rides AATA provided for the year being considered.

To enter the value into the model, first click the "Energy" tab on the user interface and click the "Energy Data: Transportation" button. Be sure to select the year of data entry and the contact providing the data in order for the data to be successfully entered. Enter the number of rides provided by the AATA in the appropriate text box simultaneously with the number of bike racks (see Section 5.1.15). Click the "Enter Data" button for the data to be input and stored in the "RawOutput" worksheet.

5.1.14.2 Secondary Data Sources
No secondary data sources were necessary for this metric.

5.1.14.3 Calculation Procedure
After the number of rides provided by AATA has been input, it is stored in the "RawOutput" worksheet. The metric requires no additional calculation and can be viewed in the "Summary" and "Graphing" worksheets.

5.1.15 Bicycle Ridership (number of bike racks)

Bicycle ridership is represented by the total number of bike racks on the U-M Ann Arbor campuses (Central, Medical, North and South) for the year being considered.

5.1.15.1 Primary Data Sources
Contact:
Terence Ramsey
Landscape Architect II
Plant Extension
(734) 260-2959
tramsey@bf.umich.edu

The U-M Plant Extension office prepares maps of each campus (Central, Medical, North and South) showing the location and number of bike racks placed throughout each campus. Upon request, Terry will send the maps for the year being considered. Each map must be carefully reviewed to make an accurate count of the total number of bike racks on each campus.

To enter the values into the model, first click the "Energy" tab on the user interface and click the "Energy Data: Transportation" button. Be sure to select the year of data entry and the contact providing the data in order for the data to be successfully entered. Enter the number of bike racks for Central, Medical, North and South campuses in the appropriate text boxes simultaneously with the number of AATA rides (see Section 5.1.14). Click the "Enter Data" button for the data to be input.

5.1.15.2 Secondary Data Sources
No secondary data sources are necessary for this metric.

5.1.15.3 Calculation Procedure
After the number of bike racks for each campus has been input, they are added together and the total number of bike racks is stored in the "RawOutput" worksheet. The metric requires no additional calculation and can be viewed in the "Summary" and "Graphing" worksheets.

5.2 Water Use

One key performance indicator and four operational metrics are reported for the category Water Use in the EDR. These performance measures help monitor the University's water usage patterns and indicate opportunities for more sustainable management of this important resource. An example of information sources and data management for a water use metric is shown in Figure 5-8. This example demonstrates the calculation of total irrigation water use. A detailed discussion of data sources and calculation procedures for all indicators and metrics in this category is included in the sections that follow.

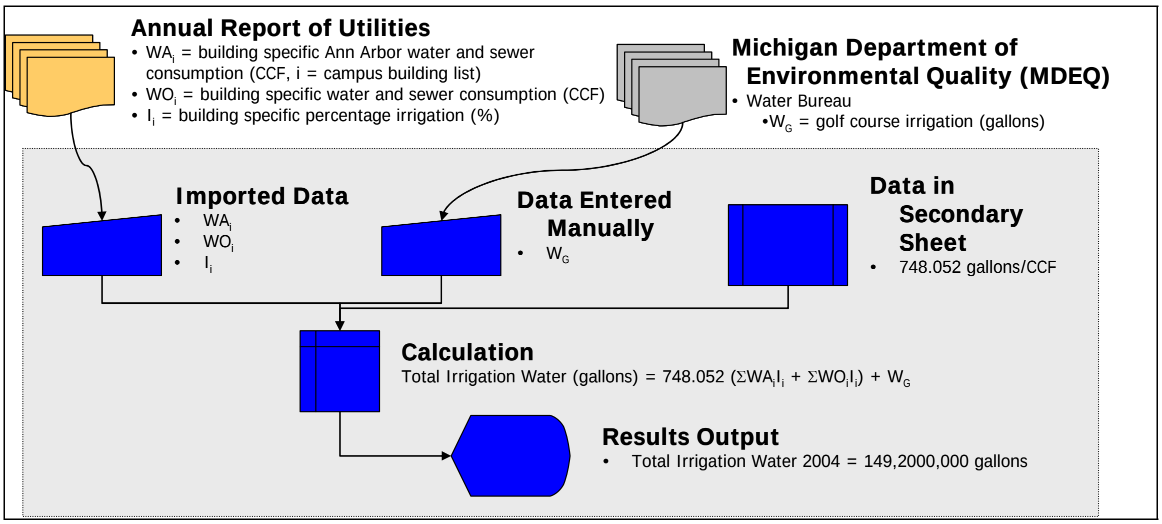


Figure 5-8. Calculation of the Total Irrigation Water Metric

5.2.1 Total Water Use (gallons, gallons/person)

The Total Water Use indicator measures the total volume of purchased water consumed by U-M buildings, Central Power Plant (CPP), and Hoover Boiler Plant, as well as the volume of water consumed by irrigating the University Golf Course and Radrick Farms Golf Course. By and large, the purchased water is supplied by the City of Ann Arbor, while well water is the source for golf course irrigation.

5.2.1.1 Primary Data Sources
Please see Sections 5.2.2 and 5.2.5 for the primary data sources.

5.2.1.2 Secondary Data Sources
The total U-M Ann Arbor campus population is required to calculate the per person normalization.

5.2.1.3 Calculation Procedure
The Total Water Use indicator is calculated using data that are imported to the EDR, as well as data that are entered manually. If the *Annual Report of Utilities* was not yet imported in the process of completing the energy category of indicators and metrics, please refer to Section 5.1.3. Please note that you only need to import the *Annual Report of Utilities* once.

The Total Water Use indicator is calculated within the "RawOutput" worksheet. Here, all building water consumption data are summed with the CPP and Hoover Boiler Plant data. Please refer to the calculation procedure in Section 5.2.2 for instructions on entering CPP and Hoover data. The water consumption sum is then multiplied by 748.052 to convert from CCF to gallons and added to the golf course irrigation total to arrive at the final indicator value. These calculations are summarized in the following equation:

> Total Water Use (gallons) = [∑ Building Water Consumption (CCF) + CPP Water Consumption (CCF) + Hoover Water Consumption (CCF)] * 748.052 gallons/CCF + Golf Course Irrigation (gallons)

The normalization of gallons/person is calculated by dividing Total Water Use (gallons) by the total U-M Ann Arbor campus population.

5.2.2 Total Purchased Water (gallons, gallons/person)

The Total Purchased Water metric indicator measures the total volume of purchased water consumed by U-M buildings, CPP, and Hoover Boiler Plant. By and large, the purchased water is supplied by the City of Ann Arbor, but other utilities supply water to certain U-M buildings.

5.2.2.1 Primary Data Sources
Contact:
Carol Varney
Business Manager, Utilities
(734) 647-0963
cvarney@umich.edu

The *Annual Report of Utilities* contains water consumption data for all of the University buildings included within the city of Ann Arbor. It is crucial to the successful operation of the EDR that the report be arranged by building and not by fund. Consumption data in this report is reported in hundred cubic feet (CCF). There are two sources of water for University buildings, the City of Ann Arbor and "other".

Contact:
Mike Swanson
Senior Engineer, Utilities
(734) 763-3011
mswaney@umich.edu

The CPP and the Hoover Boiler Plant both consume water to produce steam. Since annual water consumption figures for these two facilities are not included in the *Annual Report of Utilities*, these data are obtained from a separate contact, Mike Swanson.

5.2.2.2 Secondary Data Sources

The total U-M Ann Arbor campus population is required to calculate the per person normalization.

5.2.2.3 Calculation Procedure

The Total Purchased Water metric is calculated using data that are imported to the EDR, as well as data that are entered manually. If the *Annual Report of Utilities* has not yet been imported, please refer to Section 5.1.3 for instructions on importing this file.

The Total Purchased Water metric is calculated in a similar manner as the Total Water Use indicator, but the metric does not include golf course irrigation water. Within the "RawOutput" worksheet, the building water consumption data are summed with the CPP and Hoover Boiler Plant data. This sum is then multiplied by 748.052 to convert from CCF to gallons.

To manually enter the CPP and Hoover Boiler Plant consumption volumes, select the "Water" tab in the main user interface. The Water tab is shown in Figure 5-9. After completing the year and contact information data fields, enter the consumption volumes in the appropriate text boxes. Click the "Enter Water Data" button to write the consumption data to the "PrimaryInput" worksheet.

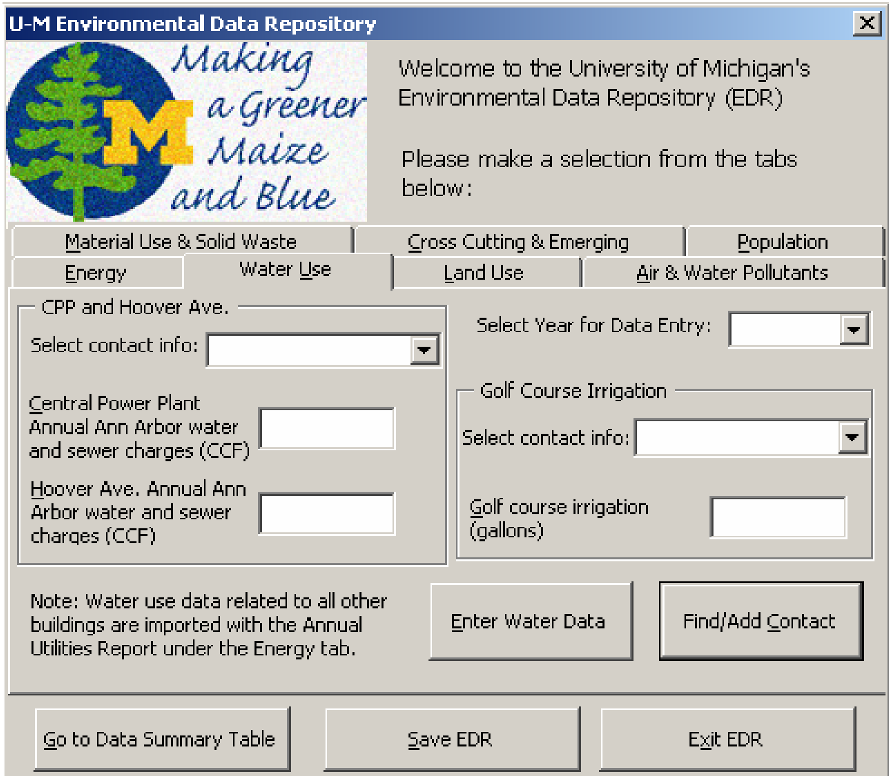


Figure 5-9. Water Use tab of Main User Interface.

The final value is displayed in the "Summary" and "Graphing" worksheets. The normalization of gallons/person is calculated by dividing Total Purchased Water (gallons) by the total U-M Ann Arbor campus population.

5.2.3 Building Specific Water Use (gallons, gallons/person)

The Building Specific Water Use metric measures the total volume of water consumed by U-M buildings within Ann Arbor's city limits. This metric does not include consumption by the CPP and Hoover Boiler Plant, nor does it include irrigation water for the University Golf Course and Radrick Farms Golf Course.

5.2.3.1 Primary Data Sources

The Building Specific Water Use metric is based on water consumption data contained in the *Annual Report of Utilities*, which is obtained from Carol Varney. Please see Section 5.2.3.

5.2.3.2 Secondary Data Sources

The total U-M Ann Arbor campus population is required to calculate the per person normalization.

5.2.3.3 Calculation Procedure
The Building Specific Water Use metric is calculated using data that are imported to the EDR from the *Annual Report of Utilities*. If the report has not yet been imported, please refer to Section 5.1.3 for importing instructions.

The Building Specific Water Use metric is calculated within the "RawOutput" worksheet. The individual building water consumption data are summed and the result is then multiplied by 748.052 to convert from CCF to gallons. The final value is displayed in the "Summary" and "Graphing" worksheets. The normalization of gallons/person is calculated by dividing Building Specific Water Use (gallons) by the total U-M Ann Arbor campus population.

5.2.4 Total Discharged to Sewers (gallons, gallons/person)

In general, most of the water consumed by U-M buildings is discharged to the sewer system. There are, however, certain buildings that do use a portion of their water for irrigating the surrounding green spaces. U-M's Occupational Safety and Environmental Health Department (OSEH) estimated that 20 percent of building irrigation water eventually flows to sewers. The Total Discharged to Sewers metric measures the volume of water discharged directly to sewers and the estimated portion of building irrigation water that is discharged to sewers.

5.2.4.1 Primary Data Source
The Total Discharged to Sewers metric is based on water consumption data contained in the *Annual Report of Utilities*, which is obtained from Carol Varney. Please see Section 5.2.3.

5.2.4.2 Secondary Data Source
Contact:
Malama Chock
OSEH Coordinator
(734) 764-9175
chock@umich.edu

The source of secondary data is a water usage study performed by OSEH from July 2000 to June 2001. A copy of the database of the study results was obtained from Malama Chock. Until a new water usage study is conducted, it is assumed that these values will apply to all years of data. This database was used to estimate the percentage of purchased water consumed for irrigation and discharged to sewers and these estimates are contained within the "BldgList" worksheet. The water usage study did not include all University buildings within Ann Arbor's city limits; it was assumed that the buildings not included in the study, with the exception of the CPP and Hoover Boiler Plant, discharge 100 percent of their water consumption to sewers. These assumptions are shown in Column E of the "BldgList" worksheet as red, bolded values. The CPP and Hoover Boiler plant are assumed to neither discharge to sewers nor irrigate surrounding green spaces.

Additionally, the total U-M Ann Arbor campus population is required to calculate the per person normalization.

5.2.4.3 Calculation Procedure
The Total Discharged to Sewers metric is calculated using data that are imported to the EDR and building irrigation percentages contained within the "BldgList" worksheet. If the *Annual Report of Utilities* has not yet been imported, please refer to Section 5.1.3 for instructions on importing the *Annual Report of Utilities*

Once the *Annual Report of Utilities* has been imported, the EDR automatically multiplies the water consumption volume of each individual building by its sewer discharge percentage value. The EDR then sums these products and writes the result to the "PrimaryInput" worksheet. In the "RawOutput" worksheet, this value is multiplied by 748.052 (gallons/CCF), converting from CCF to gallons. The normalization of gallons/person is calculated by dividing the Total Discharged to Sewers (gallons) by the total U-M Ann Arbor campus population.

5.2.5 Total Irrigation Water (gallons, gallons/acre green space)

As mentioned previously, certain U-M buildings use a portion of their consumed water to irrigate surrounding green spaces. The other irrigation activities considered for this metric take place on the University and Radrick Farms Golf Courses. The Total Irrigation Water metric measures purchased building irrigation water and golf course irrigation from wells.

5.2.5.1 Primary Data Sources
The Total Irrigation Water metric is based on water consumption data contained in the *Annual Report of Utilities*, which is obtained from Carol Varney. Please see Section 5.2.2.

Contact:
Ron Van Til
Michigan Department of Environmental Quality, Water Bureau
(517) 241-1414
vantilr@michigan.gov

The University Golf Course and the Radrick Farms Golf Course both irrigate using well water. On an annual basis, the total volume of water withdrawals is reported to the Michigan Department of Environmental Quality. This annual figure is obtained from Ron Van Til.

5.2.5.2 Secondary Data Sources
As with the Total Discharged to Sewers metric, the Total Irrigation Water metric is based on the water usage study performed by OSEH from July 2000 to June 2001. The database for this study was obtained from Malama Chock. The number of acres of maintained campus and athletic field green space is required to normalize the metric. The source of

this value is found in Section 5.3.1 of the report. Additionally, the total U-M Ann Arbor campus population is required to calculate the per person normalization.

5.2.5.3 Calculation Procedure

The Total Irrigation Water metric is calculated using data that are imported to the EDR, as well as data that are entered manually. If the *Annual Report of Utilities* has not yet been imported, please refer to Section 5.1.3 for instructions on importing the *Annual Report of Utilities*. Also refer to this same section for instructions on manually entering golf course irrigation data.

Once the *Annual Report of Utilities* has been imported, the EDR automatically multiplies the water consumption volume of each individual building by its building irrigation percentage value. The EDR then sums these products and writes the result to the "PrimaryInput" worksheet. In the "RawOutput" worksheet this value is multiplied by 748.052 (gallons/CCF) to convert from CCF to gallons and is then added to the total golf course irrigation. The final value is displayed in the "Summary" and "Graphing" worksheets. The normalization of gallons/acre green space is calculated by dividing the Total Irrigation Water (gallons) by number of acres of maintained campus and athletic field green space.

5.3 Land Use – Built and Natural Spaces

One environmental indicator and seven operational metrics are used to measure the University's relative impacts on storm water runoff and land resource management. The ratio of green space to impervious surface area on campus is indicative of the ability of University properties to absorb rainwater. Impervious surface area serves as a surrogate for other measures of storm water discharge. Additionally green space provides recreation and other benefits. An example calculation for the total green space metric is shown in Figure 5-10 below. A detailed discussion of data sources and calculation procedures for all indicators and metrics in this category is included in the sections that follow.

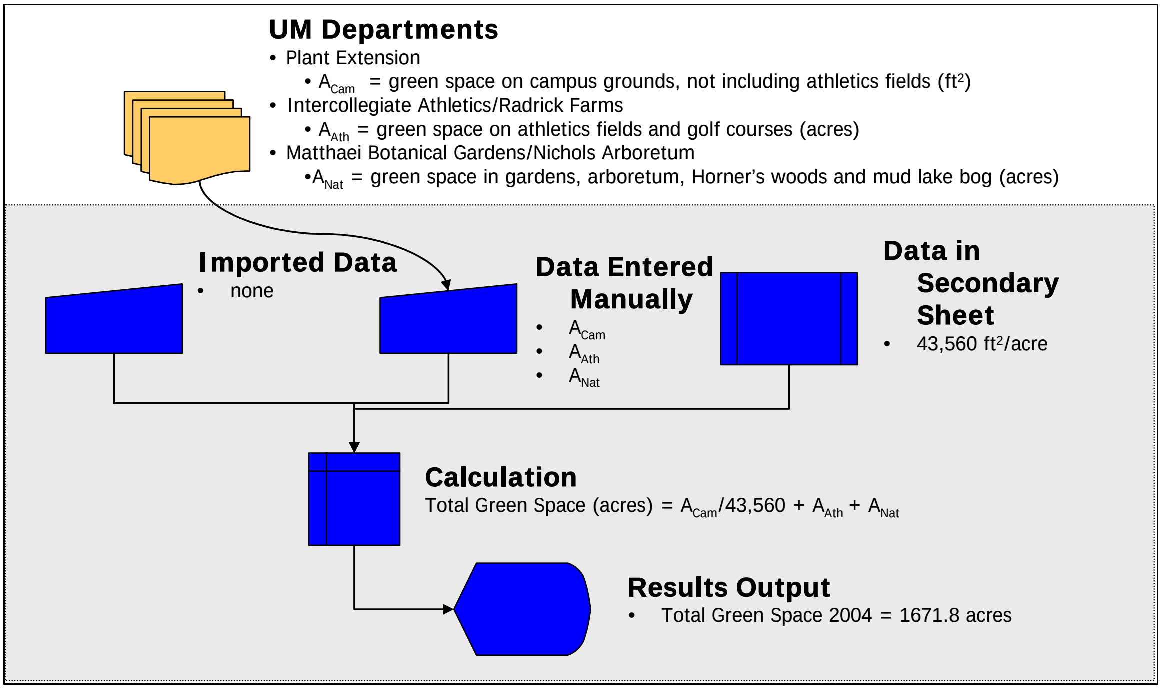


Figure 5-10. Calculation of the Total Green Space Metric

5.3.1 Total Impervious Surface Area (acres, % of U-M campus), Total Green Space (acres, % of U-M campus), Maintained Green Space (acres, % of U-M campus), Non-Maintained Green Space (acres, % of U-M campus)

Data are collected for three areas that the University maintains: 1) campus grounds (not including athletic fields); 2) athletic fields and the University and Radrick Farms golf courses; 3) Matthaei Botanical Gardens, Nichols Arboretum, Horner's Woods, and Mud Lake Bog. Impervious surfaces in this analysis include buildings, game courts, walkways, stairs and ramps, parking areas, and roadways owned and maintained by the University (excludes roads maintained by the city of Ann Arbor). Green space includes turf, planting beds, annual beds, perennial beds, woods and meadow. Maintained green space is defined as green space that is receiving any level of maintenance. Non-maintained green space in this analysis is defined as green space that is receiving *no* level of maintenance.

Data required in order to calculate the percentage of total impervious surface area and total green space are total green space and total land area. Data required in order to calculate the percentage of maintained green space are total maintained green space and total land area. Finally, the data required to calculate the percentage of non-maintained green space is total non-maintained green space and total land area. Contacts providing this data will indicate green space that is maintained or non-maintained.

5.3.1.1 Primary Data Sources

Contact:
Kenneth Rapp - Campus
Landscape Architect
Plant Extension
(734) 647-2028
kennr@bf.umich.edu

Kenn Rapp is a Landscape Architect at the U-M Ann Arbor campus. Kenn prepares an annual Campus Land Use Inventory (Excel) spreadsheet at the end of each year summarizing the total U-M Ann Arbor campus area in square footage. The inventory is broken down into components of impervious surface area (e.g. buildings, game courts, walks, stairs and ramps, parking, and roads) and pervious surface area (e.g. plantings, perennials, annuals, turf, meadows/woods, and gravel). The total green space is indicated in the spreadsheet with the column heading "Green Open Space" and the total land area is indicated with "Total." All green space for this category is maintained at some level.[10]

To enter data, click on the "Land Use" tab on the user interface and select the year of data entry. Click on the "U-M Campus" button, select the name of the contact providing the data, and enter the requested values (see Figure 5-11 below). Note: U-M Campus data entered should be in square feet.

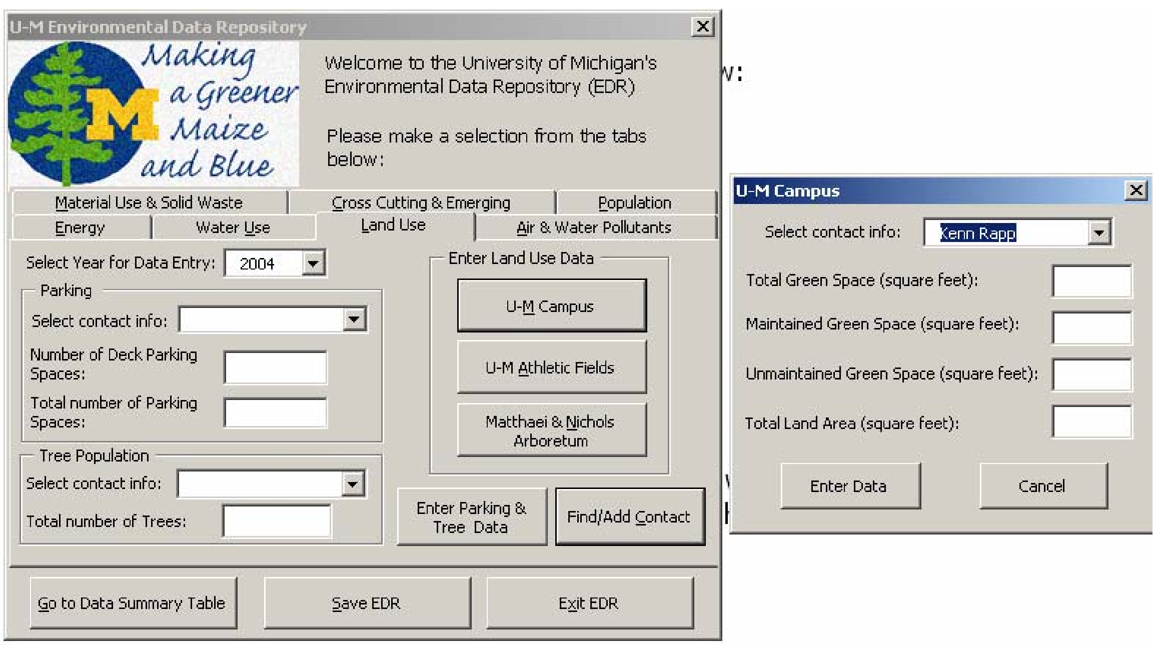


Figure 5-11. Land Use Tab and Associated Land Use Entry Form of the User Interface

[10] Communication with Kenneth Rapp, March 2005.

Contact:
Tracey Jones –
U-M Athletic Fields and the Radrick Farms and University Golf Courses
Superintendent – University Golf Course
Intercollegiate Athletics/Radrick Farms
(734) 998-6372 or (734) 320-3163
tracmon@umich.edu

Tracey Jones is the Superintendent for the University Golf Course at U-M Ann Arbor. Upon request, Tracey will prepare land use estimates (in acres) of the U-M Ann Arbor athletic fields, and the University and Radrick Farms golf courses. The estimates (in acres) will be listed in a Microsoft Word document for total impervious surface area, total green space, total maintained green space, total non-maintained green space and total land area.

Once the data have been received and are ready for entry, click on the "Land Use" tab on the user interface. Prior to entering the values, one must select a year of data entry. Click on the "U-M Athletic Fields" button, select the name of the contact sending the data, and enter the requested values. Note: U-M Athletic Field data should be entered in acres.

Contact:
Mike Hommel –
Matthaei Botanical Gardens, Nichols Arboretum, Horner's Woods & Mud Lake Bog
Superintendent – Matthaei Botanical Gardens & Nichols Arboretum
(734) 998-7061
mhommel@umich.edu

Mike Hommel is the Superintendent at Matthaei Botanical Gardens and Nichols Arboretum for the University of Michigan. Upon request, Mike will prepare land use estimates (in acres) for Matthaei Botanical Gardens, Nichols Arboretum, Horner's Woods, and Mud Lake Bog. The estimates (in acres) will be listed in a Microsoft Word document for each area (e.g. Matthaei Botanical Gardens) and broken down into maintained and non-maintained space. From these values one can determine total green space, total maintained green space, total non-maintained green space and total land area values that need to be entered.

Once the data have been received and are ready for entry, click on the "Land Use" tab on the user interface. Prior to entering the values, one must select a year of data entry. Next click on the "Matthaei & Nichols Arboretum" button, select the name of the contact sending the data, and enter the requested values. Note: Data for Matthaei Botanical Gardens, Nichols Arboretum, Horner's Woods, and Mud Lake Bog should be entered in acres.

5.3.1.2 Secondary Data Sources
No secondary data sources are necessary for this metric.

5.3.1.3 Calculation Procedure

After the data from each of the contacts for total green space, total maintained green space, total non-maintained green space, and total land area are entered, calculation of the indicators and metrics takes place. Since total land area is required for the calculation of all normalized metrics, a brief discussion of its calculation follows. Once the total land area values for the campus, athletics and various nature areas have been entered properly, they are stored in the "PrimaryInput" worksheet. These values are then added together within the worksheet and a new total land area is stored in the "RawOutput" worksheet ready for use in calculating the indicators and metrics.

Total impervious surface area (acres, % of U-M campus). After the values for total green space are entered into the EDR, they are stored in the "PrimaryInput" worksheet. The total impervious surface areas are calculated in the worksheet by subtracting total green space from total land area for the campus, athletics and various nature areas. These values are then added together to make a new total impervious surface area and this value is stored in the "RawOutput" worksheet. The percentage of total impervious surface area is calculated by dividing the new total impervious surface area by the new total land area.

Total green space (acres, % of U-M campus). After the values for total green space are entered into the EDR, they are stored in the "PrimaryInput" worksheet. The total green spaces for campus, athletics and the various nature areas are added together and this new total is stored in the "RawOutput" worksheet. The percentage of total green space is then calculated in the "RawOutput" worksheet by dividing the new total green space by the new total land area.

Maintained green space (acres, % of U-M campus). After the values for total maintained green space are entered into the EDR, they are stored in the "PrimaryInput" worksheet. The total maintained green spaces for campus, athletics and the various nature areas are added together and this new total is stored in the "RawOutput" worksheet. The percentage of total maintained green space is then calculated in the "RawOutput" worksheet by dividing the new total maintained green space by the new total land area.

Non-maintained green space (acres, % of U-M campus). After the values for total non-maintained green space are entered into the EDR, they are stored in the "PrimaryInput" worksheet. The total non-maintained green spaces for campus, athletics and the various nature areas are added together and this new total is stored in the "RawOutput" worksheet. The percentage of total non-maintained green space is then calculated in the "RawOutput" worksheet by dividing the new total non-maintained green space by the new total land area.

Note: The new total areas and percentages are stored in the "RawOutput" worksheet and can be viewed in the "Summary" and "Graphing" worksheets of the EDR.

5.3.2 Tree Population (number of trees)

The large number of trees on campus lends credence to Ann Arbor's moniker "Tree City USA." The most common shade tree on the Diag is the maple tree, and the most common ornamental tree is the crabapple tree. There are also many evergreens on the Diag including fir, hemlock, spruce and pine. North Campus also has a large number of pine and crabapple trees. The Office of Landscape Architecture and the Grounds and Waste Management department use mostly native trees in these areas.[11]

5.3.2.1 Primary Data Sources

Contact:
Marvin Pettway
University Forrester
Grounds and Waste Management Services
(734) 764-3422
marvinp@umich.edu

Marvin Pettway works in Grounds and Waste Management Services as the University Forrester and keeps an on-going inventory of the tree population on campus. Upon request, Marvin will provide the total number of trees existing on campus. This value must be input to the appropriate text box on the "Land Use" tab simultaneously with the numbers of deck and total parking spaces discussed in Section 5.3.5.
Note: Remember to always select a year for data entry and contact.

5.3.2.2 Secondary Data Sources

No secondary data sources are necessary for this metric.

5.3.2.3 Calculation Procedure

After the number of trees is entered, the value is stored in both the "PrimaryInput" and "RawOutput" worksheets with the Land Use category and the year selected. One can view the result in the "Summary" and "Graphing" worksheets. There are no additional calculations necessary for this metric.

5.3.3 Total Building Area (square footage per person)

Total building area includes total square footage of all U-M Ann Arbor campus buildings listed in the *Annual Report of Utilities* prepared at the end of each fiscal year. The list contains all buildings maintained by the University of Michigan.

[11] Rodriguez et al. Sustainability Assessment and Reporting for the University of Michigan's Ann Arbor Campus. University of Michigan, School of Natural Resources and Environment. April 2002.

5.3.3.1 Primary Data Sources
Contact:
Carol Varney
Business Manager
Utilities & Plant Engineering
(734) 647-0963
cvarney@umich.edu

The original source of data for the *Annual Report of Utilities* is a database maintained by U-M Utilities & Plant Engineering. The *Annual Report of Utilities* is provided by Carol Varney upon request and is in an Excel spreadsheet format. In order for the model to access the data for calculations, the report must be imported. This process is discussed in Section 5.1.3 of this report. Note: Remember to always select a year for data entry and contact.

5.3.3.2 Secondary Data Sources
The U-M Ann Arbor campus population is necessary in order to determine the metric. Example values and a description of campus population are given in Section 4.2.

5.3.3.3 Calculation Procedure
After the *Annual Report of Utilities* has been imported, portions of the data from this report are stored in the "BldgList" worksheet. The square footage is listed for each building entry and the model sums these areas to determine a total U-M building area in square feet. This value is stored in both the "SecondaryInput" and "RawOutput" worksheets. The model then divides the total U-M building area by the total U-M Ann Arbor population and also stores this value in the "RawOutput" worksheet in the Land Use Category for the corresponding year.

5.3.4 LEED Certification (% of U-M buildings)

All buildings given a platinum, gold, silver or bronze LEED certification by the U.S. Green Building Council qualify as a LEED certified building for this metric.

5.3.4.1 Primary Data Sources
Contact:
Douglas Hanna
University Architect
University Architect/Planner Office & Plant Extension
(734) 764-2456
dougha@bf.umich.edu

Doug Hanna works at Plant Extension Operations as a University Architect. Although no LEED certified buildings existed through 2004, Doug will keep an inventory of any buildings that receive LEED certification in the future and will record the level of certification (i.e. platinum, gold, silver, or bronze). This is also listed as a metric in the Cross Cutting & Emerging Issues category (Section 5.6). Enter data for this metric in the "Cross-Cutting & Emerging" tab simultaneously with the number of aesthetic awards U-

M received (Doug Hanna, Section 5.3.6, provides this number as well). Be sure to select a year of data entry and contact.

5.3.4.2 Secondary Data Sources

In order to calculate this metric, the total number of U-M Ann Arbor buildings needs to be determined. This is possible by using the *Annual Report of Utilities* provided by Carol Varney of Purchased Utilities. Once this report has been imported (discussed in Section 5.1), the model gains access to a listing of all the buildings considered in this analysis. The model determines how many buildings there are by counting the number of building entries there are in the "BldgList" worksheet and storing this number in the "SecondaryInput" worksheet.

5.3.4.3 Calculation Procedure

After entering the number of LEED certified buildings that are platinum, gold, silver and bronze certified for the selected year, the model stores these values in the "RawOutput" worksheet. Within the "RawOutput" worksheet the total number of LEED certified buildings is calculated by summing the numbers of platinum, gold, silver and bronze certified buildings. This value is also recorded in the "RawOutput" worksheet and is divided by the total number of buildings on U-M Ann Arbor campus to calculate the percentage of LEED certified buildings. This value is also recorded in the "RawOutput" worksheet and can be viewed in the "Summary" and "Graphing" worksheets by selecting the Cross Cutting & Emerging category.

5.3.5 Deck Parking (% of all parking spaces)

For this analysis, U-M Ann Arbor campus parking spaces includes all U-M colored lot, metered, campus housing, motorcycle, and loading zone spaces.

5.3.5.1 Primary Data Sources

Contact:
Rebecca Seiser
Administrative Associate I
University Parking Services
(734) 647-3615
rseiser@bf.umich.edu

Rebecca Seiser works at the Parking and Transportation Services department and maintains this on-going inventory of U-M Ann Arbor campus parking spaces. Data values necessary to calculate this indicator include the number of deck parking spaces and the total number of parking spaces on U-M Ann Arbor campus. Upon request, Rebecca will send these values and they must be input to the appropriate text boxes within the "Land Use" tab of the user interface simultaneously with the U-M tree population provided by Marvin Pettway (Section 5.3.2).
Note: Remember to always select a year for data entry and contact.

5.3.5.2 Secondary Data Sources

No secondary data sources were necessary for this metric.

5.3.5.3 Calculation Procedure

After the number of U-M deck parking spaces and total number of U-M parking spaces are entered, the model stores these numbers in the "PrimaryInput" worksheet corresponding to the year selected. The model then divides the number of deck parking spaces by the total number of parking spaces to give the percentage of deck parking spaces and stores this value in the "RawOutput" worksheet.

5.4 Emissions – Air and Water Pollutants

One key performance indicator and five operational metrics are reported in the category air and water pollutants. These measures provide an overview of the impacts of the University on atmospheric and aquatic ecosystems, with a focus on greenhouse gas emissions. The calculation procedure for mobile source greenhouse gas emissions from bio-based fuels is shown in Figure 5-12. These emissions result from the combustion of fuels derived from renewable bio-based materials and are tracked separately from emissions resulting from the combustion of the fossil portion of the fuel. A detailed discussion of data sources and calculation procedures for all indicators and metrics in this category is included in the sections that follow.

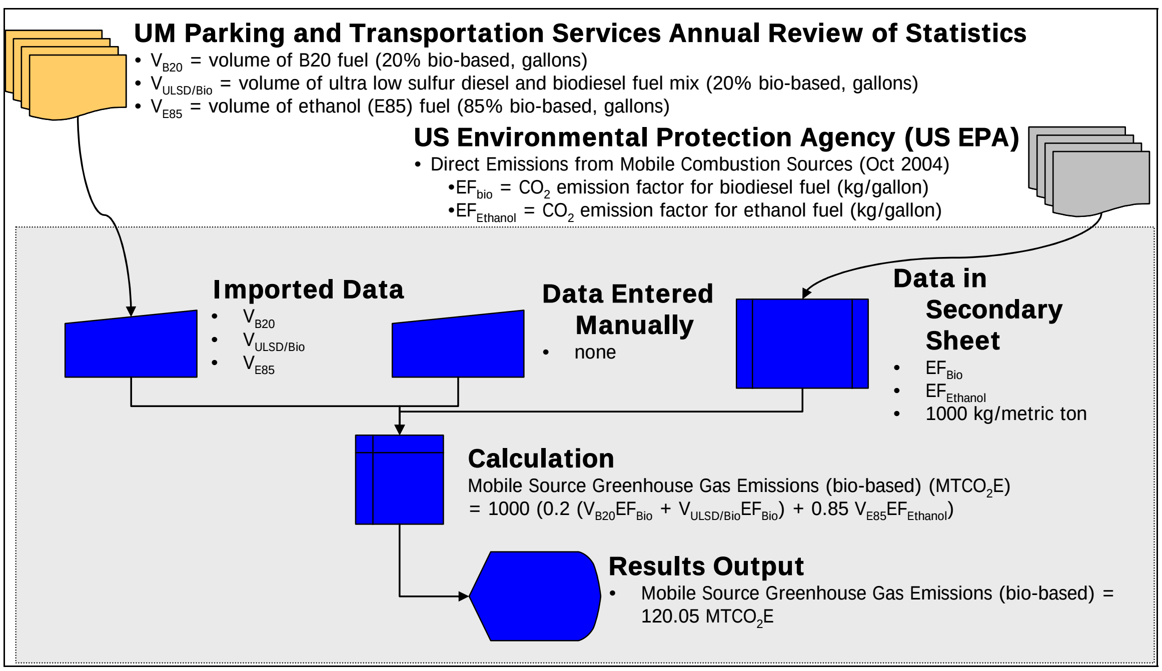


Figure 5-12. Calculation of the Mobile Source Greenhouse Gas Emissions (bio-based) Metric

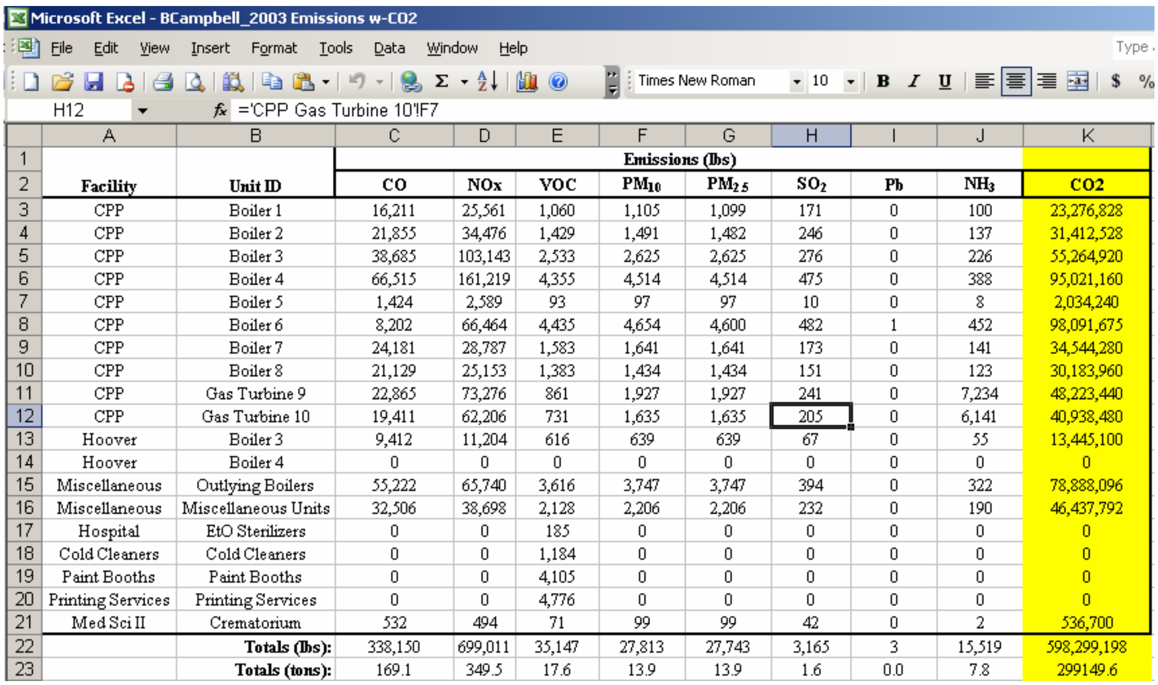
5.4.1 Total Greenhouse Gas Emissions ($MTCO_2E$, $MTCO_2E$/person, MTCE, MTCE/person)

Greenhouse gas (GHG) emissions are a by-product of fossil fuel combustion. Fossil fuel combustion is required to provide energy for a large number of buildings and transportation on the U-M Ann Arbor campus. This indicator is measured by the amount of GHG emissions released as a result of energy consumption by U-M buildings and transportation.

5.4.1.1 Primary Data Sources

Contact:
Brandi Campbell
OSEH Rep II
Occupational Safety & Environmental Health
(734) 647-9017
campbelb@umich.edu

Brandi Campbell works for U-M Occupational Safety & Environmental Health (OSEH) and prepares Excel spreadsheets (see Figure 5-13 below) summarizing the annual air emissions of a variety of air pollutants resulting from on-site fuel combustion. Upon request, OSEH will send the Excel file containing the total (in pounds) of carbon dioxide (CO_2) equivalent emissions from stationary sources at U-M for input to the model.



	A	B	C	D	E	F	G	H	I	J	K
1			Emissions (lbs)								
2	Facility	Unit ID	CO	NOx	VOC	PM_{10}	$PM_{2.5}$	SO_2	Pb	NH_3	CO2
3	CPP	Boiler 1	16,211	25,561	1,060	1,105	1,099	171	0	100	23,276,828
4	CPP	Boiler 2	21,855	34,476	1,429	1,491	1,482	246	0	137	31,412,528
5	CPP	Boiler 3	38,685	103,143	2,533	2,625	2,625	276	0	226	55,264,920
6	CPP	Boiler 4	66,515	161,219	4,355	4,514	4,514	475	0	388	95,021,160
7	CPP	Boiler 5	1,424	2,589	93	97	97	10	0	8	2,034,240
8	CPP	Boiler 6	8,202	66,464	4,435	4,654	4,600	482	1	452	98,091,675
9	CPP	Boiler 7	24,181	28,787	1,583	1,641	1,641	173	0	141	34,544,280
10	CPP	Boiler 8	21,129	25,153	1,383	1,434	1,434	151	0	123	30,183,960
11	CPP	Gas Turbine 9	22,865	73,276	861	1,927	1,927	241	0	7,234	48,223,440
12	CPP	Gas Turbine 10	19,411	62,206	731	1,635	1,635	205	0	6,141	40,938,480
13	Hoover	Boiler 3	9,412	11,204	616	639	639	67	0	55	13,445,100
14	Hoover	Boiler 4	0	0	0	0	0	0	0	0	0
15	Miscellaneous	Outlying Boilers	55,222	65,740	3,616	3,747	3,747	394	0	322	78,888,096
16	Miscellaneous	Miscellaneous Units	32,506	38,698	2,128	2,206	2,206	232	0	190	46,437,792
17	Hospital	EtO Sterilizers	0	0	185	0	0	0	0	0	0
18	Cold Cleaners	Cold Cleaners	0	0	1,184	0	0	0	0	0	0
19	Paint Booths	Paint Booths	0	0	4,105	0	0	0	0	0	0
20	Printing Services	Printing Services	0	0	4,776	0	0	0	0	0	0
21	Med Sci II	Crematorium	532	494	71	99	99	42	0	2	536,700
22		Totals (lbs):	338,150	699,011	35,147	27,813	27,743	3,165	3	15,519	598,299,198
23		Totals (tons):	169.1	349.5	17.6	13.9	13.9	1.6	0.0	7.8	299149.6

Figure 5-13. OSEH Annual Air Emissions MS Excel File

To enter these data into the model, click the "Air & Water Pollutants" tab on the user interface. Click the "Emissions Data: Air & Water Pollutants" button. Be sure to select the year of data entry and the contact providing the data in order for the data to be successfully entered. Enter the CO_2 equivalent emissions (stationary sources), criteria air pollutants (stationary sources), and total salt and sand use (see Sections 5.4.5 and 5.4.6) simultaneously. Click the "Enter Data" button for the data to be input and stored in the "PrimaryInput" worksheet for use in calculations.

Contact:
Renee Jordan
Administrative Associate I
Parking & Transportation Services
(734) 615-0527
reneej@umich.edu

The U-M PTS prepares an annual statistics review at the end of each fiscal year (June 30th) summarizing the total volume of fuel consumed listed by type of fuel (e.g. unleaded gasoline, B20, ULSD/Biodiesel mix, and E85). Renee Jordan enters the data necessary (total gallons of unleaded gasoline, B20, ULSD/Biodiesel mix, and E85 consumed) for calculating the resulting GHG emissions into an Excel spreadsheet named "TransportationStats." This worksheet has been prepared to facilitate data entry and needs to be sent via email in order for the contact to enter data into the appropriate cells (see Figure 5-6). The file contains an "Instructions" worksheet for ease of data entry by the contact.

Contact:
Carol Varney
Business Manager
Utilities & Plant Engineering
(734) 647-0963
cvarney@umich.edu

In order to calculate GHG emissions from purchased electricity, it is necessary to collect the amount of purchased electricity consumed by buildings. These data are found in the *Annual Report of Utilities*, which is obtained from Carol Varney. The original source of data for the *Annual Report of Utilities* is a database maintained by U-M Utilities & Plant Engineering. In order for the model to access the data for calculations, the report must be imported. This process is discussed in Section 5.1.3 of this report.

5.4.1.2 Secondary Data Sources

Additional data necessary to calculate this indicator are discussed below, in addition to the total U-M Ann Arbor campus population (including students, faculty and staff on the U-M Ann Arbor campus, as well as those at the U-M Hospital). This data is stored in the "SecondaryInput" worksheet and should be input manually each year.

Off-site Stationary Sources

Data from the EIA are required to determine the fuel mix of purchased electricity and the heat rates of coal, natural gas, and fuel oil-fired power plants. The electronic files that are used to calculate the fuel mix and heat rates of purchased electricity are available from the following website: http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html. Detailed instructions outlining the calculation procedures are found in Section 5.1.3.

Carbon coefficients for coal, natural gas, and fuel oil-fired power plants are also required to calculate GHG emissions from purchased electricity. These coefficients convert the amount of electrical energy produced (in quadrillion Btus) by each of the three fuel types to the mass of carbon emitted (in million metric tons of carbon equivalent). All carbon coefficients are obtained from the EIA. (Source: Department of Energy, Energy Information Administration (2003). *Emissions of Greenhouse Gases in the United States 2003.* http://www.eia.doe.gov/oiaf/1605/ggrpt/pdf/tab6.1.pdf)

Mobile Sources
The U.S. Environmental Protection Agency (EPA) released a document (Climate Leaders GHG Inventory Protocol Core Module Guidance: Direct Emissions from Mobile Combustion Sources) in October 2004 containing each of the emission factors for each type of fuel consumed for transportation purposes at U-M, with the exception of ULSD. According to Michael Wang (Assessment of Well-to-Wheels Energy Use and GHG Emissions of Fischer-Topsch Diesel, 2002) the ULSD CO_2 and C emission factors should be assumed to be the same as those for conventional diesel. The 2004 CO_2 and C emission factors are shown in Table 5-2.

Table 5-2. CO_2 and Carbon Emission Factors, and Combustion Efficiencies for Transportation Fuels (2004)

Fuel	kg CO_2/gallon	kg C/gallon	Combustion Efficiency[12]
Unleaded Gasoline	8.79	2.42	0.99
Conventional Diesel	10.08	2.78	0.99
Biodiesel	9.29	2.56	0.99
Ultra Low Sulfur Diesel	10.08	2.78	0.99
Ethanol	5.5	1.52	0.99

To enter the emission factors for each fuel, one must first exit from the user interface and select the “SecondaryInput” worksheet. If the values have not already been input, follow the process described in Section 5.1.8 for updating heating values.

5.4.1.3 Calculation Procedure

On-site Stationary Sources
After the data has been input, they are stored in the “PrimaryInput” worksheet for use in calculations. The pounds of CO_2 equivalence are converted to metric tons of CO_2 equivalence ($MTCO_2E$) by dividing by 2205 pounds per metric ton. This value is then multiplied by the fraction 12/44 to convert the value to metric tons of C equivalence (MTCE).

Off-site Stationary Sources
Calculating GHG emissions from purchased electricity begins with importing the *Annual Report of Utilities* and calculating the fuel mix and heat rate of purchased electricity.

[12] U.S. Environmental Protection Agency. *Climate Leaders GHG Inventory Protocol Core Module Guidance: Direct Emissions from Mobile Combustion Sources.* October 2004. The U.S. EPA Inventory of Greenhouse Gas Emissions and Sinks uses a fraction of carbon oxidized factor of 0.99 for all oil and oil-based products, as recommended by International Panel on Climate Change (IPCC) guidelines. Based on emissions data, EPA is currently examining whether this fraction is higher for motor vehicle fuels.

Please refer to Section 5.1.3 for instructions on importing this file to the EDR. Instructions on calculating and entering fuel mix and heat rate data are also included in Section 5.1.3.

Once the *Annual Report of Utilities* has been imported and the fuel mix and heat rate data have been entered, the EDR calculates the amount of electricity purchased from each fuel type. These calculations are performed by summing all electricity purchases for North Campus and other consumption and then multiplying the sum by the percentage of purchased electricity that is generated from coal and natural gas-fired power plants. The values are written directly to the "PrimaryInput" worksheet. Please note that the electricity contribution from fuel oil-fired powered plants is assumed to be negligible.

Within the "RawOutput" worksheet, the EDR multiplies the amounts of purchased electricity that is generated from coal and natural gas by their appropriate carbon coefficient. The results are then summed, as shown in the following equation:

Purchased electricity GHG emissions (MTCE) =
[Purchased Electricity Generated from Coal (Btu) * (Quad/10^{15} Btu) * Utility Coal Carbon Coefficient (MMTCE/Quad)] * 1,000,000 metric tons/million metric ton + [Purchased Electricity Generated from Natural Gas (Btu) * (Quad/10^{15} Btu) * Natural Gas Carbon Coefficient (MMTCE/Quad)] * 1,000,000 metric tons/million metric ton

Mobile Sources

After the "TransportationStats" file has been imported, the data from this file are stored in the "Transportation_Input" worksheet and the total fuel consumption (gallons) for unleaded gasoline, B20, ULSD/Biodiesel mix, and E85 is stored in the "PrimaryInput" worksheet. The quantities (gallons) of each fuel type are multiplied by the corresponding emission factors (kg CO_2/gallon and kg C/gallon) and are then added together to calculate the total kilograms of CO_2 and C (respectively) emitted by mobile sources for the year. The emissions values are converted to metric tons by dividing by 1000 kilograms per metric ton.

Mobile Sources GHG emissions (MTCE) =
{ [Unleaded Fuel (gal) * Unleaded Fuel Carbon Content (kg C/gal)] + [B20 Fuel (gal) * 0.8 * Conventional Diesel Carbon Content (kg C/gal)] + [B20 Fuel (gal) * 0.2 * Biodiesel Carbon Content (kg C/gal)] + [ULSD/Biodiesel Mix Fuel (gal) * 0.8 * ULSD Carbon Content (kg C/gal)] + [ULSD/Biodiesel Mix Fuel (gal) * 0.2 * Biodiesel Carbon Content (kg C/gal)] + [E85 Fuel (gal) * 0.85 * Ethanol Fuel Carbon Content (kg C/gal)] + [E85 (gal) * 0.15 * Unleaded Fuel Carbon Content (kg C/gal)] } / {1000 kg/metric tons}

The calculations for Total GHG emissions take place in the "RawOutput" worksheet. The GHG emissions (in terms of both $MTCO_2E$ and MTCE) as a result of on- and off-site stationary sources are added together and the values are recorded separate from the GHG emissions resulting from transportation. The stationary source and transportation GHG emissions values are then added together to give the Total GHG emissions resulting from U-M activities. These values are then normalized ($MTCO_2E$/person and MTCE/person) by dividing by the total U-M Ann Arbor population.

5.4.2 Criteria Air Pollutants from Stationary Sources (pounds, pounds/person)

Criteria air pollutants for this analysis include particulate matter with diameter equal to or less than 2.5 and 10 microns (PM-2.5 and PM-10, respectively), carbon monoxide, nitrogen oxides, sulfur dioxide, and lead, in addition to volatile organic compounds (an ozone precursor).

5.4.2.1 Primary Data Sources

Contact:
Brandi Campbell
OSEH Rep II
Occupational Safety & Environmental Health
(734) 647-9017
campbelb@umich.edu

The U-M Occupational Safety & Environmental Health (OSEH) prepares Excel spreadsheets listing the totals of annual criteria air pollutant emissions resulting from on-site fuel combustion (see Figure 5-13). Upon request, OSEH will send the Excel file containing the totals (in pounds) of criteria air pollutant emissions from stationary sources for input to the model.

To enter this data into the model, click the "Air & Water Pollutants" tab on the user interface. Click the "Emissions Data: Air & Water Pollutants" button. Be sure to select the year of data entry and the contact providing the data in order for the data to be successfully entered. Enter the stationary source emissions (2004 data provided in Table 5-3) simultaneously with the total salt and sand use (see Sections 5.4.5 and 5.4.6). Click the "Enter Data" button for the data to be input and stored in the "PrimaryInput" worksheet for use in calculations.

Table 5-3. U-M Ann Arbor Campus Stationary Source Emissions (2004)

Air Pollutant	Lbs Emitted
Carbon Monoxide (CO)	338,150
Nitrogen Oxides (NO_x)	699,011
Volatile Organic Compounds (VOC)	35,147
Particulate Matter - 10 (PM-10)	27,813
Particulate Matter – 2.5 (PM-2.5)	27,743
Sulfur Dioxide (SO_2)	3,165
Lead (Pb)	3

5.4.2.2 Secondary Data Sources

The total U-M Ann Arbor campus population is necessary in order to determine this metric and is provided by the Office of Academic Programs (see Section 4.2). If the population data is not already input to the "SecondaryInput" worksheet, this data should be input into the appropriate text boxes in the "Population" tab of the user interface for the year being considered.

5.4.2.3 Calculation Procedure
After the data has been input, they are stored in the "PrimaryInput" and "RawOutput" worksheets. Each value is then divided by the total U-M Ann Arbor population to normalize the metric with units of pounds per person (lbs/person). This value is also stored in the "RawOutput" worksheet and can be viewed in the "Summary" and "Graphing" worksheets.

5.4.3 Mobile Sources (fossil): Greenhouse Gas Emissions ($MTCO_2E$, $MTCO_2E$/person, MTCE, MTCE/person)

All non-renewable fossil fuels consumed by vehicles (including trucks, buses, vans, and various types of automobiles) owned and maintained by the University of Michigan will be considered in the calculation of this metric. The types of fuel containing non-renewable fossil fuels consumed by University vehicles are unleaded gasoline, B20, the mix of 80% ULSD with 20% biodiesel, and E85.

5.4.3.1 Primary Data Sources
Contact:
Renee Jordan
Administrative Associate I
Parking & Transportation Services
(734) 615-0527
reneej@umich.edu

The U-M PTS prepares annual statistics at the end of each fiscal year (June 30^{th}) summarizing the volume of fuel consumed listed by fuel type (e.g. unleaded gasoline, B20, ULSD/Biodiesel mix, and E85). The contact enters this data into an Excel spreadsheet named "TransportationStats." This worksheet has been prepared to facilitate data entry and needs to be sent via email in order for the contact to enter data into the appropriate cells. This worksheet is designed to reflect the data contained in the Parking & Transportation Services annual statistics review and should allow the contact to copy and paste data currently collected. The file contains an "Instructions" worksheet for ease of data entry. The process for importing this file once it has been completed and returned is in Section 5.1.8.

5.4.3.2 Secondary Data Sources
Additional data necessary to calculate the GHG emissions resulting from fossil fuel combustion in mobile sources are the carbon dioxide (CO_2) and carbon (C) equivalent emission factors of each fuel. The U.S. EPA released a document (Climate Leaders GHG Inventory Protocol Core Module Guidance: Direct Emissions from Mobile Combustion Sources) in October 2004 containing each of these factors, with the exception of that for ULSD. According to Michael Wang (Assessment of Well-to-Wheels Energy Use and GHG Emissions of Fischer-Topsch Diesel, 2002) the ULSD CO_2 and C emission factors should be assumed to be the same as those for conventional diesel. The 2004 CO_2 and C emission factors for each fuel are shown in Table 5-2.

To enter the emission factors for each fuel, one must first exit from the user interface and select the "SecondaryInput" worksheet. If the values have not already been input, follow the process described in Section 5.1.8 for updating the heating values.

5.4.3.3 Calculation Procedure

After the "TransportationStats" file has been imported, the data from this file is stored in the "Transportation_Input" worksheet. The fuel consumption (gallons) for unleaded gasoline, B20, ULSD/Biodiesel mix, and E85 are stored in the "PrimaryInput" worksheet. Since this metric only considers the non-renewable portion of each fuel type, the amount consumed of each fuel type is multiplied by the fraction that is non-renewable. Table 5-4 shows the fraction of non-renewable fossil fuel that each fuel type contains.

Table 5-4. Non-Renewable and Bio-Based Fractions by Volume of Select Fuels

Fuel Type	Fraction Non-renewable	Fraction Bio-based
Unleaded Gasoline	1.0	0.0
B20	0.8	0.2
ULSD/Biodiesel Mix	0.8	0.2
E85	0.15	0.85

The quantities (gallons) of each fuel type that are non-renewable are multiplied by the corresponding emission factor (kg CO_2/gallon and kg C/gallon) and are then added together to calculate the total kilograms of CO_2 and C (respectively) emitted by mobile sources for the year. The emissions are in units of kilograms and are converted to metric tons by dividing by 1000 kilograms per metric ton. The new values are then normalized by dividing by the U-M Ann Arbor population. The calculations discussed above take place in the "RawOutput" worksheet and the results can be viewed in the "Summary" and "Graphing" worksheets within the Emissions category.

Mobile Sources (fossil) GHG emissions (MTCE) =
{ [Unleaded Fuel (gal) * Unleaded Fuel Carbon Content (kg C/gal)] + [B20 Fuel (gal) * 0.8 * Conventional Diesel Carbon Content (kg C/gal)] + [ULSD/Biodiesel Mix Fuel (gal) * 0.8 * ULSD Carbon Content (kg C/gal)] + [E85 (gal) * 0.15 * Unleaded Fuel Carbon Content (kg C/gal)] } / {1000 kg/metric tons}

5.4.4 Mobile Sources (bio-based): Greenhouse Gas Emissions (MTCO_2E, MTCO_2E/person, MTCE, MTCE/person)

All bio-based fuels consumed by vehicles (including trucks, buses, vans, and various types of automobiles) owned and maintained by the U-M will be considered in the calculation of this metric. The types fuel containing bio-based fuel consumed by University vehicles are B20, the mix of 80% ULSD with 20% biodiesel, and E85.

5.4.4.1 Primary Data Sources

Contact:
Renee Jordan
Administrative Associate I
Parking & Transportation Services
(734) 615-0527
reneej@umich.edu

The U-M PTS prepares annual statistics at the end of each fiscal year (June 30th) summarizing the volume of fuel consumed listed by fuel type (e.g. B20, ULSD/B20 mix, and E85). The contact enters these data into an Excel spreadsheet named "TransportationStats." This worksheet has been prepared to facilitate data entry and needs to be sent via email in order for the contact to enter data into the appropriate cells. This worksheet is designed to reflect the data contained in the Parking & Transportation Services annual statistics review and will allow the contact to copy and paste data currently collected. The file contains an "Instructions" worksheet for ease of data entry. The process for importing this file once it has been completed and returned is in Section 5.1.8.

5.4.4.2 Secondary Data Sources

Additional data necessary to calculate the GHG emissions resulting from the combustion of bio-based fuels in mobile sources are the carbon dioxide (CO_2) and carbon (C) equivalent emission factors of each fuel. The U.S. EPA released a document (Climate Leaders GHG Inventory Protocol Core Module Guidance: Direct Emissions from Mobile Combustion Sources) in October 2004 containing each of these factors. The 2004 CO_2 and C emission factors for each fuel are in Table 5-2.

To enter the emission factors for each fuel, one must first exit from the user interface and select the "SecondaryInput" worksheet. If the values have not already been input, follow the process described in Section 5.1.8 for updating the fuel heating values.

5.4.4.3 Calculation Procedure

After the "TransportationStats" file has been imported, the data from this file are stored in the "Transportation_Input" worksheet. The fuel consumption (gallons) for B20, ULSD/Biodiesel mix, and E85 are stored in the "PrimaryInput" worksheet. Since this metric only considers the bio-based portion of each fuel type, the amount consumed of each fuel type is multiplied by the fraction that is bio-based. Table 5-4 shows the fraction of non-renewable and bio-based fuels that each fuel type contains.

Once the quantities of bio-based fuel consumed are calculated, these values (gallons of fuel) are multiplied by the corresponding emission factors (kg CO_2/gallon and kg C/gallon) and are added together to calculate the total kilograms of CO_2 and C emitted by mobile sources for the year. The emissions are in units of kilograms and are converted to metric tons by dividing by 1000 kilograms per metric ton. The new values are then normalized by dividing by the U-M Ann Arbor population. The calculations discussed above take place in the "RawOutput" worksheet and the results can be viewed in the "Summary" and "Graphing" worksheets within the Emissions category.

Mobile Sources (bio-based) GHG emissions (MTCE) =
{ [B20 Fuel (gal) * 0.2 * Biodiesel Carbon Content (kg C/gal)] + [ULSD/Biodiesel Mix Fuel (gal) * 0.2 * Biodiesel Carbon Content (kg C/gal)] + [E85 Fuel (gal) * 0.85 * Ethanol Fuel Carbon Content (kg C/gal)] } / {1000 kg/metric tons}

5.4.5 Salt Use (pounds, pounds/person)

Salt use here refers to all salt applied to the U-M Ann Arbor campus as a grounds de-icing material by the Grounds & Waste Management Services department.

5.4.5.1 Primary Data Sources

Contact:
Robert Doletzky
Service Foreman II
Grounds & Waste Management Services
(734) 764-3537
doletzky@umich.edu

Rob Doletzky of U-M Grounds & Waste Management Services maintains an annual (fiscal year) summary of total salt (in tons) applied to grounds as a de-icing material. Upon request, the contact sends an Excel file containing the total salt and sand use.

To enter the total salt use into the model, click the "Air & Water Pollutants" tab on the user interface and click the "Emissions Data: Air & Water Pollutants" button. Be sure to select the year of data entry and the contact providing the data in order for the data to be successfully entered. Enter the total salt and sand use simultaneously with the stationary source emissions (see Sections 5.4.2 and 5.4.6). Click the "Enter Data" button for the data to be input and stored in the "PrimaryInput" worksheet for use in calculations.

5.4.5.2 Secondary Data Sources

The total U-M Ann Arbor campus population is necessary in order to determine this metric and is provided by the Office of Academic Programs (see Section 4.2). If the population data are not already input to the "SecondaryInput" worksheet, these data should be input into the appropriate text boxes in the "Population" tab of the user interface for the year being considered.

5.4.5.3 Calculation Procedure

After the data have been input, they are stored in the "PrimaryInput" worksheet. The data are in units of short tons and must be converted to pounds by multiplying by 2000 pounds per short ton. This calculation is done and the result is stored in the "RawOutput" worksheet within the Emissions category for the year selected. This value is then divided by the total U-M Ann Arbor population to calculate the desired metric with units of pounds per person (lbs/person). This value is also stored in the "RawOutput" worksheet and can be viewed in the "Summary" and "Graphing" worksheets.

5.4.6 Sand Use (pounds, pounds/person)

Sand use here refers to any sand applied to the U-M Ann Arbor campus as a grounds de-icing material by the Grounds & Waste Management Services department.

5.4.6.1 Primary Data Sources

Contact:
Robert Doletzky
Service Foreman II
Grounds & Waste Management Services
(734) 764-3537
doletzky@umich.edu

Rob Doletzky of U-M Grounds & Waste Management Services maintains an annual (fiscal year) summary of total sand (in tons) applied to grounds as a de-icing material. Upon request, the contact sends an Excel file containing the total salt and sand use.

To enter the total sand use into the model, click the "Air & Water Pollutants" tab on the user interface and click the "Emissions Data: Air & Water Pollutants" button. Be sure to select the year of data entry and the contact providing the data in order for the data to be successfully entered. Enter the total salt and sand use simultaneously with the stationary source emissions (see Sections 5.4.2 and 5.4.5). Click the "Enter Data" button for the data to be input and stored in the "PrimaryInput" worksheet for use in calculations.

5.4.6.2 Secondary Data Sources

The total U-M Ann Arbor campus population is necessary in order to determine this metric and is provided by the Office of Academic Programs (see Section 4.2). If the population data are not already input to the "SecondaryInput" worksheet, these data should be input into the appropriate text boxes in the "Population" tab of the user interface for the year being considered.

5.4.6.3 Calculation Procedure

After the data have been input, they are stored in the "PrimaryInput" worksheet. The data are in units of short tons and must be converted to pounds by multiplying by 2000 pounds per short ton. This calculation is done and the result is stored in the "RawOutput" worksheet within the Emissions category for the year selected. This value is then divided by the total U-M Ann Arbor population to calculate the desired indicator with units of pounds per person (lbs/person). This value is also stored in the "RawOutput" worksheet and can be viewed in the "Summary" and "Graphing" worksheets.

5.5 Material Use and Solid Waste

Two indicators and 20 operational metrics provide an overview of the University's management of solid waste. This category includes metrics for recycling of paper and containers as well as information on the handling of regulated wastes and composting. The calculations and data involved in determining values for composting are shown in

Figure 5-14 below. A detailed discussion of data sources and calculation procedures for all indicators and metrics in this category is included in the sections that follow.

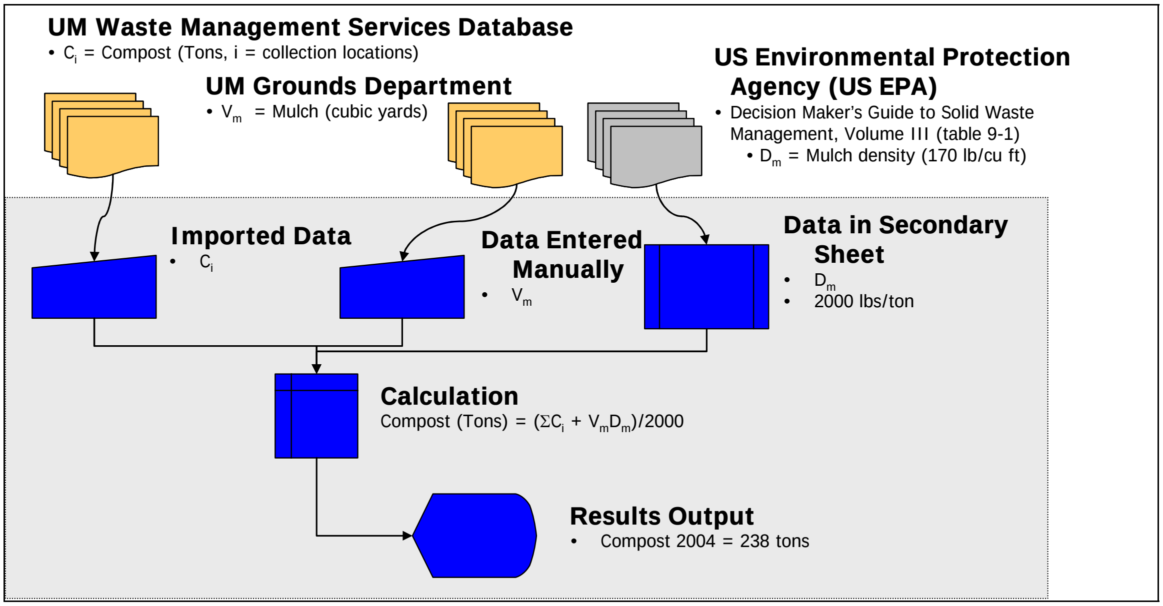


Figure 5-14. Calculation of Composting Metric

5.5.1 Total Waste (tons, tons/person)

There are three primary organizations within the U-M that are responsible for managing waste generated on campus. They are the Waste Management Services of the Plant Operations Division (WMS), the Utilities and Waste Management division of the U-M Health System Facilities Services (UHS), and the Waste Management department of Occupational Safety and Environmental Health (OSEH). In general, WMS manages the collection and recycling of non hazardous waste, UHS manages the collection and recycling of all hospital wastes, and OSEH is responsible for managing hazardous waste and regulated recycling.

During the typical non-regulated waste collection activities, WMS trucks pick up waste, paper, and mixed containers from the various dumpsters on campus. These trucks then drive to the Ann Arbor Materials Recovery Facility (MRF). Here, the trucks are weighed and the garbage and recyclables are processed with the MRF's other incoming materials. Materials that are not recovered for recycling are sent to the landfill.

The Total Waste indicator measures the total amount of regulated non-hazardous and non-regulated waste generated from the Ann Arbor campus and the U-M hospital. The indicator includes all generated waste, whether it is recycled, reused, or sent to a landfill.

5.5.1.1 Primary Data Sources

Please refer to Sections 5.5.3, 5.5.4, and 5.5.11 for descriptions of primary data sources.

5.5.1.2 Secondary Data Source
Please refer to Section 5.5.4 for the secondary data source.

5.5.1.3 Calculation Procedure
The Total Waste indicator is the sum of refuse, and regulated and non-regulated recycling collected from University buildings and the U-M hospital. The measurement of Total Hospital Waste, Composting, Reuse, Total Construction Waste, and Regulated Recycling are described in greater detail in the subsequent sections. The WMS General Waste term refers to the sum of refuse and non-regulated recycling collected from University buildings. Instructions for importing the "WMS_InputMod" file are given in Section 5.5.4 and instructions for entering hospital waste data are given in Section 5.5.3. The Total Waste indicator will not be correctly calculated until all of the material use and solid waste data are entered in the EDR. Please note that only the solid regulated recycling materials are included in the calculation of Total Waste. No calculations are performed to convert the liquid wastes to mass equivalents.

Within the "RawOutput" worksheet, the Total Waste indicator is calculated by the following equation:

> Total Waste (tons) = Total Hospital Waste (tons) + Composting (tons) + Reuse (tons) + [Total Construction Waste (lbs) + WMS General Waste (lbs) + Regulated Recycling (lbs)] / 2000 lbs/ton

The normalization of tons/person is calculated in the "RawOutput" worksheet by dividing the result by the total U-M Ann Arbor campus population.

5.5.2 Percent Recycled (% of Total Waste)

The Percent Recycled indicator measures the percentage of the total campus and U-M hospital waste that is recycled. This includes paper and cardboard, composting, material reuse, mixed containers, construction in-house waste, and regulated items, such as fluorescent lamp ballasts, batteries, and consumer electronics. The measurement of Paper Recycling, Mixed Container Recycling, Reuse, Composting, Total Hospital Waste, Composting, Reuse, Construction In-House, and Regulated Recycling are described in greater detail in the subsequent sections.

5.5.2.1 Primary Data Sources
Please refer to Sections 5.5.3, 5.5.4, and 5.5.11 for descriptions of primary data sources.

5.5.2.2. Secondary Data Source
Please refer to Section 5.5.4 for the secondary data source.

5.5.2.3 Calculation Procedure
Within the "RawOutput" worksheet, the Percent Recycled indicator is calculated by the following equation:

Percent Recycled = [Paper Recycled (tons) + Glass Containers Recycled (tons) + Metal Containers Recycled (tons) + Construction In-House Waste Recycled (tons) + Composting (tons) + Reuse (tons) + Regulated Recycling (tons) + Other Hospital Recycling (tons)] / Total Waste (tons)

The Percent Recycled indicator will not be correctly calculated until all of the material use and solid waste data are entered in the EDR. The term "other hospital recycling (tons)" refers to the total amount of scrap wood and metal, and yellow kitchen grease collected from the hospital. Please note that only the solid regulated recycling materials are included in the Percent Recycled indicator.

5.5.3 Hospital Waste (tons, tons/person)

The metric of Hospital Waste refers to the total amount of waste generated by the U-M hospital, including items that are recycled. This value and all associated measurements of hospital waste only include the U-M hospitals within Ann Arbor and not the satellite clinics in locations outside Ann Arbor's city limits.

5.5.3.1 Primary Data Sources

Contact:
David Tyler
UMH Waste Management/Recycling Foreman
(734) 936-6266 (pager #9505)

Data relating to all hospital refuse and recycling are only available in hard copy and through personal communication with the data contact, David Tyler. At the end of each calendar year, the U-M hospital prepares a report summarizing hospital refuse and recycling activities. Note that these hospital data refer to the previous calendar year, not fiscal year.

5.5.3.2 Secondary Data Source

The staff and faculty population of the U-M hospital is required for this metric.

5.5.3.3 Calculation Procedure

To calculate the Hospital Waste metric, begin by choosing the "Material Use and Solid Waste" tab in the main user interface. Next, click the "U-M Hospital Waste" button to display the hospital data entry form. Be sure to choose a year and contact information.

After selecting a year and contact, manually enter hospital data in the appropriate text boxes. Once the "Enter Data" button is clicked, the EDR writes data from the text boxes directly to the "PrimaryInput" worksheet. There are no calculations associated with the Hospital Waste metric, measured in tons. The metric is simply the total amount of waste generated by the hospital, which is obtained directly from the value entered into the hospital data entry form. The "RawOutput" worksheet calculates the normalization of tons/person by dividing Hospital Waste (tons) by the total hospital staff population.

5.5.4 Waste from U-M Campus (tons, tons/person)

The Waste from U-M Campus metric is a measurement of the total waste generated from U-M buildings, not including the hospital. This value includes all materials that are either recycled or disposed in a landfill following generation. Please note that regulated recycling items are not included in this metric, since regulated items are collected from both the campus and the hospital. There is currently no method in place to allocate generation of all items between locations.

5.5.4.1 Primary Data Sources

Contact:

Tracey Artley
U-M Waste and Recycling Coordinator
(734) 763-5539
artleyt@umich.edu

The U-M Waste Management Services stores data relating to University refuse and recycling in a Microsoft Access database, referred to here as the WMS database. This database includes composting, construction in-house debris, recycling, reuse, and general refuse data. The file folder, "WMS_Input", is emailed to the data contact. This folder contains the input spreadsheet, WMS_InputMod.xls, and a Word document of instructions on how the contact should complete the spreadsheet. Output from the database is entered into the "WMS_InputMod" file by the data contact, Tracy Artley. The file is then returned for importation to the EDR. A portion of "WMS_InputMod" is shown as Figure 5-15.

	A	B	C	D	E	F	G	H
7	compost	Betsey Barbour House	30029	140	8101.80003			
8	compost	East Quadrangle	30076	463	25181.32999			
9	compost	Helen Newberry	30029	140	8101.80003			
10	compost	Mary Markley Hall	30128	104	5837.599995			
11	compost	Media Union	00396R	61	3387.350001			
12	compost	Pierpont Commons	01272	475	26840.12			
13	compost	South Quadrangle	30226	447	26084.10985			
14	compost	West Quadrangle	30280	600	31541.26012			
15								
16	general	Type of Material	Total Weight (pounds)					
17	general							
18	general	Mixed Containers	251560.00					
19	general	Other	47940.00					
20	general	Paper	4466700.00					
21	general	Scrap Metal	49762.22					
22	general	Scrap Wood	318360.00					
23	general	Trash	10860170.00					
24								
25	construction	Type of Material	Total Weight (pounds)					
26	construction							
27	construction	Other	28120					
28	construction	Scrap Metal	195260					
29	construction	Scrap Wood	111580					
30	construction	Trash	2890640					
31								
32	recycling	Type of Material	Type of Service	nOfWeight (pounds)				
33	recycling							
34	recycling	Mixed Containers	Primary Recycling	251560				
35	recycling	Other	Primary Recycling	2660				
36	recycling	Other	Secondary Recycling	34540				
37	recycling	Other	Trash	10740				
38	recycling	Paper	Primary Recycling	4455520				
39	recycling	Paper	Secondary Recycling	11180				

Input

Figure 5-15. Screenshot of "WMS_InputMod" File.

Contact:
Bill McAllister
Yard Manager
(734) 764-3424
bjom@umich.edu

In addition to the composting dining hall food wastes, the U-M composts woody debris collected during grounds maintenance activities. The Grounds department tracks the annual volume of woody debris mulch produced.

5.5.4.2 Secondary Data Sources

Source:

U.S. EPA (1995) *Decision Maker's Guide to Solid Waste Management, Volume II*. Table 9-1. Office of Solid Waste, Municipal and Industrial Solid Waste Division. Washington, D.C.

In order to convert the volume of woody debris mulch provided by the Grounds department, it is necessary to multiply this value by a density conversion factor. The density of woody debris mulch is assumed to be a constant value of 170 pounds/cubic yard. Also, the total U-M Ann Arbor Campus population is used to normalize this metric.

5.5.4.3 Calculation Procedure

In order to calculate the Waste from U-M Campus metric, it is necessary to import the "WMS_InputMod" file. Please note that this file needs to be imported only once per reporting year. Begin by selecting the "Material Use and Solid Waste" tab of the main user interface. Next, click the "U-M Data" button to display the "U-M Waste Management Services Data" input form. As shown in Figure 5-16, this form has three tabs: "Import U-M Data", "Manual U-M Data", and "External Data."

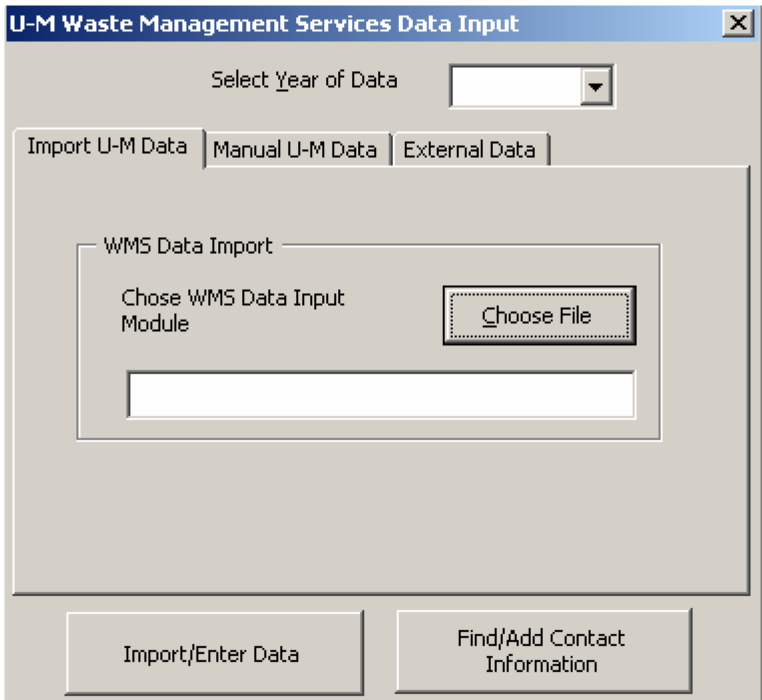


Figure 5-16. U-M Waste Management Services Data Input Form

To enter WMS data in the form of the "WMS_ImportMod" file, select the "Import U-M Data" tab. Select the data year and then click the "Choose File" button to select the "WMS_ImportMod" Excel file. Since the data contact information is included in the "WMS_InputMod" file, there is no data contact field within the "Import Data" tab.

At this point, you can either click the "Import/Enter Data" button at the bottom of the form to import the WMS data, or you can continue to the other data tabs. If the "Import/Enter Data" button is clicked, the EDR automatically imports the data to a temporary worksheet, "HidInput." The EDR then copies the WMS data to the appropriate locations in the "PrimaryInput" worksheet. The "RawOutput" worksheet calculates the metric based on the data in the "PrimaryInput" worksheet. Within "RawOutput", the Waste from U-M Campus metric is calculated by the following equation:

Waste from U-M Campus (tons) = [Σ Compost (lbs) + Σ Construction In House Waste (lbs) + WMS General Waste] / 2000

The WMS General Waste term refers to the general refuse, paper, and mixed containers collected from University dumpsters by WMS. The normalization of this metric is calculated in the "RawOutput" worksheet by dividing by the U-M Ann Arbor campus population (excluding hospital staff and faculty).

5.5.5 Paper Recycled (tons, % of total waste)

The Paper Recycled metric is a measurement of the total amount of paper and cardboard collected for recycling from the campus and the U-M hospital. WMS tracks the amount of paper recycled as a separate category. The U-M hospital does disaggregate the mass of paper collected for recycling at the main hospitals and the satellite clinics. It is important not to include the paper recycling at the satellite clinics.

5.5.5.1 Primary Data Sources

The mass of paper collected for recycling by WMS is obtained from Tracy Artley and the masses of paper and cardboard collected for recycling by the U-M hospital are obtained from David Tyler.

5.5.5.2 Secondary Data Source

There is no secondary data source for the Paper Recycled metric.

5.5.5.3 Calculation Procedure

The Paper Recycled metric is equal to the sum of the amount paper and cardboard collected for recycling from the hospital and the amount of paper collected from campus buildings. The amount of paper collected from campus is included in the "Waste_InputMod" file. Therefore, the Paper Recycled metric cannot be calculated until the "Waste_InputMod" file is imported into the EDR. Please refer to Section 5.5.4 for instructions on importing this file. The amount of paper and cardboard collected for recycling from the U-M hospital is entered manually. Please refer to Section 5.5.3 for instructions on entering hospital waste data.

In the "RawOutput" worksheet, the EDR calculates the Paper Recycled metric by taking the sum of the campus and U-M hospital paper and cardboard data. This sum is then divided by 2000 to convert from lbs to tons. The normalization of percent of total waste is calculated by dividing Paper Recycled by the Total Waste indicator.

5.5.6 Glass Containers Recycled (tons, % of total waste), Plastics Recycled (tons, % of total waste), Metal Containers Recycled (tons, % of total waste)

WMS does not separately track the collection of glass, metal, and plastic containers for recycling. Instead, all three groups of materials are handled as "mixed containers". Assuming that the composition of the U-M's mixed container stream is equivalent to the Ann Arbor MRF, it is possible to estimate the mass of each of the three container groups. Unlike WMS, the U-M hospital does separately track plastic recycling.

The Glass and Metal Containers Recycled metrics reflect the amount of glass and metal containers, respectively, collected for recycling from the campus waste stream. The Plastics Recycled metric measures the mass of plastic containers collected for recycling from the campus and the U-M hospital.

5.5.6.1 Primary Data Sources

The total mass of mixed containers collected from the campus is obtained from Tracy Artley. The mass of plastic containers collected from the U-M hospital is obtained from David Tyler. Please refer to Sections 5.5.3 and 5.5.4.

5.5.6.2 Secondary Data Source

Contact:
Bill Leonidas
FCR Recycling
(704) 379-0625
Bill.Leonidas@casella.com

In order to calculate the amount of mixed containers recycled, it is necessary to obtain the mixed container stream breakdown. This breakdown is updated annually and represents the overall mixed waste stream at the Ann Arbor MRF, not just materials collected from U-M. It is assumed that the composition of U-M's mixed container stream is the same as the MRF receives.

5.5.6.3 Calculation Procedure

Calculating the Glass and Metal Containers Recycled Metrics involves importing the "WMS_InputMod" file, while calculating the Plastics Recycled Metric involves the additional entry of hospital data. For instructions on importing the "WMS_InputMod" file, please refer to Section 5.5.4. For instructions on how to manually enter hospital data, please refer to Section 5.5.3.

The mass of mixed containers collected for recycling is first written to the temporary worksheet, "HidInput", and then copied to the "PrimaryInput" worksheet. In order to enter the breakdown of the MRF's mixed container stream choose the "External Data" tab. If updated data are not available, there is the option to use default values embedded in the EDR. These values were obtained during the year 2004 data collection from Bill Leonidas. Whether or not updated values are entered, the EDR writes the mixed container percentages to the "SecondaryInput" worksheet.

The Glass and Metal Containers Recycled metrics are calculated in the "RawOutput" worksheet by multiplying the total mass of mixed containers by the appropriate mixed container percentage. These values are then divided by 2000 to convert from pounds to tons. Calculating the Plastic Containers Recycled metric involves the additional step of adding the amount of plastic containers recycled at the hospital. Within the "RawOutput" worksheet, the amount of mixed containers is multiplied by the plastic mixed waste percentage. Next, this value is divided by 2000 to convert from pounds to tons and is then added to the amount of plastic containers collected from the hospital.

The normalization of all three container recycling metrics is calculated in the "RawOutput" worksheet by dividing the final metric value (in tons) by the Total Waste indicator.

5.5.7 Construction In-House Waste Recycled (tons, % of Construction In-House Waste)

During construction and renovation activities on the U-M Ann Arbor campus, discarded materials are collected in roll-off dumpsters. Collectively, these materials are referred to as construction in-house waste. The scrap metal and scrap wood portions of the construction in-house waste are recycled, while the unrecoverable portions are sent to landfill. The Construction In-House Waste Recycled metric measures the amount of construction waste from the Ann Arbor campus that is collected for recycling.

5.5.7.1 Primary Data Source

Data relating to construction materials recycling are obtained from Tracy Artley. There are four categories of construction in-house waste: other, scrap metal, scrap wood, and trash. Please refer to Section 5.5.4.

5.5.7.2 Secondary Data Source

There is no secondary data source for Construction In-House Waste Recycled.

5.5.7.3 Calculation Procedure

The metric is calculated by first importing the "WMS_InputMod" file. For instructions on importing this file, please refer to Section 5.5.4 After the WMS data are imported, the "RawOutput" worksheet calculates the Construction In-House Waste metric by summing the masses of scrap metal and scrap wood collected for recycling.

The normalization for this metric is calculated in the "RawOutput" worksheet by dividing the tons of Construction In-House Waste Recycled by the sum of all construction waste. The sum of all construction waste reflects the total amount of construction waste collected by the U-M, regardless of whether or not it is sent for recycling.

5.5.8 Composting (tons, tons/person)

Composting activities on the U-M Ann Arbor campus take the form of food waste and woody debris and leaf mulch. Food waste is collected from eight locations around campus by WMS. Mulch is produced from leaves and woody debris collected during grounds maintenance activities. The Composting metric reflects the mass of mulch produced by composting activities, not the mass of leaves and woody debris collected. Conversely, the amount of food waste collected for composting is measured by this metric.

5.5.8.1 Primary Data Sources

The mass of food compost collected from the U-M Ann Arbor campus is obtained from Tracy Artley and the annual amount of mulch produced is obtained from William McAllister. Please refer to Section 5.5.4.

5.5.8.2 Secondary Data Source
The density of mulch is a constant value of 170 lbs / cubic yard. Please refer to Section 5.5.4 for the source of this value. Also, the total U-M Ann Arbor Campus population is used to normalize the Composting metric.

5.5.8.3 Calculation Procedure
The Composting (tons) metric is calculated from food waste data imported with the "WMS_InputMod" file and mulch data manually entered into the EDR. Please refer to Section 5.5.4 for instructions on importing this file. To enter mulch data, select the "Manual Data Entry" tab in the "U-M Waste Management Services" form and enter data in the appropriate text box. Click the "Import/Enter Data" button to write the value to the "PrimaryInput" worksheet.

To enter the volume of mulch produced, select the "Manual Data Entry" tab within the "U-M Waste Management Services" form. Choose the data contact, enter the value into the appropriate text box, and click the "Import/Enter Data "button to write the value to the "PrimaryInput" worksheet. In the "RawOutput" worksheet, the mulch volume is multiplied by the mulch conversion factor to arrive at the mass of mulch produced. This value is then added to the sum of total food waste collected and then divided by 2000 to convert lbs to tons. The normalization of tons/person is calculated by dividing Composting (tons) by the U-M Ann Arbor campus population (not including hospital staff).

5.5.9 Reuse-Property Disposition ($, $/person)

The U-M's Property Disposition is responsible for selling surplus U-M property. This surplus property takes the form of office furniture and supplies, computer equipment, lab equipment, kitchen supplies, and many other items. The U-M's Property Disposition tracks all sales of equipment and provides an annual sales figure at the end of each fiscal year.

5.5.9.1 Primary Data Source
Contact:
Jim Day
Manager, Property Disposition
764-2470
dayj@umich.edu

Property Disposition's annual sales total is obtained from Jim Day.

5.5.9.2 Secondary Data Source
The total U-M Ann Arbor Campus population is used to normalize this metric.

5.5.9.3 Calculation Procedure
The Reuse-PD ($) metric is equal to the annual sales of U-M's Property Disposition; no additional calculations are required within the EDR. To enter the annual sales total, begin by selecting the "Material Use and Solid Waste" tab of the main user interface and click

the “U-M Data” button to display the “U-M Waste Management Services” form. Next, choose the “Manual Data Entry” tab and enter the annual sales total in the appropriate text box. Confirm that the year and data contact information have been selected before clicking the “Import/Enter Data” button. The EDR writes the sales value to the “PrimaryInput” worksheet, which is directly referenced in the “RawOutput” worksheet.

The normalization of the Reuse-PD metric is calculated in the “RawOutput” worksheet by dividing the sales figure by the total U-M Ann Arbor campus population.

5.5.10 Reuse (tons, tons/person)

When students move out of on-campus housing, discarded items such as clothing and books are collected by WMS for reuse. The Reuse metric reflects the total mass of items collected for reuse during student moveout.

5.5.10.1 Primary Data Source

The mass of items collected for reuse during student moveout is obtained from Tracy Artley.

5.5.10.2 Secondary Data Source

The total U-M Ann Arbor Campus population is used to normalize this metric.

5.5.10.3 Calculation Procedure

Data required to calculate the Reuse (tons) metric are contained in the “WMS_InputMod” file. For instructions on how to import this file, please refer to Section 5.5.4. The total mass of items collected is calculated by the EDR and written to the “HidInput” worksheet and then to the “PrimaryInput” worksheet. This sum is then divided by 2000 in the “RawOutput” worksheet to convert lbs to tons. The normalization is calculated in the “RawOutput” Worksheet by dividing Reuse (tons) by the total U-M Ann Arbor campus population.

5.5.11 Regulated Recycling (8 metrics)

Regulated recycling metrics include (units):

- Batteries (tons)
- Lamp Ballasts (tons)
- Fluorescent Light Bulbs (tons)
- Consumer Electronics (tons)
- Solvents (gallons)
- Transportation Oils (gallons)
- Latex Paint (gallons)
- Coolants (gallons)

As mentioned previously, OSEH is responsible for collecting and tracking regulated materials recycling. These materials include solids (batteries, lamp ballasts, fluorescent light bulbs, and consumer electronics) and liquids (solvents, transportation oils, latex paint, and coolants). The solid regulated recycling materials are reported in tons and are included in the Total Solid Waste and Percent Recycled metrics. The liquid regulated recycling materials are reported in gallons and are not included in the Total Solid Waste and Percent Recycled metrics. Please note that the Solvents metric is equal to the total volume of xylene, acetone, and formalin recycled. Also, since consumer electronics recycling did not begin until 2005, data are not available for years prior to this.

5.5.11.1 Primary Data Source

Contact:
Andy Berki
OSEH Coordinator
(734) 647-3120
aberki@umich.edu

The U-M also recycles regulated materials that are solids (batteries, fluorescent lamp ballasts, consumer electronic equipment) and regulated materials that are liquids (xylene, acetone, formalin, latex paint, transportation oils, and coolants). These items are collectively known as regulated recycling. These recycling programs are managed by OSEH and annual data on the total mass of items recycled is available from Andy Berki.

5.5.11.2 Secondary Data Source

There are no secondary data sources for the regulated recycling metrics.

5.5.11.3 Calculation Procedure

In order to calculate the regulated recycling metrics, begin by selecting the "Material Use and Solid Waste" tab of the main user interface. Next, click the "U-M Data" button to display the "U-M Waste Management Services Data Input" form. In the "Manual U-M Data" tab, click the "Enter Regulated Recycling Data" button. Once this button is clicked, the "Regulated Recycling" form is displayed. Here, all of the regulated recycling data are manually input to the EDR. The "Regulated Recycling" form is shown as Figure 5-17.

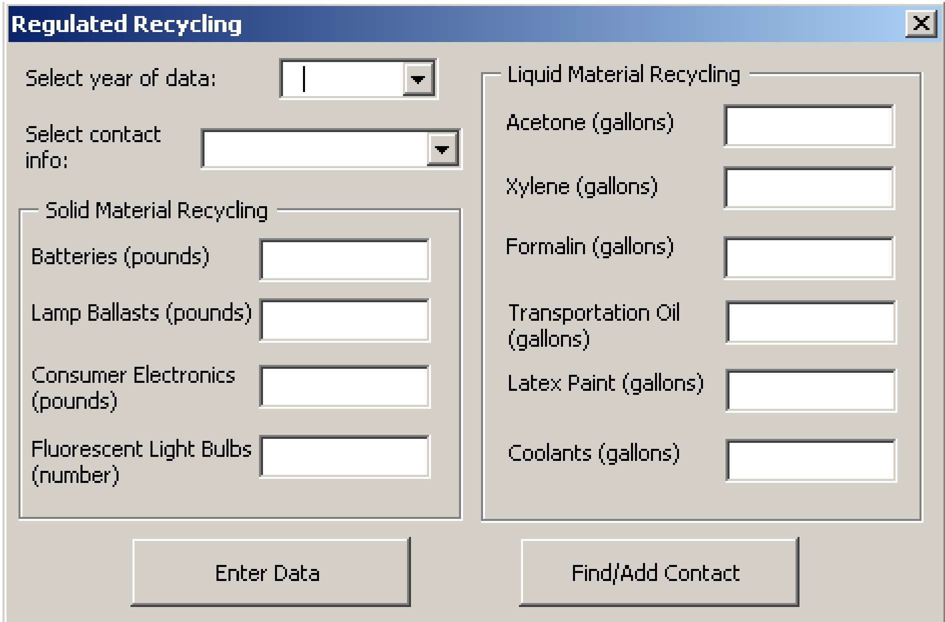


Figure 5-17. Regulated Recycling Data Input Form

Once the "Enter Data" button is clicked, the EDR will write the data directly to the "PrimaryInput" worksheet. With the exception of fluorescent light bulbs, all regulated recycling data written to the EDR in their original unit of measure. In the case of fluorescent light bulbs, it is assumed that one bulb weighs approximately 1 pound.

The weights of the solid regulated recycling materials are divided by 2000 to convert from lbs to tons in the "RawOutput" worksheet. Also, the volumes of xylene, acetone, and formalin are summed and reported together as one category, "solvents".

5.6 Cross Cutting and Emerging Issues

The Cross Cutting and Emerging Issues category includes indicators and metrics that capture ideas for measures that cross traditional category boundaries and provide alternative environmental perspectives. For example this category includes measures for conditioned building space and aesthetics, which provide information on the quality of the workplace and educational environment at the University. While other metrics, such as LEED ratings, provide measures that influence performance in multiple categories.

The calculation of the building utilization (conditioned space) metric is shown in Figure 5-18 below. A detailed discussion of data sources and calculation procedures for all indicators and metrics in this category is included in the sections that follow.

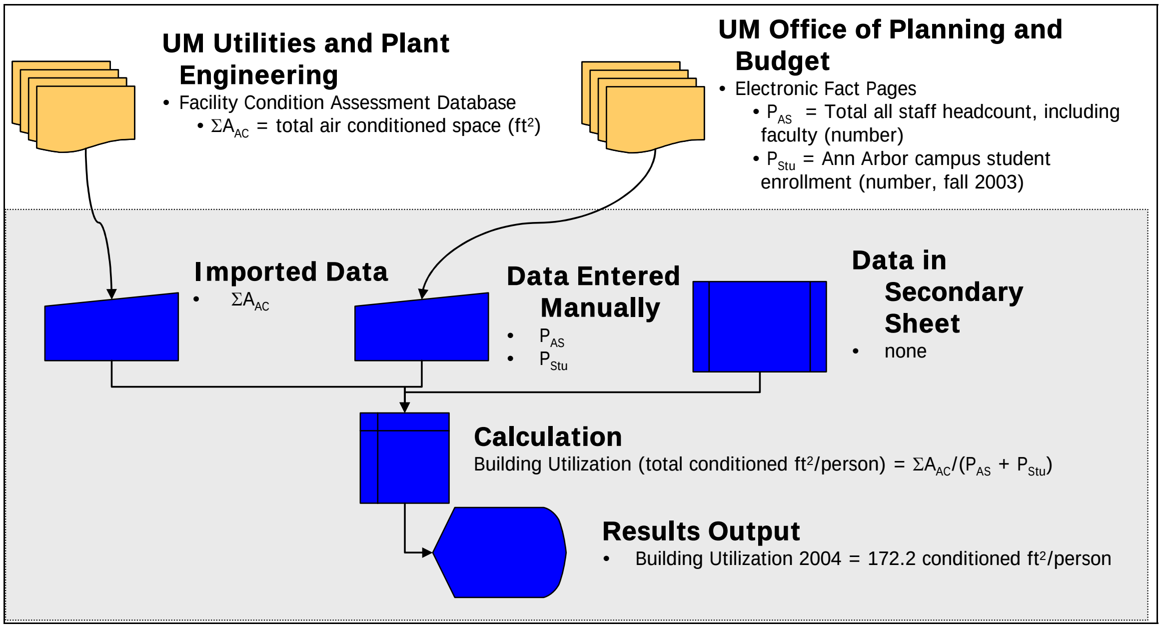


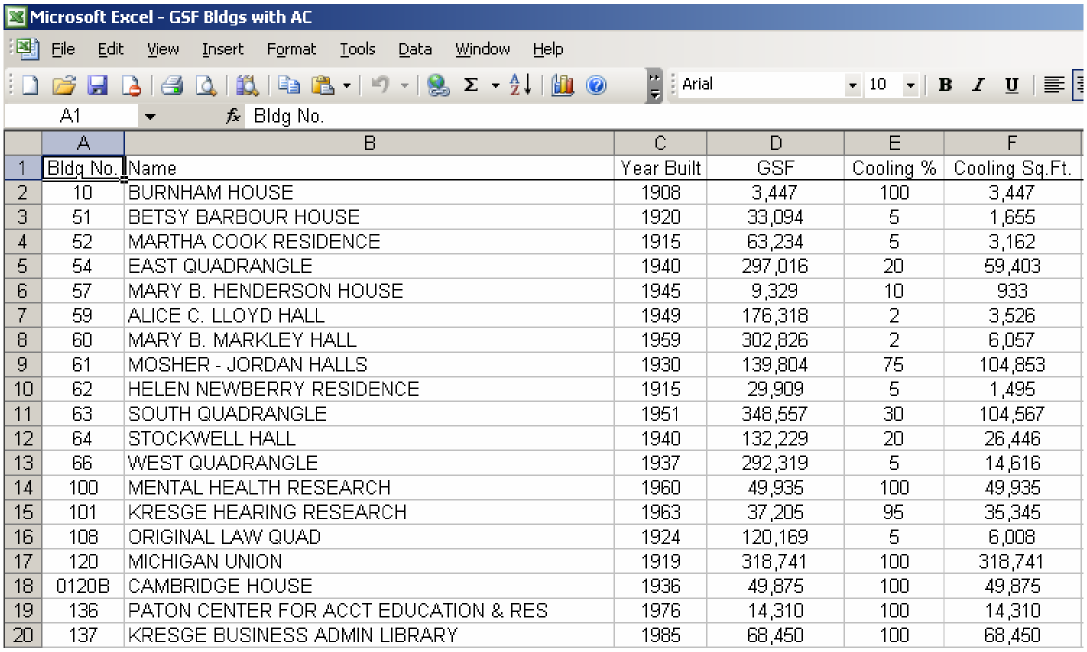
Figure 5-18. Calculation of the Building Utilization Metric

5.6.1 Building Utilization (total conditioned building square footage, square footage per person)

Total conditioned building area is defined in this analysis as the square footage of any portion of U-M Ann Arbor campus buildings receiving air conditioning.

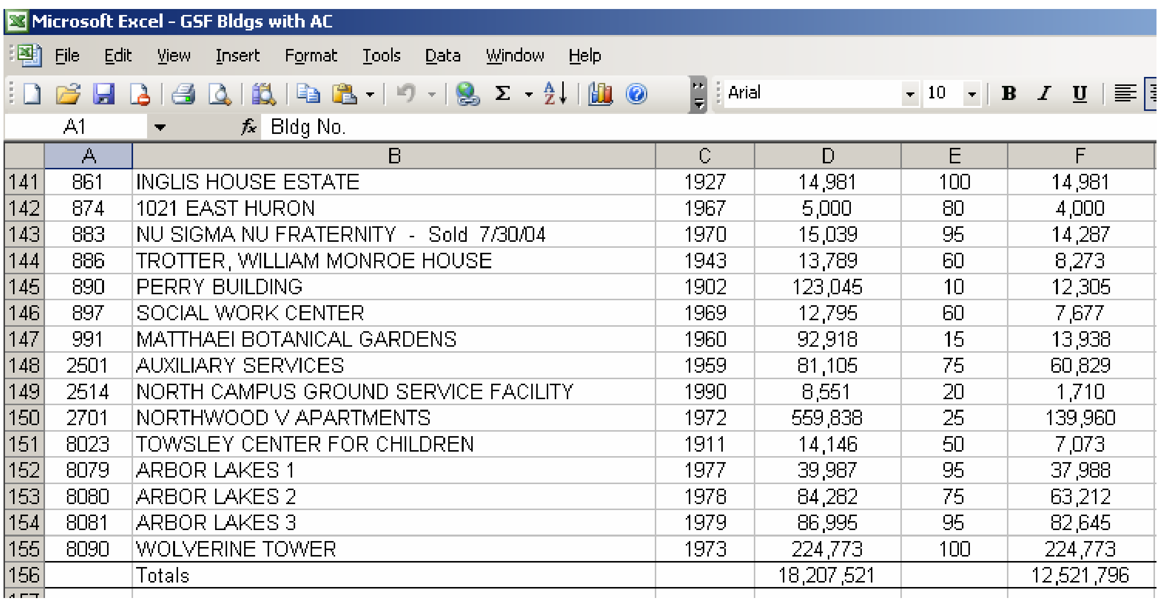
5.6.1.1 Primary Data Sources
Contact:
Mike Bowen
Mechanical Engineer
Utilities & Plant Engineering
(734) 647-5797
mbowen@umich.edu

Data for this metric is maintained by the Utilities and Plant Engineering department in the Facility Condition Assessment (FCA) database. Upon request, the contact performs a query within the FCA database (selecting the "% air conditioned" field and using key search words "cooling" and "square feet"). The contact replaces the results of the query from the previous year with the new results in the Excel spreadsheet "GSF Bldgs with AC." This worksheet has been prepared to facilitate data entry and needs to be sent via email in order for the contact to enter data into the appropriate cells. The spreadsheet shows by column all buildings receiving any air conditioning (building number, name and year built), the gross square footage of each building, the percentage (of area) cooled in each building, and the square footage being cooled in each building (see Figure 5-19 below). It is critical that the last cell containing data in the last column be the total square footage cooled at U-M (see Figure 5-20 below) since the model uses the data in this cell for calculating the metric.



	A	B	C	D	E	F
1	Bldg No.	Name	Year Built	GSF	Cooling %	Cooling Sq.Ft.
2	10	BURNHAM HOUSE	1908	3,447	100	3,447
3	51	BETSY BARBOUR HOUSE	1920	33,094	5	1,655
4	52	MARTHA COOK RESIDENCE	1915	63,234	5	3,162
5	54	EAST QUADRANGLE	1940	297,016	20	59,403
6	57	MARY B. HENDERSON HOUSE	1945	9,329	10	933
7	59	ALICE C. LLOYD HALL	1949	176,318	2	3,526
8	60	MARY B. MARKLEY HALL	1959	302,826	2	6,057
9	61	MOSHER - JORDAN HALLS	1930	139,804	75	104,853
10	62	HELEN NEWBERRY RESIDENCE	1915	29,909	5	1,495
11	63	SOUTH QUADRANGLE	1951	348,557	30	104,567
12	64	STOCKWELL HALL	1940	132,229	20	26,446
13	66	WEST QUADRANGLE	1937	292,319	5	14,616
14	100	MENTAL HEALTH RESEARCH	1960	49,935	100	49,935
15	101	KRESGE HEARING RESEARCH	1963	37,205	95	35,345
16	108	ORIGINAL LAW QUAD	1924	120,169	5	6,008
17	120	MICHIGAN UNION	1919	318,741	100	318,741
18	0120B	CAMBRIDGE HOUSE	1936	49,875	100	49,875
19	136	PATON CENTER FOR ACCT EDUCATION & RES	1976	14,310	100	14,310
20	137	KRESGE BUSINESS ADMIN LIBRARY	1985	68,450	100	68,450

Figure 5-19. Screenshot of "GSF Bldgs with AC" MS Excel File



	A	B	C	D	E	F
141	861	INGLIS HOUSE ESTATE	1927	14,981	100	14,981
142	874	1021 EAST HURON	1967	5,000	80	4,000
143	883	NU SIGMA NU FRATERNITY - Sold 7/30/04	1970	15,039	95	14,287
144	886	TROTTER, WILLIAM MONROE HOUSE	1943	13,789	60	8,273
145	890	PERRY BUILDING	1902	123,045	10	12,305
146	897	SOCIAL WORK CENTER	1969	12,795	60	7,677
147	991	MATTHAEI BOTANICAL GARDENS	1960	92,918	15	13,938
148	2501	AUXILIARY SERVICES	1959	81,105	75	60,829
149	2514	NORTH CAMPUS GROUND SERVICE FACILITY	1990	8,551	20	1,710
150	2701	NORTHWOOD V APARTMENTS	1972	559,838	25	139,960
151	8023	TOWSLEY CENTER FOR CHILDREN	1911	14,146	50	7,073
152	8079	ARBOR LAKES 1	1977	39,987	95	37,988
153	8080	ARBOR LAKES 2	1978	84,282	75	63,212
154	8081	ARBOR LAKES 3	1979	86,995	95	82,645
155	8090	WOLVERINE TOWER	1973	224,773	100	224,773
156		Totals		18,207,521		12,521,796

Figure 5-20. Screenshot of "GSF Bldgs with AC" MS Excel File Demonstrating the Last Worksheet Row

In order for the model to access this data for calculations, the spreadsheet must be imported from the "Cross-Cutting & Emerging" tab. To import the spreadsheet, first select a contact and click the "Import Building Data" button. Select the file "GSF Bldgs with AC" and click OK. A message box will appear displaying the pathname of the file you selected. After clicking the OK button, the spreadsheet will automatically be imported to the "CrossCutting_Input" worksheet. At this point, the model takes the total square footage cooled and stores the value in the "PrimaryInput" worksheet under the year selected for data entry.

5.6.1.2 Secondary Data Sources

The U-M Ann Arbor campus population is necessary in order to determine the metric. Example values and a description of campus population are given in Section 4.2.

5.6.1.3 Calculation Procedure

After the Excel file has been imported, the data from this file are stored in the "CrossCutting_Input" worksheet and the total square footage cooled is stored in the "PrimaryInput" worksheet. This value is divided by the total U-M Ann Arbor population and is stored in the "RawOutput" worksheet in the Cross Cutting & Emerging Category for the corresponding year.

5.6.2 Educational Programs and Initiatives

These data are not currently available and no centralized data collection system exists. A discussion of data collection efforts appears below. This metric should be revisited in the future for incorporation in environmental reporting efforts consistent with the Environmental Task Force recommendations.

5.6.2.1 Primary Data Sources

Contact:
Ken Kohrs
Special Counsel to the Provost for Environmental Sustainability Research and Education
(734) 615-1549
kkohrs@umich.edu

Ken Kohrs provided information from the Environmental and Sustainability Research and Education Study for the project team. This study is expected to result in the formation of a centralized information source for sustainability at the University of Michigan. For example a web-based portal is being developed to provide information on research and educational offerings at the University. This study project is currently on-going and may result in the formation of a sustainability "institute" or similar entity on campus that would serve as a source for future information on educational programs and initiatives

5.6.2.2 Secondary Data Sources

No secondary data sources are considered for this metric.

5.6.2.3 Calculation Procedure

No data are currently available; however, when data are collected they should not require any manipulation.

5.6.3 LEED Certification (number of buildings LEED certified, % of total U-M buildings)

All buildings given a platinum, gold, silver or bronze LEED certification qualify as a LEED certified building for this metric.

5.6.3.1 Primary Data Sources

Contact:
Douglas Hanna
University Architect
University Architect/Planner Office & Plant Extension
(734) 764-2456
dougha@umich.edu

Doug Hanna works at Plant Extension Operations as a University Architect. Although no LEED certified buildings existed through 2004, Doug will keep an inventory of any buildings that receive LEED certification in the future and will record the level of certification (i.e. platinum, gold, silver, or bronze). This is also listed as a metric in the Land Use Category, however this data should be entered in the "Cross-Cutting & Emerging" tab simultaneously with the number of aesthetic awards U-M received (Doug Hanna, Section 5.6.4, also provides this number). Be sure to select a year of data entry and contact.

5.6.3.2 Secondary Data Sources

In order to calculate this metric, the total number of U-M Ann Arbor buildings needs to be determined. This is possible by using the *Annual Report of Utilities* provided by Carol Varney of Purchased Utilities. Once this report has been imported (discussed in Section 5.1), the model gains access to a listing of all the buildings considered in this analysis. The model determines how many buildings there are by counting the number of building entries there are in the "BldgList" worksheet and storing this number in the "SecondaryInput" worksheet.

5.6.2.3 Calculation Procedure

After entering the number of LEED certified buildings that are platinum, gold, silver and bronze certified for the selected year, the model stores these values in the "RawOutput" worksheet. Within the "RawOutput" worksheet the total number of LEED certified buildings is calculated by summing the numbers of platinum, gold, silver and bronze certified buildings. This value is also recorded in the "RawOutput" worksheet and is divided by the total number of buildings on U-M Ann Arbor campus to calculate the percentage of LEED certified buildings. This value is also recorded in the "RawOutput" worksheet and can be viewed in the "Summary" and "Graphing" worksheets by selecting the Cross Cutting & Emerging category.

5.6.4 Aesthetics (number of planning, architecture and environmental design awards received)

This metric includes all planning, architectural, and environmental design awards received during the selected year.

5.6.4.1 Primary Data Sources

Contact:
Douglas Hanna
University Architect
University Architect/Planner Office & Plant Extension
(734) 764-2456
dougha@umich.edu

Doug Hanna works at Plant Extension Operations as a University Architect and keeps an inventory of awards and nominations the University receives for planning, architectural, and environmental design projects. Upon request, Doug provides an Excel spreadsheet named "Awards and Nominations Log" which lists all the awards and nominations received by year, award name and project. Count only those projects that received an *award* and enter this number in the appropriate text box on the "Cross-Cutting & Emerging" tab simultaneously with the number of LEED certified buildings that are platinum, gold, silver and bronze certified for the selected year (Doug Hanna, Section 5.6.3, provides this data as well). Be sure to select a year for data entry and contact.

5.6.4.2 Secondary Data Sources

No secondary data sources are considered for this metric.

5.6.4.3 Calculation Procedure

After the number of awards received is entered, the value is stored in the "RawOutput" worksheet within the Cross-Cutting and Emerging Issues category for the year selected. One can view the result in the "Summary" worksheet by selecting the Cross-Cutting & Emerging category. There were no additional calculations necessary for this metric.

6. Implementation Activities and Resources

The EDR is a tool designed to facilitate the process of environmental reporting for the University of Michigan Ann Arbor campus. A single user, familiar with this report, the use of Microsoft Excel, environmental principles, and the University should be able to accomplish all data collection activities associated with annual reporting in relatively short order. This user is referred to as the environmental data coordinator in the discussion that follows.

Throughout the process of reporting the environmental data coordinator is responsible for coordination and communication with the various University units responsible for measuring and collecting the source data. In addition, other University representatives from departments such as communications, the Provost's office, OSEH, and Plant Operations will need to be involved in the reporting process to develop the text and narrative content of an environmental report. A skilled data coordinator using the EDR can quickly provide the data required for reporting, but greater depth of discussion will require communication and subject area expertise.

One approach for filling the need for a part-time environmental data coordinator is the use of a student intern. This intern would need to possess the skills and qualities described above and could serve as the data coordinator during the summer months. Staff from CSS and/or OSEH could serve as advisors and supervisors for the intern. Other options for filling this position may also include a part-time position, temporary appointment, partial funding for existing staff or other limited employment arrangement.

The EDR should minimize the time required for data management in the environmental reporting process. The time required for data collection and compilation will depend heavily on the time required for communications with the University operating units, however, a maximum of two months should be allotted for the effort. With outstanding cooperation, data provision, and a user familiar with the EDR tool, results for University-wide reporting could be generated very efficiently. The ETF and other University leaders can facilitate this process by helping to establish the importance of environmental reporting as a key responsibility of the University.

In addition to resources required to support a data coordinator position, support will be required for report development, publication and dissemination. The ETF recommended a combination of limited printed publications with internet distribution via a website. Ultimately, it should be possible to integrate EDR output directly with a University website, however, this has not been attempted to date.

7. Conclusion

President Coleman charged the Environmental Task Force to "…identify ten to twelve indicators that best measure the University's progress with respect to environmental stewardship and to investigate how these indicators might best be measured and included in a periodic University report." While the initial findings of the ETF addressed the first of these activities, the information in this report and the accompanying data collection and management tool address the later, namely the facilitation of measurement and reporting at the University of Michigan.

In all, the Environmental Data Repository facilitates data collection from 18 University departments and eight external data sources, and uses these values to calculate annual performance relative to eight performance indicators and 51 operational metrics. This tool represents a significant streamlining of the environmental reporting process at the University and enables efficient generation of annual performance values.

The next step in environmental reporting at the University of Michigan will be the development of the narrative and visual portions of a report that tell the story of environmental performance to all University stakeholders.

Appendix A:

UNIVERSITY OF MICHIGAN ENVIRONMENTAL TASK FORCE ADVISORY REPORT TO PRESIDENT MARY SUE COLEMAN

APRIL 20, 2004

Making a Greener Maize and Blue

ENVIRONMENTAL TASK FORCE

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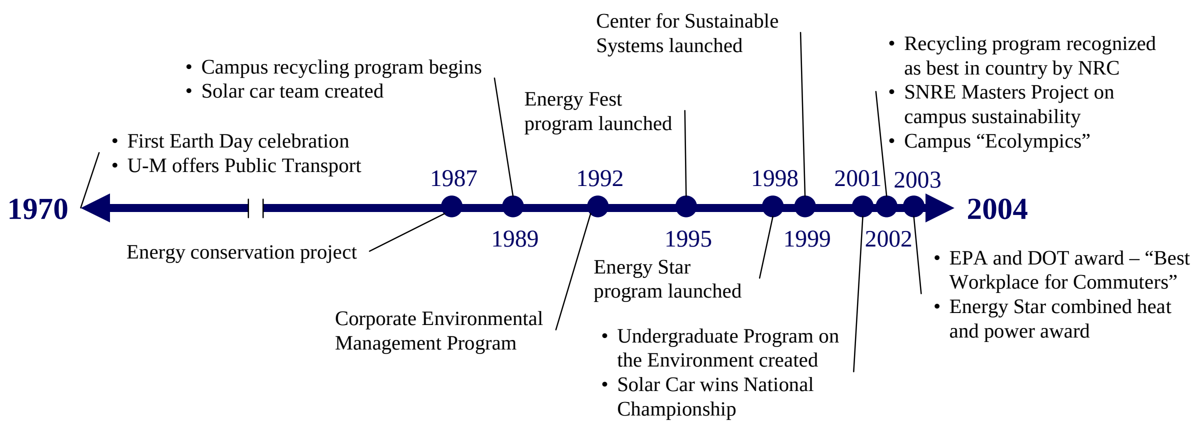
INTRODUCTION

In 2003, President Mary Sue Coleman established an Environmental Task Force to "develop a plan for the University of Michigan to create a more sustainable future." This Task Force is charged with identifying indicators which best measure the progress of the University with respect to its environmental performance, as well as investigating how these indicators might best be measured and reported on a regular basis. This report presents recommendations of the Task Force in response to President Coleman's charge.

Environmental Stewardship at the University of Michigan

The University of Michigan (U-M) has a long history of leadership and innovation on environmental issues (see timeline below).[1] There are close to 200 environmental stewardship projects currently underway at the University.[2] These include programs in recycling, energy conservation, building design, pollution prevention, emissions reduction, alternative-fuel vehicles, storm water management and de-icing and anti-icing impact reduction. A complete list of programs and initiatives is included in the Appendix. Noteworthy initiatives include Energy Star, alternative-fuel vehicles and recycling. Through the implementation of U.S. Environmental Protection Agency's Energy Star program, which began in 1997, U-M saves 25 million kilowatt-hours of electricity annually, enough to power 1,600 average-size homes.[1] This program also saves $9.7 million per year.[2] In recognition of these efforts, the Central Power Plant received the EPA Energy Star Combined Heat & Power Award in September 2003. U-M also operates the largest alternative-fueled fleet in the state with 110 diesel-powered vehicles that burn bio-diesel fuel and more than 400 passenger cars that burn ethanol fuel.[2] Lastly, recycling efforts at U-M capture roughly 30 percent of the solid waste stream. In recognition of its recycling efforts, U-M received the National Recycling Coalition's 2001 Outstanding School Program.[2]

Chronology of Select Environmental Initiatives at the University of Michigan



[1] Rodriguez et al (2002) *Sustainability Assessment and Reporting for the University of Michigan's Ann Arbor Campus*

[2] Brown, Diane (March 3, 2003) U-M continues environmental stewardship work. *The University Record.*

Environmental Efforts at other Colleges and Universities

In a survey administered as part of a report by the National Wildlife Federation's Campus Ecology Program, over 60 percent of U.S. institutions of higher learning were found to exhibit good environmental practices. When asked why campuses were implementing environmental programs, the number one response from college presidents (from 64% of those surveyed) was that such programs fit with the culture and values on America's college and university campuses. Presidents also cited public relations (47%) and cost-effectiveness (41%) as important factors.[3]

Over 270 colleges and universities worldwide have produced campus sustainability assessments. Approximately half of these were comprehensive sustainability assessments, while the other half were focused on one specific issue within the broader sustainability arena.[4] U.S. institutions producing reports include Michigan State University,[5] University of Florida,[6] Pennsylvania State University,[7] University of Vermont,[8] University of North Carolina[9] and Yale University.

Examples of Environmental Initiatives at other Institutions

- Rutgers University gives solid and liquid food waste to farmers for animal feed.
- By recycling tree prunings, Colorado State produces roughly 2,000 cubic yards of mulch each year.
- Harvard's Green Campus Initiative has created a $3 million loan fund to help finance green projects.
- In October 2003, Lewis & Clark College became the first campus in the nation to comply with the Kyoto Protocol.
- In May 2001, Indiana University became the first university to prohibit the purchase of products derived from old growth forests.
- Connecticut College has committed to offset over 40% of its electricity consumption over the next two years with wind energy

Environmental Assessment and Reporting at U-M

Following an initial research effort to explore the feasibility of developing a sustainability report for the University, a team of School of Natural Resources & Environment (SNRE) graduate students formed in January 2001 to assess the environmental, social and economic performance of the University's Ann Arbor campus (UM-AA). Their research was conducted in collaboration with U-M's Center for Sustainable Systems and U-M's Occupational Safety and Environmental Health Department (OSEH) and involved over 30 other U-M departments. Project objectives included:

- To propose a definition of sustainability and a framework for assessment tailored to UM-AA

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[3] McIntosh et al (2001) *State of the Campus Environment: A National Report Card on Environmental Performance and Sustainability in Higher Education*. A National Wildlife Federation Report.
[4] Glasser, Harold, Andrew Nixon, and Jason Tallant (2002) *Campus Sustainability Assessment Review Project*. Paper for presentation at Economicology 4.5 conference.
[5] Michigan State University Campus Sustainability Report (2003) (http://www.ecofoot.msu.edu/files/pdfs/sustainability.pdf)
[6] University of Florida Sustainability Indicators (2001) (http://www.sustainable.ufl.edu/indicators.pdf)
[7] Penn State Indicators Report (2000) (http://www.bio.psu.edu/greendestiny/publications/gdc-indicators_2000.pdf)
[8] Tracking UVM: An Environmental Report Card for the University of Vermont for the years 1990 to 2000 (2002) (http://www.uvm.edu/greening/trackinguvm.pdf)
[9] UNC Chapel Hill Campus Sustainability Report (2003) (http://sustainability.unc.edu/Documents/AnnualReportWeb2003.pdf)

- To use the framework to evaluate a set of sustainability indicators
- To highlight findings in a Prototype Sustainability Report
- To provide recommendations for an institutionalized reporting process

Indicators were proposed using the Global Reporting Initiative (GRI)[10] as a template, and were based on an extensive review of reports from corporations and other colleges and universities. Twenty-five environmental performance indicators were defined and these served as the basis for selecting the eight Environmental Performance Indicators recommended in this report. The findings of the students' efforts were presented to Interim President B. Joseph White in June of 2002, and to President Mary Sue Coleman in December of 2002.

THE PRESIDENT'S CHARGE TO THE ENVIRONMENTAL TASK FORCE

President Coleman established the U-M Environmental Task Force with the following charge:

> *Environmental stewardship is a key responsibility of the University, the city of Ann Arbor, and, indeed, the nation. The importance of stewardship is reflected not only in its relevance to our students, faculty, staff, and alumni; but, also in response to growing environmental challenges such as global warming, urban sprawl, limited natural resources and the loss of biodiversity.*
>
> *In its role as a world-class educational institution, the University of Michigan has historically led by example. With respect to environmental stewardship, the University should pursue leadership in its approach to environmental policies, practice, and education by setting a standard for other universities, for the state, and the local community.*
>
> *To this effect, I am establishing a task force that will develop a plan for the University of Michigan to create a more sustainable future. It is the charge of this group to identify ten to twelve indicators that best measure the university's progress with respect to environmental stewardship and to investigate how these indicators might best be measured and included in a periodic university report. I ask the task force to supply me with an advisory report, to be submitted early in the Winter 2004 semester, which will be shared with the Provost and Executive Vice President for Academic Affairs, the Executive Vice President and Chief Financial Officer, and the Executive Vice President for Medical Affairs as well as the University community.*

---

[10] The Global Reporting Initiative is a multi-stakeholder process and independent institution whose mission is to develop and disseminate globally applicable Sustainability Reporting Guidelines. See www.globalreporting.org.

OBJECTIVE AND SCOPE OF TASK FORCE REPORT

The objective of this Environmental Task Force Advisory Report is to respond to the President's charge to identify indicators of environmental progress and to devise a plan for the periodic reporting of these indicators to the University community. The assessment and reporting of environmental performance is expected to provide multiple benefits to the University and the broader community, including the following:[1]

Benefits of Assessment	Benefits of Reporting
▪ Identification of cost-savings ▪ Reduction of environmental risks ▪ Measurement of performance improvement initiatives ▪ Better evaluation of costs and benefits of different forms of capital, including environmental ▪ Better identification and management of intangible assets such as reputation ▪ Identification of new opportunities for development	▪ Tool for tracking progress ▪ Improved stakeholder engagement and feedback ▪ Enhanced ability to educate U-M community about environmental issues ▪ Creation of new networks of communication within U-M ▪ Build and/or bolster reputation for transparency and credibility

Institutionalizing the indicators and a reporting process will enable the University to measure its progress with respect to environmental stewardship on the Ann Arbor campus. In the future, it is expected that the proposed indicators can be used to track environmental performance for the Dearborn and Flint campuses, using the UM-AA reporting process as a model. It is also envisioned that social and economic indicators will be developed and included in future reports.

As a consequence of meeting with the President, the Task Force limited its selection to a manageable set of eight Environmental Performance Indicators that best measure the University's impact and progress with respect to environmental stewardship. In proposing these eight indicators, the Task Force recognizes the complexity of the environmental issues that will be assessed and reported. These issues can be global or local in scale, highly interconnected, can cause both acute and chronic health effects and can pose long term threats with irreversible consequences. The Task Force also recognizes the complexity of the U-M itself in terms of aspects such as size and diversity of activities (e.g. education, research, medical care, and recreation). Certain indicators were normalized to better represent changes over time in facilities, the population of the University community and the core activities of the University.

The Task Force acknowledges that, in assessing the impacts of the Ann Arbor campus, most upstream and downstream environmental impacts are not inventoried due to modeling complexity and lack of data. Environmental impacts result from upstream activities including the production of goods and services imported by U-M and from downstream activities such as waste disposal and wastewater treatment. The Ann Arbor campus system boundary is defined as all university-owned and operated land and infrastructure within the city limits of Ann Arbor that is utilized mainly by University faculty, staff, or students, as well as Matthaei Botanical Gardens and Radrick Farms Golf Course. However, it is important to recognize the relationship between the University campus and the local community in achieving broader environmental sustainability objectives. For example, the location of University employee residences is a key factor in determining the environmental impacts associated with commuting.

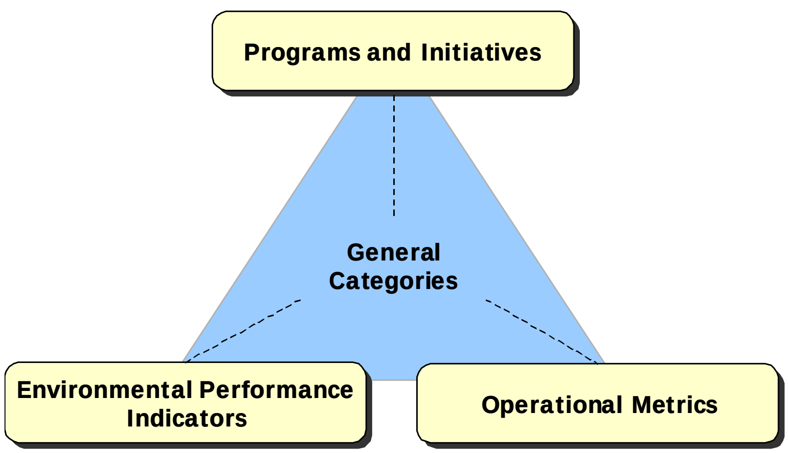
Since data are available for these indicators dating to 1990, the University will be able to make historical comparisons. The 1990 data can be considered the baseline data, with more recent and future data allowing for trend analysis.

PROPOSED ENVIRONMENTAL PERFORMANCE INDICATORS

Overview of Framework

With the objective of identifying a set of environmental performance indicators, the Task Force developed a framework to capture the impact and progress of the U-M with respect to environmental issues. The framework, which is depicted below, is comprised of: six General Categories for assessing environmental performance; a set of eight Environmental Performance Indicators for evaluating campus wide performance; and Operational Metrics to provide a more detailed assessment of specific operations and activities of the University. In addition, existing Programs and Initiatives are identified that guide environmental improvement in each General Category. Assessment, monitoring, and developing the programs and initiatives proposed for the eight environmental performance indicators have the potential to not only enhance the performance and quality of the campus, but also to engage students and faculty through courses, research projects and outreach.

Environmental Assessment and Reporting Framework



General Categories

The first step in selecting a set of measurable and reportable environmental performance indicators was the selection of a set of General Categories that best captured the environmental footprint of the UM-AA campus. These six General Categories were chosen for their significance of impact, campus-wide applicability and availability of data. These categories are:

1. **Energy: Buildings and Transportation**
2. **Water Use**
3. **Land Use: Built and Natural Spaces**
4. **Emissions: Air Pollutant Emissions and Water Discharges**
5. **Material Use and Solid Waste**
6. **Cross-Cutting and Emerging Issues**

The category "Cross-Cutting and Emerging Issues" was included to classify indicators, metrics and programs that are cross cutting and to provide a means for capturing ideas that might be implemented in the future. For example, the Leadership in Energy and Environmental Design (LEED) program of the U.S. Green Building Council is a rating system for buildings that assesses energy and environmental performance. LEED addresses Categories 1 through 5. This category can also be used to report on health and safety indicators. The Global Reporting Initiative framework and the prototype U-M sustainability report classify health indicators under social sustainability rather than environmental sustainability. Health and safety indicators can be included here provisionally until a social sustainability reporting process is implemented. In the future, this category might also include indicators relating to environmental education and research at U-M.

Environmental Performance Indicators

The Task Force used the following criteria for identifying and selecting campus wide Environmental Performance Indicators:

- Identify indicators that best represent the University's "environmental footprint"
- Ensure that data is readily available for evaluating each indicator
- Identify at least one indicator for each General Category
- Limit the set to a manageable number of campus wide environmental indicators

The eight indicators were derived from the General Categories presented above, and utilize the same numbering scheme. For example the first Environmental Performance Indicator, *Primary Energy Consumption*, is numbered 1.1 and belongs to the General Category *Energy: Buildings and Transportation* (number 1 above). These eight Environmental Performance Indicators are shown in the table below. Following the table, these indicators are defined, and the basis for selection and units of measurement for each are presented.

General Category	**Environmental Performance Indicators**
1. Energy: Buildings and Transportation	1.1 Primary Energy Consumption 1.2 Renewable Energy Contribution
2. Water Use	2.1 Water Use
3. Land Use: Built and Natural Spaces	3.1 Impervious Surface Area
4. Emissions: Air Pollutant Emissions and Water Discharges	4.1 Greenhouse Gas Emissions
5. Material Use and Solid Waste	5.1 Solid Waste 5.2 Percent of Solid Waste Recycled
6. Cross-Cutting and Emerging Issues	6.1 Building Utilization

1.1 Primary Energy Consumption

Basis for Selection

At the 1992 Earth Summit in Rio de Janeiro, and in a publication, which followed (Agenda 21), the United Nations Conference on Environment and Development recognized that the largest impact of human development comes from energy production, distribution, and use. Agenda 21 points out that much of the world's energy is produced and used in ways that may not be sustainable if total demand continues to increase and technology remains unchanged.[1] Environmental impacts associated with the production and consumption of energy include global climate change, acid rain, hazardous air pollution, smog, radioactive waste and habitat destruction. Similarly, energy consumption is arguably at the root of the University's most significant environmental impacts.

Definition, Units and Normalization

This indicator measures the total primary energy consumption by the University and includes the energy used in powering the campus, including U-M facilities and transportation systems. Primary energy is defined as the total energy consumed by end users, including the energy consumed by electricity generation facilities (e.g. electric utilities). In keeping with U.S. Department of Energy (DOE) convention, the units of measurement for primary energy consumption will be British Thermal Units, or BTU.[11] This indicator will be reported on a total and per capita basis, the latter of which will account for fluctuations in the campus population.[12] Along with BTU per person, this indicator may also be reported on the basis of Barrels of Oil Equivalents (BOE) per person.

Primary Energy Consumption	
Units:	BTU
Normalization:	BTU/person Barrels of oil equivalent/person

1.2 Renewable Energy Contribution

Basis for Selection

Renewable energy sources address major challenges of our conventional energy system including resource scarcity and security, greenhouse gas emissions and air pollution impacts. Currently, the most promising forms of renewables include wind, biofuels (fuel derived from plant material) and solar thermal and photovoltaic technologies. The University has taken several steps to increase its use of renewable energy, particularly in the transportation sector.

Definition, Units and Normalization

Renewable energy contribution is defined as the percentage of total campus energy consumption from renewable sources. The DOE defines renewable energy as "energy resources that are naturally replenishing but flow-limited. Renewable energy resources include: biomass, hydro, geothermal, solar, wind, ocean thermal, wave action, and tidal action."[13] This indicator will be reported as percentage of total UM-AA campus energy consumption.

Renewable Energy Contribution	
Units:	% of campus energy provided by renewable sources

[11] One British Thermal Unit is the amount of energy required to raise the temperature of one pound of water by one degree Fahrenheit.

[12] The SNRE Master's Project team defined "campus population" as the sum of students, faculty and staff.

[13] U.S. DOE Energy Information Administration. Energy Glossary (http://www.eia.doe.gov/glossary/glossary_main_page.htm)

2.1 Water Use

Basis for Selection

The U-M AA's educational, research, residential, and recreational activities require the use of freshwater, a use that can impact the ecosystems from which the City of Ann Arbor obtains its water. About 80 percent of the City of Ann Arbor's water supply is withdrawn from the Huron River at Barton Pond, while the remaining 20 percent comes from the Steere Farm wells located on the west side of town.[1] A portion of the water used by the University is returned to the Huron River following tertiary treatment by the City's wastewater treatment plant. It is projected that the Great Lakes Region's reliance on groundwater will increase with further population shifts, development and demands of a water dependent economy.[14] For this reason, it is important to monitor and report the University's water usage and manage it in a way that is sustainable in the long run.

Definition, Units and Normalization

Total water use is defined as the total volume of water used in buildings, power plant operations and landscape maintenance on the Ann Arbor campus. This indicator will be measured in gallons, and will be normalized on a per capita basis to account for growth in University population.

Water Use	
Units:	Gallons
Normalization:	Gallons/person

3.1 Impervious Surface Area

Basis for Selection

In addition to this use of water supplied by the City of Ann Arbor, the Ann Arbor campus also contributes storm water and snow melt runoff into the Huron River. Storm water runs off impervious surfaces and flows via storm drains either untreated or with minimal treatment into the Huron River. This storm water may contain a variety of pollutants, including animal waste, litter, oil or pesticides, all of which can have harmful impacts on water quality and aquatic ecosystems. Green space, on the other hand, can absorb and filter the precipitation that falls upon it. Green space serves other ecosystem functions as well, for example habitat for plant and animal species as well as recreation. For these reasons, an increase over time in the ratio of impervious surface area to total surface area on campus would have negative environmental implications.[1]

Definition, Units and Normalization

In the SNRE Master's Project report, the authors included the following categories in total impervious surface area: sidewalks and plazas, gravel surfaces, parking lots, ramps and stairs and game courts. Data were not available for roads and buildings, though the team did make an estimate for surface area covered by buildings. In the future, it is hoped that these two categories are included in data collection. This indicator will be measured in acres and normalized as a percentage of total campus area.

Impervious Surface Area	
Units:	Acres
Normalization:	% of campus area

[14] Institute of Water Research (1999) Michigan State University. Michigan's Drinking Water: What is Groundwater? from Rodriguez et al (2002)

4.1 Greenhouse Gas Emissions

Basis for Selection

Atmospheric concentration of carbon dioxide (CO_2) continues to increase in part due to human activities including the combustion of fossil fuels, agricultural activity and land use changes. The global CO_2 concentration of 373 parts per million (ppm)[15] in 2002 was 33 percent higher than that of the preindustrial era (280 ppm), and is projected to be significantly higher by the end of the century (estimated range of 550 to 970 ppm).[16] While the effects of increased levels of atmospheric greenhouse gases are difficult to predict, the Intergovernmental Panel on Climate Change (IPCC) has found that:[16]

- The global average surface temperature has increased over the 20th Century by roughly 0.6°C
- Globally, it is very likely that the 1990s was the warmest decade, and 1998 the warmest year on record
- Snow and ice cover have decreased in the 20th century
- Average sea level worldwide rose by 0.1 to 0.2 meters during the 20th century

The IPCC predicts that global average temperatures will increase from 1.4 to 5.8°C by 2100, with an average predicted increase of around 2.5°C.[16] The expected consequences of these warmer temperatures include flooding of coastal areas, more severe weather events such as hurricanes and changes in local temperature and precipitation that will shift agricultural production zones and adversely impact plant and animal species.[17] With respect to the University and the region in which it is located, evidence suggests that winters are getting shorter, average annual temperatures are increasing, the duration of lake ice cover is decreasing and heavy rainstorms are becoming more common.[18]

Definition, Units and Normalization

This indicator will inventory the greenhouse gas emissions resulting from campus activities. The six greenhouse gases identified for inclusion in the United Nations Framework Convention on Climate Change are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6). Each gas differs in its ability to absorb heat in the atmosphere –

Greenhouse Gas Emissions	
Units:	Metric tons CO_2 equivalent Metric tons carbon equivalent (MTCE)
Normalization:	MT CO_2 eqv./person MTCE/person

[15] Keeling, C.D. and T.P. Whorf (2003) Atmospheric CO2 records from sites in the SIO air sampling network. In Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. (http://cdiac.esd.ornl.gov/trends/co2/sio-mlo.htm)

[16] IPCC (2001) Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T.,Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp. (http://www.grida.no/climate/ipcc_tar/wg1/005.htm)

[17] U.S. EPA. Global Warming – Impacts. (http://yosemite.epa.gov/oar/globalwarming.nsf/content/Impacts.html)

[18] Kling, G.W., K. Hayhoe, L.B. Johnson, J.J. Magnuson, S. Polasky, S.K. Robinson, B.J. Shuter, M.M. Wander, D.J. Wuebbles, D.R. Zak, R.L. Lindroth, S.C. Moser, and M.L. Wilson (2003). *Confronting Climate Change in the Great Lakes Region: Impacts on our Communities and Ecosystems*. Union of Concerned Scientists, Cambridge, Massachusetts, and Ecological Society of America, Washington, D.C.

the so-called Global Warming Potential (GWP).[19] For example, methane traps over 23 times more heat per molecule than CO_2, and SF_6 is 22,200 times more potent than CO_2.[20] Estimates of greenhouse gas emissions are often presented in units of metric tons of carbon equivalents (MTCE), which weights each gas by its GWP. Using this convention, CO_2 accounts for over 83 percent of GHG emissions, while methane and nitrous oxide contribute roughly 9 and 6 percent respectively.[20]

The University will report greenhouse gas emissions in both million tons of CO_2 equivalent and millions tons of carbon equivalent (MTCE). As was the case with the SNRE Master's Project, the University will measure and report emissions of three of the six gases identified above: CO_2, methane and nitrous oxide. This indicator will be reported on an aggregate basis to assess the University's total GHG footprint, as well as on a per capita basis to normalize for fluctuations in campus population.

5.1 Solid Waste

Basis for Selection

Waste generation by Americans has increased at a significant rate. In 1960, Americans produced an average of 2.7 pounds of municipal solid waste (MSW) per capita per day. By 2001, that figure reached 4.4 pounds per capita per day.[21] The generation and disposal of solid waste poses several environmental problems, including land use for landfills and groundwater contamination through leaching. Closer to home, the Michigan Department of Environmental Quality estimates that the state of Michigan has 15-17 years of landfill disposal capacity remaining at current rates of solid waste disposal. Compounding this problem is an increasing volume of imported waste from New York and Toronto.[22]

Definition, Units and Normalization

Solid waste generated at the University consists of a mixture of everyday items such as paper, packaging, yard clippings, bottles and food scraps. The inventory of solid waste will report the quantity of non-hazardous waste from the University including the medical facilities. This solid waste will be measured in tons, and normalized on a per capita basis.

Solid Waste	
Units:	Tons
Normalization:	Tons/person

5.2 Percent of Solid Waste Recycled

Basis for Selection

Reducing the amount of solid waste disposed of not only reduces the impacts associated with landfills (e.g. land usage, leaching), but it also means that less virgin material and energy are consumed in producing new products. The recycling rate indicates the extent to which waste is diverted from landfills and instead recovered for reuse.

[19] As defined by the U.S. EPA, "the global warming potential of a greenhouse gas is the ratio of global warming, or radiative forcing, from the emission of one unit mass of a greenhouse gas to that of one unit mass of carbon dioxide over a specified time horizon."

[20] U.S. EPA (2003) Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2001.

[21] U.S. EPA (2003) Municipal Solid Waste Basic Facts (http://www.epa.gov/epaoswer/non-hw/muncpl/facts.htm)

[22] Michigan Department of Environmental Quality (2000) Report of the Solid Waste Importation Task Force to Governor John Engler and Department of Environmental Quality Director Russell J. Harding. Cited in Rodriguez et al (2002).

Definition, Units and Normalization

The percent of solid waste recycled is defined as the total solid waste recycled in a given year divided by the total solid waste generated in that year. It will be expressed as percentage of solid waste recycled per year.

Percent of Solid Waste Recycled	
Units:	Percent of solid waste recycled

6.1 Building Utilization

Basis for Selection

Campus buildings are major source of environmental impacts ranging from raw material and energy consumption to air emissions. In the United States, buildings account for 30 percent of raw material use, 36 percent of total energy use and 30 percent of greenhouse gas emissions.[23] More efficient utilization of buildings can reduce resource requirements and other environmental impacts related to building construction, operation, and maintenance. This can also translate into capital and operating cost savings.

Definition, Units and Normalization

This indicator measures the total area of conditioned buildings per person. A less area intensive building footprint per capita would generally reflect a greater efficiency in the use of resources for construction, operation and maintenance of campus facilities. One approach to improving this indicator is to focus on better utilization of existing space rather than construct new facilities.

Building Utilization	
Units:	Total area of conditioned buildings (ft^2)
Normalization:	ft^2/person

Operational Metrics

Complementing the Environmental Performance Indicators is a set of Operational Metrics that provide greater detail on campus environmental performance. Certain Operational Metrics are directly linked to the eight Environmental Performance Indicators, while others address additional environmental issues. For the indicator Primary Energy Consumption, Building Energy Consumption is an example of the former, while Campus Bus Ridership is an example of the latter (see the table "General Category: Energy – Buildings and Transportation" below for an example of how Operational Metrics are linked with Environmental Performance Indicators).

Programs and Initiatives

Also associated with each General Category is a series of Programs and Initiatives underway at the U-M that address a particular environmental impact. For example, Programs and Initiatives associated with Primary Energy Consumption include Energy Star, the Greening of Dana, and the University's bio-diesel and ethanol fuel programs. A complete list of programs and initiatives is included in the Appendix.

[23] U.S. Green Building Council. Why Build Green? (http://www.usgbc.org/AboutUs/whybuildgreen.asp)

Example of General Category Energy – Building and Transportation

To demonstrate how General Categories, Environmental Performance Indicators, Operational Metrics and Programs and Initiatives fit together, below is an example of the General Category Energy – Buildings and Transportation.[24]

General Category: Energy – Buildings and Transportation

	Units	**Normalization**
Environmental Performance Indicators (2)		
Total Energy Consumption	BTU	BTU/person Barrels of oil equivalent/person
Renewable Energy Contribution	Percent renewable	
Operational Metrics (15)		
Building Energy Consumption	BTU	BTU/ft^2 BTU/person BTU/ft^2/person
Total Electricity Consumption	MWh	
Electricity from Renewable Sources	Percent	
Transportation Energy Consumption	BTU	BTU/person
Bus Energy Consumption	BTU	BTU/passenger mile
Fleet Vehicles Energy Consumption	BTU	
Fleet Fuel Economy	MPG by vehicle class	
Renewable Percentage for Transportation Energy		
Campus Bus Ridership	Total passengers Passenger miles	
Car/Van Pooling (U-M pool vehicles only)	Vehicle miles traveled *Passenger miles traveled	
AATA Bus Passes	Number of passes	
AATA Bus Ridership	Total number of rides	
*Bicycle Ridership	Number of bike racks	
*Vehicular Commuting	Vehicle miles traveled Passenger miles traveled BTU	
*Air Travel	Passenger miles traveled BTU	
Programs and Initiatives (examples)		
Energy Conservation	Energy Star, Green Lights, Poster Campaign	
Renewable Electricity Purchases		
Combined Heat and Power		
Biodiesel and Ethanol Fuel		
Plant Extension Office Design Guidelines	80 strategies for all new construction and retrofits	
Greening of Dana	Radiant cooling system, insulation of building envelope	

*Data is not yet collected for this indicator.

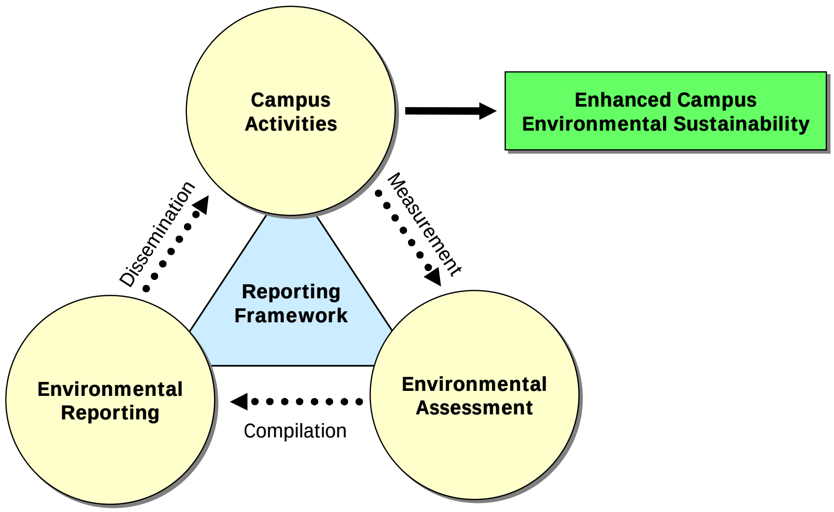
[24] Matrices for the other General Categories are included in the Appendix of this report

IMPLEMENTATION PLAN FOR ENVIRONMENTAL ASSESSMENT AND REPORTING

Overview of Assessment and Reporting

The reporting framework shown earlier supports the assessment and reporting process as shown in the figure below. The programs and initiatives from the framework support improvement of ongoing campus activities that are measured and evaluated as part of the assessment process. The environmental indicators described earlier are compiled from this assessment for reporting and dissemination back to the campus community.

Overview of Assessment and Reporting Process



Responsibilities for Data Collection and Reporting

With eight Environmental Performance Indicators identified, the next step is to ensure that an effective and efficient system is in place to manage the data throughout the reporting life cycle (i.e. collection, compilation, analysis, storage, reporting). It is imperative that clear responsibility is assigned for each of these phases. It should be noted that Units within the University already track about 75 percent of the raw data that underlie the eight Environmental Performance Indicators. For example, the U-M Utilities Department gathers basic data on energy sources for electricity, heating and cooling and hot water.[1] It is likely that additional resources need only be dedicated to the collection of the remaining 25 percent of the raw data, as well as central data compilation, data analysis, conversion to appropriate measurement units, normalization and actual production of the periodic report.

Report Content and Reporting Frequency

Given that data are currently being collected for the eight indicators, the Task Force recommends that the University report on these indicators on an annual basis. Such frequency will enable the University to chart its progress towards environmental sustainability, to assess whether or not its Programs and Initiatives are having the desired impact and to set meaningful objectives. Such frequency could also better position the U-M to engage stakeholders on these issues.

For manageability and efficiency, it is recommended that the bulk of the periodic campus environmental report be dedicated to the eight Environmental Performance Indicators. Therefore, each year, concerned parties can assess and chart the University's environmental performance along the same eight criteria. The Task Force suggests that in each report, the authors select a particular topic to highlight, presenting University efforts and accomplishments. For example, the report might focus on Transportation to highlight the University's alternative fuel programs. By going in depth on a particular theme, the authors can then present certain Operational Metrics and Programs and Initiatives that demonstrate the University's commitment to environmental stewardship. Models for such a layout can be found in corporate environmental reports, of which there are many.

Dissemination Plan

In producing and disseminating this report, it is important to first consider who will be using the report and how will they be using it. The report could be printed in a small number for those stakeholders who prefer this medium. The report could also be converted to an electronic file and either emailed to the University community or placed on the University's existing Environmental Stewardship website at http://www.umich.edu/~urel/stewardship.

RECOMMENDATIONS FOR FUTURE DEVELOPMENT

It is expected that campus environmental assessment and reporting will be an iterative process that is refined over time as the University follows new developments in environmental science, technology, policy and practice and receives feedback from internal and external stakeholders. With this in mind, the following issues should be considered as the University proceeds with periodic reporting:

Near Term Recommendations

Use this report to establish goals to guide improved campus environmental performance

Reporting itself is not the ultimate goal of this proposed effort, rather reporting is a means to improve campus environmental performance. Through this report, the University can track its progress on environmental stewardship and establish meaningful goals.

Revise and refine indicators based on new and improved understanding of important environmental issues

Reporting on environmental performance is a dynamic process, and indicators may need to adjust accordingly. For example, it is possible that new environmental challenges may arise in the future – challenges that impact the University and are worthy of reporting. It is also possible that the science underlying these indicators may change over time. For example, the Global Warming Potential of particular greenhouse gases has changed over time as model accuracy has improved. In these instances and others, the report should present the current indicators in a way that allows for comparison to indicators of prior reports. The advisory committee mentioned below might help in setting the University's agenda on these issues.

Solicit feedback on report content and presentation

The authors of the report should ask themselves how and why relevant stakeholders are using the report. The Task Force may consider exploring ways to accept feedback on the report, for example surveying users on report content, relevance and transparency.

Longer Term Recommendations

Establish an assessment and reporting advisory committee

In preparing the Sustainability Report, the SNRE Master's Project team drew upon the expertise of a steering committee comprised of representatives from industry, academia, government and non-profits. This committee held expertise in environmental reporting as well as in certain subject matters covered by the team. A similar, multidisciplinary review board might be considered for the U-M's reporting process. Many acknowledged experts and committed stakeholders can be found on the Ann Arbor campus.

Incorporate social and economic indicators

In the corporate world, the "triple bottom line" approach to measuring the value creation and depletion is fast becoming commonplace. This approach consists of three equally weighted categories of impact: social, environmental, and economic. Like definitions of environmental sustainability, the triple bottom line framework is grounded in the recognition that the long term health and prosperity of companies hinge upon positive stocks of economic, environmental, and social resources.[1] Similarly with the University, environmental efforts are not conducted in a vacuum. The University has both social and economic impacts, and faces certain social and economic realities that can shape the University's progress towards environmental goals. The SNRE Master's Project team included a set of social and economic indicators in its Prototype Report – indicators which might be used to stimulate discussion as to which are the most relevant to include in a campus report. One particular topic, Health and Safety, is often considered under social indicators as it is under the Global Reporting Initiative framework. Future U-M reports might consider this topic under social indicators, or under the General Category Other, as many Health and Safety issues have environmental attributes.

Incorporate cultural and aesthetic indicators

Another dimension of environmental performance and stewardship is cultural, aesthetic and even spiritual. Although more difficult to quantify, these qualitative factors are too important to be overlooked. For instance, the physical beauty of landscape, buildings, public art, interior space, and everyday artifacts often determines people's level of attachment, which determines the level of stewardship, which in turn determines how long and how well it is sustained. Well-designed and well-crafted buildings in beautiful settings are the hallmark of great university and college campuses, which are among the most cherished, integrated and sustained environments on the planet. In an increasingly technological and secular world, aesthetics play a critical and needed role in cultural and spiritual well-being. Accordingly, tracking the quality of landscape, architecture and design at the University through metrics such as design awards and honors, would be a sympathetic effort in addition to quantitative indicators.

Relationship to teaching and research

The goals outlined above all have the potential to be integrated with courses, research projects, and informal campus activism involving both undergraduate and graduate students. These opportunities present a chance to capture some of the idealism and energy of students and to expand the boundaries of educational experience. Based on experience at this and other college campuses, students take pride in contributing to the improvement of their school and its reputation.

Demonstrate and highlight the "business case" for environmental stewardship
If the University were endowed with unlimited financial resources, it would likely undertake most environmental initiatives that were presented. However, this is not the case, especially with the current funding reductions at the state level. It therefore may become more important for the University to demonstrate the business case for undertaking environmental programs. Certain University initiatives create tangible financial value, for example the Energy Star upgrades generate annual savings of close to $10 million.[2] Others may generate more qualitative benefits that may make the project worthwhile. For example, the University has received quite a bit of positive press on the Greening of Dana project. To be able to make the business case in the future, it will be necessary to measure and report the financial aspects of environmental stewardship at the U-M.

Track and utilize the Global Reporting Initiative framework
The Global Reporting Initiative (GRI) is "a multi-stakeholder process and independent institution whose mission is to develop and disseminate globally applicable Sustainability Reporting Guidelines." GRI is fast becoming the standard in corporate sustainability reporting, and it is believed that there will be GRI guidelines developed specifically for colleges and universities. Given the wide use and acceptance of GRI, the U-M should monitor developments in the GRI guidelines.

APPENDIX: GENERAL CATEGORY MATRICES

General Category: Water Use

	Units	**Normalization**
Environmental Performance Indicators (1)		
Total Water Use	Gallons	Gallons/person
Operational Metrics (4)		
Total Purchased Water	Gallons	Gallons/person
*Total Discharged to Sewers	Gallons	Gallons/person
**Building Specific Water Use	Gallons	Gallons/person
**Total Irrigation Water	Gallons	Gallons/area maintained green space
Programs and Initiatives (examples)		
Eco Program (focus on water conservation)	Education and outreach to influence behavior	
Greening of Dana	Waterless urinals Composting toilets	
Cooling Tower Optimization		
Sanitary and Storm Water Pollution Prevention Program	Retention basins	

*Data is not yet collected for this indicator.
** Limited data is collected for this indicator.

General Category: Land Use – Built and Natural Spaces

	Units	**Normalization**
Environmental Performance Indicators (1)		
Total Impervious Surface Area	Acres	Percent of campus area
Operational Metrics (9)		
Total Green Space	Acres	Percent of campus area
Maintained Green Space	Acres	Percent of campus area
Unmaintained (Natural) Green Space	Acres	Percent of campus area
Impervious Surface	Acres	Percent of campus area
Tree Population	Number of Trees	
Protected Natural Spaces		Percent of campus area
Total Building Area	Total building square footage	Square footage/person
LEED Certification	Number of LEED certified buildings on campus	Percent of total buildings
Deck Parking	Percentage of all parking spaces that are in parking decks	
Programs and Initiatives (examples)		
Conversion of Surface Lots to Porous Pavement		
Wetland Projects		
Invasive Species Control		

General Category: Emissions – Air and Water Pollutants

	Units	Normalization
Environmental Performance Indicators (1)		
Total Greenhouse Gas Emissions	Metric tons of CO_2 eqv. Metric tons of carbon eqv.	MT CO_2 eqv./person MTCE/person
Operational Metrics (6)		
Criteria Air Pollutants from Stationary Sources (O_3[25], PM, CO, NO_X, SO_2, Pb)	Pounds emitted for each pollutant	Pounds/person
* Air Pollutants from Mobile Sources	Pounds emitted for each pollutant	Pounds/person
Fertilizer Use (e.g., potassium, phosphorous, nitrogen)	Pounds	Pounds/person
Salt Use	Pounds	Pounds/person
Sand Use	Pounds	Pounds/person
Pesticide Use, Solid and Liquid (includes herbicides, insecticides and fungicides)	Pounds (solids) or gallons (liquids)	Pounds or gallons per person
Programs and Initiatives (examples)		
Continuous Emissions Monitoring	Power plant emissions monitored using a chemical analyzer	

*Data is not yet collected for this indicator.

General Category: Material Use and Solid Waste

	Units	Normalization
Environmental Performance Indicators (2)		
Total Solid Waste	Tons	Tons/person
Percent Recycled	Percent	
Operational Metrics (12)		
Hospital Waste	Tons	Tons/person**
Waste from Campus Buildings	Tons	Tons/person
Waste from Auxiliary Buildings	Tons	Tons/person
Paper Recycled	Tons	Percent of total paper generated
Glass Containers Recycled	Tons	Percent of total glass generated
Plastics Recycled	Tons	Percent of total plastics generated
Metal Containers Recycled	Tons	Percent of total metal generated
Construction In-house Waste Recycled	Tons	Percent of total construction in-house waste generated
Composting	Tons	Tons/person
Reuse (PD or Ann Arbor Recycling)	Tons	Tons/person
Materials Reuse (Housing Moveout)	Tons	Tons/person**
*Paper Purchases and Recycled Paper Purchases Including Chlorine-Free Paper	Tons	Tons/person
Programs and Initiatives (examples)		
Recycling Initiative		
Composting Program		
Greening of Dana	Composting toilets	
Recycling Award Program		

[25] Ozone is not emitted directly into the air, but rather is created at ground level by a chemical reaction between NOx and volatile organic compounds (VOC) in the presence of heat and sunlight.

Property Disposition	
Ann Arbor Reuse	

*Data is not yet collected for this indicator.
**Need to define "person" in this context.

General Category: Cross Cutting and Emerging Issues

	Units	Normalization
Environmental Performance Indicators (example, additional indicators to developed over time)		
Building Utilization	Total conditioned building square footage	Square footage/person
Operational Metrics (examples)		
Educational Programs and Initiatives	Assessment procedures to be developed	
LEED Certification	Number of buildings (Include LEED award level)	Percent of total buildings
Aesthetics	Number of planning, architecture and environmental design awards received.	
Programs and Initiatives (to be determined over time)		

APPENDIX: SUSTAINABILITY PROJECT LIST 2004

ENERGY CONSERVATION
Utilities
Energy Star - Five Stages
Green Computing
Direct Digital Control Systems
Central Power Plant – Co-Generation
Lighting Retrofits
Variable Air Volume (VAV) Controls - existing buildings and new construction
Renewable Power Purchases
Energy Reduction - Behavioral Modification Campaign
New Energy Conservation Initiatives
Transportation
Heavy Duty Transit Coaches – Particulate filters
Electric Vehicles – 6
Ethanol Fueled Vehicles – 400
Vehicle Oil Recycled
Oil Filters Recycled
Alternative Degreaser Use
Hybrid Electric Vehicle Loaner – pending
Hybrid Electric Bus Review
Free Vanpooling Program
AATA Bus Passes
Ultra-low sulfur fuel use
Use of bio-diesel B-20 fuel
TRAVEL
Green Travel Web Assistance
RECYCLING
Grounds and Waste Management
Paper and Cardboard
Mixed Containers (glass, plastic, aluminum, steel food and beverage containers)
Scrap Metals
Food Waste Composting
Animal Bedding Waste
Brush & Tree Trimmings
Football Stadium recycling program
Student Move-In
Student Move-Out
Other Stuff (Ink jet cartridges, transparencies, polystyrene foam, packing peanuts, text books, office supplies, TGT's -To Good to Trash)

PLANT MAINTENANCE
Paint Recycling
Environmentally Friendly Product Usage
CFC Collection/re-use
A/C Systems Oil Recovery
Metal Recycling -fittings/faucets/valves,etc
Sanitary waste improvement
Wire Recycling
Useable overages/outdated commodities
GROUNDS AND WASTE MANAGEMENT
Invasive Species Program
Salt Use Reduction Program
Sand Use Reduction Program
Tree Planting Program
Low Maintenance Plantings
Reduce Irrigation Usage
Native Plantings
Natural Landscape Design
Pesticide/Herbicide Reduction program
Phosphorous Fertilizer phase out
CONSTRUCTION
Supplemental General Conditions
Instructions to Contractor
Design Guidelines- General Requirements
Sustainability parameters
Design Guidelines - Site work
Jobsite Salvage
Demolition - Jobsite Recycling
Carpet Recycling
Earthwork
Fill Materials
Engineered Granular Fill
Lawn Repair
Slag
Xeriscaping
Leaf Composting
Recycled Plastic in Outdoor Construction
Buffalo Grass
Recycled Gypsum

Design Guidelines - Concrete
Cast In Place Concrete
Blast Furnace Slag
Fly Ash Mixes
Design Guidelines - Masonry
Concrete
Brick
Petroleum Brick
Insulated Concrete
Design Guidelines - Metals
Structural Steel
Metal Fabrications
Design Guidelines - Wood and Plastics
Rough Carpentry
Treated Wood
Adhesives
Plywood
Architectural Woodwork
Division 7 - Thermal and Moisture Protection
Roofing Insulation
Rigid Insulation
Recycled Insulation
Cellulose Insulation
Design Guidelines - Windows and Doors
Flush Wood Doors
Aluminum Storefront
Glazing
Mirror
Design Guidelines - Finishes
Gypsum Board Assemblies
Ceramic Tile
Dimension Stone Tile
Acoustic Ceilings
Resilient Flooring
Cork Flooring
Linoleum Flooring
Bamboo Flooring
Resinous Flooring
Painting
Electrostatically Applied Coatings
Wood Floor Finish

Multicolored Interior Coatings
Adhesives
Design Guidelines - Specialties
Toilet Compartments
Signs
Lockers
Design Guidelines - Equipment
Energy Star Rated
Design Guidelines - Furnishings
Casework - Adhesives
Casework - Woods
Design Guidelines - Conveying Systems
Motors
Design Guidelines - Mechanical
Variable speed drive (VSD) applications for reduced BHP and energy consumption
VSD / Chilled Water
CFC Contractor Use
Reduce use of HCFC refrigerants
Old Chiller Use
Minimize or eliminate use of ethylene glycol in chilled water and hot water heating systems
Air Cooled Chillers
Maximize use of "free cooling" and heat recovery systems to reduce HVAC energy consumption
Design Guidelines- Electrical
Electronic Ballasts
Fluorescent Lights
Compact Fluorescent Lights
Switching
Occupancy Sensors
Dimmer Switches
Metal Halide
Transformers
Emergency Generators
Natural Gas Generators
Additional Construction Topics
LEED Design Criteria
Recycle Construction Materials
Soil Erosion Reduction
Greening of Dana
Stormwater P2 Structural Controls

BUSINESS SCHOOL
Executive Residence - "Green Hotel"
MICHIGAN UNION, LEAGUE, PIERPONT COMMONS
Recycling
Recycle food waste
Recycling cardboard, plastics, aluminum
Utilities and Energy
Utilities- Reduce water consumption
Utilities- Reduce water consumption
Further Utilization of Insight DDC system
Reduce lighting energy consumption
Mechanical
Convert to environmentally friendly refrigerants
POLLUTION PREVENTION
Recycling
Fluorescent Light Bulbs
Ballasts
Chemical Redistribution Program
Solvent Recycling - Distillation
Battery Recycling
Oil Filter Recycling
Paint Thinner Re-Use
Waste Minimization
Micro-Teaching Techniques in Laboratories
Mixed Waste Minimization Program
Chemical Tracking Program
Silver Recovery Program
Alcohol Reuse
Product Substitution
PBT Reduction
Mercury Thermometer Elimination Program
Bulk Mercury Elimination Program
BUILDING SERVICES
Integrated Pest Management
Environmentally Friendly Cleaning Products
Energy Reduction Cleaning Techniques
Stormwater Best Management Practices

PURCHASING
Green Purchasing - Prime Vendors - Web
Micro-quantity in Prime Vendor Contracts
Incorporate sustainability into customer reporting
Green Product Catalog
Icon
Green Product Identification
SUSTAINABILITY COMMUNICATION CAMPAIGN
Develop sustainability communication plan
STORMWATER POLLUTION PREVENTION
Wastewater Pollution Reduction
Best Management Practices
AIR POLLUTION REDUCTION
Title V Permitting Process
Health System Incinerator Removal
HOUSING
Governing Ideas
Task Group
Communication
Networking
Recycling
Best Practices Research and Initiatives
Training and Education

Appendix B: 2004 Environmental Performance for the University of Michigan, Ann Arbor

General Category	Indicators, Metrics, and Normalizations (units)	2004 Results
Energy - Buildings and Transportation	Total Energy Consumption (Bbl/person)	18.0
	Total Energy Consumption (Btu)	7.58001E+12
	Total Energy Consumption (Btu/person)	104,254,208
	Percentage Renewable Energy	0.29%
	AATA Bus Ridership	851,000
	Bicycle Ridership (Number of bike racks)	3,366
	Building Energy (Btu)	7.47911E+12
	Building Energy (Btu/ft2)	270,419
	Building Energy (Btu/ft2/person)	3.72
	Building Energy (Btu/person)	102,866,443
	Bus Energy Consumption (Btu)	35,211,327,293
	Bus Energy Consumption (Btu/passenger)	7,488
	Campus Bus Ridership (Total passengers)	4,702,261
	Generated Electricity Consumption (MWh)	238,248
	Purchased Electricity from Renew. Sources (MWh)	1,066
	Purchased Electricity (MWh)	242,176
	Fleet Vehicles Energy Consumption (Btu)	65,688,938,409
	Renewable Percentage for Transportation Energy (%)	18%
	Transportation Energy Consumption (Btu)	1.009E+11
	Transportation Energy Consumption (Btu/person)	1,387,765
	Van Pooling (Passenger miles)	3,094,729
	Van Pooling (Vehicle miles)	471,210
	Purchased Electricity from Renew. Sources (%)	0.44%
	Generated Electricity from Renew. Sources (%)	0.00%
Water Use	Total Water Use (gal)	1,237,461,853
	Total Water Use (gal/person)	17,020
	Building Specific Water Use (gal)	1,016,409,438
	Building Specific Water Use (gal/person)	13,980
	Total Discharge to Sewers (gal)	902,032,593
	Total Discharge to Sewers (gal/person)	12,406
	Total Irrigation Water (gal)	149,195,063
	Total Purchased Water (gal)	1,202,643,703
	Total Purchased Water (gal/person)	16,541
	Total Irrigation Water (gal/acre green space)	213,472
Land Use - Built and Natural Spaces	Total Impervious Surface Area (% of campus area)	20%
	Total Impervious Surface Area (acres)	415
	Deck Parking (# of deck parking spots)	9,492
	Deck Parking (% of parking spaces that are parking decks)	41%
	Maintained Green Space (% of campus area)	35%
	Maintained Green Space (acres)	725
	Total Building Area (ft2)	27,657,452
	Total Building Area (ft2/person)	380
	Total Green Space (% of campus area)	80%
	Total Green Space (acres)	1,672
	Total Land Area (acres)	2,087
	Tree Population	14,954
	Unmaintained (Natural) Green Space (% of campus area)	45%
	Unmaintained (Natural) Green Space (acres)	947

Appendix B: 2004 Environmental Performance for the University of Michigan, Ann Arbor

General Category	Indicators, Metrics, and Normalizations (units)	2004 Results
Emissions - Air and Water Pollutants	Total Greenhouse Gas Emissions (MTCE)	129,722
	Total Greenhouse Gas Emissions (MTCE)/person	2
	Total Greenhouse Gas Emissions (MTCO2E)	475,574
	Total Greenhouse Gas Emissions (MTCO2E)/person	7
	Mobile Sources: Renewable GHG Emissions (MTCO2E)	1,220
	Mobile Sources: Fossil GHG Emissions (MTCO2E)	5,834
	Salt Use (lbs)	3,026,000
	Salt Use (lbs/person)	41.6
	Sand Use (lbs)	20,000
	Sand Use (lbs/person)	0.28
	Stationary Sources: CO (lbs)	287,068
	Stationary Sources: CO (lbs/person)	3.9
	Stationary Sources: Greenhouse Gas Emissions (MTCE)	127,778
	Stationary Sources: Greenhouse Gas Emissions (MTCO2E)	468,519
	Stationary Sources: NOx (lbs)	651,752
	Stationary Sources: NOx (lbs/person)	9.0
	Stationary Sources: Pb (lbs)	3.0
	Stationary Sources: Pb (lbs/person)	0.00
	Stationary Sources: PM-10 (lbs)	27,237
	Stationary Sources: PM-10 (lbs/person)	0.37
	Stationary Sources: PM-2.5 (lbs)	26,808
	Stationary Sources: PM-2.5 (lbs/person)	0.37
	Stationary Sources: SO2 (lbs)	6,842
	Stationary Sources: SO2 (lbs/person)	0.09
	Stationary Sources: Volatile Organic Compounds (lbs)	29,068
	Stationary Sources: Volatile Organic Compounds (lbs/person)	0.40

Appendix B: 2004 Environmental Performance for the University of Michigan, Ann Arbor

General Category	Indicators, Metrics, and Normalizations (units)	2004 Results
Material Use and Solid Waste	Total Solid Waste (tons)	12,959
	Total Solid Waste (tons/person)	0.18
	% Recycled	28%
	Composting (tons)	238
	Composting (tons/person)	0.02
	Construction In-house Waste Recycled (%)	10%
	Construction In-house Waste Recycled (tons)	153
	Regulated Recycling- Batteries (tons)	17
	Regulated Recycling- Lamp Ballasts (tons)	18
	Regulated Recycling- Fluorescent Bulbs (tons)	35
	Regulated Recycling- Consumer Electronics (tons)	-
	Regulated Recycling- Solvents (gallons)	-
	Regulated Recycling- Transportation Oil (gallons)	-
	Regulated Recycling- Latex Paint (gallons)	-
	Regulated Recycling- Coolants (gallons)	-
	Glass Containers Recycled (% of total waste)	1.0%
	Glass Containers Recycled (tons)	126
	Hospital Waste (tons)	3,111
	Hospital Waste (tons/person)	0.28
	Metal Containers Recycled (% of total waste)	0.12%
	Metal Containers Recycled (tons)	15.7
	Paper Recycled (% of total waste)	23%
	Paper Recycled (tons)	2,917
	Plastics Recycled (% of total waste)	0.31%
	Plastics Recycled (tons)	40.4
	Reuse (tons)	0.23
	Reuse (tons/person)	0.00
	Reuse-PD ($)	$ 1,300,000
	Reuse-PD ($/person)	$ 17.88
	Waste from U-M Campus (tons)	9,848
	Waste from U-M Campus (tons/person)	0.16
Cross Cutting and Emerging Issues	Building Utilization (total conditioned ft2)	12,521,796
	Building Utilization (total conditioned ft2/person)	172
	Aesthetics (# of awards received)	4
	LEED Certification (# of LEED Bronze certified buildings)	-
	LEED Certification (# of LEED certified buildings)	-
	LEED Certification (# of LEED Gold certified buildings)	-
	LEED Certification (# of LEED Platinum certified buildings)	-
	LEED Certification (# of LEED Silver certified buildings)	-
	LEED Certification (% of all buildings)	-

Appendix C: Contacts for 2004 Data Collection

Data Category	Data Description	Name	Organization	Phone	Email
Cross-Cutting	LEED Buildings & Aesthetic Awards	Doug Hanna	Univ Arch/Planner Ofc & Plant Ext.	764-2456	dougha@umich.edu
Cross-Cutting	Conditioned Square Footage	Mike Bowen	Utilities/Plant - Mechanical Eng.	647-5797	mbowen@umich.edu
Emissions	Stationary Source Emissions	Brandi Campbell	OSEH	647-9017	campbelb@umich.edu
Emissions	Salt and Sand Use	Rob Doletzky	Grounds & Waste Mgmt Services	764-3537	doletzky@umich.edu
Energy	CPP and Hoover Energy Data	Mike Swanson	Utilities	763-3011	mswaney@umich.edu
Energy	Electricity from Renewable	Andy Berki	OSEH	647-3120	aberki@umich.edu
Energy	Annual Utilities Report	Carol Varney	Utilities	647-0963	cvarney@umich.edu
Energy	Bicycle Racks	Terry Ramsey	Plant Extension	260-2959	tramsey@bf.umich.edu
Energy	AATA Bus Ridership	Dave Miller	Parking & Transportation Services	647-0948	dvmiller@umich.edu
Energy	U-M Transportation Statistics	Renee Jordan	Parking & Transportation Services	615-0527	reneej@umich.edu
Land Use	U-M Campus Land Use Data	Kenn Rapp	Plant Landscape Arch	647-2028	kennr@bf.umich.edu
Land Use	U-M Athletic Fields Land Use Data	Tracey Jones	Intercollegiate Athletics/Radrick Farms	998-6372 or 320-3163	tracmon@umich.edu
Land Use	Matthaei & Nichols Arb Land Use Data	Mike Hommel	Botanical Gardens & Arboretum	998-7061	mhommel@umich.edu
Land Use	Parking	Becky Seiser	University Parking Services	647-3615	rseiser@umich.edu
Land Use	Tree Population	Marvin Pettway	Grounds & Waste Mgmt Services	764-3422	marvinp@umich.edu
Waste	Mixed Container Percentages	Bill Leonidas	FCR Recycling (Ann Arbor MRF)	704-379-0625	Bill.Leonidas@casella.com
Waste	WMS Data	Tracy Artley	WMS	763 5539	artleyt@umich.edu
Waste	Property Disposition	Jim Day	Property Disposition	3764 2470	dayj@umich.edu
Waste	Mulch	William McAllister	Grounds	764 3424	bjom@umich.edu
Waste	Hospital Data	David Tyler	UMH Waste Management	936-6266 (pager, #9505)	davidt@umich.edu
Waste	Regulated Recycling	Andy Berki	OSEH	647-3120	aberki@umich.edu
Water Use	Building Water Consumption	Carol Varney	Utilities	647-0963	cvarney@umich.edu
Water Use	CPP and Hoover Water Consumption	Mike Swanson	Utilities	763-3011	mswaney@umich.edu
Water Use	Golf Course Irrigation	Ron Van Til	DEQ Water Bureau	(517) 241-1414	vantilr@michigan.gov

Appendix D: Visual Basic Code

ThisWorkbook (worksheet code)

```
Private Sub workbook_open()

'   Contains code for setting up the EDR
'   The Interface worksheet is activated, a greeting msgbox is displayed,
'   the main user interface is shown, and the scroll area for the Interface
'   worksheet is set

   Worksheets("Interface").Activate
   MsgBox "Welcome to the University of Michigan's Environmental Data Repository" & vbCrLf & " " & vbCrLf & _
       "Designed and programmed by: " & vbCrLf & "Center for Sustainable Systems" & vbCrLf & _
       "3012 Dana Bldg. 440 Church St." & vbCrLf & "The University of Michigan, Ann Arbor, MI  48109 1115", _
           vbOKOnly, "U-M Environmental Data Repository"
    Load StartForm
    StartForm.Show
    Worksheets("Interface").ScrollArea = "a1"

   With Worksheets("SecondaryInput")
       .Protect UserInterfaceOnly:=True
       .ScrollArea = "A1:P43"
    End With

End Sub
```

Interface (worksheet code)

```
Private Sub CommandButton1_Click()
    Load StartForm
    StartForm.Show
End Sub
```

Appendix D: Visual Basic Code

StartForm

```
Private Sub CommandButton7_Click()
   AddContactForm.Show
End Sub

Private Sub AddContactBut_Click()
   AddContactForm.Show
End Sub

Private Sub CommandButton6_Click()
   AddContactForm.Show
End Sub

Private Sub EmissFormBut_Click()
   EmissionsForm.Show
End Sub

Private Sub TransFormBut_Click()
   TransForm.Show
End Sub

Private Sub CommandButton1_Click()
   UHS_Input.Show
End Sub

Private Sub CommandButton2_Click()
  WMS_Input.Show
End Sub

Private Sub LaunchBuildECB_Click()
   UtilForm.Show
End Sub

Private Sub SaveEDRbut_Click()
   Dim ModelName As String
   ModelName = ActiveWorkbook.Name
   Workbooks(ModelName).Save
End Sub

Private Sub CommandButton4_Click()
   Unload StartForm
   StartForm.Hide
End Sub

Private Sub CommandButton5_Click()
   Worksheets("Summary").Activate
End Sub
Private Sub EnterWaterBut_Click()
   Dim WaterYear As Integer
   Dim WaterCase As String
'   Forces user to select a year
   Select Case StartForm.WaterYearCB.Value
      Case Is = ""
         MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
         Exit Sub
```

```
    End Select

'   Forces user to select a Contact
    If (StartForm.WaterContactCB.Value = "" And StartForm.CPPwater.Value <> "") Or _
        (StartForm.GolfIrrContactCB.Value = "" And StartForm.IrrWaterTB.Value <> "") Then
         WaterCase = MsgBox("Please Select a contact", vbOKOnly, "Contact Not Specified")
        Select Case WaterCase
        Case vbOK
            Exit Sub
        End Select
    End If

'   Defines variable, "WaterYear"
    WaterYear = StartForm.WaterYearCB.Value
    WaterColumn = WorksheetFunction.Match(WaterYear, Range("BldgData!1:1"), 0)

'   Checks if data exist; protects against data overwrite
    If Worksheets("BldgData").Cells(4, WaterColumn).Value <> "" _
        And StartForm.HoovWater.Value <> "" Then
        WaterAns1 = MsgBox("You are about to overwrite Hoover Plant data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case WaterAns1
                Case vbNo
                    Exit Sub
            End Select
    End If

'   Checks if data exist; protects against data overwrite
    If Worksheets("BldgData").Cells(3, WaterColumn).Value <> "" _
        And StartForm.CPPwater.Value <> "" Then
        WaterAns2 = MsgBox("You are about to overwrite Central Power Plant data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case WaterAns2
                Case vbNo
                    Exit Sub
            End Select
    End If

'   Enters water data from CPP and Hoover Ave Plant
    If Not StartForm.CPPwater.Value = "" Then
        Worksheets("BldgData").Cells(3, WaterColumn).Value = StartForm.CPPwater.Value
    End If
    If Not StartForm.HoovWater.Value = "" Then
        Worksheets("BldgData").Cells(4, WaterColumn).Value = StartForm.HoovWater.Value
    End If

'   Checks if irrigation data exist; protects against data overwrite
    If Worksheets("PrimaryInput").Cells(104, WorksheetFunction.Match(WaterYear, Range _
            ("PrimaryInput!3:3"), [0])).Value <> "" _
        And StartForm.IrrWaterTB.Value <> "" Then
        WaterAns3 = MsgBox("You are about to overwrite golf course irrigation data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case WaterAns3
                Case vbNo
                    Exit Sub
            End Select
```

```
    End If

'   Enters golf course irrigation water
    If Not StartForm.IrrWaterTB.Value = "" Then
        Sheets("PrimaryInput").Cells(104, WorksheetFunction.Match(WaterYear, Range _
            ("PrimaryInput!3:3"), [0])).Value = StartForm.IrrWaterTB.Value
    End If

    If (StartForm.IrrWaterTB.Value <> "" And Sheets("PrimaryInput").Cells(104, _
        WorksheetFunction.Match(WaterYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
            Or (StartForm.CPPwater.Value <> "" And Worksheets("BldgData").Cells(3, _
                WaterColumn).Value <> "") Or (StartForm.HoovWater.Value <> "" And _
                    Worksheets("BldgData").Cells(4, WaterColumn).Value <> "") Then
                    MsgBox "Data entered successfully!"
                    Else
                    MsgBox "Data were not entered"
    End If

'   Adds the last name of contact to ContactTracking worksheet
    If StartForm.WaterContactCB.Value <> "" Then Sheets("ContactTracking") _
        .Cells(25, WorksheetFunction.Match(WaterYear, Range("ContactTracking!3:3"), [0])) _
            .Value = Right(StartForm.WaterContactCB.Value, _
                (Len(StartForm.WaterContactCB.Value) - WorksheetFunction.Find(" ", _
                    WaterContactCB.Value)))
    If StartForm.GolfIrrContactCB.Value <> "" Then Sheets("ContactTracking") _
        .Cells(26, WorksheetFunction.Match(WaterYear, Range("ContactTracking!3:3"), [0])) _
            .Value = Right(StartForm.GolfIrrContactCB.Value, _
                (Len(StartForm.GolfIrrContactCB.Value) - WorksheetFunction.Find(" ", _
                    GolfIrrContactCB.Value)))

    StartForm.CPPwater.Value = ""
    StartForm.HoovWater.Value = ""
    StartForm.WaterYearCB.Value = ""
    StartForm.WaterContactCB.Value = ""
    StartForm.IrrWaterTB.Value = ""

End Sub
Private Sub SecDataEnterBut_Click()
    Dim PopYear As Integer
    Dim FControl As Control
    Dim PopAns As Variant, PopAns2 As Variant

'   Forces user to select a year
    Select Case StartForm.PopYearCB.Value
        Case Is = ""
            MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
            Exit Sub
    End Select

    PopYear = StartForm.PopYearCB.Value

'   Checks if data have already been written and prompts for data overwrite
    If Sheets("SecondaryInput").Cells(9, WorksheetFunction.Match(PopYear, Sheets("SecondaryInput") _
        .Range("2:2"), [0])).Value <> "" Then
            PopAns = MsgBox("You are about to overwrite campus population data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
```

```
            Select Case PopAns
                Case vbNo
                    Exit Sub
            End Select
    End If

'   Pastes sum of student and campus staff populations
    If StartForm.StuPopTB.Value <> "" And StartForm.StaffPopTB.Value <> "" Then
        Sheets("SecondaryInput").Cells(9, WorksheetFunction.Match(PopYear, Sheets("SecondaryInput") _
            .Range("2:2"), [0])).Value = Val(StartForm.StuPopTB.Value) + _
                Val(StaffPopTB.Value)
        Else: MsgBox "Student and campus staff populations will not be entered"
    End If

'   Checks if data have already been written and prompts for data overwrite
    If Sheets("SecondaryInput").Cells(10, WorksheetFunction.Match(PopYear, Sheets("SecondaryInput") _
        .Range("2:2"), [0])).Value <> "" Then
            PopAns2 = MsgBox("You are about to overwrite hospital staff population data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case PopAns2
                Case vbNo
                    Exit Sub
            End Select
    End If

'   Pastes hospital staff population
    If StartForm.HStaffPopTB.Value <> "" Then
        Sheets("SecondaryInput").Cells(10, WorksheetFunction.Match(PopYear, Sheets("SecondaryInput") _
            .Range("2:2"), [0])).Value = Val(StartForm.HStaffPopTB.Value)
        Else: MsgBox "Hospital staff population will not be entered"
    End If

    If Sheets("SecondaryInput").Cells(9, WorksheetFunction.Match(PopYear, Sheets("SecondaryInput") _
        .Range("2:2"), [0])).Value <> "" Then
            MsgBox "Campus populations successfully entered"
    End If

    If Sheets("SecondaryInput").Cells(10, WorksheetFunction.Match(PopYear, Sheets("SecondaryInput") _
        .Range("2:2"), [0])).Value <> "" Then
            MsgBox "Hospital staff population successfully entered"
    End If

'   Clears textboxes on form
    For Each FControl In StartForm.Controls
         On Error Resume Next
         FControl.Value = ""
    Next FControl

End Sub

Private Sub UserForm_Initialize()
    Dim j As Integer
    For j = 0 To 10
        AddYear = 2000 + j
            PopYearCB.AddItem AddYear
            LandYearCB.AddItem AddYear
```

```
        CrossCutYearCB.AddItem AddYear
        WaterYearCB.AddItem AddYear
    Next j

    Dim Contacts As Variant
    Dim i As Integer
    Dim CName As String

    Contacts = Sheets("contactList").Range("ContactNames").Value

'   Enters contact names in each ComboBox
    For i = 1 To UBound(Contacts, 1)
        CName = Contacts(i, 2) & " " & Contacts(i, 1)
        StartForm.DeckContactCB.AddItem CName
        StartForm.TreeContactCB.AddItem CName
        StartForm.AwardContactBut.AddItem CName
        StartForm.BUtzContactBut.AddItem CName
        StartForm.WaterContactCB.AddItem CName
        StartForm.GolfIrrContactCB.AddItem CName
    Next i
End Sub

'   Land Use data input
Private Sub CampusLandBut_Click()
    Select Case StartForm.LandYearCB.Value
        Case Is = ""
            MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
            Exit Sub
    End Select

    CampusLandForm.Show

End Sub

Private Sub AthleticLandBut_Click()
    Select Case StartForm.LandYearCB.Value
        Case Is = ""
            MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
            Exit Sub
    End Select

    AthleticLandForm.Show

End Sub

Private Sub MBGNALandBut_Click()
    Select Case StartForm.LandYearCB.Value
        Case Is = ""
            MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
            Exit Sub
    End Select

    MBGNALandForm.Show

End Sub
```

Appendix D: Visual Basic Code

```
Private Sub EnterLandBut_Click()

    Dim LandYear As Integer
    Dim LandColumn As Integer
    Dim LandAns As String

'   Activate LandUse_Raw Worksheet
    Application.ScreenUpdating = False
    Sheets("PrimaryInput").Activate

'   Defines variable, "LandYear"
    LandYear = StartForm.LandYearCB.Value
    LandColumn = WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), 0)

'   This code warns against overwriting Land Use data
    For a = 72 To 74
        If Worksheets("PrimaryInput").Cells(a, LandColumn).Value <> "" Then
            B = 1
        End If
        B = B + B
    Next a
    If B > 0 And (StartForm.TextBox1.Value <> "" Or StartForm.TextBox2.Value <> "" Or _
        StartForm.TextBox3.Value <> "") Then
        LandAns = MsgBox("You are about to overwrite Land Use data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case LandAns
                Case vbNo
                    Exit Sub
            End Select
    End If

'   Import # of deck spaces, total spaces and trees for output
    If StartForm.LandYearCB.Value = 1990 Then
        Range("C72").Value = StartForm.TextBox1.Value
        Range("C73").Value = StartForm.TextBox2.Value
        Range("C74").Value = StartForm.TextBox3.Value
    ElseIf StartForm.LandYearCB.Value = 1999 Then
        Range("D72").Value = StartForm.TextBox1.Value
        Range("D73").Value = StartForm.TextBox2.Value
        Range("D74").Value = StartForm.TextBox3.Value
    ElseIf StartForm.LandYearCB.Value = 2000 Then
        Range("E72").Value = StartForm.TextBox1.Value
        Range("E73").Value = StartForm.TextBox2.Value
        Range("E74").Value = StartForm.TextBox3.Value
    ElseIf StartForm.LandYearCB.Value = 2001 Then
        Range("F72").Value = StartForm.TextBox1.Value
        Range("F73").Value = StartForm.TextBox2.Value
        Range("F74").Value = StartForm.TextBox3.Value
    ElseIf StartForm.LandYearCB.Value = 2002 Then
        Range("G72").Value = StartForm.TextBox1.Value
        Range("G73").Value = StartForm.TextBox2.Value
        Range("G74").Value = StartForm.TextBox3.Value
    ElseIf StartForm.LandYearCB.Value = 2003 Then
        Range("H72").Value = StartForm.TextBox1.Value
        Range("H73").Value = StartForm.TextBox2.Value
        Range("H74").Value = StartForm.TextBox3.Value
```

```
ElseIf StartForm.LandYearCB.Value = 2004 Then
    Range("I72").Value = StartForm.TextBox1.Value
    Range("I73").Value = StartForm.TextBox2.Value
    Range("I74").Value = StartForm.TextBox3.Value
ElseIf StartForm.LandYearCB.Value = 2005 Then
    Range("J72").Value = StartForm.TextBox1.Value
    Range("J73").Value = StartForm.TextBox2.Value
    Range("J74").Value = StartForm.TextBox3.Value
ElseIf StartForm.LandYearCB.Value = 2006 Then
    Range("K72").Value = StartForm.TextBox1.Value
    Range("K73").Value = StartForm.TextBox2.Value
    Range("K74").Value = StartForm.TextBox3.Value
ElseIf StartForm.LandYearCB.Value = 2007 Then
    Range("L72").Value = StartForm.TextBox1.Value
    Range("L73").Value = StartForm.TextBox2.Value
    Range("L74").Value = StartForm.TextBox3.Value
ElseIf StartForm.LandYearCB.Value = 2008 Then
    Range("M72").Value = StartForm.TextBox1.Value
    Range("M73").Value = StartForm.TextBox2.Value
    Range("M74").Value = StartForm.TextBox3.Value
ElseIf StartForm.LandYearCB.Value = 2009 Then
    Range("N72").Value = StartForm.TextBox1.Value
    Range("N73").Value = StartForm.TextBox2.Value
    Range("N74").Value = StartForm.TextBox3.Value
ElseIf StartForm.LandYearCB.Value = 2010 Then
    Range("O72").Value = StartForm.TextBox1.Value
    Range("O73").Value = StartForm.TextBox2.Value
    Range("O74").Value = StartForm.TextBox3.Value
End If

If (StartForm.TextBox1.Value <> "" And Sheets("PrimaryInput").Cells(72, _
    WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (StartForm.TextBox2.Value <> "" And Sheets("PrimaryInput").Cells(73, _
            WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), _
                [0])).Value <> "") Or (StartForm.TextBox3.Value <> "" And _
                    Sheets("PrimaryInput").Cells(74, WorksheetFunction.Match(LandYear, _
                        Range("PrimaryInput!3:3"), [0])).Value <> "") Then
                MsgBox "Data entered successfully!"
                Else
                MsgBox "Data were not entered"
End If

'   Adds the last name of contact to ContactTracking worksheet
If StartForm.DeckContactCB.Value <> "" Then Sheets("ContactTracking") _
    .Cells(15, WorksheetFunction.Match(LandYear, Range("ContactTracking!3:3"), [0])) _
        .Value = Right(StartForm.DeckContactCB.Value, _
            (Len(StartForm.DeckContactCB.Value) - WorksheetFunction.Find(" ", _
                DeckContactCB.Value)))
If StartForm.TreeContactCB.Value <> "" Then Sheets("ContactTracking") _
    .Cells(16, WorksheetFunction.Match(LandYear, Range("ContactTracking!3:3"), [0])) _
        .Value = Right(StartForm.TreeContactCB.Value, _
            (Len(StartForm.TreeContactCB.Value) - WorksheetFunction.Find(" ", _
                TreeContactCB.Value)))
Sheets("Interface").Activate
Application.ScreenUpdating = True
```

```
End Sub
'   End Land Use data input

'   Start Cross-Cutting and Emerging Issues data input
Private Sub BldgUtzBut_Click()
    Dim Filt As String
    Dim FilterIndex As Integer
    Dim Title As String
    Dim CrossCuttingFileName As Variant
    Dim ModelName As String

    ModelName = ActiveWorkbook.Name
    Application.ScreenUpdating = False

'   Set up list of file filters
    Filt = "Text Files (*.txt),*.txt," & _
            "Excel Files (*.xls),*.xls," & _
            "Comma Separated Files (*.csv), *.csv," & _
            "ASCII Files (*.asc), *.asc," & _
            "All Files (*.*), *.*"

'   Display *.xls by default
    FilterIndex = 2

'   Set the dialog box caption
    Title = "Select Building Utilization File to Import"

'   Get the file name
    CrossCuttingFileName = Application.GetOpenFilename _
        (FileFilter:=Filt, FilterIndex:=FilterIndex, Title:=Title)

'   Exit if dialog box canceled
    If CrossCuttingFileName = False Then
        MsgBox "No file was selected."
        Exit Sub
    End If

'   Display full path and name of the Building Utilization file
    MsgBox "You selected " & CrossCuttingFileName

'   Clear existing CrossCutting_Input worksheet
    Sheets("CrossCutting_Input").Activate
    Columns("A:F").ClearContents

'   Open CrossCuttingFileName & export range to csv file
    Workbooks.Open Filename:=CrossCuttingFileName
    Sheets("Conditioned").Activate

'   Determine last row containing data
    Set ExcelLastCell = ActiveSheet.Cells.SpecialCells(xlLastCell)
    LastDataRow = ExcelLastCell.Row
    Row = ExcelLastCell.Row
    Do While Application.CountA(ActiveSheet.Rows(Row)) = 0 And Row <> 1
        Row = Row - 1
    Loop
        LastDataRow = Row
```

```
'   Determine last column containing data
    Set ExcelLastCell = ActiveSheet.Cells.SpecialCells(xlLastCell)
    lastdatacolumn = ExcelLastCell.Column
    Column = ExcelLastCell.Column
    Do While Application.CountA(ActiveSheet.Columns(Column)) = 0 And Column <> 1
        Column = Column - 1
    Loop
        lastdatacolumn = Column

'   Exporting a range to a csv text file
    Dim Filename As String
    Dim NumRows As Long, NumCols As Integer
    Dim r As Long, c As Long
    Dim Data
    Dim ExpRng As Range

    NumCols = Column
    NumRows = Row
'   Prompt for saving range as a csv file - error exists in this method
'     Title = "Save Imported File As"
    Filename = Workbooks(ModelName).Path & "\" & "CrossCutTempfile.csv"
    Open Filename For Output As #1
        For r = 1 To NumRows
            For c = 1 To NumCols
                Data = Cells(r, c).Value
                If IsNumeric(Data) Then Data = Val(Data)
                If IsEmpty(Cells(r, c)) Then Data = ""
                If c <> NumCols Then
                    Write #1, Data;
                Else
                    Write #1, Data
                End If
            Next c
        Next r
    Close #1

    ActiveWorkbook.Close savechanges:=False

'   Activate temp worksheet
    Worksheets("CrossCutting_Input").Activate

'   Place exported range in temp worksheet for calculations
     With ActiveSheet.QueryTables.Add(Connection:= _
        "TEXT;" & Filename, Destination:=Range("A1"))
        .Name = "tempfile"
        .FieldNames = True
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .PreserveFormatting = True
        .RefreshOnFileOpen = False
        .RefreshStyle = xlOverwriteCells
        .SavePassword = False
        .SaveData = True
        .AdjustColumnWidth = True
        .RefreshPeriod = 0
```

```
        .TextFilePromptOnRefresh = False
        .TextFileStartRow = 1
        .TextFileParseType = xlDelimited
        .TextFileTextQualifier = xlTextQualifierDoubleQuote
        .TextFileCommaDelimiter = True
        .TextFileColumnDataTypes = Array(1, 1, 1, 1)
        .Refresh BackgroundQuery:=True
        On Error Resume Next
    End With

'   Defines variables
    CrossYear = StartForm.CrossCutYearCB.Value
    NextColumn = Application.WorksheetFunction.Match(CrossYear, Range("ContactTracking!3:3"), 0)
    CrossColumn = WorksheetFunction.Match(CrossYear, Range("PrimaryInput!3:3"), 0)

'   This code warns against overwriting Cross-Cutting data
    If Worksheets("PrimaryInput").Cells(101, CrossColumn).Value <> "" Then
        B = 1
    End If
    B = B + B
    If B > 0 Then
        CrossAns = MsgBox("You are about to overwrite Cross-Cutting & Emerging Issues data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case CrossAns
                Case vbNo
                    Exit Sub
            End Select
    End If

'   Import total conditioned square footage
    Sheets("CrossCutting_Input").Activate
    If StartForm.CrossCutYearCB.Value = 1990 Then
        Sheets("PrimaryInput").Range("C101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 1999 Then
        Sheets("PrimaryInput").Range("D101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2000 Then
        Sheets("PrimaryInput").Range("E101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2001 Then
        Sheets("PrimaryInput").Range("F101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2002 Then
        Sheets("PrimaryInput").Range("G101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2003 Then
        Sheets("PrimaryInput").Range("H101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2004 Then
        Sheets("PrimaryInput").Range("I101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2005 Then
        Sheets("PrimaryInput").Range("J101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2006 Then
```

```
        Sheets("PrimaryInput").Range("K101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2007 Then
        Sheets("PrimaryInput").Range("L101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2008 Then
        Sheets("PrimaryInput").Range("M101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2009 Then
        Sheets("PrimaryInput").Range("N101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    ElseIf StartForm.CrossCutYearCB.Value = 2010 Then
        Sheets("PrimaryInput").Range("O101").Value =
LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200"))
    End If

'   Not Working - Checks if data in PrimaryInput page matches data entered into Textboxes
'    If (LASTINCOLUMN(Sheets("CrossCutting_Input").Range("F1:F200").Value <> "") And
Sheets("PrimaryInput").Cells(101, _
'        WorksheetFunction.Match(CrossYear, Range("PrimaryInput!3:3"), [0])).Value <> "") Then
'            MsgBox "Data entered successfully!"
'            Else
'            MsgBox "Data were not entered"
'    End If

'   Counts the number of entries in Column C of the BldgList worksheet
'   This total includes entries that are not buildings (such as parking lots and electric
'   signs)
    Sheets("SecondaryInput").Cells(38, WorksheetFunction.Match(CrossYear, _
        Range("SecondaryInput!2:2"), [0])).Value = WorksheetFunction.CountA(Range _
            ("BldgNames"))

    Sheets("Interface").Activate
    Application.ScreenUpdating = True
End Sub

'   Returns the contents of the last non-empty cell in a column
    Function LASTINCOLUMN(rng As Range)
        Application.Volatile
        With rng.Parent
            With .Cells(.Rows.Count, rng.Column)
                If Not IsEmpty(.Value) Then
                    LASTINCOLUMN = .Value
                ElseIf IsEmpty(.End(xlUp)) Then
                    LASTINCOLUMN = ""
                Else
                    LASTINCOLUMN = .End(xlUp).Value
                End If
            End With
        End With
    End Function

Private Sub EnterCrossBut_Click()
    Dim CrossYear As Integer
    Dim CrossColumn As Integer
    Dim CrossAns As String
```

```
    Application.ScreenUpdating = False

'   Forces user to select a year
    Select Case StartForm.CrossCutYearCB.Value
        Case Is = ""
            MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
            Exit Sub
    End Select

'   Defines variables
    CrossYear = StartForm.CrossCutYearCB.Value

'   Activate CrossCutting_Output Worksheet
    Sheets("RawOutput").Activate

'   Import # of LEED Certified buildings & Aesthetic awards for output
    If StartForm.CrossCutYearCB.Value = 1990 Then
        Range("D5").Value = StartForm.TextBox4.Value
        Range("D6").Value = StartForm.TextBox7.Value
        Range("D7").Value = StartForm.TextBox8.Value
        Range("D8").Value = StartForm.TextBox9.Value
        Range("D10").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 1999 Then
        Range("D14").Value = StartForm.TextBox4.Value
        Range("D15").Value = StartForm.TextBox7.Value
        Range("D16").Value = StartForm.TextBox8.Value
        Range("D17").Value = StartForm.TextBox9.Value
        Range("D19").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2000 Then
        Range("D23").Value = StartForm.TextBox4.Value
        Range("D24").Value = StartForm.TextBox7.Value
        Range("D25").Value = StartForm.TextBox8.Value
        Range("D26").Value = StartForm.TextBox9.Value
        Range("D28").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2001 Then
        Range("D32").Value = StartForm.TextBox4.Value
        Range("D33").Value = StartForm.TextBox7.Value
        Range("D34").Value = StartForm.TextBox8.Value
        Range("D35").Value = StartForm.TextBox9.Value
        Range("D37").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2002 Then
        Range("D41").Value = StartForm.TextBox4.Value
        Range("D42").Value = StartForm.TextBox7.Value
        Range("D43").Value = StartForm.TextBox8.Value
        Range("D44").Value = StartForm.TextBox9.Value
        Range("D46").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2003 Then
        Range("D50").Value = StartForm.TextBox4.Value
        Range("D51").Value = StartForm.TextBox7.Value
        Range("D52").Value = StartForm.TextBox8.Value
        Range("D53").Value = StartForm.TextBox9.Value
        Range("D55").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2004 Then
        Range("D59").Value = StartForm.TextBox4.Value
        Range("D60").Value = StartForm.TextBox7.Value
```

```
        Range("D61").Value = StartForm.TextBox8.Value
        Range("D62").Value = StartForm.TextBox9.Value
        Range("D64").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2005 Then
        Range("D68").Value = StartForm.TextBox4.Value
        Range("D69").Value = StartForm.TextBox7.Value
        Range("D70").Value = StartForm.TextBox8.Value
        Range("D71").Value = StartForm.TextBox9.Value
        Range("D73").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2006 Then
        Range("D77").Value = StartForm.TextBox4.Value
        Range("D78").Value = StartForm.TextBox7.Value
        Range("D79").Value = StartForm.TextBox8.Value
        Range("D80").Value = StartForm.TextBox9.Value
        Range("D82").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2007 Then
        Range("D86").Value = StartForm.TextBox4.Value
        Range("D87").Value = StartForm.TextBox7.Value
        Range("D88").Value = StartForm.TextBox8.Value
        Range("D89").Value = StartForm.TextBox9.Value
        Range("D91").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2008 Then
        Range("D95").Value = StartForm.TextBox4.Value
        Range("D96").Value = StartForm.TextBox7.Value
        Range("D97").Value = StartForm.TextBox8.Value
        Range("D98").Value = StartForm.TextBox9.Value
        Range("D100").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2009 Then
        Range("D104").Value = StartForm.TextBox4.Value
        Range("D105").Value = StartForm.TextBox7.Value
        Range("D106").Value = StartForm.TextBox8.Value
        Range("D107").Value = StartForm.TextBox9.Value
        Range("D109").Value = StartForm.TextBox5.Value
    ElseIf StartForm.CrossCutYearCB.Value = 2010 Then
        Range("D113").Value = StartForm.TextBox4.Value
        Range("D114").Value = StartForm.TextBox7.Value
        Range("D115").Value = StartForm.TextBox8.Value
        Range("D116").Value = StartForm.TextBox9.Value
        Range("D118").Value = StartForm.TextBox5.Value
    End If

    If StartForm.AwardContactBut.Value = "" And StartForm.TextBox5.Value <> "" Then
        MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
        Exit Sub

    End If

'   Adds the last name of contact to ContactTracking worksheet
    If StartForm.AwardContactBut.Value <> "" Then Sheets("ContactTracking") _
        .Cells(19, WorksheetFunction.Match(CrossYear, Range("ContactTracking!3:3"), [0])) _
            .Value = Right(StartForm.AwardContactBut.Value, _
                (Len(StartForm.AwardContactBut.Value) - WorksheetFunction.Find(" ", _
                    AwardContactBut.Value)))
    If StartForm.BUtzContactBut.Value <> "" Then Sheets("ContactTracking") _
        .Cells(20, WorksheetFunction.Match(CrossYear, Range("ContactTracking!3:3"), [0])) _
            .Value = Right(StartForm.BUtzContactBut.Value, _
```

```
            (Len(StartForm.BUtzContactBut.Value) - WorksheetFunction.Find(" ", _
               BUtzContactBut.Value)))

   Sheets("Interface").Activate
   Application.ScreenUpdating = True
End Sub
'   End Cross-Cutting and Emerging Issues data input
```

Appendix D: Visual Basic Code

AddContactForm

```
Option Explicit

Private Sub AddContactBut2_Click()
'   Enters new contact information to ContactNames list
'   Will not enter information unless all textboxes are completed
    Dim FControl As Control
    Dim Contacts As Variant
    Dim ConCount1 As Integer, ConCount2 As Integer

    Application.ScreenUpdating = False

    ConCount1 = Sheets("ContactList").Range("ContactNames").Rows.Count

    Contacts = Sheets("contactList").Range("ContactNames").Value

    Do Until WMS_Input.MixContactCB.ListCount = 0
        AthleticLandForm.AthLanContactCB.RemoveItem 0
        CampusLandForm.CampLanContactCB.RemoveItem 0
        EmissionsForm.EmissContactCB.RemoveItem 0
        EmissionsForm.SalSanContactCB.RemoveItem 0
        MBGNALandForm.MBGContactCB.RemoveItem 0
        StartForm.DeckContactCB.RemoveItem 0
        StartForm.TreeContactCB.RemoveItem 0
        StartForm.AwardContactBut.RemoveItem 0
        StartForm.BUtzContactBut.RemoveItem 0
        StartForm.WaterContactCB.RemoveItem 0
        TransForm.BikeContactCB.RemoveItem 0
        TransForm.AATAContactCB.RemoveItem 0
        TransForm.TransContactCB.RemoveItem 0
        UHS_Input.UHContactCB.RemoveItem 0
        UtilForm.AURContactCB.RemoveItem 0
        UtilForm.REContactCB.RemoveItem 0
        UtilForm.CPPContactCB.RemoveItem 0
        WMS_Input.PDContactCB.RemoveItem 0
        WMS_Input.MulchContactCB.RemoveItem 0
        WMS_Input.MixContactCB.RemoveItem 0
    Loop

    If CfNameTB.Value <> "" And ClNameTB.Value <> "" And ClNameTB.Value <> "" _
        And CTeleTB.Value <> "" And CEmailTB.Value <> "" Then
            With Sheets("ContactList")
                .Rows("14:14").Insert Shift:=xlDown
                .Range("A14") = ClNameTB.Value
                .Range("B14") = CfNameTB.Value
                .Range("c14") = COrgTB.Value
                .Range("d14") = CTeleTB.Value
                .Range("e14") = CEmailTB.Value
            End With
            Application.Goto Reference:=Range("ContactNames")
            Selection.Sort Key1:=Range("A2"), Order1:=xlAscending, Header:=xlNo, _
                OrderCustom:=1, Orientation:=xlTopToBottom
            Sheets("Interface").Activate
    Else
        MsgBox "Please enter full contact information"
```

```
      Exit Sub
   End If

   CfNameTB.Value = ""
   ClNameTB.Value = ""
   ConOrgTB.Value = ""
   CTeleTB.Value = ""
   CEmailTB.Value = ""

   Dim i As Integer
   Dim CName As String

   Contacts = Sheets("contactList").Range("ContactNames").Value

'   Enters contact names in each ComboBox
   For i = 1 To UBound(Contacts, 1)
      CName = Contacts(i, 2) & " " & Contacts(i, 1)
      AthleticLandForm.AthLanContactCB.AddItem CName
      CampusLandForm.CampLanContactCB.AddItem CName
      EmissionsForm.EmissContactCB.AddItem CName
      EmissionsForm.SalSanContactCB.AddItem CName
      MBGNALandForm.MBGContactCB.AddItem CName
      StartForm.DeckContactCB.AddItem CName
      StartForm.TreeContactCB.AddItem CName
      StartForm.AwardContactBut.AddItem CName
      StartForm.BUtzContactBut.AddItem CName
      StartForm.WaterContactCB.AddItem CName
      TransForm.BikeContactCB.AddItem CName
      TransForm.AATAContactCB.AddItem CName
      TransForm.TransContactCB.AddItem CName
      UHS_Input.UHContactCB.AddItem CName
      UtilForm.AURContactCB.AddItem CName
      UtilForm.REContactCB.AddItem CName
      UtilForm.CPPContactCB.AddItem CName
      WMS_Input.PDContactCB.AddItem CName
      WMS_Input.MulchContactCB.AddItem CName
      WMS_Input.MixContactCB.AddItem CName
   Next i

   ConCount2 = Sheets("ContactList").Range("ContactNames").Rows.Count
   If ConCount1 + 1 = ConCount2 Then
      MsgBox "Contact information added successfully"
      Else
      MsgBox "Contact information was not added"
   End If

   AddContactForm.Hide
   Unload AddContactForm
   Application.ScreenUpdating = True
End Sub

Private Sub FindContactBut_Click()
'   Displays contact information
   Dim ContactYear As Integer
   Dim ContactCat As String
   Dim ContactName As String
```

```
    ContactYear = AddContactForm.ContactYearCB.Value
    ContactCat = AddContactForm.ContactCatCB.Value

    If Sheets("ContactTracking").Cells((Application.WorksheetFunction.Match _
        (ContactCat, Sheets("ContactTracking").Range("ContactCats"), [0]) + 3), Application _
            .WorksheetFunction.Match(ContactYear, Sheets("ContactTracking") _
                .Range("3:3"), [0])).Value = "" Then
                MsgBox "There is no contact for " & ContactYear
                Exit Sub
    End If

    If Sheets("ContactTracking").Cells((Application.WorksheetFunction.Match _
        (ContactCat, Sheets("ContactTracking").Range("ContactCats"), [0]) + 3), _
            Application.WorksheetFunction.Match(ContactYear, Sheets("ContactTracking") _
                .Range("3:3"), [0])).Value <> "" Then
        ConNameTB.Value = Sheets("ContactTracking").Cells((Application.WorksheetFunction _
            .Match(ContactCat, Sheets("ContactTracking").Range("ContactCats"), [0]) + 3), _
                Application.WorksheetFunction.Match(ContactYear, Sheets("ContactTracking") _
                    .Range("3:3"), [0])).Value
        ContactName = AddContactForm.ConNameTB.Value
        On Error Resume Next
        ConOrgTB.Value = Sheets("ContactList").Cells(Application.WorksheetFunction.Match _
            (ContactName, Sheets("ContactList").Range("A:A"), [0]), 3).Value
        ConPhTB.Value = Sheets("ContactList").Cells(Application.WorksheetFunction.Match _
            (ContactName, Sheets("ContactList").Range("A:A"), [0]), 4).Value
        On Error Resume Next
        ConEmailTB.Value = Sheets("ContactList").Cells(Application.WorksheetFunction.Match _
            (ContactName, Sheets("ContactList").Range("A:A"), [0]), 5).Value
        On Error Resume Next
    End If
End Sub

Private Sub UserForm_Initialize()
    Dim ContactCats As Variant
    Dim i As Integer
    ContactCats = Sheets("ContactTracking").Range("ContactCats").Value

'   Adds years to dropdown menu
    With ContactYearCB
        .AddItem "2000"
        .AddItem "2001"
        .AddItem "2002"
        .AddItem "2003"
        .AddItem "2004"
        .AddItem "2005"
        .AddItem "2006"
        .AddItem "2007"
        .AddItem "2008"
        .AddItem "2009"
    End With
    For i = 1 To UBound(ContactCats, 1)
        AddContactForm.ContactCatCB.AddItem ContactCats(i, 1)
    Next i

End Sub
```

Appendix D: Visual Basic Code

UtilForm

```
Option Explicit

Private Sub AddContactBut_Click()
   AddContactForm.Show
End Sub

Private Sub UtilImportBut_Click()
'   Procedure to import and write building energy data
   Dim UtilFileName As String
   Dim BldgNum As Integer
   Dim Bldgs As Variant
   Dim EnergyCat As Variant, BldgArea As Variant
   Dim c As Variant
   Dim h As Integer, i As Integer, j As Integer, k As Integer, l As Integer
   Dim a As Integer, B As Integer, D As Integer
   Dim firstAddress As Variant
   Dim UtYear As Long
   Dim UtilMsg As String
   Dim UtilAns As String, UtilAns2 As String, UtilAns3 As String
   Dim FControl As Control
   Dim AreaSum As Double
   Dim NumRows As Long, NumCols As Integer
   Dim x As Long, y As Integer
   Dim UtilData
   Dim ExpRng As Range
   Dim csvFileName As String
   Dim HeatRate As Integer
   Dim IrrWater As Double
   Dim SewerWater As Double
   AreaSum = 0
   Dim ModelName As String

   ModelName = ActiveWorkbook.Name
   Application.ScreenUpdating = False

'   Defines variable, "UtilFileName"
   UtilFileName = UtilForm.UtilFileNameTB.Value

'   Forces user to select a year
   Select Case UtilForm.UtYearCB.Value
      Case Is = ""
         MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
         Exit Sub
   End Select

'   Defines variable, "UtYear"
   UtYear = UtilForm.UtYearCB.Value

'   Based on year, selects which columns to paste data to
   Select Case UtYear
      Case 1999
         k = 0
      Case 2000
         k = 8
```

```
        Case 2001
            k = 16
        Case 2002
            k = 24
        Case 2003
            k = 32
        Case 2004
            k = 40
        Case 2005
            k = 48
        Case 2006
            k = 56
        Case 2007
            k = 64
        Case 2008
            k = 72
        Case 2009
            k = 80
    End Select

'   This code protects against writing over existing Utilities Report data
    If Application.WorksheetFunction.Max(Sheets("BldgData").Cells(5, (3 + k)), _
        Cells(370, (3 + k))) > 0 And UtilForm.UtilFileNameTB.Value <> "" Then _
          UtilAns = MsgBox("You are about to overwrite Utilities Report data for " _
          & UtYear & vbNewLine & "Do you wish to continue?", vbYesNo, _
              "Caution: Data Overwrite")
             Select Case UtilAns
                 Case vbNo
                     UtilForm.UtilFileNameTB.Value = ""
                     UtilForm.UtYearCB.Value = ""
                     Exit Sub
              End Select

'   This code warns against overwriting CPP and Hoover Plant data
    For a = 4 + k To 10 + k
        If Worksheets("BldgData").Cells(3, a).Value <> "" Then
            B = 1
        End If
        If Worksheets("BldgData").Cells(4, a).Value <> "" Then
            D = 1
        End If
        B = B + B
        D = D + D
    Next a
    If B > 0 And (UtilForm.CPPFuelOil.Value <> "" Or UtilForm.CPPGas.Value <> "") Then
        UtilAns2 = MsgBox("You are about to overwrite CPP data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case UtilAns2
                Case vbNo
                    Exit Sub
            End Select
    End If
    If D > 0 And (UtilForm.HoovGas.Value <> "") Then
        UtilAns3 = MsgBox("You are about to overwrite Hoover Plant data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case UtilAns3
```

```
            Case vbNo
               Exit Sub
         End Select
   End If

'  Assures that data contact has been selected and writes contact to "ContactTracking"
'  worksheet
   If UtilForm.AURContactCB.Value = "" And UtilForm.UtilFileNameTB.Value <> "" Then
      MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
      Exit Sub
   ElseIf UtilForm.AURContactCB.Value <> "" And UtilForm.UtilFileNameTB.Value <> "" Then
      Sheets("ContactTracking").Cells(11, WorksheetFunction.Match(UtYear, _
         Range("ContactTracking!3:3"), [0])).Value = Right(UtilForm.AURContactCB _
            .Value, (Len(UtilForm.AURContactCB.Value) - WorksheetFunction.Find(" ", _
               UtilForm.AURContactCB.Value)))
      Sheets("ContactTracking").Cells(24, WorksheetFunction.Match(UtYear, _
         Range("ContactTracking!3:3"), [0])).Value = Right(UtilForm.AURContactCB _
            .Value, (Len(UtilForm.AURContactCB.Value) - WorksheetFunction.Find(" ", _
               UtilForm.AURContactCB.Value)))
   End If
   If UtilForm.CPPContactCB.Value = "" And UtilForm.CPPGas.Value <> "" Then
      MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
      Exit Sub
   ElseIf UtilForm.CPPContactCB.Value <> "" And UtilForm.CPPGas.Value <> "" Then
      Sheets("ContactTracking").Cells(9, WorksheetFunction.Match(UtYear, _
         Range("ContactTracking!3:3"), [0])).Value = Right(UtilForm.CPPContactCB _
            .Value, (Len(UtilForm.CPPContactCB.Value) - WorksheetFunction.Find(" ", _
               UtilForm.CPPContactCB.Value)))
   End If
   If UtilForm.REContactCB.Value = "" And UtilForm.RenewETB.Value <> "" Then
      MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
      Exit Sub
   ElseIf UtilForm.REContactCB.Value <> "" And UtilForm.RenewETB.Value <> "" Then
      Sheets("ContactTracking").Cells(10, WorksheetFunction.Match(UtYear, _
         Range("ContactTracking!3:3"), [0])).Value = Right(UtilForm.REContactCB _
            .Value, (Len(UtilForm.REContactCB.Value) - WorksheetFunction.Find(" ", _
               UtilForm.REContactCB.Value)))
   End If

'  Imports .xls sheet if input module was selected and converts to .csv file
'  Alerts user if the input module was not selected
   If UtilForm.UtilFileNameTB.Value <> "" Then
      Workbooks.Open Filename:=UtilFileName
      Sheets(1).Activate
      Cells.MergeCells = False
      Set ExpRng = Range("a1:r3500")
      NumCols = ExpRng.Columns.Count
      NumRows = ExpRng.Rows.Count
      csvFileName = Workbooks(ModelName).Path & "\" & _
         "Annual Report by Building.csv"
      Open csvFileName For Output As #1
         For y = 1 To NumRows
            For x = 1 To NumCols
               UtilData = ExpRng.Cells(y, x).Value
               If IsNumeric(UtilData) Then UtilData = Val(UtilData)
               If IsEmpty(ExpRng.Cells(y, x)) Then UtilData = ""
```

```
                If x <> NumCols Then
                    Write #1, UtilData;
                Else
                    Write #1, UtilData
                End If
            Next x
        Next y
    Close #1
    ActiveWorkbook.Close savechanges:=False

'   Imports and pastes data from CSV file
    Workbooks(ModelName).Sheets("UtilCSV").Activate
    With ActiveSheet.QueryTables.Add(Connection:= _
        "TEXT;" & csvFileName, Destination:=Range("A1"))
        .FieldNames = True
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .PreserveFormatting = True
        .RefreshOnFileOpen = False
        .RefreshStyle = xlOverwriteCells
        .SavePassword = False
        .SaveData = True
        .AdjustColumnWidth = False
        .RefreshPeriod = 0
        .TextFilePromptOnRefresh = False
        .TextFilePlatform = xlWindows
        .TextFileStartRow = 1
        .TextFileParseType = xlDelimited
        .TextFileTextQualifier = xlTextQualifierDoubleQuote
        .TextFileConsecutiveDelimiter = False
        .TextFileTabDelimiter = False
        .TextFileSemicolonDelimiter = False
        .TextFileCommaDelimiter = True
        .TextFileSpaceDelimiter = False
        .TextFileColumnDataTypes = Array(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1)
    On Error Resume Next
        .Refresh BackgroundQuery:=False
    End With
  End If

'   Defines list of buildings as an array
  Bldgs = Worksheets("BldgList").Range("BldgNums").Value

'   Pastes Number of buildings
  Sheets("SecondaryInput").Cells(43, WorksheetFunction.Match(UtYear, Sheets("SecondaryInput") _
    .Range("2:2"), 0)).Value = WorksheetFunction.CountA(Range("BldgNames"))
'   Activates sheet with pasted .CSV data
'   Loops through building numbers in Bldg array, finding matching building
'   numbers in Utilities Report.
'   Copies and pastes data based on heading ("Electricity", "Electricity-CPP", etc)
  Worksheets("UtilCSV").Activate
  With Worksheets("UtilCSV").Range("A:A")
    For i = 1 To UBound(Bldgs, 1)
        Set c = .Find(Bldgs(i, 1), LookAt:=xlWhole, LookIn:=xlValues)
        If Not c Is Nothing Then
            firstAddress = c.Address
```

```
            Do
'              Finds and sums the building areas
               For h = 1 To 7
                  BldgArea = Worksheets("UtilCSV").Range(firstAddress) _
                     .Offset(h, 1).Value
                  Select Case BldgArea
                     Case "Total"
                        AreaSum = AreaSum + Range(firstAddress).Offset(h, 5).Value
                     End Select
               Next h
               Set c = .FindNext(c)
               Loop While Not c Is Nothing And c.Address <> firstAddress
            Do
'              Finds and pastes the utilties data
               For j = 1 To 5
                  EnergyCat = Worksheets("UtilCSV").Range(firstAddress). _
                     Offset(j, 1).Value
                  Select Case EnergyCat
                     Case "Ann Arbor Water and Sewer"
                        Range(firstAddress).Offset(j, 5).Copy _
                           Worksheets("BldgData").Cells(i + 4, 3 + k)
                     Case "Water & Sewer"
                        Range(firstAddress).Offset(j, 5).Copy _
                           Worksheets("BldgData").Cells(i + 4, 4 + k)
                     Case "Electricity-CPP"
                        Range(firstAddress).Offset(j, 5).Copy _
                           Worksheets("BldgData").Cells(i + 4, 5 + k)
                     Case "Electricity-NC"
                        Range(firstAddress).Offset(j, 5).Copy _
                           Worksheets("BldgData").Cells(i + 4, 6 + k)
                     Case "Electricity"
                        Range(firstAddress).Offset(j, 5).Copy _
                           Worksheets("BldgData").Cells(i + 4, 7 + k)
                     Case "Recharge Bulk Gas"
                        Range(firstAddress).Offset(j, 5).Copy _
                           Worksheets("BldgData").Cells(i + 4, 8 + k)
                     Case "Natural Gas"
                        Range(firstAddress).Offset(j, 5).Copy _
                           Worksheets("BldgData").Cells(i + 4, 9 + k)
                     Case "Fuel Oil"
                        Range(firstAddress).Offset(j, 5).Copy _
                           Worksheets("BldgData").Cells(i + 4, 10 + k)
                     End Select
                  Next j
               Set c = .FindNext(c)
            Loop While Not c Is Nothing And c.Address <> firstAddress
         End If
      Next i
   End With

'  Pastes Total Building area to sheet
   If Not UtilForm.UtilFileNameTB.Value = "" Then Sheets("SecondaryInput") _
      .Cells(8, Application.WorksheetFunction _
         .Match(UtYear, Sheets("SecondaryInput").Range("2:2"), [0])) _
            .Value = AreaSum
```

Appendix D: Visual Basic Code

```
'   Calculates the volume of water discharged to sewers and used for irrigation
    For l = 5 To UBound(Bldgs, 1)
        IrrWater = IrrWater + (Sheets("BldgData").Cells(l, WorksheetFunction.Match(UtYear, _
            Range("BldgData!1:1"), 0)).Value * Sheets("BldgList").Cells(l - 3, 6).Value) + _
                (Sheets("BldgData").Cells(l, WorksheetFunction.Match(UtYear, _
                    Range("BldgData!1:1"), 0) + 1).Value * Sheets("BldgList").Cells(l - 3, 6).Value)
        SewerWater = SewerWater + (Sheets("BldgData").Cells(l, WorksheetFunction.Match(UtYear, _
            Range("BldgData!1:1"), 0)).Value * Sheets("BldgList").Cells(l - 3, 5).Value) + _
                (Sheets("BldgData").Cells(l, WorksheetFunction.Match(UtYear, _
                    Range("BldgData!1:1"), 0) + 1).Value * Sheets("BldgList").Cells(l - 3, 5).Value)
    Next l
    Sheets("PrimaryInput").Cells(102, (WorksheetFunction.Match(UtYear, _
        Range("PrimaryInput!3:3"), 0))).Value = IrrWater * 748.052
    Sheets("PrimaryInput").Cells(103, (WorksheetFunction.Match(UtYear, _
        Range("PrimaryInput!3:3"), 0))).Value = SewerWater * 748.052

'   Pastes renewable electricity data (converts from kWh to MWh)
'   Will not paste over data if input textbox is blank
    If Not UtilForm.RenewETB.Value = "" Then
        Worksheets("PrimaryInput").Cells(105, (WorksheetFunction.Match _
            (UtYear, Sheets("PrimaryInput").Range("3:3"), [0]))).Value = _
                Val(UtilForm.RenewETB.Value) / 1000
    End If

'   Pastes manually inputed CPP data
'   Will not paste over data if input textbox is blank
    If Not UtilForm.CPPGas.Value = "" Then
        Worksheets("BldgData").Cells(3, 8 + k).Value = UtilForm.CPPGas.Value
    End If
    If Not UtilForm.CPPFuelOil.Value = "" Then
        Worksheets("BldgData").Cells(3, 10 + k).Value = UtilForm.CPPFuelOil.Value
    End If

'   Pastes manually inputed Hoover data
'   Will not paste over data if input textbox is blank
    If Not UtilForm.HoovGas.Value = "" Then
        Worksheets("BldgData").Cells(4, 8 + k).Value = UtilForm.HoovGas.Value
    End If

'   Calculates and enters total heat rate for purchased electricity
    If CoalPerTB.Value <> "" And CoalHRTB.Value <> "" Then
        HeatRate = ((CoalPerTB.Value / 100) * CoalHRTB.Value) + ((NGPerTB.Value / 100) _
            * NGHRTB.Value) + ((NucPerTB.Value / 100) * NucHRTB.Value) + ((FOPerTB.Value / 100) * _
                FOHRTB.Value) + ((HyPerTB.Value / 100) * HyHRTB.Value) + ((ORPerTB.Value / 100) * _
                    ORHRTB.Value)
        Sheets("SecondaryInput").Cells(3, (Application.WorksheetFunction _
            .Match(UtYear, Sheets("SecondaryInput").Range("2:2"), [0]))).Value = HeatRate
    End If

'   Enters fuel mix and heat rate for coal, natural gas, and fuel oil. Also fuel mix %'s for
'   hydro and other renewables.
'   These values are used to calculate greenhouse gas emissions from purchased electricity
    If CoalPerTB.Value <> "" Then Sheets("SecondaryInput").Cells(34, (Application.WorksheetFunction _
            .Match(UtYear, Sheets("SecondaryInput").Range("2:2"), [0]))).Value = CoalPerTB.Value / 100
    If NGPerTB.Value <> "" Then Sheets("SecondaryInput").Cells(35, (Application.WorksheetFunction _
            .Match(UtYear, Sheets("SecondaryInput").Range("2:2"), [0]))).Value = NGPerTB.Value / 100
```

```
    If FOPerTB.Value <> "" Then Sheets("SecondaryInput").Cells(36, (Application.WorksheetFunction _
            .Match(UtYear, Sheets("SecondaryInput").Range("2:2"), [0]))).Value = FOPerTB.Value / 100
    If HyPerTB.Value <> "" Then Sheets("SecondaryInput").Cells(37, (Application.WorksheetFunction _
            .Match(UtYear, Sheets("SecondaryInput").Range("2:2"), [0]))).Value = HyPerTB.Value / 100
    If ORPerTB.Value <> "" Then Sheets("SecondaryInput").Cells(38, (Application.WorksheetFunction _
            .Match(UtYear, Sheets("SecondaryInput").Range("2:2"), [0]))).Value = ORPerTB.Value / 100
    If CoalHRTB.Value <> "" Then Sheets("SecondaryInput").Cells(39, (Application.WorksheetFunction _
            .Match(UtYear, Sheets("SecondaryInput").Range("2:2"), [0]))).Value = CoalHRTB.Value
    If NGHRTB.Value <> "" Then Sheets("SecondaryInput").Cells(40, (Application.WorksheetFunction _
            .Match(UtYear, Sheets("SecondaryInput").Range("2:2"), [0]))).Value = NGHRTB.Value
    If FOHRTB.Value <> "" Then Sheets("SecondaryInput").Cells(41, (Application.WorksheetFunction _
            .Match(UtYear, Sheets("SecondaryInput").Range("2:2"), [0]))).Value = FOHRTB.Value

'   Clears worksheet, displays Msgbox, clears all txt- and comboboxes
    Worksheets("UtilCSV").Cells.Delete Shift:=xlUp

    If Worksheets("BldgData").Cells(16, 5 + k).Value = "" And UtilForm.UtilFileNameTB _
        .Value <> "" Then
            MsgBox "The Annual Utilities Report was not imported", vbOKOnly
            Exit Sub
    End If

    MsgBox "Data entered successfully!", vbOKOnly
    For Each FControl In UtilForm.Controls
        FControl.Value = ""
        On Error Resume Next
    Next FControl
    Worksheets("Interface").Activate
    UtilForm.Hide
    Application.ScreenUpdating = True
End Sub

Private Sub UserForm_Initialize()
    Dim Contacts As Variant
    Dim i As Integer
    Dim CName As String

    Contacts = Sheets("contactList").Range("ContactNames").Value

'   Enters contact names in each ComboBox
    For i = 1 To UBound(Contacts, 1)
        CName = Contacts(i, 2) & " " & Contacts(i, 1)
            UtilForm.AURContactCB.AddItem CName
            UtilForm.REContactCB.AddItem CName
            UtilForm.CPPContactCB.AddItem CName
    Next i

'   Displays the heat rates for hydropower and other renewables.
'   These are constant values and are not written to the EDR.
    UtilForm.HyHRTB.Value = 3412
    UtilForm.ORHRTB.Value = 3412
'   When the UtilForm is shown, the following years are added
'   to the dropdown menu:
    With UtYearCB
        .AddItem "1999"
        .AddItem "2000"
```

```
        .AddItem "2001"
        .AddItem "2002"
        .AddItem "2003"
        .AddItem "2004"
        .AddItem "2005"
        .AddItem "2006"
        .AddItem "2007"
        .AddItem "2008"
        .AddItem "2009"
        .AddItem "2010"
    End With
End Sub

Private Sub UtilFileChoose_Click()
'   Selects name of Annual Utilities Report to import
    Dim Filt As String
    Dim FilterIndex As Integer
    Dim Title As String
    Dim UtilFileName As Variant

'   Sets up list of file filters
    Filt = "CSV Files (*.csv),*.csv," & _
        "Excel Files (*.xls),*.xls," & "All Files (*.*),*.*"

'   Displays *.csv by default
    FilterIndex = 2

'   Sets the dialog box caption
    Title = "Select Annual Utilities Report to Import"

'   Gets the file name
    UtilFileName = Application.GetOpenFilename _
        (FileFilter:=Filt, _
         FilterIndex:=FilterIndex, _
         Title:=Title)

'   Exits if dialog box canceled
    If UtilFileName = False Then
        MsgBox "No file was selected"
        Exit Sub
    End If

'   Displays full path and name of the Util file in the textbox
    UtilForm.UtilFileNameTB.Value = UtilFileName

End Sub
```

Appendix D: Visual Basic Code

TransForm

```
Private Sub CommandButton2_Click()
   AddContactForm.Show
End Sub
Private Sub UserForm_Initialize()
   With ComboBox1
      .AddItem "1990"
      .AddItem "1999"
      .AddItem "2000"
      .AddItem "2001"
      .AddItem "2002"
      .AddItem "2003"
      .AddItem "2004"
      .AddItem "2005"
      .AddItem "2006"
      .AddItem "2007"
      .AddItem "2008"
      .AddItem "2009"
      .AddItem "2010"
   End With

   Dim Contacts As Variant
   Dim i As Integer
   Dim CName As String

   Contacts = Sheets("ContactList").Range("ContactNames").Value

'   Enters contact names in each ComboBox
   For i = 1 To UBound(Contacts, 1)
      CName = Contacts(i, 2) & " " & Contacts(i, 1)
      TransForm.BikeContactCB.AddItem CName
      TransForm.AATAContactCB.AddItem CName
      TransForm.TransContactCB.AddItem CName
   Next i
End Sub

Private Sub CommandButton1_Click()
   Application.ScreenUpdating = False
   Dim Filt As String
   Dim FilterIndex As Integer
   Dim Title As String
   Dim TransportFileName As Variant
   Dim Filename As String
   Dim NumRows As Long, NumCols As Integer
   Dim r As Long, c As Long
   Dim Data
   Dim ExpRng As Range
   Dim ModelName As String

   ModelName = ActiveWorkbook.Name
   NumCols = Column
   NumRows = Row

'   Set up list of file filters
   Filt = "Text Files (*.txt),*.txt," & _
```

```
        "Excel Files (*.xls),*.xls," & _
        "Comma Separated Files (*.csv), *.csv," & _
        "ASCII Files (*.asc), *.asc," & _
        "All Files (*.*), *.*"

'   Display *.xls by default
    FilterIndex = 2

'   Set the dialog box caption
    Title = "Select Transportation File to Import"

'   Get the file name
    TransportFileName = Application.GetOpenFilename _
       (FileFilter:=Filt, FilterIndex:=FilterIndex, Title:=Title)

'   Exit if dialog box canceled
    If TransportFileName = False Then
       MsgBox "No file was selected."
       Exit Sub
    End If

'   Display full path and name of the Transport file
    MsgBox "You selected " & TransportFileName

'   Open TransportFileName & export range to csv file
    Workbooks.Open Filename:=TransportFileName
    Sheets("Trans_input").Activate

'   Determine last row containing data
    Set ExcelLastCell = ActiveSheet.Cells.SpecialCells(xlLastCell)
    LastDataRow = ExcelLastCell.Row
    Row = ExcelLastCell.Row
    Do While Application.CountA(ActiveSheet.Rows(Row)) = 0 And Row <> 1
       Row = Row - 1
    Loop
       LastDataRow = Row

'   Determine last column containing data
    Set ExcelLastCell = ActiveSheet.Cells.SpecialCells(xlLastCell)
    lastdatacolumn = ExcelLastCell.Column
    Column = ExcelLastCell.Column
    Do While Application.CountA(ActiveSheet.Columns(Column)) = 0 And Column <> 1
       Column = Column - 1
    Loop
       lastdatacolumn = Column

'   Exporting a range to a csv text file
'   Prompt for saving range as a csv file

    Filename = Workbooks(ModelName).Path & "\" & "Transtempfile.csv"
    Open Filename For Output As #1
       For r = 1 To LastDataRow
          For c = 1 To lastdatacolumn
             Data = Cells(r, c).Value
             If IsNumeric(Data) Then Data = Val(Data)
             If IsEmpty(Cells(r, c)) Then Data = ""
```

```
            If c <> lastdatacolumn Then
                Write #1, Data;
            Else
                Write #1, Data
            End If
        Next c
    Next r
Close #1

ActiveWorkbook.Close
'   Activate temp worksheet
    Workbooks(ModelName).Sheets("Transportation_Input").Activate
    With ActiveSheet.QueryTables.Add(Connection:= _
        "TEXT;" & Filename, Destination:=Range("A1"))
        .FieldNames = True
        .RowNumbers = False
        .FillAdjacentFormulas = False
        .PreserveFormatting = True
        .RefreshOnFileOpen = False
        .RefreshStyle = xlOverwriteCells
        .SavePassword = False
        .SaveData = True
        .AdjustColumnWidth = False
        .RefreshPeriod = 0
        .TextFilePromptOnRefresh = False
        .TextFilePlatform = xlWindows
        .TextFileStartRow = 1
        .TextFileParseType = xlDelimited
        .TextFileTextQualifier = xlTextQualifierDoubleQuote
        .TextFileConsecutiveDelimiter = False
        .TextFileTabDelimiter = False
        .TextFileSemicolonDelimiter = False
        .TextFileCommaDelimiter = True
        .TextFileSpaceDelimiter = False
        .TextFileColumnDataTypes = Array(1, 1, 1, 1)
    On Error Resume Next
        .Refresh BackgroundQuery:=False
    End With

'   Format Transportation_Input worksheet
Rows("1:1").Select
Selection.Font.Bold = True
Columns("B:B").ColumnWidth = 19.71
Range("B1:C1").Select
With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = False
End With
Rows("14:14").Select
```

```
    Selection.Font.Bold = True
    Rows("17:17").Select
    Selection.Font.Bold = True
    Range("B17:D17").Select
    With Selection
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
        .WrapText = False
        .Orientation = 0
        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = False
    End With
    Columns("C:C").ColumnWidth = 14.43
    Columns("D:D").ColumnWidth = 7.14
    Columns("A:A").ColumnWidth = 31
    Range("A1").Select

'   Defines variable, "TransYear"
    Dim TransYear As Integer
    Dim TransColumn As Integer
    Dim TransAns As String

    TransYear = TransForm.ComboBox1.Value
    TransColumn = WorksheetFunction.Match(TransYear, Range("PrimaryInput!3:3"), 0)

'   This code warns against overwriting Transportation data
    For a = 43 To 56
        If Worksheets("PrimaryInput").Cells(a, TransColumn).Value <> "" Then
            B = 1
        End If
        B = B + B
    Next a
    If B > 0 Then
        TransAns = MsgBox("You are about to overwrite Transportation data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case TransAns
                Case vbNo
                    Exit Sub
            End Select
    End If

'   Copy data to PrimaryInput worksheet for corresponding year
    If TransForm.ComboBox1.Value = 1990 Then
        Sheets("Transportation_Input").Range("C2:C13").Copy _
        Sheets("PrimaryInput").Range("C43:C54")
        Sheets("Transportation_Input").Range("C15:C16").Select
        Application.CutCopyMode = False
        Selection.Copy Sheets("PrimaryInput").Range("C55:C56")

        Sheets("PrimaryInput").Activate
        Range("C57").Value = "=SUM(Transportation_Input!C18:C59)"
        Range("C58").Value = "=SUM(Transportation_Input!D18:D59)"
        Range("C59").Value = "=SUM(Transportation_Input!E18:E59)"
```

```
ElseIf TransForm.ComboBox1.Value = 1999 Then
    Sheets("Transportation_Input").Range("C2:C13").Copy _
    Sheets("PrimaryInput").Range("D43:D54")
    Sheets("Transportation_Input").Range("C15:C16").Select
    Application.CutCopyMode = False
    Selection.Copy Sheets("PrimaryInput").Range("D55:D56")

    Sheets("PrimaryInput").Activate
    Range("D57").Value = "=SUM(Transportation_Input!C18:C59)"
    Range("D58").Value = "=SUM(Transportation_Input!D18:D59)"
    Range("D59").Value = "=SUM(Transportation_Input!E18:E59)"

ElseIf TransForm.ComboBox1.Value = 2000 Then
    Sheets("Transportation_Input").Range("C2:C13").Copy _
    Sheets("PrimaryInput").Range("E43:E54")
    Sheets("Transportation_Input").Range("C15:C16").Select
    Application.CutCopyMode = False
    Selection.Copy Sheets("PrimaryInput").Range("E55:E56")

    Sheets("PrimaryInput").Activate
    Range("E57").Value = "=SUM(Transportation_Input!C18:C59)"
    Range("E58").Value = "=SUM(Transportation_Input!D18:D59)"
    Range("E59").Value = "=SUM(Transportation_Input!E18:E59)"

 ElseIf TransForm.ComboBox1.Value = 2001 Then
    Sheets("Transportation_Input").Range("C2:C13").Copy _
    Sheets("PrimaryInput").Range("F43:F54")
    Sheets("Transportation_Input").Range("C15:C16").Select
    Application.CutCopyMode = False
    Selection.Copy Sheets("PrimaryInput").Range("F55:F56")

    Sheets("PrimaryInput").Activate
    Range("F57").Value = "=SUM(Transportation_Input!C18:C59)"
    Range("F58").Value = "=SUM(Transportation_Input!D18:D59)"
    Range("F59").Value = "=SUM(Transportation_Input!E18:E59)"

ElseIf TransForm.ComboBox1.Value = 2002 Then
    Sheets("Transportation_Input").Range("C2:C13").Copy _
    Sheets("PrimaryInput").Range("G43:G54")
    Sheets("Transportation_Input").Range("C15:C16").Select
    Application.CutCopyMode = False
    Selection.Copy Sheets("PrimaryInput").Range("G55:G56")

    Sheets("PrimaryInput").Activate
    Range("G57").Value = "=SUM(Transportation_Input!C18:C59)"
    Range("G58").Value = "=SUM(Transportation_Input!D18:D59)"
    Range("G59").Value = "=SUM(Transportation_Input!E18:E59)"

ElseIf TransForm.ComboBox1.Value = 2003 Then
    Sheets("Transportation_Input").Range("C2:C13").Copy _
    Sheets("PrimaryInput").Range("H43:H54")
    Sheets("Transportation_Input").Range("C15:C16").Select
    Application.CutCopyMode = False
    Selection.Copy Sheets("PrimaryInput").Range("H55:H56")
```

```
        Sheets("PrimaryInput").Activate
        Range("H57").Value = "=SUM(Transportation_Input!C18:C59)"
        Range("H58").Value = "=SUM(Transportation_Input!D18:D59)"
        Range("H59").Value = "=SUM(Transportation_Input!E18:E59)"

    ElseIf TransForm.ComboBox1.Value = 2004 Then
        Sheets("Transportation_Input").Range("C2:C13").Copy _
        Sheets("PrimaryInput").Range("I43:I54")
        Sheets("Transportation_Input").Range("C15:C16").Select
        Application.CutCopyMode = False
        Selection.Copy Sheets("PrimaryInput").Range("I55:I56")

        Sheets("PrimaryInput").Activate
        Range("I57").Value = "=SUM(Transportation_Input!C18:C59)"
        Range("I58").Value = "=SUM(Transportation_Input!D18:D59)"
        Range("I59").Value = "=SUM(Transportation_Input!E18:E59)"

    ElseIf TransForm.ComboBox1.Value = 2005 Then
        Sheets("Transportation_Input").Range("C2:C13").Copy _
        Sheets("PrimaryInput").Range("J43:J54")
        Sheets("Transportation_Input").Range("C15:C16").Select
        Application.CutCopyMode = False
        Selection.Copy Sheets("PrimaryInput").Range("J55:J56")

        Sheets("PrimaryInput").Activate
        Range("J57").Value = "=SUM(Transportation_Input!C18:C59)"
        Range("J58").Value = "=SUM(Transportation_Input!D18:D59)"
        Range("J59").Value = "=SUM(Transportation_Input!E18:E59)"

    ElseIf TransForm.ComboBox1.Value = 2006 Then
        Sheets("Transportation_Input").Range("C2:C13").Copy _
        Sheets("PrimaryInput").Range("K43:K54")
        Sheets("Transportation_Input").Range("C15:C16").Select
        Application.CutCopyMode = False
        Selection.Copy Sheets("PrimaryInput").Range("K55:K56")

        Sheets("PrimaryInput").Activate
        Range("K57").Value = "=SUM(Transportation_Input!C18:C59)"
        Range("K58").Value = "=SUM(Transportation_Input!D18:D59)"
        Range("K59").Value = "=SUM(Transportation_Input!E18:E59)"

    ElseIf TransForm.ComboBox1.Value = 2007 Then
        Sheets("Transportation_Input").Range("C2:C13").Copy _
        Sheets("PrimaryInput").Range("L43:L54")
        Sheets("Transportation_Input").Range("C15:C16").Select
        Application.CutCopyMode = False
        Selection.Copy Sheets("PrimaryInput").Range("L55:L56")

        Sheets("PrimaryInput").Activate
        Range("L57").Value = "=SUM(Transportation_Input!C18:C59)"
        Range("L58").Value = "=SUM(Transportation_Input!D18:D59)"
        Range("L59").Value = "=SUM(Transportation_Input!E18:E59)"

    ElseIf TransForm.ComboBox1.Value = 2008 Then
        Sheets("Transportation_Input").Range("C2:C13").Copy _
        Sheets("PrimaryInput").Range("M43:M54")
```

```
        Sheets("Transportation_Input").Range("C15:C16").Select
        Application.CutCopyMode = False
        Selection.Copy Sheets("PrimaryInput").Range("M55:M56")

        Sheets("PrimaryInput").Activate
        Range("M57").Value = "=SUM(Transportation_Input!C18:C59)"
        Range("M58").Value = "=SUM(Transportation_Input!D18:D59)"
        Range("M59").Value = "=SUM(Transportation_Input!E18:E59)"

    ElseIf TransForm.ComboBox1.Value = 2009 Then
        Sheets("Transportation_Input").Range("C2:C13").Copy _
        Sheets("PrimaryInput").Range("N43:N54")
        Sheets("Transportation_Input").Range("C15:C16").Select
        Application.CutCopyMode = False
        Selection.Copy Sheets("PrimaryInput").Range("N55:N56")

        Sheets("PrimaryInput").Activate
        Range("N57").Value = "=SUM(Transportation_Input!C18:C59)"
        Range("N58").Value = "=SUM(Transportation_Input!D18:D59)"
        Range("N59").Value = "=SUM(Transportation_Input!E18:E59)"

    ElseIf TransForm.ComboBox1.Value = 2010 Then
        Sheets("Transportation_Input").Range("C2:C13").Copy _
        Sheets("PrimaryInput").Range("O43:O54")
        Sheets("Transportation_Input").Range("C15:C16").Select
        Application.CutCopyMode = False
        Selection.Copy Sheets("PrimaryInput").Range("O55:O56")

        Sheets("PrimaryInput").Activate
        Range("O57").Value = "=SUM(Transportation_Input!C18:C59)"
        Range("O58").Value = "=SUM(Transportation_Input!D18:D59)"
        Range("O59").Value = "=SUM(Transportation_Input!E18:E59)"
    End If

    Sheets("Interface").Activate
    Application.ScreenUpdating = True
End Sub

Private Sub EnterTransBut_Click()
    Dim i As Long
    Dim MySum As Integer
    MySum = 0
    Dim TransYear As Integer

'   Forces user to select a year
    Select Case TransForm.ComboBox1.Value
        Case Is = ""
            MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
            TransForm.Hide
            Exit Sub
    End Select

    TransYear = TransForm.ComboBox1.Value
'   Activate RawOutput Worksheet
    Application.ScreenUpdating = False
    Sheets("RawOutput").Activate
```

Appendix D: Visual Basic Code

```
'   Import AATA Bus Ridership value and sum bike racks for output
    If TransForm.ComboBox1.Value = 1990 Then
        Range("D791").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("D792").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 1999 Then
        Range("D815").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("D816").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2000 Then
        Range("D839").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("D840").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2001 Then
        Range("D863").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("D864").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2002 Then
        Range("D887").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("D888").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2003 Then
        Range("D911").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("D912").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2004 Then
        Range("D935").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("D936").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2005 Then
        Range("D959").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
```

```
            + TransForm.TextBox4.Value
        Range("D960").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2006 Then
        Range("D983").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("D984").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2007 Then
        Range("D1007").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("D1008").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2008 Then
        Range("D1031").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("D1032").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2009 Then
        Range("D1055").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("1056").Value = MySum
    ElseIf TransForm.ComboBox1.Value = 2010 Then
        Range("1079").Value = TransForm.TextBox5.Value
        MySum = MySum + TransForm.TextBox1.Value _
            + TransForm.TextBox2.Value _
            + TransForm.TextBox3.Value _
            + TransForm.TextBox4.Value
        Range("1080").Value = MySum
    End If

'   Forces user to choose contact information if transportation
'   data has been entered.
'   Writes contact information to "ContactTracking" worksheet
    If (TextBox1.Value <> "" Or TextBox2.Value <> "" Or TextBox3.Value <> "" Or TextBox4.Value <> "") _
        And TransForm.BikeContactCB.Value = "" Then
            MsgBox "Please select a contact"
            Exit Sub
    End If

    If (TextBox1.Value <> "" Or TextBox2.Value <> "" Or TextBox3.Value <> "" Or TextBox4.Value <> "") _
        And TransForm.BikeContactCB.Value <> "" Then
            Sheets("ContactTracking").Cells(21, WorksheetFunction.Match(TransYear, _
            Range("ContactTracking!3:3"), [0])).Value = Right(TransForm.BikeContactCB _
                .Value, (Len(TransForm.BikeContactCB.Value) - WorksheetFunction.Find(" ", _
                    TransForm.BikeContactCB.Value)))
    End If
```

```
    If TextBox5.Value <> "" And TransForm.AATAContactCB.Value = "" Then
        MsgBox "Please select a contact"
        Exit Sub
    Else: If TextBox5.Value <> "" And TransForm.AATAContactCB.Value <> "" _
      Then Sheets("ContactTracking").Cells(22, WorksheetFunction.Match(TransYear, _
        Range("ContactTracking!3:3"), [0])).Value = Right(TransForm. _
          AATAContactCB.Value, (Len(TransForm.AATAContactCB.Value) - WorksheetFunction _
            .Find(" ", TransForm.AATAContactCB.Value)))
    End If
    If TransForm.TransContactCB.Value <> "" Then
      Sheets("ContactTracking").Cells(23, WorksheetFunction.Match(TransYear, _
        Range("ContactTracking!3:3"), [0])).Value = Right(TransForm.TransContactCB _
          .Value, (Len(TransForm.TransContactCB.Value) - WorksheetFunction.Find(" ", _
            TransForm.TransContactCB.Value)))
    End If

'   Summary calculations done in Excel
    Unload TransForm
    Sheets("Interface").Activate
    Application.ScreenUpdating = True
End Sub

Private Sub CancelButton_Click()
    Unload TransForm
End Sub
```

Appendix D: Visual Basic Code

AthleticLandForm

```
Private Sub UserForm_Initialize()
  Dim Contacts As Variant
  Dim i As Integer
  Dim CName As String

  Contacts = Sheets("contactList").Range("ContactNames").Value

'  Enters contact names in each ComboBox
  For i = 1 To UBound(Contacts, 1)
    CName = Contacts(i, 2) & " " & Contacts(i, 1)
    AthleticLandForm.AthLanContactCB.AddItem CName
  Next i
End Sub

Private Sub EnterAthleticBut_Click()
  Dim LandYear As Integer
  Dim LandColumn As Integer
  Dim LandAns As String

'  Forces user to select a year
  Select Case StartForm.LandYearCB.Value
    Case Is = ""
      MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
      MBGNALandForm.Hide
      Exit Sub
  End Select

  LandYear = StartForm.LandYearCB.Value

'  Activate LandUse_Raw Worksheet
  Application.ScreenUpdating = False
  Sheets("PrimaryInput").Activate

'  Defines variables
  LandColumn = WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), 0)

'  This code warns against overwriting Athletic Land Use data
  For a = 61 To 77
    If Worksheets("PrimaryInput").Cells(a, LandColumn).Value <> "" Then
      B = 1
    End If
    B = B + B
  Next a
  If B > 0 And (AthleticLandForm.TextBox2.Value <> "" Or AthleticLandForm.TextBox3.Value <> "" _
    Or AthleticLandForm.TextBox4.Value <> "" Or AthleticLandForm.TextBox5.Value <> "") Then
    LandAns = MsgBox("You are about to overwrite Athletic Land Use data." _
      & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
      Select Case LandAns
        Case vbNo
          Exit Sub
      End Select
  End If
```

Appendix D: Visual Basic Code

```
'   Input athletics land use data for output
    If StartForm.LandYearCB.Value = 1990 Then
        Range("C64").Value = AthleticLandForm.TextBox2.Value
        Range("C67").Value = AthleticLandForm.TextBox3.Value
        Range("C70").Value = AthleticLandForm.TextBox4.Value
        Range("C77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 1999 Then
        Range("D64").Value = AthleticLandForm.TextBox2.Value
        Range("D67").Value = AthleticLandForm.TextBox3.Value
        Range("D70").Value = AthleticLandForm.TextBox4.Value
        Range("D77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2000 Then
'       Range("E61").Value = AthleticLandForm.TextBox1.Value
        Range("E64").Value = AthleticLandForm.TextBox2.Value
        Range("E67").Value = AthleticLandForm.TextBox3.Value
        Range("E70").Value = AthleticLandForm.TextBox4.Value
        Range("E77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2001 Then
        Range("F64").Value = AthleticLandForm.TextBox2.Value
        Range("F67").Value = AthleticLandForm.TextBox3.Value
        Range("F70").Value = AthleticLandForm.TextBox4.Value
        Range("F77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2002 Then
        Range("G64").Value = AthleticLandForm.TextBox2.Value
        Range("G67").Value = AthleticLandForm.TextBox3.Value
        Range("G70").Value = AthleticLandForm.TextBox4.Value
        Range("G77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2003 Then
        Range("H64").Value = AthleticLandForm.TextBox2.Value
        Range("H67").Value = AthleticLandForm.TextBox3.Value
        Range("H70").Value = AthleticLandForm.TextBox4.Value
        Range("H77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2004 Then
        Range("I64").Value = AthleticLandForm.TextBox2.Value
        Range("I67").Value = AthleticLandForm.TextBox3.Value
        Range("I70").Value = AthleticLandForm.TextBox4.Value
        Range("I77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2005 Then
        Range("J64").Value = AthleticLandForm.TextBox2.Value
        Range("J67").Value = AthleticLandForm.TextBox3.Value
        Range("J70").Value = AthleticLandForm.TextBox4.Value
        Range("J77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2006 Then
        Range("K64").Value = AthleticLandForm.TextBox2.Value
        Range("K67").Value = AthleticLandForm.TextBox3.Value
        Range("K70").Value = AthleticLandForm.TextBox4.Value
        Range("K77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2007 Then
        Range("L64").Value = AthleticLandForm.TextBox2.Value
        Range("L67").Value = AthleticLandForm.TextBox3.Value
        Range("L70").Value = AthleticLandForm.TextBox4.Value
        Range("L77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2008 Then
        Range("M64").Value = AthleticLandForm.TextBox2.Value
        Range("M67").Value = AthleticLandForm.TextBox3.Value
        Range("M70").Value = AthleticLandForm.TextBox4.Value
```

```
        Range("M77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2009 Then
        Range("N64").Value = AthleticLandForm.TextBox2.Value
        Range("N67").Value = AthleticLandForm.TextBox3.Value
        Range("N70").Value = AthleticLandForm.TextBox4.Value
        Range("N77").Value = AthleticLandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2010 Then
        Range("O64").Value = AthleticLandForm.TextBox2.Value
        Range("O67").Value = AthleticLandForm.TextBox3.Value
        Range("O70").Value = AthleticLandForm.TextBox4.Value
        Range("O77").Value = AthleticLandForm.TextBox5.Value
    End If

'   Checks if data in PrimaryInput page matches data entered into Textboxes
    If (AthleticLandForm.TextBox2.Value <> "" And Sheets("PrimaryInput").Cells(64, _
        WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (AthleticLandForm.TextBox3.Value <> "" And Sheets("PrimaryInput").Cells(67, _
        WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (AthleticLandForm.TextBox4.Value <> "" And Sheets("PrimaryInput").Cells(70, _
        WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (AthleticLandForm.TextBox5.Value <> "" And Sheets("PrimaryInput").Cells(77, _
        WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") Then
            MsgBox "Data entered successfully!"
            Else
            MsgBox "Data were not entered"
    End If

    If AthleticLandForm.AthLanContactCB.Value = "" And (AthleticLandForm.TextBox2.Value <> "" _
        Or TextBox3.Value <> "" Or TextBox4.Value <> "") Then
        MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
        Exit Sub
    ElseIf AthleticLandForm.AthLanContactCB.Value <> "" And (AthleticLandForm.TextBox2.Value <> "" _
        Or TextBox3.Value <> "" Or TextBox4.Value <> "") Then
        Sheets("ContactTracking").Cells(13, WorksheetFunction.Match(LandYear, _
            Range("ContactTracking!3:3"), [0])).Value = Right(AthleticLandForm.AthLanContactCB _
                .Value, (Len(AthleticLandForm.AthLanContactCB.Value) - WorksheetFunction.Find(" ", _
                    AthleticLandForm.AthLanContactCB.Value)))
    End If

    Sheets("Interface").Activate
    Application.ScreenUpdating = True
    Unload AthleticLandForm
End Sub

Private Sub CancelButton_Click()
    Unload AthleticLandForm
End Sub
```

Appendix D: Visual Basic Code

CampusLandForm

```
Private Sub UserForm_Initialize()
   Dim Contacts As Variant
   Dim i As Integer
   Dim CName As String

   Contacts = Sheets("ContactList").Range("ContactNames").Value

'  Enters contact names in each ComboBox
   For i = 1 To UBound(Contacts, 1)
      CName = Contacts(i, 2) & " " & Contacts(i, 1)
      CampusLandForm.CampLanContactCB.AddItem CName
   Next i
End Sub

Private Sub EnterCampusBut_Click()
   Dim LandYear As Integer
   Dim LandColumn As Integer
   Dim LandAns As String

'  Forces user to select a year
   Select Case StartForm.LandYearCB.Value
      Case Is = ""
         MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
         CampusLandForm.Hide
         Exit Sub
   End Select

   LandYear = StartForm.LandYearCB.Value

'  Activate LandUse_Raw Worksheet
   Application.ScreenUpdating = False
   Sheets("PrimaryInput").Activate

'  Defines variables
   LandColumn = WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), 0)

'  This code warns against overwriting Campus Land Use data
   For a = 60 To 76
      If Worksheets("PrimaryInput").Cells(a, LandColumn).Value <> "" Then
         B = 1
      End If
      B = B + B
   Next a
   If B > 0 And (CampusLandForm.TextBox2.Value <> "" Or CampusLandForm.TextBox3.Value <> "" _
      Or CampusLandForm.TextBox4.Value <> "" Or CampusLandForm.TextBox5.Value <> "") Then
      LandAns = MsgBox("You are about to overwrite Campus Land Use data." _
         & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
         Select Case LandAns
            Case vbNo
               Exit Sub
         End Select
   End If
```

Appendix D: Visual Basic Code

```
'   Input campus land use data for output
    If LandYear = 1990 Then
        Range("C63").Value = CampusLandForm.TextBox2.Value
        Range("C66").Value = CampusLandForm.TextBox3.Value
        Range("C69").Value = CampusLandForm.TextBox4.Value
        Range("C76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 1999 Then
        Range("D63").Value = CampusLandForm.TextBox2.Value
        Range("D66").Value = CampusLandForm.TextBox3.Value
        Range("D69").Value = CampusLandForm.TextBox4.Value
        Range("D76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 2000 Then
        Range("E63").Value = CampusLandForm.TextBox2.Value
        Range("E66").Value = CampusLandForm.TextBox3.Value
        Range("E69").Value = CampusLandForm.TextBox4.Value
        Range("E76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 2001 Then
        Range("F63").Value = CampusLandForm.TextBox2.Value
        Range("F66").Value = CampusLandForm.TextBox3.Value
        Range("F69").Value = CampusLandForm.TextBox4.Value
        Range("F76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 2002 Then
        Range("G63").Value = CampusLandForm.TextBox2.Value
        Range("G66").Value = CampusLandForm.TextBox3.Value
        Range("G69").Value = CampusLandForm.TextBox4.Value
        Range("G76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 2003 Then
        Range("H63").Value = CampusLandForm.TextBox2.Value
        Range("H66").Value = CampusLandForm.TextBox3.Value
        Range("H69").Value = CampusLandForm.TextBox4.Value
        Range("H76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 2004 Then
        Range("I63").Value = CampusLandForm.TextBox2.Value
        Range("I66").Value = CampusLandForm.TextBox3.Value
        Range("I69").Value = CampusLandForm.TextBox4.Value
        Range("I76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 2005 Then
        Range("J63").Value = CampusLandForm.TextBox2.Value
        Range("J66").Value = CampusLandForm.TextBox3.Value
        Range("J69").Value = CampusLandForm.TextBox4.Value
        Range("J76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 2006 Then
        Range("K63").Value = CampusLandForm.TextBox2.Value
        Range("K66").Value = CampusLandForm.TextBox3.Value
        Range("K69").Value = CampusLandForm.TextBox4.Value
        Range("K76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 2007 Then
        Range("L63").Value = CampusLandForm.TextBox2.Value
        Range("L66").Value = CampusLandForm.TextBox3.Value
        Range("L69").Value = CampusLandForm.TextBox4.Value
        Range("L76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 2008 Then
        Range("M63").Value = CampusLandForm.TextBox2.Value
        Range("M66").Value = CampusLandForm.TextBox3.Value
        Range("M69").Value = CampusLandForm.TextBox4.Value
        Range("M76").Value = CampusLandForm.TextBox5.Value
```

```
    ElseIf LandYear = 2009 Then
        Range("N63").Value = CampusLandForm.TextBox2.Value
        Range("N66").Value = CampusLandForm.TextBox3.Value
        Range("N69").Value = CampusLandForm.TextBox4.Value
        Range("N76").Value = CampusLandForm.TextBox5.Value
    ElseIf LandYear = 2010 Then
        Range("O63").Value = CampusLandForm.TextBox2.Value
        Range("O66").Value = CampusLandForm.TextBox3.Value
        Range("O69").Value = CampusLandForm.TextBox4.Value
        Range("O76").Value = CampusLandForm.TextBox5.Value
    End If

'   Checks if data in PrimaryInput page matches data entered into Textboxes
    If (CampusLandForm.TextBox2.Value <> "" And Sheets("PrimaryInput").Cells(63, _
       WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
       Or (CampusLandForm.TextBox3.Value <> "" And Sheets("PrimaryInput").Cells(66, _
       WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
       Or (CampusLandForm.TextBox4.Value <> "" And Sheets("PrimaryInput").Cells(69, _
       WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
       Or (CampusLandForm.TextBox5.Value <> "" And Sheets("PrimaryInput").Cells(76, _
       WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") Then
            MsgBox "Data entered successfully!"
            Else
            MsgBox "Data were not entered"
    End If

    If (CampusLandForm.TextBox2.Value <> "" Or TextBox3.Value <> "" Or TextBox4.Value <> "") _
        And CampLanContactCB.Value = "" Then
            MsgBox "Please select a contact"
            Exit Sub
    End If

    If (CampusLandForm.TextBox2.Value <> "" Or TextBox3.Value <> "" Or TextBox4.Value <> "") _
        And CampLanContactCB.Value <> "" Then
            Sheets("ContactTracking").Cells(12, WorksheetFunction.Match(LandYear, _
            Range("ContactTracking!3:3"), [0])).Value = Right(CampusLandForm.CampLanContactCB _
                .Value, (Len(CampusLandForm.CampLanContactCB.Value) - WorksheetFunction.Find(" ", _
                    CampusLandForm.CampLanContactCB.Value)))
    End If

    Unload CampusLandForm
    Sheets("Interface").Activate
    Application.ScreenUpdating = True
End Sub

Private Sub CancelButton_Click()
    Unload CampusLandForm
End Sub
```

Appendix D: Visual Basic Code

MBGNALandForm

```
Private Sub UserForm_Initialize()
   Dim Contacts As Variant
   Dim i As Integer
   Dim CName As String

   Contacts = Sheets("contactList").Range("ContactNames").Value

'  Enters contact names in each ComboBox
   For i = 1 To UBound(Contacts, 1)
      CName = Contacts(i, 2) & " " & Contacts(i, 1)
      MBGNALandForm.MBGContactCB.AddItem CName
   Next
End Sub

Private Sub EnterMBGNABut_Click()
   Dim LandYear As Integer
   Dim LandColumn As Integer
   Dim LandAns As String

'  Forces user to select a year
   Select Case StartForm.LandYearCB.Value
      Case Is = ""
         MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
         MBGNALandForm.Hide
         Exit Sub
   End Select

   LandYear = StartForm.LandYearCB.Value
   NextColumn = Application.WorksheetFunction.Match(LandYear, Range("ContactTracking!3:3"), 0)

'  Activate LandUse_Raw Worksheet
   Application.ScreenUpdating = False
   Sheets("PrimaryInput").Activate

'  Defines variables
   LandColumn = WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), 0)

'  This code warns against overwriting MBG, NA, Horners Woods, & Mud Lake Bog Land Use data
   For a = 62 To 78
      If Worksheets("PrimaryInput").Cells(a, LandColumn).Value <> "" Then
         B = 1
      End If
      B = B + B
   Next a
   If B > 0 And (MBGNALandForm.TextBox2.Value <> "" Or MBGNALandForm.TextBox3.Value <> "" _
      Or MBGNALandForm.TextBox4.Value <> "" Or MBGNALandForm.TextBox5.Value <> "") Then
      LandAns = MsgBox("You are about to overwrite Land Use data." _
         & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
         Select Case LandAns
            Case vbNo
               Exit Sub
         End Select
   End If
```

Appendix D: Visual Basic Code

```
'   Input campus land use data for output
    If StartForm.LandYearCB.Value = 1990 Then
        Range("C65").Value = MBGNALandForm.TextBox2.Value
        Range("C68").Value = MBGNALandForm.TextBox3.Value
        Range("C71").Value = MBGNALandForm.TextBox4.Value
        Range("C78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 1999 Then
        Range("D65").Value = MBGNALandForm.TextBox2.Value
        Range("D68").Value = MBGNALandForm.TextBox3.Value
        Range("D71").Value = MBGNALandForm.TextBox4.Value
        Range("D78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2000 Then
        Range("E65").Value = MBGNALandForm.TextBox2.Value
        Range("E68").Value = MBGNALandForm.TextBox3.Value
        Range("E71").Value = MBGNALandForm.TextBox4.Value
        Range("E78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2001 Then
        Range("F65").Value = MBGNALandForm.TextBox2.Value
        Range("F68").Value = MBGNALandForm.TextBox3.Value
        Range("F71").Value = MBGNALandForm.TextBox4.Value
        Range("F78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2002 Then
        Range("G65").Value = MBGNALandForm.TextBox2.Value
        Range("G68").Value = MBGNALandForm.TextBox3.Value
        Range("G71").Value = MBGNALandForm.TextBox4.Value
        Range("G78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2003 Then
        Range("H65").Value = MBGNALandForm.TextBox2.Value
        Range("H68").Value = MBGNALandForm.TextBox3.Value
        Range("H71").Value = MBGNALandForm.TextBox4.Value
        Range("H78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2004 Then
        Range("I65").Value = MBGNALandForm.TextBox2.Value
        Range("I68").Value = MBGNALandForm.TextBox3.Value
        Range("I71").Value = MBGNALandForm.TextBox4.Value
        Range("I78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2005 Then
        Range("J65").Value = MBGNALandForm.TextBox2.Value
        Range("J68").Value = MBGNALandForm.TextBox3.Value
        Range("J71").Value = MBGNALandForm.TextBox4.Value
        Range("J78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2006 Then
        Range("K65").Value = MBGNALandForm.TextBox2.Value
        Range("K68").Value = MBGNALandForm.TextBox3.Value
        Range("K71").Value = MBGNALandForm.TextBox4.Value
        Range("K78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2007 Then
        Range("L65").Value = MBGNALandForm.TextBox2.Value
        Range("L68").Value = MBGNALandForm.TextBox3.Value
        Range("L71").Value = MBGNALandForm.TextBox4.Value
        Range("L78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2008 Then
        Range("M65").Value = MBGNALandForm.TextBox2.Value
        Range("M68").Value = MBGNALandForm.TextBox3.Value
        Range("M71").Value = MBGNALandForm.TextBox4.Value
        Range("M78").Value = MBGNALandForm.TextBox5.Value
```

```
    ElseIf StartForm.LandYearCB.Value = 2009 Then
        Range("N65").Value = MBGNALandForm.TextBox2.Value
        Range("N68").Value = MBGNALandForm.TextBox3.Value
        Range("N71").Value = MBGNALandForm.TextBox4.Value
        Range("N78").Value = MBGNALandForm.TextBox5.Value
    ElseIf StartForm.LandYearCB.Value = 2010 Then
        Range("O65").Value = MBGNALandForm.TextBox2.Value
        Range("O68").Value = MBGNALandForm.TextBox3.Value
        Range("O71").Value = MBGNALandForm.TextBox4.Value
        Range("O78").Value = MBGNALandForm.TextBox5.Value
    End If

'   Checks if data in PrimaryInput page matches data entered into Textboxes
    If (MBGNALandForm.TextBox2.Value <> "" And Sheets("PrimaryInput").Cells(65, _
        WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (MBGNALandForm.TextBox3.Value <> "" And Sheets("PrimaryInput").Cells(68, _
        WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (MBGNALandForm.TextBox4.Value <> "" And Sheets("PrimaryInput").Cells(71, _
        WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (MBGNALandForm.TextBox5.Value <> "" And Sheets("PrimaryInput").Cells(78, _
        WorksheetFunction.Match(LandYear, Range("PrimaryInput!3:3"), [0])).Value <> "") Then
            MsgBox "Data entered successfully!"
            Else
            MsgBox "Data were not entered"
    End If

    If MBGNALandForm.MBGContactCB.Value = "" And (MBGNALandForm.TextBox2.Value <> "" _
        Or TextBox3.Value <> "" Or TextBox4.Value <> "") Then
        MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
        Exit Sub
    ElseIf MBGNALandForm.MBGContactCB.Value <> "" And (MBGNALandForm.TextBox2.Value <> "" _
        Or TextBox3.Value <> "" Or TextBox4.Value <> "") Then
            Sheets("ContactTracking").Cells(14, WorksheetFunction.Match(LandYear, _
            Range("ContactTracking!3:3"), [0])).Value = Right(MBGNALandForm.MBGContactCB _
                .Value, (Len(MBGNALandForm.MBGContactCB.Value) - WorksheetFunction.Find(" ", _
                    MBGNALandForm.MBGContactCB.Value)))
    End If

    Sheets("Interface").Activate
    Application.ScreenUpdating = True
    Unload MBGNALandForm
End Sub

Private Sub CancelButton_Click()
    Unload MBGNALandForm
End Sub
```

Appendix D: Visual Basic Code

EmissionsForm

```
Private Sub AddContactBut_Click()
   AddContactForm.Show
End Sub

Private Sub UserForm_Initialize()
   Dim Contacts As Variant
   Dim i As Integer
   Dim CName As String

   Contacts = Sheets("contactList").Range("ContactNames").Value

'   Enters contact names in each ComboBox
   For i = 1 To UBound(Contacts, 1)
      CName = Contacts(i, 2) & " " & Contacts(i, 1)
      EmissionsForm.EmissContactCB.AddItem CName
      EmissionsForm.SalSanContactCB.AddItem CName
   Next i

   With ComboBox1
      .AddItem "1990"
      .AddItem "1999"
      .AddItem "2000"
      .AddItem "2001"
      .AddItem "2002"
      .AddItem "2003"
      .AddItem "2004"
      .AddItem "2005"
      .AddItem "2006"
      .AddItem "2007"
      .AddItem "2008"
      .AddItem "2009"
      .AddItem "2010"
   End With

End Sub

'In future insert Command button to show FertPestForm and write code to import data

Private Sub EnterEmissBut_Click()
   Dim EmissYear As Integer
   Dim EmissColumn As Integer
   Dim EmissAns As String

'   Forces user to select a year
   Select Case EmissionsForm.ComboBox1.Value
      Case Is = ""
         MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
         Exit Sub
   End Select

   EmissYear = EmissionsForm.ComboBox1.Value

'   Activate Emissions_Raw Worksheet
   Application.ScreenUpdating = False
```

```
    Sheets("PrimaryInput").Activate

'   Defines variable, "EmissYear"
    EmissYear = EmissionsForm.ComboBox1.Value
    EmissColumn = WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), 0)

'   This code warns against overwriting Emissions data
    For a = 79 To 89
        If Worksheets("PrimaryInput").Cells(a, EmissColumn).Value <> "" Then
            B = 1
        End If
        B = B + B
    Next a
    If B > 0 And (EmissionsForm.TextBox1.Value <> "" Or EmissionsForm.TextBox2.Value <> "" Or _
        EmissionsForm.TextBox3.Value <> "" Or EmissionsForm.TextBox4.Value <> "" _
        Or EmissionsForm.TextBox5.Value <> "" Or EmissionsForm.TextBox6.Value <> "" _
        Or EmissionsForm.TextBox7.Value <> "" Or EmissionsForm.TextBox8.Value <> "" _
        Or EmissionsForm.TextBox10.Value <> "" Or EmissionsForm.TextBox11.Value <> "") Then
        EmissAns = MsgBox("You are about to overwrite Emissions data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case EmissAns
                Case vbNo
                    Exit Sub
            End Select
    End If

'   Input pounds of emissions, salt and sand
    If EmissionsForm.ComboBox1.Value = 1990 Then
        Range("C79").Value = EmissionsForm.TextBox1.Value
        Range("C81").Value = EmissionsForm.TextBox2.Value
        Range("C82").Value = EmissionsForm.TextBox3.Value
        Range("C83").Value = EmissionsForm.TextBox4.Value
        Range("C84").Value = EmissionsForm.TextBox5.Value
        Range("C85").Value = EmissionsForm.TextBox6.Value
        Range("C86").Value = EmissionsForm.TextBox7.Value
        Range("C87").Value = EmissionsForm.TextBox8.Value
        Range("C88").Value = EmissionsForm.TextBox10.Value
        Range("C89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 1999 Then
        Range("D79").Value = EmissionsForm.TextBox1.Value
        Range("D81").Value = EmissionsForm.TextBox2.Value
        Range("D82").Value = EmissionsForm.TextBox3.Value
        Range("D83").Value = EmissionsForm.TextBox4.Value
        Range("D84").Value = EmissionsForm.TextBox5.Value
        Range("D85").Value = EmissionsForm.TextBox6.Value
        Range("D86").Value = EmissionsForm.TextBox7.Value
        Range("D87").Value = EmissionsForm.TextBox8.Value
        Range("D88").Value = EmissionsForm.TextBox10.Value
        Range("D89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2000 Then
        Range("E79").Value = EmissionsForm.TextBox1.Value
        Range("E81").Value = EmissionsForm.TextBox2.Value
        Range("E82").Value = EmissionsForm.TextBox3.Value
        Range("E83").Value = EmissionsForm.TextBox4.Value
        Range("E84").Value = EmissionsForm.TextBox5.Value
        Range("E85").Value = EmissionsForm.TextBox6.Value
```

```
        Range("E86").Value = EmissionsForm.TextBox7.Value
        Range("E87").Value = EmissionsForm.TextBox8.Value
        Range("E88").Value = EmissionsForm.TextBox10.Value
        Range("E89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2001 Then
        Range("F79").Value = EmissionsForm.TextBox1.Value
        Range("F81").Value = EmissionsForm.TextBox2.Value
        Range("F82").Value = EmissionsForm.TextBox3.Value
        Range("F83").Value = EmissionsForm.TextBox4.Value
        Range("F84").Value = EmissionsForm.TextBox5.Value
        Range("F85").Value = EmissionsForm.TextBox6.Value
        Range("F86").Value = EmissionsForm.TextBox7.Value
        Range("F87").Value = EmissionsForm.TextBox8.Value
        Range("F88").Value = EmissionsForm.TextBox10.Value
        Range("F89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2002 Then
        Range("G79").Value = EmissionsForm.TextBox1.Value
        Range("G81").Value = EmissionsForm.TextBox2.Value
        Range("G82").Value = EmissionsForm.TextBox3.Value
        Range("G83").Value = EmissionsForm.TextBox4.Value
        Range("G84").Value = EmissionsForm.TextBox5.Value
        Range("G85").Value = EmissionsForm.TextBox6.Value
        Range("G86").Value = EmissionsForm.TextBox7.Value
        Range("G87").Value = EmissionsForm.TextBox8.Value
        Range("G88").Value = EmissionsForm.TextBox10.Value
        Range("G89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2003 Then
        Range("H79").Value = EmissionsForm.TextBox1.Value
        Range("H81").Value = EmissionsForm.TextBox2.Value
        Range("H82").Value = EmissionsForm.TextBox3.Value
        Range("H83").Value = EmissionsForm.TextBox4.Value
        Range("H84").Value = EmissionsForm.TextBox5.Value
        Range("H85").Value = EmissionsForm.TextBox6.Value
        Range("H86").Value = EmissionsForm.TextBox7.Value
        Range("H87").Value = EmissionsForm.TextBox8.Value
        Range("H88").Value = EmissionsForm.TextBox10.Value
        Range("H89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2004 Then
        Range("I79").Value = EmissionsForm.TextBox1.Value
        Range("I81").Value = EmissionsForm.TextBox2.Value
        Range("I82").Value = EmissionsForm.TextBox3.Value
        Range("I83").Value = EmissionsForm.TextBox4.Value
        Range("I84").Value = EmissionsForm.TextBox5.Value
        Range("I85").Value = EmissionsForm.TextBox6.Value
        Range("I86").Value = EmissionsForm.TextBox7.Value
        Range("I87").Value = EmissionsForm.TextBox8.Value
        Range("I88").Value = EmissionsForm.TextBox10.Value
        Range("I89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2005 Then
        Range("J79").Value = EmissionsForm.TextBox1.Value
        Range("J81").Value = EmissionsForm.TextBox2.Value
        Range("J82").Value = EmissionsForm.TextBox3.Value
        Range("J83").Value = EmissionsForm.TextBox4.Value
        Range("J84").Value = EmissionsForm.TextBox5.Value
        Range("J85").Value = EmissionsForm.TextBox6.Value
        Range("J86").Value = EmissionsForm.TextBox7.Value
```

```
        Range("J87").Value = EmissionsForm.TextBox8.Value
        Range("J88").Value = EmissionsForm.TextBox10.Value
        Range("J89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2006 Then
        Range("K79").Value = EmissionsForm.TextBox1.Value
        Range("K81").Value = EmissionsForm.TextBox2.Value
        Range("K82").Value = EmissionsForm.TextBox3.Value
        Range("K83").Value = EmissionsForm.TextBox4.Value
        Range("K84").Value = EmissionsForm.TextBox5.Value
        Range("K85").Value = EmissionsForm.TextBox6.Value
        Range("K86").Value = EmissionsForm.TextBox7.Value
        Range("K87").Value = EmissionsForm.TextBox8.Value
        Range("K88").Value = EmissionsForm.TextBox10.Value
        Range("K89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2007 Then
        Range("L79").Value = EmissionsForm.TextBox1.Value
        Range("L81").Value = EmissionsForm.TextBox2.Value
        Range("L82").Value = EmissionsForm.TextBox3.Value
        Range("L83").Value = EmissionsForm.TextBox4.Value
        Range("L84").Value = EmissionsForm.TextBox5.Value
        Range("L85").Value = EmissionsForm.TextBox6.Value
        Range("L86").Value = EmissionsForm.TextBox7.Value
        Range("L87").Value = EmissionsForm.TextBox8.Value
        Range("L88").Value = EmissionsForm.TextBox10.Value
        Range("L89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2008 Then
        Range("M79").Value = EmissionsForm.TextBox1.Value
        Range("M81").Value = EmissionsForm.TextBox2.Value
        Range("M82").Value = EmissionsForm.TextBox3.Value
        Range("M83").Value = EmissionsForm.TextBox4.Value
        Range("M84").Value = EmissionsForm.TextBox5.Value
        Range("M85").Value = EmissionsForm.TextBox6.Value
        Range("M86").Value = EmissionsForm.TextBox7.Value
        Range("M87").Value = EmissionsForm.TextBox8.Value
        Range("M88").Value = EmissionsForm.TextBox10.Value
        Range("M89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2009 Then
        Range("N79").Value = EmissionsForm.TextBox1.Value
        Range("N81").Value = EmissionsForm.TextBox2.Value
        Range("N82").Value = EmissionsForm.TextBox3.Value
        Range("N83").Value = EmissionsForm.TextBox4.Value
        Range("N84").Value = EmissionsForm.TextBox5.Value
        Range("N85").Value = EmissionsForm.TextBox6.Value
        Range("N86").Value = EmissionsForm.TextBox7.Value
        Range("N87").Value = EmissionsForm.TextBox8.Value
        Range("N88").Value = EmissionsForm.TextBox10.Value
        Range("N89").Value = EmissionsForm.TextBox11.Value
    ElseIf EmissionsForm.ComboBox1.Value = 2010 Then
        Range("O79").Value = EmissionsForm.TextBox1.Value
        Range("O81").Value = EmissionsForm.TextBox2.Value
        Range("O82").Value = EmissionsForm.TextBox3.Value
        Range("O83").Value = EmissionsForm.TextBox4.Value
        Range("O84").Value = EmissionsForm.TextBox5.Value
        Range("O85").Value = EmissionsForm.TextBox6.Value
        Range("O86").Value = EmissionsForm.TextBox7.Value
        Range("O87").Value = EmissionsForm.TextBox8.Value
```

```
        Range("O88").Value = EmissionsForm.TextBox10.Value
        Range("O89").Value = EmissionsForm.TextBox11.Value
    End If

'   Checks if data in PrimaryInput page matches data entered into Textboxes
    If (EmissionsForm.TextBox1.Value <> "" And Sheets("PrimaryInput").Cells(79, _
        WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (EmissionsForm.TextBox2.Value <> "" And Sheets("PrimaryInput").Cells(81, _
        WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (EmissionsForm.TextBox3.Value <> "" And Sheets("PrimaryInput").Cells(82, _
        WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (EmissionsForm.TextBox4.Value <> "" And Sheets("PrimaryInput").Cells(83, _
        WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (EmissionsForm.TextBox5.Value <> "" And Sheets("PrimaryInput").Cells(84, _
        WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (EmissionsForm.TextBox6.Value <> "" And Sheets("PrimaryInput").Cells(85, _
        WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (EmissionsForm.TextBox7.Value <> "" And Sheets("PrimaryInput").Cells(86, _
        WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (EmissionsForm.TextBox8.Value <> "" And Sheets("PrimaryInput").Cells(87, _
        WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (EmissionsForm.TextBox10.Value <> "" And Sheets("PrimaryInput").Cells(88, _
        WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), [0])).Value <> "") _
        Or (EmissionsForm.TextBox11.Value <> "" And Sheets("PrimaryInput").Cells(89, _
        WorksheetFunction.Match(EmissYear, Range("PrimaryInput!3:3"), [0])).Value <> "") Then
            MsgBox "Data entered successfully!"
            Else
            MsgBox "Data were not entered"
    End If
    If (TextBox1.Value <> "" And EmissContactCB.Value = "") Or (TextBox10.Value <> "" And _
        SalSanContactCB.Value = "") Then
            MsgBox "Please select a contact"
            Exit Sub
    End If
    If TextBox1.Value <> "" And EmissContactCB.Value <> "" Then
        EmissYear = EmissionsForm.ComboBox1.Value
          Sheets("ContactTracking").Cells(17, WorksheetFunction.Match(EmissYear, _
           Range("ContactTracking!3:3"), [0])).Value = Right(EmissionsForm.EmissContactCB _
              .Value, (Len(EmissionsForm.EmissContactCB.Value) - WorksheetFunction.Find(" ", _
                 EmissionsForm.EmissContactCB.Value)))
    End If
    If TextBox10.Value <> "" And SalSanContactCB.Value <> "" Then
        EmissYear = EmissionsForm.ComboBox1.Value
          Sheets("ContactTracking").Cells(18, WorksheetFunction.Match(EmissYear, _
           Range("ContactTracking!3:3"), [0])).Value = Right(EmissionsForm.SalSanContactCB _
              .Value, (Len(EmissionsForm.SalSanContactCB.Value) - WorksheetFunction.Find(" ", _
                 EmissionsForm.SalSanContactCB.Value)))
    End If
    Unload EmissionsForm
    Sheets("Interface").Activate
    Application.ScreenUpdating = True
End Sub

Private Sub CancelButton_Click()
    Unload EmissionsForm
End Sub
```

Appendix D: Visual Basic Code

WMS_Input

```
Option Explicit

Private Sub RegRecBut_Click()
   RegRecycleForm.Show
End Sub

Private Sub AddContactBut_Click()
   AddContactForm.Show
End Sub

Private Sub GlassDefCB_Click()
'   Toggles default and user-specified value
'   for % mixed containers is glass
   Select Case GlassDefCB.Value
      Case False: WMS_Input.GlassPer.Value = ""
      Case True: WMS_Input.GlassPer.Value = 56
      End Select
End Sub

Private Sub MetalDefCB_Click()
'   Toggles default and user-specified value
'   for % mixed containers is metal
   Select Case MetalDefCB.Value
      Case False: WMS_Input.MetalPer.Value = ""
      Case True: WMS_Input.MetalPer.Value = 12.5
      End Select
End Sub

Private Sub PlasticDefCB_Click()
'   Toggles default and user-specified value
'   for % mixed containers is plastic
   Select Case PlasticDefCB.Value
      Case False: WMS_Input.PlasticPer.Value = ""
      Case True: WMS_Input.PlasticPer.Value = 18.5
      End Select
End Sub

Private Sub WMSChoose_Click()
'   Selects name of data module to import
'   Sub GetWMSImportFilename()
   Dim Filt As String
   Dim FilterIndex As Integer
   Dim Title As String
   Dim WMSFileName As Variant

'   Sets up list of file filters
   Filt = "Comma Separated Files (*.csv),*.csv," & _
         "Excel Files (*.xls),*.xls," & _
         "All Files (*.*),*.*"

'   Displays *.csv by default
   FilterIndex = 2

'   Sets the dialog box caption
```

```
    Title = "Select WMS File to Import"

'   Gets the file name
    WMSFileName = Application.GetOpenFilename _
        (FileFilter:=Filt, _
         FilterIndex:=FilterIndex, _
         Title:=Title)

'   Exits if dialog box canceled
    If WMSFileName = False Then
        MsgBox "No file was selected"
        Exit Sub
    End If

'   Displays full path and name of the WMS file
    WMS_Input.WMSFileName.Value = WMSFileName
End Sub

Private Sub WMSImport_Click()
'   Imports WMS data, both from input module and manually-entered
'   data fields.
    Dim c As Variant
    Dim WMSYear As Integer
    Dim NextColumn As Integer
    Dim D As Range
    Dim ReuseSum As Variant
    Dim firstAddress As String
    Dim Reuse_Range As Range
    Dim a As Integer, B As Integer
    Dim WMSans As String, WMSans2 As Boolean
    ReuseSum = 0
    Dim NumRows As Long, NumCols As Integer
    Dim x As Long, y As Integer
    Dim WMSData
    Dim ExpRng As Range
    Dim csvFileName As String, ModelName As String

    ModelName = ActiveWorkbook.Name

'   Forces user to select a year
    Select Case WMS_Input.WMSYear.Value
        Case Is = ""
            MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
            Exit Sub
    End Select

    Application.ScreenUpdating = False
'   Defines variables, WMSYear and NextColumn
    WMSYear = WMS_Input.WMSYear.Value
    NextColumn = Application.WorksheetFunction.Match(WMSYear, Range("PrimaryInput!3:3"), 0)

'   Performs check if WMS data has already been imported for selected year
'   Prompts user for data overwrite
    For a = 29 To 43
        If Sheets("PrimaryInput").Cells(a, NextColumn).Value <> "" Then
            B = 1 + B
```

```
        End If
    Next a
    If B > 0 And WMS_Input.WMSFileName.Value <> "" Then
        WMSans = MsgBox("You are about to overwrite WMS data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
            Select Case WMSans
                Case vbNo
                    WMS_Input.WMSFileName.Value = ""
                    WMS_Input.WMSYear.Value = ""
                    Exit Sub
            End Select
    End If

'   Assures that data contact has been selected and writes contact to "ContactTracking" worksheet
    If WMS_Input.MulchContactCB.Value = "" And WMS_Input.MulchVol.Value <> "" Then
        MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
        Exit Sub
    ElseIf WMS_Input.MulchContactCB.Value <> "" And WMS_Input.MulchVol.Value <> "" Then
        Sheets("ContactTracking").Cells(7, WorksheetFunction.Match(WMSYear, _
            Range("ContactTracking!3:3"), [0])).Value = Right(WMS_Input.MulchContactCB _
                .Value, (Len(WMS_Input.MulchContactCB.Value) - WorksheetFunction.Find(" ", _
                    WMS_Input.MulchContactCB.Value)))
    End If
    If WMS_Input.PDContactCB.Value = "" And WMS_Input.PDTB.Value <> "" Then
        MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
        Exit Sub
    ElseIf WMS_Input.PDContactCB.Value <> "" And WMS_Input.PDTB.Value <> "" Then
        Sheets("ContactTracking").Cells(6, WorksheetFunction.Match(WMSYear, _
            Range("ContactTracking!3:3"), [0])).Value = Right(WMS_Input.PDContactCB _
                .Value, (Len(WMS_Input.PDContactCB.Value) - WorksheetFunction.Find(" ", _
                    WMS_Input.PDContactCB.Value)))
    End If
    If WMS_Input.MixContactCB.Value <> "" Then
        Sheets("ContactTracking").Cells(4, WorksheetFunction.Match(WMSYear, _
            Range("ContactTracking!3:3"), [0])).Value = Right(WMS_Input.MixContactCB _
                .Value, (Len(WMS_Input.MixContactCB.Value) - WorksheetFunction.Find(" ", _
                    WMS_Input.MixContactCB.Value)))
    End If
    If WMS_Input.RegContactCB.Value = "" And WMS_Input.BattTB.Value <> "" Then
        MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
        Exit Sub
    ElseIf WMS_Input.RegContactCB.Value <> "" Then
        Sheets("ContactTracking").Cells(27, WorksheetFunction.Match(WMSYear, _
            Range("ContactTracking!3:3"), [0])).Value = Right(WMS_Input.RegContactCB _
                .Value, (Len(WMS_Input.RegContactCB.Value) - WorksheetFunction.Find(" ", _
                    WMS_Input.RegContactCB.Value)))
    End If

'   Imports .xls sheet if input module was selected and converts to .csv file
'   Alerts user if the incorrect input module was not selected
    ElseIf WMS_Input.WMSFileName.Value <> "" Then
        Workbooks.Open Filename:=WMSFileName
        Sheets(1).Activate
        If Range("A1").Value <> "Name:" Then
            MsgBox "The incorrect file was selected. Please make the correct selection."
            WMS_Input.WMSFileName.Value = ""
```

```
            WMS_Input.WMSYear.Value = ""
            Exit Sub
        End If
        If Range("B1").Value = "" Then
            MsgBox "Contact information was not entered in WMS_InputMod." & vbCrLf & _
                "Please open the file and enter the missing information."
            WMS_Input.WMSFileName.Value = ""
            WMS_Input.WMSYear.Value = ""
            Exit Sub
        End If
        Set ExpRng = Range("a1:f64")
        NumCols = ExpRng.Columns.Count
        NumRows = ExpRng.Rows.Count
        csvFileName = Workbooks(ModelName).Path & "\" & "WMS_InputMod.csv"
        Open csvFileName For Output As #1
            For y = 1 To NumRows
                For x = 1 To NumCols
                    WMSData = ExpRng.Cells(y, x).Value
                    If IsNumeric(WMSData) Then WMSData = Val(WMSData)
                    If IsEmpty(ExpRng.Cells(y, x)) Then WMSData = ""
                    If x <> NumCols Then
                        Write #1, WMSData;
                    Else
                        Write #1, WMSData
                    End If
                Next x
            Next y
        Close #1
        ActiveWorkbook.Close savechanges:=False

'   Imports the .csv file to
        Workbooks(ModelName).Sheets("HidInput").Activate
        With ActiveSheet.QueryTables.Add(Connection:= _
            "TEXT;" & csvFileName, Destination:=Range("A1"))
            .FieldNames = True
            .RowNumbers = False
            .FillAdjacentFormulas = False
            .PreserveFormatting = True
            .RefreshOnFileOpen = False
            .RefreshStyle = xlOverwriteCells
            .SavePassword = False
            .SaveData = True
            .AdjustColumnWidth = False
            .RefreshPeriod = 0
            .TextFilePromptOnRefresh = False
            .TextFilePlatform = xlWindows
            .TextFileStartRow = 1
            .TextFileParseType = xlDelimited
            .TextFileTextQualifier = xlTextQualifierDoubleQuote
            .TextFileCommaDelimiter = True
            .TextFileColumnDataTypes = Array(1, 1, 1, 1, 1)
        On Error Resume Next
            .Refresh BackgroundQuery:=False
        End With
    End If
```

Appendix D: Visual Basic Code

```
'   Copies and pastes imported data only if input module was selected
    If WMS_Input.WMSFileName.Value <> "" Then
        Worksheets("HidInput").Range("E7:E14").Copy Worksheets("PrimaryInput") _
            .Cells(4, NextColumn)
        Worksheets("HidInput").Range("c18,c20").Copy Worksheets("PrimaryInput") _
            .Cells(41, NextColumn)
        Worksheets("HidInput").Range("D35:D37,D40:D49").Copy Worksheets _
            ("PrimaryInput").Cells(28, NextColumn)
        Worksheets("HidInput").Range("C27:C30").Copy Worksheets("PrimaryInput") _
            .Cells(13, NextColumn)
        Worksheets("ContactTracking").Cells(5, NextColumn - 1).Value = Right(Worksheets _
            ("HidInput").Range("B1").Value, (Len(Worksheets("HidInput").Range("B1") _
                .Value) - WorksheetFunction.Find(" ", Worksheets("HidInput") _
                    .Range("B1").Value)))
    End If

'   Prompts the user for data overwrite.
'   Pastes values from textboxes to "PrimaryInput" worksheet only if textbox is not null
   If WMS_Input.MulchVol.Value <> "" And Sheets("PrimaryInput") _
       .Cells(12, NextColumn).Value <> "" Then
           WMSans = MsgBox("You are about to overwrite WMS data." _
               & vbNewLine & "Do you wish to continue?", vbYesNo, _
                   "Caution: Data Overwrite")
           Select Case WMSans
               Case vbNo
                   Exit Sub
               Case vbYes
                   Worksheets("PrimaryInput").Cells(12, NextColumn).Value _
                       = WMS_Input.MulchVol.Value
           End Select
    ElseIf WMS_Input.MulchVol.Value <> "" And Sheets("PrimaryInput") _
            .Cells(12, NextColumn).Value = "" Then
                Worksheets("PrimaryInput").Cells(12, NextColumn).Value _
                    = WMS_Input.MulchVol.Value
    End If

'   Pastes default or user input data for mulch conversion and mixed container %'s
    If WMS_Input.MixContactCB.Value = "" And WMS_Input.WMSFileName.Value <> "" Then
        MsgBox "Please select a mixed container % contact", vbOKOnly, "Contact Info Not Specified"
        Exit Sub
    End If
    Worksheets("SecondaryInput").Cells(12, NextColumn + 1).Value = WMS_Input.GlassPer.Value / 100
    Worksheets("SecondaryInput").Cells(13, NextColumn + 1).Value = WMS_Input.PlasticPer.Value / 100
    Worksheets("SecondaryInput").Cells(14, NextColumn + 1).Value = WMS_Input.MetalPer.Value / 100

'   Finds the cells with "pounds" and sums the values of cells that are directly left
'   Sums data from housing moveout and recycle Ann Arbor items
'   Pastes sum into worksheet
    Set Reuse_Range = Worksheets("HidInput").Range("a51:g70")
    With Reuse_Range
        Set D = .Find("pounds", LookIn:=xlValues)
        If Not D Is Nothing Then
            firstAddress = D.Address
            Do
                ReuseSum = ReuseSum + D.Offset(0, -1).Value
                Set D = .FindNext(D)
```

```
            Loop While Not D Is Nothing And D.Address <> firstAddress
        End If
    End With

  Worksheets("PrimaryInput").Cells(27, NextColumn).Value = ReuseSum

'  Clears "HinInput" worksheet
    Sheets("HidInput").Cells.Clear
    MsgBox "Data entered successfully."
    Unload WMS_Input
    Sheets("Interface").Activate
    Application.ScreenUpdating = True
End Sub

Private Sub UserForm_Initialize()
    Dim Contacts As Variant
    Dim i As Integer
    Dim CName As String

    Contacts = Sheets("ContactList").Range("ContactNames").Value

'   Enters contact names in each ComboBox
    For i = 1 To UBound(Contacts, 1)
        CName = Contacts(i, 2) & " " & Contacts(i, 1)
        WMS_Input.PDContactCB.AddItem CName
        WMS_Input.MulchContactCB.AddItem CName
        WMS_Input.MixContactCB.AddItem CName
    Next i

'   Adds years to dropdown menu
    With WMSYear
        .AddItem "2000"
        .AddItem "2001"
        .AddItem "2002"
        .AddItem "2003"
        .AddItem "2004"
        .AddItem "2005"
        .AddItem "2006"
        .AddItem "2007"
        .AddItem "2008"
        .AddItem "2009"
        .AddItem "2010"
    End With

'   Sets defult values or user-defined values for mixed containers and mulch
    WMS_Input.GlassPer.Value = 56
    WMS_Input.PlasticPer.Value = 18.5
    WMS_Input.MetalPer.Value = 12.5
End Sub
```

Appendix D: Visual Basic Code

UHS_Input

```
Option Explicit

Private Sub AddContactBut_Click()
   AddContactForm.Show
End Sub

Private Sub EnterButton_Click()
'   Pastes UHS data into worksheet
   Dim NextColumn As Integer
   Dim UHSyear As Integer
   Dim UHSTB(6) As Variant
   Dim i As Integer, a As Integer, B As Integer
   Dim TB As TextBox
   Dim UHSans As Variant
   B = 0

'   Forces user to select a year
   Select Case UHS_Input.UHS_Year.Value
      Case Is = ""
         MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
         Exit Sub
   End Select

   UHSyear = UHS_Input.UHS_Year.Value
'   Matches input columns to year of data
   NextColumn = Application.WorksheetFunction.Match(UHSyear, Range("PrimaryInput!3:3"), 0)

'   Stores textbox values in the UHSTB array
   UHSTB(0) = UHS_Input.UHSrefuseTB.Value
   UHSTB(1) = UHSpaperTB.Value
   UHSTB(2) = UHScardTB.Value
   UHSTB(3) = UHSwoodTB.Value
   UHSTB(4) = UHSmetalTB.Value
   UHSTB(5) = UHSplasticTB.Value
   UHSTB(6) = UHSgreaseTB.Value

'   Assures that data contact has been selected and writes contact to "ContactTracking" worksheet
   Select Case UHS_Input.UHContactCB.Value
      Case Is = ""
         MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
         Exit Sub
      Case Is <> ""
      Sheets("ContactTracking").Cells(8, WorksheetFunction.Match(UHSyear, _
         Range("ContactTracking!3:3"), [0])).Value = Right(UHS_Input.UHContactCB _
            .Value, (Len(UHS_Input.UHContactCB.Value) - WorksheetFunction.Find(" ", _
               UHS_Input.UHContactCB.Value)))
   End Select

'   Checks if UHS data has already been entered and cautions user of overwrite
   For a = 0 To 6
      If UHSTB(a) <> "" And Worksheets("PrimaryInput").Cells _
         (a + 17, NextColumn).Value <> "" Then
      B = B + 1
      End If
```

```
    Next a

    If B > 0 Then
        UHSans = MsgBox("You are about to overwrite UHS data." _
            & vbNewLine & "Do you wish to continue?", vbYesNo, "Caution: Data Overwrite")
        Select Case UHSans
            Case vbNo
                Exit Sub
        End Select
    End If

'   Only pastes data that is entered in textboxes
'   Null textbox values will not be pasted in the sheet
    For i = 0 To UBound(UHSTB)
        If UHSTB(i) <> "" Then
            Sheets("PrimaryInput").Cells(17 + i, NextColumn) = UHSTB(i)
        End If
    Next i

    Unload UHS_Input
End Sub

Private Sub UserForm_Initialize()
    Dim Contacts As Variant
    Dim i As Integer
    Dim CName As String

    Contacts = Sheets("ContactList").Range("ContactNames").Value

'   Enters contact names in each ComboBox
    For i = 1 To UBound(Contacts, 1)
    CName = Contacts(i, 2) & " " & Contacts(i, 1)
        UHS_Input.UHContactCB.AddItem CName
    Next i

    With UHS_Year
        .AddItem "2000"
        .AddItem "2001"
        .AddItem "2002"
        .AddItem "2003"
        .AddItem "2004"
        .AddItem "2005"
        .AddItem "2006"
        .AddItem "2007"
        .AddItem "2008"
        .AddItem "2009"
        .AddItem "2010"
    End With
End Sub
```

Appendix D: Visual Basic Code

RegRecyclingForm

```
Option Explicit

Private Sub ContactBut_Click()
   Load AddContactForm
   AddContactForm.Show
End Sub

Private Sub EntDataBut_Click()

Dim RegYear As Integer
Dim RegTB(9) As Variant
Dim a As Integer, B As Integer, c As Integer, D As Integer, e As Integer, f As Integer
Dim NextColumn As Integer
Dim RegAns As Variant
Dim SolidCheck As Boolean
Dim LiquidCheck As Boolean

   Application.ScreenUpdating = False
'  Forces user to select a year
   Select Case RegRecycleForm.RegYearCB.Value
      Case Is = ""
         MsgBox "Please select a year", vbOKOnly, "Year Not Specified"
         Exit Sub
   End Select

   RegYear = RegRecycleForm.RegYearCB.Value
   NextColumn = Application.WorksheetFunction.Match(RegYear, _
      Range("PrimaryInput!3:3"), 0)

'  Stores each textbox value in the array RegTB()
   RegTB(0) = BattTB.Value
   RegTB(1) = LBTB.Value
   RegTB(2) = CETB.Value
   RegTB(3) = FLBTB.Value
   RegTB(4) = AcetoneTB.Value
   RegTB(5) = XyleneTB.Value
   RegTB(6) = FormalinTB.Value
   RegTB(7) = TransOilTB.Value
   RegTB(8) = LatexTB.Value
   RegTB(9) = CoolTB.Value

'  Assures that data contact has been selected and writes contact to "ContactTracking" worksheet
   If RegRecycleForm.RegContactCB.Value = "" Then
      MsgBox "Please select a contact", vbOKOnly, "Contact Info Not Specified"
      Exit Sub
   ElseIf RegRecycleForm.RegContactCB.Value <> "" Then
      Sheets("ContactTracking").Cells(27, WorksheetFunction.Match(RegYear, _
         Range("ContactTracking!3:3"), [0])).Value = Right(RegRecycleForm _
            .RegContactCB.Value, (Len(RegRecycleForm.RegContactCB _
               .Value) - WorksheetFunction.Find(" ", RegRecycleForm _
                  .RegContactCB.Value)))
   End If

'  If any values have been entered into textboxes 0 to 3, B will be >0
```

```
'   and the sum of the textbox values is stored as SolidSum
    For a = 0 To 3
        If RegTB(a) <> "" And Worksheets("PrimaryInput").Cells _
            (a + 106, NextColumn).Value <> "" Then B = B + 1
    Next a

'   If any values have been entered into textboxes 4 to 9, C will be >0
'   and the sum of the textbox values is stored as LiquidSum
    For c = 4 To 9
        If RegTB(c) <> "" And Worksheets("PrimaryInput").Cells _
            (c + 106, NextColumn).Value <> "" Then D = D + 1
    Next c

'   Performs check to determine if values have been entered in text boxes
'   and whether or not a final value has already been written into the worksheet.
'   If values are entered into at least one text box and a final value already exists
'   in the worksheet, the user will be prompted for data overwrite.
    If B > 0 Then
            RegAns = MsgBox("You are about to overwrite regulated recycling data." _
                & vbNewLine & "Do you wish to continue?", vbYesNo, _
                    "Caution: Data Overwrite")
            Select Case RegAns
                Case vbNo
                    Exit Sub
            End Select
    End If

    For e = 0 To 3
        If RegTB(e) <> "" Then Worksheets("PrimaryInput").Cells(106 + e, NextColumn) _
            .Value = RegTB(e)
    Next e

    If D > 0 Then
            RegAns = MsgBox("You are about to overwrite regulated recycling data." _
                & vbNewLine & "Do you wish to continue?", vbYesNo, _
                    "Caution: Data Overwrite")
            Select Case RegAns
                Case vbNo
                    Exit Sub
            End Select
    End If

    For f = 4 To 9
        If RegTB(f) <> "" Then Worksheets("PrimaryInput").Cells(106 + f, NextColumn) _
            .Value = RegTB(f)
    Next f

    Unload RegRecycleForm
End Sub

Private Sub UserForm_Initialize()
    Dim Contacts As Variant
    Dim i As Integer
    Dim CName As String

    Contacts = Sheets("ContactList").Range("ContactNames").Value
```

Appendix D: Visual Basic Code

```
'   Enters contact names in each ComboBox
    For i = 1 To UBound(Contacts, 1)
        CName = Contacts(i, 2) & " " & Contacts(i, 1)
        RegRecycleForm.RegContactCB.AddItem CName
    Next i

'   Adds years to dropdown menu
    With RegYearCB
        .AddItem "2000"
        .AddItem "2001"
        .AddItem "2002"
        .AddItem "2003"
        .AddItem "2004"
        .AddItem "2005"
        .AddItem "2006"
        .AddItem "2007"
        .AddItem "2008"
        .AddItem "2009"
        .AddItem "2010"
    End With
End Sub
```

Summary (worksheet code)

```
Option Explicit

Private Sub PivotRefreshBut_Click()
'   Refreshes data contained in pivot table
    ActiveSheet.PivotTables("SummaryPivot").RefreshTable
End Sub

Sub RestrictPTuse()
'   Protects the pivot table, yet allows user to choose which data are displayed
'   Does not have to be run every time workbook is opened
'   Will need to change "False" statements to "True" and re-run to unprotect
'   the pivot table

    Dim p As PivotField

    With Sheets("Summary").PivotTables("SummaryPivot")
        .EnableDrilldown = False
        .EnableWizard = True
        .PivotCache.EnableRefresh = True
        For Each p In .PivotFields
            p.DragToData = False
            p.DragToHide = False
            p.DragToColumn = False
            p.DragToRow = False
            p.DragToPage = False
        Next p
    End With

End Sub
```

Appendix D: Visual Basic Code

Graphing (worksheet code)

```
Option Explicit

Private Sub Worksheet_SelectionChange(ByVal Target As Excel.Range)
   Call UpdateChart
End Sub

Private Sub Worksheet_Activate()
   Call TableFormat
End Sub

Sub UpdateChart()
   Dim TheChartObj As ChartObject
   Dim TheChart As Chart
   Dim UserRow As Long
   Dim CatTitles As Range
   Dim SrcRange As Range
   Dim SourceData As Range
   Dim CAddress As Integer

   CAddress = Sheets("Summary").Range("6:6").End(xlToRight).Column

   If Sheets("Graphing").CheckBox1 Then
      Set TheChartObj = ActiveSheet.ChartObjects(1)
      Set TheChart = TheChartObj.Chart
      UserRow = ActiveCell.Row
      If UserRow < 7 Or IsEmpty(Cells(UserRow, 1)) Then
         TheChartObj.Visible = False
      Else
         Set CatTitles = Range(Cells(7, 1), Cells(7, CAddress))
         Set SrcRange = Range(Cells(UserRow, 1), Cells(UserRow, CAddress))
         Set SourceData = Union(CatTitles, SrcRange)
         TheChart.SetSourceData Source:=SourceData, PlotBy:=xlRows
         TheChartObj.Visible = True
      End If
   End If
End Sub

Sub TableFormat()
Dim CellRange As Variant
   Dim i As Integer, j As Integer
   Dim Cell2 As Range
   Dim TableRight As Integer
   Dim TableDown As Integer

   TableRight = Sheets("Summary").Range("6:6").End(xlToRight).Column
   TableDown = Sheets("Summary").Range("a5").End(xlDown).Row

   CellRange = Sheets("Graphing").Range(Sheets("Graphing").Cells(6, 1), _
      Sheets("Graphing").Cells(TableDown, TableRight)).Value
   Application.ScreenUpdating = False
   Sheets("Graphing").Cells.Borders.LineStyle = xlNone

   For i = 0 To UBound(CellRange, 1)
      For j = 1 To UBound(CellRange, 2)
```

```
            Sheets("Graphing").Cells(i + 6, j).Borders.Weight = xlThin
        Next j
    Next i

    Sheets("Graphing").Columns("A:A").EntireColumn.AutoFit
    Application.ScreenUpdating = True
End Sub
```