Detroit Water and Sewerage Department

Wastewater Master Plan

DWSD Project No. CS-1314

Year 2050 Population and Employment Projections

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CDM

Task A.3.b – Establish Population Projections

This document contains the following sections:

- 2030 RFT Extension to 2050
- 2030 RDF Extension to 2050, by TAZ
- 2030 RDF Employment by Industrial Class Extended to 2050, by County
- SEMCOG 2030 Regional Development Forecast (RDF) Extended to 2050, by County

2030 RFT Extension to 2050

February 2002

Abstract
This document describes the technical procedures used to extend 2030 Regional Forecast Totals (RFT, including population, households, and employment) by five year intervals to 2050.

By Walter Obiero

SEMCOG Data Center Technical Documentation

O:/Obiero/2050RFTs/2030RFTto2050.wpd

2030 RFT Extension to 2050

Purpose
To produce regional 2050 totals by five year intervals that can be used to control 2030 RDF extended to 2050 RDF TAZ figures.

Data Input
- 2030 REMI Output
  - -Births
  - -Deaths
  - -Net International and Domestic Migration
  - -Population by Age
- 2050 Middle Series US Population Projection
  - -Births
  - -Deaths
  - -Net International and Domestic Migration
- 2025 US Labor Force Participation Rates
  - -Aged 16-64 Labor Force Participation Rates
  - -Aged 65+ Labor Force Participation Rates
- Five-year-survival rates from Michigan State Life Table (this is the proportion of population of a given age group that survives for the next five years).

Overview
2030 population total at the regional level is extended to 2050 using the component procedures: births, deaths and net migration. All these data come from the original REMI output. Then group quarters population is extended to 2050 based largely on the changes due population aged 65 and above. Persons per household from 2030 is also extended to 2050. Once we have extended group quarters population and persons per household 2050 total number of households is derived from 2050 total population. It is believed that extending group quarters population and persons per households reduces the magnitude of errors when total number of households is directly extended to 2050. Extension of total employment to 2050 was done by (1) cohort-component method (2) extending labor participation rates from 2025 to 2050, and (3) extending jobs-to-worker ratio from 2030 to 2050.

Process for Extending Total Population

Step 1: Extending Natural Increase
REMI output has a time series data on natural increase that can be used to fit a linear trend over time. The nation's 2050 middle series population projection also has future time series data on

natural increase for the whole country. The region's 2030 natural increase from REMI was expressed as a proportion of the country's natural increase. It is the trend of the region's proportion of natural increase to the whole country that was extended to 2050 assuming linearity. Once these proportions are extended to 2050, they are multiplied by the nation's 2050 natural increase data to generate the region's natural increase for each forecast year: 2035, 2040, 2045, and 2050. Appendix A shows the details of the extension. Separate births and deaths extension were done to check on the extended natural increase.

Step 2: Extending Net International Migration
Both US net international migration and region's net international migration (REMI output) were used to extend the region's net international migration to 2050. The 2030 net international migration data were expressed as a proportion of the nation's net international migration. The proportions were then extended to 2050 assuming linearity. Once these proportions were extended to 2050, they were multiplied by the nation's 2050 net international migration data to generate the region's net international migration for each year: 2035, 2040, 2045, and 2050. Appendix A shows the details of the extension.

Step 3: Extending Net Domestic Migration
This step uses only the 2030 REMI output on net domestic migration which are then extended to 2050.

Step 4: Computing Total Population
Since we have all the components (natural increase, net international and domestic migration) extended to 2050, population total for each year was computed as follows:

$P_{2035}=P_{2030} + NI_{2030\text{-}2035} + \text{Net } I_{2030\text{-}2035} + \text{Net } DI_{2030\text{-}2035}$

$P_{2040}= P_{2035} + NI_{2035\text{-}2040} + \text{Net } I_{2035\text{-}2040} + \text{Net } DI_{2035\text{-}2040}$

$P_{2045}=P_{2040} + NI_{2040\text{-}2045} + \text{Net } I_{2040\text{-}2045} + \text{Net } DI_{2040\text{-}2045}$

$P_{2050}=P_{2045} + NI_{2045\text{-}2050} + \text{Net } I_{2045\text{-}2050} + \text{Net } DI_{2045\text{-}2050}$

P=Total Population

NI=Natural Increase (Births-Deaths)

Net I=Net International Migration

Net DI=Net Domestic Migration

Process for Extending Group Quarters Population

Step 5: Year 2000 to 2030 group quarters population numbers were extended to 2050 based on increasing trend.

Process for extending Persons Per Household

Step 6: Based on 2000-2030 RDF trend of persons per household declining by either 0.02 or 0.04, persons per household was declined by 0.02 every five years to 2045 and then declined by 0.01 to 2050 assuming that after 2045 the rate of decline in persons per household will eventually stabilize around 2.28.

Step 7: Calculating number of households for 2035, 2040, 2045, and 2050. The group quarters population was deducted from the total population to get household population for the four years listed above. Household population was then converted to number of households by dividing household population with persons per household.

The results of steps 1 to 7 are presented in the following table.

	2035	**2040**	**2045**	**2050**
Total Population	5,491,042	5,573,220	5,648,338	5,716,010
Total Households	2,304,804	2,355,861	2,404,250	2,438,354
Group Quarters	120,848	131,180	142,605	156,564
Persons Per Household	2.33	2.31	2.29	2.28

Process for extending Total Employment

Step 1: Establish Household Base population by five-year age groups. For this purpose RFT for the year 2030 is the base population. To get 2030 household population by age, 2030 total group quarters population was distributed to various age groups according to percent distribution of 2000 census group quarters population by age groups.

Step 2: Obtain age-specific five-year survival rates from Michigan Life Table. The survival rates for age groups 65+ were adjusted upwards by 2.5 percent under the assumption that significant improvements on mortality will occur only at these age groups.

Step 3: Multiply age-specific survival rate with its age-specific base population to project household population after five year period. For example, to get 2035 population aged 5 to 9, we multiplied 2030 population aged 0-4 by its five-year survival rates. Appendix B shows the details of this procedure.

Step 4: From step 3, obtain population aged 16-64 and 65+ for the forecast years 2035, 2040, 2045 and 2050. Survival rates procedure shown in Appendix B produces population aged 15-64 years. To get the required 16-64, we multiplied age 15-64 by the proportion of age 16-64 to age 15-64 based on REMI output.

Step 5: Use migration data from steps 2 and 3 under total population section to account for migration impact on age groups 16-64 and 65+. INS 1999 data by age was used to split the net total international migrants into age groups <16, 16-64, and 65+. Appendix B shows the result of this procedure.

Step 6: Obtain labor force participation rates for age groups 16-64 and 65+ from a book entitled *"Demographics of the US: Trends and Projections"* by Cheryl Russel (2000). Labor force participation rates are from 2000 to 2025. Extend these labor force participation rates linearly to 2050.

Step 7: Labor force participation rates are multiplied by population 16-64 and 65+ separately to produce number of people in labor force for each age group. The result from this step should be number in labor force 16-64 and 65+ for each year since 2000 to 2050.

Step 8: Calculate the ratio of jobs-to-worker by dividing total employment with number in labor force. This is only possible for years 2000 to 2030.

Step 9: The ratios obtained in step 8 above were extended to 2050 by allowing a 1.0 percentage growth, assuming more secondary jobs in the future.

Step 10: Convert the number in labor force to total employment by multiplying number in labor force with the ratios developed in steps 8 and 9. Appendix B shows the result of this procedure.

Component Method for Extending Total Population from 2030 to 2050

Time Period	Natural Increase				International Migration			Domestic Migration
	2050 US Natural Increase	2030 SEMCOG Natural Increase	Extended Proportions of SEMCOG to US Natural Increase	Extended 2050 SEMCOG Natural Increase	2050 US Net International Migration	Extended Proportions of SEMCOG to US Net Int. Migration	Extended 2050 SEMCOG Net Int. Migration	Extended 2050 SEMCOG Net Dom. Migration
00-05	7,651,296	103,770	0.0135624083	103,770	4,788,515	0.009775473	46,810	-64,290
05-10	8,090,495	98,820	0.0122143330	98,820	4,070,364	0.013331732	54,265	-66,980
10-15	8,717,556	91,370	0.0104811486	91,370	3,640,897	0.018513295	67,405	-71,950
15-20	8,920,391	76,560	0.0085825834	76,560	3,735,178	0.016569491	61,890	-45,330
20-25	8,729,242	64,165	0.0073505810	64,165	4,112,496	0.016875396	69,400	-36,090
25-30	8,332,012	56,375	0.0067660728	56,375	4,891,297	0.015379356	75,225	-35,195
30-35	8,015,403		0.0051777904	41,502	5,272,661	0.015068293	79,450	-31,195
35-40	7,899,483		0.0035895111	28,355	5,146,454	0.015950627	82,089	-28,267
40-45	7,983,674		0.0020012319	15,977	5,056,140	0.016840603	85,148	-26,007
45-50	8,269,360		0.0004129526	3,415	4,987,367	0.017735393	88,453	-24,196

Extended Total Population

Year	Total Population	Numerical change
2030	5,401,285	
2035	5,491,042	89,757
2040	5,573,220	82,177
2045	5,648,338	75,119
2050	5,716,010	67,672

Appendix B-Basic Table for Extending Employment to 2050

	2030 Hholdpop (Base Population)	Survival Rates (Michigan Life Table)	Projected 2035 Population	Projected 2040 Population	Projected 2045 Population	Projected 2050 Population
Five Year Births	**328,233**	**0.99803**				
Age 0 - 4 years	324,236	0.998088496	327,586			
Age 5-9 Years	319,469	0.998859007	323,616	326,960		
Age 10-14 Years	318,623	0.997200056	319,104	323,247	326,587	
Age 15-19 Years	326,933	0.994860495	317,731	318,211	322,342	325,673
Age 20-24 Years	316,644	0.994547622	325,253	316,098	316,575	320,685
Age 25 - 29 Years	321,788	0.993806229	314,918	323,480	314,374	314,849
Age 30 - 34 Years	320,804	0.991971578	319,795	312,967	321,476	312,427
Age 35 - 39 Years	330,444	0.989292933	318,229	317,228	310,455	318,895
Age 40 - 44 Years	325,760	0.984610032	326,906	314,822	313,831	307,130
Age 45 - 49 Years	320,304	0.976266192	320,747	321,875	309,977	309,001
Age 50 - 54 Years	292,134	0.962210016	312,702	313,134	314,235	302,620
Age 55 - 59 Years	316,462	0.941585738	281,095	300,885	301,301	302,360
Age 60 - 64 Years	310,313	0.911199024	297,976	264,675	283,309	283,701
Age 65 - 69 Years	**338,652**	0.889763337	282,757	271,515	241,171	258,151
Age 70 - 74 Years	**305,470**	0.869609402	**301,320**	251,587	241,584	214,585
Age 75 - 79 Years	**235,016**	0.858836699	**265,640**	**262,031**	218,782	210,084
Age 80 - 84 Years	**148,664**	0.775729669	**201,840**	**228,141**	**225,042**	187,898
Age 85 and older	118,563		**115,323**	**156,573**	**176,976**	**174,572**
Pop15-64	3,181,587		3,135,350	3,103,373	3,107,875	3,097,342
Pop65ov	1,146,365		1,166,880	1,169,848	1,103,556	1,045,290
Adjusted 16-64	3,113,883		3,068,630	3,037,333	3,041,739	3,031,430
Migration			2030-2035	2035-2040	2040-2045	2045-2050
Net International			**79,450**	**82,089**	**85,148**	**88,453**
16-64			58,952	60,910	63,180	65,632
ag65ov			3,973	4,104	4,257	4,423
Net Domestic			**-31,195**	**-28,267**	**-26,007**	**-24,196**
16-64			-9,183	-6,158	-3,637	-1,445
ag65ov			-18,821	-19,968	-21,106	-22,249
Final 16-64			3,118,399	3,092,085	3,101,282	3,095,617
Final ag65ov			1,152,032	1,153,984	1,086,707	1,027,464

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Age 40 - 44 Years	325,760	0.984610032	326,906	314,822	313,831	307,130
Age 45 - 49 Years	320,304	0.976266192	320,747	321,875	309,977	309,001
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Age 80 - 84 Years	**148,664**	0.775729669	**201,840**	**228,141**	**225,042**	187,898
Age 85 and older	118,563		**115,323**	**156,573**	**176,976**	**174,572**
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Adjusted 16-64	3,113,883		3,068,630	3,037,333	3,041,739	3,031,430
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16-64			58,952	60,910	63,180	65,632
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Net Domestic			**-31,195**	**-28,267**	**-26,007**	**-24,196**
16-64			-9,183	-6,158	-3,637	-1,445
ag65ov			-18,821	-19,968	-21,106	-22,249
Final 16-64			3,118,399	3,092,085	3,101,282	3,095,617
Final ag65ov			1,152,032	1,153,984	1,086,707	1,027,464

Appendix B (Cont)--Extending Total Employment from 2030 to 2050

		16-64		65+		Number In Labor Force				Ratio of	Employment
	Household Population	16-64 Household Population	Participation Rates	Household Population	Participation rates	16-64 In Labor Force	65+ In Labor Force	Total Labor Force	Employment	Jobs to Worker	Numerical Change
2000	4,752,063	3,077,676	0.760	541,827	0.1250	2,339,034	67,728	2,406,762	2,673,710	1.11092	
2005	4,853,894	3,267,648	0.770	579,911	0.1345	2,516,089	77,998	2,594,087	2,785,155	1.07366	111,445
2010	4,948,262	3,321,279	0.780	639,738	0.1450	2,590,598	92,762	2,683,360	2,894,486	1.07868	109,331
2015	5,042,473	3,301,271	0.782	747,112	0.1500	2,581,594	112,067	2,693,660	2,986,444	1.10869	91,958
2020	5,123,709	3,230,523	0.781	889,121	0.1500	2,523,038	133,368	2,656,406	3,038,407	1.14380	51,963
2025	5,208,301	3,158,958	0.780	1,034,570	0.1500	2,463,987	155,186	2,619,173	3,069,981	1.17212	31,574
2030	5,290,280	3,113,883	0.788	1,146,365	0.1500	2,454,145	171,955	2,626,099	3,113,129	1.18546	43,148
2035	5,370,194	3,118,399	0.790	1,152,032	0.1500	2,462,316	172,805	2,635,121	3,142,964	1.19272	29,835
2040	5,442,040	3,092,085	0.793	1,153,984	0.1508	2,453,423	173,963	2,627,386	3,176,082	1.20884	33,118
2045	5,505,733	3,101,282	0.797	1,086,707	0.1515	2,472,639	164,640	2,637,280	3,204,857	1.21521	28,775
2050	**5,559,446**	3,095,617	0.801	1,027,464	0.1523	2,480,021	156,443	2,636,464	3,230,701	1.22539	25,844

2030 RDF Extension to 2050, by TAZ

February 2002

Abstract

This document describes the technical process used to extend household, group quarters, population, and employment numbers by Traffic Analysis Zones (TAZs) from the 2030 Regional Development Forecast (RDF) by five year intervals to 2050.

SEMCOG Data Center Technical Documentation

Revised February 27, 2002

Purpose

The RDF to 2030 is completed and the consultant to the Detroit Water and Sewerage Department (DWSD), Camp Dresser & McKee Inc., has asked us to project the small area population and employment numbers further to 2050. They require this for planning infrastructure maintenance and expansion needs in the DWSD 50-year master plan.

Abbreviations

HH	households
Pop	population
GQ	group quarters
Emp	employment
RDF	regional development forecast
TAZ	traffic analysis zone (a.k.a. small area)
MH	maximum households

Definitions

Maximum Households (MH) = Current Households + Vacant Holding Capacity (VHC)
Maximum Households is a soft limit and is the maximum amount of households a TAZ can accomodate once the vacant holding capacity is consumed.

r_{max}	maximum rate of growth over five years after MH reached
HH_n	households in period n
HH^i	households in TAZ i
C_n	regional control total for period n
$r_{s_{2,3}}$	calculated rate of growth using standard formula between periods two and three

Overview

SEMCOG has households, group quarters, population, and employment at the small area level projected to 2030 at five year intervals as part of the RDF. We continue extending these TAZ numbers to 2050 using a simplified version of the formula used to project from 2000 to 2030. For households, we limit the rate of growth to a maximum of five percent growth per period after the vacant holding capacity has been consumed. For group quarters, we use a simpler formula where regional growth is allocated only to areas that are growing, in proportion to their existing size. Then, we adjust the growth rates of these numbers such that the numbers sum to regional totals up to 2050. An Excel workbook is used because it is the simplest method.

Due to annexations, some TAZs were split into pieces. The new uniquely identifying key for each polygonal small area became a combination of TAZ identifier and MCD identifier. However, throughout this document, we continue to refer to the post-annexation polygons as TAZs.

Process

Step 1: Formula for the Rate of Growth of Households

The standard formula used to calculate a future period's households follows:

$$HH_{t+1} = HH_t\left[1 + r_{s_{t,t+1}}\right]$$

$$r_{s_{t,t+1}} = \left[\frac{2}{3}\left(\frac{HH_t - HH_{t-1}}{HH_{t-1}}\right) + \frac{1}{3}\left(\frac{HH_{t-1} - HH_{t-2}}{HH_{t-2}}\right)\right]$$

In words, the rate of growth during period t equals the weighted average of growth in the two previous periods with double weight given to the most recent period.

We assume the following rule: if the standard calculated rate of growth between period t and t+1 would cause HH_{t+1} to exceed the MH for the zone, then we use an adjusted formula for the rate.

$$r_{a_{t,t+1}} = \left(r_{\max}\right)^{\left(\frac{HH_{t+1}-MH}{HH_{t+1}-HH_t}\right)}$$

This formula is the condensed version of a longer formula which says, in principle, that households grow at the standard formula rate up to MH and grows at the smaller of the maximum rate or the standard formula rate thereafter.

We assume the following rule: if the households in the prior period have already exceeded MP, then we simply use the following formula, but only when the standard rate of growth would have been greater or equal to r_{max}.

$HH_{t+1} = HH_t * (1 + r_{max})$

Combining all of these rules, we get the final programmatic formula:

if ($HH_t * r_s$ > MP and $r_s > r_{max}$)
then
if (HH_t > MP)
then
$HH_{t+1} = HH_t * r_{maz}$
else
$HH_{t+1} = HH_t * \left(r_{\max}\right)^{\left(\frac{HH_{t+1}-MP}{HH_{t+1}-HH_t}\right)}$
else
$HH_{t+1} = HH_t * r_s$

where,
r_s = rate of growth from period t to t+1 using the standard formula

Step 2: Controlling by regional totals

The final step is to control the HH numbers by the regional control totals. Here, we adjust the rates of growth of each TAZ by a factor such that the raw HH total will equal the control total. The formula follows:

hh controlled = controlled total growth/raw total growth * (raw change in hh) + previous hh number

$$HH_{t+1(c)} = \frac{C_{t+1} - C_t}{\sum_{i=0}^{\#tazs} HH^i_{t+1} + \sum_{i=0}^{\#tazs} HH^i_{t(c)}} \times \left(HH_{t+1} - HH_{t(c)}\right) + HH_{t(c)}$$

Since controlled total growth (from the RFTs) was generally less than the raw calculated total growth, we reduced

the growth rates of all the TAZs. One side effect of this controlling is that fast growing TAZs over their maximum hh will grow less than the actual maximum of five percent per five years. We chose this formula rather than ordinary normalization because that method caused a discontinuity between 2030 and 2035. In addition to the discontinuity, TAZs that were growing very slowly appeared to lose households post-2035.

Step 3: Converting HH to Population

To convert HH to Population for a particular TAZ, we simply multiplied the 2030 persons per household number by the number of households in each period. Persons per household in 2030 by TAZ was obtained from other RDF work. The final step was to control these numbers by the regional forecast totals for household population. We controlled household population to RFTs using the same method as for HH.

Later, we calculate household size for each TAZ by dividing household population by number of households. If not for the separate controlling of households and household population, household size would remain constant over the forecast period.

Step 4: Adjusting for Detroit Control Totals

For both households and household population, we adjusted the normalization formula to account for Detroit control totals and regional control totals. Detroit TAZs are controlled using the ordinary forumula. The remaining TAZs are controlled to the difference between regional control totals and Detroit control totals. This ensures that Detroit TAZs sum up to the Detroit control total and the whole set of TAZs sum up to the regional control total.

Step 6: Projecting Group Quarters Population

We divided the TAZs into two groups, those with increasing group quarters population from 2020 to 2030, and those with no change in group quarters population in the same period. We assumed that those with level population would continue to experience no growth and those that had increased would continue to increase. This is because the TAZs with increasing group quarters population had both the presence of assisted living facilities (or nursing homes) and increases in population over 65. We did not set any maximum group quarters population. These numbers are finally controlled to regional totals as before.

Step 7: Total Population Forecast

The final population for each TAZ at each five year interval is simply the sum of the household population and group quarters population. The sum of these equals the regional forecast totals for population because the two components were controlled before adding.

Step 8: Entering Formulas Into Excel

The formulas were entered into an Excel workbook in a series of four worksheets as follows:

HHto2050	Projections of HH to 2050
HHtoPop	Conversion of Households to Population
GQPop	Projections of GQ Population to 2050
FinalPopForecast	Sum of group quarters and houshold population to give final population.

The formulas in one sheet generally use data calculated in the previous sheet. Thus, all the sheets are linked together and changes in one affect the remaining. The maximum rate of growth is a named cell (*vhcmaxchange*) and is entered on the *HHto2050* sheet. The formulas are safe for TAZs with negative growth because they are using percentages, not absolute values.

In addition to these four worksheets, we added several ancilliary sheets for input and output data. For convenience, all the columnar data by TAZ was entered onto a *SourceData* worksheet. The data can be updated simply by copying the data from the RDF Access query and pasting it over the existing data. This data includes the MCD identifier, TAZ identifier, households from 2020 to 2030, persons per household in 2030, maximum

households, and group quarters population from 2020 to 2030.

To export the final data back to Access, we added three more sheets, *Export Step 1*, *Export Step 2*, and *Export Final*. Each of these sheets contains the following data from 2035 to 2050: total population, group quarters population, household population, households, and household size. On the *Export Step 1* sheet, we simply refer to the data from the extension sheets. We also calculate household size as the household population divided by the number of households (unless households is zero, in which case household size is also zero). On the *Export Step 2* sheet, we adjust household size up to one for those TAZs with household size less than one and greater than zero. Then, we recalculate the household population and the total population. Each formula or value only links to the *Export Step 1* or *Export Step 2* sheet. Finally, the *Export Final* sheet simply takes the values calculated on the *Export Step 2* sheet, and rounds them to whole numbers or to two decimal places for household size. This sheet can be directly imported into Access.
The entire sequence of calculations from *SourceData* to *Export Final* is automated and does not require any manual intervention except the entering of the control totals. These cells are highlighted with purple colored text.

Step 9: Employment Trend Extension

We projected employment to 2050 separately from the rest of the extension, but in the same Excel workbook and using the same process. The employment sheets in order are *EmpSourceData*, *Employment*, and *ExportEmp*. The *EmpSourceData* contains for each TAZ, employment in 2020, 2025, and 2030, and maximum employment. The *Employment* sheet projects employment to 2050 using the same process as the households sheet, except there are no adjustments for Detroit control totals. Finally, *ExportEmp* organizes for export MCD identifier, TAZ identifier, and employment from 2035 to 2050.

Conclusion

The standard formula basically extends growth from 2030 to 2050 at the growth rate established between 2020 to 2030. In addition, the weighted average formula tends to flatten out curve in the growth rate. The one exception is for TAZs with high rates of growth (more than five percent per five years) reaching their maximum household capacity. In this case, the growth rate abruptly changes to five percent every five years for the remainder of the forecast. (Note that controlling reduces the actual maximum growth rate.) In general, the farther out a forecast, the less we can predict and the simpler should be the rules for the forecast. Thus, for fifty years out, extending the historical trend and controlling to regional forecast totals provides a baseline estimate using the least objectionable methodology.

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2030 RDF Employment by Industrial Class Extended to 2050, by County

February 2002

Overview: This document describes the technical procedures used to extend 2030 Regional Development Forecast (RDF) employment numbers by eight industrial classes to 2050 by five year intervals for seven counties in Southeast Michigan.

Extending regional employment numbers by industrial class from 2030 to 2050
SEMCOG's 2030 Regional Development Forecast (RDF) includes employment numbers by eight industrial classes by five year intervals up to 2030. These eight classes are as follows:

Abbreviation	Description
ag	Agriculture (including Agricultural Services), Mining, and Natural Resources
mfg	Manufacturing
tcu	Transportation, Communication, and Utilities
whl	Wholesale Trade
rtl	Retail Trade
fire	Finance, Insurance, and Real Estate
srv	Services
pub	Public Administration

After total employment numbers were extended from 2030 to 2050 (see SEMCOG Data Center technical documentation *"2030 RFT Extension to 2050"*), employment numbers by each industrial class were extended individually. For extending manufacturing jobs, a regression analysis was performed based on 2000 to 2030 trend. For all other industrial classes, a "weighted rate of growth" method was used. This method computes the rate of growth for the current forecast period based on the weighted average of growth in the two previous periods with double weight given to the most recent period (see SEMCOG Data Center technical documentation *"2030 RDF Extension to 2050 by TAZ"* for the detailed formula). The extended employment numbers by eight industrial classes were then controlled by total employment.

Extending county numbers
For each county, employment numbers by eight industrial classes were also extended from 2030 to 2050 by five year intervals using the same "weighted rate of growth" method described above. Then a fratarization procedure was used to ensure that the sum of employment of all classes equals county total employment and the sum of the employment of one class of all counties equal regional employment of that class. Fratarization is a process to normalize the cell values to column totals and row totals, iteratively until equilibrium, the point at which all cells tally in both directions.

By Xuan Liu
SEMCOG Data Center Technical Documentation

SEMCOG 2030 Regional Development Forecast (RDF)
Extended to 2050, by County

	1990	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
SEMCOG Region												
Total Jobs	2,350,310	2,673,052	2,780,356	2,891,055	2,982,833	3,034,557	3,066,141	3,109,481	3,142,966	3,176,068	3,204,861	3,230,686
ag	30,424	31,441	30,073	32,230	34,267	36,168	38,369	41,185	43,650	46,429	49,296	52,327
mfg	486,644	491,029	488,183	479,008	485,583	485,758	475,954	458,831	460,223	452,426	443,937	432,739
tcu	124,287	140,602	143,043	144,654	147,198	148,360	151,165	153,843	155,257	157,019	158,595	160,116
whl	121,200	145,353	156,070	163,675	171,002	174,120	176,266	179,258	180,427	182,111	183,529	184,890
rtl	441,167	469,237	474,585	498,917	521,429	533,969	539,544	548,902	552,277	557,350	561,576	565,638
fire	173,122	206,324	211,353	214,584	220,039	224,824	230,372	239,511	245,645	252,912	259,907	267,027
srv	904,892	1,096,525	1,182,189	1,260,224	1,303,572	1,330,868	1,353,037	1,384,487	1,401,240	1,422,426	1,441,650	1,460,625
pub	68,502	92,541	94,860	97,763	99,743	100,490	101,434	103,464	104,247	105,395	106,371	107,324
Livingston												
Total Jobs	39,339	59,159	70,537	78,716	86,784	92,660	97,652	103,869	109,148	114,528	118,906	122,605
ag	1,756	1,970	1,873	1,900	1,930	1,931	1,957	2,120	2,210	2,319	2,403	2,470
mfg	8,186	11,113	12,273	12,942	14,103	14,578	14,658	14,315	14,514	14,364	14,065	13,592
tcu	1,071	1,338	1,795	1,983	2,223	2,409	2,629	2,890	3,119	3,367	3,594	3,808
whl	2,036	3,096	3,574	3,911	4,226	4,433	4,629	4,901	5,082	5,278	5,419	5,526
rtl	8,772	13,111	15,670	18,109	20,731	22,587	24,111	25,950	27,417	28,992	30,327	31,515
fire	3,455	6,214	6,953	7,485	8,063	8,575	9,140	9,861	10,426	11,036	11,551	12,013
srv	12,935	20,565	26,251	30,052	33,000	35,510	37,765	40,869	43,275	45,914	48,166	50,196
pub	1,085	1,752	2,148	2,334	2,508	2,637	2,763	2,963	3,105	3,258	3,381	3,485
Macomb												
Total Jobs	333,722	381,864	394,317	405,730	418,017	423,600	427,706	433,303	437,712	442,133	446,125	449,757
ag	3,374	4,168	3,923	4,210	4,470	4,663	4,896	5,207	5,444	5,719	5,994	6,274
mfg	102,751	110,465	105,787	105,297	105,518	104,234	101,501	97,640	97,303	95,211	92,993	90,251
tcu	10,160	10,930	12,230	12,334	12,841	13,152	13,615	14,107	14,430	14,815	15,186	15,560
whl	14,013	16,823	18,725	19,261	20,223	20,760	21,133	21,700	21,938	22,286	22,602	22,918
rtl	71,606	70,727	69,592	71,065	72,654	72,453	71,816	71,953	70,963	70,341	69,627	68,926
fire	16,605	21,217	22,755	23,082	24,037	24,830	25,741	27,125	28,069	29,215	30,350	31,530
srv	104,301	135,948	149,338	158,343	165,974	171,047	176,302	182,522	186,356	191,116	195,740	200,462
pub	10,913	11,586	11,967	12,138	12,300	12,461	12,702	13,049	13,209	13,430	13,633	13,836
Monroe												
Total Jobs	50,364	54,444	58,510	62,590	66,809	70,654	74,032	77,748	80,718	83,531	85,972	88,151
ag	2,350	2,479	2,321	2,398	2,460	2,524	2,622	2,751	2,820	2,892	2,945	2,987
mfg	9,430	12,435	12,236	12,563	13,267	13,888	14,341	14,614	15,319	15,704	15,998	16,146
tcu	4,208	3,805	3,896	3,714	3,546	3,328	3,140	2,974	2,757	2,557	2,357	2,165
whl	1,489	1,957	2,258	2,499	2,765	2,998	3,222	3,473	3,666	3,871	4,063	4,251
rtl	10,690	11,373	12,533	13,880	15,142	16,291	17,222	18,269	18,982	19,728	20,391	21,013
fire	2,123	2,863	3,223	3,481	3,792	4,099	4,395	4,775	5,063	5,374	5,672	5,966
srv	18,964	17,798	20,255	22,128	23,803	25,426	26,939	28,667	29,862	31,129	32,257	33,328
pub	1,110	1,734	1,788	1,927	2,034	2,100	2,151	2,225	2,249	2,276	2,289	2,295
Oakland												
Total Jobs	681,031	910,363	955,006	1,009,955	1,049,724	1,066,624	1,074,004	1,087,399	1,097,187	1,106,743	1,114,985	1,122,352
ag	8,397	9,565	8,791	9,375	9,874	10,294	10,887	11,625	12,288	13,009	13,740	14,495
mfg	116,987	131,353	130,186	127,769	130,796	129,211	125,202	119,175	118,407	115,135	111,774	107,777
tcu	30,089	32,793	34,939	35,396	36,137	36,429	37,064	37,723	38,126	38,571	38,961	39,321
whl	46,746	62,864	65,768	68,919	71,403	71,804	71,705	71,940	71,561	71,307	70,947	70,550
rtl	130,230	150,971	155,246	165,159	174,244	178,940	180,940	184,394	186,207	188,428	190,435	192,408
fire	70,704	98,237	97,571	99,236	100,973	101,290	101,883	104,053	104,991	106,249	107,335	108,388
srv	268,006	407,625	443,684	484,032	505,244	517,149	524,480	535,892	542,524	550,394	557,611	564,698
pub	9,878	16,955	18,821	20,069	21,053	21,507	21,843	22,597	23,083	23,650	24,182	24,715
St. Clair												
Total Jobs	55,735	64,516	66,295	70,515	73,753	76,398	78,649	81,278	83,468	85,548	87,356	88,995
ag	2,533	2,207	1,852	1,808	1,764	1,687	1,644	1,620	1,571	1,524	1,473	1,418
mfg	10,565	13,093	12,123	11,983	11,982	11,860	11,604	11,255	11,302	11,106	10,862	10,537
tcu	3,984	4,860	5,099	5,364	5,595	5,774	5,958	6,148	6,269	6,389	6,486	6,569
whl	1,657	2,379	2,788	3,103	3,423	3,677	3,892	4,126	4,319	4,523	4,717	4,907
rtl	13,121	13,261	13,494	14,065	14,747	15,291	15,711	16,213	16,514	16,830	17,086	17,313
fire	3,038	3,645	3,744	3,862	4,055	4,290	4,547	4,905	5,196	5,518	5,831	6,150
srv	19,440	22,691	24,891	27,847	29,623	31,208	32,633	34,288	35,546	36,878	38,104	39,292
pub	1,392	2,380	2,304	2,483	2,564	2,611	2,660	2,723	2,751	2,780	2,797	2,809

SEMCOG 2030 Regional Development Forecast (RDF)
Extended to 2050, by County

	1990	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Washtenaw												
Total Jobs	213,928	232,175	244,213	262,120	273,221	279,741	284,437	289,969	294,467	298,757	302,403	305,673
ag	4,550	4,549	4,039	4,377	4,602	4,751	4,903	5,074	5,193	5,324	5,440	5,554
mfg	37,363	34,517	38,330	41,032	43,048	44,292	44,728	44,308	45,694	46,142	46,477	46,495
tcu	6,912	8,916	9,216	9,745	10,187	10,411	10,732	11,068	11,299	11,555	11,786	12,012
whl	6,177	6,618	7,614	8,181	8,762	9,172	9,501	9,903	10,197	10,527	10,841	11,156
rtl	33,166	38,888	39,590	42,628	45,560	47,211	48,200	49,573	50,372	51,324	52,177	53,024
fire	10,970	10,729	11,779	12,366	12,736	13,163	13,563	14,319	14,843	15,460	16,053	16,662
srv	110,208	119,998	125,327	134,283	138,225	140,323	142,131	144,626	145,496	146,738	147,651	148,503
pub	4,549	7,960	8,318	9,508	10,101	10,418	10,679	11,098	11,371	11,687	11,978	12,267
Wayne												
Total Jobs	976,191	970,531	991,478	1,001,429	1,014,525	1,024,880	1,029,661	1,035,915	1,040,266	1,044,828	1,049,114	1,053,153
ag	7,464	6,503	7,274	8,162	9,167	10,318	11,460	12,788	14,124	15,642	17,301	19,129
mfg	201,362	178,053	177,248	167,422	166,869	167,695	163,920	157,524	157,684	154,764	151,768	147,941
tcu	67,863	77,960	75,868	76,118	76,669	76,857	78,027	78,933	79,257	79,765	80,225	80,681
whl	49,082	51,616	55,343	57,801	60,200	61,276	62,184	63,215	63,664	64,319	64,940	65,582
rtl	173,582	170,906	168,460	174,011	178,351	181,196	181,544	182,550	181,822	181,707	181,533	181,439
fire	66,227	63,419	65,328	65,072	66,383	68,577	71,103	74,473	77,057	80,060	83,115	86,318
srv	371,038	371,900	392,443	403,539	407,703	410,205	412,787	417,623	418,179	420,257	422,121	424,146
pub	39,575	50,174	49,514	49,304	49,183	48,756	48,636	48,809	48,479	48,314	48,111	47,917