Draft Technical Support Document

Carbon Monoxide Redesignation Request And Maintenance Plan For The Fort Collins Non-Attainment Area

June 12, 2002

DRAFT

Colorado Department of Public Health and Environment
Air Pollution Control Division
Technical Services Program
4300 Cherry Creek Drive South
Denver, Colorado 80246

1992-2015

Draft Fort Collins Urban Growth Area Emission Inventories

The mobile source and area/non-road emission inventories to support the Fort Collins redesignation request are summarized in the following table.

Year	Urban Growth Area VMT	Fleet Avg. CO rate G/mi	Inventory Tons/day	Inventory Tons/day	Total Inventory Tons/day	Strategies
1992	1,861,417	46.11	94.6	23.8	118.4	Idle I/M 1992 oxy level
1998	2,516,439	29.17	80.9	24.8	105.7	Idle I/M 1998 oxy level
2004	2,740,108	26.2	89.5	18.7	108.2	No controls
2005	3,236,739	25.58	91.3	17.5	108.8	No controls
2010	3,709,693	18.34	75.0	19.5	94.5	No controls
2015	4,182,646	15.49	71.4	22.4	93.9	No controls

The technical support documentation to support these emission inventories is contained in the following sections of this document**.**

Fort Collins Carbon Monoxide Maintenance Plan Mobile Source Emission Inventories

Fort Collins Urban Growth Area Vehicle Miles Traveled and Vehicle Speed Estimates

The Fort Collins component of the Nort Front Range 2025 Regional Transportation Plan demand modeling is the basis for the vehicle miles traveled (VMT) estimates used for the development of these emission inventories. USEPA's recently released MOBILE6 model (1/23/2002) was used as the basis for the emission factor estimates. The VMT and speeds resulting from the travel-demand modeling were the primary inputs for the estimation of the VMT-related carbon monoxide emissions in Fort Collins.

Travel demand-modeling for the North Front Range Transportation and Air Quality Planning Council (NFRTAQPC) was performed by Kimley-Horn and Associates, Inc. for a base year of 1998 and out-year estimates of 2005, 2015 and 2025. The 1998, 2005 and 2015 travel-demand modeling results for the Fort Collins Urban Growth area were used in this inventory analysis.

The Base Year inventory for the redesignation request analysis is 1992. A methodology based on HPMS traffic count data for 1992 and 1998 was developed to estimate the 1992 VMT based on the 1998 travel demand-model VMT estimates. This methodology is documented in Appendix A. The 1998 transportation model speeds were used to estimate the speeds in 1992. In order to determine the potential effects of this assumption, a simple MOBILE6 speed sensitivity analysis was performed. Between 1998 and 2005 the speeds resulting from the travel-demand modeling indicate the VMT-weighted fleet average speed will decrease by 2.6 mph. This would be a good estimate of how much the speeds may have changed between 1992 and 1998. Since the VMT in 1992 was substantially less than in 1998, it is possible that the fleet averaged speed would be about 2.6 mph higher in 1992. The MOBILE6 model speed sensitivity was tested using this 2.6 mph factor. All of the 1998 speeds were increased by a factor of 2.6 mph and the inventory analysis was re-run. A .4% increase in carbon monoxide emissions resulted from this sensitivity test. Since a lower mobile source carbon monoxide emission estimate is considered more conservative in this case, the 1998 speeds were used to estimate the speeds in 1992.

The 2010 VMT was estimated by averaging the 2005 and 2015 travel demand modeled networks.

An average of the 2005 and 2015 speeds from the travel demand modeling were used to characterize the 2010 speeds for the MOBILE6 inputs.

Tables 1 through Table 5 summarize the VMT estimates and vehicle speeds resultant from the travel demand modeling and the 1992 VMT estimate methodology.

Table 1
1992 Vehicle Miles Traveled in the Fort Collins Urban Growth Area

Area	Facility	VMT			Speed		
Type	Class	AM	PM	OFF	AM	PM	OFF
CBD	Centroid Connector	4994	6178	23721	20	20	23
CBD	Collector	468	480	2082	20	20	23
CBD	Major Arterial	10354	12533	48133	27.2	27.6	32.4
CBD	Minor Arterial	1392	1640	5963	25	25	28
CBD	Principal Arterial	2011	2447	9406	27.6	27.8	32.7
Rural	Centroid Connector	37	48	183	22	22	27
Rural	Collector	434	464	1864	39.5	40.8	44.8
Rural	Freeway	5266	6927	24504	51	50.5	56.6
Rural	Frontage Road	0	0	0	0.0	0.0	0.0
Rural	Major Arterial	0	0	0	0.0	0.0	0.0
Rural	Minor Arterial	0	0	0	0.0	0.0	0.0
Rural	Principal Arterial	0	0	0	0.0	0.0	0.0
Urban	Centroid Connector	28077	36542	144596	15	15	20
Urban	Collector	11611	12996	50451	28.9	29.1	33.7
Urban	Expressway	20372	24849	86628	40.9	42.6	46.6
Urban	Freeway	27789	35623	124513	62.8	63.5	67.1
Urban	Freeway Ramp	1357	1712	5957	19.5	20.3	24.4
Urban	Frontage Road	646	439	1800	24.8	24.9	29.9
Urban	Major Arterial	107260	135269	504468	37.5	38.2	42.2
Urban	Minor Arterial	24376	26898	107608	33.5	33.9	38.8
Urban	Principal Arterial	24822	30721	112510	35.2	37	40.8

Table 2
1998 Vehicle Miles Traveled and Speeds in the Fort Collins Urban Growth Area

Area	Facility	VMT			Speed		
Type	Class	AM	PM	OFF	AM	PM	OFF
CBD	Centroid Connector	6399	7916	30396	19.9	20.0	23.0
CBD	Collector	600	615	2668	20.0	20.0	23.0
CBD	Major Arterial	14077	17039	65440	26.8	27.4	31.9
CBD	Minor Arterial	1783	2102	7641	24.9	24.9	28.0
CBD	Principal Arterial	2734	3326	12789	27.3	27.7	32.5
Rural	Centroid Connector	47	61	234	22.0	22.0	27.0
Rural	Collector	556	594	2388	39.9	41.3	45.5
Rural	Freeway	16060	21127	74735	51	50.5	56.6
Rural	Frontage Road	0	0	0	0.0	0.0	0.0
Rural	Major Arterial	0	0	0	0.0	0.0	0.0
Rural	Minor Arterial	0	0	0	0.0	0.0	0.0
Rural	Principal Arterial	0	0	0	0.0	0.0	0.0
Urban	Centroid Connector	35978	46825	185286	15.0	15.0	20.0
Urban	Collector	14878	16653	64648	28.7	29.0	33.4
Urban	Expressway	29940	36519	127311	40.7	42.4	46.3
Urban	Freeway	38830	49777	173987	63.4	64.5	68.8
Urban	Freeway Ramp	1896	2393	8323	22.5	22.8	27.5
Urban	Frontage Road	836	568	2331	22.4	24.5	29.3
Urban	Major Arterial	138849	175107	653039	36.8	37.6	41.4
Urban	Minor Arterial	31236	34467	137889	33.7	34.1	38.9
Urban	Principal Arterial	32133	39769	145645	34.2	36.3	39.8

Table 3
2005 Vehicle Miles Traveled and Speeds in the Fort Collins Urban Growth Area

Area	Facility	VMT			Speed		
Type	Class	AM	PM	OFF	AM	PM	OFF
CBD	Centroid Connector	6840	8555	33082	19.9	20.0	23.0
CBD	Collector	728	766	3420	19.9	20.0	23.0
CBD	Major Arterial	15558	19028	74154	26.3	27.0	31.3
CBD	Minor Arterial	1869	2187	8162	24.8	24.9	28.0
CBD	Principal Arterial	3034	3755	14511	27.1	27.4	32.1
Rural	Centroid Conn	165	219	834	22.0	22.0	27.0
Rural	Collector	983	1121	4220	34.0	38.4	40.9
Rural	Freeway	17896	22771	80929	54.8	45.3	45.7
Rural	Frontage Road	0	0	0	0.0	0.0	0.0
Rural	Major Arterial	0	0	0	0.0	0.0	0.0
Rural	Minor Arterial	0	0	0	0.0	0.0	0.0
Rural	Principal Arterial	0	0	0	0.0	0.0	0.0
Urban	Centroid Connector	46649	61107	242372	15.0	15.0	20.0
Urban	Collector	27634	32919	129632	28.6	29.0	33.4
Urban	Expressway	37755	45954	166208	35.1	37.3	39.7
Urban	Freeway	46391	60291	210175	57.3	58.6	62.5
Urban	Freeway Ramp	2360	2881	10548	21.6	22.5	26.6
Urban	Frontage Road	2794	2396	10157	22.4	22.8	28.0
Urban	Major Arterial	169049	217628	802986	34.7	36.0	39.4
Urban	Minor Arterial	46879	56452	226871	31.0	32.8	36.3
Urban	Principal Arterial	36087	46131	171643	31.1	32.8	34.2

Table 4
2010 Vehicle Miles Traveled and Speeds in the Fort Collins Urban Growth Area

Area	Facility	VMT			Speed		
Type	Class	AM	PM	OFF	AM	PM	OFF
CBD	Centroid Connector	7502	9414	36565	19.9	20.0	23.0
CBD	Collector	961	862	4002	19.9	20.0	22.9
CBD	Major Arterial	16964	20848	82240	25.8	26.7	30.6
CBD	Minor Arterial	2130	2435	9318	24.6	24.9	27.9
CBD	Principal Arterial	3294	4064	15817	26.7	26.9	31.2
Rural	Centroid Connector	251	341	1296	22.0	22.0	27.0
Rural	Collector	1107	1352	4936	29.2	32.3	34.0
Rural	Freeway	18752	23417	84936	34.4	38.6	40.4
Rural	Frontage Road	0	0	0	0.0	0.0	0.0
Rural	Major Arterial	0	0	0	0.0	0.0	0.0
Rural	Minor Arterial	0	0	0	0.0	0.0	0.0
Rural	Principal Arterial	0	0	0	0.0	0.0	0.0
Urban	Centroid Connector	55352	72061	285687	15.0	15.0	20.0
Urban	Collector	30466	35410	144475	27.3	27.9	31.8
Urban	Expressway	40781	49257	179323	32.4	34.9	36.9
Urban	Freeway	51335	65707	236233	49.9	52.9	54.1
Urban	Freeway Ramp	2788	3541	12439	20.9	21.7	26.0
Urban	Frontage Road	3590	3307	15240	21.4	22.2	25.7
Urban	Major Arterial	198287	253605	946358	33.1	34.7	37.4
Urban	Minor Arterial	57046	69749	276967	29.7	31.6	34.4
Urban	Principal Arterial	38299	48979	180608	29.0	30.9	31.9

Table 5
2015 Vehicle Miles Traveled and Speeds in the Fort Collins Urban Growth Area

Area	Facility	VMT			Speed		
Type	Class	AM	PM	OFF	AM	PM	OFF
CBD	Centroid Connector	8164	10272	40049	19.8	19.9	22.9
CBD	Collector	1194	958	4585	19.9	20.0	22.9
CBD	Major Arterial	18371	22668	90326	25.3	26.4	30.0
CBD	Minor Arterial	2390	2683	10473	24.3	24.9	27.9
CBD	Principal Arterial	3555	4374	17123	26.3	26.5	30.4
Rural	Centroid Connector	337	463	1757	22.0	22.0	27.0
Rural	Collector	1231	1583	5653	24.3	26.2	27.0
Rural	Freeway	19607	24063	88942	34.4	38.6	40.4
Rural	Frontage Road	0	0	0	0.0	0.0	0.0
Rural	Major Arterial	0	0	0	0.0	0.0	0.0
Rural	Minor Arterial	0	0	0	0.0	0.0	0.0
Rural	Principal Arterial	0	0	0	0.0	0.0	0.0
Urban	Centroid Connector	64054	83015	329002	15.0	15.0	20.0
Urban	Collector	33298	37900	159317	25.9	26.8	30.3
Urban	Expressway	43808	52560	192438	29.7	32.5	34.1
Urban	Freeway	56280	71122	262292	42.5	47.1	45.7
Urban	Freeway Ramp	3217	4200	14330	20.2	20.9	25.5
Urban	Frontage Road	4386	4218	20322	20.4	21.5	23.3
Urban	Major Arterial	227524	289582	1089731	31.5	33.4	35.4
Urban	Minor Arterial	67213	83047	327062	28.3	30.4	32.5
Urban	Principal Arterial	40511	51826	189572	26.9	28.9	29.6

MOBILE6 SPEED VMT and VMT BY HOUR files

The AM, PM and Off peak speeds and VMT resulting from the travel-demand model were pre-processed into input files for MOBILE6. The code for the Fortran program designed to accomplish this formatting, M6input.f, is in Appendix B. M6input.f also writes the Scenario Record files: one record for each area type and facility class. Consequently, twenty-one distinct scenarios result from the MOBILE6 input pre-processing. Twenty-one distinct diurnal profiles of VMT BY HOUR also result from this processing. Since MOBILE6 accepts speed profiles only for freeway and arterial facility classes, SPEED VMT profiles are referenced in the Scenario Records in the MOBILE6 input files only for these two facility classes.

Automobile Emission Control Strategies:

As part of Colorado's Carbon Monoxide State Implementation Plan (SIP), automobile Inspection and Maintenance (I/M) programs have been operating in Colorado Automobile Inspection and Repair (AIR) Program areas since 1982. An oxygenated fuel program has been operating in the same areas since 1988. The 1992 AIR I/M program operating in Fort Collins and oxygenated fuel programs (in MOBILE6 input format) are characterized as follows:

1992 Emission Control Strategies:

```
> Basic I/M Program -- Idle Testing for pre-1982 GAS VEHICLES
> Default Cutpoints
I/M PROGRAM        : 1 1982 2025 1 TRC IDLE
I/M MODEL YEARS    : 1 1952 1987
I/M VEHICLES       : 1 22222 22222222 2
I/M STRINGENCY     : 1 25.0
I/M COMPLIANCE     : 1 74.0
I/M WAIVER RATES   : 1 1.71 1.71
I/M EFFECTIVENESS  : 1 0.50 0.50 0.50
I/M GRACE PERIOD   : 1 2

I/M PROGRAM        : 2 1982 2025 2 TRC IDLE
I/M MODEL YEARS    : 2 1988 1990
I/M VEHICLES       : 2 22222 22222222 2
I/M STRINGENCY     : 2 25.0
I/M COMPLIANCE     : 2 74.0
I/M WAIVER RATES   : 2 1.71 1.71
I/M GRACE PERIOD   : 2 2

I/M PROGRAM        : 3 1982 2025 1 TRC IDLE
I/M MODEL YEARS    : 3 1991 1992
I/M VEHICLES       : 3 22222 22222222 2
I/M STRINGENCY     : 3 25.0
I/M COMPLIANCE     : 3 74.0
I/M WAIVER RATES   : 3 1.71 1.7
I/M GRACE PERIOD   : 3 2

ANTI-TAMP PROG     :
82 75 91 22222 22222222 2 21 074 22211111

OXYGENATED FUELS   : .80 .20 .021 .035 2
```

Note that the 'I/M PROGRAM' record for all three I/M program definitions indicates the year 2025 as the I/M program end year. Since the calendar year for a MOBILE6 run is 1992, using 2025 as the end year does not affect the MOBILE6 emission factor results.

1998 Emission Control Strategies:

The 1998 I/M program operating in Fort Collins and the AIR Program oxygenated fuel programs (in MOBILE6 input format) can be characterized as follows:

```
> Basic I/M Program -- Idle Testing for pre-1982 GAS VEHICLES
> Default Cutpoints
I/M PROGRAM        : 1 1982 2025 1 TRC IDLE
I/M MODEL YEARS    : 1 1952 1980
I/M VEHICLES       : 1 22222 22222222 2
I/M STRINGENCY     : 1 21.0
I/M COMPLIANCE     : 1 74.0
```

```
I/M WAIVER RATES   : 1 .08 .08
I/M EFFECTIVENESS  : 1 0.50 0.50 0.50
I/M GRACE PERIOD   : 1 5

I/M PROGRAM        : 2 1982 2025 1 TRC 2500/IDLE
I/M MODEL YEARS    : 2 1981 1981
I/M VEHICLES       : 2 22222 22222222 2
I/M STRINGENCY     : 2 21.0
I/M COMPLIANCE     : 2 74.0
I/M WAIVER RATES   : 2 .08 .08
I/M GRACE PERIOD   : 2 5

I/M PROGRAM        : 3 1982 2025 2 TRC 2500/IDLE
I/M MODEL YEARS    : 3 1982 2025
I/M VEHICLES       : 3 22222 22222222 2
I/M STRINGENCY     : 3 21.0
I/M COMPLIANCE     : 3 74.0
I/M WAIVER RATES   : 3 .08 .08
I/M GRACE PERIOD   : 3 5

ANTI-TAMP PROG      :
82 75 94 22222 22222222 2 21 074 22111112

OXYGENATED FUELS   : .050 .950 .027 .035 2
```

Note that the 'I/M PROGRAM' record for all three I/M program definitions indicates the year 2025 as the I/M program end year. Since the calendar year for the MOBILE6 run is 1998, using 2025 as the end year does not affect the MOBILE6 emission factor results.

No state mandated automobile emission control strategies were assumed in the MOBILE6 emission factor generated for 2005, 2010 and 2015.

Fort Collins Automobile Fleet Vehicle Miles Traveled Mix

Since 1988, Colorado SIP mobile source emission inventories were prepared using regional information on the mix of vehicles in the fleet. This fleet mix information was collected in a roadway count survey in the late 1980s. Today, this survey information is dated. Consequently, Colorado believes that default fleet mix values in MOBILE6 model released on January 29, 2002 (Ref. 67FR4254) more closely characterizes the fleet mix in Fort Collins than the dated Colorado information. Default MOBILE6 fleet mix vehicle miles traveled were utilized to generate 1998, 1992, 2005, 2010 and 2015 emission factors.

Fort Collins VMT BY FACILITY Definitions for MOBILE6

MOBILE6 calculates emission factors based on four facility class definitions. These are freeway, arterial, ramps and locals. These four facility class definitions were assigned to the facility classes defined by the travel-demand modeling as follows:

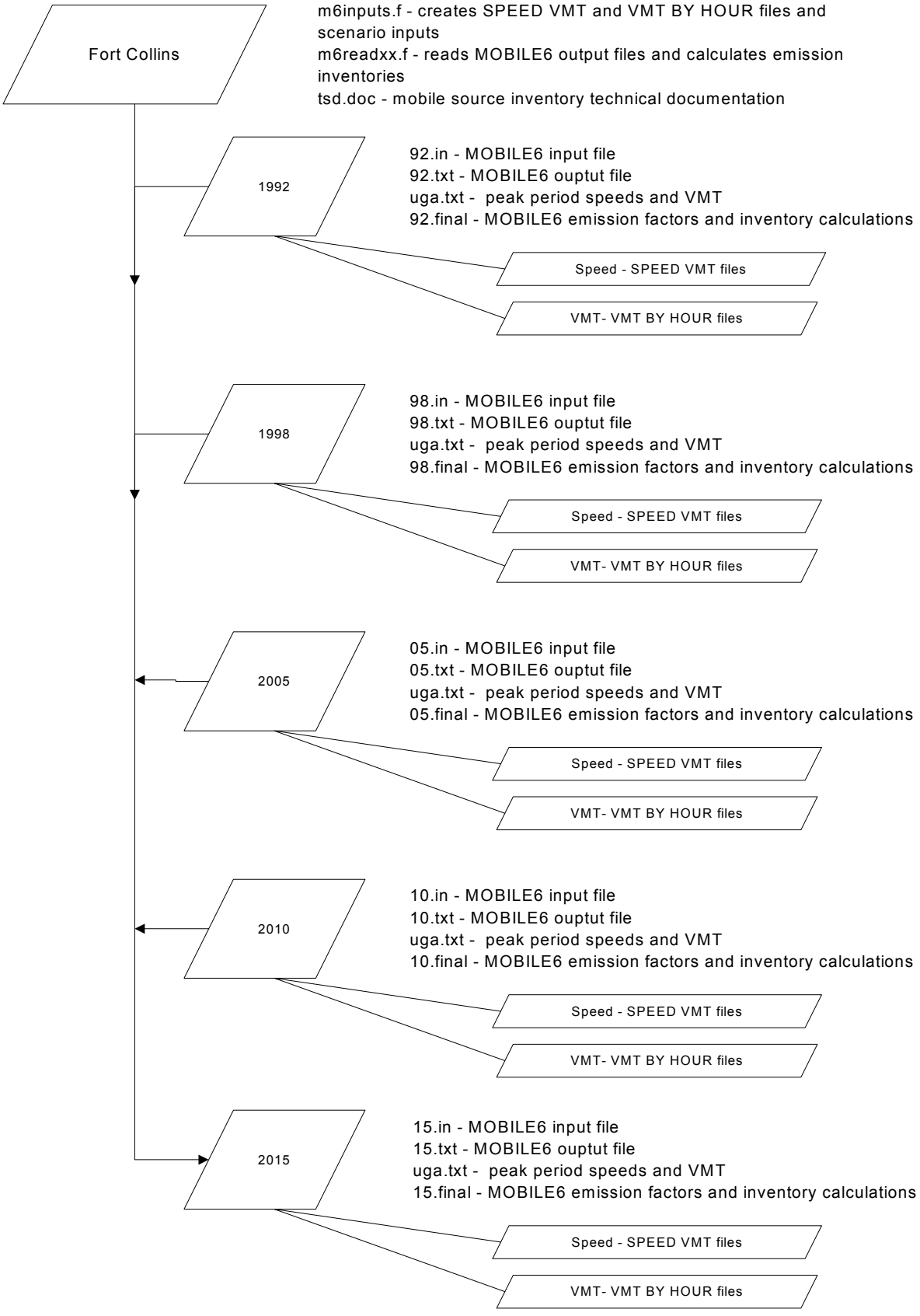
Fort Collins Facility Classes	MOBILE6 Facility Assignments
Freeway	Freeway
Expressway	Freeway
Principal Arterial	Arterial
Major Arterial	Arterial
Minor Arterial	Arterial
Collector	Arterial
Ramps	Ramps
Frontage	Arterial
Centroid Connector	Local

These facility class assignments are referenced in the Scenario Record inputs. The references point to input files defining the various classes. These input files, art.txt, fwy.txt, rmp.txt and loc.txt are included on the diskette with the MOBILE6 input and output files

MOBILE6 Input and Output files

The MOBILE6 input and output files along with the Fortran programs used to read the output files and generate the emission inventories are included on the diskette accompanying this document. The directory structure and file organization of these files is as follows:

Diagram 1: Directory structure of digital files for Fort Collins Mobile Source Inventory TSD



MOBILE6 Emission Factors and Emission Inventory Calculations

Table 6 through Table 10 show the emission factors and the results of the emission inventory calculations.

Table 6
1992 VMT, MOBILE6 Emission Factors and Inventory in the Fort Collins Urban Growth Area

Area Type	Facility Class	VMT	MOBILE6 CO Factor	grams/ day	tons/ day
CBD	Centroid Connector	34,893	52.05	1,816,120	2.002
CBD	Collector	3,030	48.08	145,655	0.161
CBD	Major Arterial	71,020	44.49	3,159,663	3.483
CBD	Minor Arterial	8,994	45.52	409,428	0.451
CBD	Principal Arterial	13,864	44.43	615,892	0.679
Rural	Centroid Connector	268	52.04	13,922	0.015
Rural	Collector	2,761	44.76	123,585	0.136
Rural	Freeway	36,697	47.11	1,728,626	1.905
Urban	Centroid Connector	209,215	52.04	10,887,779	12.002
Urban	Collector	75,058	44.21	3,318,167	3.658
Urban	Expressway	131,849	45.02	5,936,220	6.544
Urban	Freeway	187,925	50.27	9,446,229	10.413
Urban	Freeway Ramp	9,026	55.68	502,522	0.554
Urban	Frontage	2,885	45.27	130,623	0.144
Urban	Major Arterial	746,997	44.40	33,163,665	36.557
Urban	Minor Arterial	158,883	44.08	7,003,548	7.720
Urban	Principal Arterial	168,053	44.20	7,427,628	8.188
Totals:		1,861,417	46.11	85,829,270	94.611

Table 7
1998 VMT, MOBILE6 Emission Factors and Inventory in the Fort Collins Urban Growth Area

Area Type	Facility Class	VMT	MOBILE6 CO Factor	grams/ day	tons/ day
CBD	Centroid Connector	44,711	30.87	1,380,014	1.521
CBD	Collector	3,882	29.87	115,947	0.128
CBD	Major Arterial	96,556	27.92	2,695,933	2.972
CBD	Minor Arterial	11,526	28.41	327,441	0.361
CBD	Principal Arterial	18,849	27.87	525,365	0.579
Rural	Centroid Connector	343	30.86	10,577	0.012
Rural	Collector	3,538	28.72	101,622	0.112
Rural	Freeway	111,923	30.62	3,426,625	3.777
Urban	Centroid Connector	268,088	30.86	8,273,470	9.120
Urban	Collector	96,179	27.78	2,671,383	2.945
Urban	Expressway	193,769	28.82	5,584,998	6.156
Urban	Freeway	262,595	33.05	8,677,962	9.566
Urban	Freeway Ramp	12,612	39.06	492,632	0.543
Urban	Frontage	3,735	28.58	106,754	0.118
Urban	Major Arterial	966,995	28.17	27,240,252	30.027
Urban	Minor Arterial	203,592	27.90	5,681,030	6.262
Urban	Principal Arterial	217,547	27.97	6,083,919	6.706
Totals:		2,516,439	29.17	73,395,924	80.905

Table 8

2005 VMT, MOBILE6 Emission Factors and Inventory in the Fort Collins Urban Growth Area

Area Type	Facility Class	VMT	MOBILE6 CO Factor	grams/ day	tons/ day
CBD	Centroid Connector	48,477	26.77	1,297,593.52	1.430
CBD	Collector	4,915	26.35	129,493.28	0.143
CBD	Major Arterial	108,740	24.78	2,694,902.63	2.971
CBD	Minor Arterial	12,219	25.14	307,121.48	0.339
CBD	Principal Arterial	21,300	24.74	526,871.10	0.581
Rural	Centroid Connector	1,218	26.76	32,596.11	0.036
Rural	Collector	6,324	25.13	158,903.19	0.175
Rural	Freeway	121,596	26.24	3,190,930.24	3.517
Urban	Centroid Connector	350,128	26.76	9,370,830.22	10.330
Urban	Collector	190,185	24.65	4,687,118.84	5.167
Urban	Expressway	249,917	24.98	6,241,928.88	6.881
Urban	Freeway	316,857	29.08	9,213,881.29	10.157
Urban	Freeway Ramp	15,789	33.38	527,088.62	0.581
Urban	Frontage	15,347	25.40	389,825.20	0.430
Urban	Major Arterial	1,189,663	24.93	29,654,735.67	32.689
Urban	Minor Arterial	330,202	24.66	8,143,444.87	8.977
Urban	Principal Arterial	253,862	24.55	6,231,040.57	6.869
Totals:		3,236,739	25.58	82,798,305.72	91.270

Table 9

2010 VMT, MOBILE6 Emission Factors and Inventory in the Fort Collins Urban Growth Area

Area Type	Facility Class	VMT	MOBILE6 CO Factor	grams/ day	tons/ day
CBD	Centroid Connector	53,481	20.05	1,072,353.73	1.182
CBD	Collector	5,825	19.21	111,919.38	0.123
CBD	Major Arterial	120,052	18.10	2,173,068.57	2.395
CBD	Minor Arterial	13,882	18.33	254,477.26	0.281
CBD	Principal Arterial	23,175	18.08	418,988.25	0.462
Rural	Centroid Connector	1,888	20.04	37,841.30	0.042
Rural	Collector	7,395	18.19	134,496.08	0.148
Rural	Freeway	127,104	18.26	2,321,427.02	2.559
Urban	Centroid Connector	413,100	20.05	8,282,649.08	9.130
Urban	Collector	210,350	18.09	3,805,022.08	4.194
Urban	Expressway	269,361	17.90	4,820,493.26	5.314
Urban	Freeway	353,276	18.86	6,664,190.64	7.346
Urban	Freeway Ramp	18,768	22.16	415,895.86	0.458
Urban	Frontage	22,137	18.67	413,315.94	0.456
Urban	Major Arterial	1,398,250	17.89	25,017,489.96	27.577
Urban	Minor Arterial	403,762	17.96	7,250,752.14	7.993
Urban	Principal Arterial	267,885	18.06	4,837,742.60	5.333
Totals:		3,709,693	18.34	68,032,123.14	74.993

Table 10

2015 VMT, MOBILE6 Emission Factors and Inventory in the Fort Collins Urban Growth Area

Area Type	Facility Class	VMT	MOBILE6 CO Factor	grams/ day	tons/ day
CBD	Centroid Connector	58,485	17.08	998,811.23	1.101
CBD	Collector	6,736	16.16	108,860.94	0.120
CBD	Major Arterial	131,365	15.25	2,003,182.46	2.208
CBD	Minor Arterial	15,546	15.44	239,996.24	0.265
CBD	Principal Arterial	25,051	15.23	381,527.52	0.421
Rural	Centroid Connector	2,558	17.07	43,665.50	0.048
Rural	Collector	8,466	15.47	130,940.60	0.144
Rural	Freeway	132,612	15.41	2,043,280.26	2.252
Urban	Centroid Connector	476,071	17.08	8,129,868.64	8.962
Urban	Collector	230,515	15.24	3,513,274.80	3.873
Urban	Expressway	288,806	15.09	4,356,925.93	4.803
Urban	Freeway	389,694	15.95	6,216,013.58	6.852
Urban	Freeway Ramp	21,747	18.16	394,905.00	0.435
Urban	Frontage	28,927	16.04	463,955.80	0.511
Urban	Major Arterial	1,606,837	15.09	24,251,988.78	26.733
Urban	Minor Arterial	477,321	15.14	7,225,211.30	7.964
Urban	Principal Arterial	281,909	15.22	4,290,653.58	4.730
Totals:		4,182,646	15.49	64,793,062.14	71.422

Fort Collins Carbon Monoxide Maintenance Plan Area/Non-road Emission Inventories

Source Cat.	1992	1998	2005	2010	2015
Residential Heating	0.19	0.20	0.25	0.30	0.33
Commercial Heating	0.06	0.07	0.09	0.11	0.13
Commercial Non-road	3.9	4.8	6.5	7.9	10.0
Construction Non-road	1.9	1.9	1.6	1.7	1.9
Industrial Non-road	1.8	1.9	2.0	2.1	2.2
Commercial Lawn and Garden	1.4	1.5	1.8	2.0	2.4
Residential Lawn and Garden	0.2	0.2	0.3	0.3	0.3
Agriculture Non-road	0.003	0.003	0.003	0.003	0.004
Recreation Non-road	0.128	0.131	0.138	0.144	0.151
Wood Burning	13.5	13.6	4.2	4.3	4.3
Railroad Non-road	0.010	0.012	0.012	0.013	0.015
Railroad Locomotives	0.026	0.029	0.030	0.032	0.037
Point Sources	0.7	0.4	0.5	0.6	0.6
Total(ton/day)	**23.8**	**24.8**	**17.5**	**19.5**	**22.4**

Residential and Commercial Heating Emissions for 1998 were based on Version 1.5 of the 1999 EPA National Emissions Inventory (NEI) for Larimer County and were apportioned to the nonattainment area by households using the 1990 Census. Daily emissions were obtained from annual emissions by multiplying by the ratio of heating degree days in the high CO season (November, December and January) to the entire year (0.475599, based on National Weather Service data for Fort Collins for 1900 to 2000 with a base of 65 degrees F) and dividing by 92(the number of days in the season). Projections to other years were based on population and employment projections from the land use and transportation plan.

Non-road Emissions with the exception of railroad were based on the EPA Non-road model, and apportioned to the nonattainment area by households using the 1990 Census. Railroad Non-road Emissions from the Non-road model were apportioned to the nonattainment area by the miles of track. Recreational Non-road Emissions were apportioned to the nonattainment area by land area. The following equipment categories were excluded from the Lawn and Garden categories in computing the winter emissions: Commercial Turf Equipment, Front Mowers, Lawn & Garden Tractors, Lawn mowers, Other Lawn & Garden Eqp., Rear Engine Riding Mowers, Rotary Tillers < 6 HP, Trimmers/Edgers/Brush Cutter. The following lawn and garden equipment winter emissions were included: Chippers/Stump Grinders, Chain Saws < 6 HP, Leafblowers/Vacuums, Shredders < 6 HP, Snowblowers.

Railroad Locomotive Emissions for 1998 were based on Version 1.5 of the 1999 EPA National Emissions Inventory (NEI) for Larimer County and were apportioned to the nonattainment area by miles of track. Projections to other years were based on the change in Railroad Non-road emissions.

Wood burning emissions were developed by calculating per-household wood burning rates from the Wood Burning Survey used for the Fort Collins CO SIP, and the 2002 Wood Burning Survey, and multiplying by the appropriate AP-42 emission factors. The number of households for each year was taken from the land use and transportation plan. Daily emissions were obtained from annual emissions by multiplying by the ratio of heating degree days in the high CO season (November, December and January) to the entire year (0.475599, based on National Weather Service data for Fort Collins for 1900 to 2000 with a base of 65 degrees F) and dividing by 92(the number of days in the season). Fireplace emissions were held constant at 1992 levels. The installation of non-certified Wood Burning devices including masonry fireplaces is prohibited by County and City regulations.

1992 Point Source Emissions were taken from the 1993 Fort Collins Periodic Inventory (those within the Urban Growth Boundary/Nonattainment Area). 1998 Point Source Emissions were taken from the Colorado Air Inventory System which is based on the stationary source permit data. Point Source Emissions after 1998 are grown by the growth in non-retail employment.

LARIMER COUNTY	UGA	Non-UGA	Total	Fraction in UGA
Area (square meters)	196,138,190	6,619,527,861	6,815,666,050	0.028778
Households (1990)	46,045		70,472.00	0.653380

Calculation of the 1992 Demographic Information:

The following numbers are for within the Urban Growth Boundary/Nonattainment Area. 1998 through 2020 numbers are from the North Front Range Transportation and Land Use Plan. 1990 households and employment are from an earlier transportation and land use plan provided by the North Front Range Air Quality Planning Council. 1992 calculated by interpolation.

	1990	1992	1998	2005	2010	2015	2020	1992/1998 Factor
Employment	51,145	53,955	60,980	76,002	86,731	97,461	108,190	0.884797
Households	46,045	47,022	49,464	59,410	66,514	73,618	80,722	0.950625
Non Retail EMPLOYMENT			47,631	59,731	68,373	68,373	77,016	

FT. COLLINS Wood Burning:

New stoves from 1992 through 1998 assumed to equal population growth times existing stoves. Fireplaces and existing stove 1992 through 1998 emissions held constant from 1990.

From 1990 SIP Inventory						
1990	NUMBER	CORDS	kg/cord	ef (g/kg)	kg burned	kg/hh
Fireplaces	17102	0.58	1,100	126	10911076	260.862
Conv.	3,561	1.02	1,100	115.4	3995442	
Phase I	826	1.02	1,100	58.9	926772	
Phase II	1,081	1.02	1,100	48.7	1212882	
Total Stoves	5,468				6135096	146.6779
No. Households	41,827					
Adjusted 1990 (increased by ratio of 46,045/41,827 – the revised households estimate for 1990):						
Fireplaces	18,827	0.58	1,100	126	12,011,391	
Conv.	3,920	1.02	1,100	115.4	4,398,240	
Phase I	909	1.02	1,100	58.9	1,019,898	
Phase II	1,190	1.02	1,100	48.7	1,335,180	
Total Stoves	5,468					
No. Households	46,045					

1992 STOVES:	NUMBER	CORDS	kg/cord	ef (g/kg)	kg burned
Conv.	3,920	1.02	1,100	115.4	4,398,240
Phase I	909	1.02	1,100	58.9	1,019,898
Sum = Conv. 1992	4,829				5,418,138
Phase II from 1990	1,190				
No. Households	47,022				
New Stoves(%HH increase * Total1990 stoves)	128				
Total 1992 Phase II	1,318				
TOTAL Stoves 1992 (conventional + Phase II)	6,147				
Fraction phase II	0.2623				
1998 STOVES:					
Conv. 1992	4,829				
Phase II from 1992	1,318				
No. Households	49,464				
New Stoves(%HH increase * Total1992 stoves)	319				
Total 1996 Phase II	1,637				
TOTAL Stoves 1996 (conventional + Phase II)	6,466				
Fraction phase II	0.2532				

Average EF (g/kg)	CO
Fireplace	126.3
conventional	115.4
Phase II	53.5

	1990	1992	1998	2005	2010	2015	2020
Households	46,045	47,022	49,464	59,410	66,514	73,618	80,722

	HDD ratio	Days per season	kg burned/HH	*1992* Fraction phase II	1992 kg burned	*1992 CO (t/d)*	*1998* Fraction phase II	1998 kg burned	*1998 CO (t/d)*
Fireplace	0.475599	92	260.862		12,011,391	8.645		12,011,391	8.645
conventional	0.475599	92	146.6779		6,753,784	4.441		6,753,784	4.441
Phase II	0.475599	92	146.6779	0.2144	1,478,489	0.451	0.2532	1,836,709	0.560
TOTAL						13.537			13.646

2005 and Later Wood Burning:

According to calculations based on the 2002 Fort Collins Wood Burning Survey (see Attachment 3), the average Wood Burning rate for fireplaces and stoves combined is 116.69 kg per household. Since there is no data on the break out between stoves and fireplaces, the ratio found in 1990 is used. This gives a Wood Burning rate per household of 74.69 kg per household for fireplaces and 42.00 kg per household for stoves.

According to calculations based on the 2002 Fort Collins Wood Burning Survey, 5.4% of the households have Wood Burning stoves, and 32.9% of the households have Wood Burning fireplaces. Of the 5.4% of the households with stoves, 30.71% have certified stoves.

		2002		annual	**2005**
	fraction	Number	Number	growth	Number
Fireplaces		18,142	18,142	-0.00331	17,902
Conv.	0.692913		3,692	-0.02140	3,376
Phase II	0.307087		1,636	0.03409	1,859
Total Stoves		5,328	5,328		5,235
No. Households		55,147			59,410
wb soves/hh		0.096621			0.0881

Based on the changes in fireplace and stove ownership from 1990 to 2002, as reflected in the surveys, the number of wood burning stoves and fireplaces per household in 2005 would be less than in 2002. To be conservative, the total number of stoves per household is held constant after 2002, and the total amount of wood burned in fireplaces is held constant at 2002 levels .

		Number	**fraction**	**kg burned**	**emissions (t/d)**
2005	**Rate**				
Fireplaces(constant at 2002 levels)				4,119,209	2.96
Annual growth Conv.	-0.021	3,376	0.5881	1,467,499	0.97
Phase II		2,364	0.4119	1,027,678	0.31
wb soves/hh	0.097	5,740		**TOTAL**	**4.24**
2010					
Fireplaces(constant at 2002 levels)				4,119,209	2.96
Annual growth Conv.	-0.021	3,015	0.4691	1,310,456	0.86
Phase II		3,412	0.5309	1,483,083	0.45
wb soves/hh	0.097	6,427		**TOTAL**	**4.28**
2015					
Fireplaces(constant at 2002 levels)				4,119,209	2.96
Annual growth Conv.	-0.021	2,653	0.3730	1,153,414	0.76
Phase II		4,460	0.6270	1,938,488	0.59
wb soves/hh	0.097	7,113		**TOTAL**	**4.31**

1998 Point Sources within UGA	
facility_name	1998 tpd
DON KEHN CONST INC	0.214175
AGILENT TECHNOLOGIES	0.102942
AGGREGATE INDUSTRIES - WCR, INC.	0.004767
REAGER FUNERAL HOME AND CREMATORY	0.000008
COLORADO STATE UNIV	0.068849
POUDRE VALLEY HOSP	0.004029
TOTAL	0.39

Non-road Model Emissions tons per day

Area	Agricultural Equipment	Commercial Equipment	Construction and Mining Equipment	Industrial Equipment	Lawn and Garden Equipment (Com)	Lawn and Garden Equipment (Res)	Recreational Equipment
1992							
Larimer County	0.093	5.911	2.905	2.782	3.541	0.425	4.454
Urban Growth Area	0.0027	3.862	1.898	1.818	2.314	0.278	0.1282
1998							
Larimer County	0.098	7.38	2.862	2.884	3.623	0.468	4.555
Urban Growth Area	0.0028	4.822	1.870	1.884	2.367	0.306	0.1311
2005							
Larimer County	0.104	9.98	2.525	3.091	4.375	0.540	4.793
Urban Growth Area	0.0030	6.521	1.650	2.020	2.859	0.353	0.1379
2010							
Larimer County	0.111	12.087	2.628	3.189	4.862	0.612	4.99
Urban Growth Area	0.0032	7.897	1.717	2.084	3.177	0.400	0.1436
2015							
Larimer County	0.129	15.331	2.932	3.311	5.805	0.736	5.243
Urban Growth Area	0.0037	10.017	1.916	2.163	3.793	0.481	0.1509

Non-road Model Input File For 1998

The "Non-road Model Input File for 1998" was produced automatically by the NonRoad Model. The inputs to the model that are reflected in this file are those within the */NAME/…/*END/ delimiters such as:

/OPTIONS/
Title 1 : Fort Collins 98
Title 2 :
Fuel RVP for gas : 12.4
Oxygen Weight % : 3.0
Gas sulfur % : 0.034
Diesel sulfur % : 0.3300
CNG/LPG sulfur % : 0.003
Minimum temper. (F): 21
Maximum temper. (F): 53
Average temper. (F): 36
Altitude of region : LOW
/END/

Written by Nonroad interface at 12/18/2001 11:09:00 AM
This is the options file for the NONROAD program.
The data is sperated into "packets" bases on common
information. Each packet is specified by an
identifier and a terminator. Any notes or descriptions
can be placed between the data packets.

10/8/1999 changed default RVP from 9.0 to 8.0

PERIOD PACKET

This is the packet that defines the period for
which emissions are to be estimated. The order of the
records matter. The selection of certain parameters
will cause some of the record that follow to be ignored.
The order of the records is as follows:

1 - Char 10 - Period type for this simulation.
Valid responses are: ANNUAL, SEASONAL, and MONTHLY
2 - Char 10 - Type of inventory produced.
Valid responses are: TYPICAL DAY and PERIOD TOTAL
3 - Integer - year of episode (4 digit year)
4 - Char 10 - Month of episode (use complete name of month)
5 - Char 10 - Type of day
Valid responses are: WEEKDAY and WEEKEND

/PERIOD/
Period type : Seasonal
Summation type : Typical day
Year of episode : 1998
Season of year : Winter
Month of year :
Weekday or weekend : Weekday
/END/

OPTIONS PACKET

This is the packet that defines some of the user
options that drive the model. Most parameters are
used to make episode specific emission factor

adjustments. The order of the records is fixed.
The order is as follows.

1 - Char 80 - First title on reports
2 - Char 80 - Second title on reports
3 - Real 10 - Fuel RVP of gasoline for this simulation
4 - Real 10 - Oxygen weight percent of gasoline for simulation
5 - Real 10 - Percent sulfur for gasoline
6 - Real 10 - Percent sulfur for diesel
7 - Real 10 - Percent sulfur for LPG/CNG
8 - Real 10 - Minimum daily temperature (deg. F)
9 - Real 10 - maximum daily temperature (deg. F)
10 - Real 10 - Representative average daily temperature (deg. F)
11 - Char 10 - Flag to determine if region is high altitude
Valid responses are: HIGH and LOW
12 - Char 10 - Flag to determine if RFG adjustments are made
Valid responses are: YES and NO

/OPTIONS/
Title 1 : Fort Collins 98
Title 2 :
Fuel RVP for gas : 12.4
Oxygen Weight % : 3.0
Gas sulfur % : 0.034
Diesel sulfur % : 0.3300
CNG/LPG sulfur % : 0.003
Minimum temper. (F): 21
Maximum temper. (F): 53
Average temper. (F): 36
Altitude of region : LOW
/END/

REGION PACKET

This is the packet that defines the region for which emissions are to be estimated.

The first record tells the type of region and allocation to perform.

Valid responses are:
US TOTAL - emissions are for entire USA without state breakout.

50STATE - emissions are for all 50 states and Washington D.C., by state.

STATE - emissions are for a select group of states and are state-level estimates

COUNTY - emissions are for a select group of counties and are county level estimates. If necessary, allocation from state to county will be performed.

SUBCOUNTY - emissions are for the specified sub counties and are subcounty level estimates. If necessary, county to subcounty allocation will be performed.

The remaining records define the regions to be included. The type of data which must be specified depends on the region level.

US TOTAL - Nothing needs to be specified. The FIPS code 00000 is used automatically.

50STATE - Nothing needs to be specified. The FIPS
code 00000 is used automatically.

STATE - state FIPS codes

COUNTY - state or county FIPS codes. State FIPS
code means include all counties in the
state.

SUBCOUNTY - county FIPS code and subregion code.

/REGION/
Region Level : COUNTY
Larimer County CO : 08069
/END/

or use -
Region Level : STATE
Michigan : 26000

SOURCE CATEGORY PACKET

This packet is used to tell the model which source
categories are to be processed. It is optional.
If used, only those source categories list will
appear in the output data file. If the packet is
not found, the model will process all source
categories in the population files.

All Equipment - just put semicolon at start of packet name line
or use the following SCC list -

:2260000000
:2265000000
:2267000000
:2268000000
:2270000000
:2282000000
:2285000000

Diesel Only -

:2270000000
:2282020000
:2285002015

Spark Ignition Only -

:2260000000
:2265000000
:2267000000
:2268000000
:2282005010
:2282005015
:2282010005
:2285004015
:2285006015

This is the packet that lists the names of output files
and some of the input data files read by the model. If
a drive:\path\ is not given, the location of the
NONROAD.EXE file itself is assumed. You will probably
want to change the names of the Output and Message files
to match that of the OPTion file, e.g., MICH-97.OPT,
MICH-97.OUT, MICH-97.MSG, and if used MICH-97.AMS.

/RUNFILES/

```
ALLOC XREF        : c:\nonroad\data\allocate\allocate.xrf
ACTIVITY          : c:\nonroad\data\activity\activity.dat
TECHNOLOGY        : c:\nonroad\data\tech\tech.dat
SEASONALITY       : c:\nonroad\data\season\season.dat
REGIONS           : c:\nonroad\data\season\season.dat
MESSAGE           : c:\nonroad\ftco98.msg
OUTPUT DATA       : c:\nonroad\ftco98.out
EPS2 AMS          :
/END/

------------------------------------------------------------
This is the packet that defines the equipment population
files read by the model.
------------------------------------------------------------
/POP FILES/
Population File    : c:\nonroad\data\pop\co.pop
/END/

POPULATION FILE    : c:\nonroad\data\POP\MI.POP


------------------------------------------------------------
This is the packet that defines the growth files
files read by the model.
------------------------------------------------------------
/GROWTH FILES/
National defaults  :C:\nonroad\data\growth\nation.grw
/END/

------------------------------------------------------------
This is the packet that defines the spatial
allocation files read by the model.
------------------------------------------------------------
/ALLOC FILES/
Air Transportation :c:\nonroad\data\allocate\co_airtr.alo
Contruction empl.  :c:\nonroad\data\allocate\co_const.alo
Havested Cropland  :c:\nonroad\data\allocate\co_farms.alo
Golf Course estab. :c:\nonroad\data\allocate\co_golf.alo
Wholesale establis.:c:\nonroad\data\allocate\co_holsl.alo
Family housing     :c:\nonroad\data\allocate\co_house.alo
Logging empl.      :c:\nonroad\data\allocate\co_loggn.alo
Landscape empl.    :c:\nonroad\data\allocate\co_lscap.alo
Metal mining empl. :c:\nonroad\data\allocate\co_metal.alo
Manufacturing empl.:c:\nonroad\data\allocate\co_mnfg.alo
Oil & Gas employees:c:\nonroad\data\allocate\co_oil.alo
Census population  :c:\nonroad\data\allocate\co_pop.alo
RV Park employees  :c:\nonroad\data\allocate\co_rvprk.alo
Surface water area :c:\nonroad\data\allocate\co_water.alo
/END/

------------------------------------------------------------
This is the packet that defines the emssions factors
files read by the model.
------------------------------------------------------------
/EMFAC FILES/
THC exhaust       : c:\nonroad\data\emsfac\exhthc.emf
CO exhaust        : c:\nonroad\data\emsfac\exhco.emf
NOX exhaust       : c:\nonroad\data\emsfac\exhnox.emf
PM exhaust        : c:\nonroad\data\emsfac\exhpm.emf
BSFC              : c:\nonroad\data\emsfac\bsfc.emf
Crankcase         : c:\nonroad\data\emsfac\crank.emf
Spillage          : c:\nonroad\data\emsfac\spillage.emf
Diurnal           : c:\nonroad\data\emsfac\diurnal.emf
/END/

------------------------------------------------------------
```

This is the packet that defines the deterioration factors
files read by the model.

/DETERIORATE FILES/
THC exhaust : c:\nonroad\data\detfac\exhthc.det
CO exhaust : c:\nonroad\data\detfac\exhco.det
NOX exhaust : c:\nonroad\data\detfac\exhnox.det
PM exhaust : c:\nonroad\data\detfac\exhpm.det
/END/

Optional Packets - Add initial slash "/" to activate

/STAGE II/
Control Factor : 0
/END/
Enter percent control: 95 = 95% control = 0.05 x uncontrolled
Default should be zero control.

MODELYEAR OUT/
by-model-year out : C:\nonroad\outputs\template.bmy
/END/

SI REPORT/
SI report file-CSV :C:\NONROAD\OUTPUTS\NRPOLLUT.CSV
/END/

Railroad and Rail Service Equipment Emissions

Larimer County Rail											
98	92	98	5	10	15						
total rr	total rse	total rse	total rse	total rse	total rse						
0.0603	0.0213	0.0242	0.0245	0.0265	0.0308						
T_Length	LENGTH	92 rse t/d	92 t/d rr	98 rse t/d	98 t/d rr	05 rse t/d	05 rr t/d	10 rse t/d	10 rr t/d	15 rse t/d	15 rr t/d
111,801	54,239	0.010	0.026	0.012	0.029	0.012	0.030	0.013	0.032	0.015	0.037

Appendix A

Draft Fort Collins Urban Growth Area VMT Estimate for 1992

Draft Fort Collins Urban Growth Area VMT Estimate for 1992

Background

Fort Collins measured a second-high maximum ambient 8-hour carbon monoxide concentrations of 6.9 ppm in 1992. This implies that the 1992 emission inventory which resulted in this ambient concentration for Fort Collins is a reasonable estimate of the maximum allowable level of carbon monoxide emissions to maintain the carbon monoxide NAAQS. The USEPA has indicated that 1992 would be the earliest year approvable for a base year in the development of a technical demonstration for redesignation of the Fort Collins non-attainment area to attainment(see Attachment 1 for attached memo).

The North Front Range Transportation and Air Quality Council (NFRTAQPC) completed *a Mobility Report Card and Household Travel Survey* in 1998. During 1999, planning for the redesignation analysis commenced. At that time, NFRTAQPC felt that limited MPO funds would be spent more wisely on a travel demand model development for 1998 using the *Mobility Report Card* survey data. A later, more current year based on the 1998 survey would also be more useful to the MPO from a planning perspective and in the development of Transportation Improvement Plans and Regional Transportation Plans. Consequently, a travel demand model based on 1998 was developed for the NFRTAQPC over the 10/2000 to 10/2001 timeframe. This travel demand model served as the basis for the 2025 Regional Transportation Plan for NFRTAQPC and will be the basis of the NFRTAQPC 2003-2008 Transportation Improvement Plan.

Fort Collins Redesignation Base Year Implications

By 1998, the second-high eight-hour average ambient carbon monoxide concentrations in Fort Collins had dropped to around 5.0 parts per million. Consequently, a 1998 inventory represents a level of carbon monoxide emission resulting in ambient concentration of 5.0 parts per million. Since the carbon monoxide NAAQS is 9.0 parts per million for an eight-hour average, 1998 carbon monoxide emission level represent a level significantly below that needed to attain the ambient standard. Using 1998 as the base year without a complex modeling demonstration to allow higher emission levels eliminates the possibility of relaxing the oxygenated fuels or the automobile inspection and maintenance program in the short term as well as longer term (Calcagni, 1982).

Despite the high rate of VMT growth in the Fort Collins area between 1992 and 1998, the level of emissions in 1992 would be expected to be significantly higher than 1998 as reflected in the ambient concentration which was closer to the carbon monoxide NAAQS in 1992. Using 1992 as the base year will eliminate the necessity for over-control while still assuring emission levels that maintain the carbon monoxide NAAQS. Consequently, APCD will use 1992 as the base year for the redesignation technical analysis.

Background on 1992-1998 VMT Estimates

An estimate of VMT in Fort Collins in 1992 is essential to the development of an estimate of mobile source carbon monoxide inventory in 1992. Coincidentally and independent of APCD's redesignation technical analysis efforts, the Fort Collins Land Use Transportation and Air Quality (LUTRAQ) team undertook a study to estimate VMT growth rates in Fort Collins between 1990 and 1998. This team prepared an internal report, *Estimation of VMT and VMT growth rate*, June 22, 2001, This report is included in Attachment 2 of this document. The team evaluated the VMT growth rate in the Fort

Collins area using three different methodologies: travel demand modeling, HPMS and local traffic counts and fuel consumption rates. The report provides an independent summary and analysis of information concerning VMT growth in Fort Collins. The report concludes that the best estimate of VMT growth in Fort Collins between 1990 and 1998 is 4.9% per year compounded annually. This 4.9% per year estimate is based in transportation modeling for the NFRTAQPC region done for the 2015 and 2020 North Front Range Transportation Improvement Plans. Unfortunately, these modeling analyses cannot be used for this analysis since and the modeling was not time-of-day based and the speeds resultant from the travel demand modeling were representative of congested conditions. The geographical area for the transportation modeling described in the LUTRAQ report was slightly different than the recently defined Fort Collins Urban Growth Area. Consequently, the numeric magnitude of the 2015 and 2025 TIP VMT results can not be directly compared to the VMT resultant from the 2025 Regional Transportation Plan (basis of this redesignation technical analysis and resultant 1992 estimate of VMT).

Methodology for Estimating 1992 VMT in Fort Collins

The USEPA and USDOT recommend two methods for estimating VMT (*Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources*, section 3.4). The direct use of Highway Performance Management System (HPMS) generated VMT is one of the recommendations. The second method, travel demand modeling, also relies on HPMS data. The VMT estimates resultant from transportation planning and travel demand modeling are required to be consistent with HPMS. HPMS data is used directly in the calibration of travel demand modeling, assuring that the travel demand model results are consistent with HPMS.

HPMS data or any standardized, quality assured 'traffic count' data for that matter are an excellent source and information available to infer estimates of VMT levels. Traffic counts are a measure of actual activities on roadways. Independent of the Fort Collins LUTRAQ study, APCD has obtained and analyzed HPMS data for the Fort Collins area. The results the APCD of HPMS traffic count analysis between 1992 and 1998 was identical to the HPMS traffic count data analysis performed by Fort Collins. Both analyses indicated a 4.6% per year, compounded annually between 1994 and 1998 (see HPMS table in Method 3, LUTRAQ report: compounded growth rate = [1998 VMT / 1994 VMT]^(1/(1994-1998)) = [2,262,000/1,887,000]^.25) = 1.0464 per year).

The APCD has developed a methodology to use the HPMS traffic count data with the results of the 1998 NFRTAQPC travel demand model to estimate 1992 VMT in Fort Collins. The goal of this methodology is to determine the growth rates between 1992 and 1998 based on the HPMS traffic data as a function of area type and facility class. These growth rates can then be applied to the 1998 transportation model results to estimate the 1992 VMT in the Fort Collins Urban Growth area. The APCD will use the 1992 VMT estimated from this methodology to estimate a 1992 base case mobile source emission inventory for Fort Collins.

HPMS Traffic Count Data in the Fort Collins Urban Growth Area

Table 1 describes the route location, 1992 and 1998 HPMS ADT counts in the Fort Collins Urban Growth Area. In order to match the area type and facility class designation with the Fort Collins Transportation modeling, the area type and facility class of these locations was determined directly from the 1998 transportation modeling.

Table 1

ROUTE	Description of Location	1992 ADT	1998 ADT
001A	ON SH 1 N/O COUNTRY CLUB DR (Urban/Min. Art.)	4650	5481
001A	ON SH 1 N/O GREGORY RD (Urban/Min. Art.)	4350	5152
001A	ON SH 1 E/O SH 287, FT COLLINS (Urban/Min. Art.)	6100	7783
014C	ON SH 14, RIVERSIDE AVE SE/O SH 287 (CBD, Maj. Art.)	11100	16595
014C	ON SH 14, RIVERSIDE AVE SE/O LINDEN ST (CBD, Maj)	11200	16175
014C	ON SH 14, RIVERSIDE AVE NW/O MULBERRY ST (CBD, Maj)	14500	18906
014C	ON SH 14, MULBERRY ST E/O RIVERSIDE AVE	16200	22372
014C	ON SH 14, 14 E/O I-25 (Urban/Maj. Arterial)	4400	6722
025A	ON I-25 S/O PROSPECT ST INTERCHANGE (Urban/Fwy)	28600	33426
025A	ON I-25 S/O SH 1 INTERCHANGE (Urban/Fwy)	11400	15460
025A	ON I-25 S/O SH 14 INTERCHANGE (Urban/Fwy)	20400	29248
025A	ON I-25 N/O SH 392 INTERCHANGE (Rural/Fwy)	30200	50498
025A	ON I-25 N/O SH 14 INTERCHANGE (Urban/Fwy)	15400	19220
068A	ON SH 68 E/O SH 287 (Urban/Expressway)	20300	26678
068A	ON SH 68 E/O STOVER ST (Urban/Expressway)	20300	25523
068A	ON SH 68 E/O BROADWAY DR (Urban/Expressway)	20300	23003
068A	ON SH 68 E/O LEMAY AVE (Urban/Expressway)	20000	25838
068A	ON SH 68 E/O TIMBERLINE RD (Urban/Expressway)	19800	23317
068A	ON SH 68 E/O CO RD 9 (Urban/Expressway)	19300	25628
068A	ON SH 68 W/O I-25 (Urban/Expressway)	18800	26259
287C	ON SH 287 S/O SH 68, HARMONY RD (Urban/Maj. Art.)	29200	28779
287C	ON SH 287 N/O SH 68, HARMONY RD(Urban/Maj. Art.)	32800	37182
287C	ON SH 287 N/O CO RD 32(Urban/Maj. Art.)	21900	22477
287C	ON SH 287 N/O ELIZABETH ST (Urban/Maj. Art.)	32400	39282
287C	ON SH 287 E/O E JCT OLD SH 287 (Rural/Maj. Art.)	10400	16491
287C	ON SH 287 E/O SHIELDS ST (Urban/Maj. Art.)	9200	14810
287C	ON SH 287 NW/O SH 1 (Urban/Maj. Art.)	11000	17645
287C	ON SH 287 S/O SH 1 (Urban/Maj. Art.)	15700	20587
287C	ON SH 287 S/O WILLOX LN (Urban/Maj. Art.)	17500	22162
287C	ON SH 287 N/O VINE DR (Urban/Maj. Art.)	19100	25208
287C	ON SH 287 N/O WILLOW ST (CBD/Maj. Art.)	22400	24578
287C	ON SH 287 N/O SH 14, RIVERSIDE AVE (CBD/Maj. Art.)	22000	25103
287C	ON SH 287 S/O SH 14, RIVERSIDE AVE (CBD/Maj. Art.)	14200	17540
287C	ON SH 287 N/O MOUNTAIN AVE (CBD/Maj. Art.)	16200	22057
287C	ON SH 287 N/O TRIBLY RD, CO RD 34 (CBD/Maj. Art.)	24000	24368
287C	ON SH 287 S/O MULBERRY ST, FT COLLINS (CBD/Maj. Art.)	25900	30040
287C	ON SH 287 NW/O E JCT OLD SH 287 (Rural/Maj. Art.)	6250	7356
287C	ON SH 287 N/O PITKIN ST, FT COLLINS (CBD/Maj. Art.)	33000	42118
287C	ON SH 287 N/O PROSPECT ST, FT COLLINS (CBD/Maj. Art.)	34100	41803
287C	ON SH 287 S/O PROSPECT ST, FT COLLINS (Urban/Maj. Art.)	39400	52936
287C	ON SH 287 S/O STUART ST, FT COLLINS (Urban/Maj. Art.)	38500	45480
287C	ON SH 287 N/O DRAKE RD, FT COLLINS (Urban/Maj. Art.)	40000	53672
287C	ON SH 287 S/O DRAKE RD, FT COLLINS (Urban/Maj. Art.)	38700	44639
287C	ON SH 287 S/O SWALLOW RD, FT COLLINS (Urban/Maj. Art.)	38000	44324
287C	ON SH 287 S/O FOOTHILLS PKWY (Urban/Maj. Art.)	38000	43483
287C	ON SH 287 N/O HORSETOOTH RD (Urban/Maj. Art.)	36300	46529
287C	ON SH 287 S/O HORSETOOTH RD (Urban/Maj. Art.)	38100	50836
287C	ON SH 287 N/O TROUTMAN PKWY (Urban/Maj. Art.)	34900	38967

287C	ON SH 287 N/O MULBERRY ST (Urban/Maj. Art.)	17100	25418

Summary of HPMS Traffic Count Data by Area Type and Facility Class

The HPMS traffic count data in Table 1 can be summarized by facility type. Table 2 is this base set of HPMS traffic count data in Table 1 volume weighted and summarized by the route and area type and facility class.

Table 2

ROUTE	Name	Facility	Area type	Sum of 92 ADT	Sum 98 ADT	Growth Factor
001A	Terry Lake Rd	Minor Arterial	Urban	15100	18416	0.2196
014C	Mulberry	Expressway	Urban	32800	50190	0.5302
014C	Riverside Ave	Major Arterial	Urban	20600	29094	0.4123
014C	Riverside Ave	Major Arterial	CBD	36800	51676	0.4042
025A	I25	Freeway	Rural	30200	50498	0.6721
025A	I25	Freeway	Urban	75800	97354	0.2844
068A	Harmony Rd	Expressway	Urban	138800	176246	0.2698
287C	Highway 287	Major Arterial	Rural	6250	7356	0.1770
287C	College Ave	Major Arterial	Urban	565100	689857	0.2208
287C	College Ave	Major Arterial	CBD	184900	228657	0.2367

Similar road class and area types from the Table 2 (Urban/Expressway, Urban Major Arterial and CBD/Major Arterial) can be further aggregated and volume weighted. Table 3 lists the aggregation (volume weighted) of the duplicated area type and facility class HPMS traffic count data.

Table 3

Urban/Expressway						
ROUTE	Name	Facility	Area type	Sum of 92 ADT	Sum 98 ADT	Growth Factor
014C	Mulberry	Expressway	Urban	32800	50190	0.530182927
068A	Harmony Rd	Expressway	Urban	138800	176246	0.269783862
				171600	226436	0.3196
Urban/Major Arterial						
ROUTE	Name	Facility	Area type	Sum of 92 ADT	Sum 98 ADT	Growth Factor
014C	Riverside Ave	Major Arterial	CBD	36800	51676	0.40423913
287C	College Ave	Major Arterial	CBD	184900	228657	0.236652244
				221700	280333	0.2645
CBD/Major Arterial						
ROUTE	Name	Facility	Area type	Sum of 92 ADT	Sum 98 ADT	Growth Factor
014C	Riverside Ave	Major Arterial	Urban	20600	29094	0.412330097
287C	College Ave	Major Arterial	Urban	565100	689857	0.220769775
				585700	718951	0.2275

HPMS Traffic Count Based Growth Rates

Table 4 describes the final set of HPMS ADT derived growth factors that will be used to estimate the 1992 VMT in the Fort Collins Urban Growth Area.

Table 4

Category Assignment	Area Type	Facility Class	1998 - 1992 Growth Factor (1- Growth Factor from Tables 2 and 3)
1	CBD	Major Arterial	.7355
2	Urban	Freeway	.7156
3	Urban	Expressway	.6804
4	Urban	Major Arterial	.7725
5	Urban	Minor Arterial	.7804
6	Rural	Freeway	.3279
7	Rural	Major Arterial	.8230

1992 Fort Collins VMT Estimate Based on HPMS Traffic Counts

Table 5 summarizes the application of the growth rates to the 1998 travel demand model to estimate 1992 VMT in the Fort Collins Urban Growth area:

Table 5

1998 Baseline Fort Collins UGA			1998-1992	
AREA_TYPE	FACILITY_T	1998 VMT	growth factor /category	1992 VMT
CBD	Centroid Conn	44,711	.7804 / 5	34,893
CBD	Collector	3,882	.7804 / 5	3,030
CBD	Major Arterial	96,556	.7355 / 1	71,020
CBD	Minor Arterial	11,526	.7804 / 5	8,994
CBD	Principal Art	18,849	.7355 / 1	13,864
Rural	Centroid Conn	343	.7804 / 5	268
Rural	Collector	3,538	.7804 / 5	2,761
Rural	Freeway	111,923	.3279 / 6	36,697
Urban	Centroid Conn	268,088	.7804 / 5	209,215
Urban	Collector	96,179	.7804 / 5	75,058
Urban	Expressway	193,769	.6804 / 3	131,849
Urban	Freeway	262,595	.7156 / 2	187,925
Urban	Freeway Ramp	12,612	.7156 / 2	9,026
Urban	Frontage Road	3,735	.7725 / 4	2,885
Urban	Major Arterial	966,995	.7725 / 4	746,997
Urban	Minor Arterial	203,592	.7804 / 5	158,883
Urban	Principal Art	217,547	.7725 / 4	168,053
		2,516,439		1,861,417

Area types and facility classes in the 1998 Fort Collins transportation data set that are not represented in the HPMS traffic count data (Table 4) are assigned growth rates of the closest area type and facility class possible. The assignments are made as follows:

1. Centroid connectors and Collector facility classes for all area types were assigned the Urban/Minor arterial growth rate.

2. CBD/Principal Arterial was assigned the CBD/Major Arterial growth rate.
3. CBD and Rural Minor Arterial were assigned the Urban/Minor Arterial growth rate.
4. Rural Frontage and Principal rate were assigned the Rural/Major Arterial growth rates.
5. Urban Expressway was assigned the Urban Freeway growth rate.
6. Urban Frontage and Principal were assigned the Urban Major Arterial growth rate.

Summary and Conclusions

- The 1992 VMT in the Fort Collins Urban Growth area using the methodology described in the above section is 1,861,417 miles traveled per day. This equates to a growth rate of 4.8%, compounded annually between 1992 and 1998.

- The Fort Collins LUTRAQ committee study recommended that the best estimate of VMT growth between 1990 and 1998 was 4.9%, compounded annually. This best estimate is based on transportation modeling performed for 1990, 1995 and 1998.

On the basis of the information provided in this paper, the APCD believes that the 1992 VMT in Table 5 represents a reasonable and credible estimate of 1992 VMT in the Fort Collins Urban Growth Area. The matrix of VMT in Table5 will be used to estimate the 1992 emissions related to mobile sources in the Fort Collins Urban Growth Area.

Attachment 1

Mackae

UNITED STATES ENVIRONMENTAL PROTECTION AGENC
REGION 8
999 18TH STREET - SUITE 500
DENVER, CO 80202-2466

FAX TRANSMITTAL
OPTIONAL FORM 99 (7-90)
To Lisa Silva
Dept./Agency APCD / COPHE
From Tim Russ EPA
Phone # 303-312-6479
# of pages ▶ 5

JAN 6 1999

Ref: 8P-AR

Ms. Lisa Silva
Air Pollution Control Division
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

Re: Attainment Year Selection for the Fort Collins Carbon Monoxide (CO) Redesignation

Dear Lisa:

The purpose of this letter is to respond specifically to the questions posed in your letter of November 23, 1998, (copy enclosed) to EPA and also your letter of December 28, 1998, (copy enclosed) to Vicky McLane of the North Front Range Transportation and Air Quality Planning Council (NFRT&AQPC). In short, your interpretation of EPA's redesignation policy and guidance, with respect to the selection of the attainment year emission inventory, is correct.

EPA has allowed areas to use a prior year, other than the two most recent consecutive years, as the attainment year inventory for a CO redesignation only if the area has demonstrated attainment for the entire time period. For example, if a State plans on submitting a CO redesignation request and maintenance plan in 1999, but would like to use 1990 as the attainment year, the area must show continuous attainment of the CO standard from 1990 through 1999. In addition, it should be noted, that the Clean Air Act (CAA) and EPA's redesignation policy guidance both state that an area must show attainment of the appropriate National Ambient Air Quality Standard (NAAQS) up to and including the time that EPA promulgates the redesignation. Further, should an area violate the applicable NAAQS prior to the effective date of the **Federal Register** action, EPA must withdraw the action.

With respect to your question regarding the attainment year selection for Fort Collins, EPA agrees that the first year that could be used is 1992. Also, EPA will not require a revised 1990 base year emissions inventory.

In closing, EPA is aware that the State may decide to select 1993 as the attainment year inventory for the Fort Collins CO redesignation. This is acceptable. However, these 1993 data will already be six years old if the redesignation is submitted to the Air Quality Control Commission in 1999. Perhaps a more recent year for the attainment year inventory may be more

appropriate. In addition, the State needs to remember that EPA should be allowed up to two years to process the redesignation request. Assuming EPA receives the Fort Collins CO redesignation request in 2000, the maintenance plan must demonstrate maintenance to at least the end of 2012.

Should there be any further questions, please contact me at (303) 312-6479.

Sincerely,

Tim Russ

Tim Russ
Environmental Scientist

cc: Jonah Staller, 8RC
Larry Svoboda, 8P-AR
Mark Komp, 8P-AR
Brian Woodruff, City of Fort Collins
Vicky McLane, NFRT&AQPC

Attachment 2

Fort Collins LUTRAQ Team
VMT Reduction Project

Estimation of VMT and VMT growth rate

June 22, 2001

Summary

The number of daily vehicle miles traveled (VMT) in the Fort Collins area is an important factor affecting land use, transportation, and air quality programs. Yet it cannot be measured directly, but only estimated. This report reviews three methods to estimate VMT, based on traffic modeling, traffic counts, and fuel use.

Traffic modeling, calibrated using traffic counts, is found to be the best method to estimate both VMT and the VMT growth rate. The reporting frequency should be every two years. Resources have been requested in the 2002-03 budget process that would support a traffic-model-based VMT estimate on a continuing basis.

The best estimate of the compound annual growth rate of VMT between 1990 to 1998 is found to be 4.9%. The best estimate for 2000 is 3,080,000 daily vehicle miles traveled. It is intended that these estimates be updated regularly and used consistently by various City Departments and programs.

The City Plan Monitoring Project tracks, among other "trigger" indicators, the ratio of the VMT growth rate to the Population growth rate. We find that this ratio is 1.7:1. Therefore VMT is growing faster than population, and the indicator is "triggered."

Introduction

The measurement of VMT is central to the mission of the LUTRAQ team. That is, "to develop a comprehensive program to reduce the annual rate of growth of total daily vehicle miles traveled, so that it does not exceed the rate of growth in population and employment, and see that it is carried out." VMT has always been a difficult indicator because it is not measured directly, rather it is always estimated. This report describes three ways to estimate VMT — based on traffic modeling, based on traffic counts, and based on fuel-use.

City Plan air quality objectives not only call for reduction in VMT growth but also stipulates the measurement method: "VMT is calculated using the MINUTP traffic simulation model or equivalent, calibrated using traffic count data." Traffic modeling, however, has not been a consistent source of VMT information. Calibrated model runs have been done at least three years apart in order to update the Regional Transportation Plan. The LUTRAQ Team therefore decided to explore other estimation techniques to supplement traffic modeling, in order to gain confidence in the estimates and to increase the frequency of reporting.

This report has several purposes:

- To summarize VMT estimates from 1990 to the present.
- To provide estimates of both current VMT and the VMT growth rate which would be used consistently by City staff in various departments and programs.
- To determine whether VMT is growing faster than population, which is a "trigger indicator" in the City Plan Monitoring Project.
- To provide for a regular update of the VMT and VMT growth estimates.

Method 1 – Transportation modeling

Traffic models simulate the amount of traffic on each roadway, taking into account housing patterns, employment patterns, and roadway capacity. The calibration process adjusts the simulation so that it reproduces the traffic levels actually occurring. Total VMT is then calculated by adding up the VMT contribution of each roadway.

Eric Bracke, John Daggett, and Brian Woodruff drafted this report for the LUTRAQ Team. The three of us are in agreement that the best way to estimate VMT, or VMT growth, is using traffic model runs that have been calibrated to ground counts. This methodology was also used in the Mobility Report Card prepared for the North Front Range Transportation and Air Quality Planning Council (NFR) for the years 1995 and 1998.

During the 1990's the NFR did calibrated model runs for the base years of three Regional Transportation Plans (RTP). The model domain is the "urbanized area," similar to the Community Growth Area. Please see Attachment 1 for details. The following table provides the basic data.

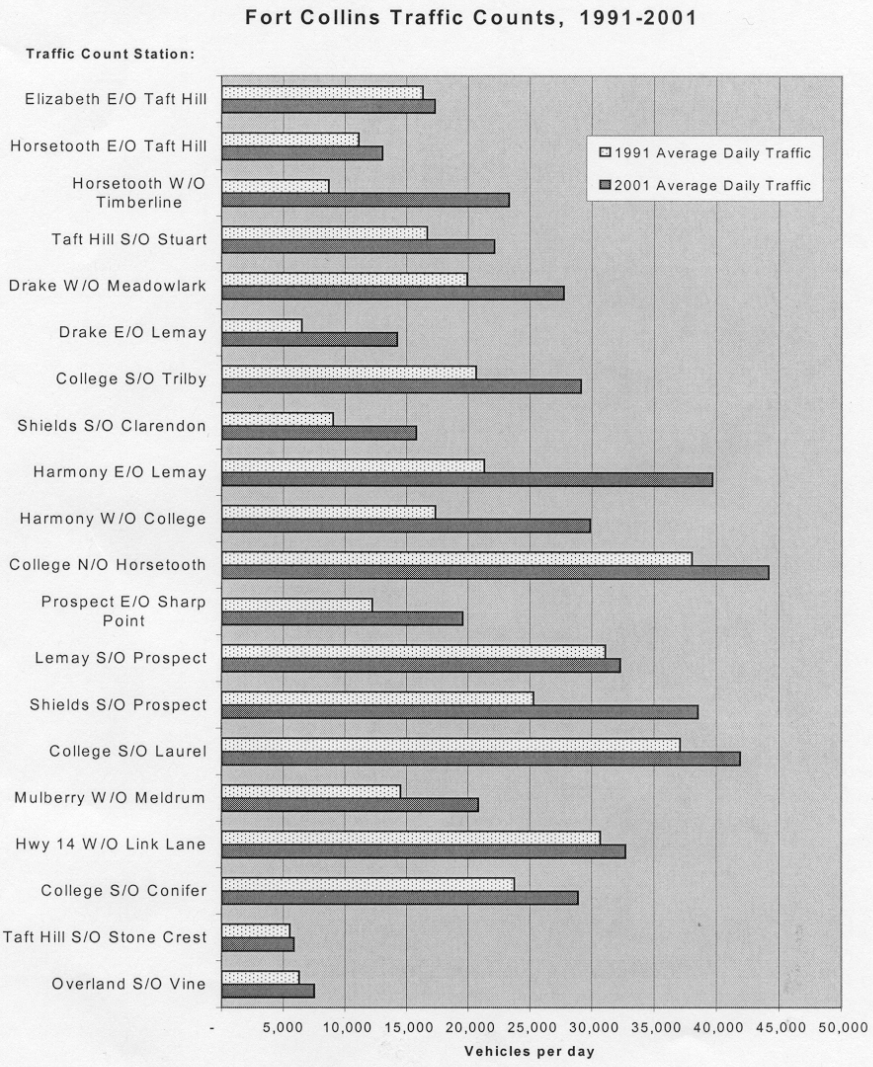
Regional Transportation Plan base-year model

YEAR	SOURCE	VEHICLE MILES OF TRAVEL PER DAY
1990	2015 NFR RTP Model 1990 Base year	1,914,493
1995	2020 NFR RTP Model 1995 Base year	2,398,614
1998	2015 NFR RTP Model 1998 Base year	2,814,506

Method 2 – Traffic Counts

Traffic counts constitute the only real data we have. But unless we were to count traffic on every segment of every street, traffic counts do not represent total VMT. Still, traffic counts provide a useful check on the VMT growth rate calculated from other methods.

Fort Collins arterial street traffic counts for 1991 and 2001 are shown in the following graph. Data table can be are found in Attachment 3. A growth estimate is obtained by totaling the various counts and calculating a compound annual growth factor. This comes out to 3.1% annual growth 1991 through 2001 and 1.8% annual growth from 2000 to 2001.



The Highway Performance Management System (HPMS) maintained by the Federal Highway Administration provides another estimate of area-wide VMT which is based on local traffic counts. Estimates are reported for each urbanized area in the annual "Highway Statistics" report. However, the HPMS does not include travel on local/collector roadways and is based on only a few count locations on arterials. The traffic engineering profession generally believes that the HPMS under-estimates travel. The advantage of the HPMS is that it uses a consistent estimation methodology, which allows various urban areas to be compared. For our purposes, the change in the estimate over time matters more then the estimate itself – it provides another check on the VMT growth rate.

Highway Performance Management System

YEAR	ESTIAMTED TOTAL DAILY VMT IN THE FORT COLLINS URBANIZED AREA
1994	1,887,000
1995	2.013,000
1996	2,012,000
1997	2,172,000
1998	2,262,000
1999	2,347,000

Method 3 – Fuel-Use Data

USEPA published a methodology to estimate area-wide VMT based on fuel usage data. This is summarized in Attachment 2. The analysis boils down to a simple equation: VMT = [FUEL USE] X [FUEL ECONOMY]. In other words, MILES = GALLONS X [MILES PER GALLON].

Data are available for the analysis. The tricky part, however, is zeroing in on the amount of fuel used in the Fort Collins area, because fuel statistics are reported only at the state level. Therefore we estimate Fort Collins share of statewide fuel use according to Fort Collins share of four other parameters relative to statewide totals:

- Population
- Vehicle registration
- Service station sales
- Total sales

There are a few drawbacks to this method. First, we are forced to assume that all fuel purchased here is used here, i.e., that fuel imported and exported inside vehicle fuel tanks cancels out. Second, the four local parameters used to disaggregate state fuel use give divergent results for the VMT compound growth rate, ranging from 4.3% to 13.2%. This analysis uses the average of all four, resulting in a 6.3% compound growth rate.

Among the advantages, this method estimates total area-wide VMT, which is the indicator we need, and it provides an estimate for each year. Thus the VMT estimate based on fuel use provides a check on both VMT and VMT growth rate.

Conclusion, findings

The following graph shows the results for three methods: modeling, HPMS, and fuel-use. We can see that the model-based and fuel-based estimates are close. The HPMS-based estimate is lower, as expected, since it does not include collector/local streets.

Best estimate of VMT growth rate

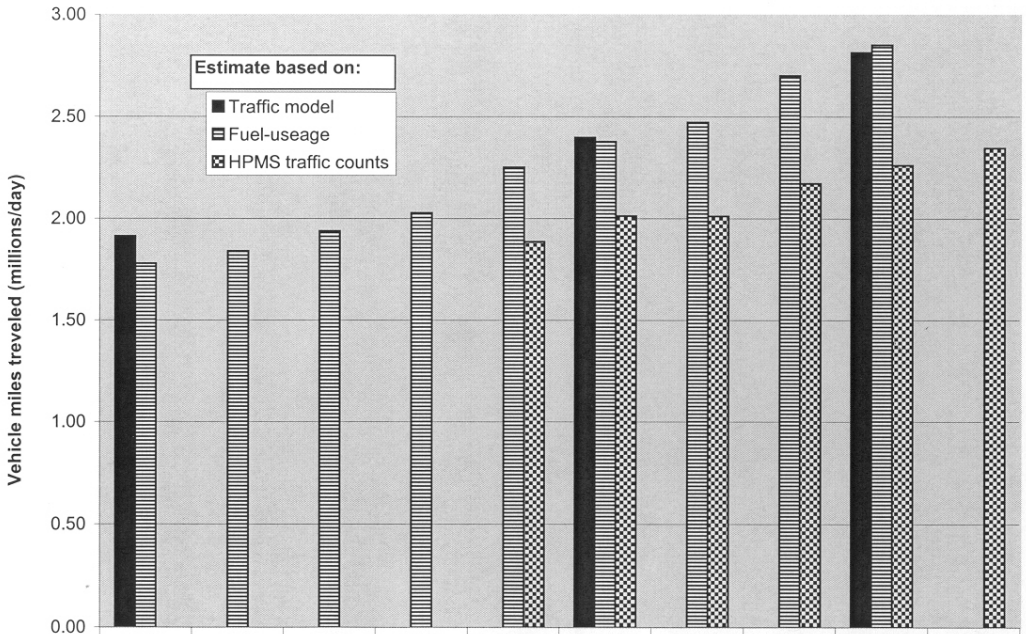
The following compound annual growth rates were calculated using all data from the summary graph:

ESTIMATION METHOD	COMPOUND ANNUAL VMT GROWTH RATE	COMMENTS
Model-based	4.9%	• Covers Urbanized Area • Data for 1990, 1995, 1998 only
Fuel-use-based	6.3%	• Covers City of Fort Collins • Average of a range of estimates (4.3%-13.2%) • Data for 1990-1998
Traffic-count-based (HPMS)	4.4%	• Covers Urbanized Area • Data for 1994-1999 only
Mean	5.2%	
Median	4.9%	

The "best" estimate of VMT growth from 1990 to 1998 is probably around 5%. Since the model-based estimate is the presumed favorite, and since that method is close to both the mean and median of the estimates, **we select 4.9% as the best estimate of 1990-98 VMT growth within the Fort Collins Urbanized Area or Community Growth Area.**

It is worth noting that the Mobility Report Card reported that the compound annual VMT growth rate from 1995-1998 was significantly higher, at 7.3%. An examination of the Mobility Report Card data and modeling practice and assumptions show a manipulation of the base year (1995). The base year for the Mobility Report Card produced different VMT results than its NFR Regional Transportation Plan 1995 model counterpart. Based on an examination of the two models, staff determined the NFR Regional Transportation Plan 1995 model to be a more reasonable estimation of travel in that year. It should be noted that both models achieve a very similar estimate of VMT for the 1998 model year.

Fort Collins VMT estimated three ways



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Traffic model	1.91					2.40			2.82	
Fuel-useage	1.78	1.84	1.94	2.03	2.25	2.38	2.47	2.70	2.85	
HPMS traffic counts					1.89	2.01	2.01	2.17	2.26	2.35

It is possible that, over a three-year period, the growth could be higher or lower than our "best estimate" based on an eight-year period. We are confident, however, that 4.9% is a realistic estimate of VMT growth that could be sustained over the long term.

Ratio of VMT growth to population growth

The City Plan Monitoring Project reports every second year on a variety of indicators. One of these is the ratio of VMT growth rate to population growth rate — a "trigger indicator," which tracks whether the ratio is greater than unity (VMT growing faster than population) or less than unity (VMT growing slower than population). The reporting period for the current biennial report is 1998-2000.

Unfortunately, we have no information specific to that time period. We assume, therefore, that our "best estimate" of 1990-1998 VMT growth holds for the 1998-2000 period as well. The state demographer data indicate the 1990-2000 population-growth rate for the City of Fort Collins is 2.9%. We assume that this growth rate applies as well to the Urbanized Area.

Using these estimates we calculate VMT growth / POPULATION growth = 4.9% / 2.9% = 1.7, or, expressed as a ratio, 1.7:1. **Therefore, VMT is growing faster than population and the City Plan indicator is "triggered."**

Although we have made several assumptions is calculating this ratio, there can be little doubt that the indicator has been triggered. Even the lowest estimate of VMT growth discussed in this report (4.3%) is greater than the population growth rate. And although we would prefer to use the population growth rate for the Urbanized Area, our substitution of the City growth rate does not change the calculated ratio significantly. The ratio will be recalculated once census tract data become available that permit calculation of the Urbanized Area population growth rate.

Best estimate of current VMT

Because we have no estimates of VMT for year 2000, it will be necessary to use the previous years' data to make a projection. The model-based estimates give us an equation to predict VMT for any year, assuming exponential (or compound) growth, VMT(year) = 1.8177 exp(0.0479*[year-1989]). Using this equation we calculate the best estimate of current VMT as follows.

Estimate based on 4.9% compound annual growth rate

YEAR	TOTAL DAILY VMT IN THE FORT COLLINS COMMUNITY GROWTH AREA
1998	2,800,000
1999	2,930,000
2000	3,080,000
2001	3,230,000
2002	3,390,000
2003	3,550,000
2004	3,730,000
2005	3,910,000

Regular updates of VMT and VMT growth

Since traffic modeling has been selected as the best way to estimate both VMT and the VMT growth rate, it is important to perform traffic modeling and calibration on a regular basis. Every two years would meet most needs and specifically would suffice for the City Plan Monitoring Project. The resources needed in order to maintain a biennial, calibrated traffic model are being requested through the 2002-03 biennial budget process. It is worth noting that a biennial, calibrated traffic model would provide the City with a tool that would have usefulness far beyond the reporting of VMT and VMT growth.

In addition, the fuel-use-based and HPMS-based estimates will be updated annually in order to provide a crosscheck on the model-based estimates. Although the fuel-based and HPMS-based estimates are of secondary value, they have the advantage of being inexpensive and annual.

Attachments:

1. **Traffic model memo**
2. **Fuel-use methodology**
3. **Traffic counts**

ATTACHMENT 1

MEMORANDUM

DATE: May 25, 2001

TO: LUTRAQ Team

THRU: Brian Woodruff

FROM: John Daggett, Senior Transportation Planner

RE: Modeled Vehicle Miles of Travel

The following analysis is based on examination of historical transportation demand forecasting model runs over the past decade. Staff examined four Regional Transportation Plan (RTP) models and the Mobility Report Card and Mason Models and selected the base year results for comparison. The Regional Transportation Plans were for the 2010, 2015, 2020, and 2025 planning horizons. Staff used the 1990, 1995, and 1998 base-year results.

This analysis is broken into two sets of estimates for VMT. The first set uses the trend line established by the RTP models starting with the 1990 base year. The second follows the trend established by the Mobility Report Card starting with the 1990 base year. The RTP 1990 base is common to both trend analysis approaches.

Percent change calculations are made using two methods: straight-line percentage increases and compounded percent change. The first assumes a linear relationship and implies a simple mathematical relationship between the highest and lowest value in the range of VMT numbers and probably overstates the rate of change.

The second method assumes there is a relationship between each annual increment of change. The compound method may more accurately describe the rate of change in the data being analyzed.

The RTP Model Results

This approach specifically uses the forecasting models, validated to traffic counts, for model outputs for the base years (1990, 1995, and 1998) that were employed in the development of the 2015, 2020, and 2025 Regional Transportation Plans for the North Front Range Transportation & Air Quality Planning Council. The following table shows the results of comparative change in VMT and percentage growth over the eight-year period from 1990 to 1998. Percentage change is presented as both straight line and compounded.

RTP Base Model Statistics

Year	Source	Vehicle Miles of Travel Per Day	Straight Line % Change in VMT (from Previous Base)	Straight Line % Change in VMT Annualized (from Previous Base)	Total Compounded % Change in VMT (from Previous Base)	Compounded % Change in VMT Annualized (from Previous Base)
1990	2015 NFR RTP Model - 1990 Base	1,914,493				
1995	2020 NFR RTP Model - 1995 Base	2,398,614	25.29%	5.06%	23.06%	4.61%
1998	2015 NFR RTP Model - 1998 Base	2,814,506	17.34%	5.78%	15.92%	5.47%
Period 1990 - 1998			47.01%	5.88%	39.44%	4.93%

The MRC Model Results

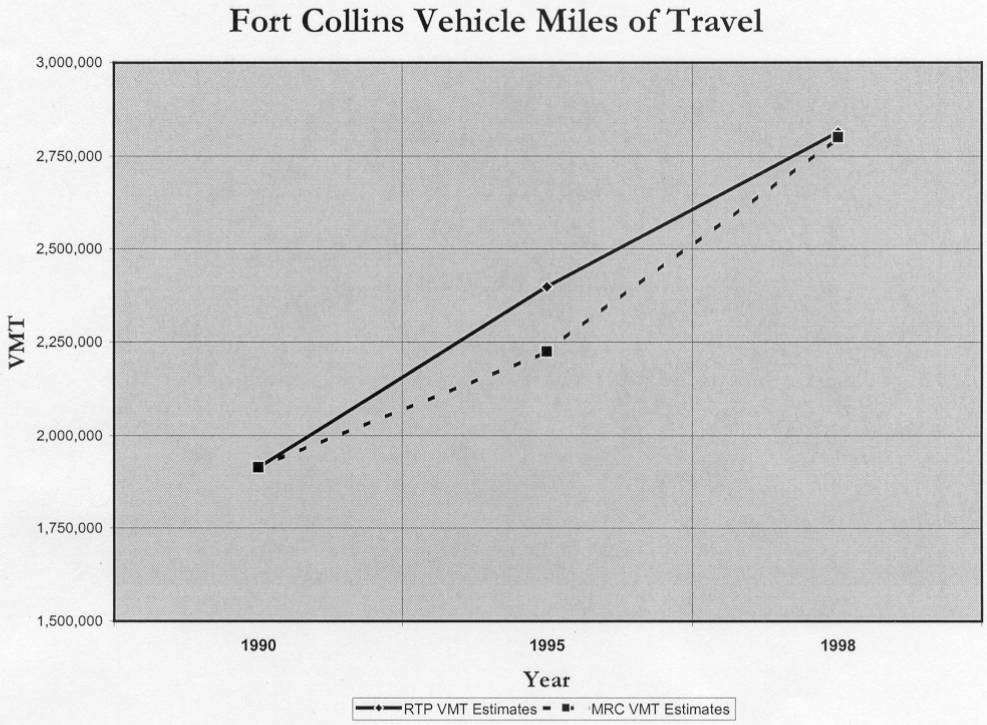
This approach specifically uses the forecasting models, validated to traffic counts, for model outputs for the base years (1990, 1995, and 1998) that were employed in the development of the 2015 Regional Transportation Plans and the Mobility Report Card project for the North Front Range Transportation & Air Quality Planning Council. The following table shows the results of comparative change in VMT and percentage growth over the eight-year period from 1990 to 1998. Percentage change is presented as both straight line and compounded.

MRC Base Model Statistics

Year	Source	Vehicle Miles of Travel Per Day	Total Straight Line % Change (from Previous Base)	Straight Line % Change Annualized (from Previous Base)	Total Compounded % Change (from Previous Base)	Compounded % Change Annualized (from Previous Base)
1990	2015 NFR RTP Model - 1990 Base	1,914,493				
1995	NFR MRC Model - 1995 Base	2,225,000	16.22%	3.24%	15.25%	3.05%
1998	NFR MRC Model - 1998 Base	2,801,000	25.89%	8.63%	23.94%	7.98%
Period 1990 - 1998			46.31%	5.79%	38.96%	4.87%

Conclusions

The following graph shows the difference in the two modeling outputs related to Fort Collins vehicle miles of travel.



Although there is a significant difference between the two model approaches as to when the VMT change occurred during the eight-year period from 1990 to 1998, the extent of the change over the entire period using either method gives similar results. The RTP approach yields a percentage change range of 47.01% (straight line) - 39.44% (compounded) for the entire period compared with the MRC approach results of 46.31% (straight line) - 38.96% (compounded).

Both analyses produce either straight line or compounded percent change for the entire period (1990-1998) well beyond population growth. The RTP method produces annualized straight line and compounded percentage change at 5.88% and 4.93% respectively. The MRC method produces annualized straight line and compounded percentage change at 5.79% and 4.87% respectively.

cc: Gary Diede, Transportation Operations & Projects Director
Randy Hensley, Transportation Planning & Parking Manager

ATTACHMENT 2

Excerpt from

ESTIMATION OF MOBILE SOURCE FUEL CONSUMPTION AND AREA VMT

(Source: USEPA, 1996)

OVERVIEW OF METHODOLOGY

Emissions associated with on-road motor vehicle use are an important element of any emission inventory. The USEPA provides a mobile source emission factor model (MOBILE) that estimates vehicle emission factors. These emission factors are combined with locale-specific estimates of vehicle miles traveled (VMT) to estimate mobile source emissions. VMT estimates are available from state departments of transportation (DOT) or county planning agencies, such as metropolitan transportation planning organizations (MPO). While readily available at the resolution needed for air quality planning purposes (e.g., county or even sub-county levels), these VMT estimates are usually compiled for transportation network planning purposes, not for air quality planning. The adequacy of these estimates for air quality planning purposes can vary depending upon the area and the VMT estimation methods used.

This subsection presents a method to independently derive VMT for comparison with transportation planners' estimates of VMT. Specifically, this section presents a means to estimate VMT from fuel consumption and fleet fuel economy. Locale-specific or national average data may be used, depending upon availability. If the results of this fuels-based method differ substantially from transportation planners' estimates, further investigation may be warranted.

In order to allow a valid comparison of results, the fuels-based method must be based upon data that are independent of transportation planners' estimates of VMT. Tax revenue data and demographic statistics are used to disaggregate statewide figures of on-road fuel consumption provided by the Federal Highway Administration (FHWA). On-road fuel consumption is also corrected for refueling losses. Locally determined fleet fuel economy is suggested for use, although national average fuel economy may be used if no other data are available.

A. OVERVIEW OF CALCULATION PROCEDURES

The basis of this methodology is a five-step procedure to estimate VMT. Before proceeding, the following data must be obtained:

- Statewide gasoline and special fuels consumption data which are published annually in *Highway Statistics* by the Federal Highway Administration.
- Information regarding the extent of Stage I and Stage II refueling control measures in the area of interest; these are available from state agencies or the EPA.
- Registration distributions and mileage accumulation rates should be used to determine local fuel economy if possible; otherwise, national averages contained in the MOBILE model can be used.
- Economic and population statistics which are maintained by state and federal agencies for the U.S., state, and counties of interest (see List of Contacts, Appendix A).

The five steps in the methodology, described in detail below, are as follows:

Step 1: Adjust statewide gasoline and special fuels distributions to account for off-road use.

Step 2: Geographically disaggregate fuel distribution from Step 1 and assign fuel volumes to the counties of interest according to each county's share of economic and population indicators.

Step 3: Adjust the fuel distributions obtained in Step 2 for refueling losses. The result represents the counties' on-road fuel consumption.

Step 4: Calculate diesel- and gasoline-powered fleet fuel economies. This is achieved by weighting on-road fuel economies according to vehicle stock (numbers of vehicles) and mileage accumulation rates. If possible, local data should be used. However, a method to use national averages extracted from MOBILE 5 is described for cases where no other data are available.

Step 5: Multiply on-road fuel consumption by fleet fuel economies to calculate VMT.

ATTACHMENT 3

FORT COLLINS TRAFFIC COUNT DATA

Station #	Location	1991 Average Daily Traffic	2001 Average Daily Traffic	Diff. 91-01	% Change 91-01
261	Overland S/O Vine	6,272	7,506	1,234	19.7%
255	Taft Hill S/O Stone Crest	5,512	5,864	352	6.4%
2085	College S/O Conifer	23,742	28,889	5,147	21.7%
2060	Hwy 14 W/O Link Lane	30,689	32,719	2,030	6.6%
2117	Mulberry W/O Meldrum	14,512	20,819	6,307	43.5%
2051	College S/O Laurel	37,083	41,896	4,813	13.0%
2033	Shields S/O Prospect	25,296	38,506	13,210	52.2%
2029	Lemay S/O Prospect	31,084	32,287	1,203	3.9%
2024	Prospect E/O Sharp Point	12,215	19,553	7,338	60.1%
277	College N/O Horsetooth	38,020	44,156	6,136	16.1%
2119	Harmony W/O College	17,314	29,858	12,544	72.5%
2114	Harmony E/O Lemay	21,291	39,677	18,386	86.4%
213	Shields S/O Clarendon	9,018	15,782	6,764	75.0%
200	College S/O Trilby	20,624	29,117	8,493	41.2%
2021	Drake E/O Lemay	6,472	14,224	7,752	119.8%
2019	Drake W/O Meadowlark	19,905	27,720	7,815	39.3%
2036	Taft Hill S/O Stuart	16,655	22,105	5,450	32.7%
2010	Horsetooth W/O Timberline	8,677	23,297	14,620	168.5%
2006	Horsetooth E/O Taft Hill	11,107	13,040	1,933	17.4%
2044	Elizabeth E/O Taft Hill	16,305	17,284	979	6.0%
	Grand Total	***371,793***	***504,299***	132,506	35.6%

Compounded Annual Growth Rate: ***3.10%***

Outdoor Air Quality Survey

Spring, 2002 Report:

City of Fort Collins

The purpose of this survey and report was to provide the City of Fort Collins with their bi-yearly assessment of the knowledge, attitudes, perceptions and behavior of a representative sample of residents concerning outdoor air quality. For the 2002 survey, special emphasis was placed on wood burning and wood smoke.

Environmental Behavior Consulting
Cheryl L. Asmus, Ph.D., Environmental Psychologist
4056 Laveta Drive
Loveland, CO 80538
970-461-4995
ebc@frii.com
6/3/02

Table of Contents

BACKGROUND

The City of Fort Collins' Air Quality Policy Plan AQPP identifies air quality in Fort Collins to be an issue of significant importance to the City. The City of Fort Collins performs a survey of the general population to assess (1) the appropriateness of the priorities listed in the City's current Air Quality Action Plan (AQAP) and the AQPP; (2) to help define the questions that will give direction to policy, planning, outreach and marketing; (3) to help staff assess current programs and to plan future actions; and (4) to address any other temporary and current air quality issues.

In February of 2000, the four Fort Collins' air quality surveys underwent a rigorous reliability and validity evaluation. The result was an Indoor Air Quality Survey (IAQ) and an Outdoor Air Quality Survey (OAQ) performed on alternating years. The first revised OAQ survey was performed in the fall of 2001. To get both surveys on the schedule of being administered in the Spring on alternating years, the OAQ survey was again administered in the spring of 2002 and the report is on the following pages. In addition, a wood smoke management effort that had been ongoing in the City needed data immediately.

One can always make changes in the home that will not have major effects on lifestyle, and WILL be effective, but outside of the home, or outdoor air quality, the major pollutant is an item that can not easily be forfeited without sometimes some very major changes by the respondent: the automobile. In addition, the air quality is in the control of many, not just the respondent. A community survey could ask what actions the respondent takes, but these are better addressed using objective monitoring techniques. However, a perception and attitude survey can tell the policy makers and planners where their actions and programs might be most effective by measuring the respondent's individual (beliefs, knowledge), social (attitudes), cultural (community norms) and situational (amount of perceived control) variables that go into predicting the intent to act in either pro-environmental or non- pro-environmental ways in their community.

The Outdoor Air Quality survey is designed to address the following objectives:

- Provide knowledge of which programs or events have reached the public;
- Be a measure of which marketing techniques were most effective;
- Measure the resident's perception of the major source of pollution in Fort Collins;
- Determine the resident's belief in "who" is responsible for maintaining and improving air quality in FC;
- Tell planners where to focus programmatic efforts that will be most readily accepted;
- Use attitudes to predict the residents' intent to "reduce the daily miles traveled with his of her vehicle" and some factors that are more likely than others to predict this;
- Measure of apathy due to loss of perceived control over the situation;
- Measure of the current pleasantness rating of the air in FC to compare over time;
- Determine the major source of heat used in FC homes; and
- Determine the number and kind of "other" types of heat, especially wood stoves or wood-burning fireplaces along with are they certified, how often these are used, what percentage of heating they are used for, and (in the case of wood) how much wood is burned.
- Preferences for wood smoke management options currently under consideration.

EXECUTIVE SUMMARY

The 2002 Outdoor Air Quality Survey Objectives and Results:

Objective 1: Knowledge of which programs or events have reached the public and how many have participated in them;

- Emissions Stickers: 77% Participated
- Earth-day: 94% either Participated/Heard of it
- CO2 in the Home 75% either Participated/Heard of it
- Clean Air Logo: 30% Heard of it
- Wood-Smoke Response Line: 22% Heard of it
- Lawn-Mower Rebate: 21% Heard of it

Objective 2: A measure of which marketing techniques were most effective;

Most Effective

- Local Newspaper 63%
- Utility Bill Insert 63%
- Radio 24%
- TV 20%
- Fliers/Brochures 15%
- Friends 12%
- Job 12%

Least Effective

- City Line 0.7%
- Presentations 2%
- Children 4%
- Internet 4%

Objective 3: Residents' perceptions of the major source of air pollution in Fort Collins;

Major

- Gasoline Vehicles: 62%
- Diesel Vehicles: 56%

Minor

- Wood-Burning(Fort Collins): 47%
- Wood-Burning("Your neighborhood"): 47%
- Industry: 42%
- Transfort Buses 30%

Objective 4: The residents' belief in "who" is most responsible for maintaining and improving air quality in Fort Collins;

This question was dropped this year to provide room for the extra wood smoke questions.

Objective 5: Where to focus efforts that will be most readily accepted;

1. Improve Traffic Light Timing to Reduce Vehicle Idling at Lights.
2. Increase Enforcement of Exhaust Regulations for Gas/Diesel Vehicles
3. Prohibit wood-burning on high pollution days
4. Increase Enforcement of Emissions Law
5. Do more to reduce the "Brown Cloud" and improve visibility.
7. Promote the Use of Alternative Fuel Vehicles.
8. Improve safety and access for bikes, skates, pedestrians

Objective 6: An attitude scale that will (1) predict the resident's intent to behave in a pro-environmental way and which factors are more important in their decision; and (2) predict the residents' intent to "reduce the daily miles traveled with his/her vehicle" and some factors that are more likely than others to predict this.

Using "I feel a personal obligation to help improve the AQ in FC" as the intent to behave pro-environmentally and which factors weigh heavier in that decision are listed in the next table. The higher the R^2, the more important this factor is to whether or not they will make personal pro-environmental decisions. In other words, this table shows that when the respondent understands that "small changes" THEY make will improve the air quality, they are more likely to feel a personal obligation to make changes. This tells you where and how to address education programs. Other important factors to the resident to behave in a way that would improve air quality is how they feel about emissions inspections, visibility, the environment, global warming, people with respiratory problems, and odor.

Statement	R^2
I feel that small changes I make can affect the AQ in FC.	.51
Even if no longer required, FC should retain the MV emissions inspection program.	.22
FC has a problem with visibility due to air pollution.	.15
AP in FC is significant enough to hurt the environment.	.15
FC Residents will be negatively affected by global warming.	.15
The City and residents (including myself) of FC are contributing to global warming.	.15
People with respiratory problems have a right to breathe clean air.	.14
AP in FC makes the air smell bad	.12
AP in FC hurts the local economy.	.09
AP in FC is significant enough to cause human health problems, at least for some of the residents. Many of the people I know in FC will NOT be willing to change their day-to-day transportation habits to improve AQ.	.09 .02

The next table shows which factors impact the respondent more in making their decision to reduce the daily miles driven in their vehicle. Results shows that tax break incentives, being able to ride a bike for work or errands, and taking the bus for errands and/or work and if it was more convenient are good predictors of whether or not a respondent would reduce the number of miles that they drive their vehicle each day. Keeping their vehicle tuned up or contributing $10 to subsidize the repair of high polluting vehicles do not predict individual behavior change in reducing miles driven.

Statement	R^2
Reduce the daily miles traveled in my car if there were tax break incentives.	.28
Ride a bike for errands and/or work.	.25
Take the bus for errands and/or work.	.18
Use public transportation if it were more convenient for me.	.16
Keep my vehicle tuned up.	.11
Contribute $10 when registering my vehicle to subsidize repair of high polluting vehicles.	.06

Objective 7: Measure the apathy of residents due to loss of perceived control over the quality of the air in Fort Collins:

Comparing the means of *"Will anything be done"* to *"Can anything be done"* show that they are significantly different ($p < .000$). This tells us that people believe that something can be done but won't be done. Efforts to reverse this belief, which will lead to apathy (they will stop doing anything individually too) should be undertaken.

Objective 8: Current pleasantness rating of the air in Fort Collins for comparison over time.

Very Good	18.7
Good	49.6
Fair	20.2
Poor	0

Objective 9: Major sources of heat used in Fort Collins homes.

1.Natural Gas		80%
2.Hot Water Heater/Furnace		37%
3.Electric		15%
4.Solar Passive	4%	
5.Propane		3%
6. Wood	3%	
7. Solar Active	1.3%	
8. Other	0.7%	
9. Coal		0%

Objective 10: Number and other types of heat sources, especially wood stoves or wood-burning fireplaces.

There were 271 homes with wood-burning appliances (fireplace, insert or stove). Of these, most burnt no wood to less than ¼ of a cord last winter and used it either not at all, or 1-2 times per month. The wood smoke management option most preferred was the least intrusive, of course, and was a voluntary "no burn" on high pollution days.

Summary

The Outdoor Air Quality Survey was conducted in May of 2002. Of the 1500 surveys sent out to a random sample of residents of Fort Collins by mail, we got a very good response for a total of 818 completed surveys were returned, or 55%. The summary of the survey objectives are listed in the previous section of the Executive Summary.

As a way to determine the effectiveness of the City's Air Quality information programs and events, respondents were asked if they recalled hearing about or participating in some of the current and recent programs. In response, residents said they were most familiar with the *Emission Sticker Law*, *Earthday*, and *Carbon Monoxide in the Home* through participation in the programs. *Earthday*, *Carbon Monoxide in the Home*, and the *Clean Air Logo* were substantial in the "heard of it" category.

Next we asked where the resident recalls seeing or hearing information about air quality issues in Fort Collins. Residents responded the most to the *Local Newspaper* (63%),and the *City Utility Bill Insert* (63%). The least effective measures of getting information was *City Line*(.7%), *Presentations* (2%), *Children* (2%), and *Internet* (2%).

Residents perceive *Gasoline Vehicles* (62%) and *Diesel Vehicles* (56%) as the major source of air pollution in Fort Collins.

Sixty two per cent (62%) of the residents state that the air pollution in Fort Collins affects them in some negative way (allergies, respiratory, visually, indoor air. The biggest concern is visibility or that it C*auses a "Brown Cloud*" (76%) and it *Obscured Mountain Views* (70%).

One question focused on *where* the resident believed the City should focus their efforts to best address air quality issues in Fort Collins. The overwhelming response was to *Improve Traffic Light Timing to Reduce Vehicle Idling at Lights* (76% "Strongly Agree). Another response that was chosen often as a "Strongly Agree" was to *Increase Enforcement of Exhaust Regulations for Both Gas and Diesel Vehicles* (55%). Overall, residents agreed more (97%-60%) with the current or planned programs or plans. Even though these were the most frequently picked options, the best predictors of *what* the respondent thinks the City should be doing was to reduce the "brown cloud" and local greenhouse gas emissions; increase enforcement of exhaust regulations and the emissions law; and decrease wood burning.

When asked the question of what the resident would be willing to do to help reduce air pollution in Fort Collins, overall, most residents agreed they would be willing to do something (average of 55.3%) compared to those residents who disagreed that they would be willing to do something (average of 36.4%). The top action residents would be willing to take is to keep their *vehicles tuned up*. An action the residents would very much oppose (69%) is to *contribute $10 when registering vehicle to subsidize repair of high-polluting vehicles.*

The next scale, or set of questions, can tell planners an overall "intent to act/behave" on the resident's part to help reduce air pollution in Fort Collins. Overall, most residents agreed, (70%) that they would be more likely to act (or at least be open to accepting pro-environmental programs or plans), pro-environmentally. See Objective 6.

Even though residents believe that something can be done to improve or maintain the air quality in Fort Collins (70%), only 21% believe something *will* be done.

The main source of heat used in the homes of the respondents was natural gas (79%). Hot water (37%), and electric (15%) were the next most checked sources.

The most common additional source of heat used in homes was electric (16%), followed closely by wood (14%) and passive solar (9%).

Gas fireplaces are the top *other source* of heat for residents (38%) followed very closely by wood burning fireplaces (33%) and electric fireplaces (15%). Gas heat sources show that about half are certified, but all other sources only show ¼ to 1/3 certified. Gas fireplaces (19.4%) followed by wood heat sources (14.5%) are used to provide the highest percentage of heat for the homes in the survey.

There were 271 homes with wood-burning appliances (fireplace, insert or stove). Of these, most burnt no wood to less than ¼ of a cord last winter and used it either not at all, or 1-2 times per month. The wood smoke management option most preferred was the least intrusive, of course, and was a voluntary "no burn" on high pollution days.

The number of respondents that stated they have experienced unacceptable air quality dropped sharply from 2001 (46%) to 2002 (38%).

Most respondents believe that Fort Collins' air quality will be worse (62%) in five years, while 31% believe it will not change, and only 6% believe it will be better than it is now.

Very few people warm their cars up on cold mornings (16%) longer than 2 minutes, and half (50%) do not warm it up at all.

The numbers of people who will allow guests to smoke in their homes (6.6%) has increased, while the number of people actually smoking in their own homes (7.1%) has dramatically decreased (2000 survey, 17.1%).

The respondents of this survey were equally represented by males and females. The majority fell between 40 and 60 years of age, were two-member households, not pregnant, and 31.8% stated that there was a member suffering from asthma, emphysema, heart disease, or other respiratory ailments. Of these 31.8%, 58.8% believed that the outdoor air negatively impacted their respiratory problems. Most lived here more than 10 years (62%), 60% had a Bachelor's degree or higher and a median family income in the $40,000-$59,000 range. Most respondents were employed outside the home (47%), with an increasing number of self-employed (12%) and retired (28%). Home-owners were the majority of (81.2%), 48.3% live in a home that is more than one-story, a single story (44.1%), with the number of respondents living in apartments or condominiums decreasing steadily.

Recommendations would be to closely examine the marketing efforts that people consistently recognize. Through the additional analyses (regression) it is also apparent that the citizens want the City to improve the visibility and health impacts of the outdoor air in Fort Collins. They also need to understand very clearly the individual impacts they can make. The growing discrepancy between what the residents believe can be done and what will be done also needs to be addressed.

Survey Sample

Response Rate

The Outdoor Air Quality Survey was conducted in May of 2002. The survey used a non-experimental design (survey) with a stratified (by zip code) random sampling of 1,500 residents of the City of Fort Collins. The survey was a mail survey using the Total Design Method (Dillman, 1978) of surveying in order to achieve a higher response rate. Data was scanned into a Scantron scanner for accuracy, and results were analyzed using SPSS for Windows. A total of 818 completed surveys were returned, for a response rate of 55%.

Selecting the Sample

The method used to select a sample for the surveys was stratified random sampling. In random stratified sampling there is some sub-group in a population that is of interest and can be identified. The sub-groups in a community survey are frequently identified by zip codes. The zip codes in Fort Collins represent the various regions of the City. If we had selected a simple random sample of 1,500 residents, we might not have obtained a representative sample from one or more of the zip codes, or regions of the City. The City of Fort Collins has five zip codes and two post office box zip codes. Four of the zip codes (80521, 80524, 80525, 80526) are approximately equally represented in number. Another is a relatively new zip code (80528) and has significantly fewer addresses than the first four. The two post office box zip codes are 80522 in the old post office building downtown, and 80527 in the newer post office building in the south end of town. There is another zip code in Fort Collins (80523) that is exclusive to the University, Colorado State University. No surveys were mailed to 80523. This does not mean the survey excluded students. The only students excluded were ones living on campus in resident halls, dormitories or campus housing. Any students living off campus had an equal chance to be included in the survey. As such, the surveys were mailed proportionately to each zip code (excluding 80523) and the numbers mailed to each can be seen in Table 1.

Table 1. Stratified Random Sampling of 1,500 Surveys by City of Fort Collins' Zip Codes

Zip Codes	Number of Surveys Mailed
80521	350
80524	350
80525	350
80526	350
80528	100

An up-to-date, accurate "resident" mailing list was obtained through a reputable local mailing list company. The mailing list company was directed to randomly sample from the above zip codes. A computer-based record system was used to generate the random list.

Determining Sample Size

The formula used to determine the size of sample necessary to meet the above criteria is:

$$n = (t)^2 (p)(q)/d^2$$

$$(1.96)^2 (.5)(1-.5)/.04^2 = \mathbf{600}$$

Where:

n = sample size needed

t = 1.960 for a 95% confidence limit

p = the proportion estimate (e.g., .50)

q = (1 - p)

d = margin of error (degree of precision or 4%)

In other words, a sample of 600 returned surveys would be an adequate sample at a confidence level of 95%, a margin of error of 4%, and a probability of 0.5. This survey's response rate was 48%.

The response rate for this survey, 818 responses, fell well over the 600 recommended.

METHOD

Survey Procedure

The framework for implementing the 2002 Outdoor Air Quality survey followed the Total Design Method (TDM) developed by Don Dillman (1978). Among other techniques, this method makes use of mailings which both inform potential respondents of forth-coming surveys and remind them to answer and return the survey materials. Typical response rates using this method range from 60% to 99% depending on the perceived importance to the respondent, and the length of the questionnaire. These rates meet established standards of "very good" (Babbie, 1973; as cited in Edwards, Thomas, Rosenfeld & Booth-Kewley, 1997).

Outline of Survey Procedure Below is an outline of the survey procedure used.

A. Tasks completed before sending out the survey:
   1. Obtained approval from Natural Resources Board
   2. Chose random sample and determined sample size
   3. Developed surveys, scanning software and database to score surveys
   4. Ordered surveys and address labels
   5. Ordered envelopes, postcards, letters (cover, introductory, second and third letters)
   6. Generated address label database to keep track of respondents
   7. Developed database for survey responses
   8. Sent introductory letter April15, 2002 (See Appendix A)

B. Sending out the survey (See Appendix B & C):
   1. Prepared return envelopes
   2. Prepared survey packet
   3. Sent survey packet April 22, 2002

C. Sending out reminder letters:
   1. Sent first reminder postcard April 29, 2002 (See Appendix D)
   2. Sent second copy of the survey with a follow-up cover letter May 6, 2002 to non-respondents (See Appendix E)
   3. Sent a third final reminder letter May 13, 2002 to non-respondents (See Appendix F)

D. Established a final date to accept completed surveys: May 25, 2002.

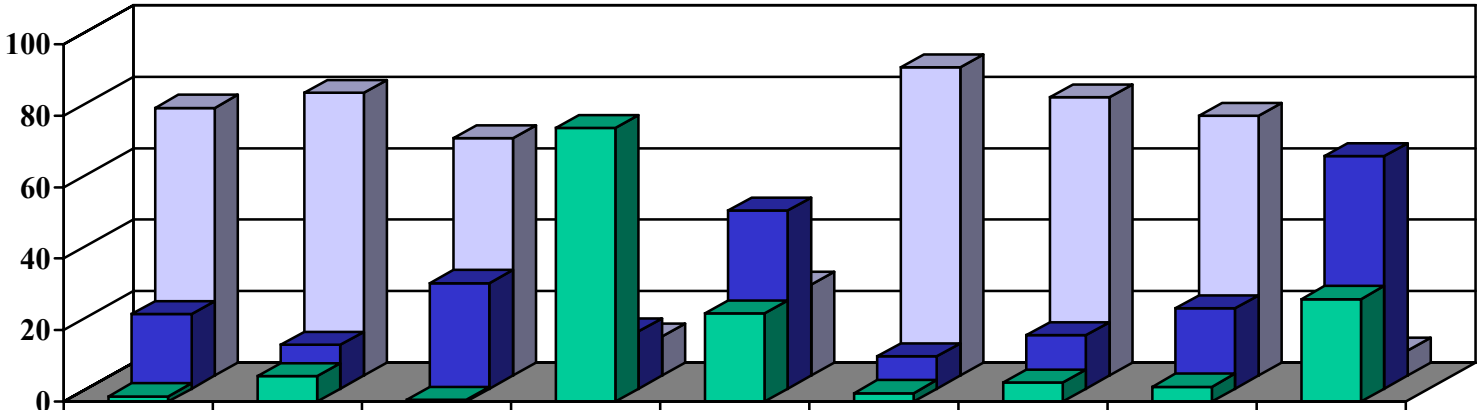
Detailed Results

Outdoor Air Quality Survey Results

Q1. In Order to Address Air Quality Issues, the City Focuses on a Variety of Specific Programs and Events. Do you Recall Hearing About, or Participating in, Any of the Following?

The first set of questions focused on specific air quality programs or campaigns currently in place at the City. As a check on marketing success, the responses can tell *where* money and time was well spent and where it was not well spent. This list is updated as needed for each survey year. The *Emission Sticker Law*, *Earthday*, and *Carbon Monoxide in the Home* were the programs/events most people had participated in. *Earthday*, *Carbon Monoxide in the Home*, and the *Clean Air Logo* were substantial in the "heard of it" category. On the other hand, with the exception of *Earthday*, *Emissions Sticker*, and *Carbon Monoxide in the Home*, most events and programs listed fell in the "Never Heard of It" response category.

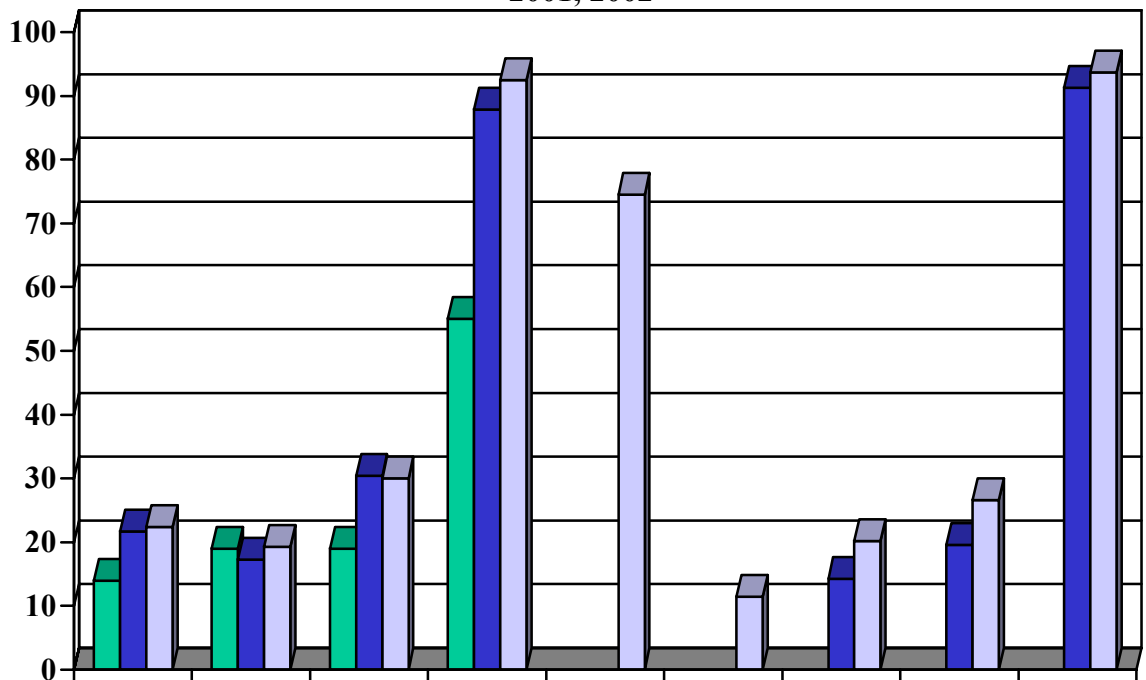
Figure 1. Percentage of Respondents Reached Through Programs and Events: 2002



	Lawn Mower Rebate	CarCare Maintenance	Clean Air Logo	Emissions Sticker	CO2 in Home	ClimateWise	Idling Campaign	Wood-smoke Complaint Line	Earthday
Participated	1.5	7.1	0.5	76.5	24.7	2.4	5.3	4.2	28.7
Heard of it	20.9	12.2	29.5	16	49.8	9	14.9	22.4	65
Never Heard of it	74.9	79.1	66.4	10.9	25.4	86.3	77.8	72.7	7

The survey in 1999 was the first year this question was asked (see Figure 2). New to this survey were the programs/events, *Carbon Monoxide in the Home*, and *ClimateWise*. Though not many changes can be seen, it is still evident that in the past few years, an increasing percentage of residents are being reached by these programs and events.

Figure 2: Either "Heard Of" or "Participated In" Programs and Events Comparison 1999, 2001, 2002

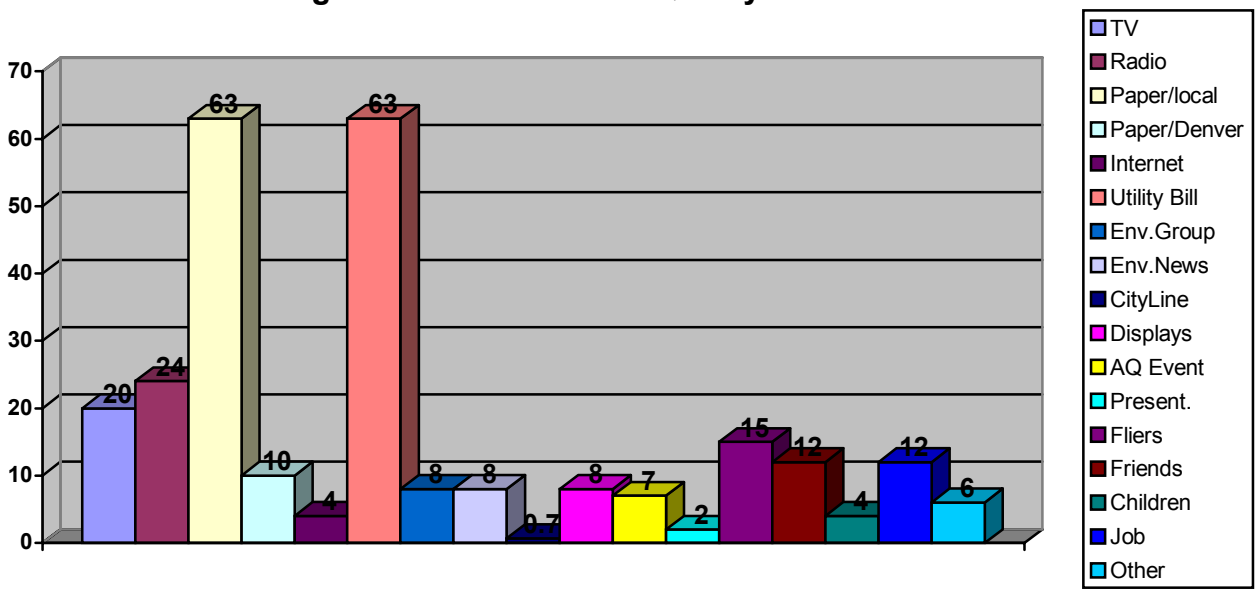


	Lawn Mower Rebate	CarCare Maintenance	Clean Air Logo	Emissions Complian	CO2 in Home	Climate Wise	Idling Campaign	Wood Complaint Line	Earthday
1999	14	19	19	55					
2001	21.7	17.3	30.4	87.9			14.3	19.6	91.3
2002	22.4	19.3	30	92.5	74.5	11.4	20.2	26.6	93.7

Q2. Where do you Recall Seeing or Hearing Information About Air Quality Issues in Fort Collins?

Education of citizens of Fort Collins is a significant part of the City's air quality program. This question gives planners and staff an indication of ***the success of some recent programs and events the City uses to address air quality issues***. This question is also updated each survey year as appropriate. Question Two asked the residents how they recalled receiving information about air quality issues in Fort Collins. The *local newspaper* (63%) and the *utility bill inserts* (63%) were the main sources of information about air quality information (see Figure 3). The least effective sources were found to be: *City Line, Presentations, Children,* and *Internet*.

Figure 3. Sources of Air Quality Information



Comparing years 1997, 1999, 2001, and 2002 (Table 1) we find that very few reall changes are occurring in the sources of air quality information overall. City Line, however, appears to be on a steady decline along with Environmental Groups or News. The utility bill insert and local newspaper remain strong sources of information for residents.

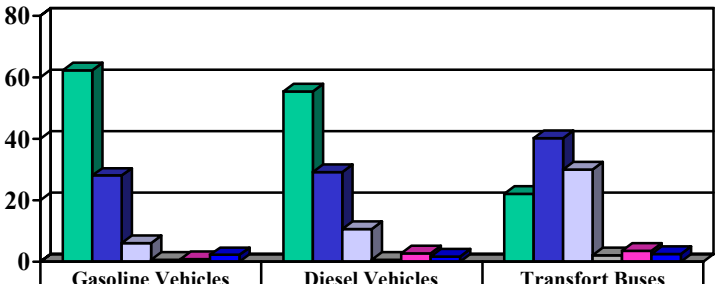
Table 2. Sources of Air Quality Information Comparisons: 1997, 1999, 2001, 2002

Source of Information	Recalled or Heard Information			
	1997 (%)	**1999 (%)**	**2001 (%)**	**2002 (%)**
TV	22	20	22	20
Radio	27	15	27	24
Local Newspaper	64	49	67	63
Denver Newspaper	16	11	8	10
Internet	5	2	4	4
Utility Bill Insert	58	57	61	63
Environmental Group	19	10	8	8
Environmental News	16	10	10	8
City Line	6	3	2	1
Displays	*	7	13	8
Air Quality Program/Event	*	*	*	7
Presentations	*	2	3	2
Flyers/Brochures	*	12	14	15
Friends	30	8	10	12
Children	13	4	3	4
Jobs/School	15	7	11	12
Other	7	3	6	6

Q3. For Each of the Following, Please Indicate if you believe it is a Major, Moderate, or Minor Source of Air Pollution in Fort Collins.

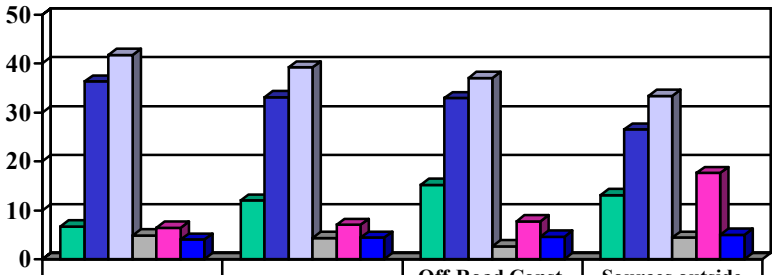
Question Three will directly tell planners and staff where the respondent believes the source of air pollution is coming from and how major, moderate, minor, or non-contributing that source is perceived to be by the respondent. Figures 4a, 4b, and 4c show that gasoline vehicles, followed closely by diesel vehicles are the perceived major source of air pollution in the opinion of the resident. Of the three motor vehicle categories (gasoline, diesel, bus), buses were considered as "minor" sources of air pollution compared to either diesel or gasoline vehicles; with gasoline and diesel three times more than the bus. All others were perceived to be "minor" sources of air pollution in Fort Collins.

Figure 4a: Sources of Air Pollution in Fort Collins



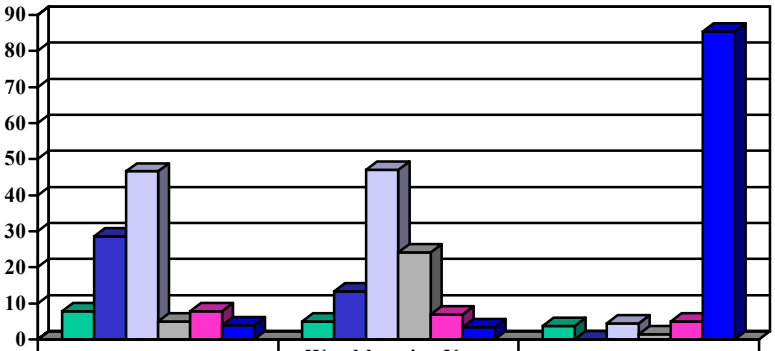
	Gasoline Vehicles	Diesel Vehicles	Transfort Buses
Major	62.3	55.5	22
Moderate	28	29.1	40.2
Minor	6	10.6	30
Does Not Contribute	0.5	0.6	2
Don't Know	0.7	2.7	3.4
Missing Values	2.1	1.5	2.4

Figure 4b: Sources of Air Pollution in Fort Collins



	Industry	Street Dust	Off-Road Const. Equip.	Sources outside FC
Major	6.7	12	15.2	13.1
Moderate	36.3	33.1	32.9	26.5
Minor	41.7	39.2	37	33.4
Does Not Contribute	4.9	4.3	2.6	4.4
Don't Know	6.4	7	7.7	17.6
Missing Values	4	4.4	4.6	5

Figure 4c: Sources of Air Pollution in Fort Collins



	Wood-burning in FC	Wood-burning Your Neighborhood	Other
Major	7.9	4.9	3.8
Moderate	28.6	13.4	0
Minor	46.6	47.1	4.4
Does Not Contribute	5	24.2	1.5
Don't Know	7.9	7	5
Missing Values	3.9	3.4	85.3

Comparing the 2002 survey to previous surveys, Table 3 shows that diesel and gasoline vehicles are still considered to be the biggest contributors to air pollution in Fort Collins. Transfort buses showed a slight increase as a major or moderate source, along with a decrease as a minor source. All other sources, showed a decrease as a major and moderate source, and an increase as a minor source. All together, it appears the respondents perceive motor vehicle emissions to be the major contributing source of air pollution in Fort Collins.

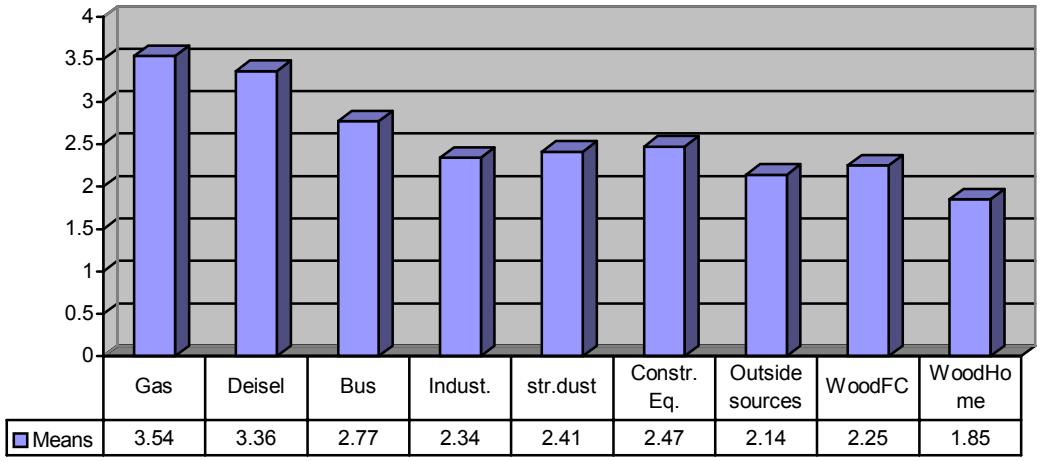
Table 3. Sources of Air Pollution in Fort Collins Comparison: 1997, 1999, 2001, 2002

Sources of AP in FC	Major				Moderate				Minor				Doesn't Contrib.			
	'97	'99	'01	'02	'97	'99	'01	'02	'97	'99	'01	'02	'97	'99	'01	'02
Gasoline Vehicles	57	65	70	62	32	26	22	28	9	9	7	6	<1	<1	0.3	.5
Diesel Vehicles	56	50	56	56	33	35	30	29	9	12	9	11	<1	<1	0.7	.6
Transfort Buses	20	25	21	22	37	36	39	40	37	36	35	30	2	1	1.7	2
Industry in Fort Collins	8	11	13	7	39	37	40	36	43	39	35	42	4	5	4	5
Street Dust	16	17	20	12	32	38	36	33	44	37	31	39	5	5	5	4
Off-Road Construction	*	15	22	15	*	45	37	33	*	32	31	37	*	3	3	3
Sources Outside FC	11	14	18	13	33	30	32	27	27	30	29	33	6	4	3	4
Wood burning Stoves in FC	17	12	15	8	32	32	39	29	40	45	39	47	6	6	2	5
WB in Your Neighborhood	*	*	*	5	*	*	*	13	*	*	*	47	*	*	*	24

A graphic view of the means of the major sources of air pollution in Fort Collins validate that gas and diesel vehicles are considered to be the major sources of air pollution. Wood smoke in their home/neighborhoods had the lowest mean. As to be expected, a test of significance between the means of "wood smoke in Fort Collins" and "wood smoke in your neighborhood" revealed highly significant differences between the two choices ($\underline{p} < .001$). It is common for an individual to perceive a negative situation to be affecting "everyone else" and not them, even when it is. The psychological explanation for this perception is called cognitive dissonance. It is cognitively dissonant for an individual to believe that they are *knowingly* doing something "wrong." In this example, it is

cognitively dissonant to believe that they are knowingly choosing to live someplace that has negative ambient air. Especially when they may be one of the contributors of that negative air. As such, the respondents in this survey believe that wood smoke is negatively affecting the air quality in Fort Collins, but not in their neighborhood, even though "their neighborhood" is in Fort Collins.

Figure 5. Mean Comparisons of Sources of Air Pollution



	Gas	Deisel	Bus	Indust.	str.dust	Constr. Eq.	Outside sources	WoodFC	WoodHome
Means	3.54	3.36	2.77	2.34	2.41	2.47	2.14	2.25	1.85

Q4, Q5, Q6, Q7. Reliability of Scales

Four of the questions in this survey, Questions Four, Five, Six and Seven, though made up of several questions each, described a "general" scale that represented a concept, or construct. To verify that each question does actually make up a "scale" that reliably measures one factor, an analysis of reliability was performed on each, or a Cronbach's Alpha (α). The closer Cronbach's Alpha comes to 1.0, the more reliable the scale. Table Four shows the reliability scores for Questions Four, Five, Six and Seven. All four scales have good to excellent reliability.

Table 4. Reliability Scores of Questions Four, Five, Six and Seven.

Questions	α
Q4. Adverse Affects of Air Pollution	.87
Q5. Where City Should Focus Programs and Plans	.89
Q6. Something Should be Done about Air Quality in Fort Collins	.88
Q7. Actions Resident Would Take to Help Reduce Air Pollution	.80

Q4. Air Pollution in Fort Collins Affects Me Because it…

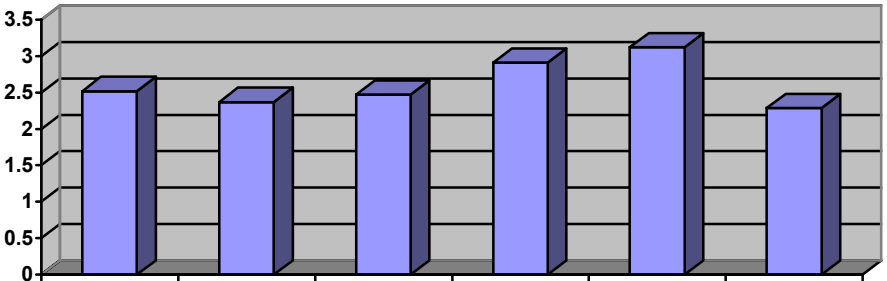
Question Four measured the resident's opinion or belief of how the outdoor air quality of Fort Collins affects their lives. Table Five shows the overall responses (the sum of all the statements or questions for each "agree" category) to Question Four. Sixty two per cent (62%) of the residents state that the air pollution in Fort Collins affects them in some negative way (allergies, respiratory, visually, indoor air). Four percent (4%) were missing values.

Table 5. Overall Responses of Adverse Affects of Air Pollution.

Strongly Agree	Agree	Somewhat Disagree	Disagree	Don't Know
25	37	12	13	9

Means of the adverse affects of air pollution show that more people believe they are affected negatively by the *visual impacts* such as "obscuring mountain views" and "creating a brown cloud" than the physical impacts. Significant differences ($p < .05$) were found between all the means except "Triggers allergies/respiratory problems" and "Causes burning/itchy eyes, nose" ($p > .05$) and "Causes long-term respiratory problems" and "Affects my indoor residential air quality."

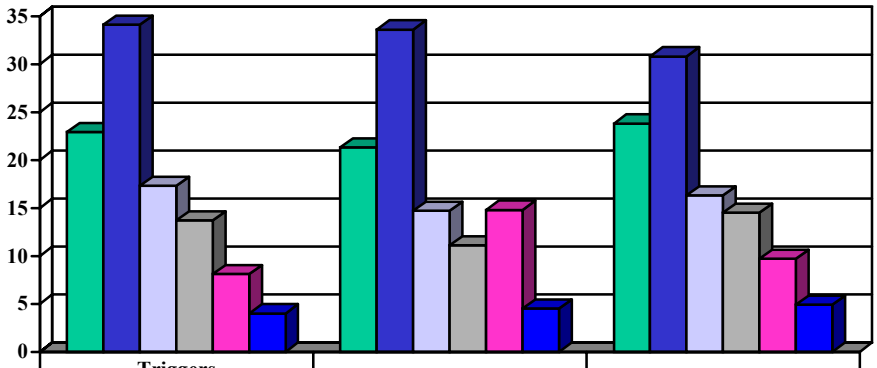
Figure 6. Mean Comparisons for Adverse Affects of Air Pollution



	Allergies	Lg-tm Resp	Burning/Itchy Eyes	Obscures Views	Brown Cloud	Affects IAQ
Means	2.52	2.37	2.47	2.91	3.12	2.29

The results of how residents perceive the adverse affects of air pollution are broken down in Figures 7a and 7b. Visual affects, such *as creating a brown cloud* and *obscuring mountain views*, are rated the highest by the respondents as an adverse affect.

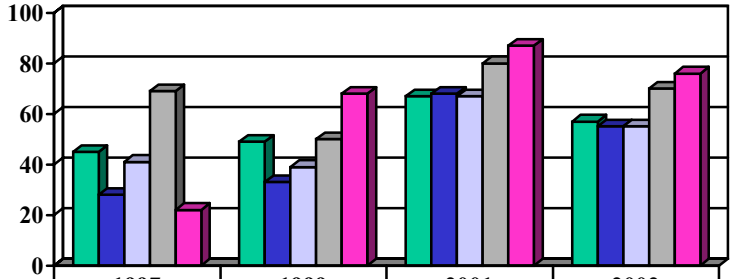
Figure 7a. Adverse Affects of Air Pollution



	Triggers Allergies/Respiratory Problems	Causes Long-Term Respiratory Problems	Causes Burning/Itchy Eyes, Nose
Strongly Agree	22.9	21.3	23.8
Somewhat Agree	34.1	33.6	30.8
Somewhat Disagree	17.3	14.7	16.3
Strongly Disagree	13.7	11.1	14.5
Don't Know	8.1	14.8	9.7
Missing Values	4	4.5	4.9

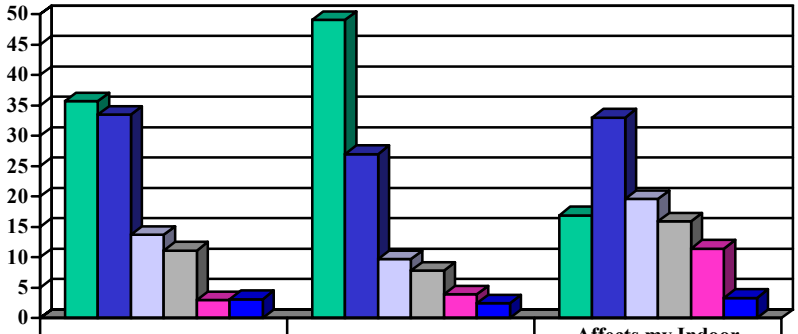
The 2001 and 2002 survey asks the respondent on a scale of "agreement" instead of the 1997 and 1999 "Yes/No" responses. The result is a more accurate and complete measure of the respondent's perceptions of the adverse affects of air pollution in Fort Collins. Even though the comparisons to previous years can not be as clear cut, comparisons between which category is perceived to be the most adverse can still be made. "Strongly Agree" and "Somewhat Agree" from the 2001 survey were added

Figure 8. Adverse Affects of Air Pollution: Changes From 1997, 1999, 2001, 2002



	1997	1999	2001	2002
Triggers Allergies/Respiratory Problems	45	49	67	57
Causes Long-Term Respiratory Problems	28	33	68	55
Causes Burning/Itchy Eyes, Nose	41	39	67	55
Obscures Mountain Views	69	50	80	70
Causes a "Brown Cloud"	77	68	87	76

Figure 7b. Adverse Affects of Air Pollution



	Obscures Mountain Views	Causes a "Brown Cloud"	Affects my Indoor Residential Air Quality
Strongly Agree	35.7	49.1	16.9
Somewhat Agree	33.5	27	33
Somewhat Disagree	13.7	9.7	19.6
Strongly Disagree	11.1	7.8	15.9
Don't Know	2.9	3.9	11.4
Missing Values	3.1	2.4	3.3

together to compare to "Yes" from the previous surveys. In looking closely at the comparisons from 2001 to 2002, "obscuring mountain views" and "creating a brown cloud" were still considered by the respondents to have the worst adverse affects (see Figure 8). With the increased choices on the questions from "Yes" to "Strongly Agree" and "Somewhat Agree" more respondents rank "allergies", "respiratory problems" and "burning, itchy eyes/nose" as important negative affects than did so in both 1997 and 1999.

Q5. To Help Improve Air Quality, City Air Quality Programs and Plans Should…

The main focus of Question Five is to determine ***where the City should focus air quality programs and plans***. Responses should help planners and staff focus efforts where they will be easily and readily accepted. In response to the statements and questions regarding where the City should focus programs and plans, overall, the resident responses ranged from 75 percent *agreeing* to 17 percent *disagreeing* more should be done by the City to better the air quality (see Table 6). Only 3 percent felt that City programs or plans "would not help."

Table 6. Overall: *"City Air Quality Programs and Plans Should…".*

Strongly Agree	Agree	Somewhat Disagree	Disagree	Would Not Help
45	30	10	7	3

The comparison of the means (Table 7) and the frequencies (Figures 8a-8d) for *"City Air Quality Programs and Plans Should…"* show that improving traffic light timing is a very high priority of what the residents believe the City should be doing to improve air quality. Increasing enforcement of exhaust regulations, prohibiting wood burning on high pollution days, increasing enforcement of emissions compliance, and doing more to improve visibility are also important to the residents.

Table 7: Mean Comparisons Of *"City Air Quality Programs And Plans Should…"* With "4" = "Strongly Agree" And "1" = "Strongly Disagree" From Highest To Lowest

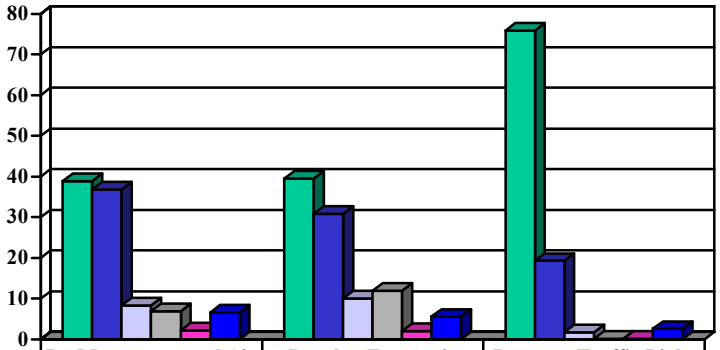
Statement	Means
Improve Traffic Light Timing to Reduce Vehicle Idling at Lights.	3.75
Increase Enforcement of Exhaust Regulations for Both Gas and Diesel Vehicles.	3.30
Prohibit wood-burning on high pollution days.	3.30
Increase Enforcement of Emissions Law.	3.26
Do more to reduce the "Brown Cloud" and improve visibility.	3.23
Promote the Use of Alternative Fuel Vehicles.	3.20
Improve safety and access for bikes, skates, pedestrians.	3.11
Develop Economic Incentives for Repair of High Polluting Vehicles.	3.00
Improve Convenience of Bus Service.	2.94
Encourage Drivers to Turn off Vehicles at any Wait Longer than 3 Minutes.	2.91
Do more to reduce local greenhouse gas emissions.	2.85
Require non-certified wood stoves to be removed at time of home sales.	2.70

Interestingly, the programs/plans that **best predict whether a person believes the City should do "more"** to control air pollution are not in the same order as the means. Table Eight shows a large effect of *doing more to reduce the brown cloud, doing more to reduce local greenhouse emissions, increasing enforcement of exhaust regulations for motor vehicles* and *increasing enforcement of emissions laws* on how strongly the resident believes the City should do more. A moderate effect is seen with *prohibiting wood-burning on high pollution days, requiring non-certified wood stoves to be removed at time of home sales*, and *promoting the use of alternative fuel vehicles* on the belief that the City should do more to control air pollution. A small effect was found for *improving convenience of bus service, developing economic incentives for repair of high polluting vehicles, improving safety and access for bikes, skates, pedestrians, encouraging drivers to turn off vehicles at any wait longer than 3 minutes*, and *improving traffic light timing to reduce vehicle idling at lights.* It is not surprising that improving traffic light timing did not predict as strongly as some of the others since almost all the respondents strongly agreed to this statement. Though the table of means (Table 7) and the frequency responses are important statistics to examine, it is also useful to look at Table 8. Means and frequencies are only revealing preferences for a program or plan to improve air quality in Fort Collins. What Table 8 tells you is how important each program or plan is to the residents in predicting whether the City should be doing more to control air pollution. In other words, programs and plans that focus on visibility, greenhouse gas emissions, exhaust from motor vehicles, and wood smoke are the programs or plans that most residents believe the City should do *more of* to control air pollution. Conversely, the programs that had a small effect on predicting strong responses to the City needing to do *more*, may have been chosen often (frequencies and means), but the same people did not think the City should actually do more of anything to control air pollution. This information should help guide your marketing efforts.

Table 8. Effect Size Of Each Program And Plan On The Resident's Belief That The City Should Do More To Control Air Pollution In Fort Collins

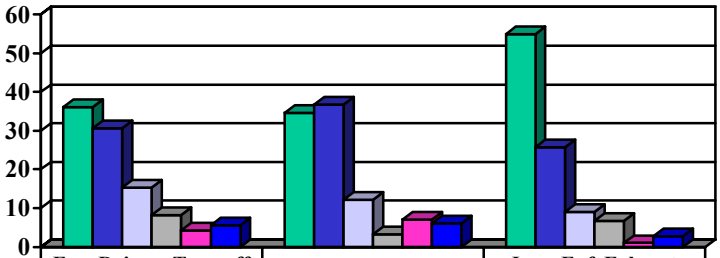
Statement	R^2
Do more to reduce the "Brown Cloud" and improve visibility.	.47
Do more to reduce local greenhouse gas emissions.	.40
Increase Enforcement of Exhaust Regulations for Both Gas and Diesel Vehicles.	.37
Increase Enforcement of Emissions Law.	.36
Prohibit wood-burning on high pollution days.	.28
Require non-certified wood stoves to be removed at time of home sales.	.26
Promoting the use of Alternative Fuel Vehicles	.26
Improve Convenience of Bus Service.	.18
Develop Economic Incentives for Repair of High Polluting Vehicles.	.17
Improve safety and access for bikes, skates, pedestrians.	.14
Encourage Drivers to Turn off Vehicles at any Wait Longer than 3 Minutes.	.07
Improve Traffic Light Timing to Reduce Vehicle Idling at Lights.	.04

Figure9a. City Air Quality Programs and Plans Should...



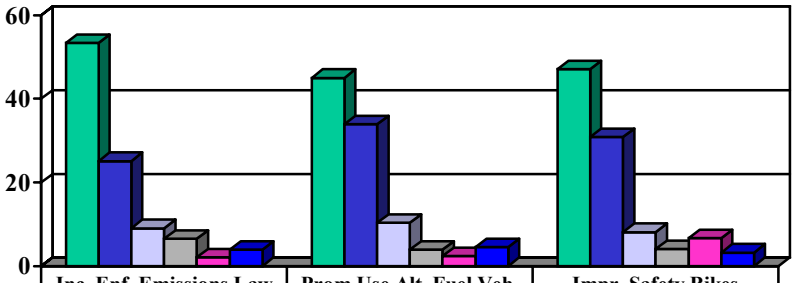
	Do More to control Air Pollution in Fort Collins	Develop Economic Incentives for Repair of High Polluting	Improve Traffic Light Timing to Reduce Vehicle Idling at Lights
Strongly Agree	38.9	39.5	75.9
Somewhat Agree	36.9	30.9	19.3
Somewhat Disagree	8.4	10.1	1.7
Strongly Disagree	7	11.9	0.2
Would Not Help	2.2	2	0.2
Missing Values	6.6	5.6	2.6

Figure 9b. City Air Quality Programs and Plans Should...



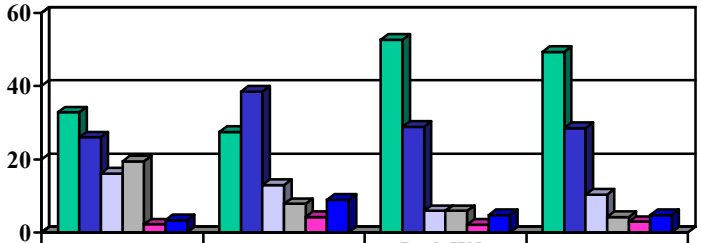
	Enc. Drivers Turn off Veh.	Improve Conven. Bus	Incr. Enf. Exhaust Regs.
Strongly Agree	36.1	34.6	54.9
Somewhat Agree	30.7	36.7	25.7
Somewhat Disagree	15.3	12.2	9
Strongly Disagree	8.2	3.3	6.7
Would Not Help	4.2	7.1	1
Missing Values	5.6	6.1	2.7

Figure 9c. City Air Quality Programs and Plans Should...



	Inc. Enf. Emissions Law	Prom.Use Alt. Fuel Veh.	Impr. Safety Bikes
Strongly Agree	53.4	45	47.1
Somewhat Agree	25.1	33.9	30.9
Somewhat Disagree	9	10.3	8.1
Strongly Disagree	6.5	3.9	4
Would Not Help	2.1	2.4	6.7
Missing Values	3.9	4.5	3.2

Figure 9d. City Air Quality Programs and Plans Should...



	Req.Non-Cert. Wood. Stoves	Reduce Local Greenhouse	Proh.Wd-Burning HghPollution	Reduce Brown Cloud
Strongly Agree	32.8	27.5	52.6	49.3
Somewhat Agree	26	38.5	28.9	28.5
Somewhat Disagree	16.1	13	5.9	10.4
Strongly Disagree	19.4	7.8	5.9	4.2
Would Not Help	2.2	4.2	2.1	2.9
Missing Values	3.4	9	4.8	4.8

As in previous years, in general, the residents support the City's efforts to improve air quality, with those agreeing with the current programs or plans. As in both 1997,1999, and 2001, residents agreed that *improved traffic light timing* should remain at the top of the list for what actions the City should take to improve air quality. Traffic signal timing was followed closely by *Increase enforcement of exhaust regulations for both gas and diesel vehicles, Improve safety and access for bikes, skates, and pedestrians,* and *Increase enforcement of emissions laws.* No major changes were observed from previous years with the exceptions of residents appear to be slightly less concerned about *bike safety and access* and more concerned about *drivers leaving vehicles running at a wait longer than 3 minutes* (Table 9).

Table 9. City "Should Focus Programs and Plans on" Comparison: 1997, 1999, 2001, 2002

Programs and Plans	Strongly Agree				Somewhat Agree				Somewhat Disagree				Strongly Disagree			
	'97	'99	'01	'02	'97	'99	'01	'02	'97	'99	'01	'02	'97	'99	'01	'02
Develop economic incentives for repair of high polluting vehicles.	32	36	44	40	37	40	36	31	16	10	10	10	9	11	9	12
Improve traffic light timing to reduce vehicle idling at lights.	76	73	76	76	20	21	21	19	2	2	2	2	<1	2	0	.2
Encourage drivers to turn off vehicles at any wait longer than 3 min.	36	30	39	36	28	32	34	31	23	19	17	15	8	13	6	8
Improve convenience of bus service.	*	48	47	35	*	7	7	37	*	8	2	12	*	6	5	3
Increase enforcement of exhaust regulations for both gas and diesel vehicle.	59	65	60	55	30	25	26	26	6	5	7	9	4	4	4	7
Increase enforcement of emissions laws.	58	58	58	53	28	27	29	25	7	6	8	9	5	6	4	7
Promote the use of alternative fuel vehicles.	39	40	50	45	39	36	38	34	10	11	7	10	4	5	2	4
Improve safety and access for bikes, skates, and pedestrians.	*	67	59	47	*	24	27	31	*	4	7	8	*	2	2	4
Require non-certified wood-stoves to be removed/replaced at time of home sale.	33	35	30	33	26	27	30	26	19	16	22	16	15	18	14	19

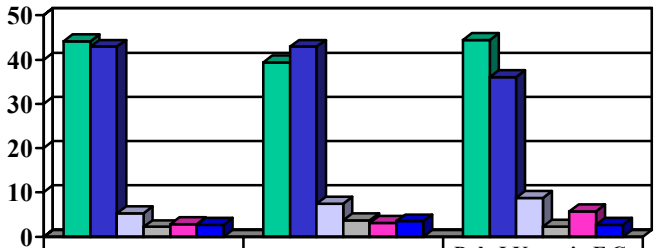
Q6. How strongly do you agree/disagree with the following?

The next scale, or set of questions, gets at the resident's belief of how big the issue of air quality in Fort Collins is to him or her. The questions are based on three factors: (1) statements of their beliefs or perceptions of the air quality in Fort Collins is (attitudes, beliefs), (2) their perception of what type of actions other residents may make (social norms), and

(3) how much difference actions they may take would make (perceived control). According to the Theory of Planned Behavior, the sum of responses to these questions should give a general idea of whether or not the resident may actually act in a pro-environmental fashion. In other words, if the residents generally agreed that there was a problem, their neighbors and friends believed there was a problem, and they could actually do some things to alleviate the problem—they would be more likely to do so. This scale can tell planners an overall "intent to act/behave.". In looking at all the responses, most residents agreed, (70%) indicating that they would be more likely to act (or at least be open to accepting pro-environmental programs or plans), pro-environmentally. See Figures 10a-10d.

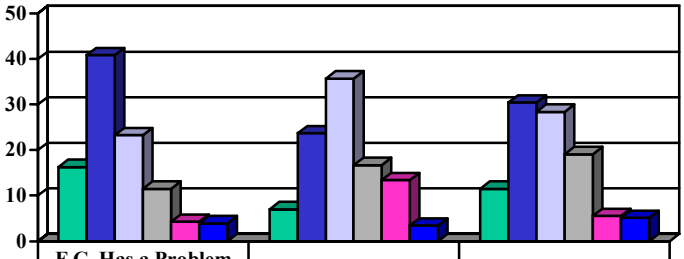
Even though people responded that they would be willing to make changes, they perceive that others will not. We see this in the first graph where they state they will make changes, but everyone they know will not. One must keep in mind the fact that to someone else, the respondent (who claims they will make changes), is "people I know in Fort Collins" and is perceived by others as not willing to make changes. The second graph shows that people are, again, disturbed by the visibility due to air pollution in Fort Collins. They agree, but not strongly, that the air pollution may be negatively impacting the economy and that the air smells bad. More people believe that Fort Collins is impacting and being impacted by global warming than do not believe this. Also, it is very clear from several places in this survey (reliability) that the emissions program is a program that should be kept.

Figure 10a: Attitudes, Norms, and Perceived Control of Air Quality in Fort Collins



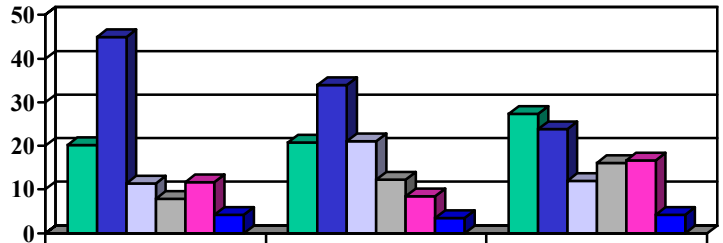
	Personal Obl. Help Improve AQ in FC	Small Changes I Make Affect AQ FC	Pple I Know in F.C. Will NOT Chge Transportation
Strongly Agree	44.1	39.4	44.4
Somewhat Agree	42.9	42.9	36.1
Somewhat Disagree	5.3	7.5	8.8
Strongly Disagree	2.2	3.7	2.3
Don't Know	2.8	3.1	5.7
Missing Values	2.7	3.5	2.7

Figure 10b: Attitudes, Norms, and Perceived Control of Air Quality in Fort Collins



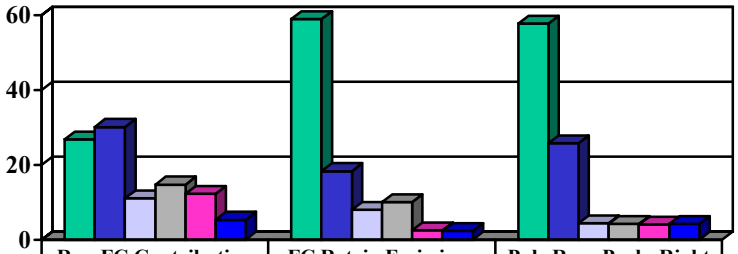
	F.C. Has a Problem with Visibility Due to Air Pollution.	AP Hurts Local Economy.	AP in F.C. Makes Air Smell Bad.
Strongly Agree	16.3	7	11.5
Somewhat Agree	40.8	23.7	30.4
Somewhat Disagree	23.2	35.7	28.4
Strongly Disagree	11.5	16.7	19.1
Don't Know	4.3	13.4	5.5
Missing Values	3.9	3.4	5.1

Figure 10c: Attitudes, Norms, and Perceived Control of Air Quality in Fort Collins



	Sign.to Cause Human Hlth Probl	Hurt Environment	Res. FC Neg. Affected by global warming
Strongly Agree	20.2	20.7	27.3
Somewhat Agree	44.9	34	23.8
Somewhat Disagree	11.4	21.1	11.9
Strongly Disagree	7.8	12.3	16.1
Don't Know	11.6	8.4	16.7
Missing Values	4.2	3.4	4.2

Figure 10d: Attitudes, Norms, and Perceived Control of Air Quality in Fort Collins



	Res. FC Contributing To Global Warming	FC Retain Emissions Program	Pple Resp Prob: Right to Clean Air
Strongly Agree	26.8	58.9	57.7
Somewhat Agree	30.1	18.3	25.7
Somewhat Disagree	11	7.9	4.3
Strongly Disagree	14.7	10	4.2
Don't Know	12.2	2.4	4
Missing Values	5.3	2.3	4.2

For 2001 and 2002, all statements were compared. Small, non-significant changes were seen.

Table 10: Comparison Between Belief Statements 2001, 2002

Statements	Strongly Agree		Somewhat Agree		Somewhat Disagree		Strongly Disagree	
	2001	2002	2001	2002	2001	2002	2001	2002
I feel a personal obligation to help improve the air quality in FC.	41	44	48	43	7	5	2	2
I feel that small changes I make *can* affect the air quality in FC	38	39	46	43	10	8	5	4
Many of the people I know in FC will NOT change their transportation habits to improve air quality in FC	41	44	39	36	12	9	1	2
FC has a problem with visibility due to air pollution	21	16	40	41	27	23	7	12
Air pollution in FC hurts the local economy	9	7	29	24	37	36	14	17
Air pollution in FC makes the air smell bad.	16	12	32	30	33	28	15	19
Air pollution in FC is bad enough to cause human health problems.	29	20	40	45	16	11	7	8
Air pollution in FC is significant enough to hurt the environment	28	21	33	34	22	21	11	12
The City of FC's residents will be negatively affected by global warming	32	27	32	24	11	12	11	16
The City and residents (including myself) of FC are contributing to global warming	34	27	37	30	10	11	10	15
Even if not required, FC should retain motor vehicle emissions inspect.	64	59	23	18	7	8	7	10
People with respiratory problems have a right to breathe clean air	68	58	23	26	4	4	3	4

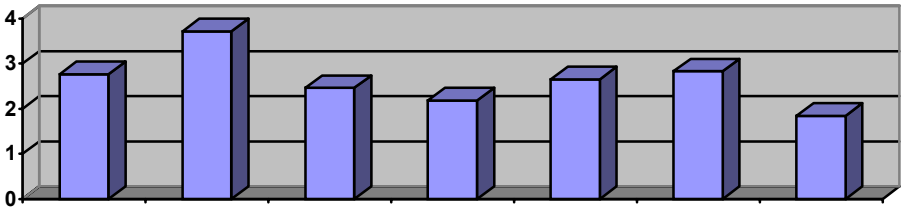
Q7. To Help Reduce Air Pollution in the City of Fort Collins, "I" Would be Willing To…

When asked the question of what the resident would be willing to do to help reduce air pollution in Fort Collins, overall, most residents agreed they would be willing to do something (average of 55.3%) compared to those residents who disagreed that they would be willing to do something (average of 36.4%). An average of 3% felt that the actions would not help anyway. The top action residents would be willing to take is to keep their *vehicles tuned up*. The next set of actions many residents state they would be willing to do is *reduce the number of miles they drive their vehicle, ride a bike for work or errands, reduce number of miles driven in car if there was a tax break incentive,* and *use public transportation if it were more convenient* (Figure 12a and 12b). An action the residents would very much oppose (69%) is to *contribute $10 when registering vehicle to subsidize repair of high-polluting vehicles.* Residents also appear to disagree/somewhat disagree that taking the bus is a possible action they might take to reduce air pollution (53 %).

Compared to 2001, 1999 and 1997, residents again picked *keep my vehicle tuned up* as a top action they would take to help reduce air pollution. This year, less residents would be willing to *ride their bike* or *take the bus* (see Table 11). Overall, residents stated they were less likely to take actions that would contribute to reducing air pollution. Even though the 2001 survey changed the dollar amount of the *contribution when registering their vehicle*, the number of residents that disagreed that this is an action they would be willing to take remained larger than those who agreed they would take.

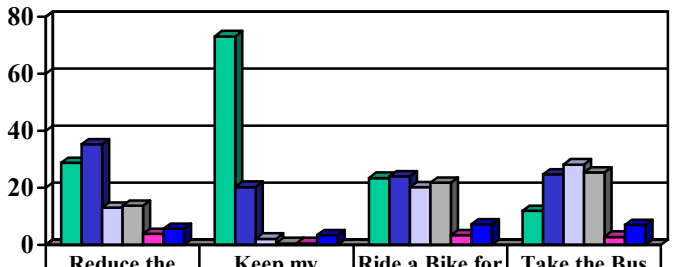
Mean comparisons of the measures of the intent to behave pro-environmentally (Figure 11) show that people are most willing to keep their car tuned up, but least willing to contribute$10.00 to subsidize the repair of high polluting vehicles. This is interesting and could be explained as, residents are willing to spend much more money on their own property to reduce air pollution, but not at all willing to spend a very small (in comparison to a tune-up) amount on someone else's property. Some thought could go into how a marketing or education program could address this issue.

Figure 11: Individual Actions Respondents Would be Willing to Do



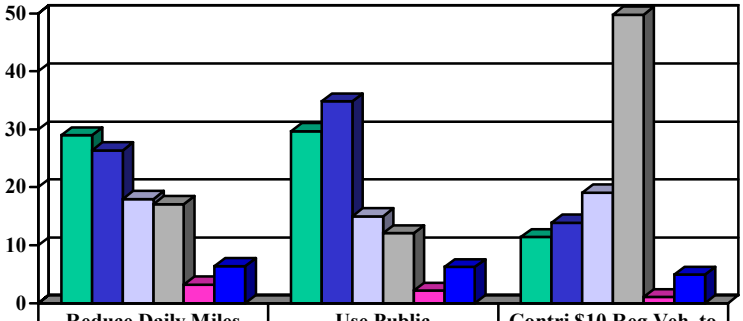
Means	2.76	3.71	2.46	2.19	2.65	2.83	1.84

Figure 12a: Individual Actions to Reduce Air Pollution



	Reduce the Number of Miles I Drive	Keep my Vehicle Tuned Up	Ride a Bike for Errands and/or Work	Take the Bus for Errands and/or Work
Strongly Agree	28.7	73.2	23.5	11.9
Somewhat Agree	35.2	20.3	24.1	24.7
Somewhat Disagree	13	2.1	20.2	28.2
Strongly Disagree	13.7	0.5	21.8	25.4
Would Not Help	3.8	0.5	3.3	2.8
Missing Values	5.6	3.4	7.2	7

Figure 12b: Individual Actions to Reduce Air Pollution



	Reduce Daily Miles Traveled in My Car if Tax Break Incentives	Use Public Transportation if more Convenient	Contri $10 Reg.Veh. to Subsidize Repair of High Polluting Vehicles
Strongly Agree	29	29.7	11.4
Somewhat Agree	26.4	34.8	13.9
Somewhat Disagree	18	15	19.1
Strongly Disagree	17.1	12.1	49.8
Would Not Help	3.2	2.1	1
Missing Values	6.4	6.2	4.9

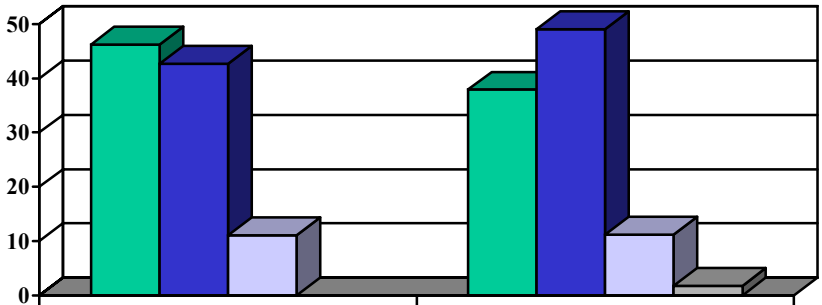
Table 11: Comparison of Individual Actions to Reduce Air Pollution: 1997, 1999, 2001, 2002

Statements	Strongly Agree				Somewhat Agree				Somewhat Disagr.				Strongly Disag.			
	'97	'99	'01	'02	'97	'99	'01	'02	'97	'99	'01	'02	'97	'99	'01	'02
Reduce the number of miles I drive my vehicle each day.	27	30	34	29	41	43	35	35	15	12	14	13	13	14	12	14
Keep my vehicle tuned up.	76	77	71	73	22	20	25	20	1	1	2	2	<1	1	<1	<1
Ride a bike for errands and/or work.	21	26	30	24	22	27	30	24	16	16	19	20	34	27	18	22
Take the bus for errands and/or work.	10	12	15	12	19	23	30	25	34	28	29	28	28	31	22	25
Reduce the daily miles traveled in my car if there were tax break incentives	*	*	34	29	*	*	34	26	*	*	16	18	*	*	11	17
Use public transportation if it was more convenient for me	*	*	40	30	*	*	36	32	*	*	13	15	*	*	9	12
Contribute ($1*) $10 when registering my vehicle to subsidize repair of high-polluting vehicles.	* 24	* 25	10	11	* 22	* 20	17	14	* 14	* 13	19	19	* 38	* 38	49	50

Q8. Have You Ever Experienced Unacceptable Outdoor Air Quality in Fort Collins?

This question was new to the 2001 survey so only comparisons with 2001 can be made. Figure 13 shows that more residents did not experience unacceptable outdoor air quality in Fort Collins. Between this question and the next question, the degree of awareness and concern in regard to air quality in Fort Collins can be found. Somewhat less than half of the respondents have at some time or another experienced unacceptable air quality in Fort Collins, but more have not. The responses to this question changed somewhat since last year and will be interesting to watch over time.

Figure 13: Resident Ever Experience Unacceptable Air Quality in Fort Collins

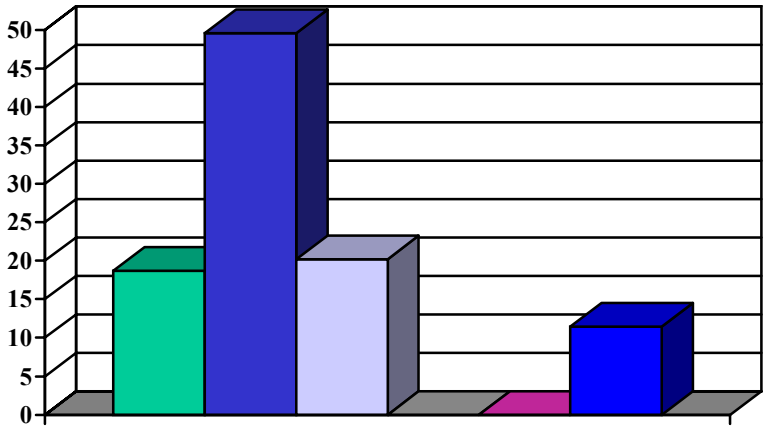


	2001	2002
Yes	46.2	37.9
No	42.7	49
Don't Know	11.1	11.2
Missing		1.8

Q9. Overall, How Would You Rate the Quality of Outdoor Air in Fort Collins?

Figure 14 shows that half of the respondents rate the overall air quality in Fort Collins as "good" (50%).

Figure 14: Rating of Overall Air Quality in Fort Collins



Very Good	18.7
Good	49.6
Fair	20.2
Poor	0
Not Sure	0
Missing Values	11.5

Table 12 shows the results of the previous surveys. Most respondents rated the air quality as "good", 46% in 1997 and 43% in 1999, with very few rating it as "excellent" or "poor." Compared to the first two surveys, both the 2001 and the 2002 surveys found less people rating the air quality as "very good." However, this year, no one rated it as "poor."

Table 12: Rating of Overall Air Quality in Fort Collins Comparison: 1997, 1999, 2001

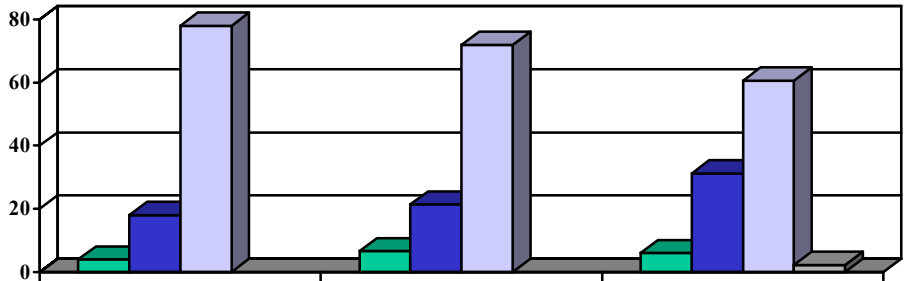
Rating	1997	1999	2001	2002
Excellent	4	6	*	*
Very Good	23	24	16	19
Good	46	43	53	50
Fair	23	23	28	20
Poor	2	2	2	0
Not Sure	*	*	0.8	0

Q10. What Do You Think Fort Collins' Air Quality Will be Like in Five Years?

Figure 15 shows that most respondents believe that Fort Collins' air quality will be worse (61%) in five years, while 31% believe it will not change, and only 6% believe it will be better than it is now. Considering that 50% consider the air quality "good" and almost half have at some time or another experienced unacceptable air quality, these results indicate that the respondents believe the air quality is going to not remain at "good", especially in light of the fact that they have already experienced unacceptable air quality. More respondents in this survey, 2002, believe that the air quality will remain the same and less believe it will get worse, however, about the same percent of respondents believe it will get better.

What about the public's feelings about the actualities? The issue the previous question and the next two questions get at concerns the respondent's view of the chances that anything effective will or can be done to maintain and/or better the air quality in Fort Collins. The next two questions directly assess whether something can be done. Results show in

Figure 15: What Will Fort Collins'Air Quality Be Like In Five Years From Now?

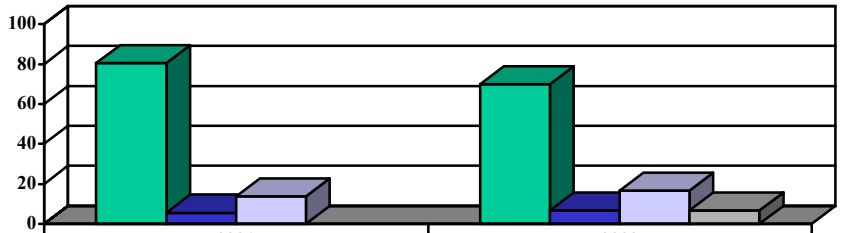


	1999	2001	2002
Better Than Now	4	6.6	6
No Change From Now	18	21.4	31.2
Worse Than Now	78	71.9	60.6
Missing Values			2.2

Figure 13 that residents do, in general, believe that something can be done to improve or maintain the air quality in Fort Collins (70%). Still, less residents in 2002 compared to 2001 think that something can be done. More people just don't know. Comparing can something be done to will something be done shows that four times as many people believe nothing will be done as can be done. This is important to note.

Q11. Do You Think Anything *Can* Be Done to Improve the Air Quality in Fort Collins?

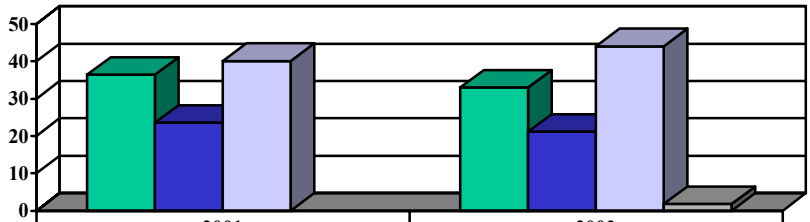
Figure 16: Can Something Be Done To Maintain or Improve the Air Quality in Fort Collins?



	2001	2002
Yes	80.5	69.9
No	5.6	6.7
Don't Know	13.8	16.7
Missing Values		6.6

Q12. Do You Think Anything *Will* Be Done to Improve the Air Quality in Fort Collins?

Figure 17: Will Something Be Done To Improve or Maintain the Quality of Air in Fort Collins?

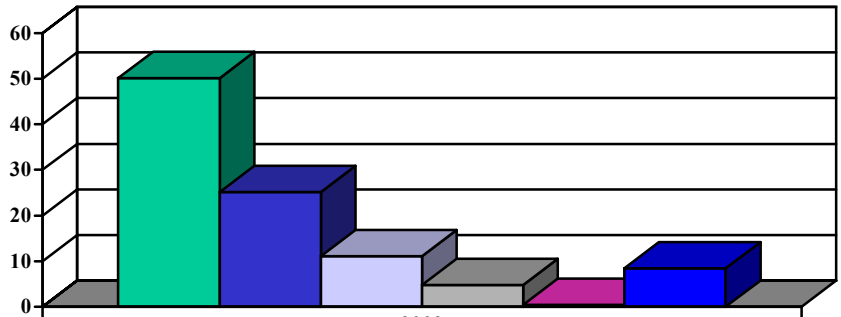


	2001	2002
Yes	36.4	33
No	23.5	21.1
Don't Know	40.1	44
Missing Values		1.8

Q13. How Long Do You *Typically* Warm Up Your Car on Winter Mornings Before Driving Away?

Figure 18 shows that almost half of the respondents do not warm up their car at all, a quarter of the respondents warm it up for 1-2 minutes, and very few warm it up more than 5 minutes.

Figure 18: Time Respondent Warms up Car on Cold Days

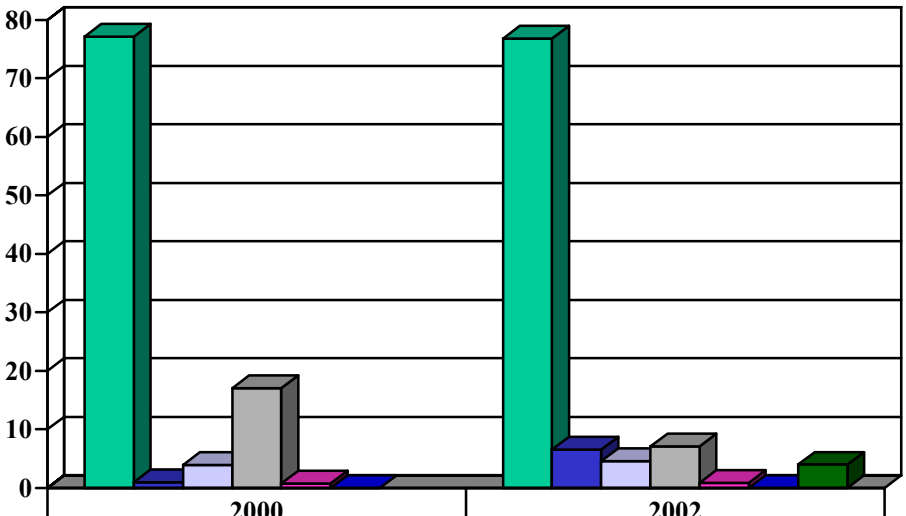


	2002
Do NOT warm up car	50.1
1-2 Minutes	25.2
3-5 Minutes	11.1
5-10 Minutes	4.8
> 10 Minutes	0.4
Missing Values	8.4

Q14. How Many People in Your Household Smoke Cigarettes, Cigars, or Pipes?

This is an interesting change from the Indoor Air Quality survey of 2000. The numbers of people who will allow guests to smoke has increased, while the number of people actually smoking in their own homes has dramatically decreased.

Figure 19: Household Smokng

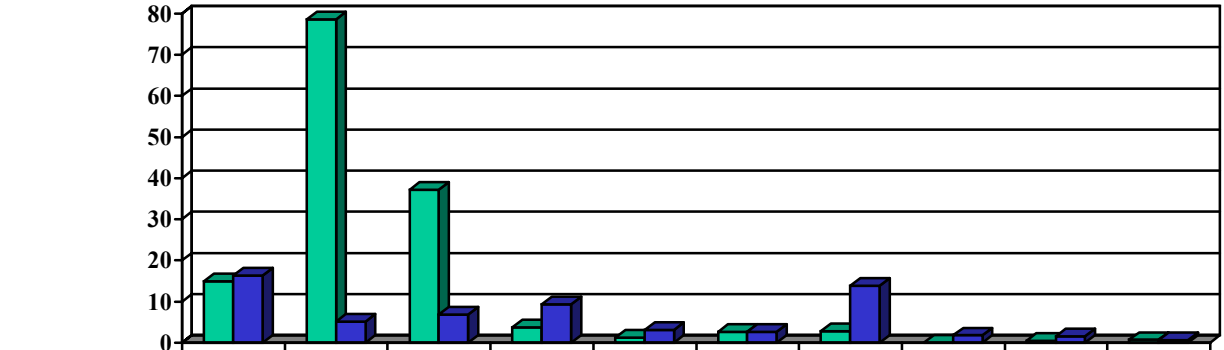


	2000	2002
No Smoking in My Home	77.2	76.8
Only Guests	1	6.6
Some, not in House	3.9	4.6
1-2 People	17.1	7.1
3-5 People	0.8	0.9
> 5 People	0	0
Missing Values		4

Q15. Main Sources of Heat Currently Used in Home.

The main source of heat used in the homes of the respondents of the 2002 survey was natural gas (79%). Hot water (37%), and electric (15%) were the next most checked sources. (see Figure 20).
* Numbers do not add to 100% because each source was checked “yes” “no.”

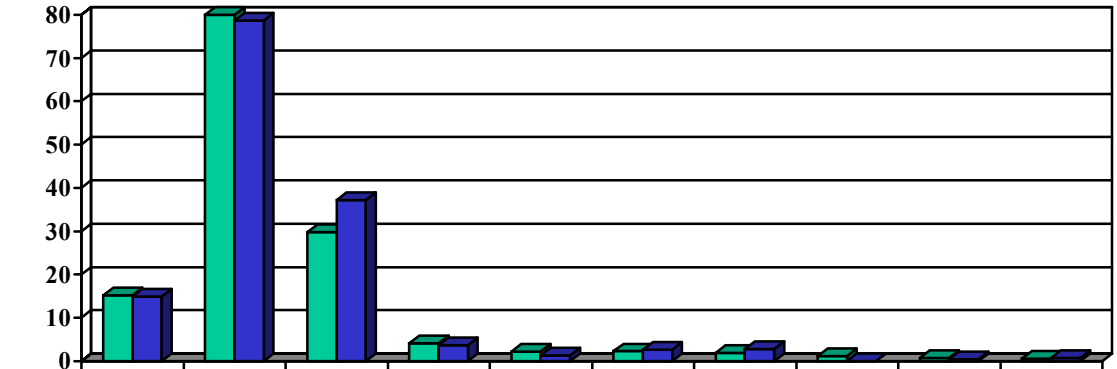
Figure 20: Main and Additional Sources of Heat



	Electric	Natural Gas	Hot Water Heater/Fu	Solar Passive	Solar Active	Propane	Wood	Coal	Other	Don't Know
Main Heat	14.9	78.6	37.2	3.7	1.3	2.7	2.8	0	0.5	0.7
Additional Heat	16.3	5.1	6.8	9.4	3.1	2.6	13.8	1.8	1.6	0.6

For previous years, 1995 and 1997, natural gas was the most common source of heat at 81% and 79% respectively. Hot water heat was not listed in 1995 as a choice and was only 4% in 1997. Electric heat was 15% in 1995 and 12% in 1997. Figure 21 shows very little change from 2001 to 2002 in the main household heating sources. Hot water decreased somewhat and wood and propane increased.

Figure 21: Comparison of Main Heating Sources: 2001, 2002

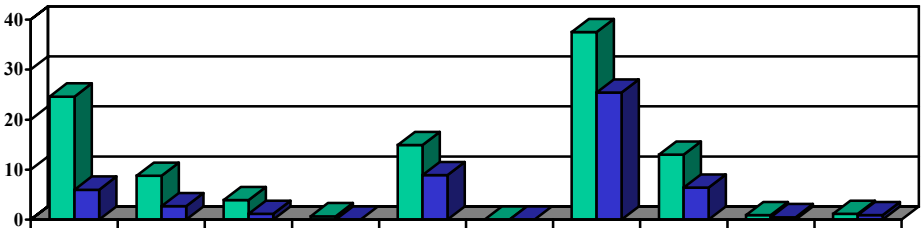


	Electric	Natural Gas	Hot Water Heater/Fu	Solar Passive	Solar Active	Propane	Wood	Coal	Other	Don't Know
2001	15.2	80	29.8	4.1	2.2	2.3	1.9	1.2	0.7	0.6
2002	14.9	78.6	37.2	3.7	1.3	2.7	2.8	0	0.5	0.7

Q16. Please Indicate if your Home has Each of the Following and if it is Certified?

Gas fireplaces are the top other source of "other sources of heat" for residents (38%) followed by wood burning fireplaces (25%) and electric fireplaces (15%). The percent of those who checked they are certified are calculated on the group of those who responded "Yes" to each. Gas fireplaces appear to be the most likely to be "certified." Any of the wood-burning sources were the least likely to be certified. (see Figure 22).

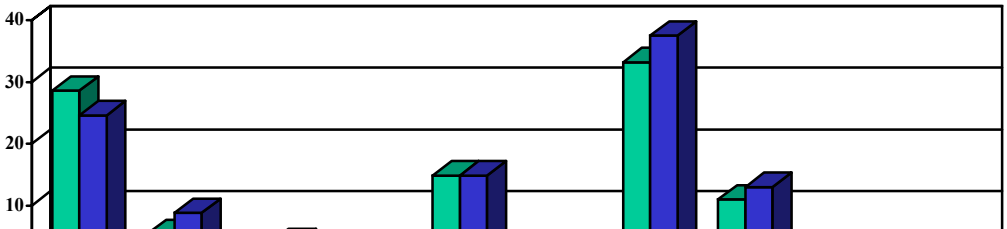
Figure 22. Percent of Homes With Other Sources of Heat and the Percent Certified



	WB Fireplace	WB Stove	WB Insert	Coal-Burning	Electric Fireplace	Masonry Heater	Gas Fireplace	Gas Stove	Pellet Stove	Other
Percent	24.6	8.8	3.9	0.7	14.9	0	37.5	13	0.9	1.2
Certified	6	2.7	1.2	0	8.9	0	25.4	6.4	0.5	0.9

Comparing results to the 2001 survey, the percent of Other Heat Sources were virtually unchanged. Small increases are seen in wood-burning stoves and inserts and a decrease in wood-burning fireplaces. Gas fireplaces and stoves are increasing.

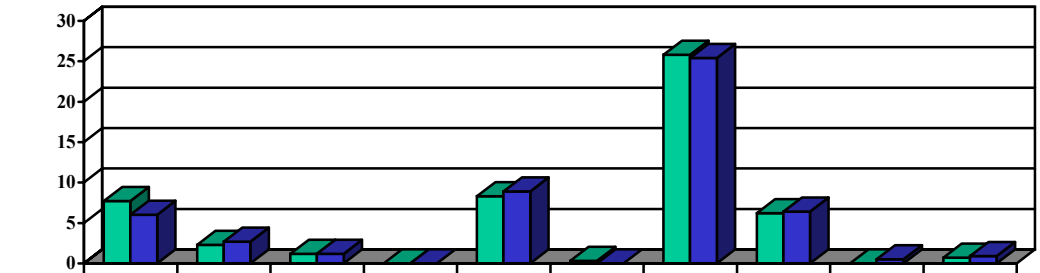
Figure 23. Comparison 2001, 2002, Percent of Homes with Other Sources of Heat



	WB Fireplace	WB Stove	WB Insert	Coal-Burning	Electric Fireplace	Masonry Heater	Gas Fireplace	Gas Stove	Pellet Stove	Other
2001	28.6	5.4	3	0.6	14.9	0.6	33.2	11	1.4	1.2
2002	24.6	8.8	3.9	0.7	14.9	0	37.5	13	0.9	1.2

Comparing the percent of those other sources of heat that were certified to the 2001 survey, again, no changes were found.

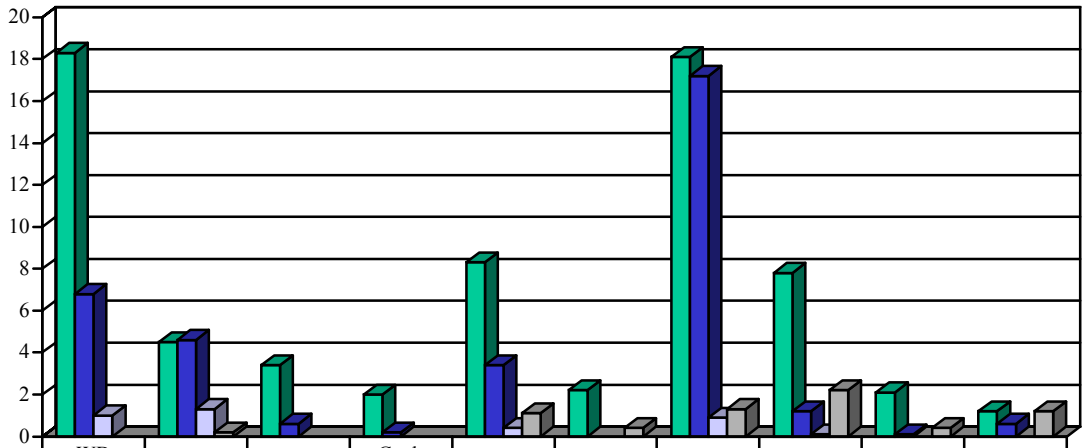
Figure 24. Comparison 2001, 2002, Percent of Other Sources of Heat That are Certified



	WB Fireplace	WB Stove	WB Insert	Coal-Burning	Electric Fireplace	Masonry Heater	Gas Fireplace	Gas Stove	Pellet Stove	Other
2001	7.7	2.3	1.2	0	8.3	0.3	25.8	6.2	0	0.7
2002	6	2.7	1.2	0	8.9	0	25.4	6.4	0.5	0.9

A new question for 2002, respondents were asked what percentage of heating each "other source of heat" provided and how often it was checked or cleaned.

Figure 25. Percentage of Heating for Other Heat Sources

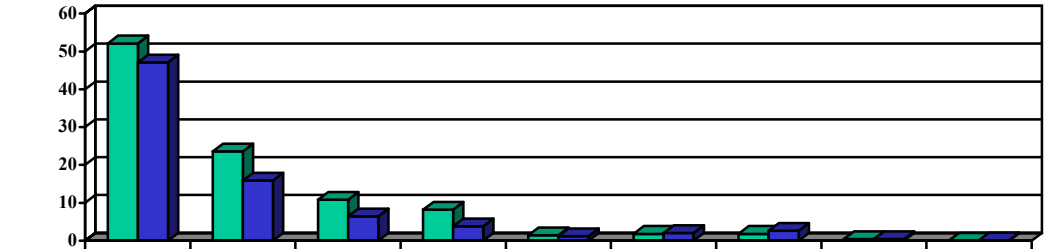


	WB Fireplace	WB Stove	WB Insert	Coal-Burning	Elect.	Masonry	Gas Frpl.	Gas Stove	Pellet	Other
none	18.3	4.5	3.4	2	8.3	2.2	18.1	7.8	2.1	1.2
<25%	6.8	4.6	0.6	0.2	3.4		17.2	1.2	0.1	0.6
25-50%	1	1.3			0.4		0.9	0.1		
>50%		0.2			1.1	0.4	1.3	2.2	0.4	1.2

Q17. If Resident Has a Wood-Burning Fireplace or Stove, How Often Was it Used Last Winter? (Figure 26)

Most respondents did not use their wood stove or fireplace at all last winter (23.6%). Only one respondent used one every day.

Figure 26: Days Per Month Wood Stove/Fireplace Used

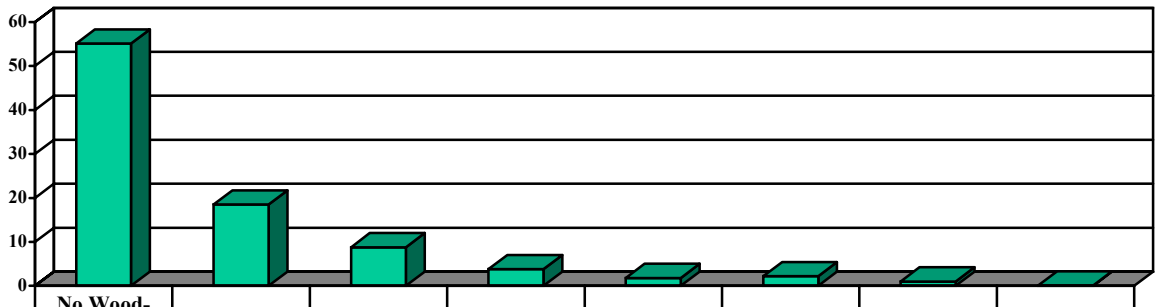


	No Wood-burning	Did not use	Once a Month	Every Couple	Once a Week	Twice a Week	3-4 X/Week	5-6 X/Week	Every Day
2001	52.1	23.6	10.8	8.2	1.4	1.8	1.8	0.4	0
2002	47.1	15.9	6.4	3.8	1.2	2	2.6	0.4	0.1

Q18. About How Much Wood Did You Burn This Past Winter in Your Fireplace of Heating Stove?

Most respondents (18.5%) did not use their wood stove or fireplace last winter. Only one used more than 3 cords and of those who did burn wood, the majority (8.8%) used under ¼ of a cord.

Figure 27: Amount Of Wood Burned in Fireplaces/Stoves Last Winter

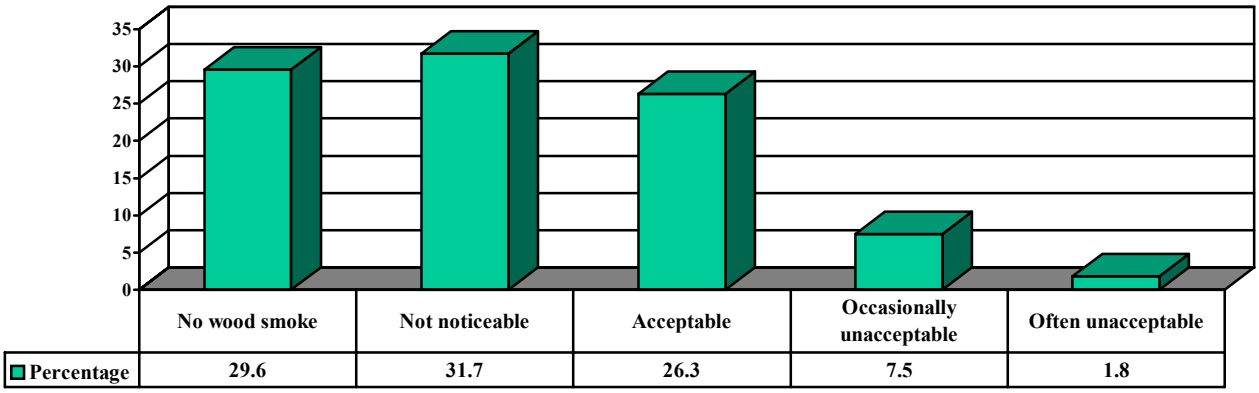


	No Wood-burning	Did not use	<1/4 Cord	1/4-1/2 Cord	1/2-1 Cord	1-2 Cords	2-3 Cords	>3 Cords
Percentage	55.1	18.5	8.8	3.8	1.8	2.2	1	0.1

Q19. To What Extent Are You Affected by Wood Smoke in Your Neighborhood?

Most respondents are not bothered by wood smoke in their neighborhood, either because there is no wood smoke (29.6%), or there is wood smoke but it is acceptable (55.9%). Only 9.3% of the respondents ever found the wood smoke in their neighborhood to be unacceptable.

Figure 28: Percentage of Respondents Affected by Wood Smoke in Their Neighborhood

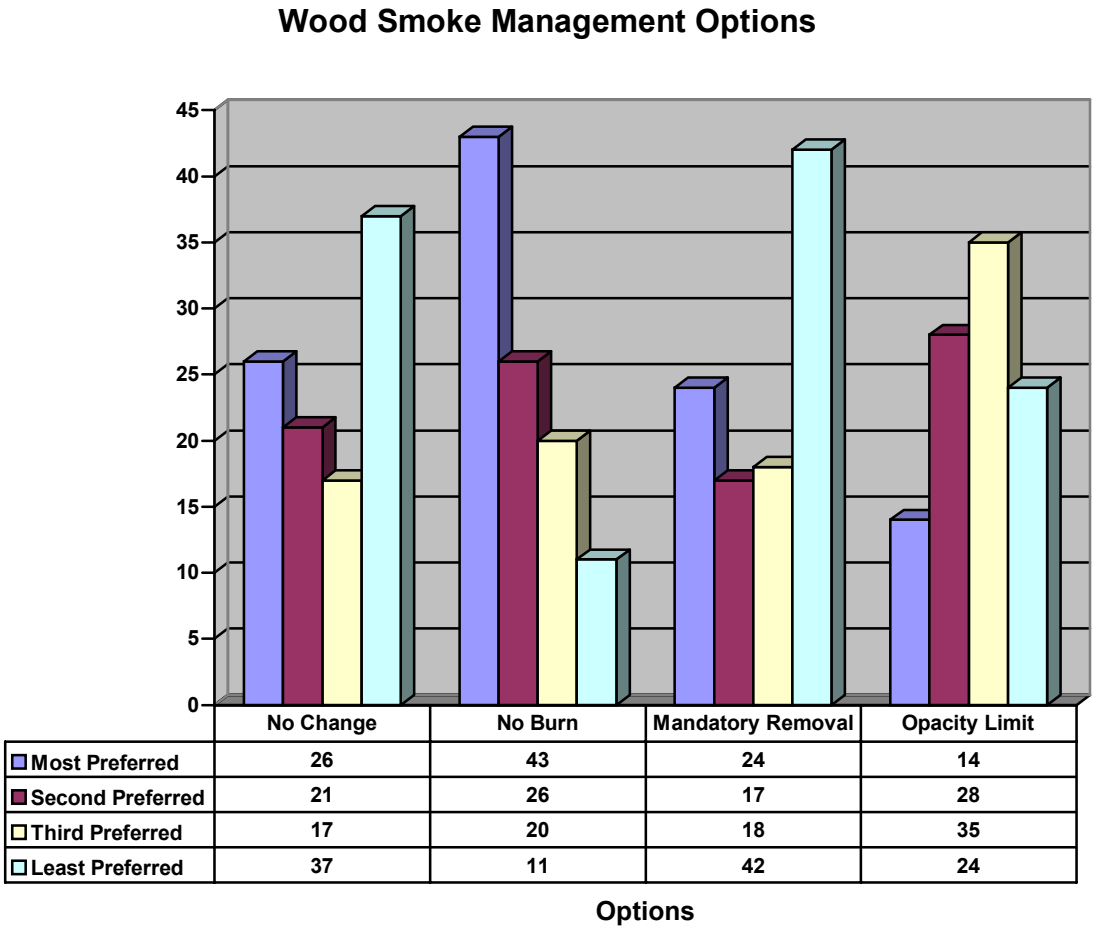


Cross-tabs were performed on the type of wood burning appliance used and the amount of wood burned last winter. In other words, is most of the wood burning occurring with fireplaces, stoves or inserts? From the crosstabulation we learn that the majority of the homes that have wood burning sources did not burn any wood last year, while the group of respondents with either an insert or a stove burnt more wood than did those with just a fireplace. The 9% in the Stove or Insert category had just an insert, and not a stove.

		Fireplace		Stove or Insert		Fireplace and Stove or Insert	
		# Responses to Q16					
# Responses to Q18		201		102		32	
		%	Number	%		%	Number
451	**No fireplace or stove**		0	9%	9	0	0
151	**None-did not use**	49%	99	35%	35	42%	13
72	**Less than ¼ cord**	30%	60	22%	22	35%	11
31	**¼ to ½ cord**	9%	17	15%	15	3%	1
15	**½ to 1 cord**	4%	8	6%	6	3%	1
18	**1 to 2 cords**	7%	13	7%	7	13%	4
8	**2 to 3 cords**	2%	4	5%	5	3%	1
1	**More than 3 cords**	0	0	1%	1	0	0

Wood Smoke Management Options Insert

An insert was included in the first survey mailing only that asked respondents to rank order a set of preferences for wood smoke management possibilities in the City of Fort Collins. Clearly, the wood smoke management option "most preferred" was the "Voluntary *No Burn* on high pollution days." The option chosen as "least preferred" was the "Mandatory removal or upgrade of Non-EPA-certified wood stoves or inserts (older than 1990)."



Means for each Option

No Change	No Burn	Mandatory Removal	Opacity Limit
2.65	1.99	2.77	2.69

Means validate that the option preferred most often was the "Voluntary *No Burn* on high pollution days" and the least preferred option, the "Mandatory removal or upgrade of Non-EPA-certified wood stoves or inserts (older than 1990)." All means were compared using a paired-samples T-test to examine for significant differences. No significant differences were found (>.01) comparing means of: No Change and Opacity Limit; No Change and Mandatory Removal; or, Mandatory Removal and Opacity Limit. Significant difference were found (<.01) when comparing means of: No Change and No Burn; No Burn and Mandatory Removal; or, No Burn and Limit Opacity.

Table 2. Paired Samples Test

Pairs	t	df	Sig. (2-tailed)
No Change From Present - Voluntary "No Burn"	9.438	476	.000
No Change From Present - Mandatory removal or upgrade of Non-certified woodstoves	-.926	476	.23
No Change From Present - Tighten residential chimney opacity limit from 40% to 20%	-.359	476	.63
Voluntary "No Burn" - Mandatory removal or upgrade of Non-certified woodstoves	-8.671	476	.000
Voluntary "No Burn" - Tighten residential chimney opacity limit from 40% to 20%	-9.614	476	.000

Mandatory removal or upgrade of Non-certified woodstoves - Tighten residential chimney opacity limit from 40% to 20%	.945	476	.29

• Objective 11: Evaluation of the survey by the residents.

Responses: 143

•**How long did the survey take you?**–Minimum time: 15 minutes
–Maximum time: 50 minutes
–Mode: 30 minutes
–Mean: 31 minutes

It is important to survey citizens' opinions of the air quality to help the city make planning decisions.

–Strongly Agree 26
–Agree 38
–Neutral 10
–Disagree 18
–Strongly Disagree 8

•**It is important to survey citizens' opinions to let the City know whether their education efforts to improve air quality are effective.**

–Strongly Agree 18
–Agree 41
–Neutral 26
–Disagree 10
–Strongly Disagree 5

Demographics

The following questions will address the demographics of the survey, or *who* responded to the survey.

Gender

The sex of the respondents (Figure 1D, Table 1D) remains essentially equal, with slightly more males responding to the surveys as females.

Figure 1D: Gender of Respondent

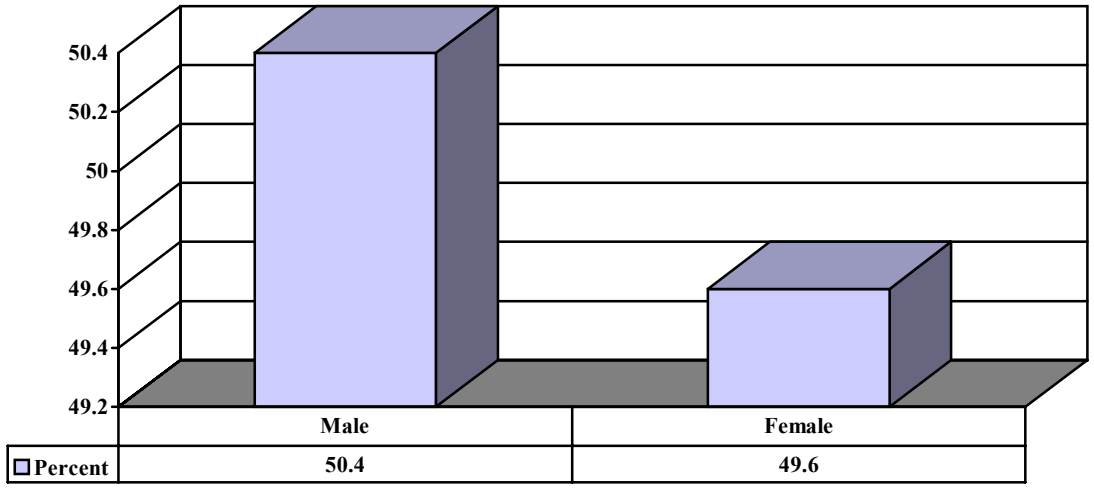


Table 1D: Gender Comparison Surveys 1994, 1995, 1997, 1999, 2001, 2002

Gender	1994	1995	1997	1999	2001	2002
Male	52.9	49	53	46	45.5	50.4
Female	47.1	51	47	54	54.5	49.6

Age of Respondent

As in previous years (Figure 2D, Table 2D), the majority of the respondents fell between 40 and 60 years of age.

Figure 2D: Age of Respondent

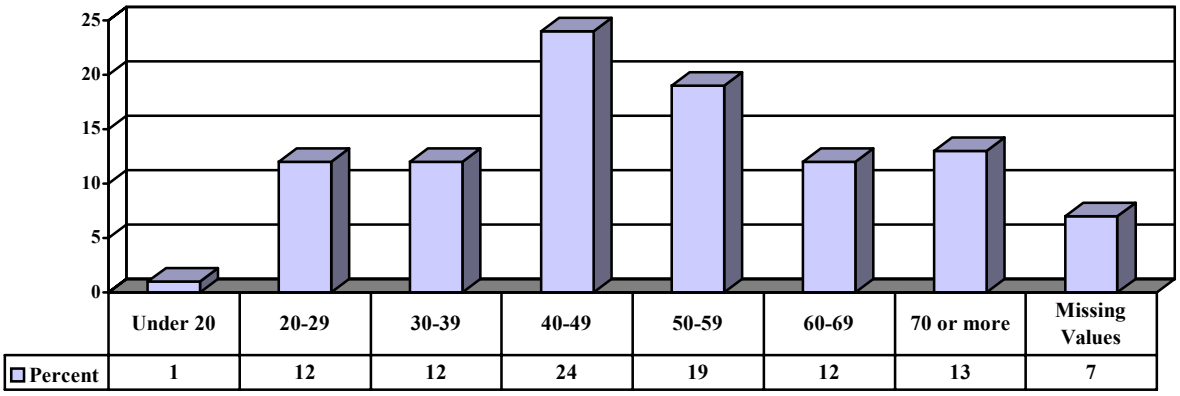


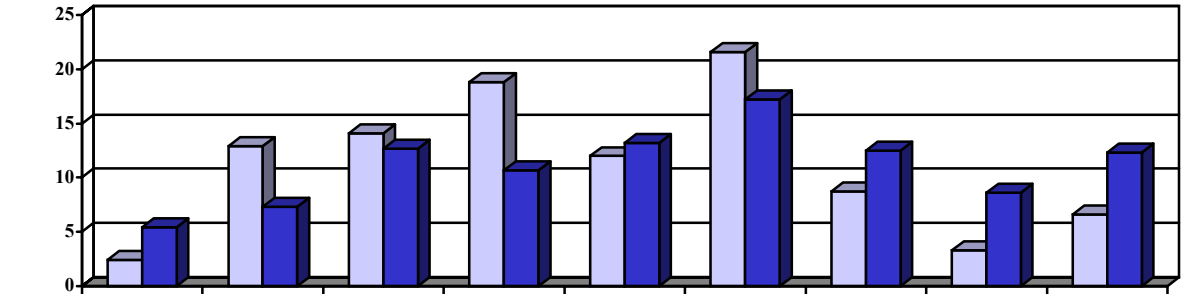
Table 2D: Age of Respondent Comparison, 1994, 1995, 1997, 1999, 2001, 2002

Age	1994	1995	1997	1999	2001	2002
Under 20	0	0	0	0	1	1
20-29	9.22	7	5	6	12.4	12
30-39	20.6	19	10	14	14.7	12
40-49	23.6	26	21	24	21.6	24
50-59	15.5	18	29	24	24.9	19
60-69	11.2	10	12	16	13.4	12
> 70	19.8	20	14	16	12.5	13

Ages of People in Household

The ages of people in the household show the largest group to be between 40 and 49 (see Figure 3D). The range of ages went from 4 months to 98 years. The mean age was between 30-39; the mode (most often occurring) is 40-49; and the average age is also 40-49.

Figure 3D: Ages of People in the Household

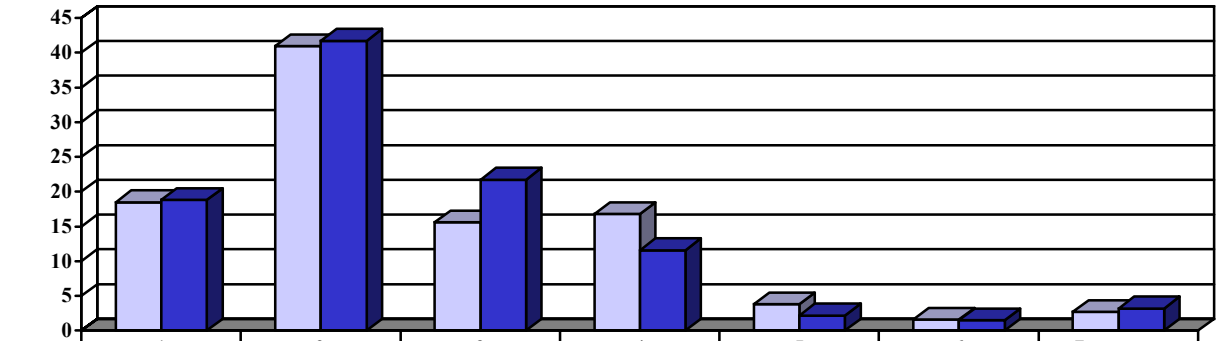


	Under 3	4-9	10-18	19-29	30-39	40-49	50-59	60-69	70 or more
2001	2.4	12.9	14.1	18.8	12	21.6	8.7	3.3	6.6
2002	5.4	7.3	12.7	10.7	13.2	17.2	12.5	8.6	12.3

Number of People in Household

The majority of the households responding to the survey were two-member households. Three and four-member households totaled 33.4%, 6.9% were five or more member households, and a fairly large 18.8% were one-member households.

Figure 4D: Number of People in the Household



	1	2	3	4	5	6	7 or more
2001	18.5	40.9	15.6	16.8	3.8	1.6	2.7
2002	18.8	41.7	21.7	11.6	2.2	1.5	3.2

Anyone in Household Pregnant?

Almost two times as many responding households reported that there was a pregnant person in their household as 2001. This number is very similar to the 1994 and 1995 surveys.

Figure 5D: Percent of Households with a Pregnant Member

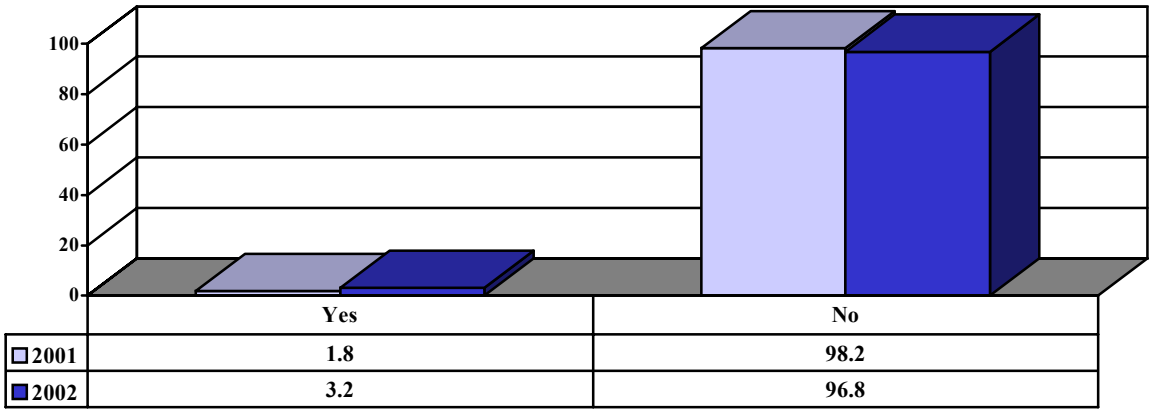


Table 3D: Anyone in Household Pregnant? Comparison: 1994, 1995, 1997, 2001, 2002

Is anyone in household currently pregnant?

Response	1994	1995	1997	2001	2002
Yes	2.4	3	2	1.8	3.2
No	97.6	97	98	98.2	96.8

Anyone in Household Suffer from Asthma, Emphysema, Heart Disease, or other Respiratory Ailments?

Of the households reporting, 31.8% stated that there was a member suffering from asthma, emphysema, heart disease, or other respiratory ailments (see Figure 6D). This number has been rising steadily since the first record in 1994 (see Table 3D).

Figure 7D shows the percent of respondents that answered "yes" to the above question, that believe the outdoor air quality negatively affects their symptoms or their health. More people (58.8%) believed that the outdoor air negatively impacted their respiratory problems than did not believe it was affecting their symptoms (41.5%).

Figure 6D: Percent of Households With Member With Asthma, Respiratory Problems

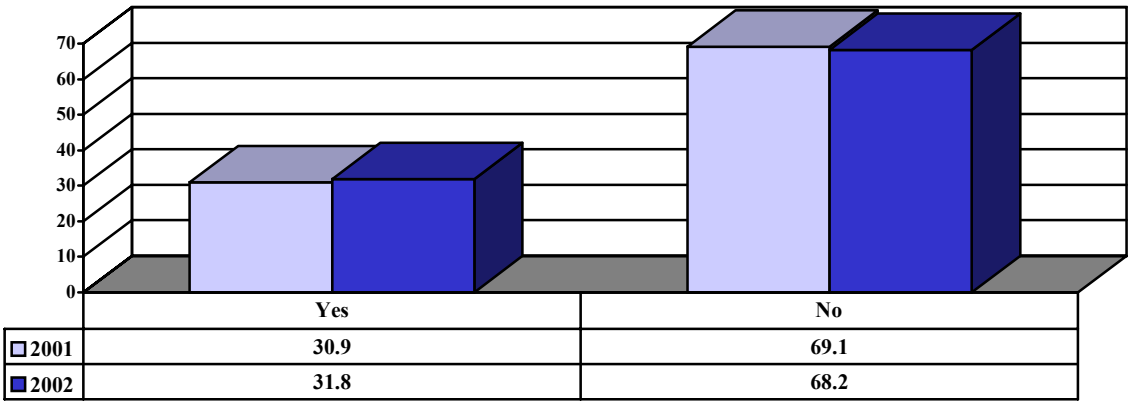
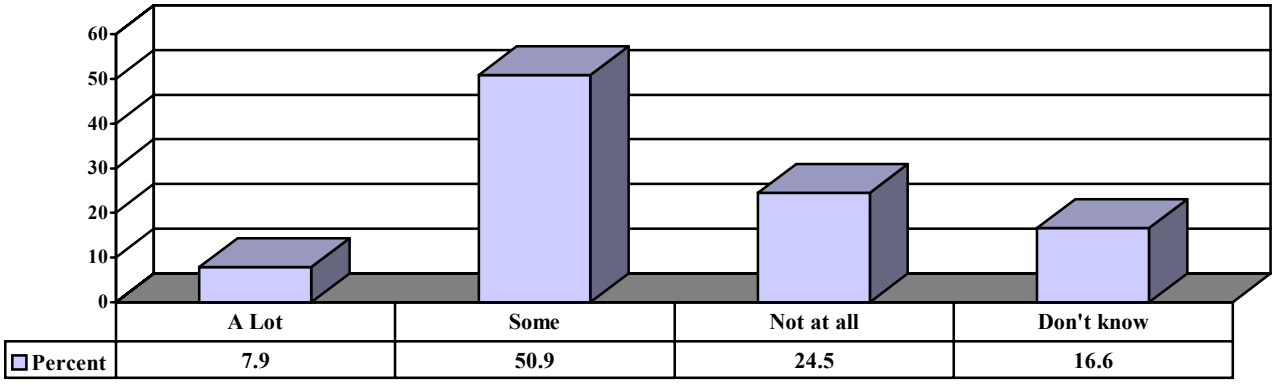


Table 4D: Percent of Households With Asthma, Emphysema, Heart Disease, or Other Respiratory Disease, Comparison: 1994, 1995, 1997, 2001, 2002

Response	1994	1995	1997	2001	2002
Yes	20.5	23	26	30.9	31.8
No	79.5	77	74	69.1	68.2

Figure 7D: Percent of Respondents that Answered "Yes" to Asthma, Emphysema, Heart Disease or Other Respiratory Ailments That Believe Outdoor Air Quality Negatively Affects Their Health



How Many Years in Fort Collins?

The 2002 survey showed a decrease in the number of respondents having lived in Fort Collins for less than five years (Figure 8D and Table 5D). The category of respondents that have lived here more than 20 years is increasing and the other categories are decreasing.

Figure 8D: Years Lived in Fort Collins

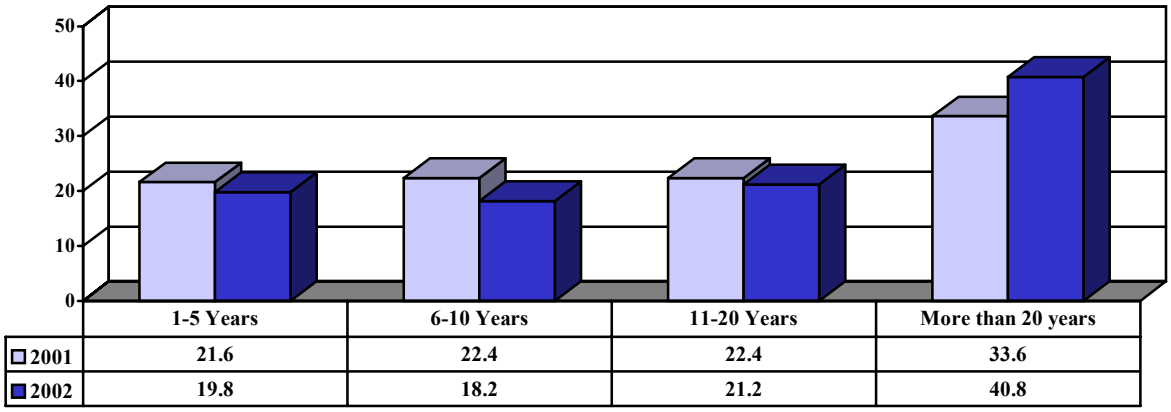


Table 5D: Years Lived in Fort Collins, Comparison: 1997, 1999, 2001, 2002

Years	1997 (%)	1999 (%)	2001 (%)	2002 (%)
0-5	17	33	22	19.8
6-10	16	17	22	18.2
11-20	27	20	22	21.2
More Than 20	39	29	34	40.8

Education Level

Figure 8D shows that most of the respondents in the survey have at least some college and a very large percentage have a graduate degree (27.1%). A closer look at Table 6D shows that very few changes from the 1997 survey to the 2002 survey can be seen in the education level of the respondents. According to the 1990 *Trends*, a report available for the City of Fort Collins, 43% of the residents have a Bachelor's degree or higher. This survey found 60% to have a Bachelor's degree or higher in the sample of respondents. Even though this number is much higher in this survey, the *Trends* data is over 10 years old.

Figure 8D: Education Level of Respondent

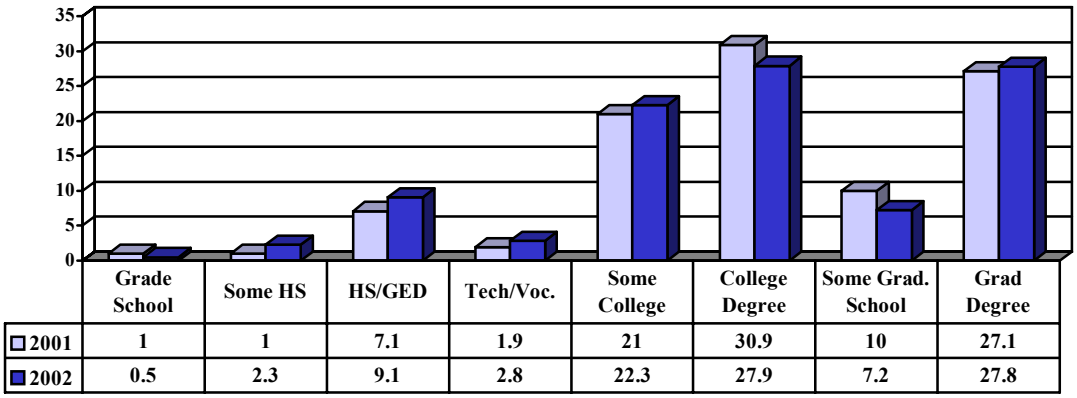


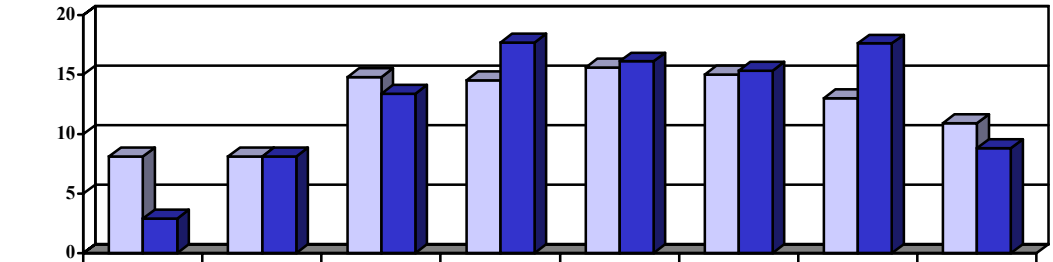
Table 6D. Respondent's Education Level, Comparison: 1994, 1995, 1997, 2001, 2002

Education Level	1994	1995	1997	2001	2002
Grade school		*	0	1	.5
Some high school	1.9	5	1	1	2.3
High school diploma/GED	34.34	5	10	7.1	9.1
Technical/vocational school	*	*	3	1.9	2.8
Some college	*	23	23	21	22.3
College degree	37.58	27	30	30.9	27.9
Some graduate degree	*	*	9	10	7.2
Graduate degree	26.16	32	23	27.1	27.8

Yearly Family Income

Figure 9D shows that a very even number of respondents reported earnings at several of the categories: $25,000-$39,999 (13.4%), $40,000-$59,999 (17.7%), $60,000-$74,999 (16.1%), and $75,000-$99,999 (15.3%). Comparing to *Trends* data from 1990, whereas the median family income was reported at $27,000, this survey's median family income was in the $40,000-$59,000 range (17.7%). Again, the *Trends* data is over 10 years old and caution must be made in comparing the two.

Figure 9D: Yearly Family Income



	< $15,000	$15,000-$24,999	$25,000-$39,999	$40,000-$59,999	$60,000-$74,999	$75,000-$99,999	$100,000 or More	Unanswered
2001	8.1	8.1	14.8	14.5	15.6	15	13	10.9
2002	2.9	8.1	13.4	17.7	16.1	15.3	17.6	8.8

Employment Situation

As in 1997, 1999, and 2001, most respondents were employed outside the home (47%), with an increasing number of self-employed (12%) and a growing group of retired respondents (28%). See Figure 10D and Table 7D.

Figure 10D: Employment Status

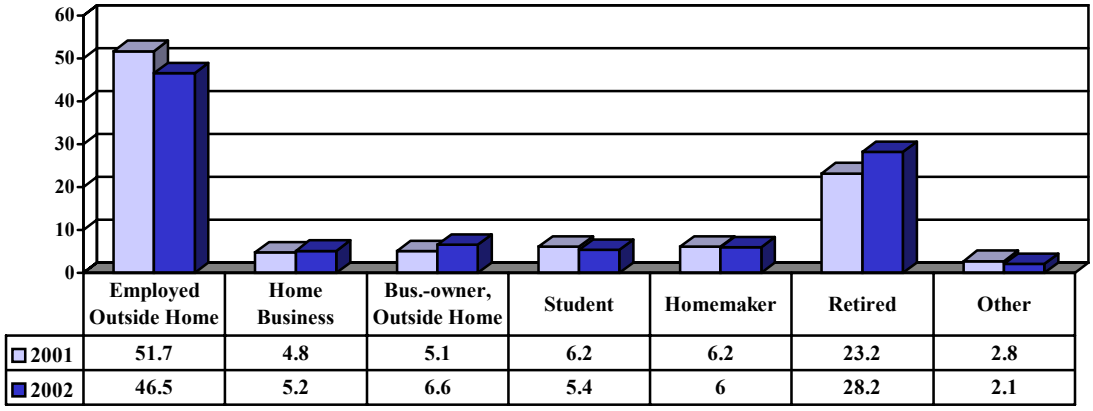


Table 7D: Employment Situation Comparison: 1997, 1999, 2001, 2002

Employment Situation	1997 (%)	1999 (%)	2001 (%)	2002 (%)
Employed Outside Home	57	53	52	47
Home Business	10	10	5	5
Business Owner-Outside Home	*	*	5	7
Student	4	9	6	5
Homemaker	5	4	6	6
Retired	24	21	23	28
Other	1	3	3	2

Home Ownership

Figure 15D shows that home-owners are the majority of the respondents of the 2002 survey (81.2%). The number of respondents that rented is considerably less in this survey. The trend of more home owners, more college graduates, and higher incomes are an indication of the reliability of the measures in that if one does go up, so too would the others be expected to increase. Home ownership appears to be slowly on the rise for respondents from 1994 through 2002 (see Table 11D and Table 8D).

Figure 11D: Home Ownership

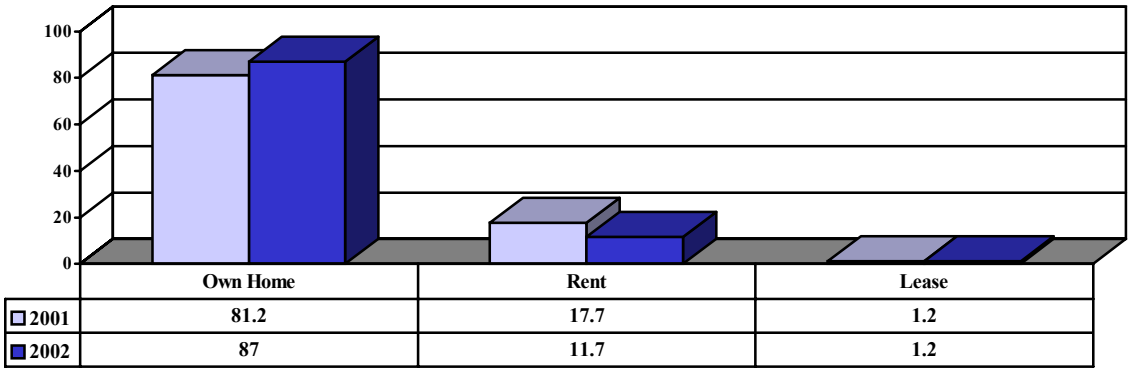


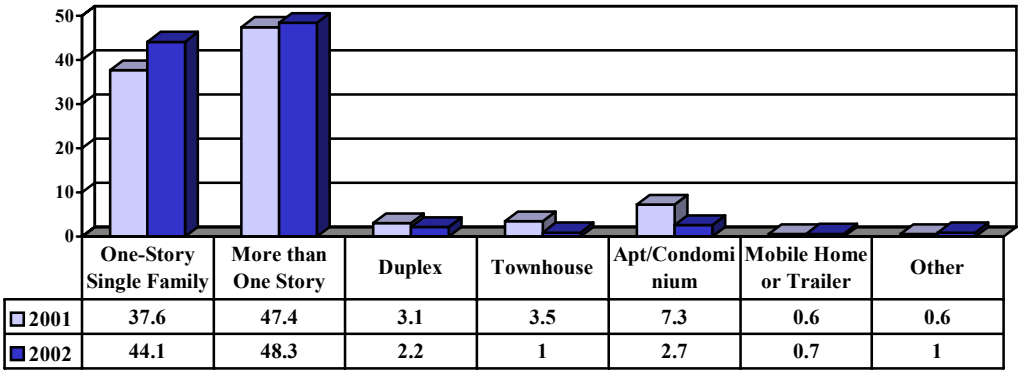
Table 8D. Home Ownership Comparison: 1994, 1995, 1997, 2001

Response	1994	1995	1997	2001	2002
Own	75.9	79	80	81.2	87
Rent	24.1	20	19	17.7	11.7
Lease	0	0	1	1.2	1.2

Home Type

Most of the respondents (48.3%) live in a home that is more than one-story, followed closely by single story (44.1%) homes which appears to be on the increase (See Figure 12D). Respondents living in apartments or condominiums is decreasing steadily (See Table 9D).

Figure 12D: Home Type



	One-Story Single Family	More than One Story	Duplex	Townhouse	Apt/Condominium	Mobile Home or Trailer	Other
2001	37.6	47.4	3.1	3.5	7.3	0.6	0.6
2002	44.1	48.3	2.2	1	2.7	0.7	1

Table 9D. Home Type Comparison: 1994, 1995, 1997, 2001, 2002

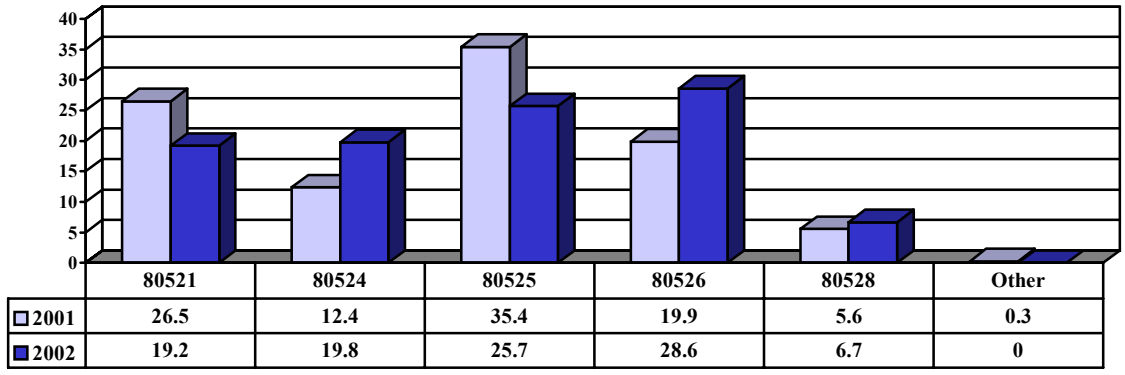
Which of the following best describes your home?

Home Type	1994	1995	1997	2001	2002
One-story single-family	34	34	33	37.6	44.1
More than one story single-family	36.9	39	44	47.4	48.3
Duplex	3.9	4	4	3.1	2.2
Townhouse	4.0	3	3	3.5	1
Apartment or condominium	16.6	12	10	7.3	2.7
Mobile home or trailer	4.5	6	4	0.6	0.7

1

Zip Code

Figure 13D: Zip Code of Respondents



	80521	80524	80525	80526	80528	Other
2001	26.5	12.4	35.4	19.9	5.6	0.3
2002	19.2	19.8	25.7	28.6	6.7	0

What is the zip code of your current residence?

Zip Code	1994	1995	1997	2001	2002
80521	21	25	20	26.5	19.2
80524	13	25	18	12.4	19.8
80525	38	25	31	35.4	25.7
80526	28	25	28	19.9	28.6
80528	0	0	0	5.6	6.7
Other	0	0	3	0.3	0