

COLORADO DIESEL EXHAUST EMISSIONS STUDY



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Colorado Air Pollution Control Division
Colorado Department of Public Health & Environment

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PART I – EXECUTIVE SUMMARY

A. Purpose of Study

The Colorado Diesel Emissions Study was undertaken to get a better understanding of the relative contributions of diesel exhaust from the on-road and the non-road sectors. Questions have been raised regarding methods used to estimate off-road diesel exhaust emissions, especially in the area of construction diesel vehicles.

The Air Pollution Control Division of the Colorado Department of Public Health & Environment hypothesized that current methods resulted in an overestimation of off-road diesel exhaust, largely due to assumptions that closely correlated construction industry dollars to diesel vehicle activity.

Because diesel exhaust contains numerous toxic compounds, exposures to it are of concern to health and environmental officials. Additional regulation of diesel exhaust sources is being contemplated at the national and state and local levels. To that end, the Colorado Department of Health & Environment has assessed in detail both on-road and non-road sources of diesel exhaust in the state.

Measured air toxics concentrations in the State are above health benchmark levels in several counties. Diesel exhaust is a likely contributor to several of the toxics measured, and improved source apportionment is desired. Air monitoring equipment typically measures toxics at twice the levels predicted by models, such as MOBILE6, MOBTOX, ASCIII. While it's true that monitors are sited where one would expect to see relatively high ambient levels of air pollutants, e.g. at busy roadway intersections, it appears that there may be problems with the pollutant dispersion and decay aspects of the models. It is hoped that the information in this report will assist in model improvements.

Sulfur content plays a significant role in particulate emissions—many of which are toxic carbonaceous materials, such as polycyclic aromatic hydrocarbons. In addition, sulfur interferes with the functioning of catalytic converters, which are designed to reduce air toxics emissions. For these reasons information regarding fuel sulfur levels is emphasized in several areas of this report.

B. Summary of Study Results

Overall study results indicate that:

- (1) On-road trucks and buses use more than twice as much diesel fuel as does off-road diesel equipment.
- (2) Colorado off-road diesel fuels typically contain significantly less sulfur than assumed by the EPA in its NONROAD model.
- (3) Construction expenditures in Colorado are less an indicator of diesel equipment usage than assumed by currently accepted models.

C. Summary of Recommendations

Preliminary recommendations:

1. To further solidify this study's conclusions,
 - a. Obtain construction industry information from F.W. Dodge
 - b. Conduct survey of landfill and mining activity data
 - c. Obtain additional information regarding ski area diesel vehicle activity
2. For a final report, develop a formalized state-specific diesel exhaust emission model that incorporates Colorado Diesel Exhaust Emissions Study findings.

PART II – BACKGROUND

CHAPTER 1: INTRODUCTION

Concerns regarding exposures to diesel exhaust emissions have prompted many studies in animals and humans. Study results largely indicate that exposures are related to higher incidences of lung cancer and that diesel exhaust emissions are likely to exacerbate other diseases, including asthma and cardio-pulmonary effects. In 2001 the EPA officially identified the combination of diesel particulate matter and diesel exhaust organic gases as a mobile source hazardous air pollutant (Mobile Source Air Toxics Rule 66 FR 17230).

The Air Pollution Control Division of the Colorado Department of Public Health & Environment recognizes that large numbers of people are exposed to vehicle exhaust on roadways. Roadways appear to be a more significant avenue of exposure to diesel emissions for large populations than off-road vehicles, regardless of the relative contributions of diesel exhaust from the off-road and on-road sectors.

The Division hypothesized that existing methods for estimating construction industry activity and diesel exhaust emissions over-estimate totals. Given the ubiquity of on-road trucks and buses and the much smaller population of off-road diesel equipment, the Division questioned estimates indicating that the off-road sectors contribute 2-5 times more diesel exhaust emissions than on-road sources.

There was also the concern that the on-road sector might be underemphasized as a source category. Because these inventories have eventual regulatory implications, the Division sought to verify their integrity and to improve them if appropriate.

Most significantly, the Division questioned accepted methods that assume a strong corollary between the amount of construction dollars spent and diesel equipment activity.

A. Terminology

For the diesel vehicle/diesel equipment category the term **“nonroad”** is used interchangeably with **“off-road”** to indicate vehicles that are operated for the most part off highways and streets. They are typically not registered for street or highway operation, though they are often ‘vehicles.’

The equipment varies widely as far as horsepower, load factors, and therefore emissions. The category includes such equipment as backhoes, excavators, graders, and other earth-moving equipment, watering trucks, forklifts, farm tractors and aircraft service vehicles. Also included are snow cats, which groom ski at resorts; certain large mowers and landscaping equipment; construction cranes and drilling equipment.

While EPA categorizes the following in its off-road category for the purposes of the Urban Air Toxics Strategy,

- Diesel Locomotives are not factored into the EPA NONROAD *Model*. The EPA estimates locomotive diesel exhaust emissions separately for the National Emissions Inventories and the National Air Toxics Assessments. For this report the APCD calculates Colorado off-road diesel fuel usage and emissions two ways—both with and without diesel locomotive emissions. (See Part III – Study Findings)
- Aircraft emissions are estimated by the Federal Aviation Administration, and are included in the NEI and NATAs. Landing and takeoff emissions information for Colorado is not discussed in this initial Colorado Diesel Exhaust Emissions report (June 2003). However, discussion of these emissions should be included in a subsequent report.

Terminology applied to construction diesel equipment can be confusing. The APCD uses the most common descriptors in its surveys, acknowledging minor differences in terms, such as ‘backhoe,’ ‘excavator,’ ‘crawler,’ etc.

Off-road diesel fuel: Sometimes dyed red to indicate it should be used off-road only. Has a legal cap of 5,000 ppm Sulfur (0.5%). However, recent diesel fuel sampling indicates that in the Denver Metro area, “high-sulfur” diesel fuel ranges from 279 ppm sulfur to 3,812 ppm sulfur, with most samples (31 out of 37 to date) below a tenth of the allowed sulfur level.

On-road low-sulfur diesel fuel: Has a legal cap of 500 ppm Sulfur (0.05%). Sampling to date (50 samples March 2003) indicates that in the Denver Metro area, the arithmetic mean average sulfur level is 380 ppm.

No.1 Diesel fuel (can be high- or low sulfur): A lighter, lower density fuel with lower flash point (100 degrees, F.) for winter use and a lower temperature cloud (gelling) point, i.e., it won’t gel unless temperature gets to – degrees, F.

No. 2 Diesel fuel (can be high- or low-sulfur): A somewhat heavier, fuel with a higher (125 degrees, F.) flash point for warmer weather use.

D-8 indicates Diesel Class 8 trucks, that are most commonly registered to operate on-road. These include most dump trucks, snow plows, equipment haulers, tankers, etc.

D-8’s, Mack trucks (Mack is a truck manufacturer and **semis** can all exist within the same engine class and are commonly certified as on-road emissions sources.

Semi is a generic reference to an on-road tractor that pulls a cargo trailer.

B. Health Effects Associated With Diesel Exhaust Emissions

Diesel fuel combustion from current off-road and on-road compression ignition engines produces sulfur oxides, which adsorbs to water to form hydrated sulfuric acid, which condenses and is released to the air as particulate matter that contains thousands of components, many of them carcinogenic and otherwise toxic.

Oxides of nitrogen, are also formed in diesel combustion. Nitrogen dioxide (NO₂), is highly toxic to various animals as well as to humans. High levels may be fatal, while lower levels affect the delicate structure of lung tissue. Humans exposed to high concentrations suffer lung irritation and potentially lung damage. Increased respiratory disease has been associated with lower level exposures.

NO_x emissions from heavy duty diesel vehicles were about the same in 1999 as they were in the 1970's.¹

Exposure to diesel engine exhaust and other combustion sources has been associated with adverse health effects for decades. Numerous studies have linked diesel engine exhaust to cancer and other diseases. Animal studies indicate bacterial mutagenicity, and in rats general toxicity, cytotoxic, inflammatory and lung function changes, oxidative stress, and macrophage functional changes.²

A meta analysis of 23 carefully controlled diesel exhaust human exposure studies indicated that regular, long-term exposure to diesel exhaust increases lung cancer risk by an estimated average of 33 %. Only two very small studies indicated otherwise. The meta study reviewers concluded that “although the risk estimates are small, they are consistently above one (1.0) and are, in aggregate, unlikely to be due to chance.”³

C. Current Methods Used to Estimate Diesel Exhaust Emissions from On-Road and Off-Road Sources

Various methods for calculating diesel exhaust emissions have been employed by state and federal agencies. States have traditionally looked at nonroad diesel sources as “area sources” for State Implementation Plan purposes. On-road sources of diesel exhaust have been estimated by states and federal agencies based on Federal Highway Administration traffic counts and/or local transportation data from metropolitan planning organizations.

For the 1996 National Air Toxics Assessment (released in 2000), diesel particulate matter (DPM) emissions were derived separately from overall mobile source toxics emissions. Assumptions were based mainly on inventories developed as part of the Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements. Off-road diesel emission estimates were then allocated to areas based in part upon the amount of construction dollars spent. This assumes a close correlation of construction dollars to diesel equipment activity.⁴

Below is the EPA equation used to estimate emissions from nonroad diesel sources:

$$\text{Emissions} = (\text{Pop}) (\text{Power}) (\text{LF}) (\text{A}) (\text{EF})$$

where

| | | |
|--------------|---|--|
| <i>Pop</i> | = | <i>Engine Population</i> |
| <i>Power</i> | = | <i>Average horsepower</i> |
| <i>LF</i> | = | <i>Load Factor (fraction of available power)</i> |
| <i>A</i> | = | <i>Activity (hours/year)</i> |
| <i>EF</i> | = | <i>Emission Factor (grams/hp-hour)</i> |

Emissions are then geographically allocated using the following calculation:

$$(\text{County population})_I / (\text{National Population})_I = (\text{County Indicator})_I / (\text{National Indicator})_I$$

where

I is an equipment application, such as construction or agriculture.

For its portion of the National Emissions Inventory and National Air Toxics Assessments, the Air Division produces off-road emission estimates based on EPA’s NONROAD Model. On-road emissions estimates are produced from MOBILE Model for several Front Range attainment/maintenance areas, and from FHWA traffic counts for all other areas statewide.

For its 1999 National Emissions Inventory the EPA is using a somewhat revised model and new speciation methods to develop diesel exhaust HAP and particulate matter emission estimates. New methods for modeling ambient levels of diesel exhaust HAP and PM are also being developed.⁵ A fully revised EPA NONROAD model is in development and scheduled to be released in 2006.

D. APCD Estimates of Comparative Emission Levels of Diesel Vehicles

For a general idea regarding average emission levels from various types/ages of diesel vehicles Mobile Sources Program staff at the Air Pollution Control Division estimated the following:

- 1) A 10 year old forklift with a 50 HP engine- emissions will be = 1 (arbitrary unit)
- 2) A model year 2000 truck with a 250 HP engine emissions = 10 (same units)
- 3) A model year 2000 truck with a 400 HP engine (18-wheeler OTR tractor) = 10
- 4) A 30 year old truck with a 250 HP engine (this was an 18-wheeler then) = 100
- 5) A 30 year old truck with a 175 HP engine (this was a mid-size then) = 200
- 6) A new locomotive at 3000Hp (mid size) using 300ppm Sulfur fuel = 500
- 7) A 30 year old locomotive at 3000 Hp and 10,000 ppm S fuel = 2000+

Assumptions:

The above values are approximations based on the following:

Emissions values are composites of PM, VOC, and NO_x in arbitrary relative units

All engines/vehicles are in reasonable mechanical condition and are being operated within their design parameters. Engines are equipped as-built and not tampered with or up-rated. All are operating on their designated fuel (maximum sulfur - off highway -5000 ppm S; on highway 300 ppm S; railroad as noted).

The 175 HP engine is more likely engaged in stop and go pickup and delivery operations, while the 250 HP truck operates on highway at a more constant load/speed. The technology of these engines is essentially the same (probably no controls), and the level of maintenance on the in-town pick-up and delivery application is probably poorer. So the poorly maintained stop and go medium truck emits twice as much than the slightly better maintained over the road truck. ⁶

CHAPTER 2: STUDY DESIGN

A major goal of the study is to verify findings by gathering information from various organizations and comparing these to staff observations. We sought to determine whether intuitive information were reconcilable with data, and whether one set of data corroborated another, e.g., comparing fuel sales with on-road vehicle miles traveled; and comparing residential construction survey data with construction permit information.

The Colorado Diesel Emissions Study was conducted in two phases. In Phase I currently accepted methods of estimating diesel emissions from off-road (a.k.a. “nonroad”) vehicles were reviewed; Colorado diesel fuel usage statistics were obtained from the State’s Department of Revenue, and a research plan was developed to fill the many gaps in our knowledge about nonroad diesel equipment activity in the state.

In Phase II the Division gathered data and evaluated off-road and on-road diesel activity using information from:

- Federal Highway Administration and APCD on-road diesel traffic counts and projections
- Colorado Department of Revenue diesel fuel sales tax data
- Sampling of diesel refueling tanks (to continue through Summer 2003)
- Diesel equipment and fuel usage information gathered via surveys to
 - ski resorts
 - municipal fleets
 - park and recreation districts
 - construction and excavation contractors
 - the largest (gold and silver) mining operation in the State.

Information was also gathered via:

- Drive-by surveys looking for road construction, other construction sites, and agricultural operations in various areas of the State
- Construction permit data from 64 counties for 1997-2002.

PM-10 air quality permit data for large construction projects (>6 months or >25 acres)

- Interviewing industry experts regarding oil and gas well development (including road building for this category)
- Reviewing other studies for assumptions regarding diesel equipment activity at landfills (TNRCC/Pollack, 1999).

The plan was a flexible one designed to take advantage of incidental but potentially significant observations made during survey work. Thus, survey questionnaires were sometimes revised, with queries added or refined. (Survey questionnaires are appended--)

The varying degrees of responsiveness to survey questions is noted. For a future report, response information should be averaged and scaled up to total equipment populations provided by F.W. Dodge data.

PART III -- STUDY FINDINGS

Information from surveys and other research is presented in this section for the following categories:

- Diesel Fuel Sales and Fuel Sulfur Levels (Denver Metro Area)
- Diesel Vehicle Miles Traveled (Denver Metro Area)
- Construction and Excavation (Denver Metro Area)
- Ski Industry (Mountains)
- Municipal Fleets (mainly Denver Metro Area)
- Landfills—Municipal Solid Waste Facilities (Statewide)
- Oil and Gas Well Development (Statewide).

Information regarding the following categories will be provided in a final report.

- Mining (Statewide)
- Aircraft service equipment (Denver International Airport)
- Commercial
- Information from completed Diesel Fuel Sulfur Sampling Study

A. Colorado Diesel Fuel Sales and Sulfur Levels

Colorado diesel fuel sales records are maintained by the Colorado Department of Revenue. Records are separated into the highway (on-road) and off-road categories. (Off-road diesel fuel is not subject to road taxes, thus users are reimbursed for any tax such tax paid at time of purchase.) Table 1 indicates Colorado on-road and off-road fuel sales for 2001 and 2002. (Diesel fuel sales records do not include locomotive diesel fuel, which is often purchased outside of the State.)

Table 1

| Year | Highway diesel fuel (gallons) | Off-road diesel fuel (gallons), |
|------|-------------------------------|---------------------------------|
| 2001 | 590 million | 193 million |
| 2002 | 576 million | 179 million |

Compiled from Colorado Department of Revenue data 2003

The EPA NONROAD Model does not calculate locomotive diesel or aircraft emissions. However, since diesel fuel is used in locomotives, and since locomotives run through metropolitan and rural areas, Table 2 shows EPA estimates of diesel fuel used by locomotives traversing Colorado for the years 1990 and 1999.

Table 2

| Year | Locomotive diesel fuel (gallons) |
|------|----------------------------------|
| 1990 | 75 million |
| 1999 | 68 million |

USEPA 1999 National Emissions Inventory

**For an estimate of total off-road diesel fuel gallons purchased in Colorado, we can add (1999) locomotive diesel fuel gallons to (2002) off-road diesel fuel gallons:
68 million gallons + 179 million gallons = 247 million gallons.**

If on-road (highway) diesel fuel purchased is assumed to be 576 million gallons, as indicated for year 2002 above, on-road diesel fuel purchased is 2.33 times that of off-road diesel fuel (576 million gallons/247 million gallons = 2.33).

Altogether, estimated fuel purchased for off- and on-road use = (247 million gallons + 576 million gallons = 823 million gallons). The off-road proportion is roughly 30 percent of the total.

B. Diesel Fuel Sampling Study

The Air Division's Mobile Sources Program is conducting an on-road / off-road diesel fuel sulfur sampling & analysis survey through June 2003. The goal is to determine the sulfur content of on-road and non-road diesel fuels in the Denver area. General fuel composition is also being characterized.

Sulfur in fuels contributes to emissions of particulates and oxides of sulfur. Sulfur oxides are lung irritants, and the chemicals readily mix with moisture in the air, then oxygen to form sulfuric acid—a major constituent of acid rain. In addition, sulfur in fuel disrupts the function of catalytic converters, which are designed to burn fuels more fully, thus reducing emissions of particulates.

A list of diesel fuel tanks was obtained from underground storage tank permit files maintained by the Division's Stationary Sources Program. Staff members sample diesel fuel in bulk terminals, retail outlets, fleet operations, and contractor and industrial fuel tanks. Representative sampling is being conducted, with a goal of collecting 150 samples by mid-2003. Approximately half of the fuel samples will be non-road samples and half will be on-road.

The goals of the sampling survey are to:

- Determine average fuel sulfur content for on-road and non-road diesel fuels.
- Determine other fuel characteristics, such as cetane, cloud point, distillation curve, and API gravity.

The sampling study is a cooperative effort with the Oil Inspector's Office. Cooperation from industry, especially from fuel providers, private and public fleets, contractors, businesses, and others has meant few restraints in obtaining the necessary fuel samples. Railroad diesel fuel tanks were not sampled.

As of March 2003, 93 diesel samples were collected, with 81 analyzed. Of the 81 samples analyzed, 43 were on-road samples, 30 off-road, and seven were on-road samples also being used for off-road purposes. The seven fuel samples used for both on-road and off-road are included in both on-road analysis and off-road analysis. One sample was not analyzed due to water contamination.

- On-Road Diesel Fuel

There is marked consistency with all on-road samples analyzed to date. Sulfur content ranges from 36 ppm to 760 ppm. For all on-road samples, the arithmetic mean average is 380 ppm with a median sulfur content of 390.

Most samples measured were between 300 and 450 ppm, with half of all samples being within the interval of 340 and 420 ppm. Only one sample, the 760 ppm sample, was over the legal limit of 500 ppm for on-road diesel fuel.

- Off-Road Diesel Fuel

The off-road diesel fuel samples showed more variability in sulfur content. Thirty-one of 37 samples meet *on-road* fuel sulfur limits (500 ppm cap). Only 6 of the samples contained sulfur levels higher than 500 ppm. They ranged from 750 ppm to 3,812 ppm sulfur. Note that this is still within the accepted ASTM standard (5,000 ppm Sulfur) for off-road diesel fuel.

Interim off-road diesel fuel samples ranged from 279 ppm to 3,812 ppm sulfur. The arithmetic mean average for all samples was 653 ppm, influenced by the six high values. Perhaps a more meaningful number is the median average of 385 ppm for the great majority of samples (31 of 37 samples) that contained less than 500 ppm sulfur.

- Diesel Fuel Sampling Study: Interim Conclusions⁷

Based on sampling and analyses to date, the diesel fuel sulfur survey indicates that on-road diesel fuel sold in the Denver Metro area contains a mean sulfur content of 390 ppm. This is well within the federal limit of 500 ppm. Analyses of other fuel properties indicate good compliance with State fuel specifications.

Sulfur levels in Colorado's off-road diesel fuel are comparable to sulfur levels found in highway diesel fuel—that is much lower than the 3,300 ppm level used by EPA in its NONROAD model for the 1999 National Emissions Inventory. (Wells)

The median sulfur content for on-road (highway) diesel fuel samples to date is 390 ppm, with an arithmetic mean average of 380 ppm sulfur.

Off-road diesel fuel samples (37 to date) generally meet *on-road* fuel sulfur limits (500 ppm cap). Only 6 of the samples contained sulfur levels higher than 500 ppm. They ranged from 750 ppm to 3,812 ppm sulfur. The arithmetic mean average for the off-road samples was 653 ppm, influenced by the six high values. If the six high values are eliminated as outliers, the median average becomes 385 ppm—below the median average for highway diesel fuel samples to date.

Even though the high values may be seen to skew the off-road diesel fuel sulfur average, the APCD incorporated them for an average for off-road diesel fuel sulfur. This is in order to be conservative, potentially over-estimating sulfur levels and health impacts.

The findings, if borne out by additional sampling and analyses, would suggest that diesel fuel sulfur assumptions used to calculate diesel emissions for Colorado should be revised downward.

This, along with predictions of upward trends in diesel truck traffic, emphasize the need to focus on the on-road sector as the major source for diesel exhaust emissions now and in the future.

Additional sampling and analyses through July 2003 should allow for more definitive conclusions.

C. Calculating Diesel PM Emissions from Fuel Usage Information

Statewide particulate diesel matter (DPM) emissions are estimated in several ways below—using varying fuel sulfur assumptions and excluding, then including, locomotive diesel fuel combustion estimates. While there are other diesel exhaust emissions of concern that may not be covered by the PM portion--such as the organic gases, only diesel particulate matter is calculated below.

In Table 3 EPA **on-road** (or highway) diesel fuel sulfur assumption (500 ppm) is compared to the arithmetic mean average of sampled sulfur levels of (380 ppm) and exhaust PM levels are calculated each way. Note that the NONROAD Model is not very sensitive to fuel sulfur assumptions. According to the model, only sulfate levels are affected by lowering sulfur levels. Organic and elemental carbons are not affected.

Table 3

| Year | Highway diesel fuel (gallons) | Sulfur level EPA assumes | Mean sampled fuel sulfur | Difference |
|---|--------------------------------------|---------------------------------|---------------------------------|-------------------|
| 2002 | 576 million | 500 ppm | 380 ppm | 24% |
| Diesel particulate matter from combustion using 2001 inventory (tons per year) | | 1,850 tpy | 1,766 tpy | 4% |

In Table 4 below the EPA **off-road** diesel fuel sulfur assumption (3300 ppm) is compared to the arithmetic mean average of sampled sulfur levels (653 ppm) and exhaust PM levels are calculated each way.

Table 4

| Year | Off-road diesel fuel (gallons), | Sulfur level EPA assumes | Mean sampled fuel sulfur | Difference |
|--|--|---------------------------------|---------------------------------|-------------------|
| 2002 | 179 million | 3300 ppm | 653 ppm | 80% |
| Particulate matter from combustion using 2001 inventory (tons per year) | | 3,134 tpy | 2,827 tpy | 9.8% |

One off-road category of diesel emissions that arguably belongs in the nonroad model is that of diesel locomotive engines. Such engines run frequently and regularly through urban, suburban and rural areas.

The EPA assumes that 68 million gallons of locomotive diesel fuel are used annually by trains traversing the State. The sulfur level is assumed to be 2700 ppm. Table 5 indicates that resulting diesel particulate matter = 412 tons per year. No testing of locomotive fuels has been conducted to date.

Table 5

| Year | Assumed sulfur level | Assumed Diesel Fuel Usage (Gallons) | Resulting diesel particulate matter (tons per year) |
|-------------|-----------------------------|--|--|
| 1990 | 2700 ppm | 75 million | 453 tpy |
| 1999 | 2700 ppm | 68 million | 412 tpy |

The representative of a large refinery in Denver indicated it sold roughly 20% of its “high-sulfur” diesel fuel, or 2,500 barrels (105,000 gallons) per day to railroads. This would amount to roughly 38 million gallons per year from the one refinery.

In order to validate the EPA’s assumptions, additional Colorado refineries should be surveyed regarding the amount of diesel fuel sold to railroads, and the sulfur level(s) in such fuels. The APCD should also ask railroad companies for fuel and mileage information.

D. Colorado On-Road Diesel Vehicle Miles Traveled (Denver Metropolitan Area)

1. Truck and Bus Traffic Metropolitan Denver and Statewide

Daily vehicle miles traveled (VMT) in the Denver Metropolitan Area in 2001 was 58,156,000 (Carbon Monoxide Redesignation Request & Maintenance Plan for the Denver Metropolitan Area, Air Quality Control Commission, 2000). Diesel trucks and buses account for roughly 9 percent of the area's VMT—5.2 million miles per day. For the year, on-road diesel truck traffic totals 1.9 billion miles⁸

The on-road diesel percentage increased somewhat from 7.86 percent in 1990 to 9.04 percent in 2002.

Pokharel, et. al. (2002) allocated 36 percent of Colorado diesel vehicle traffic and diesel fuel usage to the six-county Denver Metropolitan Area. If this holds true, then statewide diesel vehicle traffic covers roughly 14.4 million miles per day, 5.26 billion miles per year.

$$\begin{aligned} 36/100 &= 5.2 \text{ million}/14.4 \text{ million} \\ 14.4 \text{ million} \times 365 &= 5.26 \text{ billion miles per year.} \end{aligned}$$

Diesel fuel usage data and VMT data appear to correspond: As noted earlier, total Colorado highway diesel fuel sold in 2002 was 576 million gallons. Thirty-six percent of that amount would be 207 million gallons. 576 million gallons would fuel statewide on-road diesel vehicles for 5.26 billion miles roughly 11 miles to the gallon. These are reasonable figures.

Diesel truck traffic is likely to continue to increase in this age of 'point, click, and truck.' The rates of growth may be increasing significantly at this time. The Federal Highway Administration predicted that diesel truck traffic will increase by 26% in the Denver area from 2002 to 2006.⁹

E. Observed Colorado Construction

Air Division staff members, including 4 interns, traveled to various areas of the state in the summer and fall of 2002 to assess generally the amount of construction occurring in northern, southern, eastern, central and western Colorado. Staff traveled to the various areas over a total of 18 days. In general, observations are borne out by formal surveys regarding diesel equipment activity.

Observations were recorded in narrative format, and on survey forms when projects involved several diesel powered vehicles.

Because of the severe drought in 2002, agricultural activity was at a minimum even in the traditional harvest months. No tractors, balers or combines were observed in the drive-by surveys. Farming of corn and wheat—the State’s main agricultural crops—usually occurs on the eastern plains of Colorado. Staffers reported no diesel equipment activity in the eastern plains areas.

Roadway construction in the Denver Metropolitan area was dominated by the I-25 expansion project, known as T-REX (**T**ransportation **E**xpansion project). Elsewhere, highway construction and paving work were sighted sporadically. Other construction visible from roadways was noted, such as housing, office parks, hospital complexes, etc.

Spreadsheets tallying information follow the descriptive information below.

1. Northwest

In July 2002, 2-day trip: Very little construction activity was observed in Northwest Colorado. There were no major projects (longer than 6 months) on the I-70 corridor into the resort mountain towns, with the exception of a C-DOT project at Berthoud Pass near Winter Park in Grand County. With a crew of approximately 40 workers, the two-lane highway is being widened to three lanes. Roughly 50 percent of the equipment was rented.

Resorts visited were Vail, Winter Park and Copper Mountain. There was no observable construction or other diesel equipment activity at the resorts. Meetings were held with representatives of each of these resorts to gather detailed survey information regarding their off-road diesel equipment and fleets.

2. Northeast

September 2002, staff drove east on I-25 to I-76, and on to Hwy 34 east for approximately 170 miles towards Nebraska and Kansas. The designated towns for observation of diesel activity were Akron, Yuma and Wray, Colorado. Prior to reaching Akron, we passed the towns of Wiggins, Fort Morgan and Brush. Construction on I-76 at 96th avenue--mostly paving equipment—was observed. It appeared to be a relatively small project.

Akron is a very small agricultural town--perhaps 10 streets wide. No farming or construction activities were observed in the vicinity.

Yuma is a slightly larger agricultural town. Again, no visible farming or construction activity was observed.

Wray, the largest of the three eastern plains towns observed, is an agricultural town that grows and distributes the highest yield of corn in the United States. It is 13 X 22 blocks wide, 14 miles from the Kansas border, and seven miles from Nebraska. No agricultural or construction activity was observed. NOTE: Harvests were notably low in most areas of Colorado in this drought year.

A small road construction project was observed near I-76 near exit 12 onto Highway 85 North towards Greeley. It did not look like it was a large (six month project). No other diesel equipment activity was observed on this trip.

3. Central

Staff drove via I-25 to Salida, in the foothills of the Collegiate Peaks of Colorado, then north on Hwy 24 to Buena Vista, then NE-N onto Hwy 285 through Fairplay, Como, Jefferson, Bailey and into Conifer. There was heavy road construction for 5 miles on Hwy 285 at Conifer, an over- and underpass being built. A drive-by survey was taken: 11 pieces of equipment. All were idle, as it was after working hours. Staff continued into Evergreen, Genesee and east on I-70 into Denver, with no further observation of off- road diesel activity.

4. Southwest

September 2002: From Denver, staff drove I-25 to Colorado Springs. Considerable activity was observed off Academy Boulevard up Hwy 83 to Briarsgate. Staff completed a survey at "The Shops at Briarsgate." Another survey was conducted up the hill from the previous observation at a new office building; "PrimeCenter at Briarsgate." Around the bend from the previous site was a church being built, "The Jericho Center" on Chapel Hills Road.

From Colorado Springs we continued south to Hwy 50, traveled through the following towns: Pueblo, Florence, Canon City, Cotapaxi, Poncha Springs and Salida. The only construction activity observed was exiting Salida on Rt. 291 in Chaffee County, where a small subdivision was being excavated and a survey was taken.

5. Southeast

August 2002: Two routes were taken to this area of Colorado. Staff drove I-25 south through Colorado Springs, where highway construction activity was observed. US 50 was taken east to La Junta, then to Lamar. In the 226 miles traveled, no construction activity was observed. Towns driven through on US 50 were Fountain, Pueblo, Avondale, Boone,

Olney Springs, Manzanola, Rocky Ford, Swink, La Junta, Las Animas, Hasty, and Lamar.

The return trip was taken from US 287 to I-70. This is very barren area, mostly agricultural, and no activity was observed on this route either. Towns passed that were a designated part of our survey were Eads and Kit Carson. No construction activity was observed.

6. Metropolitan Denver T-REX (Transportation Expansion) Project

This \$1.67 billion multi-modal transportation project is to add 19 miles of double-track light rail connecting to the existing system at Broadway in Denver and extending along the west side of Interstate Highway 25 to Lincoln Avenue in Douglas County and in the median of I-225 from I-25 to Parker Road in Aurora. Thirteen light rail stations with parking areas are to be built.

T-REX is adding several through lanes to I-25 and I-225, and reconstructing 8 interchanges, reconstructing numerous bridges, improving drainage, as well as adding and improving road shoulders.

A variety of diesel construction vehicles are in use at any given time, and the activity is expected to continue to a project completion date of 2008.

For a future report, researchers should obtain road construction equipment and hourly usage information from CDOT and/or FW Dodge.

A limited qualitative survey of emissions was conducted using used Southeast Corridor Constructors' Air Quality Observation Logs to characterize diesel exhaust emissions from equipment used on the project from December 17, 2002 through March 28, 2003.

On most days equipment in use consists of loaders, dozers, scrapers, 10-wheel dump trucks, water trucks, drill rigs, track hoes, concrete trucks, cranes, graders, other dump trucks and back hoes. Equipment used frequently (but not daily) includes bobcats, boom trucks, concrete trucks, paving equipment, excavators, and D-8 trucks. Equipment used less frequently includes large generators, milling machines, street sweepers, compactors, hoe-rams and rollers

Typically, there were no significant visual emissions from the construction activities. On the 14 days when significant visible emissions were observed, the emissions were warming up of equipment—once due to “excessive” revving. On one occasion, significant emissions were attributed to excessively high speed; on another occasion a poorly maintained dump truck was deemed responsible. Remediation was required in each of the “excessive” cases.

7. South Metro Area: Construction on a large medical center was observed in June just south of the Denver Technological Center near I-25.

8. Residential Home Expansions and Renovations – Denver
(See Section L of this Part III)

This spreadsheet provides information regarding observed equipment pieces at the sites discussed above.

(data collected by Terri James,
Conrad Van Dyke by 9/2002,
spreadsheet by Conrad Van Dyke)

| Survey Site | Equipment Type | # Idle | # Moving |
|--|-----------------------|---------------|-----------------|
| Conifer (5 miles of road construction on US-285 including over/underpasses with all information taken at 6pm 9/12/02) | Backhoe Loader | 1 | |
| | Generators | 2 | |
| | Gradall | 1 | |
| | Paving Equip. | 1 | |
| | Rollers/Compactors | 2 | |
| | Rubber Tire Loaders | 4 | |
| Salida (Rt. 291, Chaffee County, 9/16/02) | Backhoe Loader | | 1 |
| | Bore/Drill Rigs | 1 | |
| | Off Highway Trucks | 1 | 1 |
| | Scrapers | 1 | |
| | Track Dozers | 1 | |
| | Water Wagons | 1 | |
| Colorado Springs (Primecenter @ Briargate off Hwy 83 9/16/2002) | Bore/Drill Rigs | 1 | |
| | Cranes | | 2 |
| | Forklifts | | 1 |
| | Generators | | 1 |
| | Mini Excavators | 1 | |
| | Walk Behind Compactor | 1 | |
| Colorado Springs (Briargate Prkw, off Hwy 83, shops at Briargate, 9/16/02) | Skid Steer Loaders | | 1 |
| | Scrapers | 1 | 3 |
| | Bore/Drill Rigs | | 1 |
| | Water Wagons | 1 | 2 |
| | Forklifts | | 1 |
| | Rubber Tire Loaders | 1 | |
| | Rubber Tire Tractors | | 1 |
| | Mini Excavators | 2 | |
| Generators | 2 | | |
| Colorado Springs (The Jewish Center-Church, Chapel Hills Rd., 9/16/02) | Backhoe Loader | | 1 |
| | Bore/Drill Rigs | | 1 |
| | Cranes | | 1 |
| | Generators | | 2 |
| | Roller w/Tamper | 1 | |
| Berthoud Pass (Winter Park/Granby -C-DOT project, surveys taken 7/12/02) | Backhoe Loader | | 1 |
| | Skid Steer Loaders | | 3 |
| | Generators | | 1 |
| | Air Compressors | 1 | 2 |
| | Plate | 1 | 2 |
| | Compressor/Comp. | | |
| | Roller w/Tamper | | 1 |
| | Signal Boards | | 1 |
| | Bore/Drill Rigs | 1 | |
| | Water Wagons | 1 | 1 |
| | Excavators | | 2 |

| | Motor Graders | | 1 |
|--|-------------------------|---------------|-----------------|
| | Rough Terrain Forklifts | | 1 |
| | Rubber Tire Loaders | | 3 |
| | Rubber Tire Tractors | 1 | |
| | Track Dozers | | 1 |
| Survey Site | Equipment Type | # Idle | # Moving |
| Colorado Mills Mall (Colfax Ave., Denver. Survey taken on 7/18/02, info supplied by the Construction Company) | Asphalt Pavers | 1 | 2 |
| | Roller/Compactors | 10 | 3 |
| | Rollers w/tampers | 4 | 4 |
| | Paving Equip. | 1 | 3 |
| | Trenchers | 1 | 1 |
| | Excavators | 3 | 1 |
| | Rough Terrain Forklifts | 4 | 8 |
| | Forklifts | 4 | 1 |
| | Overhead boom/scissors | 17 | 3 |
| | Rubber Tire Loaders | 7 | |
| | Rubber Tire Dozers | 3 | |
| | Track Dozers | 2 | |
| | Track Loaders | 1 | 1 |
| | Backhoe Loader | 9 | 3 |
| | Generators | 3 | 5 |
| | Street Sweepers | 1 | |
| Mini Excavators | 1 | | |
| Crawler Tractors | 3 | 4 | |
| "North Forty" (I-25 and Hwy 7, north of Denver, paving, lane expansion project, survey taken on 8/19/02, 10am, project by Kramer & Sons) | Generators | 6 | |
| | Motor Graders | 2 | 1 |
| | Gradall | 1 | |
| | Skid Steer Loaders | | 2 |
| | Signal Boards | | 2 |
| | Rubber Tire Loaders | 2 | 1 |
| | Water Wagons | 1 | 2 |
| | Dump Trucks | 2 | 5 |
| | Off Highway Trucks | 1 | 3 |
| | Roller | | 2 |
| | Scrapers | 1 | 1 |
| | Track Dozers | 1 | 1 |
| | Asphalt Pavers | 1 | 2 |
| | Backhoe Loader | 2 | 4 |
| Mini Excavators | 1 | | |
| Excavators | | 2 | |
| Ridgeway (US-550, 8 miles north of Ridgeway survey taken 9/12/02, 1am) | Paving Equip. | 1 | |
| | Motor Graders | 2 | |
| | Backhoe Loader | 1 | |
| | Dump Trucks | 2 | |
| Montrose (US 50, near the town of Cimarron, single lanes for paving 9/15/02, 12am) | Signal Boards | | 2 |
| | Generators | | 2 |
| | Gradall | 1 | |
| | Motor Graders | 1 | |
| | Dump Trucks | 2 | |
| Skid Steer Loaders | 1 | | |
| Survey Site | Equipment Type | # Idle | # Moving |
| Monarch Pass (US 50, east of the pass, bridge | Backhoe Loader | 1 | |
| | Motor Graders | 2 | |

| | | | |
|---|------------------------|---------------|-----------------|
| reconstruction, single lane, 15 minute delays, survey taken 9/12/02, 10pm) | Bull Dozer | 1 | |
| | Water Wagons | 1 | |
| | Signal Boards | | 2 |
| | Generators | | 2 |
| | Skid Steer Loaders | 1 | |
| | Cranes | 1 | |
| Parkridge Corporate Center (5.8 acre parcel -raining 6/4/02) | Bore Rigs | 1 | |
| | Cement Mixers | 4 | |
| | Cranes | | 1 |
| | Mini Excavators | 1 | |
| | Overhead boom/scissors | 4 | 2 |
| DTC Development (currently for sale -raining 6/4/02) | Backhoe Loader | 1 | 1 |
| | Cranes | 2 | |
| | Excavators | 1 | |
| | Generators | 2 | |
| | Mini Excavators | 1 | 2 |
| | Overhead boom/scissors | 5 | 2 |
| | Tractors | 1 | |
| | Water Wagons | 1 | |
| Skyridge Medical Center (In Douglas County, Highlands Ranch raining, 6/4/02) | Backhoe Loader | 3 | |
| | Bore Rigs | 2 | |
| | Cranes | 2 | |
| | Crawler Tractors | 1 | |
| | Excavators | 4 | |
| | Generators | | 1 |
| | Mini Excavators | 1 | |
| | Overhead boom/scissors | | 3 |
| | Rock/Stone Haulers | 1 | |
| | Roller w/Tamper | 2 | |
| | Rollers/Compactors | 1 | |
| | Tractors | 3 | |
| | Water Wagons | 3 | |
| | Trenchers | 3 | |
| | Wood Chippers | 1 | |
| Denver Convention Center (Speer & 14th) | Roller w/Tamper | | 2 |
| | Scrapers | 2 | |
| | Excavators | 1 | |
| | Rubber Tire Dozers | 2 | |
| | Track Loaders | 2 | |
| | Backhoe Loaders | | 4 |
| | Mini Excavators | | 1 |
| | Rock/Stone Haulers | | 4 |
| | | | |
| | | | |
| Survey Site | Equipment Type | # Idle | # Moving |
| Lowery Redevelopment Authority (adjacent to Big Bear Ice Rink, 5/21/2002) | Rollers/Compactors | | 1 |
| | Roller w/Tamper | 1 | |
| | Trenchers | 4 | |
| | Bore/Drill Rigs | | 1 |
| | Excavators | 2 | 1 |
| | Overhead boom/scissors | 2 | |
| | Backhoe Loaders | 3 | 1 |

| | | | |
|--|-----------------------|---------------|-----------------|
| | Crawler Tractors | 2 | 1 |
| | Tractors | 2 | |
| | Mowers | 3 | |
| | Street Sweepers | 1 | 1 |
| APD Expansion (Alameda & Chambers, Denver) | Cranes | | 4 |
| | Forklifts | | 6 |
| | Backhoe Loaders | | 4 |
| | Crawler Tractors | | 2 |
| | Tractors | 4 | 2 |
| | Generators | | 1 |
| | Air Compressors | | 2 |
| Home Depot Expansion (Mississippi & Blackhawk, Denver) | Roller/Compactors | | 1 |
| | Scrapers | 1 | |
| | Trenchers | | 2 |
| | Water Wagons | 1 | |
| | Excavators | | 1 |
| | Cement Mixers | | 2 |
| | Backhoe Loader | | 3 |
| | Crawler Tractors | 1 | 1 |
| | Tractors | 2 | 2 |
| | Generators | | 2 |
| Cherry Creek Drive South & Cherry | Concrete Pavers | | 2 |
| | Cement Mixers | | 3 |
| | Cranes | | 4 |
| | Forklifts | | 6 |
| | Backhoe Loader | | 2 |
| Shopping Center Construction (Alameda & Sable, Denver) | Roller/Compactors | | 2 |
| | Roller w/Tamper | | 1 |
| | Scrapers | | 2 |
| | Excavators | 1 | |
| | Cranes | | 4 |
| | Motor Graders | 2 | |
| | Backhoe Loader | 2 | 2 |
| | Crawler Tractors | 2 | |
| | Tractors | | 3 |
| | Rock/Stone Haulers | 2 | |
| I-25 (between Hampden & I -225) | Roller/Compactors | | 2 |
| | Roller w/Tamper | | 2 |
| | Scrapers | 3 | |
| | Excavators | 2 | |
| | Cranes | 3 | |
| | Rubber Tire Loaders | 2 | |
| | Track Loaders | 2 | 4 |
| | Tractors | 5 | |
| | Rock/Stone Haulers | | 4 |
| Survey Site | Equipment Type | # Idle | # Moving |
| Housing Construction (132nd & Zuni, outside of Broomfield) | Scrapers | | 2 |
| | Trenchers | | 4 |
| | Water Wagons | | 1 |
| | Excavators | | 2 |

| | | | |
|------------------|------------------|-----|-----|
| | Backhoe Loader | 2 | 2 |
| | Mini Excavators | | 1 |
| | Crawler Tractors | | 3 |
| | Tractors | | 2 |
| | Generators | | 2 |
| EQUIPMENT TOTALS | | 261 | 236 |

The above information would indicate that roughly half of equipment on a construction site is active at any given time; the other half idle.

F. Large Construction Contractors and Maintenance Fleet Managers

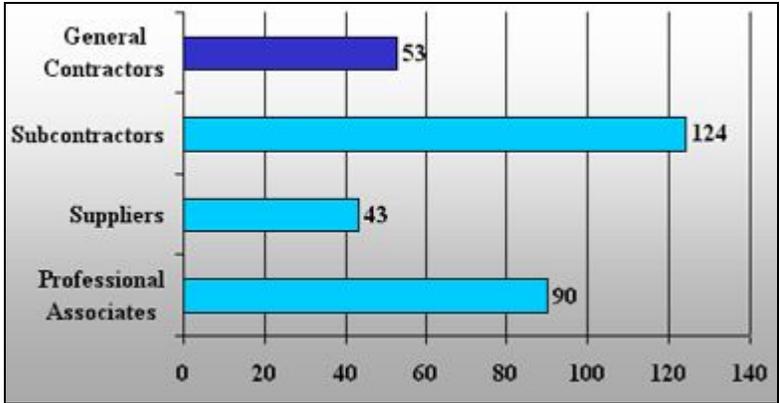
Survey data from large construction contractors and maintenance fleet managers were collected as follows. The data remain in their raw state at this writing. For a future report the statistics should be crunched, averaged, and scaled up to their respective total populations for the State. These then could be compared to FW Dodge data for reasonableness assessments.

1. Colorado Contractors Association

The Colorado Contractors Association, Inc. (CCA) is an organization representing firms that construct infrastructure, such as streets and highways, light rail facilities, bridges and dams, underground utility lines, power and telecommunication transmission centers, and stormwater and wastewater pipelines and treatment plants. Surveys were mailed to the 199 member contractors. A total of 15 contractors (7.5%) responded.

2. Associated General Contractors of Colorado

The Associated General Contractors of Colorado (AGC) is a chapter of the Associated General Contractors of America. The association has 300 members from around the state. The AGC of Colorado represents a wide variety of firms, both union and non-union shops, public and privately owned, from very large to very small. It is composed of general contractors, subcontractors, suppliers and professional service providers. Each year, AGC/C members complete 60 to 80 percent of the commercial building in the state of Colorado. Surveys were mailed to the 177 member contractors. A total of 20 contractors (11%) responded.



Associated General Contractors of Colorado membership breakdown (AGCC)

3. Rocky Mountain Fleet Management Association

The Rocky Mountain Fleet Management Association (RMFMA) is a non-profit educational association designed to enhance the practices of fleet management for managers and personnel of private and public sector fleets. Most of the RMFMA respondents were from the public sector.

Two separate surveys were mailed—the first to CCA, AGC and 96 RMFMA members. The first survey resulted in too few respondents from the RMFMA group, so a second, briefer survey was mailed three months later to RMFMA members only. A total of 40 fleet managers (42% of the 96 RMFMA members contacted) responded to one or the other survey.

This spreadsheet combines CCA, AGC and RMFMA data from the first survey

| Company | # Of | Fuel Grade | Gallons/Yr | DE Type | Engine | DE Pop. | # of | Fuel | Hours | Use | County of | AGCC, CCA, |
|--|-----------|---------------------------|--|-----------------------|---------|-----------|-------|----------|---------|----------|------------------|------------|
| | Employees | | (2001) | | Age | Hp | Units | Grade # | Use/Yr. | Profile | Operation | Rocky Mtn. |
| ADK Electric Corp. | 65 | Diesel | 90 | Air Compressors | 5 | | | Diesel | 24 | Months | Denver, Arapahoe | AGCC |
| A.P. Eberlein Co. | 80 +/- | Off Road | 15,000 | Cement & Mortar Mixer | 1 to 2 | | | Gasoline | | | | AGCC |
| | | On Road | 12,000 | Excavators | 1 to 5 | 60-100 | 6 | Off Road | 1000 | Monthly | ALL | |
| | | | | Skid Steer Loaders | 1 | 80 | 1 | Off Road | 300 | Monthly | Weld | |
| Action Air | | See Notes | Does not own any equipment with diesel engines | | | | | | | | | AGCC |
| Bradley Blasting | 3 | #2 On Road | 1,000 | Air Compressors | 10 | 90 | 1 | #2 | 300 | Weekly | JeffCo | CCA |
| | | #2 Off Road | 4,000 | Backhoe Loader | 13 | 90 | 1 | #2 | 500 | Weekly | JeffCo | |
| | | | | Rubber Tire Loaders | 10 | 130 | 1 | #2 | 500 | Weekly | JeffCo | |
| | | | | Track Drill | 8 | 190 | 1 | #2 | 1000 | Daily | JeffCo | |
| B & M Roofing of CO | 67 | #2 Premium Diesel | 4,620 | Cranes | 8 | 190 | 1 | #2 | 2000 | Daily | Boulder | AGCC |
| | | | | Forklifts | 17 | | 1 | 2 | 1000 | Daily | Boulder | |
| BT Construction, Inc. | | Off Road | 137,000 | Excavators | | 312 | 10 | Off Road | 2000 | Weekly | Front Range | CCA |
| | | Low-Sulfur | | Rubber Tire Loaders | | 145 | 7 | Off Road | 2000 | Weekly | Front Range | |
| City/County-Broomfield | 526 | #2 Low Sulfur Diesel Plus | 24,000 | Air Compressors | | | 2 | #2 | 300 | | Broomfield | RMFMA |
| | | Low Sulfur | 24,000 | Asphalt Pavers | 1 | | 1 | #2 | 500 | Seasonal | Broomfield | |
| Notes: | | | | Concrete/Indust. Saw | | | 1 | #2 | 30 | Monthly | Broomfield | |
| #2 fuel usage is for May-Oct, | | | | Forklifts | 6 to 34 | | 2 | Propane | 150 | Weekly | Broomfield | |
| Diesel Plus Low Sulfur used Nov.-April | | | | Motor Graders | 13 | 130 | 1 | #2 | 500 | Monthly | Broomfield | |
| | | | | Mowers | 1 to 19 | 20-65 | 12 | #2 | Varies | Seasonal | Broomfield | |
| | | | | Overhead, Boom, Sc | 3 | 230 | 1 | #2 | 300 | Daily | Broomfield | |
| | | | | Rollers/Compactors | 1 to 3 | 30 | 2 | #2 | 800 | Seasonal | Broomfield | |
| | | | | Rubber Tire Loaders | 2 to 9 | 114, 160, | 3 | #2 | Varies | Daily | Broomfield | |

| | | | | | | 140 | | | | | | |
|---|-----------|--------------------|------------|------------------------|---------|----------|-------|-------------|---------|---------------|------------------|------------|
| | | | | Rubber Tire Ld. (farm) | 1 to 17 | 40 | 3 | #2 | Varies | Daily | Broomfield | |
| | | | | Skid Steer Loaders | 1 | 100 | 1 | #2 | 300 | Weekly | Broomfield | |
| | | | | Street Sweepers | 1 to 6 | | 5 | #2 | Varies | Daily | Broomfield | |
| | | | | Water Wagons | 8 | 275 | 1 | #2 | 150 | Monthly | Broomfield | |
| City of Loveland | 650 | #2Clear;low S | 186,000 | Air Compressors | 4 to 21 | | 5 | #2 | 117 | Weekly | Larimer | RMFMA |
| | | | | Asphalt Pavers | 5 | | 1 | #2 | 150 | Weekly | Larimer | |
| | | | | Backhoe Loaders | 1 to 13 | | 8 | #2 | 360 | Daily | Larimer | |
| | | | | Motor Graders | <1 | | 1 | #2 | 560 | Daily | Larimer | |
| | | | | Rollers/Compactors | 1 to 26 | | 5 | #2 | 250 | Weekly | Larimer | |
| | | | | Ruber Tire Loaders | 1 to 10 | | 4 | #2 | 600 | Daily | Larimer | |
| | | | | Rubber Tire Tractors | 1 to 60 | | 6 | #2 | 380 | Weekly | Larimer | |
| | | | | Tractors | 1 to 16 | 400-425 | 2 | #2 | 6500* | Daily | Larimer | |
| | | | | Trenchers | 2 to 4 | | 2 | #2 | 240 | Weekly | Larimer | |
| | | | | Water Wagons | 1 to 31 | 400 | 2 | #2 | 3000* | Daily | Larimer | |
| | | | | Roto Mill | <1 | | 1 | #2 | 600 | Weekly | Larimer | |
| Colorado Striipe | 25 | #2 Normal at Pumps | 78,000 | Air Compressors | 0 to 12 | 85 | 10 | #2* | 20000 | Daily (seas.) | Denver, Arapahoe | CCA |
| Wright | | | | Street Sweepers | 12 | 85 | | #2* | 500 | Seasonal | Metro Area | |
| Colorado Sash | 35 | Std. Over | 4,000 | Isuzu Delivery Truck | 9 | | | Std. Diesel | 4 to 8 | Daily | Larimer, Denver | AGCC |
| & Door | | the road dies | | GMC Delivery Truck | | | | Std. Diesel | 4 to 8 | Daily | Larimer, Denver | |
| Comelco Electric | 15 | #1 | 20 | Skid Steer Loaders | 8 | 45 | | #1 | 5 | Monthly | Summit | AGCC |
| Company | # Of | Fuel Grade | Gallons/Yr | DE Type | Engine | DE Pop. | # of | Fuel | Hours | Use | County of | AGCC, CCA, |
| | Employees | | (2001) | | Age | Hp | Units | Grade # | Use/Yr. | Profile | Operation | Rocky Mtn. |
| Concrete Express | 235 | #2 Clear On Road | 180,000 | Air Compressors | | | 3 | Both | 500 | Weekly | All Metro | CCA |
| Notes: | | #2 Off Road Red | 150,000 | Backhoe Loaders | 2 to 7 | | 9 | #2 Red | 1300 | Daily | All Metro | |
| Excavators are comprised of 2@133, 5@232, 2@306 hp. | | | | Concrete Pavers | 2 to 10 | 160, 390 | 2 | #2 Red | 600 | Weekly | All Metro | |
| Rubber Tire Loaders are | | | | Concrete/Ind. Saws | 3 to 5 | | 3 | Both | 900 | Daily | All Metro | |
| | | | | Cranes | 3 to 7 | 150, 250 | 2 | #2 Red | 700 | Weekly | All Metro | |

comprised of 8@173,
1@215, 2@180
Scrapers are comprised
of
187, 240, and 2@347

| | | | | | | | |
|----------------------|---------|---------------|----|--------|------|--------|-----------|
| Excavators | 2 to 12 | 133, 232, 306 | 9 | #2 Red | 1400 | Daily | All Metro |
| Forklifts | 6 to 9 | | 2 | #2 Red | 600 | Weekly | All Metro |
| Generators | 5 | | 1 | Both | 1000 | Daily | All Metro |
| Motor Graders | 5 to 9 | 306 | 4 | #2 Red | 1800 | Daily | All Metro |
| Overhead, Boom, Scis | 5 | | 1 | #2 Red | 600 | Weekly | All Metro |
| Rollers/Compactors | 2 to 11 | | 8 | #2 Red | 600 | Daily | All Metro |
| Rubber Tire Loaders | 2 to 8 | 173, 180, 215 | 11 | #2 Red | 1800 | Daily | All Metro |
| Scrapers | 3 to 7 | 187, 240, 347 | 4 | #2 Red | 1600 | Daily | All Metro |
| Skid Steer Loaders | 1 to 3 | 60 | 11 | #2 Red | 1200 | Daily | All Metro |
| Track Dozers | 5 | 153 | 1 | #2 Red | 1200 | Weekly | All Metro |
| Tractors | 7 | | 1 | #2 Red | 1000 | Weekly | All Metro |
| Trenchers | 3 | 43.5 | 1 | #2 Red | 250 | | All Metro |
| Water Wagons | 14 | | 1 | #2 Red | 1200 | | All Metro |
| Welders | | | 2 | Both | 600 | | All Metro |

| | | | | | | | | | | | | |
|---|-----|-----------|----------|-------------------------|----------|---------------|----|--------|----------------------------|--------------|--------|-------|
| Coors Brewing Co | N/A | #2 ==.05% | 8,750 | Air Compressors | 12 to 22 | 47.5, 86 | 2 | #2 | 94, 81 | Seas., Month | JeffCo | RMFMA |
| ***Please note, the Use Profile varies depending on which piece of equip. is being referenced. Monthly, Weekly. | | | | Backhoe Loader | 19 | 85 | 1 | #2 | 1129 | Weekly | JeffCo | |
| | | | | Cranes | 14 to 18 | 110, 190, 287 | 3 | #2 | 36, 86, 399 | Weekly* | JeffCo | |
| | | | | Forklifts | 11 to 16 | 40 to 190 | 6 | #2 | 14, 96, 198, 217, 298, 405 | | JeffCo | |
| | | | | Generators | 28 | 165 | 1 | #2 | 66 | Seasonal | JeffCo | |
| | | | | Motor Graders | 22 | 138 | 1 | #2 | 84 | Monthly | JeffCo | |
| | | | | Rough Terrain Forklifts | 7 | 102 | 1 | #2 | 127 | Weekly | JeffCo | |
| | | | | Rubber Tire Loaders | 16 to 24 | 139, 310 | 2 | #2 | 52, 690 | Mnth & Wkly | JeffCo | |
| | | | | Skid Steer Loaders | 15 to 16 | 27, 27 | 2 | #2 | 114, 605 | Mnth & Wkly | JeffCo | |
| | | | Tractors | 19 to 23 | 25 | 2 | #2 | 13, 70 | Seasonal | JeffCo | | |
| | | | Welders | 12 | 28 | 1 | #2 | 70 | Monthly | JeffCo | | |

| | | | | | | | | | | | | |
|------------------|----------|--------------------|---------|---------------------|---------|-----|---|--|-----|----------|--------|-------|
| Copper Mtn. Inc. | 2500Win/ | Winter 50:50 #1:#2 | 186,000 | Mowers | 2 to 7 | 40 | 5 | | 400 | Seasonal | Summit | RMFMA |
| | 500Summ | Summer #2 #2 Red | | Rubber Tire Loaders | 3 to 20 | 150 | 3 | | 800 | Daily | Summit | |
| | | | | Skid Steer Loaders | 5 to 10 | 100 | 5 | | 200 | Weekly | Summit | |

| Company | # Of Employees | Fuel Grade | Gallons/Yr (2001) | DE Type | Engine Age | DE Pop. Hp | # of Units | Fuel Grade # | Hours Use/Yr. | Use Profile | County of Operation | AGCC, CCA, Rocky Mtn. |
|--|---|------------------|-------------------|---------------------|------------|------------|------------|--------------|---------------|-------------|---------------------|-----------------------|
| OFFROAD and #2 Clear ONROAD >0.05% Sulfur | | | | | | | | | | | | |
| | | | | Street Sweepers | 8 | 100 | 1 | | 400 | Seasonal | Summit | |
| | | | | Track Dozers | 18 | 100 | 1 | | 500 | Seasonal | Summit | |
| | | | | Tractors - Snow | 1 to 12 | 250 | 18 | | 2000 | Seasonal | Summit | |
| DeFalco Lee Construction | 28 | #2 Diesel HS Red | 30,000 | Air Compressors | 6 to 19 | 59 | 2 | #2 | 500 * | Seasonal | Boulder | CCA |
| | | | | Backhoe Loader | 4 to 9 | 115 | 5 | #2 | 1000 | Daily | Boulder | |
| | | | | Crawler Tractors | 12 to 14 | 165 | 2 | #2 | 750 | Weekly | Boulder | |
| | | | | Generators | 10 | 59 | 1 | #2 | 1000 | Seasonal | Boulder | |
| | | | | Motor Graders | 13 to 19 | 155 | 3 | #2 | 1000 | Weekly | Boulder | |
| | | | | Rollers/Compactors | 10 to 16 | 107 | 5 | #2 | 700 | Seasonal | Boulder | |
| | | | | Rubber Tire Loaders | 8 to 16 | 135 | 5 | #2 | 1000 | Daily | Boulder | |
| | | | | Scrapers | 6 | 265 | 2 | #2 | 1000 | Daily | Boulder | |
| | | | | Skid Steer Loaders | 5 | 65 | 1 | #2 | 250 | Seasonal | Boulder | |
| | | | | Tractors | 23 | 425 | 1 | On Road D. * | 500 | Weekly | Boulder | |
| | | | | Water Wagons | 9 to 13 | 210 | 2 | #2 | 500 | Daily | Boulder | |
| Doerr Associates | Notes: We install automatic door entrances & don't fit the research profile of survey | | | | | | | | | | AGCC | |
| Goodell Machinery | 8 | #2 OFFROAD | 36,000 | Air Compressors | 24 * | 80 | 2 | #2 Red | 100 | Yearly * | Weld | CCA |
| | | | | Backhoe Loader | 4 | 90 | 2 | #2 Red | 400 | | Weld | |
| | | | | Excavators | 4 to 12 * | 150 | 2 | #2 Red | 1590 | | Weld | |
| | | | | Forklifts | 24 | 75 | 2 | #2 Red | 100 | | Weld | |
| | | | | Motor Graders | 15 | 150 | 2 | #2 Red | 1200 | | Weld | |
| | | | | Rollers/Compactors | 5 to 28 | 90-170 | 2 | #2 Red | 480 | | Weld | |
| | | | | Rubber Tire Loaders | 22 to 26 | 125-170 | 2 | #2 Red | 536 | | Weld | |
| | | | | Scrapers | 23 to 28 | 140-380 | 2 | #2 Red | 800 | | Weld | |
| | | | | Skid Steer Loaders | 4 | 60 | 2 | #2 Red | 50 | | Weld | |
| | | | | Track Dozers | 23 to 44 | 90 *-200 | 2 | #2 Red | 380 | | Weld | |

| | | | | | | | | | | | | |
|-------------------------|--------|---|---------------------|-------------------------|----------|----------|----|----------|----------|----------|--------------------|------|
| Greiner Electric | 65 | Notes: | No diesel equipment | | | | | | | | AGCC | |
| G. E. Johnson Const. | 150 | #1 | 3,984 | Air Compressors | 4 to 17 | | #2 | 220 | Weekly | El Paso | AGCC | |
| | | #2 | 22,576 | Backhoe Loader | 4 | 75 | #2 | 750 | Weekly | El Paso | | |
| | | | | Cranes | 13 to 17 | 200 | #2 | 500 | Monthly | El Paso | | |
| | | | | Excavators (mini) | 8 | 27.5 | #2 | 400 | Monthly | El Paso | | |
| | | | | Excavators (large) | 8 to 13 | 125 | #2 | 500 | Monthly | El Paso | | |
| | | | | Generators | 3 | 40 | #2 | 200 | Seasonal | El Paso | | |
| | | | | Motor Graders | 4 | 165 | #2 | 500 | Monthly | El Paso | | |
| | | | | Rollers/Compactors | 9 to 16 | 100, 200 | #2 | 400 | Monthly | El Paso | | |
| | | | | Rough Terrain Forklifts | 3 | 100 | #2 | 500 | Monthly | El Paso | | |
| | | | | Rubber Tire Loaders | 2 to 7 | | | | | El Paso | | |
| | | | | Scrapers | 8 | 175 | #2 | 500 | Monthly | El Paso | | |
| | | | | Signal Boards | | 110 | #2 | 500 | Daily | El Paso | | |
| | | | | Skid Steer Loaders | 2 to 5 | 56 | #2 | 500 | Daily | El Paso | | |
| H & H Enterprises Inc., | 8 | #2 | 100 | Overhead, Boom, Sci | 2 | 56 | 1 | #2 | 200 | Weekly | Den, Arap, & Adams | AGCC |
| Hensel Phelps Const. | 300 | #2 | 3,000 | Air Compressors | | 85 | 3 | #2 | 900 | Daily | | AGCC |
| | | | | Backhoe Loaders | | 130 | 5 | #2 | 1000 | Weekly | | |
| | | | | Concrete/Indust. Saws | | | 5 | Gasoline | | | | |
| | | | | Cranes | | 240 | 3 | #2 | 1300 | Daily | | |
| | | | | Forklifts | | 185 | 3 | #2 | 1300 | Daily | | |
| | | | | Generators | | 45 | 2 | #2 | 2000 | Daily | | |
| | | | | Plate Compressors | | 30 | 3 | Gasoline | 500 | Daily | | |
| | | | | Rough Terrain Forklifts | | 120 | 3 | #2 | 1300 | Daily | | |
| | | | | Rubber Tire Loaders | | 200 | 5 | #2 | 1300 | Weekly | | |
| Hyder Construction | Notes: | Hyder subcontracts all operations that require diesel engines | | | | | | | | | AGCC | |
| KCI Construction | 12 | #2 | 300 | Backhoe Loader | 30 | 60 | 1* | #2 | 200 | Monthly | Boulder | AGCC |
| | | | | Rubber Tire Dozers | 1 | 60 | 1* | #2 | 500 | Weekly | Boulder | |
| K.E.C.I. Colorado, | 25 | | 2,000 | Air Compressors | 5 | 185 | 1 | | 250 | Seasonal | Douglas | CCA |

| | | | | | | |
|---------------------|---|--------------|---|------|----------|---------|
| Backhoe Loader | 5 | Cat 436, 416 | 2 | 1000 | Seasonal | Douglas |
| Excavators | 5 | Cat 318 | 1 | 250 | Seasonal | Douglas |
| Rollers/Compactors | 5 | Hamm, Sm. | 1 | 500 | Seasonal | Douglas |
| Rubber Tire Loaders | 1 | Cat 931 | 1 | 1000 | Seasonal | Douglas |
| Skid Steer Loaders | 5 | Scat Track | 2 | 1000 | Seasonal | Douglas |

| Company | # Of Employees | Fuel Grade | Gallons/Yr (2001) | DE Type | Engine Age | DE Pop. Hp | # of Units | Fuel Grade # | Hours Use/Yr. | Use Profile | County of Operation | AGCC, CCA, Rocky Mtn. |
|-------------------------------------|----------------|-----------------------------------|-------------------|---------------------|------------|------------|------------|--------------|---------------|-------------|---------------------|-----------------------|
| Lafarge/Western Mobile | 200 | #1 Off Road Diesel | 302,917 | Air Compressors | 3 to 21 | 76-135 | 5 | #1 Off | 1954 | Seasonal | El Paso * | CCA |
| Southern | | #1 On Road Diesel | 234,224 | Asphalt Pavers | 1 to 22 | 135-175 | 10 | #1 Off | 5916 | Seasonal | Pueblo * | |
| | | | | Backhoe Loader | 6 to 27 | 75-125 | 7 | #1 Off | 1754 | Seasonal | El Paso, Pueblo * | |
| | | | | Concrete Saws | 5 to 13 | Not Diesel | 2 | Unleaded | 56 | Seasonal | El Paso, Pueblo * | |
| | | | | Cranes | 42 | 200 | 1 | #1 Off | N/A | Seasonal | Pueblo * | |
| | | | | Forklifts | 27 | Not Diesel | 1 | Propane | 88 | Seasonal | El Paso* | |
| | | | | Generators | 3 to 31 | 75-260 | 7 | #1 Off | 2211 | Seasonal | El Paso, Pueblo * | |
| | | | | Motor Graders | 7 to 24 | 150-180 | 7 | #1 Off | 4357 | Seasonal | El Paso, Pueblo * | |
| | | | | Rollers/Compactors | 1 to 16 | 76-135 | 20 | #1 Off | 8056 | Seasonal | El Paso | |
| | | | | Rubber Tire Loaders | 3 to 38 | 135-435 | 22 | #1 Off | 34117 | Seasonal | Pueblo | |
| | | | | Skid Steer Loaders | 3 to 6 | 75 | 2 | #1 Off | 537 | Seasonal | El Paso* | |
| | | | | Street Sweepers | 3 to 23 | 75-126 | 4 | #1 Off & On | 675 | Seasonal | El Paso, Pueblo * | |
| | | | | Tractors | 7 | 24 | 1 | #1 Off | 89 | Seasonal | El Paso | |
| | | | | Welders | 3 to 23 | 24-50 | 4 | #1 Off | 371 | Seasonal | Pueblo | |
| Lawrence Const. Company - Littleton | 150 | #2 Red OFFRoad #2 Clear ONROAD | 300,000 16,000 | Air Compressors | 2 to 14 | * | 5 | #2 Red | 778 | Weekly | Adams, & | CCA |
| | | | | Backhoe Loaders | 5 to 13 | 77-98 | 4 | #2 Red | 6721 | Daily | Arap, & | |
| | | | | Cranes | 6 to 34 | 110-170 | 8 | #2 Red | 7274 | Daily | Denver, & | |
| | | | | Excavators | 1 to 14 | 110-321 | 7 | #2 Red | 9400 | Daily | El Paso, & | |
| | | | | Forklifts | 5 | 110 | 1 | #2 Red | 861 | Daily | Douglas, & | |
| | | | | Generators | 4 to 20 | 65 | 5 | #2 Red | 1200 | Monthly | JeffCo, & | |
| | | | | Motor Graders | 7 to 13 | 165-215 | 3 | #2 Red | 4708 | Daily | Pueblo | |
| | | | | Off-Highway Trucks | 4 | 296 | 3 | #2 Red | 4785 | Daily | Adams, & | |
| | | | | Overhead, Boom... | 8 | 65 | 1 | #2 Red | 1267 | Weekly | Arap, & | |

| | | | | | | | | | | | | | |
|---------------------------|--------|---|--------|------------------|----------------------|----------|---------|----|--------|--------|---------|------------|--|
| | | | | | Roller/Tamper | 5 | 40 | 1 | #2 Red | 642 | Weekly | Denver, & | |
| | | | | | Roller/Compactor | 3 to 16 | 70 -220 | 5 | #2 Red | 5878 | Daily | El Paso, & | |
| | | | | | Rough Terrain FL | 9 to 10 | 105 | 2 | #2 Red | 1060 | Daily | Douglas, & | |
| | | | | | Rubber Tire Loaders | 1 to 23 | 160-246 | 8 | #2 Red | 12375 | Daily | JeffCo, & | |
| | | | | | Rubber Tire Tractors | 4 | 175 | 1 | #2 Red | 1400 | Daily | Pueblo | |
| | | | | | Scrapers | 2 to 7 | 330-365 | 5 | #2 Red | 9510 | Daily | Adams, & | |
| | | | | | Skid Steer Loaders | 4 to 12 | 59 | 3 | #2 Red | 1135 | Daily | Arap, & | |
| | | | | | Street Sweepers | 9 | 165 | 1 | #2 Red | 187 | Weekly | Denver, & | |
| | | | | | Track Dozers | 3 to 13 | 70-570 | 6 | #2 Red | 10071 | Daily | El Paso, & | |
| | | | | | Tractors | 1 to 10 | 550 | 2 | #2 Red | 1200 | Daily | Douglas, & | |
| | | | | | Water Wagons | 16 | 175 | 1 | #2 Red | 1600 | Daily | JeffCo, & | |
| Long | Notes: | Stated that they do not operate diesel equipment in the state of Colorado | | | | | | | | | | AGCC | |
| LPR Construction | 205 | Type II | 93,600 | Air Compressors | 5 | 80 | 2 | #2 | 1200 | Weekly | Various | AGCC | |
| | | | | Cranes | 5 | 75 Ton | 2 | #2 | 2080 | Weekly | Various | | |
| | | | | Crawler Tractors | 5 | 230 Ton | 2 | #2 | 2080 | Weekly | Various | | |
| | | | | Forklifts | 3 | 8000 lbs | 4 | #2 | 1000 | Weekly | Larimer | | |
| | | | | Generators | 10 | 80 | 8 | #2 | 1200 | Weekly | Various | | |
| | | | | Mowers | 3 | 5.5 | 1 | | | | | | |
| | | | | Welders | 3 | 100 | 28 | #2 | 1200 | Weekly | Various | | |
| Ludvik Electric | Notes: | Does not have any of the vehicles represented on your listing, 7/8/02 | | | | | | | | | | AGCC | |
| Midwest Elite Steel, Inc. | Notes: | Does not have any equipment that uses diesel fuel | | | | | | | | | | CCA | |
| Pascal Construction | 18 | #2 high sulfur | 12,000 | Air Compressors | 9 | 90 | 1 | #2 | 800 | Weekly | Denver* | CCA | |

| | | | | | | |
|---------------------|---------|----------|---|----|------|----------|
| Bore/Drill Rigs | 8 to 18 | 34-90 | 4 | #2 | 1000 | Daily |
| Cranes | 40 | 162 | 1 | #2 | 25 | Seasonal |
| Excavators | 7 to 12 | 170, 275 | 2 | #2 | 1200 | Daily |
| Generators | 4 to 8 | 30 | 2 | #2 | 1000 | Monthly |
| Rubber Tire Loaders | 8 | 110 | 1 | #2 | 800 | Weekly |
| Hyd. Pump Unit | 24 | 25 | 1 | #2 | 600 | Monthly |

| Company | # Of Employees | Fuel Grade | Gallons/Yr (2001) | DE Type | Engine Age | DE Pop. Hp | # of Units | Fuel Grade # | Hours Use/Yr. | Use Profile | County of Operation | AGCC, CCA, Rocky Mtn. |
|-----------------------------|----------------|---|-------------------|--------------------|------------|------------|------------|----------------|---------------|-------------|---------------------|-----------------------|
| Phase 2 Company | 180 | Premium | 360 | Forklifts | 6 | 106 | 1 | Premium | 485 | Daily | Front Range | AGCC |
| | | | | Generators | 2 | 55.2 | 1 | Premium | 845 | Daily | Front Range | |
| Precision Excavating | 37 | Clear #2 ONROAD ?* Red #2 OFFROAD | 14,800 17,433 | Air Compressors | 3 to 28 | | 2 | #2 Red * | | | Routt | CCA |
| | | | | Backhoe Loaders | 6 to 7 | | 3 | #2 Red | | | Routt | |
| | | | | Cranes | 32 | | 1 | #2 Red | | | Routt | |
| | | | | Excavators | 5 to 12 | | 8 | #2 Red | | | Routt | |
| | | | | Generators | 11 to 30 | | 2 | #2 Red | | | Routt | |
| | | | | Motor Graders | 12 to 20 | | 2 | #2 Red | | | Routt | |
| | | | | Rollers/Compactors | 9 to 19 | | 3 | #2 Red | | | Routt | |
| | | | | Skid Steer Loaders | 5 to 11 | | 2 | #2 Red | | | Routt | |
| Track Dozers | 7 to 23 | | 4 | #2 Red | | | Routt | | | | | |
| Rolling Plains Construction | 75 | #2 Diesel | 6,600 | Backhoe Loader | 15 | | | #2 | 60 | Seasonal | Adams | AGCC |
| | | | | Skid Steer Loader | 9 | | | #2 | 120 | Seasonal | Adams | |
| | | | | FireProofing Pumps | 7 to 34 | | | #2 | 10400 | Weekly | Denver | |
| Sjostrom & Sons | Notes: | State that they are not currently doing any work in Colorado 7/1/02 | | | | | | | | | AGCC | |
| Summit County | 12 | Premium Winter Blend | 346,970 | Backhoe Loaders | 11 | | 2 | Winter Bl. J56 | 154 | yearly * | Summit | RMFMA |
| | | | | Generators | 12 | | 1 | Winter Blend | 100 | | Summit | |
| | | | | Motor Graders | 12 | | 7 | Winter Blend | 320 | | Summit | |
| | | | | Roller/Tamper | 16 | | 1 | Winter Blend | 59 | | Summit | |

| | | | | | | | | | | | | |
|--|------------------|-------------------|-------------------|-----------------------|---------------|----------------|--------------|----------------|----------------|------------------|------------------|-------------------|
| | | | | Rubber Tire Loaders | 10 | | 6 | Winter Blend | 234 | | Summit | |
| | | | | Skid Steer Loaders | 4 | | 1 | Winter Blend | 94 | | Summit | |
| | | | | Snow Removers | 6 | | 6 | Winter Blend | 347 | | Summit | |
| | | | | Street Sweepers | 8 | | 2 | Winter Blend | 173 | | Summit | |
| | | | | Track Dozers | 10 | | 2 | Winter Blend | 50 | | Summit | |
| | | | | Tractors | 13 | | 5 | Winter Blend | 173 | | Summit | |
| Tezak Heavy Equip. | 25-50 | #2 Off Road | 94,228 | Backhoe Loaders | 12 | 80 | 1 | #2 | 500 | Weekly | Varies | CCA |
| | | #2 On Road | 94,416 | Bore/Drill Rigs | 8 | 200 | 1 | #2 | 200 | | Fremont | |
| | | | | Excavators | 4 to 5 | 150-200 | 2 | #2 | 1000 | Daily | Varies | |
| Notes: | | | | Motor Graders | 15 | 180 | 1 | #2 | 1000 | Daily* see notes | Varies | |
| The item (motor grader) was listed as 4 hrs./day | | | | Roller/Tamper w/teeth | 8 | 120 | 1 | #2 | 500 | Weekly | Varies | |
| | | | | Rollers/Compactors | 12 | 120 | 1 | #2 | 500 | Weekly | Varies | |
| | | | | Rubber Tire Loaders | 3 to 17 | 150-450 | 5 | #2 | 1500 | Daily | Varies | |
| | | | | Skid Steer Loaders | 2 to 5 | 80 | 2 | #2 | 300 | Weekly | Fremont | |
| | | | | Track Dozers | 4 to 12 | 60-510 | 5 | #2 | 1000 | Daily | Varies | |
| TLM Constructors | 45 | #2 | 28,500 | Air Compressors | 8 to 16 | | 4 | #2 | | Daily | Otero | CCA |
| | | | | Asphalt Pavers | 23 | | 1 | #2 | 250 | Seasonal | Various | |
| | | | | Backhoe Loaders | 4 to 16 | 75 | 6 | #2 | 1000 each | Weekly | Various | |
| | | | | Concrete Pavers | 2 | 150 | 1 | #2 | 250 | Seasonal | Various | |
| | | | | Excavators | 6 to 13 | 200 | 2 | #2 | 1000 each | Seasonal | Various | |
| | | | | Forklifts | 8 | 75 | 1 | #2 | 1000 | Seasonal | Various | |
| | | | | Generators | 6 | 75 | 1 | #2 | 250 | Weekly | Various | |
| | | | | Motor Graders | 12 to 19 | 200 | 5 | #2 | 600 each | Seasonal | Various | |
| | | | | Rollers/Compactors | 6 to 8 | 50 | 3 | #2 | 600 each | Seasonal | Various | |
| | | | | Rubber Tire Loaders | 6 to 14 | | 5 | #2 | 600 each | Seasonal | Various | |
| | | | | Rubber Tire Tractors | 38 | 80 | 1 | #2 | 100 | Seasonal | Various | |
| | | | | Scrapers | 29 | 250 | 1 | #2 | 500 | Seasonal | Various | |
| | | | | Skid Steer Loaders | 1 to 8 | 60 | 3 | #2 | 750 each | Seasonal | Various | |
| | | | | Street Sweeper/Broom | 12 to 14 | 60 | 2 | #2 | 1000 | Seasonal | Various | |
| | | | | Trenchers | 29 | 250 | 1 | #2 | 1000 | Seasonal | Various | |
| Company | # Of | Fuel Grade | Gallons/Yr | DE Type | Engine | DE Pop. | # of | Fuel | Hours | Use | County of | AGCC, CCA, |
| | Employees | | (2001) | | Age | Hp | Units | Grade # | Use/Yr. | Profile | Operation | Rocky Mtn. |
| Yenter Companies | 180 | .005% Diesel | 130,000 | Air Compressor | 1 to 23 | | 25 | #2 | 250 | Daily | Jefferson | CCA |
| | | | | Backhoe Loaders | 6 | | 1 | #2 | 350 | Daily | All | |

| | | | | | | | | | | |
|------------------|-----------|-----|-------------------------|---------|-----|---|-----|------|-----------|-----------|
| | | | Bore/Drill Rigs | 1 to 10 | | 4 | #2 | 900 | Daily | All |
| | | | Cement & Motar Mixers | 1 to 6 | | 4 | gas | | Daily | All |
| | | | Excavators | 2 to 5 | | 5 | #2 | 1200 | Daily | All |
| | | | Excavators (mini) | 14 | | 1 | | 350 | Daily | All |
| | | | Rollers/Compactors | 3 | | 1 | #2 | 150 | Daily | Jefferson |
| | | | Rough Terrain Forklifts | 15 | | 1 | #2 | 700 | Daily | Jefferson |
| | | | Rubber Tire Loaders | 3 | | 4 | #2 | 2000 | Daily | Gilpin |
| | | | Skid Steer Loaders | 1 | | 4 | #2 | 900 | Daily | Gilpin |
| Zimmerman Metals | #1 Diesel | 460 | Crane | 28 | 120 | 1 | #1 | 30 | Quarterly | AGCC |
| | | | Forklift | 13 | 55 | 1 | #1 | 384 | Daily | |
| | | | Off Highway Truck | 2 | 150 | 1 | #1 | 215 | Daily | |

This spreadsheet shows data from the second survey—of RMFMA members only.

**Diesel Survey Database -
responses given from
Rocky Mountain Fleet
Management Asso. (or
RMFMA)**

| Name of Organization | Contact Person | # of Gallons Annually | # of Gal. Of Non-Low Sulfur | Gallons Used Off-Road | # of Off-Road Owned | # of Off-Road Rented |
|-------------------------|----------------|-----------------------|-----------------------------|-----------------------|---------------------|----------------------|
| Arvada, City of | J. Longmeyer | 68000 | 0 | 3400 | 63 | 2 |
| Aspen, City of | W. McFarlin | 38012 | 0 | 7602 | 45 | 1 |
| City of Aurora | G. Carlton | 250000-280000 | 0 | N/A | 150 | Limited |
| Aurora Public Schools | C. August | 115000 | 0 | None | None | |
| Avon/Beaver Crk. Trans. | D. Higgins | 119800 | 0 | 3300 | 9 | N/A |
| Canon City | G. Stepleton | 25000-28000 | 0 | 10000 | 4 | 0 |

| Name of Organization | Contact Person | # of Gallons Annually | # of Gal. Of Non-Low Sulfur | Gallons Used Off-Road | # of Off-Road Owned | # of Off-Road Rented |
|---|-----------------------------|-----------------------|-----------------------------|-----------------------|---------------------|----------------------|
| Cherry Creek Schools | D. Anderson | 300000 | 0 | 0 | 0 | 0 |
| Colorado Springs, City of A13 | N. Joyce | 1046129 | 0 | 186754 | 323 | 0 |
| Commerce City | F. Limmel | 9000 | 0 | 0 | 12 | 0 |
| CSU Motor Pool | G. Stroh | 52000 | 0 | 0 | 25 | 0 |
| Denver, City & County of | F. Espinosa | 1605188 | 0 | 72800 | 175 | |
| Denver Spring & Suspen. *also operates in Clear Creek, Jefferson, Adams, Arapahoe, Douglas, Summit, Park | R. Buffum | 1000 | 0 | 0 | 0 | 0 |
| Denver Water Org | M. West | 297340 | 0 | 80000 | 115 | 7 |
| Douglas Cnty. School Dist. | G. Walk | Minimal | N/A | N/A | 1 | 0 |
| Name of Organization | Contact Person | # of Gallons Annually | # of Gal. Of Non-Low Sulfur | Gallons Used Off-Road | # of Off-Road Owned | # of Off-Road Rented |
| Douglas County Dept. of Public Works | D. Fellhauer & J. Carothers | 269500 | 0 | N/A | 28 | Occasionally |
| Estes Park, Town of | D. Mahany | 11742 | 0 | 5300 | 23 | 0 |
| Foothills Golf Course | P. Janosik | 6450 | 0 | 6450 | 19 | 1 |
| Foothills Parks & Rec. | B. Johnsmiller | 65831 | 0 | 5000 | 22 | 0 |

| Fuelman of Colorado | J. Cornish | *does not operated any off-road equipment | | | | |
|---|----------------|---|-----------------------------|-----------------------|---------------------|----------------------|
| Jefferson County Schools | G. Rees | 750000 | 0 | 6500 | 53 | 0 |
| Jefferson County Fleet Services | P. Nees | 560000 | 0 | 60000 | 130 | 0 |
| Larimer County Fleet | K. Nohava | 488000 | 0 | 199000 | 102 | 0 |
| Larimer County Parks & Recreation | D. Roth | 3500 | 0 | 2500 | 8 | 4 |
| Name of Organization | Contact Person | # of Gallons Annually | # of Gal. Of Non-Low Sulfur | Gallons Used Off-Road | # of Off-Road Owned | # of Off-Road Rented |
| Littleton, City of | A. Brown | 50000-60000 | 0 | 5000 | 16 | N/A |
| Littleton Public Schools | R. Jerry | 120047 | 0 | 375 | 5 | 0 |
| LL Johnson | D. Melichior | 25000 | unknown | 250 | 15 | 0 |
| Loveland, City of | S. Kibler | 186200 | 0 | 0 | 65 | 0 |
| McCanless | Rhonda | *Only a vendor of diesel equipment, does not operate any. | | | | |
| Public Service Company of Colorado *operates in Adams, Arapahoe, Logan, Morgan, Garfield, Chaffee, Alamosa, and Summit | M. Hennesy | 383000 | Unknown | 19894 | 221 | 0 |

| Pueblo, City of | G. Schoenrock | 100566 | 0 | 25000 | 101 | 0 |
|--------------------------------------|----------------|-----------------------|-----------------------------|-----------------------|---------------------|----------------------|
| Thornton, City of | G. Curtin | 225000 | 0 | 33750 | 35 | 2 |
| Name of Organization | Contact Person | # of Gallons Annually | # of Gal. Of Non-Low Sulfur | Gallons Used Off-Road | # of Off-Road Owned | # of Off-Road Rented |
| Snowmass Village, Town of | D. Joyner | 55000 | 0 | 3664 | 10 | 0 |
| South Suburban Park & Rec. District, | S. Bunt | 16060 | 0 | 13780 | 45 | 2 to 3 |
| Steamboat Springs, City of | D. Marsh | 45000 | 0 | 45000 | 46 | 0 |
| Summit County Road & Bridge | S. Stephens | 328000 | 0 | 16400 | 27 | 1 |

G. Large Acreage Developments

PM-10 permits that address prevention of fugitive dust emissions are required for large area excavation, construction and destruction projects. Housing developments, office parks, and other projects covering 25 acres or more, or for which earth moving or grading activity would continue for 6 months or more, were tallied for all Colorado counties for 1997-2002 from the Division's PM-10 permitting system. Such projects must receive a PM-10 permit that contains provisions for limiting dust from the site.

Developers and builders typically contract the excavating and grading work to firms specializing in this work, and this is accounted for in the various surveys.

Typical large single-family housing development sites average 74 acres in the United States, Australia and Barbados, according to random hits on the Internet. Such developments provide contract housing, as opposed to custom-built—and typically accommodate a range of 1-to-7 houses per acre.

Building permits and construction cost statistics were gathered for all new privately-owned residential housing units in Colorado counties from 1997 through 2001. The information was provided by the U.S. Census Bureau, which collects building permit information monthly from municipalities and counties nationwide (<http://censtats.census.gov/bldg/bldgprmt.shtml>). Residential construction data were acquired electronically from the Bureau's Residential Construction Branch. The data includes new construction only, not alterations, expansions, renovations, which are captured in the following **Section H** of this report.

The tables and graphs that follow indicate a strong correlation exists between construction permits (new building permits of all types) and construction dollars spent. NOTE: Construction activity does not necessarily indicate diesel equipment activity. As noted elsewhere, much construction activity, including expansions and renovations, takes place in the absence of diesel equipment.

Population correlates strongly to construction project activity, especially to PM-10 permits. Additional findings are discussed after the tables and graphs.

PM-10 Permits by County & Year Projects > 25 acres or > 6 months duration

| County | 1997 | 1998 | 1999 | 2000 | 2001 | 2002* | Total Permits |
|-----------|------|------|------|------|------|-------|---------------|
| Archuleta | 1 | | | | | 1 | 2 |
| Adams | 20 | 12 | 41 | 10 | 11 | 10 | 104 |
| Alamosa | 2 | | | | 1 | | 3 |
| Arapahoe | 5 | 20 | 11 | 17 | 12 | 7 | 72 |
| Baca | 1 | 2 | 2 | | | | 5 |
| Bent | 1 | | | | | | 1 |

| | | | | | | | |
|-------------|----|----|----|----|----|---|----|
| Boulder | 7 | 4 | 22 | 2 | 1 | 3 | 39 |
| Clear Creek | 2 | | 1 | | | 1 | 4 |
| Chaffee | 2 | | | 3 | | | 5 |
| Crowley | | | | | 1 | | 1 |
| Custer | | | | 1 | | | 1 |
| Denver | 23 | 21 | 13 | 13 | 5 | 7 | 82 |
| Douglas | 3 | 2 | 1 | 10 | 2 | 3 | 21 |
| Delta | 2 | 1 | | 1 | | | 4 |
| Dolores | | | | | | 1 | 1 |
| Eagle | 7 | | | 1 | 1 | 1 | 10 |
| El Paso | 17 | 6 | 15 | 6 | 6 | 7 | 57 |
| Fremont | 3 | | 3 | 1 | | | 7 |
| Garfield | 14 | 2 | 2 | 11 | 6 | 1 | 36 |
| Grand | | | | 1 | 3 | | 4 |
| Gunnison | 2 | 1 | | 1 | 1 | | 5 |
| Hinsdale | 1 | | | | | | 1 |
| Huerfano | 2 | 1 | | | | | 3 |
| Jefferson | 29 | 16 | 18 | 12 | 12 | 5 | 92 |
| Kit Carson | 2 | 1 | 1 | 2 | 2 | | 8 |

PM-10 Permits by County & Year

Projects > 25 acres or > 6 months duration (list continued from previous page)

| County | 1997 | 1998 | 1999 ¹ | 2000 | 2001 | 2002 | Total Permits |
|----------------------|------------|------------|-------------------|------------|-----------|-----------|---------------|
| Lincoln | 4 | 1 | | 3 | | | 8 |
| Logan | 1 | | 1 | | | 3 | 5 |
| La Plata | 1 | 1 | 22 | 4 | 3 | | 31 |
| Larimer | 4 | 2 | 13 | 6 | 2 | 9 | 36 |
| Mesa | 5 | 1 | 9 | 2 | 2 | 1 | 20 |
| Moffat | 1 | 1 | 1 | 6 | 3 | 2 | 14 |
| Montezuma | | 2 | | | 2 | | 4 |
| Montrose | 1 | 3 | | 5 | | 2 | 11 |
| Morgan | 2 | | 10 | 3 | 2 | | 17 |
| Otero | 3 | | 4 | | | | 7 |
| Ouray | 1 | | | | | 1 | 2 |
| Pueblo | 14 | 3 | 10 | 7 | | | 34 |
| Phillips | | 1 | | | | | 1 |
| Pitkin | | 1 | | 1 | | | 2 |
| Prowers | 2 | | | | | | 2 |
| Rio Blanco | | | 4 | 2 | 2 | 3 | 11 |
| Rio Grand | 3 | | | | 2 | | 5 |
| Routt | 2 | 1 | 3 | 1 | | | 7 |
| Summit | 5 | | | | | | 5 |
| Teller | 2 | | | 3 | | 1 | 6 |
| Weld | 13 | 15 | 5 | 9 | 7 | 8 | 57 |
| Yuma | 1 | 1 | 1 | | | | 3 |
| Portable Sources | 3 | | | 1 | | 2 | 6 |
| Total by Year | 214 | 122 | 217 | 146 | 89 | 81 | 869 |

Broomfield data are not included since Broomfield became a Colorado county in 2001, and no data were available.

Construction permit totals follow the economy: Note the drop in the number of projects for 2001-2002.

This spreadsheet shows construction dollars spent per Colorado county from 1997 through 2002.

| Construction Cost by County and Year (last updated 10/17/2002) | | | | | | |
|---|-------------|-------------|---------------|-------------|-------------|-----------------------------|
| County | 1997 | 1998 | 1999 | 2000 | 2001 | Total Per County |
| Adams | 324,420,000 | 415,770,974 | 355,782,130 | 512,901,167 | 639,300,738 | 2,248,175,009 |
| Alamosa | 5,476,000 | 4,487,351 | 5,538,070 | 4,624,105 | 6,205,761 | 26,331,287 |
| Arapahoe | 387,852,000 | 451,601,884 | 616,155,171 | 748,566,284 | 723,894,081 | 2,928,069,420 |
| Archuleta | 34,085,000 | 52,255,292 | 49,610,470 | 71,819,650 | 52,991,074 | 260,761,486 |
| Baca | 497,000 | 828,784 | 475,000 | 320,000 | 310,000 | 2,430,784 |
| Bent | 862,000 | 1,193,300 | 437,469 | 1,564,250 | 1,168,500 | 5,225,519 |
| Boulder | 334,634,000 | 471,493,439 | 368,515,507 | 372,871,976 | 373,952,697 | 1,921,467,619 |
| Broomfield | NA | NA | NA | NA | NA | 0 |
| Chaffee | 13,668,000 | 16,397,820 | 18,567,671 | 20,860,964 | 21,261,792 | 90,756,247 |
| Cheyenne | 369,000 | 270,000 | 220,000 | 215,000 | 377,980 | 1,451,980 |
| Clear Creek | 13,673,000 | 12,035,541 | 15,383,242 | 10,171,207 | 12,622,721 | 63,885,711 |
| Conejos | 4,554,000 | 111,000 | 4,628,373 | 4,935,839 | 4,705,670 | 18,934,882 |
| Costilla | NA | NA | NA | NA | NA | 0 |
| Crowley | 80,000 | 0 | 320,000 | 1,110,000 | 200,000 | 1,710,000 |
| Custer | 22,865,000 | 13,558,465 | 8,894,450 | 18,344,964 | 15,944,787 | 79,607,666 |
| Delta | 2,941,000 | 5,437,503 | 7,475,737 | 7,219,042 | 2,893,030 | 25,966,312 |
| Denver | 176,201,000 | 338,702,107 | 299,672,600 | 314,704,168 | 405,310,586 | 1,534,590,461 |
| Dolores | 322,000 | 704,807 | 704,807 | 822,275 | 1,221,555 | 3,775,444 |
| Douglas | 806,605,000 | 949,220,333 | 1,051,254,548 | 961,042,477 | 867,183,876 | 4,635,306,234 |
| Eagle | 309,413,000 | 288,328,335 | 275,464,687 | 308,344,696 | 187,940,894 | 1,369,491,612 |
| Elbert | 8,730,000 | 8,326,381 | 39,635,055 | 47,492,068 | 43,335,635 | 147,519,139 |
| El Paso | 434,191,000 | 506,044,849 | 565,268,390 | 710,778,011 | 773,069,808 | 2,989,352,058 |
| Fremont | 26,651,000 | 17,018,356 | 30,975,293 | 28,552,748 | 30,552,415 | 133,749,812 |
| Garfield | 52,001,000 | 62,631,312 | 85,758,503 | 106,379,965 | 92,511,276 | 399,282,056 |
| Gilpin | 7,033,000 | 7,828,847 | 8,984,788 | 9,300,325 | 8,087,802 | 41,234,762 |
| Grand | 47,498,000 | 87,204,842 | 68,881,378 | 104,131,176 | 85,138,670 | 392,854,066 |
| Gunnison | 27,840,000 | 37,349,438 | 49,430,999 | 52,254,551 | 31,438,109 | 198,313,097 |
| Hinsdale | 2,292,000 | 1,673,842 | 1,673,842 | 1,953,205 | 2,164,292 | 9,757,181 |
| Huerfano | 7,360,000 | 60,000 | 8,128,375 | 8,820,489 | 9,541,573 | 33,910,437 |
| Jackson | 960,000 | 1,504,050 | 1,185,500 | 6,310,000 | 1,155,584 | 11,115,134 |
| Jefferson | 325,725,000 | 328,123,295 | 319,125,525 | 313,754,457 | 270,320,372 | 1,557,048,649 |
| Kiowa | 0 | 150,000 | 70,000 | 0 | 100,000 | 320,000 |
| Kit Carson | 1,051,000 | 1,452,507 | 4,015,309 | 3,769,872 | 1,500,799 | 11,789,487 |
| Lake | 5,137,000 | 4,330,558 | 5,269,965 | 6,471,145 | 6,488,270 | 27,696,938 |
| La Plata | 52,118,000 | 15,882,956 | 49,913,766 | 54,454,171 | 64,455,653 | 236,824,546 |
| Larimer | 291,815,000 | 354,740,130 | 403,100,414 | 427,366,062 | 431,584,889 | 1,908,606,495 |
| Las Animas | 9,486,000 | 9,677,653 | 9,171,300 | 8,023,369 | 8,236,111 | 44,594,433 |
| Lincoln | 1,500,000 | 1,600,392 | 1,251,341 | 1,375,723 | 1,075,000 | 6,802,456 |
| Logan | 9,114,000 | 7,642,719 | 6,035,939 | 6,555,642 | 5,818,660 | 35,166,960 |
| Mesa | 90,083,000 | 103,217,858 | 127,411,778 | 128,285,242 | 126,529,558 | 575,527,436 |
| Mineral | 130,000 | 68,000 | 140,833 | 151,666 | 219,363 | 709,862 |
| Moffat | 4,496,000 | 3,681,275 | 4,438,519 | 4,156,251 | 4,748,943 | 21,520,988 |

| | | | | | | |
|------------|-------------|-------------|-------------|-------------|-------------|---------------|
| Montezuma | 1,607,000 | 3,625,200 | 1,760,069 | 3,564,301 | 4,325,381 | 14,881,951 |
| Montrose | 17,752,000 | 23,155,050 | 27,076,375 | 28,962,637 | 33,462,235 | 130,408,297 |
| Morgan | 10,107,000 | 11,743,594 | 9,485,013 | 12,144,680 | 9,878,924 | 53,359,211 |
| Otero | 2,892,000 | 3,998,513 | 2,415,044 | 4,309,843 | 5,145,954 | 18,761,354 |
| Ouray | 13,872,000 | 13,770,921 | 16,833,205 | 19,020,356 | 20,074,058 | 83,570,540 |
| Park | 31,368,000 | 34,861,678 | 42,141,896 | 45,743,839 | 45,478,409 | 199,593,822 |
| Phillips | 2,053,000 | 1,031,601 | 1,894,964 | 785,084 | 1,063,934 | 6,828,583 |
| Pitkin | 107,712,000 | 107,674,049 | 152,954,551 | 138,515,895 | 81,890,546 | 588,747,041 |
| Prowers | 3,721,000 | 3,165,949 | 6,029,885 | 1,268,953 | 1,133,000 | 15,318,787 |
| Pueblo | 106,687,000 | 126,515,074 | 135,433,617 | 106,645,097 | 122,765,867 | 598,046,655 |
| Rio Blanco | 1,236,000 | 570,000 | 1,214,200 | 1,433,500 | 3,033,498 | 7,487,198 |
| Rio Grand | 11,967,000 | 10,751,465 | 11,494,749 | 14,418,155 | 13,584,029 | 62,215,398 |
| Routt | 51,504,000 | 77,232,513 | 103,939,812 | 116,784,840 | 83,793,613 | 433,254,778 |
| Saguache | 3,656,000 | 6,065,476 | 5,370,055 | 6,932,820 | 6,471,894 | 28,496,245 |
| San Juan | 723,000 | 750,223 | 503,425 | 214,980 | 2,091,276 | 4,282,904 |
| San Miguel | 43,539,000 | 72,383,662 | 81,000,946 | 122,972,148 | 100,228,717 | 420,124,473 |
| Sedgwick | 1,586,000 | 867,000 | 187,474 | 620,375 | 236,000 | 3,496,849 |
| Summit | 149,756,000 | 191,366,642 | 101,943,307 | 180,898,045 | 110,084,967 | 734,048,961 |
| Teller | 33,941,000 | 36,832,972 | 35,340,857 | 44,292,441 | 36,062,156 | 186,469,426 |
| Washington | 727,000 | 1,339,900 | 713,900 | 1,268,569 | 912,000 | 4,961,369 |
| Weld | 217,500,000 | 361,878,901 | 418,339,009 | 579,174,493 | 595,058,983 | 2,171,951,386 |
| Yuma | 967,000 | 742,200 | 1,140,372 | 1,343,640 | 1,006,450 | 5,199,662 |

Total by Year 4,658,601,000 5,672,928,778 6,026,179,469 6,822,088,893 6,593,340,415

For 1997, construction cost units are rounded to the thousands of dollars, whereas for 1998 through 2001, annual construction cost units are absolute values rounded to the dollar.

It should be noted that averaging for correlation analyses tends to obscure certain county differences, such as the fact that Mesa and Pitkin counties spent about the same amount on construction, but that Mesa County had 7 times the number of permits as were filed in Pitkin County (home of Aspen). This is very likely due to the fact of a preponderance of wealthy residents in Pitkin, who build fewer, larger homes on greater acreage. This is significant to the hypothesis of this report, namely that diesel equipment activity does not correlate directly to dollars spent.

H. Small Residential Builders/Small Developments

A survey questionnaire regarding diesel equipment usage was designed for a sample of the residential builder population in Colorado. Residential builders were targeted to form an estimate of diesel emissions from small-scale construction activities in the Denver-metro and surrounding area. For the purpose of this study, residential builders are defined as small companies (relative to large homebuilder corporations), having resources relative to the companies' limited economic strength.

The survey asked questions related to diesel activity. Samples were analyzed for project types; diesel equipment inventories; total projects per year; percent of projects requiring diesel equipment; average length of projects; and percent of time the diesel equipment is active. The data timeframe is based on an estimation of annual activities in recent seasons (i.e. 2001-2002). The residential builder population may perform construction activities such as building new residential homes and small commercial structures, renovations and restorations, roofing, and foundation work including exterior earthmoving work. Certain companies in this category operated no diesel equipment, as they were involved in renovations only, while some builders contracted out certain activities that require diesel equipment, e.g., excavating and grading of land.

Members of the Colorado Contractor Association (CCA), the Associated General Contractors of Colorado (AGC), and the Rocky Mountain Fleet Management Association (RMFMA) were excluded from this sample.

- **Sampling Method and Geographic Coverage**

Residential builder companies were listed in online directories and Colorado yellow pages. From this population, the Division generated a geographically representative sample of 25 companies based on the Denver-metro geographic region. All contributing companies in the sample were initially contacted via telephone. Although the sample size is less than the statistical standard of 30, the collected data include significant diversity to represent a wide cross section of the population.

A total of 18 residential construction companies provided full responses to survey questionnaires. Surveys were completed and returned to the Division either by telephone, facsimile, mail or electronic mail. The sampling period began on November 25, 2002, and concluded on February 3, 2003. Quality assurance measures were performed throughout the sampling procedure in order to preserve accuracy of data.

- **Limitations of Data and Resolution for This Report**

While most survey responses are based on records, some are estimations provided by company representatives based on professional experience.

Equipment load factors were not reported, as this is a constantly changing variable in the course of most diesel equipment's performance day. For a future report, load and horsepower information could be reckoned using factors from other sources. Then, averages of such factors could be worked into an equation using the above data.

Collapsing of some data was necessary when survey respondents gave ranges of data. For example, the Division averaged project durations and information regarding equipment hours in use for certain responders.

Residential builder data are diverse. The annual number of projects ranges from two to twenty four within the sample. Project length ranges from 2 days to 12 months. Five of the 18 companies surveyed said they use no diesel equipment for the type of construction work in which they specialize.

The use of diesel equipment is mainly limited to grading and foundation excavation. For those projects that employ diesel equipment, the equipment is active 31% of the time

On average, 43 percent of their projects use diesel equipment. Of that percentage, the diesel equipment is active 21% of the time.

Seven (7) of the 18 told us how many projects per year (average: 13) and their length of duration (average: 4.34 months).

Temporal assumptions: A month = 20 working days (8 hours) = 160 working hours in the Colorado construction industry since there are so many sunny days, and mild winter temps at the lower elevations.

| Company | Proj.Types | Number projects/yr. | Avg. Length Project (mos.) | Annual project hours | %Projects Use Diesel | % Time Diesel Active | Active Diesel hours per year |
|----------------|---------------------------|---------------------|----------------------------|----------------------|-----------------------|----------------------|------------------------------|
| ABC | New & renovations | 4 | 5.5 | 3,520 | 40 | 6 | 84.48 |
| ACCI | New (grade lot) | 10 | 4.0 | 6,400 | < 5 | 4 | 12.8 |
| Anthony | New | | 4.0 | | 5 (95% subcontracted) | 10 | |
| B&B | | Can we get? | | | NONE | | |
| Classic | New | 24 | 9.0 | 34,560 | 95 | 5 | 1,641.6 |
| Dovetail | | | | | NONE | | 0 |
| Eisenman | Restoration | | | | NONE | | 0 |
| Final Touch | Foundation | 20 | 1.5 | 4,800 | 7 | 5 | 16.8 |
| GCM | Roof, sheet rock | 2 | 0.10 | 32 | NONE | | 0 |
| Iglehart | All excavat | | 1.0 | | 100 | 100 | |
| Image | New | | | | NONE | | |
| Masterbilt | New | | 0.10 | | 100 | 88 | |
| Merritt | New | | 3.5 | | 90 | 5 | |
| Norris | New | | 6.0 | | 100 | 5 | |
| Parrish | Dirt/backfill | | 3.5 | | 25 | 10 | |
| Phipps | New/remodel | | 12.0 | | 50 | 25 | |
| Sattler | Excavat, concrete pumping | 10 | 0.50 | 800 | 100 | 2.5 | 20 |
| Select | Remodel, new | 10 | 4.0 | 6,400 | 65 | 10 | 416 |
| AVERAGE | | 11.43 | 3.91 | 625.6 | 43% | 15.31 | 322 |

Residential Bldrs.portrait Table.doc

Day = 8 hours
Week = 40 hours
Month = 20 days (160 hours)
Year = 1,920 hours

I. Excavation Contractors

The Excavation Contractors group is a diverse one. Their main commonality is that when they're on the job, excavators are usually running their equipment. Excavation companies may clear and grade land and dig for basements and foundations. They also excavate for drainage ditches, septic systems and swimming pools. A few excavators also build structures, such as foundations. Some grade small roads, dredge ponds, or clear away unwanted soil and construction refuse. Some are gravediggers.

As a group, Colorado excavators likely contribute a major portion of Colorado's *off-road* diesel exhaust emissions.

Representative sampling of Colorado excavators was conducted. The sampling approach was selected to maximize diversity regarding company size, range of diesel equipment, and geographic coverage. Directories were chosen from areas representing the broadest possible variety of community/geographical/economic types--including Denver Metro Area, eastern and western slope urban and rural, and mountain communities.

The group includes companies that prepare the ground for smaller residential developments and individual homes. (Larger residential projects are undertaken by national or regional companies, which are represented in **Section G** of this Part III.)

Forty-five responses were received of the 50-plus contacted. The questions asked differed slightly from those asked of the small residential construction group, as is reflected in the spreadsheet.

Excavation companies surveyed provided the information in Table XXX. Note that trucks of several types are listed as reported in the survey, even though most of the trucks would be counted as on-road vehicles for emission inventory purposes. Total reported operational hours (474,512 hours) for the 429 pieces of diesel equipment averages out to 1,106 operational hours per year for the diesel excavation equipment in the sample. This appears to be a reasonable number, given an assumed 1,920 working hours per year.

Limitations of this survey: Some survey responses were estimations or averages rather than actual counts, such as for operational hours. In a few cases equipment population was estimated. In some cases company representatives refused or could not answer certain questions. The Division conducted analyses only on respondent-supplied data, although averaging of and collapsing of data was necessary in some instances.

Even though diesel fuel type ("dyed" meaning for off-road use and a 5,000 ppm legal sulfur cap; "clear" indicating on-road fuel with a legal cap of 500 ppm sulfur) is provided, its significance with regard to emissions is not clear. See preliminary fuel sampling results in Section B of this Part III. See also the NONROAD model's low sensitivity to sulfur levels in calculating diesel exhaust particulate emissions in Section C of Part III.

Most prevalent and total number of equipment pieces from sample are as follows:

| | |
|---------------------------|-----------|
| Backhoe | 86 |
| Excavator | 74 |
| Front-end loader (Loader) | 60 |
| Class 8 truck | 29 |
| Compactor | 27 |
| Skid steer | 21 |
| Scraper | 21 |
| Grader | 16 |
| Semi or Mack truck | 16 |
| Bulldozer | 15 |
| Hauler/dump truck | 13 |
| Tandem | 09 |
| Bobcat | 07 |
| Side boom | 06 |
| Blade | 05 |
| Track hoe | 05 |
| Tractor | 04 |
| Trencher | 04 |
| Wheeled buckle loader | 02 |
| Septic pump truck | 02 |
| Blade maintainer | 01 |
| <u>Water truck</u> | <u>02</u> |
| | 429 |

For a future report, averaged information should be applied to total Colorado excavation equipment. Such statewide diesel equipment information should be purchased from FW Dodge for use in a final report.

Table XXX (Excavation Companies Surveyed)

| Excavating Company | Project types | Equipment | Pop. | Hours/year operational | Equipment Age (Years) | Fuel type |
|---|--|--|-----------------|--|--|-----------|
| Denver Metropolitan Area | | | | | | |
| Amvi | Custom foundations | Front-end loader | 1 | 1,050 | 23 | Dyed |
| Big Horn Excavating | Foundations, sewer lines, other residential | Bobcat Backhoe Loader | 1 1 1 | | 1 8 3 | |
| Black River Ranch Exc. | Retaining walls, foundations | Backhoe Loader | 2 1 | 1,500 1,500 | 1, 3 2 | Clear |
| Brent Owens' Backhoe Services | Foundations, ditches, Utilities, Compaction | Backhoe | 2 | 1,000 | 10, 3 | Clear |
| Bumblebee Backhoe | Water & sewer lines, Pools, Septic, Leach fields | Backhoe Lease: Front-end loader, Compactor, Mini excavator, Bobcat | 1 | 400 375 375 375 375 | 4 1-2 for all leased equipment | Clear |
| DACOA Inc. | Earthmoving | Scrapers, Blades, Loaders | 15 | No answer | 5 & newer | Dyed |
| D&J Excavating | Residential & Commercial | Track hoe Back hoe Grader Loader Off-road haulers Tractor Bull Dozer | Wouldn't answer | 1,680 1,680 1,680 1,680 1,680 1,680 Dozer runs very little | Most equipment under 10 years; Dozer older than 10 yrs. | Dyed |
| Duran Excavating | Excavating | Loader Excavator Grader | 19 pieces total | 105.26 each piece | 5 | Dyed |
| Earth Excavating, Inc. | Mostly residential | Loader Excavator Backhoe | 2 1 2 | 400 each piece | 5-10 | Dyed |
| Farmers' Highline Canal & Reservoir Co. | Mow and repair canal banks | Excavator Backhoe Tractors | 1 2 3 | 50 25 20 | 9 7 5 | Clear |
| Fehr's Excavating Inc. | Residential | Dump truck Loader | 2 2 | 208 each 832 each | Both 10 3, 5 | Dyed |

| Excavating Company | Project types | Equipment | Pop. | Hours/year operational | Equipment Age (Years) | Fuel type |
|---|---|--|------------------|--|---|-------------------------------|
| Denver Metropolitan Area – continued | | | | | | |
| I&M Excavating | Septic systems Roads Foundations | Backhoe | Lease | 60 | Lease 1-2-year-old equipment | Clear |
| Kelly's Excavating | Excavation Foundations | Backhoe Loader Skid Steer | 2 5 3 | 2,600 n/a n/a | 5 & newer | Dyed |
| Long Reach Excavators | Pond & ditch cleaning; Contaminated soil removal | Track Excavator | 3 | 500 each | 2,2,13 | Dyed |
| Mount Olivet Cemetery Association | Grave Digging, Pour foundation for markers | Front-end loader Grader Industrial tractor Backhoe | 1 1 1 3 | 12 96 4 12 each | 15 18 15 12 9 1 (2003 model) | Clear |
| Parker Excavating Inc. | Heavy highway grading; Utilities | Track excavator Bull dozer, Water truck Hauling truck Belly Dump Tandem Wheeled buckle-loader Small skid steer Generator | 30-35 | No answer | All within 10 years | N/a |
| Rose Hill Cemetery | Grave digging (mostly done by hand), Grading, Stump removal, Snow clearing | Backhoe | 1 | 8 | 6 | Clear |
| PBM Excavating Co. | Excavating, Foundations | Backhoe Excavator Loader Skid loader | 1 1 2 2 | 1,000 1,000 1,000 each 1,000 each | 2 2 2 2 | Clear |
| Pine Grove Excavating, Inc. | Excavating | Dump truck Backhoe Loader Excavator Skid loader | Total 14 | 600 each | All are 10 years or newer | Dyed |
| TBL Excavating Inc. | Excavating Hauling Final grades | Loaders Backhoe Excavator Tandems | Total 35 | 2,600 each | All 30 pieces 10 years or newer | Dyed Dyed Dyed Clear |
| 4 x 4 Excavating, Inc. | Residential | Backhoe Loader Bobcat | 1 2 2 | 1,040 each piece | All 5 pieces 12 years & newer | Dyed |

| Excavation Company | Project types | Equipment | Pop. | Hours/year operational | Equipment Age (Years) | Fuel type |
|-------------------------------------|---|---|--|------------------------|---|--------------------|
| Weld County | | | | | | |
| John L. Beauprez Enterprises | Residential and Community grade & gravel roads (no asphalt) | Grader | 1 | 800 | 5+ | Dyed |
| Crall & Bowers, Inc. | Commercial earthwork contractor | Backhoe Loader Grader Bobcat Dump truck | 2 5 1 3 8 | Couldn't answer | All are 12 years or newer | Dyed |
| J&J Excavating of Northern Colorado | Excavation | Backhoe Track hoe Skid loader | 2 4 1 | Couldn't answer | All 2 years or newer | Dyed |
| Lockman Excavating | Residential | Backhoe Skid steer | 1 1 | 1,500 1,500 | 3 4 | Dyed |
| McDonald Farm Enterprises | Trucking & Environmental services | Various, including on-road trucks | Total 30 | 2,000 each | 15 | Clear |
| Rinehart Construction Co. | Residential and Community | Dump truck Backhoe Loader Motor grader Trencher (large) Trencher (small) | 1 of each | Couldn't answer | 17 1 10 10 11 11 | Both |
| Trans-Colorado Excavation | Mainly residential some Community | Wheeled loader Excavator Track skid loader | 2 2 1 | 2,250 each piece | 1 2 1 | Dyed |
| Teller County | | | | | | |
| Colorado Classic Log Homes, Ltd. | Residential septic & foundations | Backhoe | 1 | 480 | 4 | Gas station diesel |
| Summit County | | | | | | |
| Stan Miller, Inc. | Excavation | Excavator Class 8 Truck Dozer Motor scraper Motor grader Backhoe.loader Self-propelled compactor Skidsteer Loader | 18 29 9 14 5 5 23 6 18 | 1,200 each piece | 6 (average) 10 12 15 9 7 6 8 10 | Clear |

| Excavation Company | Project types | Equipment | Pop. | Hours/year operational | Equipment Age (Years) | Fuel type |
|-------------------------------------|---|---|---------------------------------|---|---|-------------------------------|
| Pueblo County | | | | | | |
| Gopher Excavation, Inc. | Work for utilities and water districts | Semi-trucks Loader Excavator Backhoe | Total 25 | 307.20 average each piece | 2-24 | Both |
| Hawkins Excavating | Residential & community utilities, roads, dirt work, horse graves | Loader Backhoe Scraper Dozer Track hoe Road grader Dump truck | 1 1 1 1 1 1 2 | 55 55 0 70 65 25 55, 10 | Most pieces 20-30 years old Trucks, 40 | Clear & Dyed |
| Kearny & Sons Excavating, Inc. | Residential & community excavating; concrete batch plant | Loader Backhoe Track excavator Skid steer | 3 3 3 1 | 258.46 each piece avg. | 3-36 years | Dyed |
| Spears Excavating & Pipeline, Inc. | Residential & community excavation & utilities | Loader Backhoe Skid loader | 2 1 2 | 288 each, avg. | 3-4 years | Dyed |
| Weitzel & Sons Excavating | Mainly community, some residential & utilities | Backhoe Loader Grader Scraper Excavator Compactor Dump truck | 1 2 1 1 1 1 2 | Low hours | Low miles | Dyed |
| Mesa County | | | | | | |
| Accurate Construction & Excavating | Utility install. Septic systems, General | Excavator Skid steer loader Front-end loader 4,000-gal. water truck | 2 2 1 1 | 875 each | All 6 pieces within 10 years old | Dyed Dyed Dyed Clear |
| Bestway Services | Septic tanks and systems | Backhoe | 1 | 35 | 15-20 | Clear |
| Emergency Plumbing/Mikes Excavating | Repair sewer & water lines | Backhoe Septic pump truck | 1 1 | 768 216 | 22 22 | Dyed Clear |

| Excavation Company | Project types | Equipment | Pop. | Hours/year operational | Equipment Age (Years) | Fuel type |
|--------------------------------------|--|---|---|--|------------------------|-------------------------|
| Mesa County continued | | | | | | |
| Navahoe (sic) Backhoe Service | Footers Service lines Septic systems General excavating | Backhoe Mack truck | 1 1 | 11,200 3,200 (based on 10 months) | 3 14 | Gas station diesel fuel |
| Temple & Petty Construction | Directional boring Utilities | Excavator Dozer 2-ton truck Side boom Backhoe Skid steer Directional bore Trencher Blade maintainer | 2 1 5 6 15+ 1 5 4 1 | 1,150 each 1,150 1,150 ech 1,150 each 650 each 1,150 1,150 each 1,150 each 1,150 | Range from 10-15 years | Both |
| Telluride Gravel Inc. | General utility work | Backhoe Loader Excavator Compactor Dozer | 11 5 12 2 2 | 1,152 each 768 each 1,152 each 768 each 768 each | Range from 1-10 years | Dyed |
| La Plata County | | | | | | |
| Albrecht Lynne Backhoe Service | Utilities Septic systems Footers & Foundations | Backhoe Bulldozer | 1 1 | 160 160 | 13 26 (new engine) | Dyed |
| Diamondback Excavation | Mostly roads Rarely, septic or utilities | Excavator | 3 | 0 1,680 1,200 | 6 15 9 | Dyed |
| Durango Excavation Inc. | Utilities Septic Foundations | Backhoe Dozer | 1 1 | 500 500 | 6 5 | Dyed |
| Florida River | Excavator Snow plow | Skid steer with attachments | 1 | 1,440 | 9 | Dyed |

Day = 8 hours
Week = 40 hours
Month = 20 days (160 hours)
Year = 1,920 hours

J. Observed Residential Expansions and Renovations – Denver

Traveling from southwest of Denver to the Cherry Creek area southeast of downtown Denver from 1996 to the present has allowed the primary author to observe a variety of Metro Denver neighborhoods including several in Littleton, Englewood, Denver and Glendale.

The well-established and relatively affluent neighborhoods of Observatory Park, Washington Park, and Bonnie Brae are notable for their relatively high rates of home renovations and expansions. A homestore.com write-up notes the “pop-tops,” in which an upper story is added to existing home in Washington Park. Most original housing in Observatory Park/University Park built in the 1930s and 1950s is small. Builders have been leveling to build large new homes that sell for \$700,000 to \$900,000 .¹⁰

Over the past 4 years informal drive-by surveys indicated that numerous home expansions, renovations and pop-ups were taking place in these neighborhoods—sometimes 2-3 per city block.

Diesel equipment was seldom seen at the construction sites. Infrequently, a backhoe would be sighted—though never an operating one. A flatbed truck with operating generator was seen at one site in the four-year period.

Observations that diesel equipment was rarely present at home renovation and expansion sites contributed to the hypothesis that construction work and dollars spent would not correlate very strongly to diesel equipment activity. The survey information from small residential contractors (Section H) supports the hypothesis.

Limitations to the above information:

Most neighborhood observations were made between the hours of 7:00 and 8:00 a.m. and between 4:00 and 5:00 p.m. Thus, any diesel equipment noted was not observed during normal working hours.

Home expansions and major renovations tend to occur in “desirable,” relatively affluent neighborhoods. Observation regarding the few neighborhoods cited cannot be applied to the Denver Metro Area as a whole.

K. Comparing and Correlating Large Construction Permit Data, Other Building Permit Data, Population, and Dollars Spent in Colorado Counties

The following spreadsheets provide Colorado county data regarding

- (1) General construction (building) permits
- (2) PM-10 permits—for large acreage projects (>25 acres) that require substantial earth moving/grading with diesel equipment, and
- (3) Construction dollars spent per county.

| Building Permits by County and Year (last updated 10/17/2002) | | | | | | |
|--|-------------|-------------|-------------|-------------|-------------|----------------------|
| Prepared by Melanie Wasco CDPHE-APCD-Planning & Policy Intern | | | | | | |
| County | 1997 | 1998 | 1999 | 2000 | 2001 | Total Permits |
| Adams | 4,081 | 3,032 | 3,306 | 3,104 | 4,546 | 18,069 |
| Alamosa | 89 | 73 | 78 | 54 | 59 | 353 |
| Arapahoe | 4,131 | 3,147 | 4,356 | 4,442 | 3,745 | 19,821 |
| Archuleta | 243 | 268 | 257 | 359 | 279 | 1,406 |
| Baca | 10 | 12 | 10 | 7 | 7 | 46 |
| Bent | 15 | 23 | 14 | 17 | 12 | 81 |
| Boulder | 3,259 | 3,135 | 2,430 | 2,532 | 2,052 | 13,408 |
| Broomfield | NA | NA | NA | NA | NA | 0 |
| Chaffee | 166 | 191 | 216 | 228 | 219 | 1,020 |
| Cheyenne | 6 | 2 | 3 | 3 | 4 | 18 |
| Clear Creek | 83 | 69 | 84 | 58 | 65 | 359 |
| Conejos | 166 | 3 | 181 | 193 | 184 | 727 |
| Costilla | NA | NA | NA | NA | NA | 0 |
| Crowley | 2 | 0 | 4 | 20 | 3 | 29 |
| Custer | 218 | 137 | 90 | 134 | 107 | 686 |
| Delta | 39 | 60 | 53 | 93 | 26 | 271 |
| Denver | 2,261 | 1,870 | 1,917 | 1,720 | 1,259 | 9,027 |
| Dolores | 3 | 6 | 6 | 7 | 8 | 30 |
| Douglas | 5,563 | 5,369 | 5,689 | 4,870 | 4,200 | 25,691 |
| Eagle | 1,487 | 657 | 598 | 472 | 421 | 3,635 |
| Elbert | 316 | 297 | 288 | 317 | 302 | 1,520 |
| El Paso | 4,795 | 4,287 | 4,433 | 5,167 | 5,399 | 24,081 |
| Fremont | 327 | 248 | 405 | 381 | 366 | 1,727 |
| Garfield | 403 | 397 | 573 | 540 | 515 | 2,428 |
| Gilpin | 80 | 86 | 81 | 83 | 65 | 395 |
| Grand | 364 | 366 | 408 | 362 | 315 | 1,815 |
| Gunnison | 276 | 220 | 294 | 234 | 185 | 1,209 |
| Hinsdale | 20 | 13 | 13 | 12 | 16 | 74 |
| Huerfano | 107 | 1 | 115 | 96 | 92 | 411 |
| Jackson | 14 | 16 | 16 | 24 | 16 | 86 |
| Jefferson | 3,362 | 2,143 | 2,049 | 1,989 | 1,577 | 11,120 |
| Kiowa | 0 | 1 | 1 | 0 | 1 | 3 |

| | | | | | | |
|---------------|--------|--------|--------|--------|--------|--------|
| Kit Carson | 15 | 32 | 31 | 26 | 14 | 118 |
| Lake | 58 | 42 | 43 | 61 | 54 | 258 |
| La Plata | 465 | 126 | 392 | 406 | 418 | 1,807 |
| Larimer | 2,777 | 2,636 | 2,722 | 2,835 | 2,730 | 13,700 |
| Las Animas | 85 | 87 | 89 | 83 | 78 | 422 |
| Lincoln | 16 | 18 | 13 | 13 | 7 | 67 |
| Logan | 107 | 52 | 52 | 71 | 62 | 344 |
| Mesa | 1,114 | 1,091 | 1,281 | 1,171 | 1,169 | 5,826 |
| Mineral | 12 | 1 | 13 | 14 | 15 | 55 |
| Moffat | 60 | 34 | 44 | 41 | 44 | 223 |
| Montezuma | 27 | 58 | 22 | 34 | 35 | 176 |
| Montrose | 213 | 277 | 288 | 295 | 287 | 1,360 |
| Morgan | 127 | 182 | 99 | 113 | 96 | 617 |
| Otero | 40 | 32 | 29 | 35 | 28 | 164 |
| Ouray | 58 | 60 | 67 | 61 | 85 | 331 |
| Park | 446 | 337 | 388 | 434 | 390 | 1,995 |
| Phillips | 19 | 14 | 20 | 8 | 13 | 74 |
| Pitkin | 187 | 120 | 178 | 222 | 105 | 812 |
| Prowers | 58 | 44 | 57 | 18 | 13 | 190 |
| Pueblo | 1,139 | 1,202 | 1,249 | 1,057 | 1,176 | 5,823 |
| Rio Blanco | 16 | 5 | 18 | 16 | 25 | 80 |
| Rio Grand | 116 | 95 | 93 | 121 | 91 | 516 |
| Routt | 299 | 306 | 346 | 357 | 216 | 1,524 |
| Saguache | 136 | 84 | 119 | 134 | 106 | 579 |
| San Juan | 10 | 7 | 4 | 5 | 9 | 35 |
| San Miguel | 114 | 115 | 139 | 136 | 119 | 623 |
| Sedgwick | 21 | 9 | 2 | 4 | 2 | 38 |
| Summit | 927 | 543 | 331 | 410 | 327 | 2,538 |
| Teller | 367 | 301 | 303 | 364 | 207 | 1,542 |
| Washington | 11 | 17 | 8 | 16 | 10 | 62 |
| Weld | 2,117 | 2,802 | 3,413 | 4,001 | 3,991 | 16,324 |
| Yuma | 10 | 7 | 14 | 17 | 11 | 59 |
| Total by Year | 43,053 | 36,865 | 39,835 | 40,097 | 37,978 | |

PM 10 Land Permits by County and Year (last updated 10/1/2002)

Prepared by Conrad Van Dyke CDPHE-APCD-Planning & Policy Intern 2002

Note: 2002 Data valid as of 9/20/2002

| County | 1997 | 1998 | 1999 | 2000 | 2001 | 2002* | Total Permits |
|------------|------|------|------|------|------|-------|---------------|
| Archuleta | 1 | | | | | 1 | 2 |
| Adams | 20 | 12 | 41 | 10 | 11 | 10 | 104 |
| Alamosa | 2 | | | | 1 | | 3 |
| Arapahoe | 5 | 20 | 11 | 17 | 12 | 7 | 72 |
| Baca | 1 | 2 | 2 | | | | 5 |
| Bent | 1 | | | | | | 1 |
| Boulder | 7 | 4 | 22 | 2 | 1 | 3 | 39 |
| Cl. Creek | 2 | | 1 | | | 1 | 4 |
| Chaffee | 2 | | | 3 | | | 5 |
| Crowley | | | | | 1 | | 1 |
| Custer | | | | 1 | | | 1 |
| Denver | 23 | 21 | 13 | 13 | 5 | 7 | 82 |
| Douglas | 3 | 2 | 1 | 10 | 2 | 3 | 21 |
| Delta | 2 | 1 | | 1 | | | 4 |
| Dolores | | | | | | 1 | 1 |
| Eagle | 7 | | | 1 | 1 | 1 | 10 |
| El Paso | 17 | 6 | 15 | 6 | 6 | 7 | 57 |
| Fremont | 3 | | 3 | 1 | | | 7 |
| Garfield | 14 | 2 | 2 | 11 | 6 | 1 | 36 |
| Grand | | | | 1 | 3 | | 4 |
| Gunnison | 2 | 1 | | 1 | 1 | | 5 |
| Hinsdale | 1 | | | | | | 1 |
| Huerfano | 2 | 1 | | | | | 3 |
| Jefferson | 29 | 16 | 18 | 12 | 12 | 5 | 92 |
| Kit Carson | 2 | 1 | 1 | 2 | 2 | | 8 |
| Kiowa | | | 1 | | | | 1 |

| | | | | | | | |
|------------------|-----|-----|-----|-----|----|----|-----|
| Las Animas | | | 3 | 1 | | 2 | 6 |
| Lincoln | 4 | 1 | | 3 | | | 8 |
| Logan | 1 | | 1 | | | 3 | 5 |
| La Plata | 1 | 1 | 22 | 4 | 3 | | 31 |
| Larimer | 4 | 2 | 13 | 6 | 2 | 9 | 36 |
| Mesa | 5 | 1 | 9 | 2 | 2 | 1 | 20 |
| Moffat | 1 | 1 | 1 | 6 | 3 | 2 | 14 |
| Montezuma | | 2 | | | 2 | | 4 |
| Montrose | 1 | 3 | | 5 | | 2 | 11 |
| Morgan | 2 | | 10 | 3 | 2 | | 17 |
| Otero | 3 | | 4 | | | | 7 |
| Ouray | 1 | | | | | 1 | 2 |
| Pueblo | 14 | 3 | 10 | 7 | | | 34 |
| Phillips | | 1 | | | | | 1 |
| Pitkin | | 1 | | 1 | | | 2 |
| Prowers | 2 | | | | | | 2 |
| Rio Blanco | | | 4 | 2 | 2 | 3 | 11 |
| Rio Grand | 3 | | | | 2 | | 5 |
| Routt | 2 | 1 | 3 | 1 | | | 7 |
| Summit | 5 | | | | | | 5 |
| Teller | 2 | | | 3 | | 1 | 6 |
| Weld | 13 | 15 | 5 | 9 | 7 | 8 | 57 |
| Yuma | 1 | 1 | 1 | | | | 3 |
| Portable Sources | 3 | | | 1 | | 2 | 6 |
| Total by Year | 214 | 122 | 217 | 146 | 89 | 81 | 869 |

Construction Cost by County and Year (last updated 10/17/2002)

Prepared by Melanie Wasco CDPHE-APCD-Planning & Policy Intern

| County | 1997 | 1998 | 1999 | 2000 | 2001 | Total Per County |
|-------------|-------------|-------------|---------------|-------------|-------------|---------------------|
| Adams | 324,420,000 | 415,770,974 | 355,782,130 | 512,901,167 | 639,300,738 | 2,248,175,009 |
| Alamosa | 5,476,000 | 4,487,351 | 5,538,070 | 4,624,105 | 6,205,761 | 26,331,287 |
| Arapahoe | 387,852,000 | 451,601,884 | 616,155,171 | 748,566,284 | 723,894,081 | 2,928,069,420 |
| Archuleta | 34,085,000 | 52,255,292 | 49,610,470 | 71,819,650 | 52,991,074 | 260,761,486 |
| Baca | 497,000 | 828,784 | 475,000 | 320,000 | 310,000 | 2,430,784 |
| Bent | 862,000 | 1,193,300 | 437,469 | 1,564,250 | 1,168,500 | 5,225,519 |
| Boulder | 334,634,000 | 471,493,439 | 368,515,507 | 372,871,976 | 373,952,697 | 1,921,467,619 |
| Broomfield | NA | NA | NA | NA | NA | 0 |
| Chaffee | 13,668,000 | 16,397,820 | 18,567,671 | 20,860,964 | 21,261,792 | 90,756,247 |
| Cheyenne | 369,000 | 270,000 | 220,000 | 215,000 | 377,980 | 1,451,980 |
| Clear Creek | 13,673,000 | 12,035,541 | 15,383,242 | 10,171,207 | 12,622,721 | 63,885,711 |
| Conejos | 4,554,000 | 111,000 | 4,628,373 | 4,935,839 | 4,705,670 | 18,934,882 |
| Costilla | NA | NA | NA | NA | NA | 0 |
| Crowley | 80,000 | 0 | 320,000 | 1,110,000 | 200,000 | 1,710,000 |
| Custer | 22,865,000 | 13,558,465 | 8,894,450 | 18,344,964 | 15,944,787 | 79,607,666 |
| Delta | 2,941,000 | 5,437,503 | 7,475,737 | 7,219,042 | 2,893,030 | 25,966,312 |
| Denver | 176,201,000 | 338,702,107 | 299,672,600 | 314,704,168 | 405,310,586 | 1,534,590,461 |
| Dolores | 322,000 | 704,807 | 704,807 | 822,275 | 1,221,555 | 3,775,444 |
| Douglas | 806,605,000 | 949,220,333 | 1,051,254,548 | 961,042,477 | 867,183,876 | 4,635,306,234 |
| Eagle | 309,413,000 | 288,328,335 | 275,464,687 | 308,344,696 | 187,940,894 | 1,369,491,612 |
| Elbert | 8,730,000 | 8,326,381 | 39,635,055 | 47,492,068 | 43,335,635 | 147,519,139 |
| El Paso | 434,191,000 | 506,044,849 | 565,268,390 | 710,778,011 | 773,069,808 | 2,989,352,058 |
| Fremont | 26,651,000 | 17,018,356 | 30,975,293 | 28,552,748 | 30,552,415 | 133,749,812 |
| Garfield | 52,001,000 | 62,631,312 | 85,758,503 | 106,379,965 | 92,511,276 | 399,282,056 |
| Gilpin | 7,033,000 | 7,828,847 | 8,984,788 | 9,300,325 | 8,087,802 | 41,234,762 |
| Grand | 47,498,000 | 87,204,842 | 68,881,378 | 104,131,176 | 85,138,670 | 392,854,066 |

| | | | | | | |
|------------|-------------|-------------|-------------|-------------|-------------|---------------|
| Gunnison | 27,840,000 | 37,349,438 | 49,430,999 | 52,254,551 | 31,438,109 | 198,313,097 |
| Hinsdale | 2,292,000 | 1,673,842 | 1,673,842 | 1,953,205 | 2,164,292 | 9,757,181 |
| Huerfano | 7,360,000 | 60,000 | 8,128,375 | 8,820,489 | 9,541,573 | 33,910,437 |
| Jackson | 960,000 | 1,504,050 | 1,185,500 | 6,310,000 | 1,155,584 | 11,115,134 |
| Jefferson | 325,725,000 | 328,123,295 | 319,125,525 | 313,754,457 | 270,320,372 | 1,557,048,649 |
| Kiowa | 0 | 150,000 | 70,000 | 0 | 100,000 | 320,000 |
| Kit Carson | 1,051,000 | 1,452,507 | 4,015,309 | 3,769,872 | 1,500,799 | 11,789,487 |
| Lake | 5,137,000 | 4,330,558 | 5,269,965 | 6,471,145 | 6,488,270 | 27,696,938 |
| La Plata | 52,118,000 | 15,882,956 | 49,913,766 | 54,454,171 | 64,455,653 | 236,824,546 |
| Larimer | 291,815,000 | 354,740,130 | 403,100,414 | 427,366,062 | 431,584,889 | 1,908,606,495 |
| Las Animas | 9,486,000 | 9,677,653 | 9,171,300 | 8,023,369 | 8,236,111 | 44,594,433 |
| Lincoln | 1,500,000 | 1,600,392 | 1,251,341 | 1,375,723 | 1,075,000 | 6,802,456 |
| Logan | 9,114,000 | 7,642,719 | 6,035,939 | 6,555,642 | 5,818,660 | 35,166,960 |
| Mesa | 90,083,000 | 103,217,858 | 127,411,778 | 128,285,242 | 126,529,558 | 575,527,436 |
| Mineral | 130,000 | 68,000 | 140,833 | 151,666 | 219,363 | 709,862 |
| Moffat | 4,496,000 | 3,681,275 | 4,438,519 | 4,156,251 | 4,748,943 | 21,520,988 |
| Montezuma | 1,607,000 | 3,625,200 | 1,760,069 | 3,564,301 | 4,325,381 | 14,881,951 |
| Montrose | 17,752,000 | 23,155,050 | 27,076,375 | 28,962,637 | 33,462,235 | 130,408,297 |
| Morgan | 10,107,000 | 11,743,594 | 9,485,013 | 12,144,680 | 9,878,924 | 53,359,211 |
| Otero | 2,892,000 | 3,998,513 | 2,415,044 | 4,309,843 | 5,145,954 | 18,761,354 |
| Ouray | 13,872,000 | 13,770,921 | 16,833,205 | 19,020,356 | 20,074,058 | 83,570,540 |
| Park | 31,368,000 | 34,861,678 | 42,141,896 | 45,743,839 | 45,478,409 | 199,593,822 |
| Phillips | 2,053,000 | 1,031,601 | 1,894,964 | 785,084 | 1,063,934 | 6,828,583 |
| Pitkin | 107,712,000 | 107,674,049 | 152,954,551 | 138,515,895 | 81,890,546 | 588,747,041 |
| Prowers | 3,721,000 | 3,165,949 | 6,029,885 | 1,268,953 | 1,133,000 | 15,318,787 |
| Pueblo | 106,687,000 | 126,515,074 | 135,433,617 | 106,645,097 | 122,765,867 | 598,046,655 |
| Rio Blanco | 1,236,000 | 570,000 | 1,214,200 | 1,433,500 | 3,033,498 | 7,487,198 |
| Rio Grand | 11,967,000 | 10,751,465 | 11,494,749 | 14,418,155 | 13,584,029 | 62,215,398 |
| Routt | 51,504,000 | 77,232,513 | 103,939,812 | 116,784,840 | 83,793,613 | 433,254,778 |
| Saguache | 3,656,000 | 6,065,476 | 5,370,055 | 6,932,820 | 6,471,894 | 28,496,245 |
| San Juan | 723,000 | 750,223 | 503,425 | 214,980 | 2,091,276 | 4,282,904 |

| | | | | | | |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| San Miguel | 43,539,000 | 72,383,662 | 81,000,946 | 122,972,148 | 100,228,717 | 420,124,473 |
| Sedgwick | 1,586,000 | 867,000 | 187,474 | 620,375 | 236,000 | 3,496,849 |
| Summit | 149,756,000 | 191,366,642 | 101,943,307 | 180,898,045 | 110,084,967 | 734,048,961 |
| Teller | 33,941,000 | 36,832,972 | 35,340,857 | 44,292,441 | 36,062,156 | 186,469,426 |
| Washington | 727,000 | 1,339,900 | 713,900 | 1,268,569 | 912,000 | 4,961,369 |
| Weld | 217,500,000 | 361,878,901 | 418,339,009 | 579,174,493 | 595,058,983 | 2,171,951,386 |
| Yuma | 967,000 | 742,200 | 1,140,372 | 1,343,640 | 1,006,450 | 5,199,662 |
| Total by Year | 4,658,601,000 | 5,672,928,778 | 6,026,179,469 | 6,822,088,893 | 6,593,340,415 | |

As can be seen from the graphs below, statistics differ considerably between those from higher population counties (>150,000 pop.) and lower population counties.

NOTE: PM-10 Permit data indicates larger acreage (>25 acres) projects, and Total Construction Permits indicates all new construction permits.

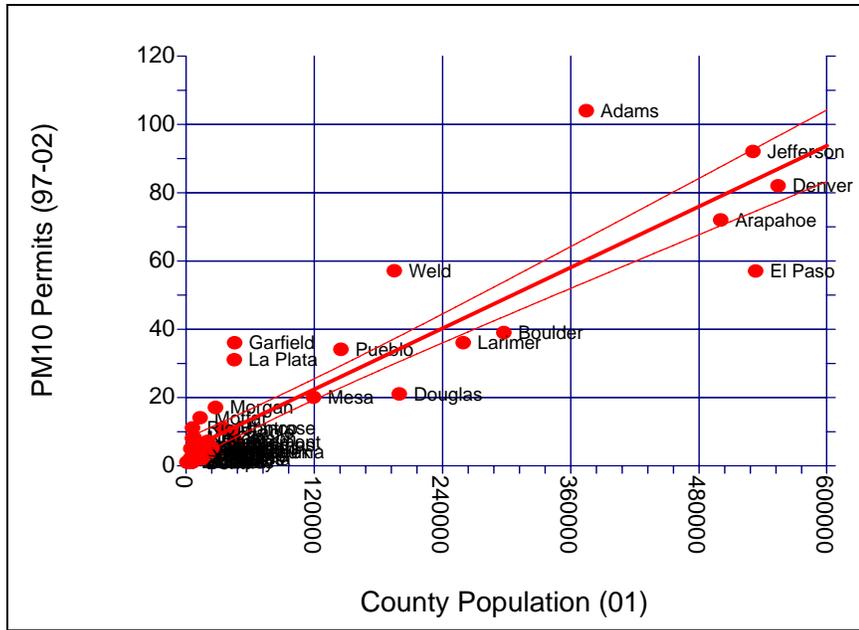
It should be re-emphasized that construction activity does not necessarily indicate diesel equipment activity. As noted in previous sections, much construction activity, including expansions and renovations, takes place in the absence of diesel equipment. Diesel equipment is in use most often at the beginning of new construction projects during land grading and excavation.

The number of larger developments (projects > 25 acres) in a county, such as government buildings, office parks and large housing tracts, occur more frequently in the higher population counties, where the correlation to population is 0.91. In smaller counties, the correlation is just 0.73, and the population-dependent variance is just 0.53. County affluence likely plays a larger role the placement of larger projects.

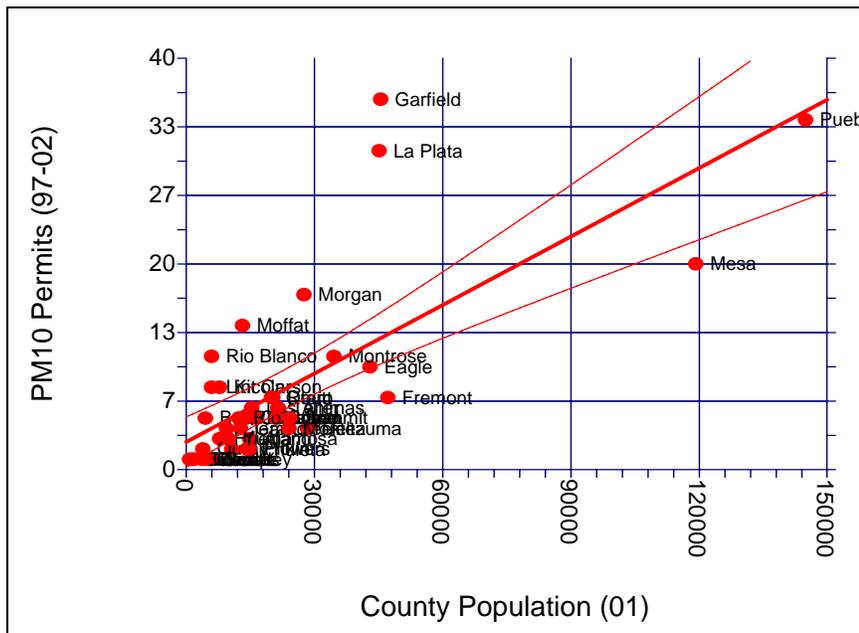
Total construction permits (all new construction projects) correlate well to both high and low population counties. Construction dollars spent in a county does not appear to depend too strongly on a county's population size, as the R-squared for high-population counties is 0.61, and 0.28 for lower-population counties.

Total construction permits correlate very strongly to dollars spent (0.97) in high-population counties, and somewhat less strongly (0.79) in lower population counties. This may be an indication of the varying affluence of the smaller counties.

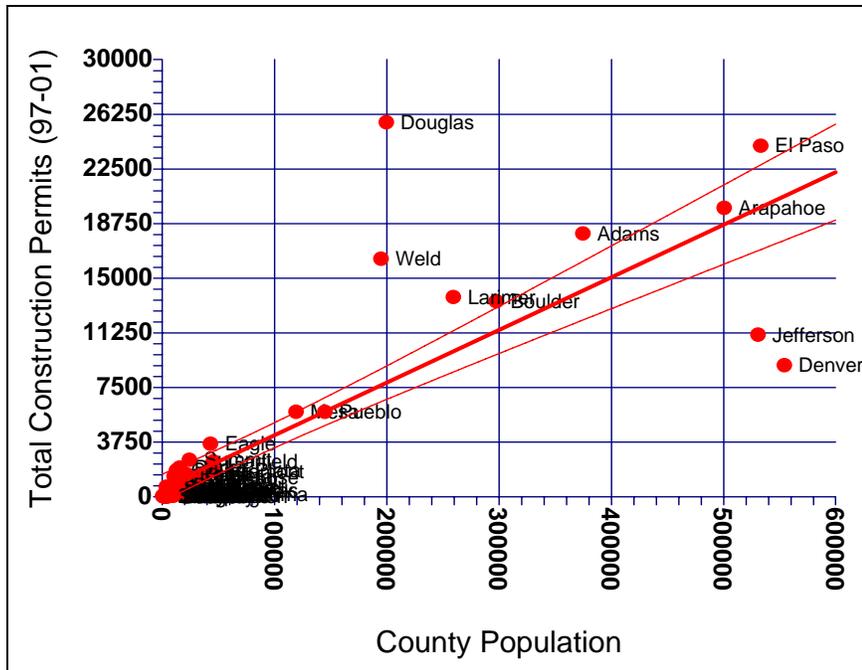
For example, Mesa and Pitkin counties spent about the same amount on construction, but Mesa County had 7 times the number of permits as were filed in Pitkin County (home of Aspen). This is likely due to the preponderance of wealthy residents in Pitkin, who build fewer, larger homes on greater acreage. This is significant to the hypothesis of this report, namely that diesel equipment activity does not correlate directly to dollars spent.



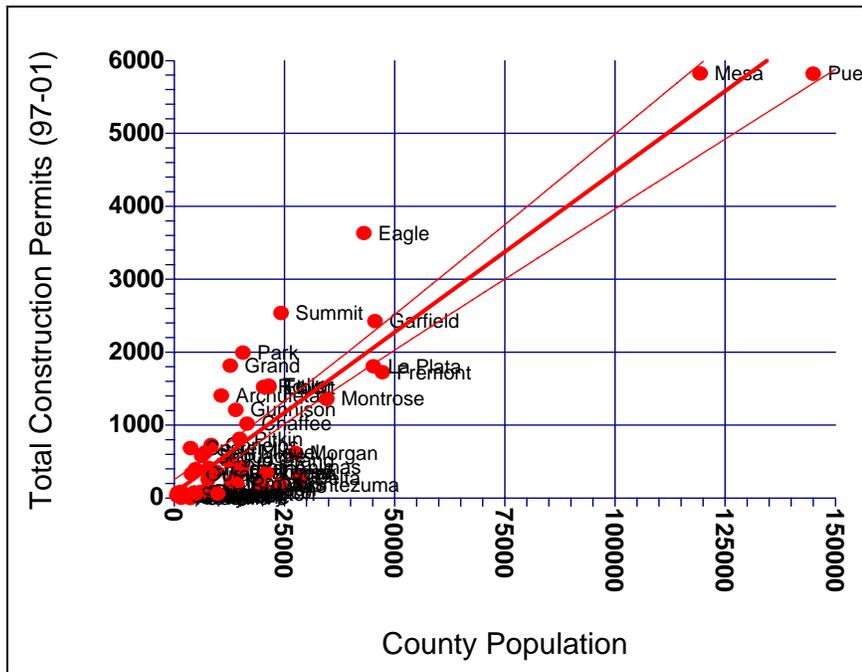
Proportion of variance in PM Permits or R-squared explained by Population is 0.83, correlation is 0.91.



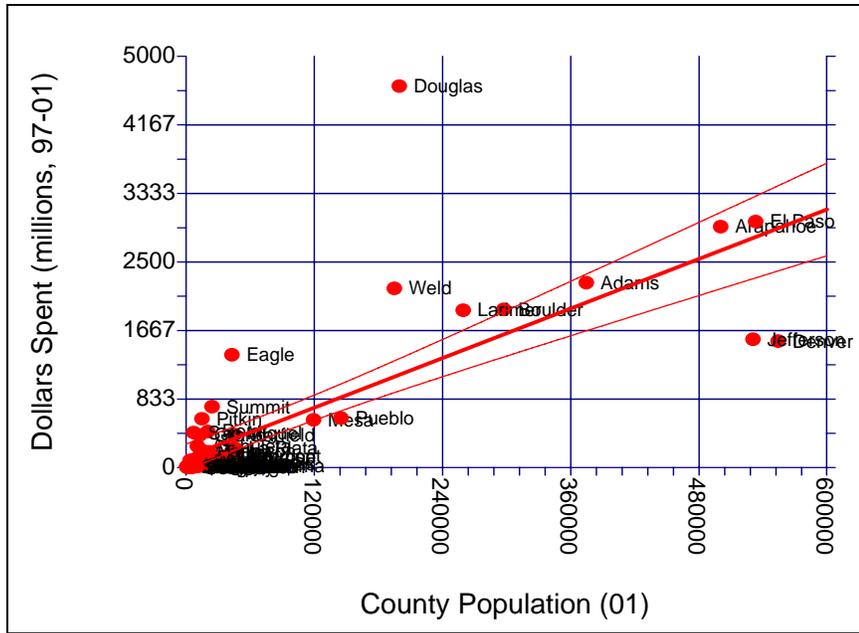
Proportion of variance in PM Permits or R-squared explained by Population is 0.53, correlation is 0.73.



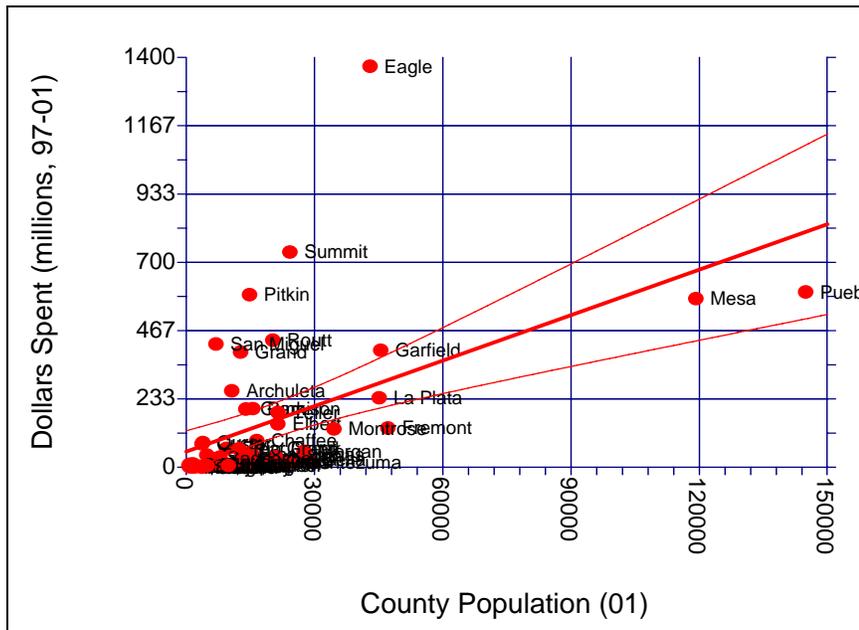
Proportion of variance in Construction Permits or R-squared explained by Population is 0.70, correlation is 0.84.



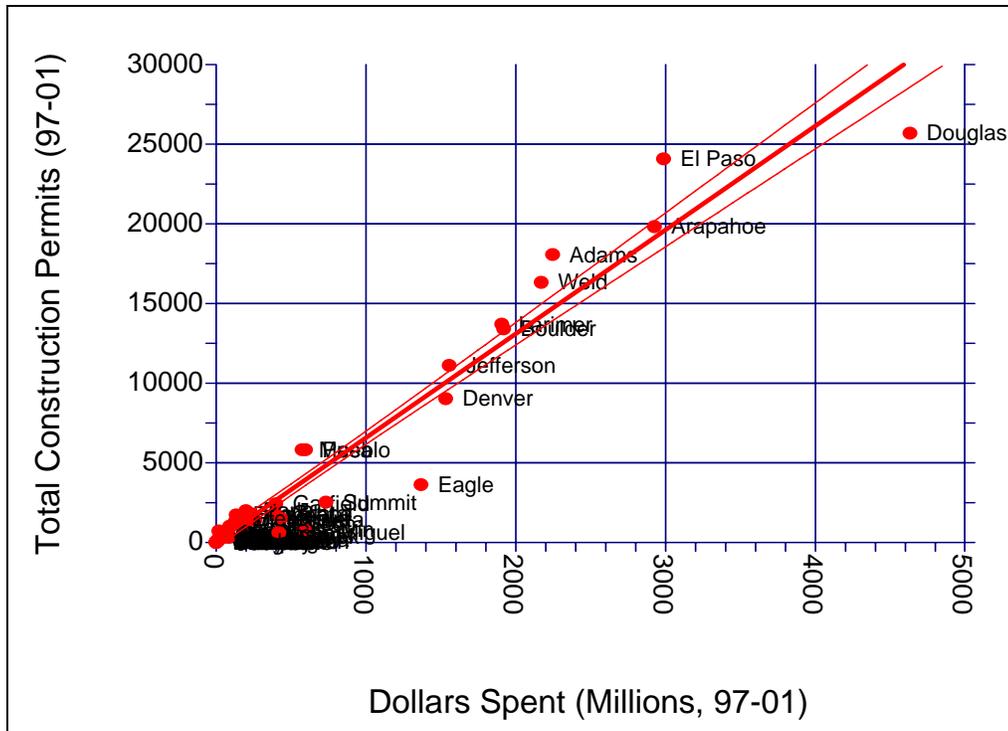
Proportion of variance in Construction Permits or R-squared explained by Population is 0.81, correlation is 0.90.



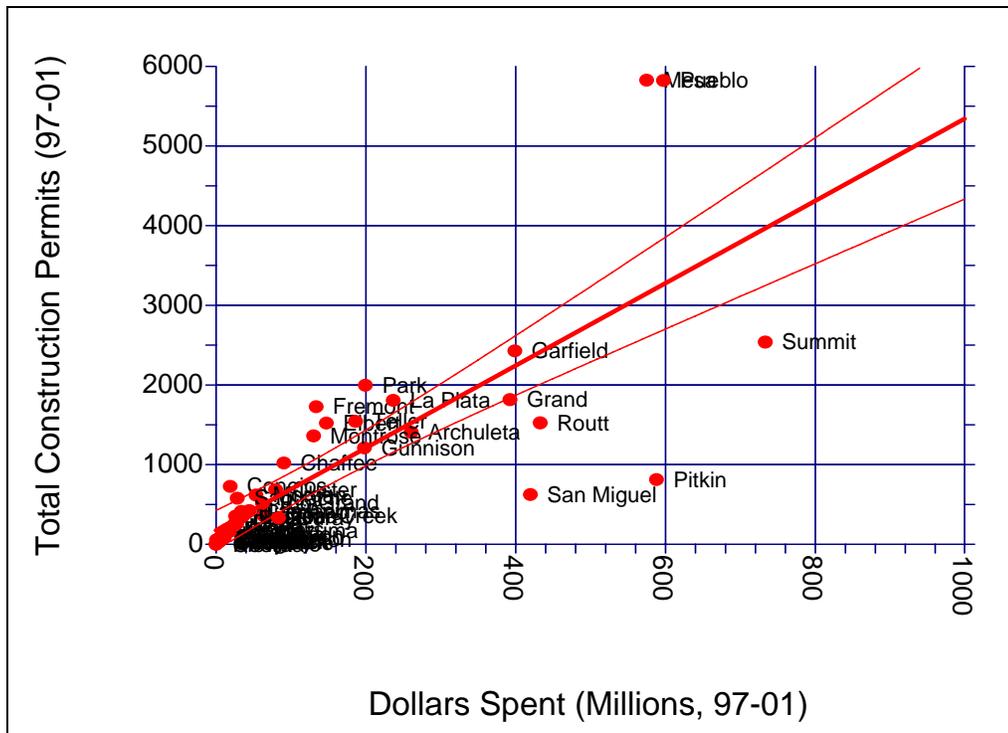
Proportion of variance in Construction Dollars or R-squared explained by Population is 0.61, correlation is 0.78.



Proportion of variance in Construction Dollars or R-squared explained by Population is 0.28, correlation is 0.53.



Proportion of variance in Construction Permits or R-squared explained by Construction Dollars is 0.95, correlation is 0.97.



Proportion of variance in Construction Permits or R-squared explained by Construction Dollars is 0.62, correlation is 0.79.

L. Off-Road Diesel Equipment Activity at Ski Areas

Ski resort years are divided into two seasons. Winter is defined as the months of November through April. Summer is defined as May through October.

There are 24 ski resorts officially listed with Colorado Ski Country USA (2002). The resorts have a cumulative 34,162 ski-able acres, i.e., groomed acres. Snow grooming equipment consumes the bulk of diesel fuel purchased by the resorts.

All ski resorts in Colorado have backup diesel engines for all ski lifts. However, for the most part, they are powered by electricity. The diesel engines are used only for emergencies and for peak shaving purposes. "Peak shaving" refers to actions taken to reduce the maximum demand on a meter over a one-month billing cycle. No diesel fuel is used for snowmaking in the state. Electricity powers all snowmakers.

Brief phone surveys gleaned the information in Table XXX. Note that there is considerable variance in fuel gallons-to-acreage ratios--a factor of 6.7 between the lowest and highest ratio--and in the gallons-to-snow cat hour ratio, a factor of 4.5 from lowest to highest. Data from the ski areas remains limited at this writing. It was therefore deemed unwise to try to average either for application to all the ski resorts. For a subsequent report, information should be gathered from a greater number of the 24 ski resorts for more representative sampling.

Table XXX

| Ski Resort (Golf course may mean significant summer Diesel emissions from lawn mowers) | Groomed acres | Snow cat hours | Diesel fuel used annually (Gallons) | Gallons per acre | Gallons per snow cat hour | Estimated Diesel Exhaust Emissions |
|---|----------------------|-----------------------|--|-------------------------|----------------------------------|---|
| Beaver Creek (1 golf course) | 1,625 | | | | | |
| Breckenridge (1 golf course) | 2,600 | 20,000 | 200,000 | 76 | 10.0 | |
| Copper Mountain (1 golf course) | 673 | 24,000 | 80,000 | 119 | 3.3 | |
| Keystone (2 golf courses) | 1,861 | | 250,000 | 134 | | |
| Snowmass (1 golf course under construction 2002-03) | 3,010 | | 260,000 (uses B-20, a 20% soy oil Biodiesel fuel, which reduces emissions) | 86 | | |
| Steamboat | 2,939 | 14,363 | 84,653 | 29 | 6.0 | |
| Vail | 5,289 | 36,000 | 256,000 | 48 | 7.0 | |
| Winter Park | 2,866 | 26,400 | 57,422 | 20 | 2.2 | |
| | | | | | | |

In-depth interviews were conducted with representatives from three ski resorts:

Copper Mountain, Vail, and Winter Park. A Copper Mountain ski area representative reported that diesel engines for their seven lifts run less than 20 hours a year. A Winter Park representative said the resort runs its ski lift diesel engines approximately one-hour per week for approximately 20 weeks per year for a total of 20 hours per year.

The following summaries give an indication of the range and variety of equipment the ski areas use (report using), seemingly irrespective of resort acreage. Survey questions may need refinement prior to being submitted to ski resort representatives.

Copper Mountain Resort

A representative reported the following diesel equipment is in use at the resort summers, mainly for the golf course:

- 3 lawn mowers
- 1 CAT crawler tractor
- 1 street sweeper
- 2 rubber tire tractors.

Summer hourly usage for this diesel equipment is approximately 2,300 hours.

Other diesel-powered equipment used year round:

- 1 emergency generator (approximately two hours a year)
- 3 rubber tire loaders
- 8 skid steer loaders with attached blade for snow removal in the winter
- 1 boom truck crane
- 1 back hoe loader.

This year round equipment runs approximately 4,700 hours a year.

Vail Resort

A representative reported the following equipment in summer months:

- 2 tractors
- 2 crawler tractors
- 2 rubber tire loaders
- 1 grader.

This seasonal equipment runs approximately 1800 hours a year.

Year round, Vail uses:

- 2 Bob Cats (skid steer loaders) approximately 400 hours a year.

*Note – Vail had one gondola and ski lifts that run during both winter and summer.

Winter Park uses the following in summer months

- 1 crawler tractor
- 1 mower
- 1 tractor
- 1 tract skidder.

Total usage is approximately 600 hours.

Year round, Winter Park uses:

- 1 air compressor
- 1 motor grader
- 4 rubber tire loaders
- 1 AEBI (mower with blower)
- 3 skid steer loaders
- 1 water treatment generator

Total year round usage is approximately 3,500 hours.

This spreadsheet provides observational information regarding equipment idle and in-use at the ski areas visited. **COLUMNS NEED FIXING**
Diesel Survey Database for Ski Resort - information collected by T. James, entered by C. Van Dyke 10/2002

| Ski Resort | Number of Employees | Diesel Fuel Used (gals) | Equipment Tyspe | Age of Engines | Hp Of Diesel Equip. | # Of Units | Fuel Type | # Of Hours Used | Used Profile | County Of Operation |
|---|---|-------------------------|----------------------|----------------|---------------------|------------|-----------|-----------------|--------------|---------------------|
| Copper Mountain (Survey done 7/12/2002) | Summer 400 | 90000 | Backhoe Loader | 8 | 90 | 1 | Blend | 400 | Yr. Round | Summit |
| | Winter 2000 | | Boom Truck | 10 | 165 | 1 | Blend | 600 | Yr. Round | Summit |
| | | | Crawler Tractors | 15 | 100 | 1 | Blend | 400 | Summer | Summit |
| | | | Generators | 55 | 75 | 1 | Blend | 100 | Yr. Round | Summit |
| | | | Mowers | 2 to 4 | 60 | 3 | Blend | 500 | Yr. Round | Summit |
| | | | Rubber Tire Loaders | 4 to 22 | 200 | 3 | Blend | 1200 | Yr. Round | Summit |
| | | | Skid Steer Loaders | 8 | 90 | 8 | Blend | 400 | Yr. Round | Summit |
| | | | Street Sweepers | 5 | 150 | 1 | Blend | 400 | Summer | Summit |
| | | | Emergency Generato | 2 | 150 | 1 | Blend | 2 | Yr. Round | Summit |
| | | | Rubber Tire Tractors | 2 to 25 | 75 | 2 | Blend | 350 | Summer | Summit |
| | | | Snow Cats | 3 to 6 | 260 | 20 | #2 | 1700 | Winter | Summit |
| | Winter Park (Survey done week of 7/12/2002) | | Summer 300 | 57422 | Air Compressors | 16 | 125 | 1 | | |
| Winter 1300 | | Crawler Tractors | 17 | | 70 | 1 | | | Seasonal | Grand |
| | | Motor Graders | 6 | | 185 | 1 | | 500 | Weekly | Grand |
| | | Mowers | 7 | | 90 | 1 | | 200 | Monthly | Grand |
| | | Rubber Tire Loaders | 4 to 17 | | 125-180 | 4 | | 200-800 | Weekly | Grand |
| | | Snow Removers | 5 | | 250 | 1 | | 200 | Seasonal | Grand |
| | | Tractors | 22 | | 25 | 1 | | 100 | Seasonal | Grand |
| | | Skid Steer | 1 to 27 | | 73-90 | 5 | | 100-4000 | Weekly | Grand |

| | | | | | | | | | | |
|-------------------|------------|-------|------------------|----------|---------|----|-------|----------|-----------|-------|
| | | | Loaders | | | | | | | |
| | | | Generators | 10 | | 1 | Blend | 20 | Emergency | Grand |
| | | | Snow Cats | 3 to 10 | 180-300 | 24 | N/A | 123-1314 | Seasonal | Grand |
| Vail | Summer 200 | 25600 | Tractors | 1 to 10 | 100 | 2 | #2 | 300 | Weekly | Eagle |
| (Survey done week | Winter N/A | 0 | Crawler tractors | 10 to 15 | 180 | 2 | #2 | 500 | Weekly | Eagle |
| of 7/12/2002) | | | Rubber Tire | 5 to 20 | 210 | 2 | #2 | 500 | Weekly | Eagle |
| | | | Loaders | | | | | | | |
| | | | Skid Steer | 3 to 6 | 46 | 2 | #2 | 400 | Weekly | Eagle |
| | | | Loaders | | | | | | | |
| | | | Snow Cats | 1 to 5 | 110-250 | 36 | | 500-1500 | Daily | Eagle |

The above information should be supplemented from additional ski resorts, systematically verified, sorted as to season, and provided to users of the NONROAD model to determine whether the model realistically reflects Colorado ski area diesel fuel usage and exhaust emissions.

M. Oil and Gas Well Drilling/Road Building

Oil and gas development is becoming a rapidly growing industry in Colorado, and deserves mention as a notable source of diesel exhaust. The Colorado Oil and Gas Conservation Commission provided historical development information, industry operational methods, and forecasted projections for future well sites.¹¹

The number of oil and gas wells statewide was estimated at 23,000 as of January 17, 2003. The wells were not categorized by the natural resource recovered because many wells extract both oil and natural gas. Issued drilling permits were the basis for statewide estimations of annual drilled wells. The number of new wells established for production years 1995 through 1999 was estimated at 1000 wells per year. Production years 2000, 2001, and 2002 have precise totals of 1,529 wells, 2,273 wells, and 2,006 wells respectively. An additional 2,006 wells are projected for year 2003, and 1,500 to 2,000 new wells are projected per year for years 2004 through 2008.

Diesel equipment is necessary to establish a new well site. A drilling rig with attached diesel generators is used to bore into the earth's surface. The rig requires between one and three diesel engines in order to operate. Rigs are active 24 hours per day until drilling is complete. Once drilling is complete, a small number of pumping units (0.5%) continue to use diesel engines. The majority of units are powered by natural gas.

The majority of wells have a depth less than 8,000 feet. Drilling duration is 3-10 days for 99% of wells. Only 1% of wells have a drilling duration of 15 or more days. Extended drilling durations are "rare," and usually caused by operational problems at the time of drilling.

Drilling activity in Colorado can be separated into geographic distributions. Thirty percent of drilling is currently conducted in the D.J. Basin. About 20% of drilling takes place in the Piceance Basin. The Raton Basin and the San Juan Basin are the third- and fourth-highest in drilling activity, with about 120 wells/year. In the Sand Wash Basin 30 to 40 wells are drilled per year. Other Basins see sporadic drilling of wells.

An estimation of annual miles of road construction was not supplied due to the complex range of geographic terrain and proximity of well development. Some wells are clustered, whereas others are remote from one another. In the D.J. Basin, the majority of roads built are between ¼ - ½ mile in length. However, in the Piceance Basin, there are many remote areas, and some roads can be up to 20 miles long. A Commission representative made a "gross assumption" that 75% of statewide wells required ¼ - ½ mile of road construction.

At 2,000 wells per year x 0.5 mile of road, that would be 1,000 miles of road to be constructed for oil and gas wells each year. Roads require excavation, grading, building of road base, and paving--all of which use diesel equipment.

For a future report, researchers should obtain additional equipment and hourly usage information from CDOT and/or FW Dodge.

N. Landfills

Based on research by the Texas Natural Resource Conservation Commission (Pollack and Tran 1999), it takes 8 horsepower hours per ton to mine or bury landfill material.

There are 72 landfills in Colorado (USEPA 2003).

For a future report the Air Division should research tonnages of landfill material moved each day by diesel equipment at the landfills.

O. Mining

The Air Division was unable to quantify diesel equipment activity the majority of Colorado mining for this report. For a future report, it is recommended that researchers follow up with the Division of Minerals and Geology regarding the 1,880 mineral and 20 coal mine permits.

Cripple Creek & Victor Mine, Teller County

The Division was able to obtain information regarding what is by far the largest gold and silver mine in the state—the Cripple Creek & Victor Gold Mine. The information is from a projection for the year 2002:

Diesel fuel purchased annually: 6,600,000 gallons (low-sulfur, i.e., <500 ppm Sulfur)

Diesel fuel used off-road: 6,595,000 gallons

Off-road diesel equipment owned:

14 haul trucks (specialized-at 326 ton capacity).

07 shovel/loaders

08 dozers

02 water trucks

02 blades

Note that the the CC&V Mining Company's equipment has enormous capacity, and is probably larger by far than equipment used by most other mining operations. Equipment runs 24/7.

PART IV: MONITORED AIR TOXICS LEVELS vs MODELED LEVELS

The states and EPA have worked to improve assumptions going into models used to develop air toxics emission estimates. The EPA's ASPEN model, as well as the ASCIII model used by the City & County of Denver appear to underestimate ambient air toxics, by a factor of 2 to 2.5 overall. This is determined by comparisons made to monitored air toxics in ambient air.

While it's true a relatively small number of monitors have been deployed, and they are sited where one would expect to see significant HAP levels, e.g., at busy intersections, the consistently higher monitoring data suggest problems with pollutant dispersion, secondary formation, and decay aspects of the models.

This is the case even though Colorado's inventory improvements regarding diesel and other toxics emissions have usually suggested that modeling inputs should be revised downward.

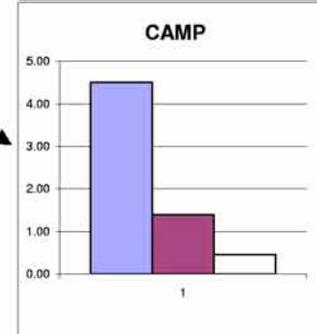
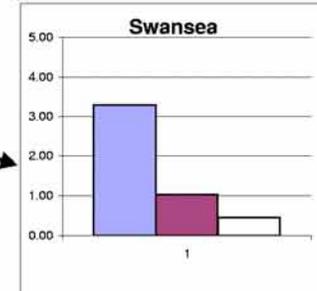
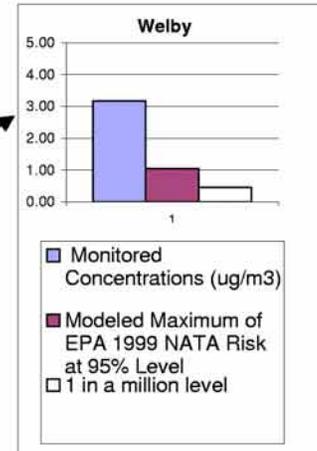
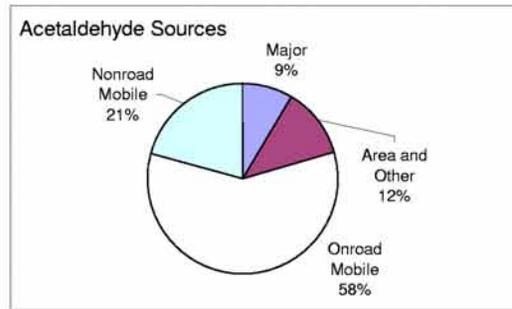
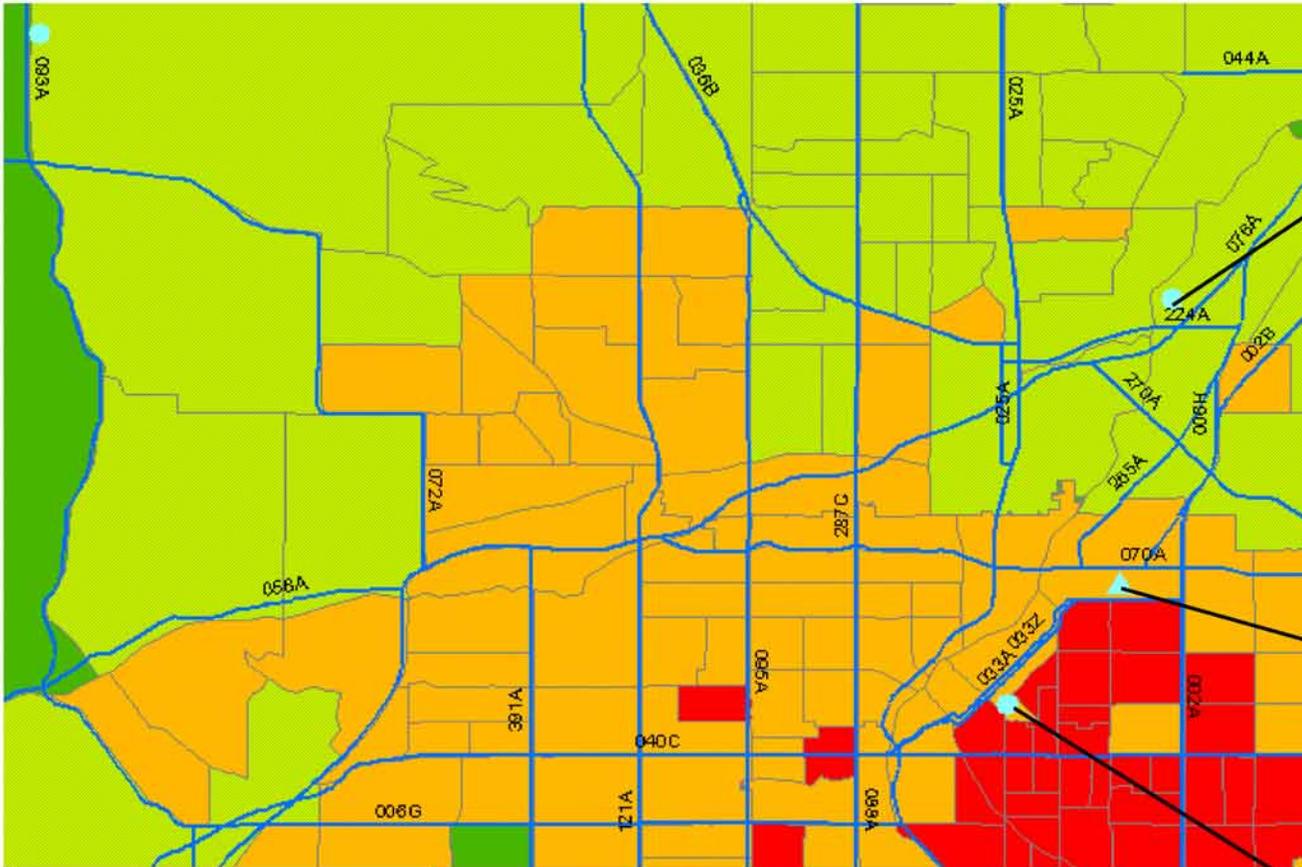
The most ubiquitous of air toxic pollutants in Colorado are Acetaldehyde, Benzene, 1,3-Butadiene, and Formaldehyde. As the following maps and graphs indicate, Denver-area monitored levels of each of these HAP (year 2002) were higher than NATA estimates for 1999.

Monitored levels of Acetaldehyde were roughly 3-4 times the NATA modeled levels. Monitored levels of Benzene and 1,3-Butadiene were slightly higher than modeled levels. Monitored levels of Formaldehyde, often a secondary-formation HAP, were 2.5-to-4.5 times the NATA-modeled levels.

Air agencies can continue to move forward with modeling refinements with the on-road and off-road diesel emissions data from this report, and bearing in mind several models' tendencies to underestimate ambient levels of air toxics at monitoring sites.

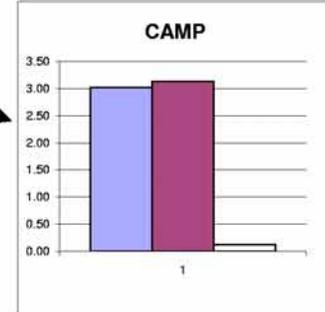
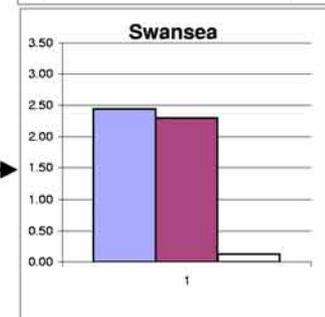
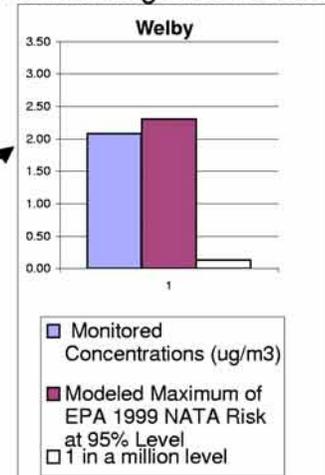
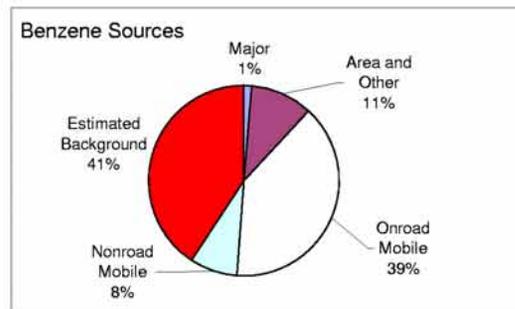
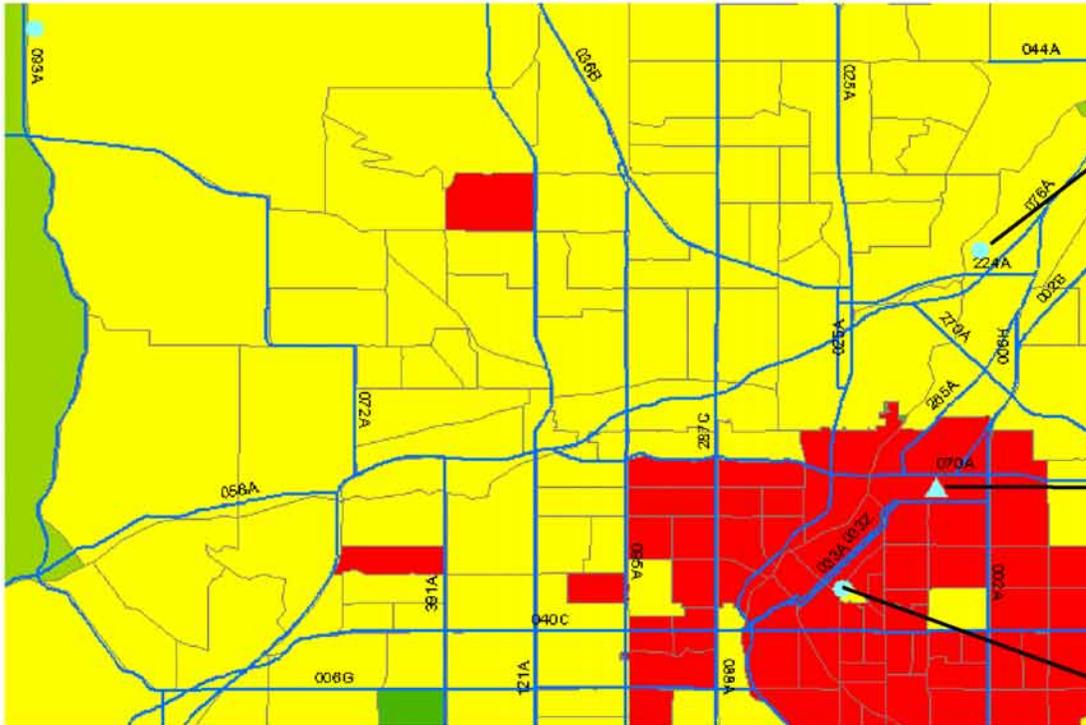
Acetaldehyde

NATA Modeling vs 2002 Monitoring



Benzene

1999 NATA Modeling vs 2002 Monitoring



PART V - RECOMMENDATIONS

To be developed in a subsequent report.

CITATIONS

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