

EASTERN MONTANA COUNTY LEVEL POPULATION PROJECTIONS

A METHODOLOGY FOR INCORPORATING THE MONTANA DEPARTMENT OF
TRANSPORTATION'S ANALYSIS OF THE ESTIMATED EFFECTS POTENTIAL
FUTURE INCREASES IN OIL PRODUCTION MAY HAVE ON THE EASTERN
MONTANA REGION'S TOTAL POPULATION WITH eREMI'S COUNTY-LEVEL
ESTIMATED POPULATION PROJECTIONS

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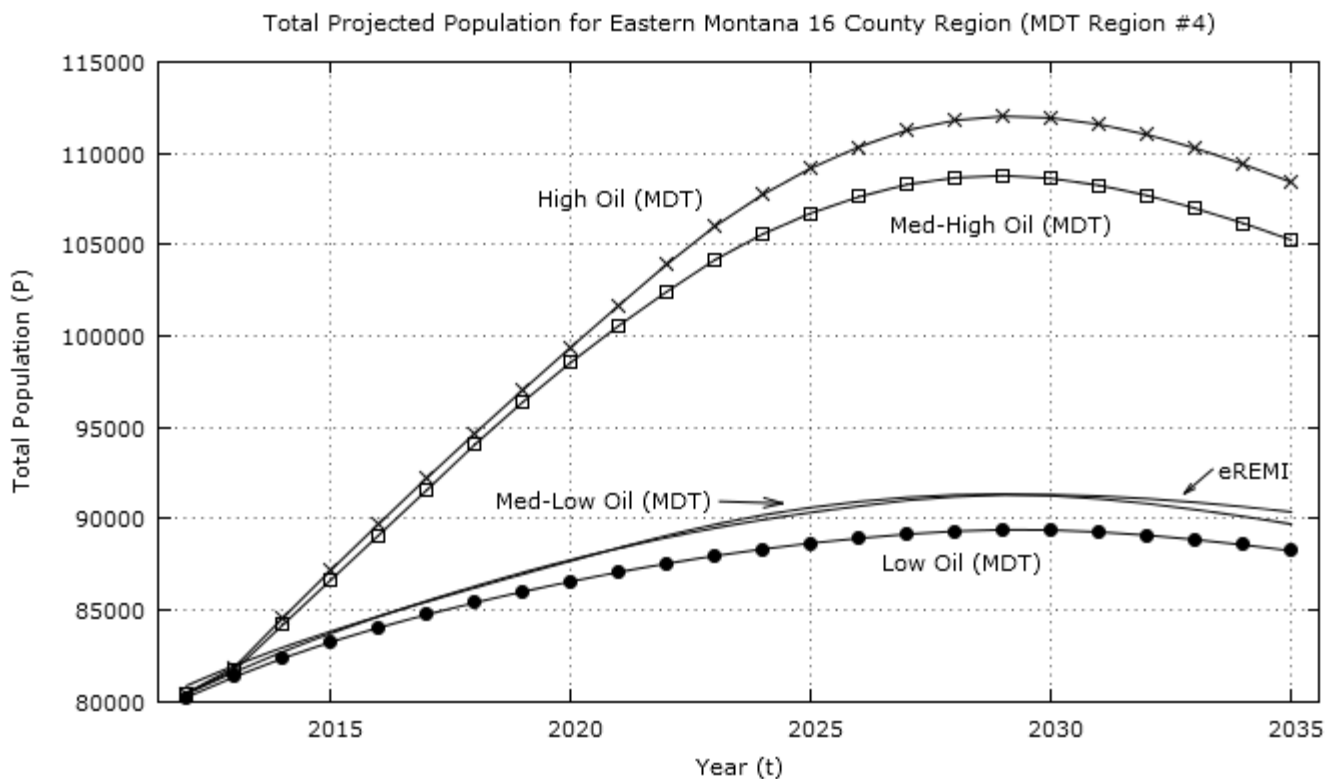
OVERVIEW

The Census and Economic Information Center (CEIC) at the Montana Department of Commerce (MDOC) purchased a population projections product, known as eREMI, from Regional Economic Models, Inc. (REMI). The eREMI product contains annual population projections (historical population from 1990 – 2010; projected population from 2011 – 2060) *at the county level* for the state of Montana.

The Montana Department of Transportation – Planning Division (MDT) has done extensive research and analytical modeling – using a REMI PI+ model – focused on the potential impacts of oil development on transportation infrastructure in eastern Montana contingent on various levels of projected oil production in Montana. As part of that research, MDT estimated growth trends of the total resident population *for the defined 16 county region in eastern Montana* (referred to as the “Region”) based on 4 potential oil production level scenarios for the time period 2012 - 2035 (See Appendix A for a map defining the Region in question).

Figure 1 (below) displays the five different projected total population trends for the Region estimated by MDT’s four levels of future oil production scenarios and one from eREMI. The projected population for the Region produced by eREMI is equal to the sum of the 16 individual eREMI county population projections that make up the Region in eastern Montana.

Figure 1.



<i>High Oil (MDT)</i>	Represents the total projected population for the Region based on MDT’s highest level of oil production scenario
<i>Med-High Oil (MDT)</i>	Represents the total projected population for the Region based on MDT’s medium-high level of oil production scenario
<i>Med-Low Oil (MDT)</i>	Represents the total projected population for the Region based on MDT’s medium-low level of oil production scenario
<i>eREMI</i>	Represents the total projected population for the Region as estimated by eREMI
<i>Low Oil (MDT)</i>	Represents the total projected population for the Region based on MDT’s lowest level of oil production scenario

The four total resident population curves for the Region produced by MDT’s research (displayed in Figure 1) are products of analytical modeling based on assumptions of, among other things, different levels of future oil production in Montana. The two curves that project fairly moderate growth in the Region (*Low Oil (MDT)* and *Med-Low Oil (MDT)*) explicitly assume low to moderate levels of oil development and production in the State, where the two curves projecting more drastic growth of the total population (*High Oil (MDT)* and *Med-High Oil (MDT)*) assume more aggressive oil development and accelerated production in the State.

Population projections for the Region based on MDT’s medium-low oil production scenario (*Med-Low Oil (MDT)*) and those produced by eREMI (*eREMI*) are almost congruent to one another over time (from 2012 – 2035) (see Figure 1). Because these two estimated growth curves are nearly equal *for the Region*, it’s assumed that eREMI’s individual population projections for each of the 16 counties provide adequate estimates of the total population *at the county level* assuming low to moderate levels of future oil production in the State.

The goal here is to allocate the projected growth of the Region (in terms of total population) based on the two higher MDT oil production scenarios (*High Oil (MDT)* and *Med-High Oil (MDT)*) to the 16 counties in the Region using eREMI county level projections as a base to maintain the idiosyncratic growth trend of each county.

METHODOLOGY

The Montana Department of Transportation, Planning Division’s (MDT) research on the potential impacts of accelerated oil production on Montana’s transportation infrastructure geographically focuses on MDT’s District 4 – the respective district is made up of 16 counties in eastern Montana (referred to as the “Region”). This paper provides a methodology to allocate the potential effects on total resident population growth presented by MDT’s analysis at the regional level to each of the individual 16 counties.

The following terms are defined as:

TP_eREMI_t is equal to the total population of the Region in year t based on eREMI projection estimates (*eREMI* in Figure 1.)

$TP_HighOil_t$ is equal to the total population of the Region in year t based on MDT’s highest level of oil production scenario (*High Oil (MDT)* in Figure 1.)

$TP_MedHighOil_t$ is equal to the total population of the Region in year t based on MDT’s medium-high level of oil production scenario (*Med-High Oil (MDT)* in Figure 1.)

t represents the year (2012 – 2035)

The total population for the Region projected by both of MDT’s higher oil production scenarios ($TP_HighOil_t$ and $TP_MedHighOil_t$) is larger in magnitude (total population) for all years t (2012 – 2035) than that of eREMI (TP_eREMI_t) (see Figure 1 above).

For explanation purposes and an attempt at clarity, MDT’s highest oil production scenario ($TP_HighOil_t$) will only be used in the following examples; the methodology used to share-out MDT’s medium-high oil production scenario ($TP_MedHighOil_t$) to the county level follows exactly the same process.

The difference between the total population of the Region in year t based on MDT's highest oil production scenario and that of eREMI projection estimates can be represented as:

Equation 1
$$diffTP_{HighOil-eREMI_t} = TP_{HighOil}_t - TP_{eREMI}_t$$

Such That: $diffTP_{HighOil-eREMI_t}$ is equal to the difference in total population projected for the Region between MDT's highest level of potential oil production scenario and eREMI

The difference in total population between MDT and eREMI for every year t (Equation 1) is essentially being distributed to the respective counties within the Region. The trick is to distribute this difference in projected population across all 16 counties in an equitable way while taking into account differences in total population and growth trends between each county from year to year.

The total population of the Region, as estimated by eREMI, can be represented as the sum the 16 county populations (Equation 2).

Equation 2
$$TP_{eREMI}_t = \sum_{Ci=1}^{16} P_{eREMI_{Ci_t}}$$

Such That: TP_{eREMI}_t is equal to the total population of the Region in year t based on eREMI projection estimates
 $P_{eREMI_{Ci_t}}$ is equal to the total population of county Ci in year t as estimated by eREMI

Each of the 16 counties that make up the Region differs in their overall size – some counties have larger populations than others. Therefore, the total population of the Region as estimated by eREMI (TP_{eREMI}_t) is disproportionally made up of the sum of the 16 county populations (Equation 2). In other words, some counties account for more of the total population (as a proportion) for the Region than others. The share of each county Ci 's population of the total population for the Region in year t as estimated by eREMI is represented by Equation 3.

Equation 3
$$shareP_{eREMI_{Ci_t}} = \frac{P_{eREMI_{Ci_t}}}{TP_{eREMI}_t}$$

Such That: $shareP_{eREMI_{Ci_t}}$ is equal to the county Ci 's share of the total population for the Region in year t as estimated by eREMI

It should be noted that for each year t , the sum of all 16 county Ci 's shares of the Region's total population (Equation 3) equals 1 (Equation 4).

Equation 4
$$\sum_{Ci=1}^{16} shareP_{eREMI_{Ci_t}} = 1$$

To calculate the final estimated population projection of each individual county C_i in year t based on MDT's highest level of future oil production scenario, the base population projection for the county C_i estimated by eREMI ($P_{eREMI_{C_i t}}$) is added to the respective county's share of the Region's total population ($shareP_{eREMI_{C_i t}}$) multiplied by the total difference in projected population between MDT's estimate and eREMI ($diffP_{HighOil-eREMI_t}$) for the Region (Equation 5).

Equation 5 $P_{HighOil_{C_i t}} = (shareP_{eREMI_{C_i t}} * diffP_{HighOil-eREMI_t}) + P_{eREMI_{C_i t}}$

Such That: $P_{HighOil_{C_i t}}$ is equal to the total population of county i in year t based on MDT's high level of oil production scenario

By using a weighting factor based on each county C_i 's proportional share of the Region's total population in each year t , as estimated by eREMI ($shareP_{eREMI_{C_i t}}$), differences in growth trends between counties relative to the overall growth of the Region are implicitly accounted for over time. In other words, if County A is projected to grow at a faster rate than County B by eREMI, County A's proportional share of the Region's total population will increase at a relatively proportional rate, over time, compared to that of County B.

Equation 5 (above) provides a function for estimating the projected population for each of the 16 counties within the Region in eastern Montana based on idiosyncratic growth trends between each county produced by eREMI as well as the Montana Department of Transportation, Planning Division's scenario analysis focused on the effects of potential increased levels of oil production in the State.

The following Results Tables section displays the quantitative results of the previously outlined process for allocating MDT's PI+ results for regional total population projections based on heightened levels of future oil production in eastern Montana to each of the 16 counties located within the Region.

RESULTS TABLES

Eastern MT County Population Projections, 2012 - 2035 -- eREMI Figures

MT County	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Carter	1,220	1,247	1,272	1,295	1,316	1,336	1,356	1,374	1,388	1,403	1,418	1,432
Custer	12,317	12,610	12,883	13,128	13,355	13,565	13,764	13,949	14,119	14,278	14,429	14,567
Daniels	1,811	1,840	1,865	1,889	1,910	1,929	1,947	1,964	1,979	1,991	1,999	2,005
Dawson	9,070	9,137	9,209	9,282	9,356	9,425	9,491	9,556	9,618	9,679	9,728	9,774
Fallon	3,164	3,303	3,430	3,548	3,654	3,751	3,839	3,918	3,992	4,056	4,112	4,158
Garfield	1,267	1,302	1,334	1,363	1,388	1,411	1,429	1,448	1,464	1,477	1,487	1,496
McCone	1,796	1,824	1,849	1,871	1,889	1,906	1,921	1,937	1,955	1,967	1,979	1,989
Phillips	4,281	4,285	4,290	4,290	4,292	4,290	4,289	4,286	4,276	4,266	4,264	4,262
Powder River	1,782	1,798	1,810	1,818	1,823	1,829	1,834	1,840	1,846	1,855	1,859	1,860
Prairie	1,225	1,246	1,267	1,291	1,314	1,335	1,356	1,376	1,394	1,411	1,426	1,441
Richland	10,383	10,702	10,989	11,247	11,484	11,705	11,915	12,112	12,294	12,462	12,621	12,763
Roosevelt	10,716	10,817	10,903	10,978	11,045	11,103	11,152	11,196	11,232	11,269	11,305	11,341
Rosebud	9,273	9,267	9,277	9,293	9,305	9,325	9,347	9,373	9,399	9,424	9,449	9,467
Sheridan	3,444	3,468	3,489	3,505	3,521	3,535	3,550	3,567	3,585	3,601	3,616	3,631
Valley	7,604	7,695	7,773	7,841	7,900	7,949	7,993	8,034	8,074	8,100	8,125	8,146
Wibaux	1,031	1,046	1,060	1,071	1,080	1,091	1,101	1,109	1,120	1,129	1,136	1,145
Total Region	80,384	81,587	82,700	83,710	84,632	85,485	86,284	87,039	87,735	88,368	88,953	89,477
MT County	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Carter	1,445	1,456	1,464	1,471	1,476	1,479	1,480	1,478	1,475	1,470	1,463	1,455
Custer	14,696	14,810	14,917	15,020	15,110	15,184	15,244	15,290	15,324	15,349	15,374	15,395
Daniels	2,012	2,017	2,021	2,023	2,025	2,024	2,021	2,015	2,008	2,000	1,991	1,981
Dawson	9,811	9,846	9,874	9,898	9,912	9,920	9,917	9,910	9,895	9,872	9,845	9,816
Fallon	4,195	4,228	4,257	4,279	4,297	4,308	4,312	4,312	4,307	4,299	4,287	4,273
Garfield	1,505	1,511	1,517	1,522	1,525	1,527	1,528	1,527	1,525	1,522	1,518	1,513
McCone	1,998	2,003	2,006	2,008	2,009	2,007	2,005	2,000	1,994	1,986	1,977	1,968
Phillips	4,263	4,256	4,252	4,252	4,247	4,241	4,234	4,223	4,210	4,195	4,177	4,156
Powder River	1,865	1,869	1,872	1,876	1,880	1,883	1,882	1,880	1,876	1,872	1,866	1,859
Prairie	1,454	1,465	1,475	1,481	1,486	1,486	1,486	1,483	1,478	1,472	1,465	1,457
Richland	12,894	13,005	13,102	13,189	13,263	13,320	13,357	13,378	13,391	13,396	13,395	13,389
Roosevelt	11,358	11,370	11,371	11,396	11,388	11,367	11,335	11,288	11,234	11,173	11,106	11,033
Rosebud	9,478	9,497	9,518	9,518	9,498	9,462	9,413	9,351	9,281	9,201	9,111	9,016
Sheridan	3,646	3,662	3,679	3,690	3,696	3,704	3,711	3,715	3,717	3,719	3,720	3,719
Valley	8,159	8,171	8,178	8,186	8,188	8,185	8,178	8,166	8,152	8,135	8,117	8,093
Wibaux	1,152	1,161	1,170	1,181	1,189	1,196	1,203	1,210	1,217	1,224	1,229	1,234
Total Region	89,931	90,327	90,673	90,990	91,189	91,293	91,306	91,226	91,084	90,885	90,641	90,357

Eastern MT County Population Projections, 2012 - 2035 -- Medium-High Oil Production (MDT) Figures

MT County	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Carter	1,221	1,249	1,295	1,340	1,385	1,431	1,478	1,521	1,559	1,596	1,633	1,667
Custer	12,327	12,626	13,112	13,585	14,057	14,528	15,000	15,444	15,858	16,247	16,613	16,956
Daniels	1,812	1,842	1,898	1,955	2,010	2,066	2,122	2,174	2,223	2,266	2,302	2,334
Dawson	9,077	9,149	9,373	9,605	9,848	10,094	10,343	10,580	10,802	11,014	11,200	11,377
Fallon	3,166	3,307	3,491	3,672	3,846	4,017	4,184	4,338	4,484	4,615	4,734	4,840
Garfield	1,268	1,304	1,358	1,410	1,461	1,511	1,557	1,603	1,644	1,681	1,712	1,741
McCone	1,797	1,826	1,882	1,936	1,988	2,041	2,094	2,145	2,196	2,238	2,279	2,315
Phillips	4,284	4,291	4,366	4,439	4,518	4,594	4,674	4,745	4,803	4,854	4,909	4,961
Powder River	1,783	1,800	1,842	1,881	1,919	1,959	1,999	2,037	2,073	2,111	2,140	2,165
Prairie	1,226	1,248	1,290	1,336	1,383	1,430	1,478	1,523	1,566	1,606	1,642	1,677
Richland	10,391	10,716	11,185	11,639	12,088	12,536	12,985	13,410	13,808	14,181	14,531	14,856
Roosevelt	10,724	10,831	11,097	11,360	11,626	11,891	12,154	12,396	12,615	12,823	13,016	13,201
Rosebud	9,280	9,279	9,442	9,617	9,794	9,987	10,186	10,378	10,556	10,724	10,879	11,019
Sheridan	3,447	3,473	3,551	3,627	3,706	3,786	3,869	3,949	4,026	4,098	4,163	4,226
Valley	7,610	7,705	7,911	8,114	8,315	8,513	8,711	8,895	9,068	9,217	9,355	9,482
Wibaux	1,032	1,047	1,079	1,108	1,137	1,168	1,200	1,228	1,258	1,285	1,308	1,333
Total Region	80,446	81,693	84,173	86,626	89,082	91,551	94,033	96,367	98,538	100,554	102,417	104,150
MT County	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Carter	1,696	1,720	1,737	1,751	1,759	1,762	1,761	1,754	1,744	1,730	1,713	1,695
Custer	17,251	17,496	17,702	17,874	18,004	18,090	18,134	18,141	18,116	18,067	18,006	17,931
Daniels	2,362	2,383	2,398	2,407	2,413	2,411	2,404	2,391	2,374	2,354	2,332	2,307
Dawson	11,517	11,632	11,718	11,779	11,810	11,818	11,797	11,758	11,698	11,620	11,530	11,433
Fallon	4,924	4,995	5,052	5,092	5,120	5,132	5,129	5,116	5,092	5,060	5,021	4,977
Garfield	1,767	1,785	1,800	1,811	1,817	1,819	1,818	1,812	1,803	1,791	1,778	1,762
McCone	2,345	2,366	2,381	2,390	2,394	2,391	2,385	2,373	2,357	2,338	2,315	2,292
Phillips	5,004	5,028	5,046	5,060	5,060	5,053	5,037	5,010	4,977	4,938	4,892	4,841
Powder River	2,189	2,208	2,222	2,232	2,240	2,243	2,239	2,231	2,218	2,203	2,185	2,165
Prairie	1,707	1,731	1,750	1,762	1,771	1,770	1,768	1,760	1,747	1,733	1,716	1,697
Richland	15,136	15,364	15,548	15,695	15,803	15,869	15,889	15,873	15,831	15,768	15,688	15,595
Roosevelt	13,333	13,432	13,494	13,561	13,569	13,542	13,484	13,393	13,281	13,151	13,007	12,851
Rosebud	11,126	11,220	11,295	11,327	11,317	11,273	11,197	11,095	10,972	10,830	10,671	10,501
Sheridan	4,280	4,326	4,366	4,391	4,404	4,413	4,414	4,408	4,394	4,377	4,357	4,332
Valley	9,578	9,653	9,705	9,742	9,756	9,751	9,728	9,689	9,638	9,575	9,507	9,426
Wibaux	1,352	1,372	1,388	1,405	1,417	1,425	1,431	1,436	1,439	1,441	1,439	1,437
Total Region	105,568	106,711	107,604	108,280	108,653	108,763	108,614	108,237	107,682	106,976	106,159	105,244

Eastern MT County Population Projections, 2012 - 2035 -- High Oil Production (MDT) Figures

MT County	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Carter	1,221	1,251	1,300	1,348	1,395	1,441	1,487	1,532	1,572	1,614	1,656	1,696
Custer	12,326	12,652	13,170	13,668	14,156	14,631	15,097	15,550	15,990	16,425	16,855	17,255
Daniels	1,812	1,846	1,907	1,967	2,025	2,081	2,136	2,189	2,241	2,290	2,335	2,375
Dawson	9,076	9,168	9,414	9,664	9,917	10,166	10,410	10,652	10,893	11,135	11,364	11,578
Fallon	3,166	3,314	3,507	3,694	3,873	4,046	4,211	4,368	4,521	4,666	4,803	4,925
Garfield	1,268	1,306	1,364	1,419	1,471	1,522	1,567	1,614	1,658	1,699	1,737	1,772
McCone	1,797	1,830	1,890	1,948	2,002	2,056	2,107	2,159	2,214	2,263	2,312	2,356
Phillips	4,284	4,299	4,386	4,467	4,549	4,627	4,704	4,778	4,843	4,908	4,981	5,049
Powder River	1,783	1,804	1,850	1,893	1,932	1,973	2,012	2,051	2,091	2,134	2,172	2,203
Prairie	1,226	1,250	1,295	1,344	1,393	1,440	1,487	1,534	1,579	1,623	1,666	1,707
Richland	10,390	10,738	11,234	11,710	12,173	12,625	13,069	13,502	13,923	14,336	14,743	15,118
Roosevelt	10,723	10,853	11,146	11,430	11,707	11,976	12,232	12,481	12,721	12,964	13,206	13,434
Rosebud	9,279	9,298	9,484	9,675	9,863	10,058	10,252	10,448	10,645	10,841	11,038	11,214
Sheridan	3,446	3,480	3,567	3,649	3,732	3,813	3,894	3,976	4,060	4,143	4,224	4,301
Valley	7,609	7,721	7,946	8,164	8,374	8,574	8,767	8,956	9,144	9,318	9,491	9,649
Wibaux	1,032	1,050	1,084	1,115	1,145	1,177	1,208	1,236	1,268	1,299	1,327	1,356
Total Region	80,440	81,860	84,545	87,155	89,707	92,205	94,641	97,026	99,363	101,658	103,910	105,989
MT County	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Carter	1,731	1,760	1,781	1,799	1,809	1,815	1,814	1,808	1,798	1,783	1,766	1,746
Custer	17,605	17,900	18,152	18,364	18,524	18,631	18,687	18,701	18,676	18,622	18,554	18,470
Daniels	2,410	2,438	2,459	2,473	2,483	2,483	2,478	2,464	2,447	2,427	2,403	2,377
Dawson	11,753	11,901	12,015	12,102	12,152	12,172	12,157	12,121	12,060	11,977	11,882	11,777
Fallon	5,025	5,110	5,180	5,232	5,268	5,286	5,286	5,274	5,249	5,216	5,174	5,127
Garfield	1,803	1,826	1,846	1,861	1,870	1,874	1,873	1,868	1,859	1,847	1,832	1,815
McCone	2,394	2,421	2,441	2,455	2,463	2,463	2,458	2,446	2,430	2,410	2,386	2,361
Phillips	5,107	5,144	5,174	5,199	5,207	5,204	5,190	5,165	5,131	5,090	5,041	4,986
Powder River	2,234	2,259	2,278	2,294	2,305	2,310	2,307	2,299	2,286	2,271	2,252	2,230
Prairie	1,742	1,771	1,795	1,811	1,822	1,823	1,822	1,814	1,801	1,786	1,768	1,748
Richland	15,446	15,719	15,943	16,126	16,260	16,344	16,374	16,362	16,320	16,253	16,166	16,063
Roosevelt	13,606	13,743	13,837	13,933	13,961	13,947	13,895	13,806	13,692	13,556	13,404	13,237
Rosebud	11,354	11,479	11,582	11,637	11,644	11,610	11,539	11,437	11,311	11,163	10,996	10,817
Sheridan	4,368	4,426	4,477	4,512	4,531	4,545	4,549	4,544	4,530	4,512	4,490	4,462
Valley	9,774	9,876	9,951	10,009	10,038	10,043	10,025	9,988	9,935	9,870	9,796	9,710
Wibaux	1,380	1,403	1,424	1,444	1,458	1,467	1,475	1,480	1,483	1,485	1,483	1,480
Total Region	107,733	109,175	110,335	111,250	111,793	112,017	111,931	111,576	111,010	110,267	109,392	108,406

APPENDIX A

MONTANA DEPARTMENT OF TRANSPORTATION – DISTRICT MAP

The Montana Department of Transportation’s analysis of the potential effects various levels of future oil production may have on Montana’s transportation infrastructure was focused on MDT’s District 4 (see the map below). Estimates of potential population projections based on MDT’s research were produced for the entire district (referred to as the “Region”) *as a whole*; providing county level population projections were beyond the scope of MDT’s study.

