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Williston Basin 2016: Employment, Population, and Housing Forecasts

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Executive Summary

Local governments in western North Dakota continue to experience substantial changes in population. The development of shale oil dramatically altered or reversed long-term trends in population size and composition. The purpose of this project was to provide the 19 oil, gas, and coal producing counties in North Dakota with future employment, population and housing forecasts.

Employment forecasts were developed for potential changes in the pace and size of shale oil development in North Dakota over the next 20 years, and for counties with low oil and gas impacts, develop projections that capture a reasonable range of future employment change given historical trends.

This study developed a new population model that incorporates dynamic linkages between employment levels, migration rates, workforce commuting behavior, and local populations. The methods developed in this study proved a substantial step forward from previous modeling efforts.

Three general crude oil price scenarios were used to frame likely employment in the Williston Basin. A low price environment would be similar to the conditions present in the Williston Basin in 2016 and 2017 with an annual completion of 400 to 800 wells per year. A moderate price environment was modeled to develop 1,000 to 1,500 wells per year. High price environments were also examined, and were expected to produce 1,750 to 2,300 wells per year.

Employment

Employment forecasts included anticipated changes in oil and gas employment (i.e., rig counts, oil field maintenance, transportation), employment in other industries, farm and ranch proprietors, and secondary job growth from oil and gas industry expansion. In the core-oil producing counties, overall employment will continue to be dominated by oil and gas activity. However, drilling efficiencies have improved substantially, are likely to continue to improve, and will allow the oil and gas industry to use fewer rigs in the future to drill the same number of wells as in previous years. Expect fewer rigs in the future even if prices return to levels observed from 2010 through 2014. Also, labor efficiencies will act to curb the growth in oil and gas industry employment even as the number of producing wells in the state increases.

In a low price environment, employment in the Williston Basin was forecasted to grow slightly. Employment over a 20-year span in a moderate oil price environment was forecasted to remain below peak regional employment observed at the end of 2014, but annual employment growth would be sufficient to present challenges for the region. A high price environment would likely result in regional employment surpassing the peak levels found 2014, and while the pace of employment growth was not expected to match the trajectory experienced from 2010 through 2014, rates of expansion would re-introduce many of the same growth issues the Williston Basin recently experienced.

It is important to remember even in higher-priced environments, the oil and gas industry is not likely to require adding service roads, well pads, depots, office space, industrial facilities, and so on, as much of that infrastructure work is complete. Also, roads and highways have undergone substantial upgrades and expanded capacity, as well as water and sewer, electrical transmission, and other public

infrastructure needs. Both private and public infrastructure required to handle a much larger oil and gas industry have largely been satisfied for the foreseeable future. Therefore, future infrastructure-based employment is likely to represent a substantially smaller component of overall regional employment, even in high oil and gas price environments, than was present from 2010 through 2014.

Population

In moderate and high price scenarios, population growth in core oil producing counties was forecasted to be similar but slightly slower than the growth rates those counties experienced from 2011 to 2014. Long-term population growth rates of 2 percent to 3 percent per year under the moderate and high price scenarios will create challenges for local jurisdictions. Population change is generally around 1 percent or less per year in the low price environment for core oil producing counties.

Population growth, albeit at very low rates, occurs in most non-core oil producing counties in the low price scenarios, except Divide, Renville and Slope Counties which were forecasted to have slight population declines. In high oil price environments, long-term population growth rates are generally around 1 percent per year or less. Population growth across the three oil price scenarios for the non-core oil producing counties is considerably lower than the rates projected for the core oil producing counties. Another interpretation of population change in the low and moderate growth scenarios is that those price environments act to stabilize or slowly grow populations in the non-core oil producing counties, and are unlikely to create rapid population growth.

Service populations were estimated using new data that indicates the proportion of the local workforce that is not a permanent resident in the Williston Basin. In moderate and high price environments, when the mix of employment in the oil and gas industry is weighted towards oil field development, core-oil production counties will have substantial service populations. These conditions will require making provisions for temporary housing in the local housing stock.

Housing

Housing requirements were based on forecasting the number householders as a percentage of future population for four age groups, and using the number of future householders to approximate the housing inventories that would be required given an area's permanent population. Future housing inventories therefore change based on the size and composition of future population. However, in examining the future rate of housing inventory growth to past rates of housing inventory change, future housing requirements are unlikely to repeat the rate of change observed in the Williston Basin from 2010 through 2014.

The percentage mix of housing types (e.g., single family, apartments) was not adjusted over the projection period. However, recent housing inventories suggest some shifting from single family housing to multi-family housing. Those shifts are consistent with changes in resident population and workforce characteristics.

The ability to close the gap between housing requirements (i.e., the amount of housing needed for the number of individuals in the area) and market demands (e.g., cost, size, amenities, location) for housing remains elusive. Existing methods of projecting housing requirements still rely heavily on current or past relationships which either 1) match householders as a percentage of current population

to future population levels as a means to estimate housing requirements, 2) assign housing requirements based on ratios of housing to employment, or 3) divide population by occupancy rates to estimate housing needs. The last two strategies were not employed in this study, which is a substantial departure from previous modeling efforts. Housing needs based on income, age, and householder characteristics can be obtained from the 2016 North Dakota Statewide Housing Needs Assessment, which would complement the housing inventory forecasts in this study.

Conclusions

Study findings do not suggest a return to the pace of employment growth or a quick return to the peak employment experienced in the Williston Basin from 2010 through 2014. The projections do indicate that employment is likely to remain at levels observed at the end of 2016, even in most low price environments, which implies the region is not likely to return to pre-shale employment levels.

Low oil price environments

Population effects in the low price environments are mixed. At a pace of adding 400 wells per year population can continue to decline or will remain mostly stable. With a pace of 600 or more wells added per year, population is likely to grow slowly for the core oil producing counties. All but the worst low oil price scenarios will act to stabilize long-term population trends.

Moderate oil price environments

Moderate price environments that produce 1,000 or more new wells per year will return the Williston Basin to healthy economic and demographic expansion. Growth will still present some challenges but is likely to remain at levels that are much more manageable than what was experienced from 2010 through 2014.

High oil price environments

High price environments that produce 1,700 or more wells per year will bring about very challenging growth conditions. Sustained high prices are likely to reintroduce many of the issues local communities and governmental jurisdictions faced during the 2010 to 2014 period. However, within the range of likely outcomes evaluated the rates of growth are likely to be remain lower than those observed from 2010 to 2014.

Additional Materials

The Vision West ND employment, population, and housing projections study produced a number of materials for constituents and stakeholders in the Williston Basin. This report focuses on study assumptions, scenarios, and modeling processes, while covering an overview of the study results.

For county-level information, Vision West ND posted a series of one-hour webinars for each county on their website. In addition to the webinars, county-specific data files are available on the Vision West ND website detailing key data and projections for each study county.

Williston Basin 2016:
Employment, Population, and Housing Forecasts

Dean A. Bangsund and Nancy M. Hodur*

Introduction

Estimating future population has been, and continues to be, a key issue for local governments in western North Dakota. For decades, a declining and aging population was the norm for much of western North Dakota, but the development of shale oil dramatically altered or reversed those long-term trends. Populations have increased and become younger as shale oil has resulted in a large influx of younger workers into the most heavily impacted communities.

The purpose of this project was to provide the 19 oil, gas, and coal producing counties in North Dakota with specific population and housing forecasts related to potential levels of future employment. The goal of the employment forecasts was to develop likely expectations for changes in the pace and size of shale oil development in North Dakota over the next 20 years, and for counties with low oil and gas impacts, develop projections that capture a reasonable range of future employment change given historical trends.

Background

Evaluations of how development of shale oil might influence population in North Dakota begun in 2010 (Ondracek et al. 2010) — a point in time when the industry begun to substantially ramp up drilling activities to secure their mineral leases in key areas of the Bakken. As industry activity grew, so did the need to better understand the trajectory and magnitude of future population change. Additional population and housing forecasting studies followed in the next several years, including work commissioned by individual cities (Bangsund and Hodur 2013; Hodur and Bangsund 2013, 2015) and studies sponsored by local and state governments (Rathge et al. 2012, KLJ 2012; Hodur et al. 2013; KLJ 2014; Bangsund and Hodur 2014).

Economic expansion from 2010 through 2014 resulted in the doubling of some local populations where oil and gas development was most concentrated, and clearly highlighted the need for population forecasts that could address lagging and incomplete demographic data and incorporate an ever evolving understanding of the geology, technology and economics of shale oil in ND. The economic expansion related to shale oil, which was unprecedented for North Dakota, and the substantial need to better forecast how and when population change would occur, led to the development of non-traditional methods for estimating population change (Bangsund and Hodur 2012).

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Non-traditional Population Modeling

Traditional demographic tools, such as standard cohort demographic models, were inadequate to address the rapidly changing conditions in the Williston Basin and lacked the data needed to accurately forecast future fertility, mortality and migration rates (Rathge et al. 2012). Those traditional approaches also failed to address the unique characteristics of the petroleum industry workforce in the Williston Basin — 1) a workforce comprised of individuals employed in the state but residing (i.e., home or permanent residence) in other states, 2) workers with specialized skills that would not likely remain employed for extended periods in North Dakota, and 3) a shortage of workers that resulted in high worker turnover, poaching, and compensation escalation among employers in the Williston Basin.

In light of those conditions and challenges, an alternate method was developed that linked population to housing and employment (Bangsund and Hodur 2012, Bangsund et al. 2012). As part of that strategy, Bangsund and Hodur (2012) developed a process to model changes in direct and secondary employment associated with the petroleum sector in western North Dakota. Estimates of labor coefficients for several segments of the petroleum industry were obtained that reflect operating conditions in the Basin in 2012 (ND Department of Mineral Resources 2012). The modelling process estimated labor for drilling, fracking, gathering systems construction, and oil field service (e.g., well site operations, crude oil pipelines, and gas plant operations). Labor coefficients have been continually refined since that period to reflect adjustments in employment requirements based on changes in production practices and influences of future technological change on industry labor requirements.

The forecasting methodology developed by Bangsund et al. (2012) separates employment in western North Dakota into employment in the petroleum industry, secondary employment associated with the petroleum industry, and employment in other industries and economic sectors. Constraints regulate the amount of future employment change in other industries (e.g., manufacturing, tourism), as well as serving to adjust current employment coefficients within the petroleum sector. Secondary employment creation is linked to direct employment in the petroleum sector and is adjusted to reconcile current employment coefficients to traditional input-output analysis multipliers (Bangsund and Hodur 2012). The model estimates total economy-wide employment at the State Planning Region level. State Planning Regions 1, 2, and 8 are reflective of the Williston, Minot, and Dickinson regions, respectively.

The model linked projected employment growth at the regional level to estimate future housing demand. The original architecture of the model was based on historic data on the regional supply of housing units from 2000 through 2010 (U.S. Census Bureau 2012a,b,c,d) and historical covered employment (i.e., quarterly census of employment and wages) (Job Service North Dakota 2012), which produced a baseline from which future expected housing demand was linked to future employment. Early in 2014, updated data on housing supply and occupancy rates (U.S. Census Bureau 2014a, b, c) and reported QCEW employment (Job Service North Dakota 2014) were incorporated into the model. The housing model was dynamic and allowed for the relationships between employment and housing demand to change over the projection period.

Since workers can, and often do, reside and work in different counties within a region, regional housing demand was allocated to counties within the regions based on trends in county housing data (Figure 1). Those trends reflect changes in the composition of county housing (e.g., percentage of existing housing in apartments is changing in some counties) and the relative county share of total

regional housing. In some counties, their share of housing in the region is increasing, both in relative terms (i.e., percentage of all housing in the region) and in absolute terms (i.e., total housing units are increasing). In other counties, recent trends in housing show some counties are increasing housing stock in absolute terms but not in relative terms (i.e., housing is increasing, just not proportional to the rate of change at the regional level). Future demand for housing, at the county level, was therefore a function of changes in housing supply relative to the region, and expected future changes in the mix of housing (e.g., shift from single family homes to apartments).

Historic data on occupancy rates (U.S. Census Bureau 2014b), information on build out rates, and future mix of housing types (e.g., houses, apartments, mobile homes) were combined in a population model that tracks a region's potential population (Figure 1). The model combined persons-per-household occupancy rates by type of housing with estimates of future housing demand to estimate population potential. The end result was an estimate of population potential that accounted for existing industries and changes in the petroleum sector in the Williston Basin. An important interpretation of the model's output lies in understanding that the model based population on expected housing demand, not expected housing supply. Since future supply of housing is unknown, an implied assumption in the modeling process was that future rates of housing supply equal future rates of housing demand. The best description of model output was population potential. Potential was defined as what the population was likely to be if housing demand was actually supplied, and occupancy rates matched historic conditions.

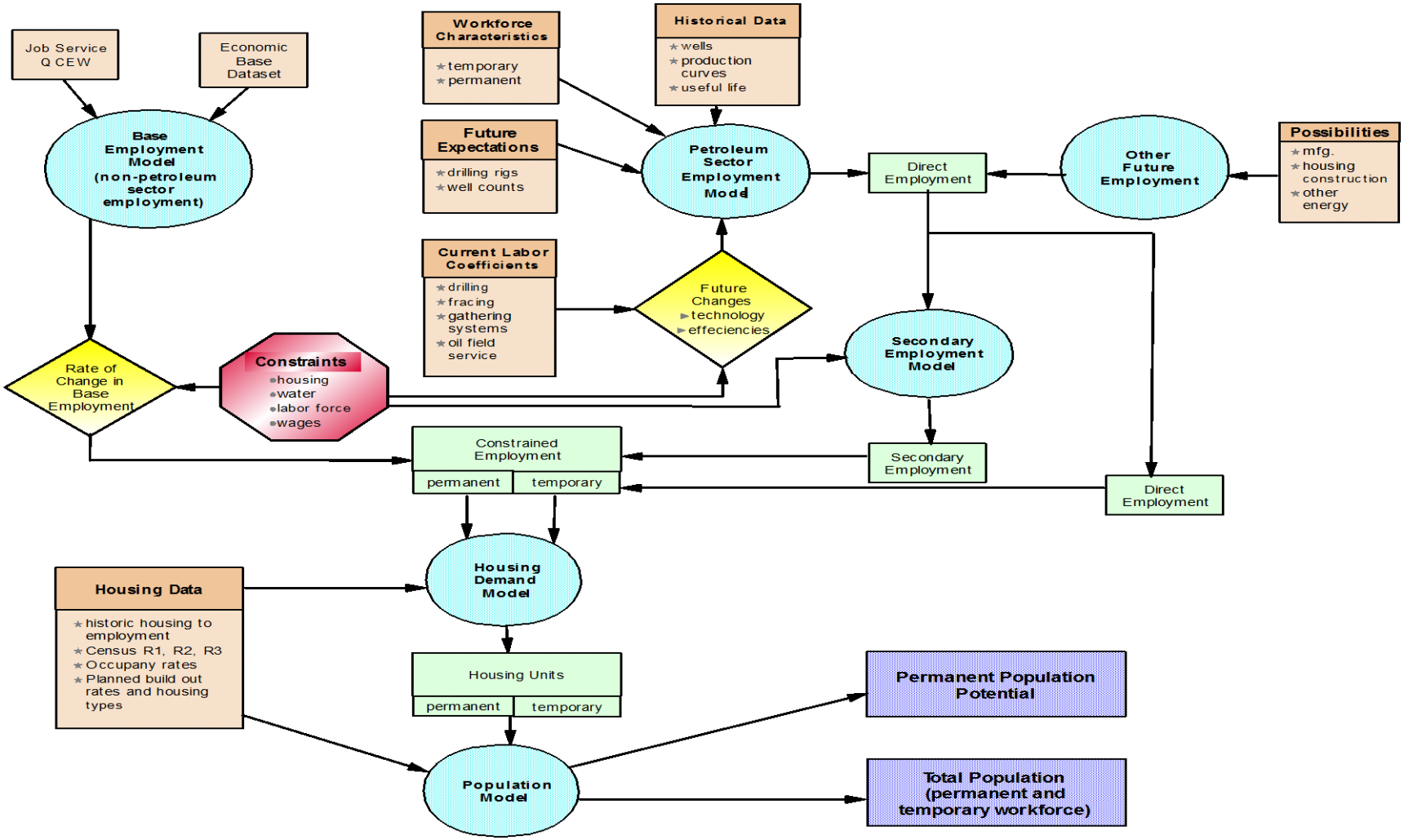

Figure 1. Schematic of NDSU Population Modeling Process for Williston Basin, 2011 through 2014

Re-cap of Economic and Socio-economic Changes to Oil and Gas Producing Counties

Conditions in the Williston Basin in 2016 are considerably different from the conditions in 2010/2011 when the first non-traditional forecasting models were developed. Employment in the oil and gas industry is not expanding, but rather has experienced a substantial contraction as a result of sharp declines in crude oil prices. The oil and gas industry lost about 14,500 jobs from 2014 to 2015 (Job Service North Dakota 2015; 2016), with additional employment reductions occurring in the first half of 2016. Crew camps, which housed thousands of workers, are largely vacant or have been shut down. Hotel room occupancies are down from previous periods, representing another indicator of reduced demand for immediate lodging in the Williston Basin. Real estate prices have been slow to decline, but adjustments in apartment rental rates at the end of 2016 were showing some moderation, reflecting a softening of housing demand.

Infrastructure in the form of streets, roads, highways, airports, water and sewer treatment plants, public facilities, schools, private offices, retail stores, malls, hotels and motels, restaurants, among other capacities in the region, have all undergone substantial expansion since 2010. The region's infrastructure has been upgraded and expanded such that population and employment growth since 2010 no longer overwhelm local private and public service providers.

The region has added about 10,000 wells since 2008, going from roughly 3,300 wells in 2008 to over 13,000 wells at the end of 2016 (ND Department of Mineral Resources 2016). The oil and gas industry, along with the overall economy, remains much larger than levels prior to the start of shale oil development. Populations are now comprised of more young adults in their prime child bearing ages. School enrollments are up, and an increase in families with children has been observed for the first time in decades (ND Statewide Housing Needs Assessment 2016).

Compared to periods prior to shale oil development, permanent populations in the Williston Basin are larger, employment remains higher, and overall output of the regional economy is substantially improved. The regional economy has been altered, and looking forward, the region will not reset to conditions that existed prior to shale oil development. Oil and gas development is ongoing despite low crude oil prices, and permanent pipeline, processing, and service capacity in the oil and gas industry suggest a long-term commitment to remain engaged in shale oil production (Bangsund and Hodur 2017).

Development of shale oil is highly likely to occur over several decades given current expectations for future price volatility, estimates of well counts needed to satisfy full development of shale formations, and the billions of dollars of investments in infrastructure made by the petroleum industry (Bangsund and Hodur 2017). Supporting that assertion is 1) the domestic desire of the United States to have home-grown energy supplies, 2) the newly modified domestic policies allowing domestic oil supplies to compete in the global crude oil export market, 3) the physical size of shale formations that allow for considerable expansion over extended periods, and 4) improving efficiencies and technologies allowing oil from shale formations to compete for investment capital with other, more conventional sources of crude oil.

Despite most local jurisdictions having added or built up their infrastructure to handle the expanded economy and the recent abatement of housing demand, future population forecasts remain extremely important for western North Dakota. The future pace of development remains uncertain and local governments' desire to use the current downturn to re-assess and more effectively plan for future

expansion—rather than be thrust into a reactionary condition which prevailed during the previous five years—all reinforce the need for up-to-date population forecasts. In 2016, the future geophysical size of the industry is perhaps less of an issue than with previous forecasts that dealt with thresholds needed to fully develop shale formations which were continually being revised upward.

In addition to an abrupt change in the economic environment, key demographic information on resident populations has mostly caught up to current conditions. Some of the new data include 1) information on workforce characteristics, 2) commuting activity and residency of workers employed in the Williston basin, 3) migration rates for permanent population, 4) up-to-date fertility and mortality rates, 5) updated housing inventories, and 6) other socio-economic data from the U.S. Census Bureau (e.g., American Community Survey[1]) that is more reflective of current conditions now that the pace of population change has moderated substantially.

Study Region

The study area encompasses 19 counties in western North Dakota, and corresponds to the membership counties in the Western Dakota Energy Association (Western Dakota Energy Association 2016)[2]. For purposes of grouping county-level results Dunn, McKenzie, Mountrail, Stark and Williams Counties are treated as the core oil producing counties and the remainder as non-core oil producing counties (Figure 2).

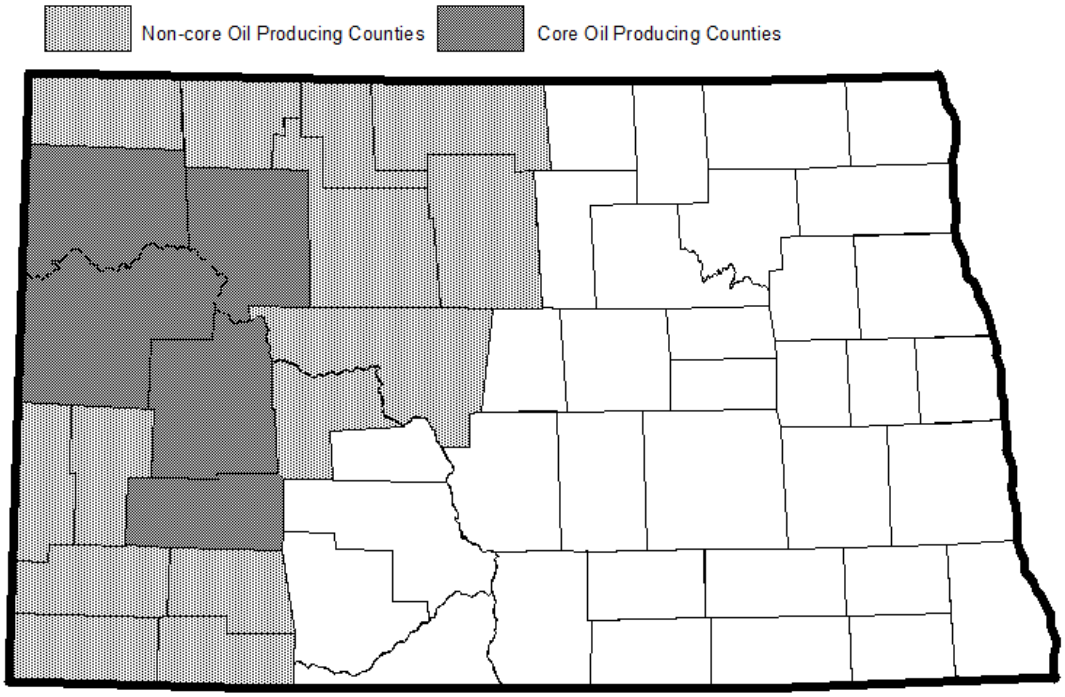

Figure 2. Study Counties

[1] American Community Survey reports data averaged over five years for areas with populations lower than 65,000 (U.S. Census Bureau 2017). As a result of averaging multiple years of survey observations during periods of rapid change, reported values can lag substantially from actual conditions, limiting the usefulness of those data .

[2] Oliver County, while a member county of the Western Dakota Energy Association, is not included in this study.

Data and Methods

Population change is a function of births, deaths, in-flows and out-flows (migration) of people. The challenge for western North Dakota is predicting how various growth rates in the local economy, largely driven by shale oil development, will affect migration rates. Recent and current conditions suggest that future economic expansion will likely require a workforce that exceeds what can be supplied by local populations. Therefore, much of the link between economic expansion and population will occur with changes in migration rates. While the link between growth in employment and population is fairly straight forward, developing a methodology to link the two factors is challenging.

Two general strategies have been used to link economic environments and migration rates in North Dakota. The first strategy uses past migration rates, reflective of a particular economic environment, and matches those historical rates with the expected future economic environment. An underlying assumption with this strategy is that migration rates will be similar in the future as in the past providing past conditions are representative of future conditions. In other words, future economic environments (and migration patterns) will be similar to past conditions. Recent examples of this strategy can be found in the 2012 North Dakota Statewide Housing Needs Assessment and 2016 North Dakota Statewide Housing Needs Assessments conducted by the Center for Social Research at North Dakota State University (Rathge et al. 2012, Hodur et al. 2017). In those studies, future population is strictly a function of using current mortality and fertility rates, and applying migration rates from past periods that are expected to match future economic conditions.

Another general strategy is to more directly link economic forecasting to changes in workforce and migration. An example of this approach includes population projections produced by the North Dakota Department of Commerce (2016). The methodology in those projections used a statewide economic model to gauge levels of future employment, and then used estimates of how North Dakota will meet the growth in workforce through potential changes in migration patterns. Additional factors were subsequently used to estimate county-level population from the statewide economic forecast.

This study developed a modeling approach that combines elements of the above two strategies into a single modeling process—one that relies partially on past migration rates and adjusts future migration rates according to forecasted economic conditions. The basic premise for the methodology is that growth in employment leads to a required increase in workforce, and subsequent increases in demand for workforce will/can produce increases in local population. Under conditions of low workforce participation rates and/or high unemployment rates, growth in employment may not necessarily result in an increase in population since additional workforce needed to match growth in employment could come from the existing population. Most areas of western North Dakota have high workforce participation rates and low unemployment rates (Job Service North Dakota 2016d, U.S. Bureau of Labor Statistics 2016), implying little capacity within the existing population to create additional workforce to fill an increase in employment.

Information recently released from the U.S. Census Bureau shows that substantial workforce does not reside and work in the same general location (U.S. Census Bureau 2016). Hodur and Bangsund (2015) also found this to be a conclusion of research based on surveys of oil industry representatives and industry workforce in the Williston Basin. These data provide a means to adjust the link between employment growth and growth in local workforce and resident population. As employment growth increases--requiring a growth in workforce--U.S. Census Bureau data can be used to split the supply of that additional workforce into residents and commuters. Further, commuter data also provides a means to allow population forecasts to be adjusted based on changes in workforce requirements in adjacent counties. As an example, growth in employment (and workforce requirements) in Williams County will

affect permanent populations in nearby counties of McKenzie, Dunn, Divide, and Mountrail, as well as other counties in western North Dakota. The same is true of employment in those counties affecting population in Williams County.

Study Assumptions

The follow assumptions, insights, and analysis factors guided the development of the projections of employment, population, and housing.

Rig Count/Pace of Oil Field Development

Pace of oil field development was based on likely industry behavior consistent with the observed relationships between historical oil prices, rig counts, and well completions. Even though consistent oil prices, regardless of the level, are unlikely over the projection period, the use of the rig counts serves to illustrate growth rates during those conditions. Additional conditions include:

-) Mineral leases are largely secure.
-) Industry focused on in-fill drilling.
-) Shale oil development is unlikely to be exhausted in the next 20 years.
-) A steady pace of development within the price scenarios means exploration and development employment will remain relatively constant (albeit declining as rig counts are modeled to slowing decline over the projection period).

Policy and Regulation

The projections were made absent of any major policy or regulatory factors substantially altering the economic landscape for shale oil development in North Dakota.

-) no fracking or other environmental regulations altering the ability to use current technologies.
-) local or state policies influencing gas capture or other similar initiatives are not likely to affect industry's ability to operate at either historical or projected pace.

Total Well Counts/Extent of Development

The development of shale oil in North Dakota for many years represented a moving target (Bangsund and Hodur 2012; Bangsund and Hodur 2015). Understanding of geology, technology, and economics within the Bakken and Three Forks Formations is still evolving, but the geology factors have matured over the last several years. Technology is still improving, leading to improved efficiencies in many segments of the industry. Economics will continue to be influenced by regulations, technology, and crude oil prices. As such, some uncertainty as to the potential future size of development has been lessened, but continued changes in technology and economic environments suggest uncertainties will remain present in the projection periods (HIS 2015). This uncertainty is likely to influence investment, development, and planning in the Basin.

The increased understanding of the geology since 2012/13, and the resulting upward adjustment to the number of well counts is consistent with:

-) Statements by oil firms in recent years that they will have increased in-field drilling densities, which adds to well counts and increases time to fully develop mineral assets. Also, recovery rates are expected to increase as a result of more wells and improved well output.
-) Recent research on well drilling densities supports companies' claims (e.g., EERC-UND Bakken Optimization Program).

-) The 'benches' or layers in the Three Forks Formation are more fully understood now as opposed to several years ago, confirming the viability of developing those shale formations.
-) the overall size of shale oil development in western North Dakota will continually need to be reassessed; however, future assessments will likely reflect refinements in current estimates as opposed to wholesale or substantial adjustments.

Other Market Factors

A number of potential factors exist that could influence oil production in the Williston Basin, such as geopolitical disruptions affecting world oil markets, changes in domestic macro-economic policies, and changes in national energy policies and environmental considerations. The projections were made without considerations for the 'what if' consequences of national or international factors that could affect oil production in North Dakota. Other considerations included:

-) The widespread adoption of enhanced oil recovery (EOR) was not modeled.
-) No constraints to moving crude oil out of the Williston Basin.
-) No substantial (or additional) price discounts accruing to North Dakota oil producers from changes in domestic market preferences for light sweet crude

Population

A number of assumptions were inherent in the population forecasts for this study. While a number of dynamic elements were incorporated into the modeling, the study used several overriding assumptions:

-) consistent fertility and mortality rates were used despite evidence that those factors have been changing in some counties.
-) future employment and workforce in the study region will continue to be heavily influenced by commuter activity and that workforce requirements in study counties will continue to represent a mix of local and non-local workers.

Housing

Housing remains a challenging issue in the Williston Basin. To get around all the possible 'what if' conditions, several assumptions were required to keep housing projections consistent with other studies and consistent with existing knowledge of housing requirements in the region.

-) updated housing inventories closely estimate the true inventory of housing in the study counties
-) largely due to the downturn in employment and substantial expansion of housing inventory, current relationships between householders within the local population were assumed to be valid predictors of future housing requirements.
-) adjustments in housing preferences and affordability issues would not alter the assumption of using current housing-to-population metrics in forecasting future housing inventories.

Estimating Future Employment

An employment forecasting model from previous projects was used to create different employment scenarios for western North Dakota (Bangsund and Hodur 201X) (Figure 3). The model is structured to estimate total economy-wide employment at the State Planning Region level. State Planning Regions 1, 2, and 8 are reflective of the Williston, Minot, and Dickinson regions, respectively. Employment estimates consist of three main components: direct employment in the oil and gas industry, secondary job creation, and employment in other industries and sectors.

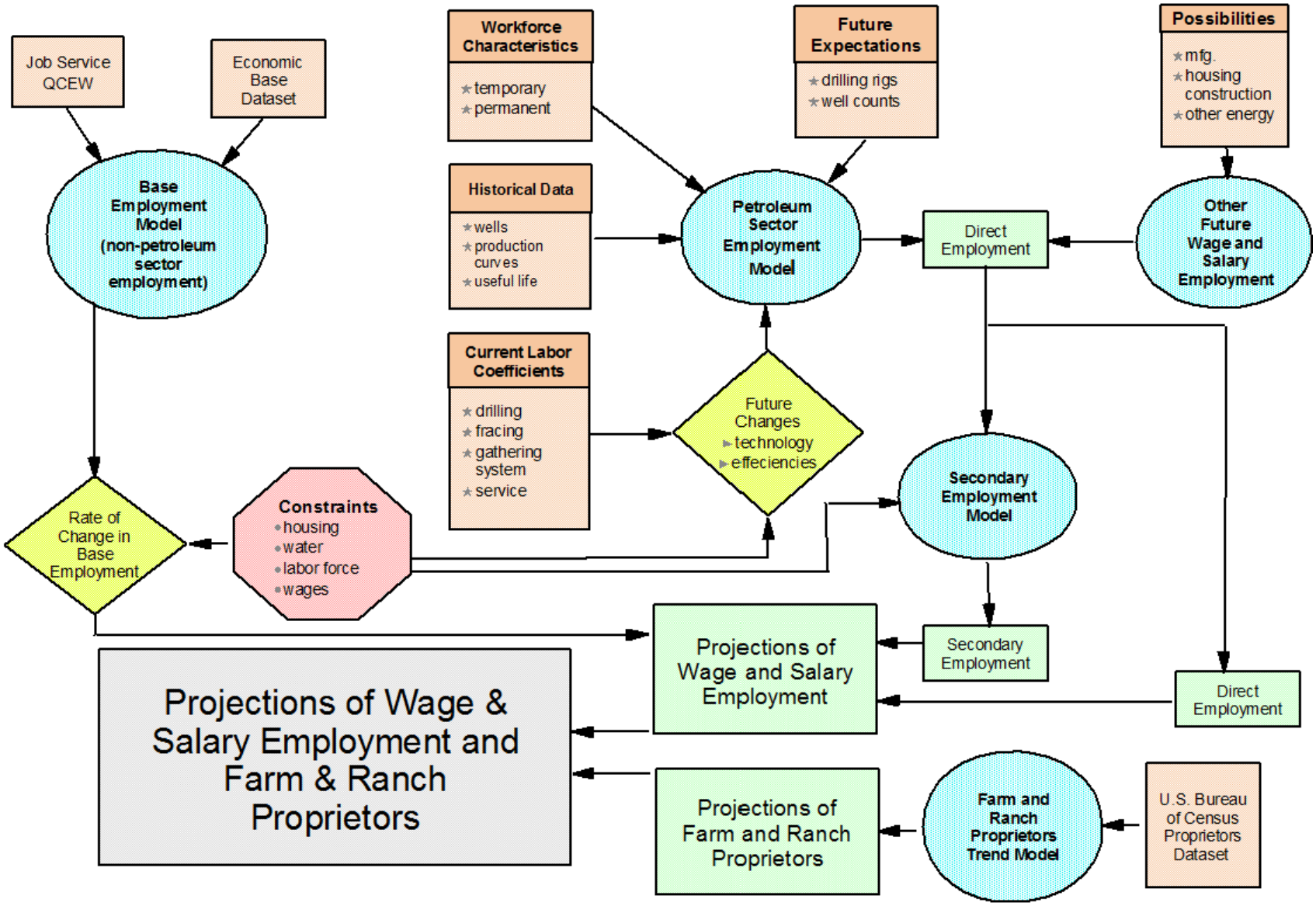

Figure 3. Schematic of NDSU Employment Modeling Process for Williston Basin, 2016

Petroleum Industry: Direct employment in the petroleum industry was estimated for drilling, hydraulic fracturing (fracking), construction of in-field gathering systems, and oil field service for each development scenario (for more detail on model design see Bangsund and Hodur 2012).

Employment in the petroleum industry was based on rig counts, well completions, number of existing wells and labor requirements for various aspects of the industry. Separate employment estimates were produced for exploration activities such as drilling and fracking, production operations such as well upkeep, infrastructure maintenance and transportation, gas plant operations, and construction of oil field infrastructure and gathering systems. Labor coefficients in the model are adjusted over time to reflect anticipated changes in labor requirements, production practices, and technological efficiencies.

Secondary Job Creation: The additional jobs expected to accrue over the projection period in the Williston Basin as a result of expansion of the oil and gas industry were estimated using a variety of methods (see Bangsund and Hodur 2012). Examples of these jobs include doctors, teachers, mechanics, home builders, sales people, store clerks, accountants, lawyers, and other jobs in the general economy.

Other Industries: Changes in total covered employment (i.e., Quarterly Census of Employment and Wages from Job Service North Dakota) in each region from 1990 through 2010 were evaluated after removing direct employment in the oil and gas industry. Trend analysis of the time-series change in total employment in the remaining industries and economic sectors provided the basis for predicting future employment in non-petroleum related industries. The observed change in employment in other industries prior to 2010 was different in each region. In the Williston area, employment was nearly flat, showing only small amounts of growth in employment in other economic sectors after removing employment in the oil and gas sector. In the Dickinson region, total employment showed steady growth after removing petroleum employment from the historical data. A similar situation was observed in the Minot region, as regional employment growth was present from 1990 through 2010 after removing employment in the oil and gas sector.

Constraints on Employment Growth: Factors that potentially reduce employment growth (i.e., housing, wages, labor force availability) were included in estimates of base employment and secondary employment [see Bangsund and Hodur (2012) for a more in-depth discussion on employment constraints]. Those constraints act to reduce the traditional (and expected) employment response in the general economy from growth in the oil and gas sector (secondary employment) and also serve to lower the potential growth rate of employment in other industries.

Long-term/permanent and Temporary/development Employment: The model divides petroleum sector employment into long-term/permanent and temporary/development employment. The classification of employment into those two categories is used to illustrate how employment within the industry is likely to shift over the study period as shale oil development matures in the Williston Basin.

Drilling and fracking, infrastructure construction, and construction of gathering systems are categorized as *temporary/development workforce*. A primary assumption in the forecasting model is that temporary employment represents jobs that are shorter-lived than the life-cycle of the oil fields. So while those workers may be onsite or in the state for an extended period, the model classifies those jobs as temporary relative to the life cycle of oil field development.

Another perspective is that those jobs would largely disappear if development stopped in the oil fields. A recent illustration of this point is evidenced by the precipitous drop in drilling and fracking operations from January 2015 to February 2016 when rig counts went from 180 to 30 (ND Department of Mineral Resources 2016).

The *long-term/permanent workforce* represents jobs related to oil well maintenance, pipeline operations, gas plant/processing activities, and other jobs that would remain even if development stopped in the oil fields. The model treats secondary jobs as long-term employment. A primary assumption in the forecasting model is that long-term jobs will be comprised of individuals who work in the Williston Basin and are established permanent residents of North Dakota.

The delineation between long-term/permanent and temporary/development workforces is important since those groupings help to show how employment in the industry will adjust, and change over time. Additional perspectives are that workers holding short-term jobs may have different demands for goods and services, housing, and infrastructure than workers with long-term jobs. While exact composition of the characteristics of individuals working in the various segments of the industry is unknown, housing needs can be estimated separately for those two classifications. Showing how the level of housing need changes is helpful in understanding that both permanent and temporary housing is required in the Williston Basin.

Sole-proprietors: Self-employed individuals represent an important component of regional employment in western North Dakota. Statistics on sole-proprietors are not part of the Quarterly Census of Employment and Wages (QCEW). Therefore, the employment forecasting model does not include sole-proprietors in estimates of future employment.

The U.S. Census Bureau released data on sole-proprietors including those classified as farmers and ranchers (U.S. Census Bureau 2016). While farmers and ranchers are not the only sole-proprietors in western North Dakota, data on non-farm sole-proprietors lacked the clarity needed to link that employment to resident or non-resident population and was not used in the study. However, farmers and ranchers predominately work and reside in the same locations and can be viewed as permanent residents. Projections of the future number of farmers and ranchers in each county were developed using data from 2000 to 2014 and were incorporated into the analysis.

Future Labor Efficiencies in Oil and Gas Industry: All industries operating in competitive markets exhibit labor efficiencies over the long term. A key assumption in the study was that labor efficiencies would occur with respect to the oil and gas industry. While substantial improvement in drilling efficiencies have been observed since the beginning of shale oil development, the study forecasted an additional 21 percent improvement in drilling productivity over the 2017 to 2040 period (Figure 4). In addition to drilling efficiency, each drilling rig was estimated to need 17 percent fewer workers by 2028 (i.e., decline from 120 workers to 100) due in part to reduction in truck transportation requirements.

Fracking operations were modeled to have a 14 percent improvement in labor requirements from 2017 to 2028. Oil field service is modeled based on the age of producing wells, and therefore labor requirements are dynamic with respect to the pace of oil field development (i.e., the number of wells added annually). Labor requirements were reduced by 75 percent over the next 14 years for truck transportation for producing wells, and those adjustments are reflective of anticipated efficiencies with moving fluids via pipeline gathering systems.

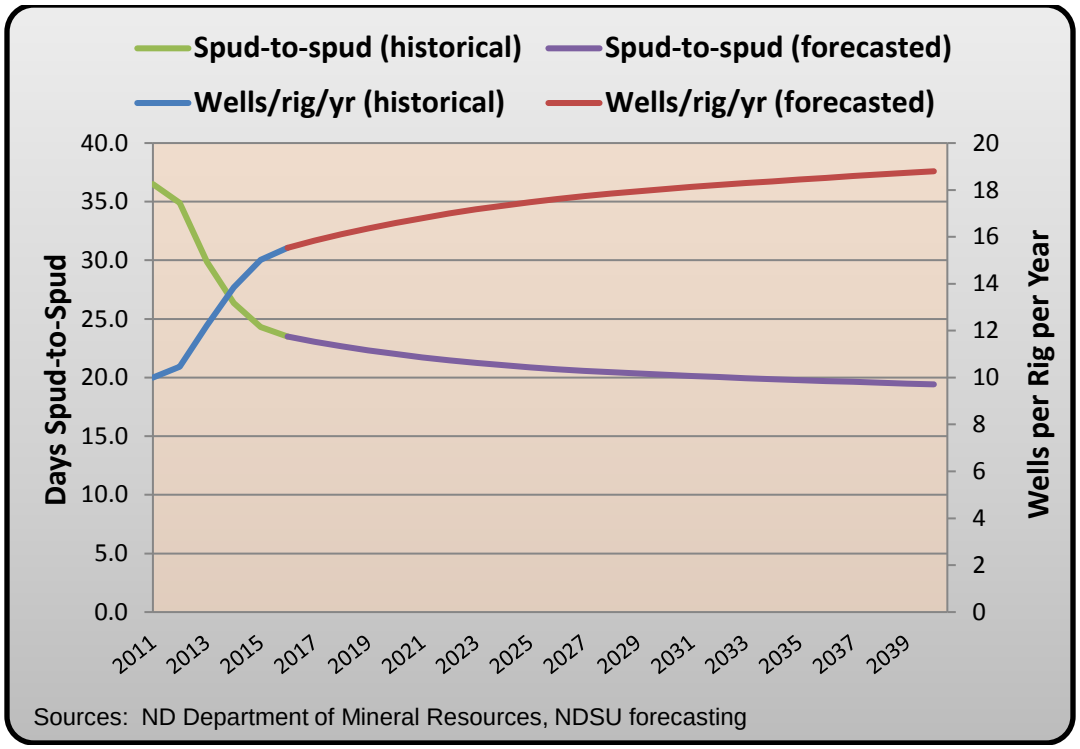

Figure 4. Anticipated Drilling Efficiencies, Shale Oil, North Dakota, 2017 through 2040

Estimating Demand and Supply of Workforce

The link between employment forecasts and population projections begins with comparing the need (demand) for workers (driven by employment forecasts) with the availability (supply) of workers (determined by local population and commuter behavior). Demand and supply of workers can be further delineated into an individual county, surrounding counties in the study area, and areas outside of the study region.

The supply of workers is estimated using commuter information and local population data for the same geographies used in the demand analysis (Figure 5). Employed workers and unemployed workers comprise an area's active workforce. Therefore, dividing employed workers (i.e., analogous to employment in this study) by the unemployment rate produces an estimate of active workforce. The active workforce, comprised of employed and unemployed workers, is a subset of the population of individuals 15 and older. Total active workforce divided by the number of individuals ages 15 and older is the participation rate. Participation rates are the percentage of all working-age adults that are considered in the workforce. Not all working age adults are in workforce force for obvious reasons (e.g., retirement, stay-at-home parents).

Workforce participation rates are multiplied by population aged 15 and older to estimate the supply of local workforce. An unemployment rate can be applied to the workforce to estimate the number of employed workers. The supply of workers is the sum of 1) available workers in the study county, 2) the number of workers in other study counties that work in the target county, and 3) workers living outside of the study region (Figure 6).

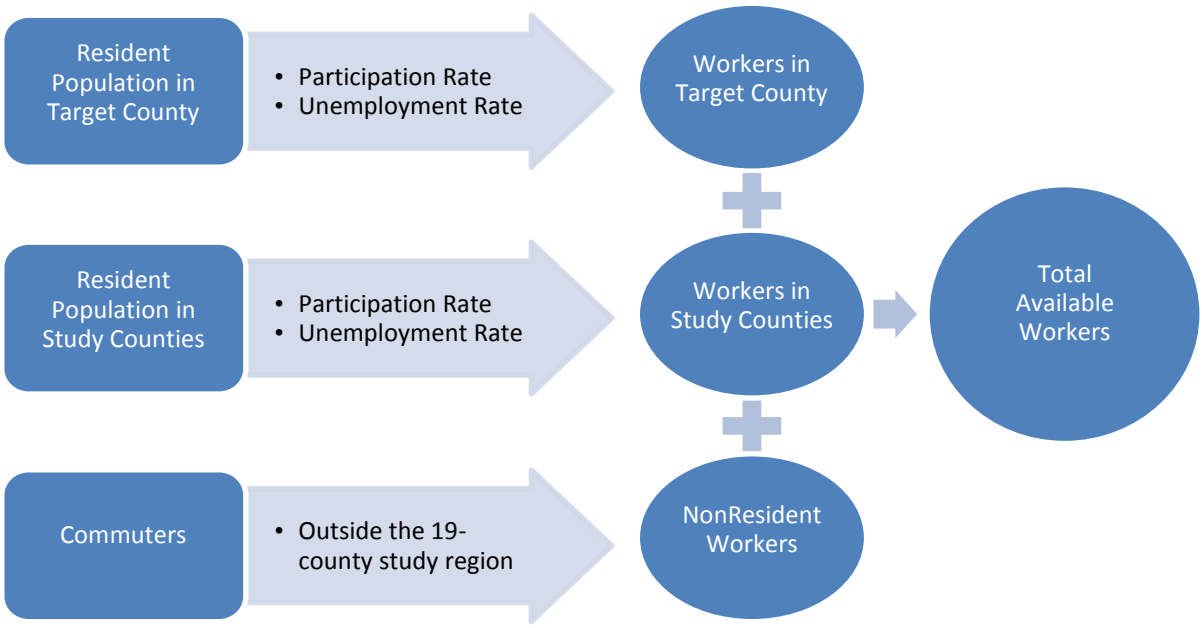

Figure 5. Estimation of the Supply of Workers

Employment forecasts represent the demand for workers[3]. Alternatively, demand can be expressed as the number of workers needed to satisfy employment within a county. Using commuting data, the demand for workers was partitioned into 1) workers from the study county, 2) workers from other counties in the study region, and 3) workers living outside of the study region. Estimates of workers (residents) in the 'other study counties' are counted as part of the demand for workers in those particular counties. For example, some jobs in Williams County are filled by residents of McKenzie County, so as employment in Williams County changes, it is expected that the demand for workforce within McKenzie County also changes. Also, part of the demand for workers in Williams County comes from the number of residents in Williams County that are expected to fill jobs in other counties (i.e., be part of the demand for workers in those other counties).

[3] Employment estimates are consistent with the criteria associated with Quarterly Census of Employment and Wages (Job Service North Dakota) and farm and ranch proprietors. Employment estimates are not adjusted to account for individuals working more than one job or individuals self-employed in economic sectors outside of agriculture.

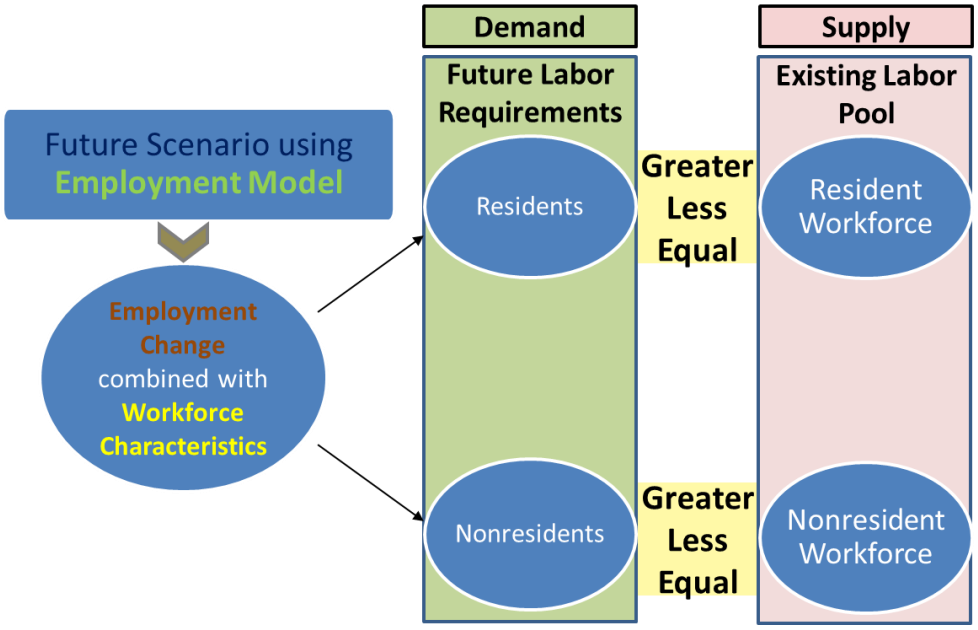

Figure 6. Linking Demand and Supply of Workers

Potential Adjustments to Population Due to Change in Employment

A number of adjustments to population and workforce can occur in the presence of an increase/decrease in employment within a given area (Figure 7). Those adjustments are in response to the balance between demand and supply of workforce. The primary tool to balance the demand and supply of workers was allowing an annual change to migration rates, and keeping participation and unemployment rates constant over the projection period.

Substantial loss of employment in western North Dakota in 2015 and 2016 produced little change in unemployment rates. Workers left the region, most likely returning to permanent residences outside of the study region or found employment in other trades/industries in the region (this is possible due to a high number of unfilled jobs remaining in the region after substantial declines in employment within the petroleum sector). Using the end of 2016 as the starting point for the projections, employment begins to slowly increase for most counties in the current crude oil price environment, which is due in part to the petroleum industry's contraction bottoming out in 2016 yet the industry is still actively adding wells in the state. Despite large declines in regional employment during 2015 and 2016, little capacity remained with the local workforce at the end of 2016 to meet an increase in future labor demand. These conditions imply that the primary means to increase the resident labor supply for scenarios with increasing employment was to increase the resident population. Since participation rates remain high and unemployment rates remain low in 2016, future growth in employment would necessitate an increase in permanent and service populations. In other words, the region does not have a large pool of active but unemployed workers readily available to fill increases in regional employment. If that was a prevalent condition, then initial increases in the demand for local workforce would come from unemployed workers in the region.

Decreases in employment can lead to out migration of permanent population, higher unemployment rates, lower workforce participation rates, and/or reduction in service population. Employment projections in this study largely exhibited growth for most counties over the 20-year projection period. When employment was projected to decline, adjustments to the net migration for

permanent population was used within the model to balance demand and supply of local workforce. In reality, small reductions in employment of local residents would initially result in changes in unemployment rates and/or subtle adjustments in the workforce participation rate. Due to the infrequent and relatively minor decline in employment for some counties in the study scenarios, using only migration as the means to bring local demand and supply of workers into balance was not perceived to over accentuate population change.

Demand for Labor is Greater than Local Supply of Labor	
Potential Effects	Implications for Population
(positive) net migration of permanent residents	Permanent population increases
Increase in nonresident commuters (non-local residents)	Service population increases
Both actions	Growth in permanent and service populations

Demand for Labor is Less than Local Supply of Labor	
Potential Effects	Implications for Population
(negative) net migration of permanent residents	Population loss
Labor participation rate declines	Little if any effects on population
Unemployment rate goes up	Little if any effects on population in short term, long term would lead to out migration

Figure 7. Potential Effects on Population Associated with Changes in Employment

Linking Workforce Requirements to Permanent Population

Initial or baseline migration, mortality, and fertility rates, by five-year cohorts, by gender, were obtained from the ND Statewide Housing Needs Assessment (Hodur et al. 2016) (Figures 8 through 10). Mortality is part of the cohort modeling process and expected deaths, by age and gender, are removed from the population prior to adjusting migration rates (Figure 11) (for more detail on the use of mortality rates see Appendix A). Fertility is also part of the cohort modeling process, but does not immediately affect the supply of workers (see Appendix A for more in-depth discussion of cohort population modeling).

The 'pattern' of fertility and mortality are contained in Figures 8 and 9. Actual fertility rates by county are confidential, and cannot be disclosed (North Dakota Department of Health 2016). Likewise, mortality rates by gender and age cohort also are confidential, and cannot be disclosed. While this report shows the 'pattern' and generic values for fertility and mortality, confidential county-level fertility and mortality data were used in the study's cohort model.

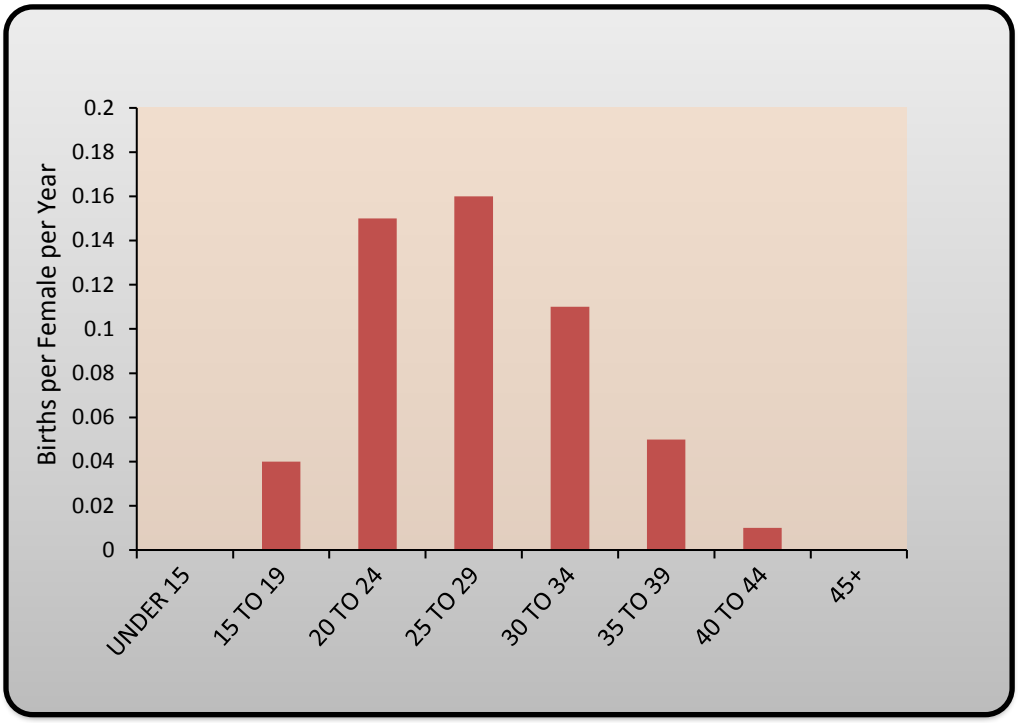

Figure 8. Representative Pattern of Fertility Rates in North Dakota Counties, 2015

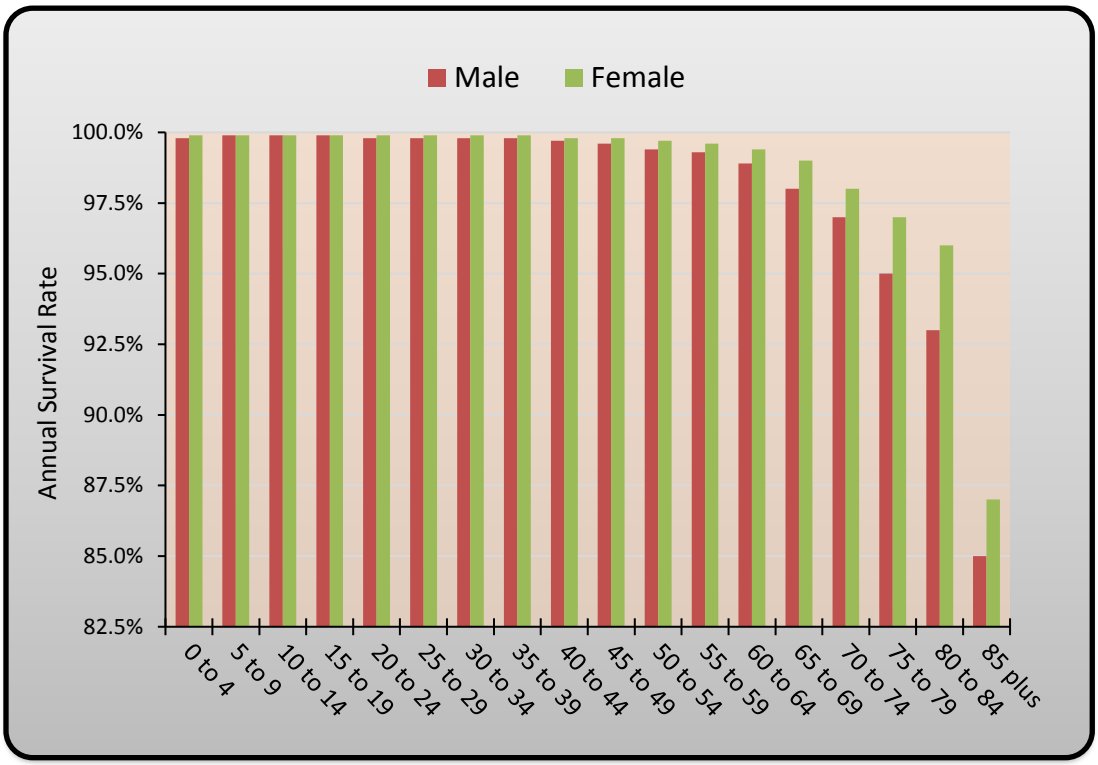

Figure 9. Representative Pattern of Survival Rates for North Dakota Counties, 2015

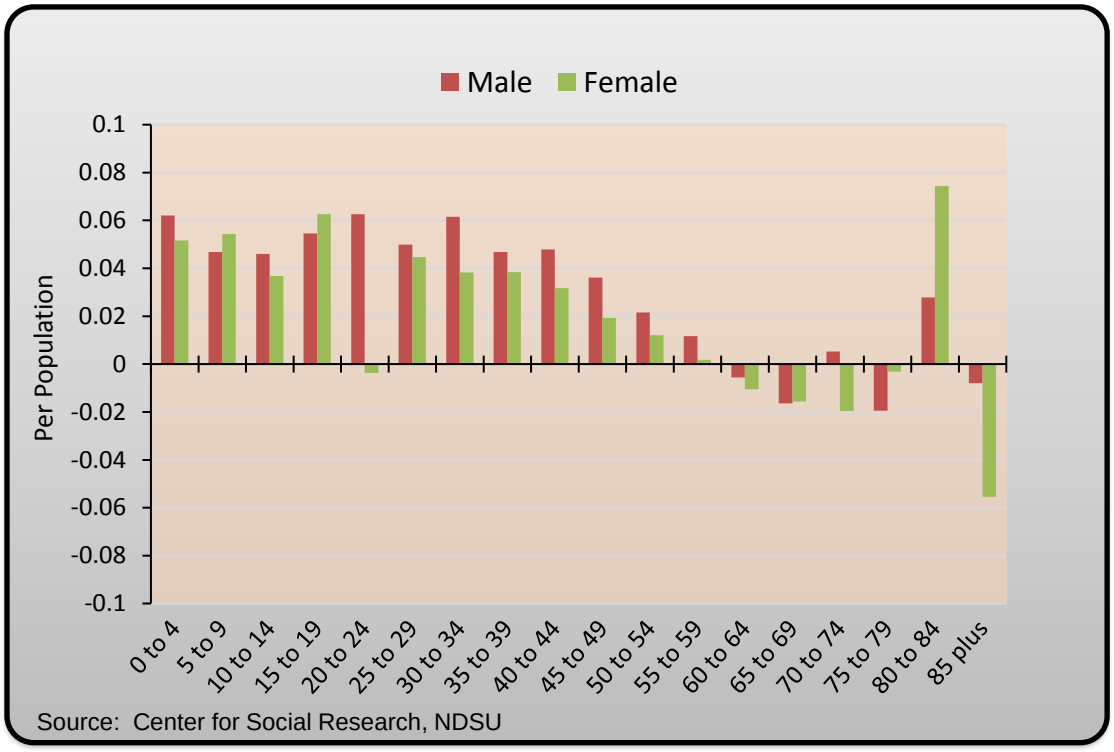

Figure 10. Example of Net Migration Rates, By Gender and Age Cohort, North Dakota Counties, 2014

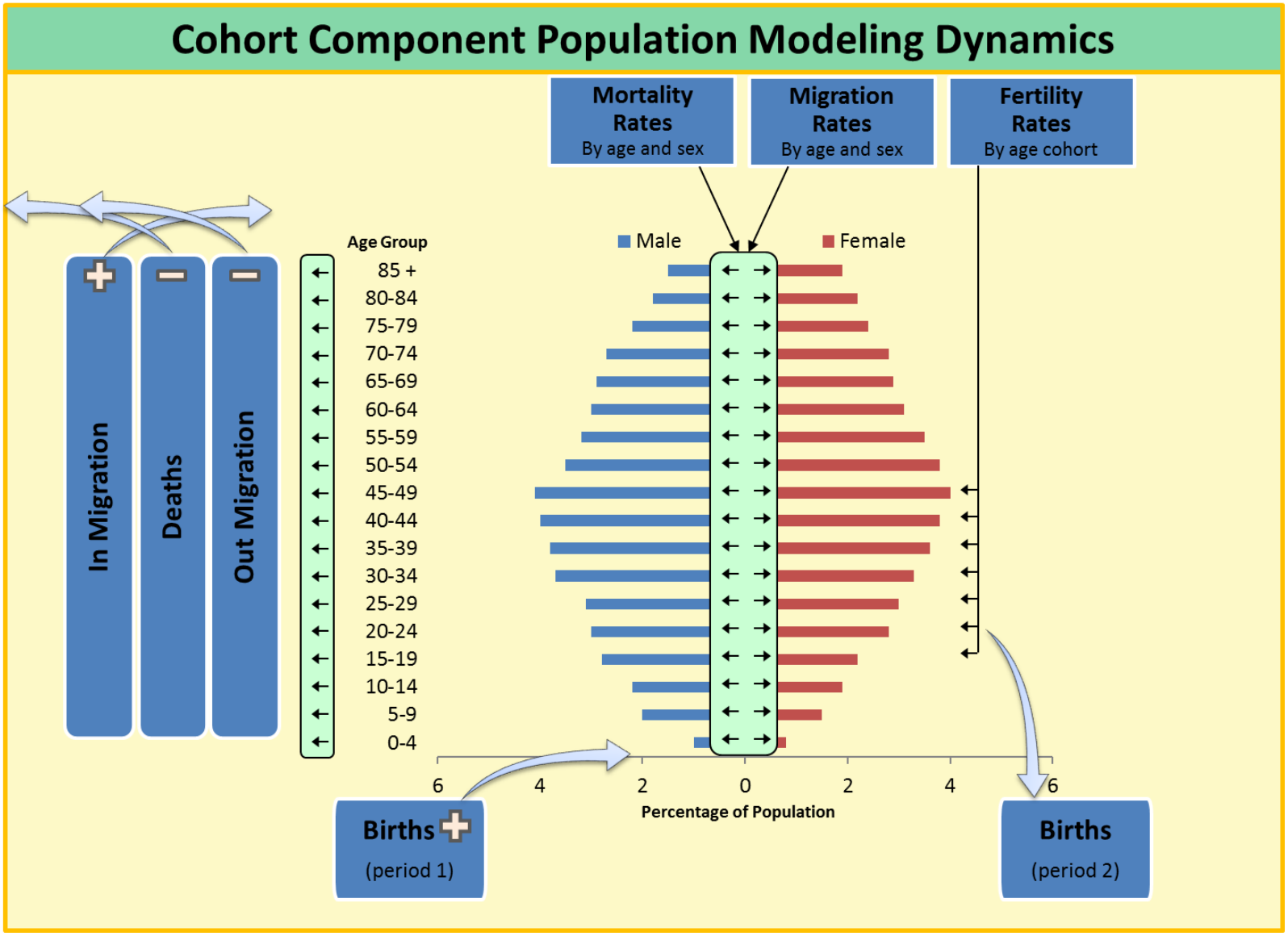

Figure 11. Representation of the Key Components of a Cohort Population Model

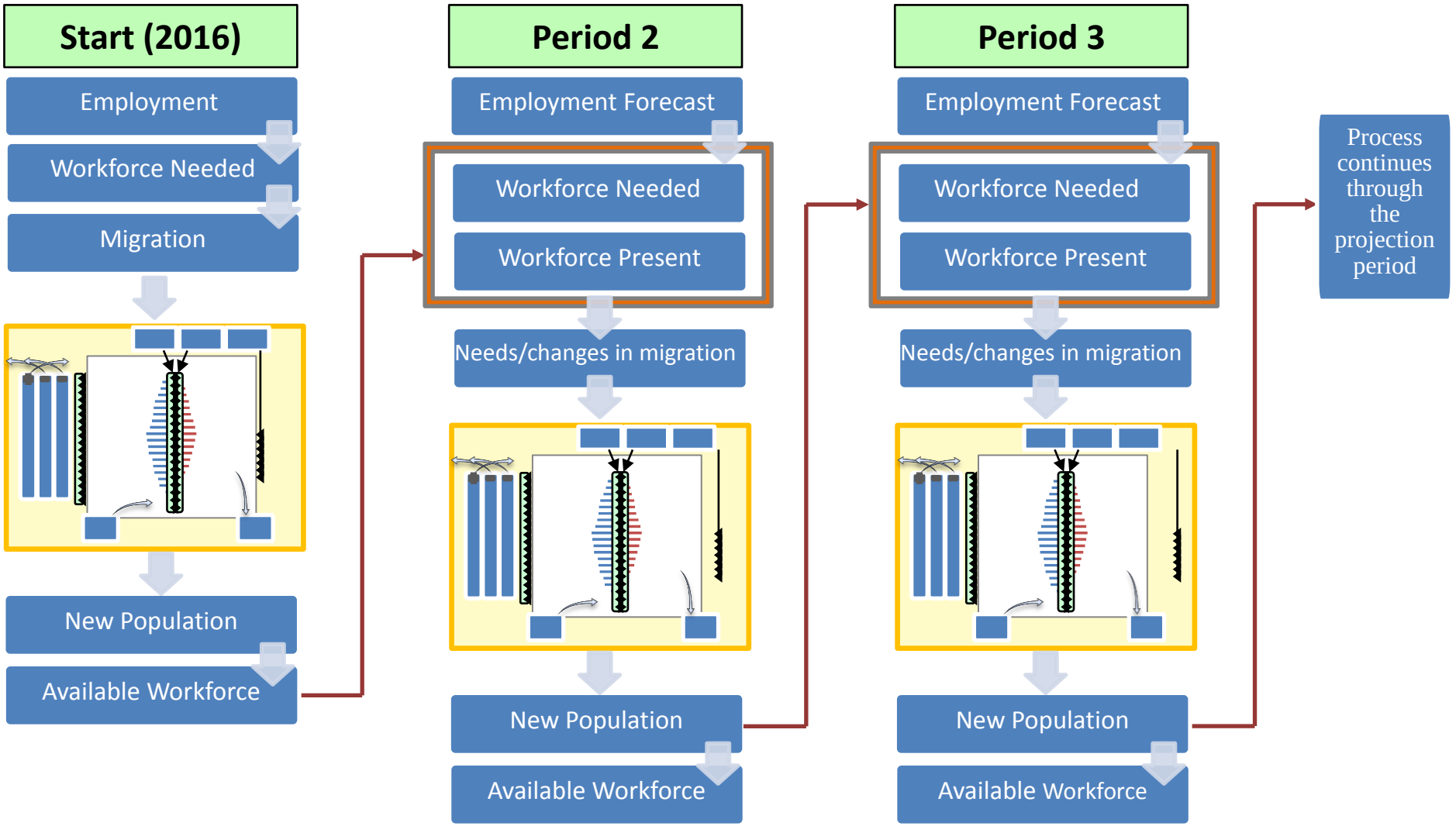

Figure 12. Representation of the Sequential Linking of a Cohort Population Model over Multiple Periods

After accounting for deaths, the analysis adjusts migration rates, by age and gender, until the cohort model produces a supply of local workers that equals the demand for local workers (see Appendix B for baseline migration rates). The supply of workers is determined by adjusting overall population to produce estimates of workforce by multiplying population, gender cohorts aged 15 and older, by county workforce participation and unemployment rates (see Appendix C for historical and projected workforce participation rates and Appendix D for historical and projected unemployment rates). Through this process, local population is allowed to change to meet the demand for local workers (Appendix E contains historical data on commuter activities and Appendix A contains detailed discussion of the computational processes linking cohort modeling, migration rate adjustments, and workforce requirements).

It was beyond the scope of this study to estimate the specific demand for workers by gender and age (e.g., number of 42-year old female workers). Therefore, the local demand for workers was not separated into the number of female and male workers by age[4]. Since the model is not required to produce a specific number of workers by age or gender, all migration rates for males and females aged 15 and older are uniformly adjusted, although baseline migration rates, obtained from the ND Housing Needs Assessment, vary by gender, age, and location (see Appendix B for migration rates by gender, age, and county). For example, if the local population needs to expand to meet a growth in the demand for local workers, the model will increase positive migration rates and reduce negative migration rates by a similar factor. Those actions will add population in all age and gender cohorts (i.e., ages 15 and older), even if the baseline migration rate was negative. Negative net migration rates do not necessarily have to become positive to provide an increase in population since a reduction in a negative migration rate implies fewer individuals in that cohort are leaving the county than would otherwise leave—these adjustments raise the population needed to produce the number of workers even if some net migration rates are negative.

Linking Workforce Requirements to Service Population

Service population is a measure of permanent residents plus non-residents working and residing temporarily within an area. Service populations are estimated in this study by adding commuters from outside the study region to estimates of permanent population for each county. Service populations also were estimated using a method that measures non local workers as a percentage of permanent population. Commuters from neighboring counties to the target county are not included in the service population under the assumption that those individuals more closely represent daily commuters largely present only during work shifts or normal business hours. For example, individuals living in McKenzie County but working in Williams County would not be counted as part of Williams County's service population.

[4] To separate the anticipated future workforce requirements into age and gender cohorts, it would be first necessary to know the age and gender of workers by economic sector. Trends in those factors would then need to be evaluated and linked to the mathematical equations adjusting migration rates across both male and female age cohorts. While those adjustments would provide insights into local population change, the requirements to implement those refinements would be considerable (employment forecasts also would need to be refined, at a minimum, down to the 2-digit North American Industrial Classification System level).

Estimating Housing Requirements

The housing model aligns housing requirements for four age cohorts (Figure 13). Population projections in each year are divided into those groups.

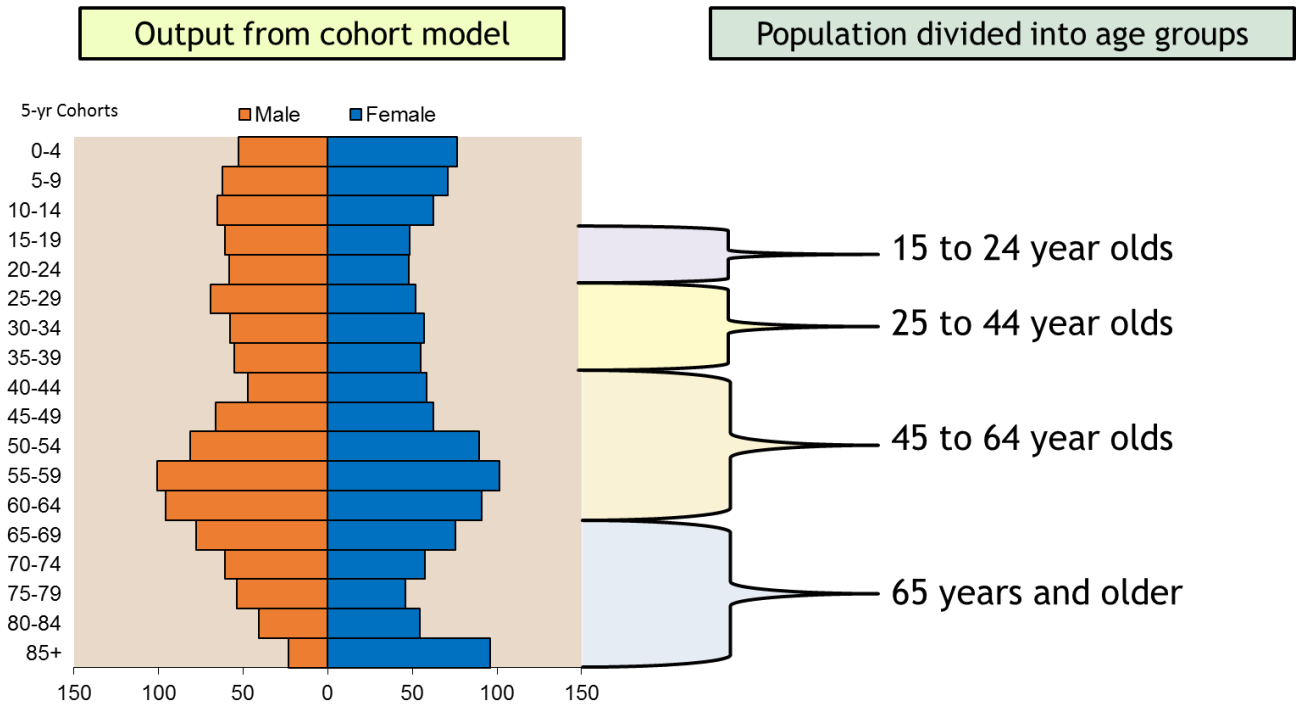

Figure 13. Placing Population into Age Cohorts, Processes for Estimating Housing Requirements

The percentage of population that is a householder in 2014 was calculated by applying the age-specific 'householder to population' ratios from the U.S. Census Bureau's 2010-2014 American Community Survey. The main assumption in the housing model is that the 2014 ratios would continue through the projection period.

A householder is described as the person, or one of the people, who own a home, are purchasing a home, or have a rental contract. Householders can be either family members (i.e., people in the household who are related by birth, marriage or adoption) or non-family members. The model does not consider whether the householder has family or non-family characteristics. The housing model treats a householder as synonymous with a household and an occupied housing unit. The historical ratio of householders, by age cohort, to total population is applied to projections of population, by age cohort, to estimate the amount of occupied housing expected for the projected level of population (Figure 14).

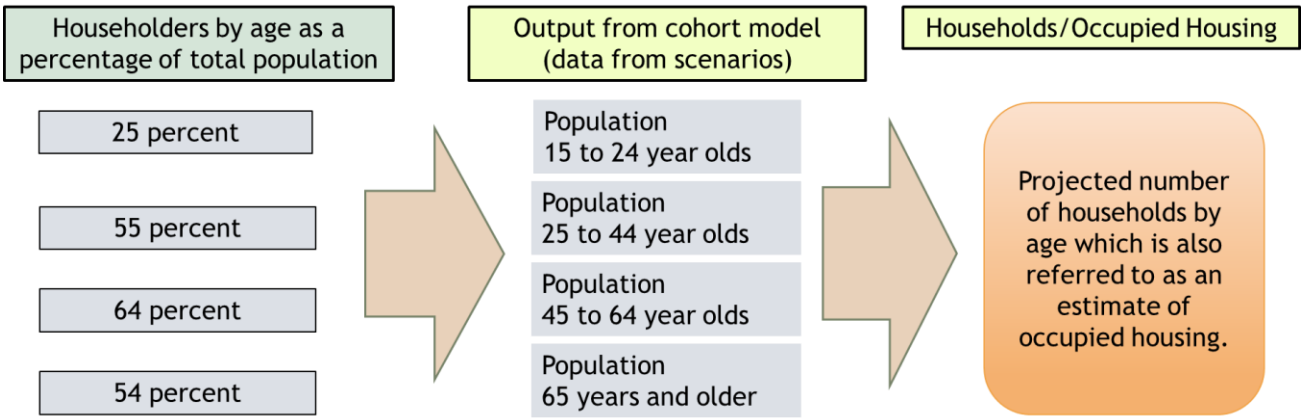

Figure 14. Estimating Number of Future Householders, Processes for Estimating Housing Requirements

Projected number of occupied housing units is then used to estimate total housing. Updated housing inventories were used to develop the ratio between occupied housing and total housing. The percentage change in future population, by age cohort, can then be applied to provide estimates of occupied and total housing (Figure 15).

A key assumption is that as the number of households increase, new housing units will be added to the housing inventory in a manner consistent with past observations. The model also assumes that the historic relationship between households and total housing units is stable and that there is an adequate inventory of housing (neither a surplus nor shortage of housing).

The 2016 North Dakota State Housing Needs Assessment examined the historical ratio of households (occupied units) to total housing units. That relationship has changed less than 1 percent since 1990 (Hodur et al. 2016). The model also assumes that the past distribution of housing units represents the appropriate mix of housing and that those relationships will hold throughout the projection period. However, that assumption should be monitored as characteristics of households may change over time and affect that distribution. For example, increased housing costs may lead to a greater proportion of younger householders or first-time homebuyers postponing purchasing a home and in turn increase the need for additional rental housing stock. The continuation of the trend of increased single non-family households and housing for seniors may increase demand for multi-family housing. The projection of future housing stock illustrates the likely response to future housing demand if historical relationships between total housing units and occupied housing units remain unchanged.

The 2016 North Dakota State Housing Needs Assessment also examined the accuracy of U.S. Census Bureau estimates by collecting building permit data from the 12 largest cities and several smaller sample cities in western North Dakota (Hodur et al. 2016). For more information on the U.S. Census Bureau's Building Permits Survey, see https://www.census.gov/construction/bps/ and for more information on how accurately U.S. Census Bureau estimates compared to actual data, see Hodur et al. (2016). This study used updated housing inventory figures provided in the 2016 North Dakota State Housing Needs Assessment.

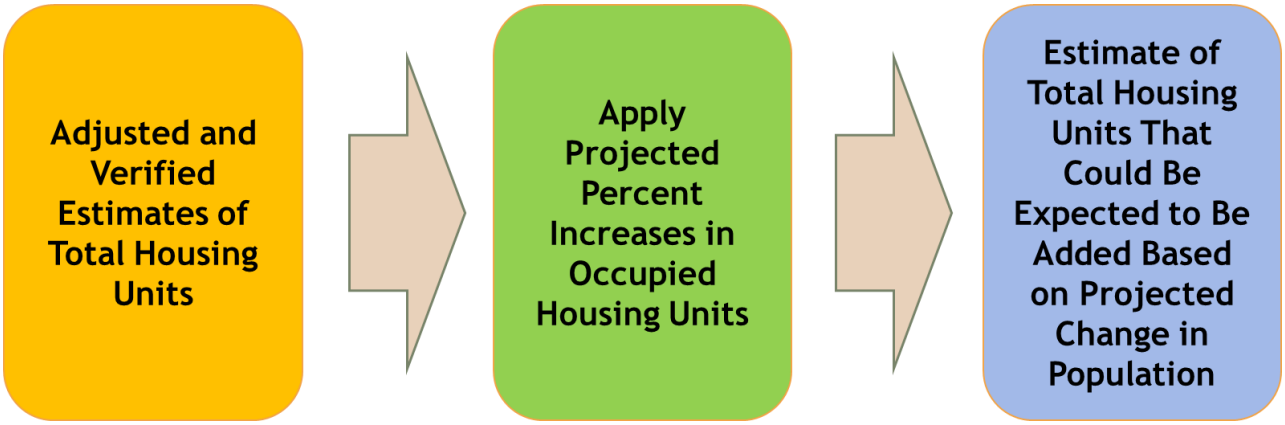

Figure 15. Estimating Future Occupied and Total Housing Units, Processes for Estimating Housing Requirements

After estimating the expected inventory of occupied and total housing, historical relationships linking owned and rented housing, by type, are used to estimate future housing requirements by type and ownership (Figure 16).

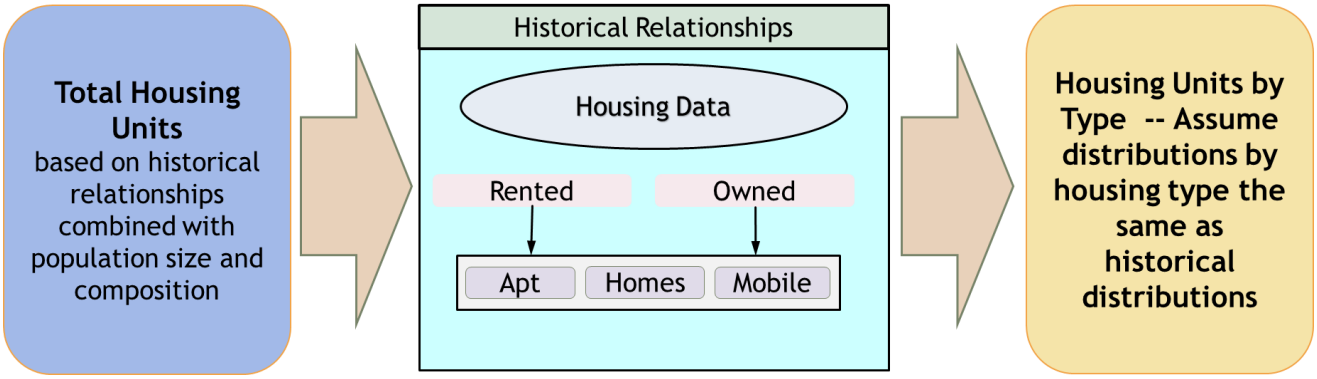

Figure 16. Obtaining Distributions of Housing by Type and Ownership, Processes for Estimating Housing Requirements

Development of Future Scenarios

This project used three general conditions relating to various price levels for crude oil. Each condition or scenario was developed to provide insight on what may be expected under a given set of conditions. Future prices and industry behavior over the next 20 years are nearly impossible to accurately forecast, as evident by the substantial price decline beginning in late 2014 which was largely unforeseen by industry and market observers.

Three price scenarios were developed that cover a reasonable range of potential conditions in the oil and gas industry. A low price scenario was based on crude oil prices remaining similar to prices in the second half of 2016. A moderate price scenario represented an improvement in crude oil prices consistent with industry expectations at the beginning of 2017. A high price environment was modeled to estimate conditions if prices exceeded $100 per barrel for West Texas Intermediate.

North Dakota oil production for the last decade has received substantial discounts compared to West Texas Intermediate prices traded on the New York Mercantile Exchange (Figure 17). Those price discounts were accounted for in the study by using first purchaser prices in North Dakota. Average monthly first purchaser crude oil prices and rig counts in North Dakota from February 2011 to July 2016 were used to provide general guidance on the level of oil field development within each price scenario (Figure 17). The number of wells drilled per month over the same period also was used to help set the range of drilling and fracking activity in each of the price scenarios (Table 1). However, several factors act to reduce the explanatory capacity of historical crude oil prices and rig counts in suggesting industry activity that may be present under future price environments.

-) Activities over much of the period of record were related primarily to asset acquisition and lease holding, which represent different economic drivers than purely in-field drilling
-) Well productivity is increasing
-) Breakeven price points for shale oil wells are declining
-) Drilling operations have exhibited considerable improvement in efficiencies since 2010
-) Prices are not the only driver of rig counts
-) Recent and proposed expansion of transportation and marketing options (e.g., Dakota Access Pipeline) for oil operators in North Dakota are expected to reduce price discounts .

A basic premise for each of the price scenarios was that the number of wells completed per year would be held constant over the projection period and rig counts would be adjusted downward as drilling efficiencies reduced the number of rigs required to match a fixed annual well count. This adjustment included anticipated future drilling productivities (see Figure 4). As structured, the price scenarios produced a fixed number of new wells annually over the projection period as the rig counts necessary to produce those new wells gradually declined (Figure 19), with the exception of a three-year ramp up in rig counts to move from a low price environment to a moderate and high price environment. The reason for the ramp-up period was to account for a transition in the pace of development that would be expected with increasing prices. In other words, it is not realistic to expect that industry activity will instantaneously be at a high rig count in 2017 through the remainder of the projection period under the high price scenario. Also, the ramp up in rig counts from 2017 into 2020 does not mean that high prices will be present in North Dakota in 2020. The scenarios are meant to demonstrate the effects that are indicative during those price environments, and should not be interpreted as a prediction of when those price environments may occur. A high price environment may not arrive in North Dakota over the next 3, 5 or 10 years, or alternatively, the industry may move in and out of a low to moderate price environment over the next 3, 5, or 10 years.

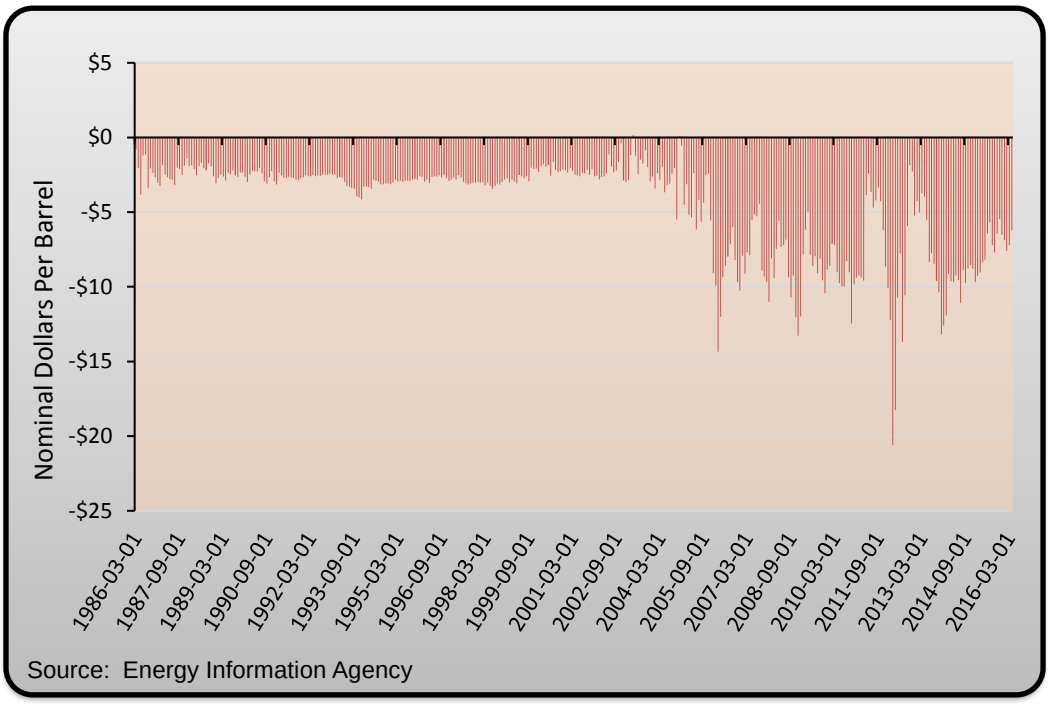

Figure 17. Price Discounts Estimated as Prices Received in North Dakota Less West Texas Intermediate Spot Price, 1986 to 2015

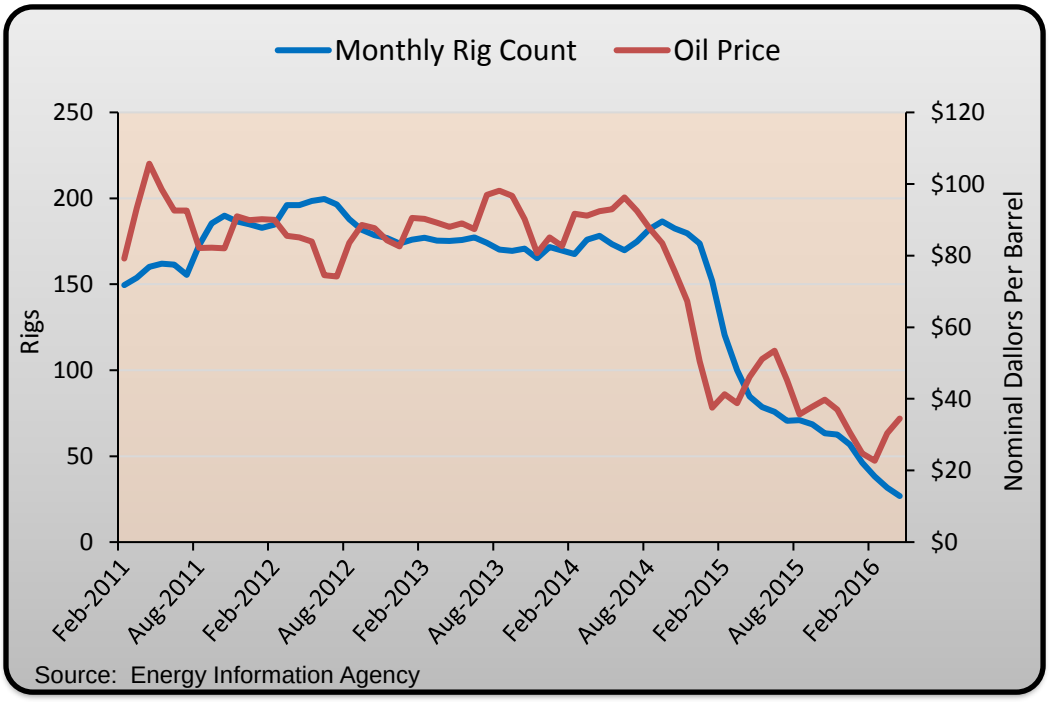

Figure 18. First Purchaser Crude Oil Prices and Rig Counts, North Dakota, February 2011 through July 2016

Table 1. Study Scenarios, Rates of Shale Oil Development, North Dakota, 2017 to 2040

Scenario	Prices[a]	Wells Completed per Year			Rig Counts per Year	
		Low	Medium	High	Low	High
Low Price	$25-$60	400	600	800	25	50
Moderate Price	$60-$90	1,000	1,250	1,500	63	95
High Price	>$90	1,700	2,000	2,300	107	145

[a] First Purchaser prices per barrel in North Dakota.

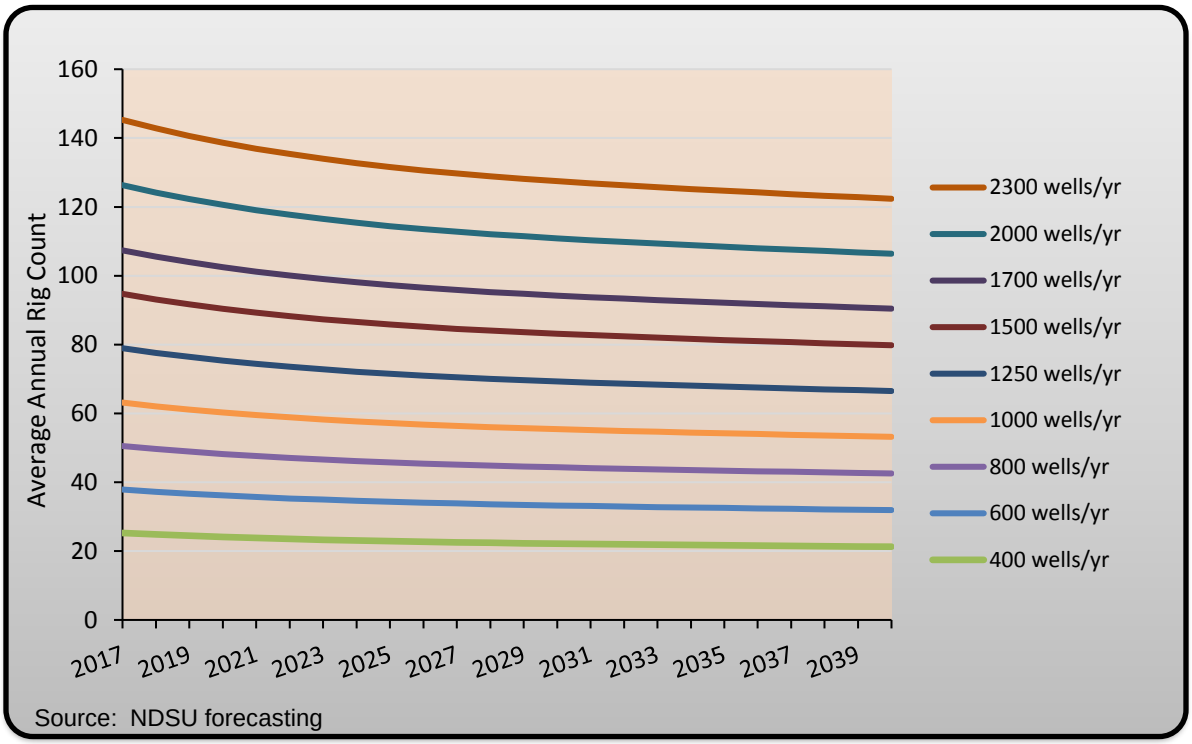

Figure 19. Estimated Rig Counts Required to Complete a Constant Number of Wells Annually, Assuming Future Drilling Efficiencies, Shale Oil, North Dakota, 2017 through 2040

Results

The overall results are best sequenced by first examining expected changes in oil and gas industry employment, then examining employment forecasts for all industries, followed by population projections, and subsequently viewing housing inventory expectations related to each scenario. Discussions of employment, population, and housing forecasts for each county have been recorded in webinars along with individual files containing historical and projected information for each county – all of which has been posted to the Vision West ND website (Vision West ND 2017). Additional data are appended at the end of this report.

Employment in Oil and Gas Activities

The low price scenario was estimated to range from 400 to 800 wells per year in North Dakota (see Table 1). The moderate price scenario was estimated to range from 1,000 to 1,500 wells per year, and the high price scenario was estimated to produce 1,700 to 2,300 wells per year. Rig counts (and well counts) were used in the employment forecasting model, along with data on the number of existing wells, expected well retirements, labor coefficients for various activities within the petroleum industry, assumptions on secondary job creation, job growth in other industries, and operational efficiencies in oil and gas activities. The employment model generated forecasts of total employment for each of three state planning regions in the study.

Future levels of employment in the oil and gas industry are directly linked to the pace of oil field development. Slow development requires less employment than rapid development, and the pace of development also affects the magnitude and timing of labor requirements for oil field service. Under the assumptions in this study, well counts in the low price scenario using the moderate rig count would result in roughly a doubling of producing wells in the state from 2017 to 2040 (Figure 20). Well counts in 2040 would increase from roughly 27,000 in the low scenario to 42,000 in the moderate price scenario. In the high price scenario, drilling 2,000 wells per year would result in about 59,000 wells in 2040 (Figure 20). Future well counts forecasted in this study are consistent with previous research efforts identifying the expected number of wells (i.e., general thresholds) given future economic conditions in the industry (KLJ 2014, Bangsund and Hodur 2015, N.D. Department of Mineral Resources 2015).

The low price scenarios add wells at annual rates substantially lower than what was experienced in North Dakota from 2010 to 2015. By contrast, the high price scenarios add wells at rates similar to the pace of well drilling observed from 2010 to 2015, albeit maintaining those rates with fewer drilling rigs. The high price scenarios therefore represent a return to rapid expansion of the oil and gas industry present during the 2010 to 2015 period. The moderate price scenario splits the difference between a much slower pace of shale oil development (i.e., as experienced in 2016) and a return to the rapid expansion of the early 2010s. However, while the pace of development in the high price scenarios may mirror those experienced in the state from 2010-2014 the underlying economic drivers for industry expansion will be different. Much of the expansion in drilling during the 2010 to 2014 period was based on firms seeking to secure leases in the Williston Basin. Future industry expansion is unlikely to be the result of oil and gas exploration firms looking to secure shale oil leases.

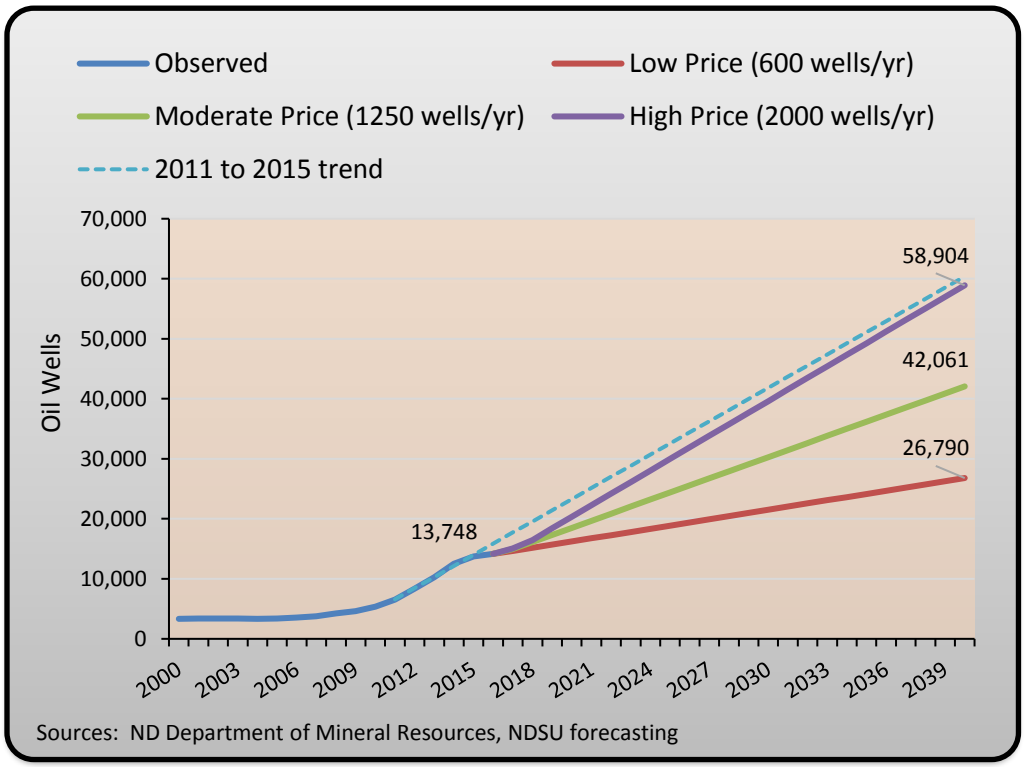

Figure 20. Historical and Projected Well Counts for the Low, Moderate, and High Price Scenarios, North Dakota, 2000 through 2040.

In the low price scenarios, oil and gas industry employment levels remains relatively unchanged, with subtle reductions in overall oil and gas industry employment in the 400 wells per year scenario and subtle gains in the 800 wells per year scenario (Table 2, Figures 21 and 22). Employment levels are in contrast to the gain in wells over the period as the state was forecasted to roughly double well counts in the low price scenarios. The primary driver of little or no employment growth is that the marginal reduction in operational labor requirements (i.e., efficiencies) is about equal to the marginal gain in employment requirements to service a larger number of wells. Industry efficiencies act to offset the addition of wells, and overall employment in the industry remains relatively unchanged over the 2017-2040 period.

In the moderate price scenarios where the state adds 1,000 to 1,500 wells per year employment increases in the oil and gas industry throughout the period (Table 2, Figures 21 and 23). While employment levels increase, overall growth remains sufficiently low that employment does not return to the thresholds observed in 2014. A moderate price scenario will return growth to the industry, but employment levels do not rebound to the previous highs observed in the state.

In an environment where the industry adds 1,700 to 2,300 wells per year, employment increases are sufficient for the industry to expand beyond employment thresholds observed in 2014 (Figures 21 and 24). However, the rate of growth remains lower than observed from 2010 through 2014.

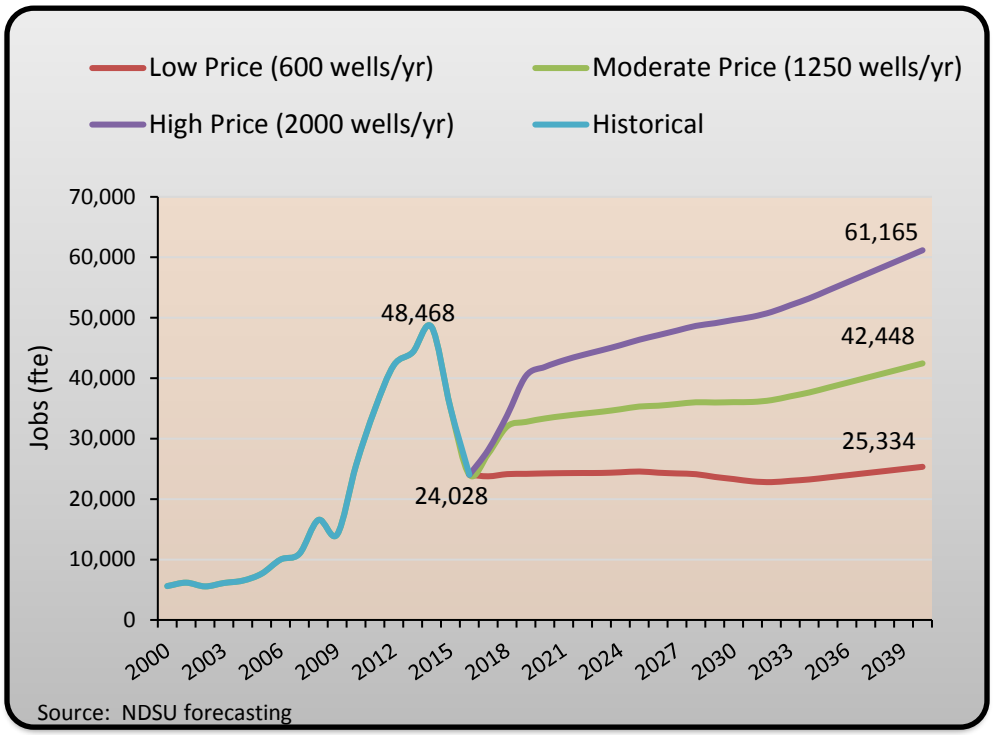

Figure 21. Historical and Projected Oil and Gas Industry Employment, by Low, Moderate, and High Price Scenarios, North Dakota, 2000 through 2040

The projections, along with assumptions on future labor and operational efficiencies, suggest that future employment growth rates are unlikely to match the rate of growth observed from 2010 – 2015 even if the pace of oil field development is similar (i.e., adding similar number of wells to the state per year). The dynamics of the employment forecasts indicate that labor efficiencies are acting to reduce future labor needs—the industry will not need as many rigs to add the same number of wells, and labor efficiencies in oil field service also mitigate the rate of employment growth associated with an expanding oil field.

Table 2. Projected Changes in Petroleum Industry Employment, by Economic Scenario, Williston Basin, North Dakota 2017 – 2040

	Low Scenarios			Moderate Scenarios			High Scenarios		
	Low	Mid	High	Low	Mid	High	Low	Mid	High
Total Change (jobs)	-3,950	1,300	6,575	11,825	18,400	25,000	29,400	37,125	44,850
Total Change (%)	-11%	7%	23%	38%	54%	70%	97%	117%	136%
Average Annual Change (Jobs)	-110	70	250	425	650	875	1,150	1,450	1,725
Average Annual Change (%)	-0.5%	0.3%	0.9%	1.4%	2.0%	2.4%	3.1%	3.5%	4.0%

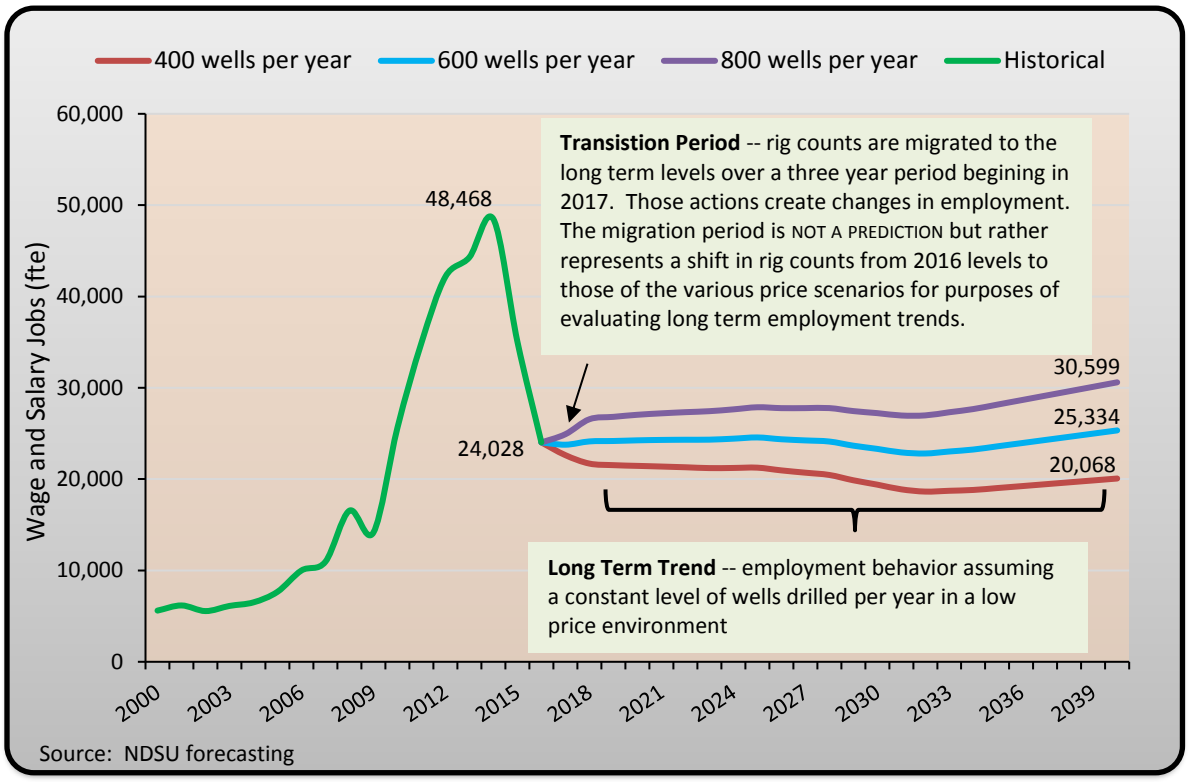

Figure 22. Historical and Projected Oil and Gas Industry Employment, Low Price Scenarios, Williston Basin, North Dakota, 2000 through 2040

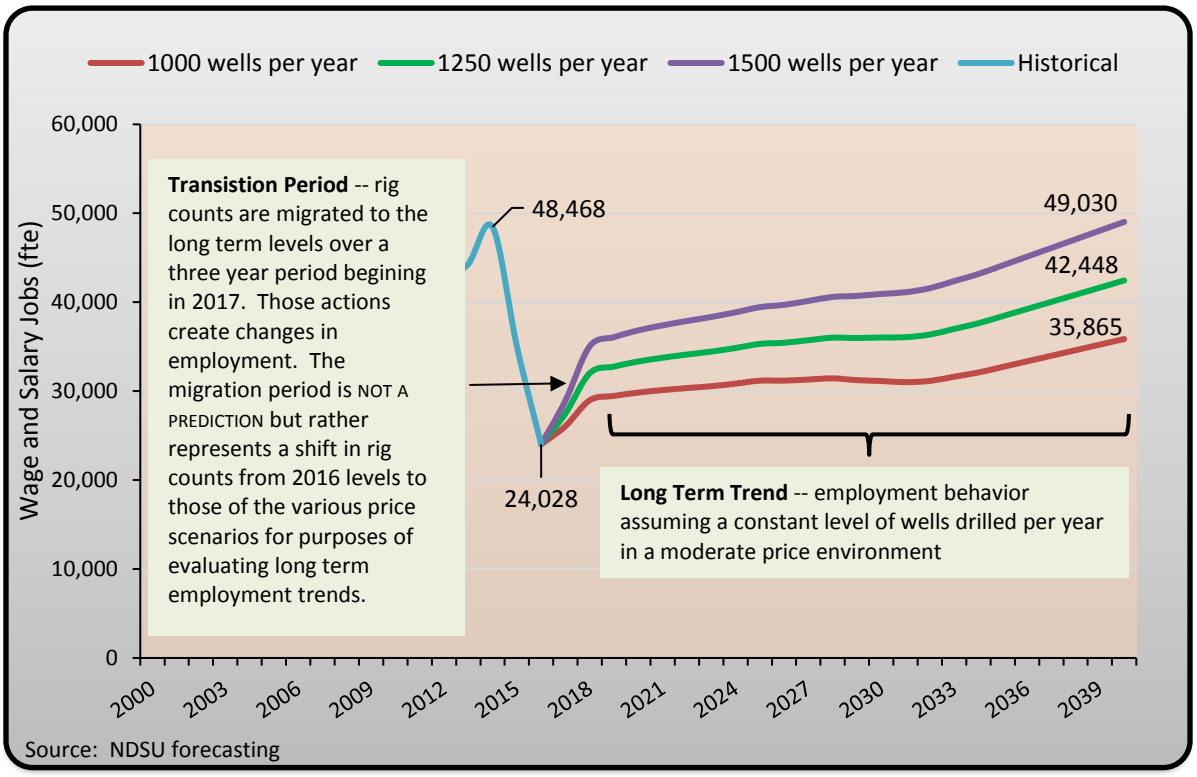

Figure 23. Historical and Projected Oil and Gas Industry Employment, Moderate Price Scenarios, Williston Basin, North Dakota, 2000 through 2040

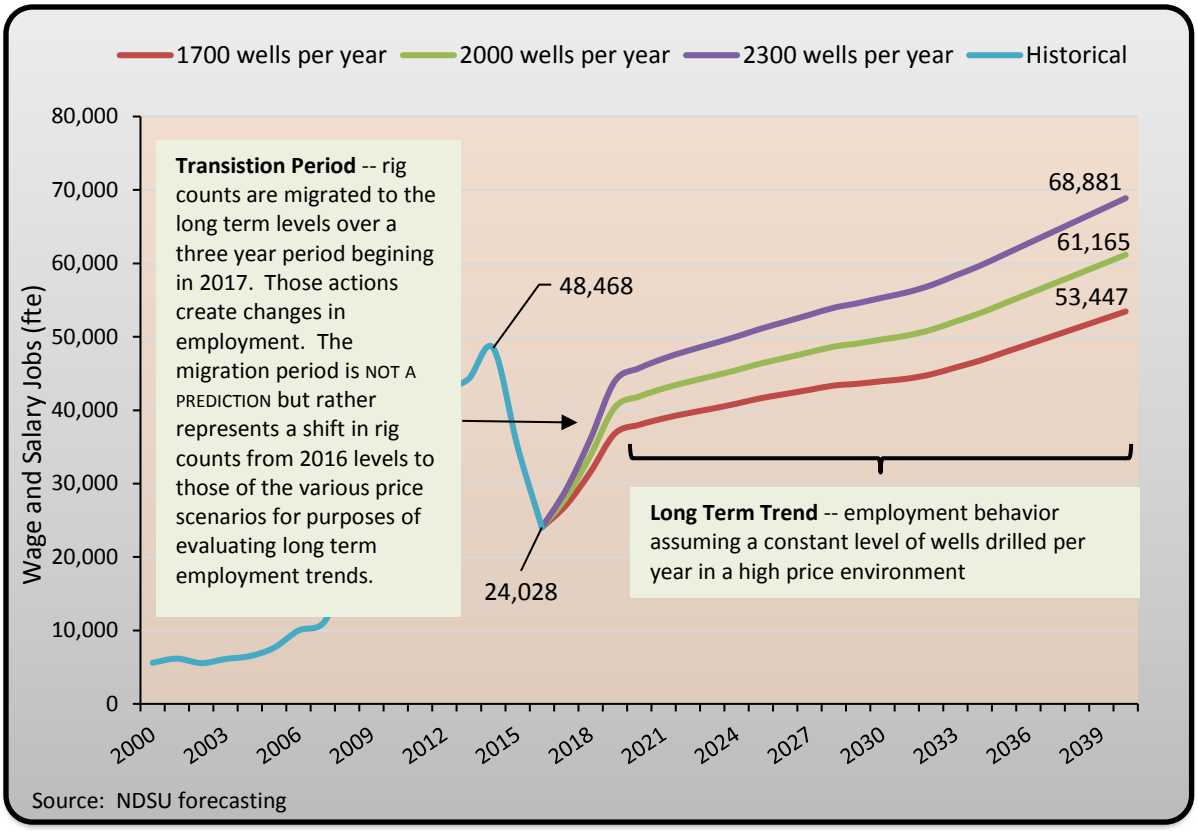

Figure 24. Historical and Projected Oil and Gas Industry Employment, High Price Scenarios, Williston Basin, North Dakota, 2000 through 2040

Delineation for temporary and permanent workers within the oil and gas industry segments was created separately for drilling, fracking, gathering systems construction, and oil field service. A key aspect to understanding the future labor characteristics and the implications of a changing labor dynamic within the industry is to identify and quantify the amount of short-term labor and long-term labor requirements within the industry. Workforce characteristics also play an important role in the techniques used to estimate secondary employment, and have substantial implications for projecting both short term and long term housing needs.

In previous forecasts, drilling activity was based mostly on asset development under a stable economic future similar to the economic conditions present in 2014 (KLJ 2014, Bentek 2012, Bangsund and Hodur 2015). Given a stable and profitable economic environment, previous projections show how the industry would gradually transition away from exploration and development to jobs tied to oil production as the shale resources reach full development potential. Full development was often expressed at needing 20 or more years given drilling rates and well-count potential. Therefore, the forecasted transition of employment in the industry was based on asset development, creating a gradual decline in drilling rigs over time.

The rapid price decline in 2015 was a reminder that economic environments in the oil and gas industry are unlikely to remain stable over extended periods. As a result, development of shale oil should not be expected to follow a non-interrupted progression until all assets are developed, despite forecasting attempts exhibiting those conditions.

A great example of the value of understanding the split in oil and gas employment into short-term and long-term (or alternatively temporary and permanent) employment occurred during the price collapse in 2015. The composition of oil and gas employment in North Dakota in 2014, prior to the price collapse in the beginning of 2015, was much different from the composition observed at the end of 2016 (Figure 25). A high proportion of jobs were associated with drilling, fracking and infrastructure construction in 2014. Those jobs will be subject to economic climates present in the oil and gas industry, and during period of low prices, drilling activity tends to remain relatively low compared to levels of activity during high prices. However, jobs related to oil field service are less prone to the same volatility as exploration and development employment. Those jobs tend to be more directly tied to well counts, oil and gas production volumes, and other elements of the industry that remain more stable than development and exploration jobs.

Under the various oil price scenarios evaluated in this study, for all but the lowest price environments, temporary workforce gradually decreases while permanent employment increases. As oil field service employment grows, so do demands for permanent housing and commercial activity. If the industry has a rapid build up of employment in exploration and development, stakeholders in the region will benefit from being able to distinguish the changes in temporary and permanent workforce within the industry (Figure 25).

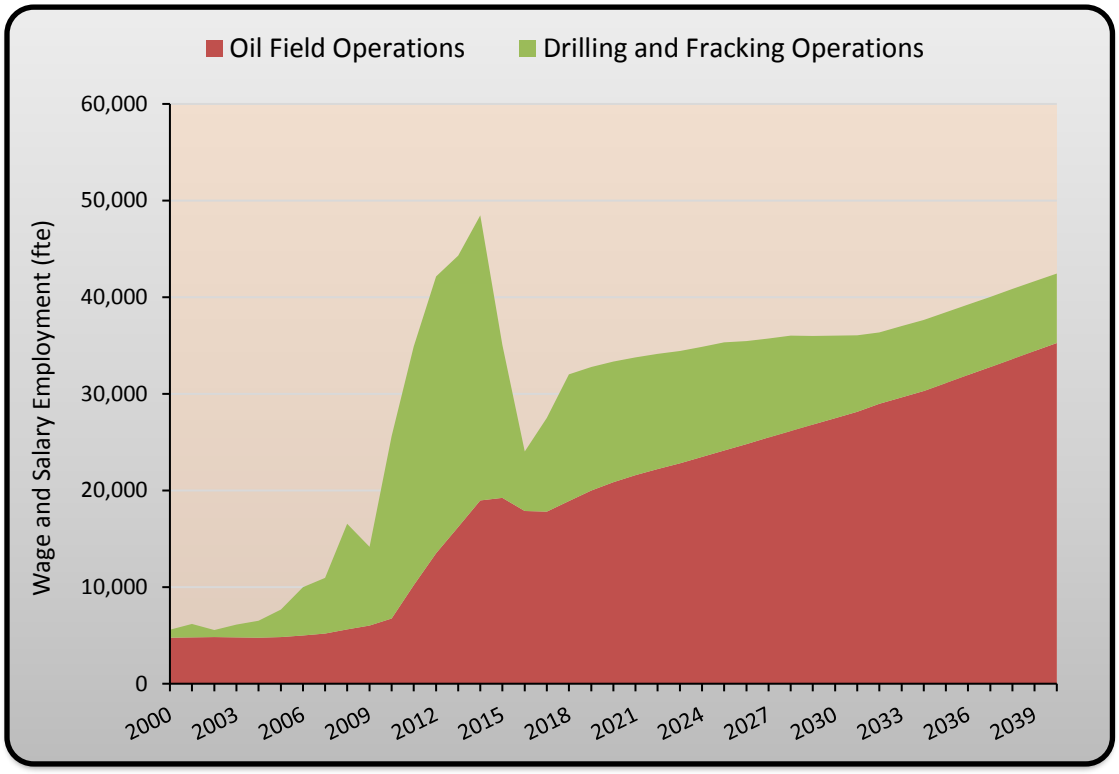

Figure 25. Historical and Projected Oil and Gas Industry Employment, Temporary and Permanent Employment, Moderate Price Scenario, Williston Basin, North Dakota, 2000 through 2040

Employment in All Sectors and Industries

It is not sufficient to only forecast employment in the oil and gas industry, the oil and gas industry also supports employment in other sectors through indirect and induced economic effects[5] and projections must include employment in other economic sectors and industries. Secondary job creation resulting from the oil and gas industry was estimated using techniques developed by Bangsund and Hodur (2012). Forecasts of employment in other industries followed the procedures developed by Bangsund and Hodur (2012, 2013). Creation of secondary employment and growth in other industries in the region varied for each the three oil price environments.

Employment in all sectors and industries was combined for Williams, McKenzie, Dunn, Stark, and Mountrail Counties as those counties represented 81 percent of all jobs in the oil and gas industry in North Dakota in 2015 (Job Service North Dakota 2016). Not only is the majority of oil and gas industry jobs located in those five counties, but oil and gas activities also comprise a substantial share (53 percent) of all private employment in those counties. Grouping those five counties, often referred to as 'core oil producing counties', helps to illustrate how employment changes in the oil and gas industry have greater relative effects in those counties than in non-core oil producing counties.

Across all of the oil price environments, total wage and salary employment grows in the core oil producing counties; however, growth rates, even in the high oil price scenarios, do not approach the pace of job creation observed from 2010 through 2015 (Figure 26). By contrast, the remaining 12 counties in the study are much less susceptible or influenced to a lesser degree by changes in oil and gas employment. The non-core oil producing counties are likely to experience employment growth more aligned with past growth rates as a higher percentage of their employment will be driven by employment in non oil and gas activities (Figure 27).

Historical changes in employment were estimated for several periods between 1990 and 2015, and compared to the employment forecasts for the three price environments (Table 3). Several historical periods were used for the comparisons since the employment trends vary considerably depending upon the inclusion or exclusion of job growth since the development of shale oil in the Williston Basin. Generally, the low oil price scenario closely matches both the absolute and percentage change in jobs for the 10 years prior to shale oil development (1996-2005). Alternatively, the growth trend for employment in the Williston Basin could be expected to mirror the changes the region experienced before shale oil development. The moderate and high price scenarios exceeded the growth in employment prior to the development of shale oil, but have lower rates of employment growth than the region experienced since shale oil started in the mid 2000s (Table 3).

[5] Indirect effects result from the oil and gas industry's purchases of locally supplied goods and services. Induced effects result from the spending of personal income of employees in the oil and gas industry and employment supported through indirect economic activity.

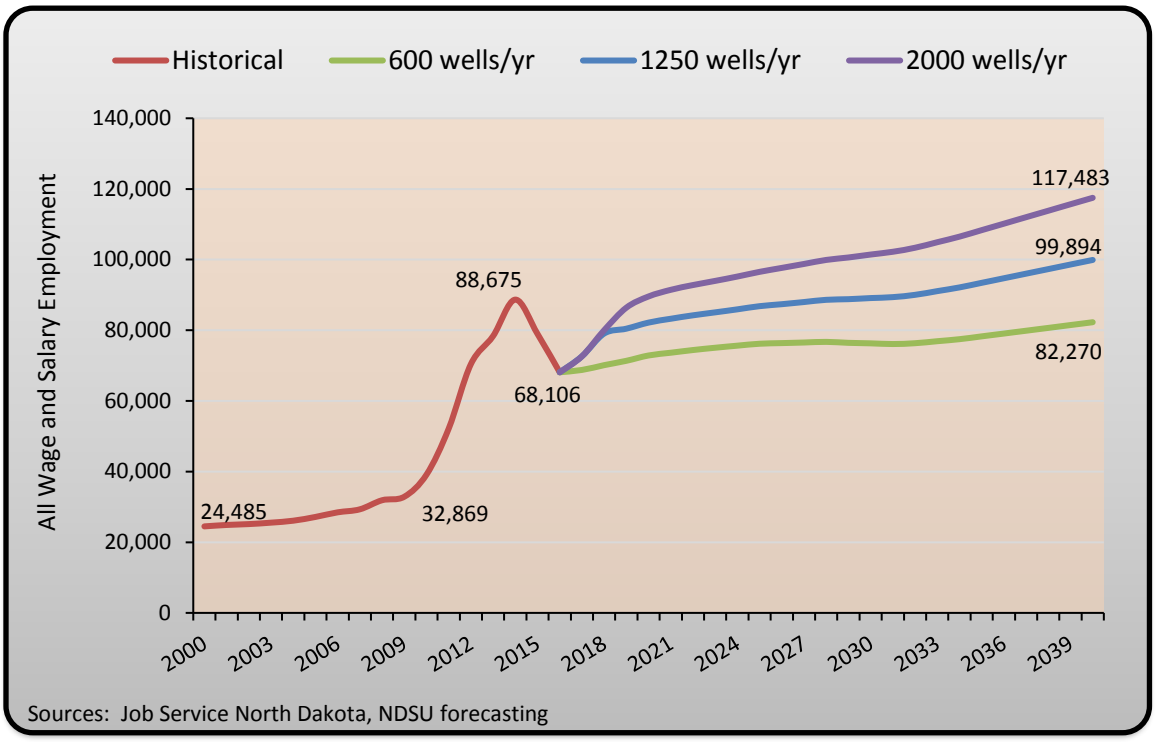

Figure 26. All Wage and Salary Employment, Williams, McKenzie, Dunn, Stark, and Mountrail Counties, North Dakota, 2000 through 2040

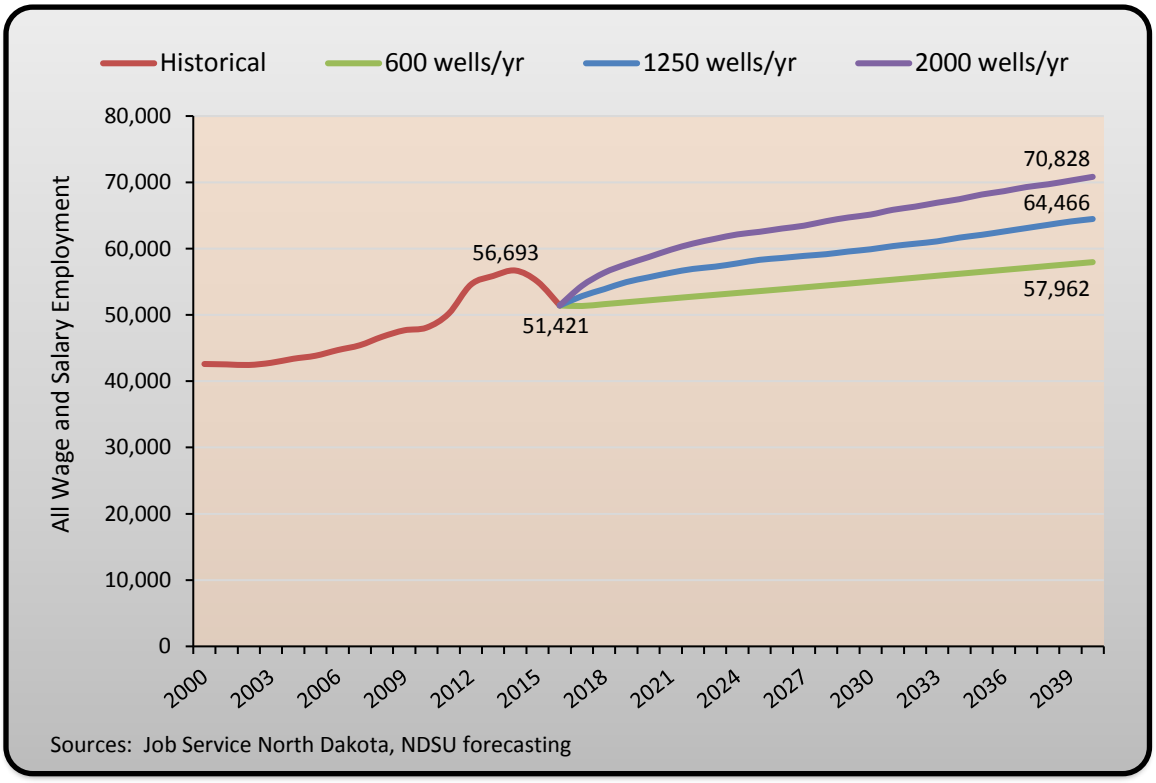

Figure 27. All Wage and Salary Employment, Adams, Billings, Bottineau, Bowman, Burke, Divide, Golden Valley, Hettinger, McHenry, McLean, Mercer, Renville, Slope and Ward Counties, North Dakota, 2000 through 2040

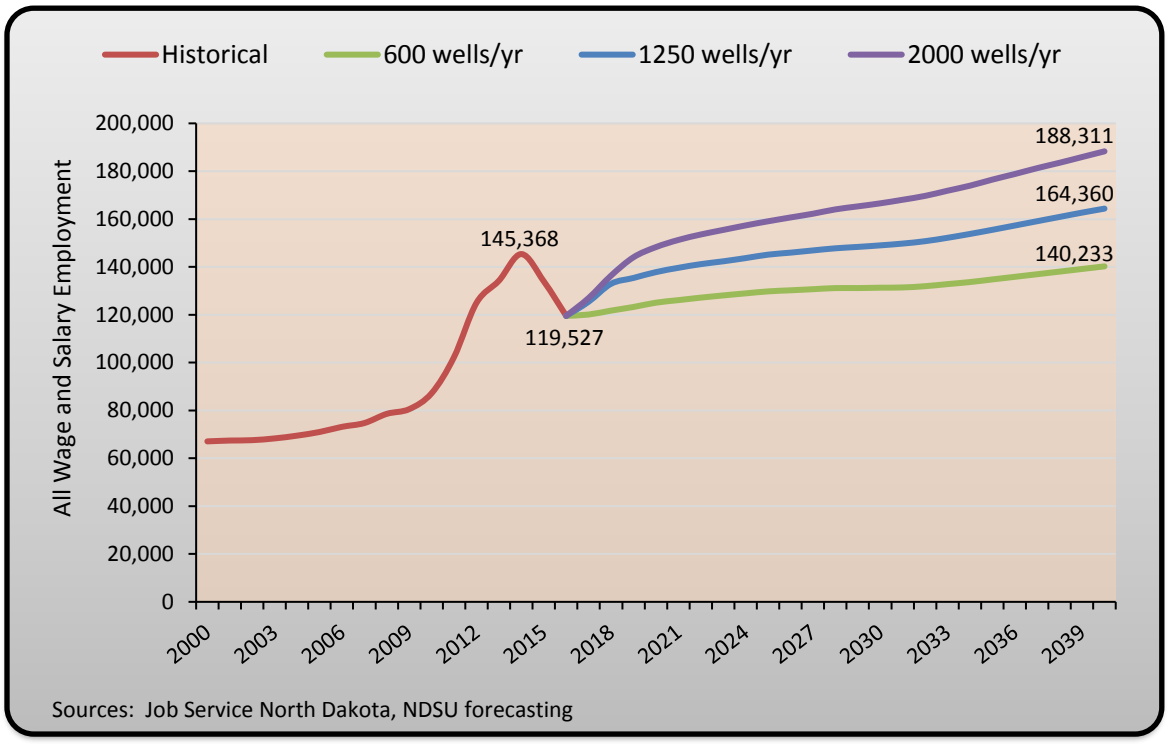

Figure 28. All Wage and Salary Employment, Williston Basin, North Dakota, 2000 through 2040

Table 3. Comparison of Historical Employment Trends to Forecasted Levels of Employment, by Scenario, Williston Basin, North Dakota, 1990-2040

	Selected Historical Periods 1990 through 2015				Future Oil Price Scenarios 2017 through 2040		
County Groups And Trend Metrics	1990 to 2015 25 years including shale	1990 to 2005 15 years before shale	2000 to 2015 15 years including shale	1996 to 2005 10 years before shale	Low Price Scenario with 600 wells/yr	Moderate Price Scenario with 1250 wells/yr	High Price Scenario with 2000 wells/yr
Core Oil Producing Counties*							
Total Change (%)	263.9	25.2	222.5	11.2	20.8	46.7	72.5
Total Change (jobs)	57,262	5,463	54,475	3,038	14,164	31,788	49,377
Average Annual Change (%)	5.7	1.5	8.7	1.3	0.8	1.6	2.3
Average Annual Change (jobs)	2,269	328	3,632	338	590	1,325	2,057
Non-Core Oil Producing Counties*							
Total Change (%)	49.7	19.3	29.2	3.8	12.7	25.4	37.7
Total Change (jobs)	18,274	7,082	12,435	1,665	6,541	13,045	19,407
Average Annual Change (%)	1.7	1.2	1.8	0.4	0.5	1.0	1.4
Average Annual Change (jobs)	675	378	829	185	273	544	809
Williston Basin (core and non-core oil producing counties)							
Total Change (%)	129.2	21.5	99.7	6.6	17.3	37.5	57.5
Total Change (jobs)	75,536	12,545	66,910	4,703	20,705	44,833	68,785
Average Annual Change (%)	3.5	1.3	4.9	0.8	0.7	1.3	1.9
Average Annual Change (jobs)	2,943	706	4,461	523	863	1,868	2,866

*Dunn, McKenzie, Mountrail, Williams, and Stark Counties were considered core oil producing counties. Adams, Billings, Bottineau, Bowman, Divide, Golden Valley, Hettinger, McHenry, McLean, Mercer, Renville, Slope, and Ward Counties were considered non-core oil producing counties.

In the low price environment in the core oil producing counties, the percentage of all employment represented by jobs in the oil and gas industry gradually reduces over the projection period (Figure 29), implying that the oil and gas industry, while continuing to grow (see Table 3, Figure 29), expands at a rate less than the economy as a whole. In the moderate price environment, the percentage of all employment represented by the oil and gas industry increases slightly over the projection period (Figures 29 and 30), suggesting that the oil and gas industry expands at a rate similar to the remainder of the economy. The percentage of all employment represented by the oil and gas industry increases from current levels in the high price environment, implying that more employment is added in the industry than the remainder of the economy. The patterns predicted in the core oil producing counties in the three price scenarios are also prevalent in the non-core oil producing counties, although the overall percentage of employment in the oil and gas industry in those counties is much lower (Figure 30).

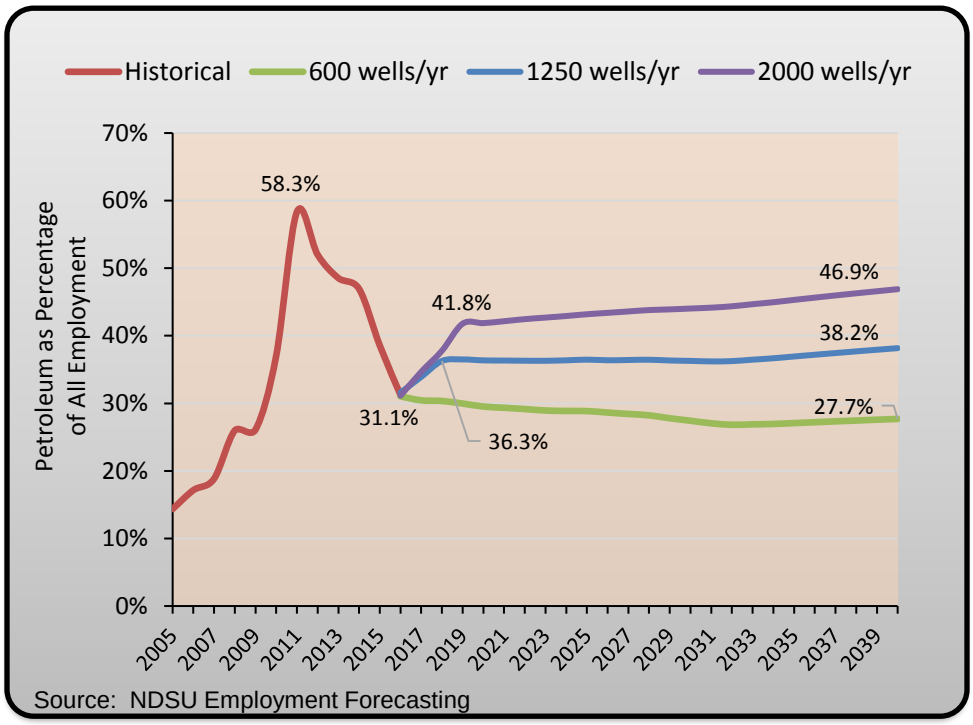

Figure 29. Employment in the Oil and Gas Industry as a Percentage of All Wage and Salary Employment, Core Oil Producing Counties, North Dakota, 2000 through 2040

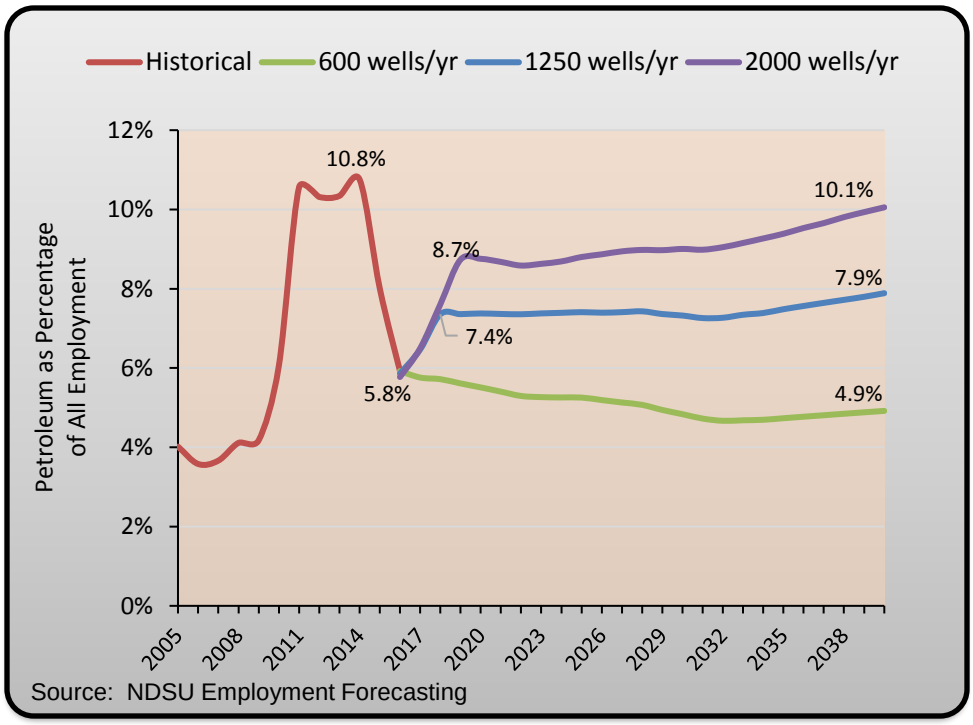

Figure 30. Employment in the Oil and Gas Industry as a Percentage of All Wage and Salary Employment, Non-core Oil Producing Counties, North Dakota, 2000 through 2040

Population Projections

Population can have different meanings depending upon the criteria used to classify people based on residence. Permanent populations are those individuals that reside in a given location and would be classified as residents of that location for official government purposes (e.g., address for Federal and state income tax). An area's permanent population is typically comprised of individuals living in permanent housing (i.e., houses, apartments, mobile homes) and represent individuals counted by the decennial censuses. Service population is the sum of the normal resident population (Census or permanent population) and additional persons who may work or reside in a location but maintain a permanent residence elsewhere. Service population is not measured by the U.S. Census Bureau. Estimates of the service population provide guidance to local jurisdictions and planners for the provision of public services, and remain an important metric for areas that experience rapid employment growth, have a large localized demand for specialized labor, or areas that have an influx of temporary residents from other causes (e.g., people displaced from a natural disaster).

Permanent Population

Projections of permanent population were combined for the core oil producing counties (Figure 31) (see Vison West ND website www.visionwestnd.com for individual county population projections). Population growth occurs in the core oil producing counties in all oil price scenarios, even if the industry only adds 400 wells per year. In the moderate and high price scenarios during the transition period when the industry ramps up drilling activities, population growth in the core oil producing counties is similar but remains slightly slower than the growth rates those counties experienced from 2011 through 2014. Long-term population growth rates of 2 percent to 3 percent per year under the moderate and high price scenarios will create challenges for local jurisdictions (Table 4). Population change is generally around 1 percent or less per year in the low price environment.

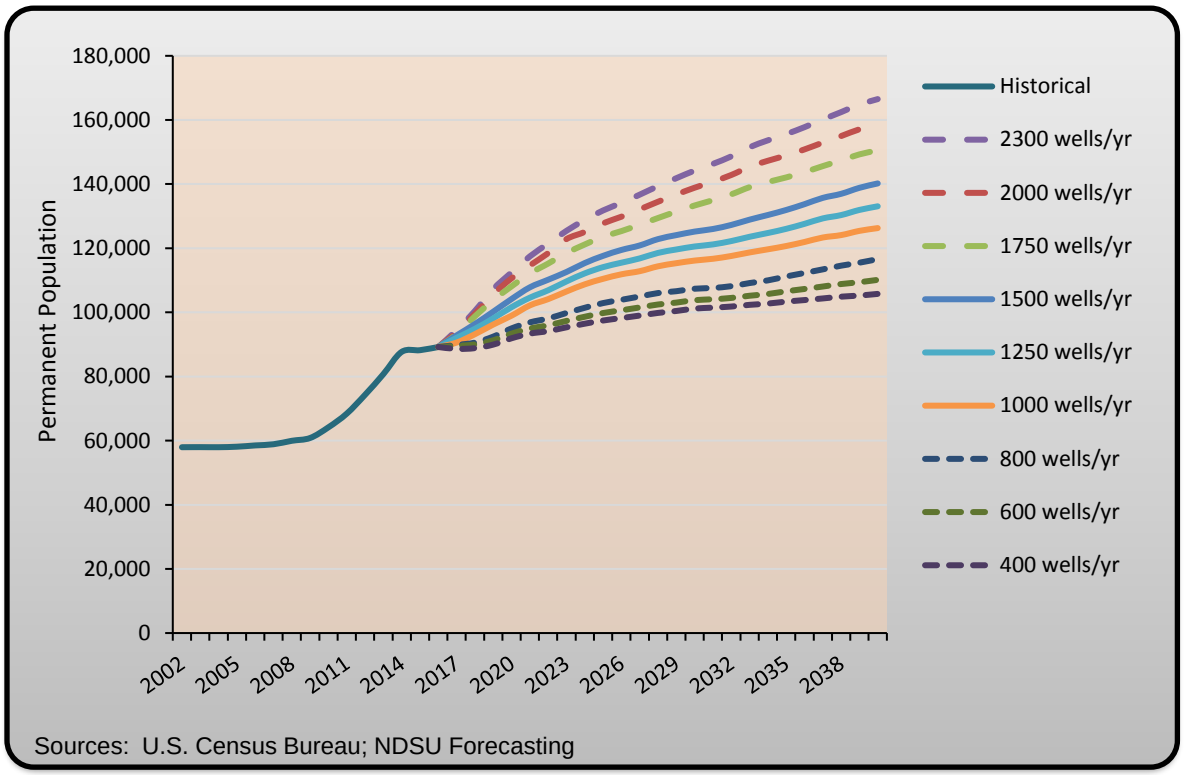

Figure 31. Historical and Projected Permanent Population, by Economic Scenario, Core Oil Producing Counties, North Dakota, 2002 through 2040

Projections of permanent population were combined for the non-core oil producing counties (Figure 32). Population growth occurs in most non-core oil producing counties in the low price scenarios, except Divide, Renville and Slope Counties have slight population declines. In the high oil price scenarios during the transition period when the industry ramps up drilling activities, population growth in the non-core oil producing counties is similar to the rates those counties experienced from 2011 through 2014. However, long-term population growth rates are generally around 1 percent per year or less under high price scenarios (Table 5). Population growth across the oil price scenarios for the non-core oil producing counties is considerably lower than the rates projected for the core oil producing counties.

Table 4. Rate of Change in Permanent Population, Core Oil Producing Counties, North Dakota, 2017 through 2035

County	Wells Drilled Per Year in ND Williston Basin	2017 to 2035 Population			
		Total Change		Average Annual	
Dunn	600 (Low Price)	560	12%	30	0.6%
	1,250 (Moderate Price)	1,300	28%	68	1.3%
	2,000 (High Price)	2,100	45%	109	2.0%
Williams	Low	6,900	21%	361	1.0%
	Mod	16,500	51%	865	2.2%
	High	26,800	82%	1,410	3.2%
McKenzie	Low	3,700	31%	195	1.4%
	Mod	5,550	47%	292	2.0%
	High	8,300	70%	437	2.8%
Mountrail	Low	2,450	25%	129	1.2%
	Mod	3,800	39%	199	1.7%
	High	5,200	54%	275	2.3%
Stark	Low	3,800	12%	200	0.6%
	Mod	9,800	32%	516	1.5%
	High	17,300	57%	912	2.4%

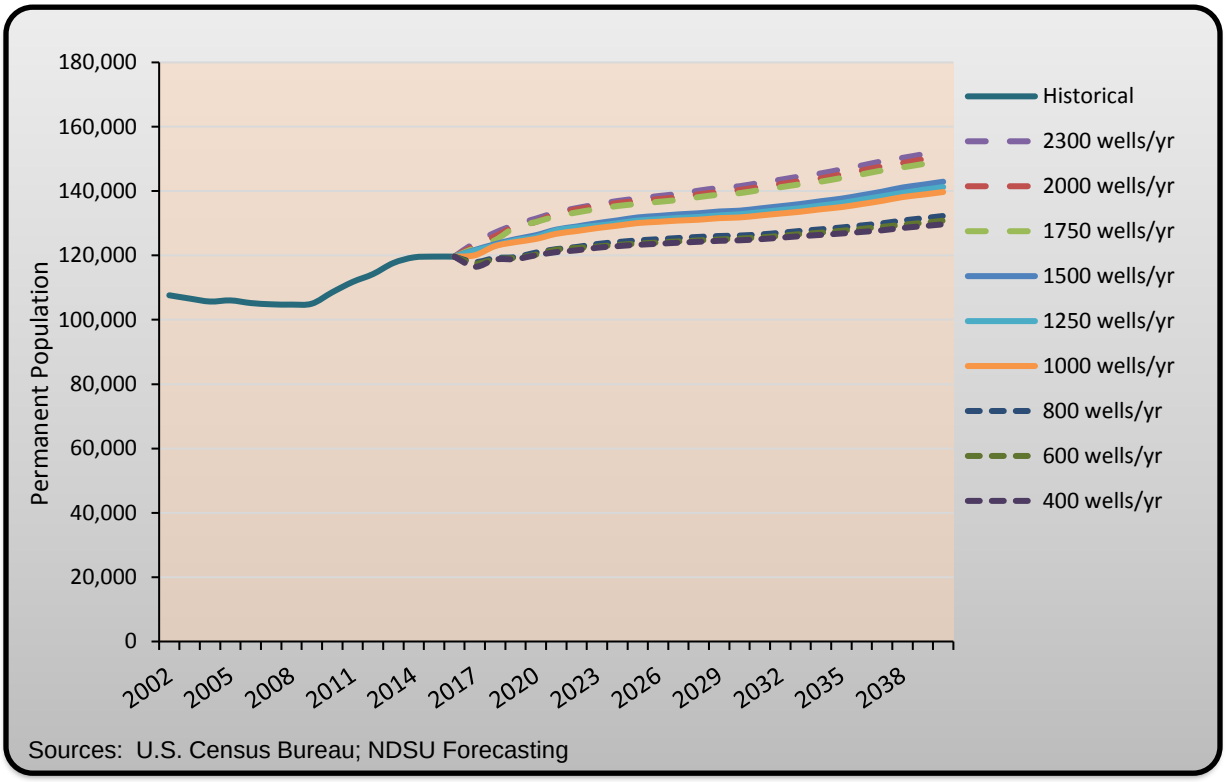

Figure 32. Historical and Projected Permanent Population, by Economic Scenario, Non-core Oil Producing Counties, North Dakota, 2002 through 2040

Table 5. Rate of Change in Permanent Population, Non-core Oil Producing Counties, North Dakota, 2017 through 2035

County	Wells Drilled Per Year in ND Williston Basin	2017 to 2035 Population			
		Total Change		Average Annual	
Adams	600 (Low Price)	200	9%	11	0.40%
	2,000 (High Price)	525	22%	28	1.10%
Billings	Low	24	3%	1.3	0.10%
	High	145	16%	7.5	0.80%
Bowman	Low	200	6%	11	0.30%
	High	820	25%	43	1.20%
Bottineau	Low	290	4%	15	0.20%
	High	1,200	18%	64	0.90%
Burke	Low	90	4%	5	0.20%
	High	430	19%	23	0.90%
Divide	Low	-40	-1.5%	-2	-0.08%
	High	360	14%	19	0.70%
Golden Valley	Low	250	13%	13	0.70%
	High	430	24%	23	1.10%
Hettinger	Low	81	3%	4	0.2%
	High	330	12%	17	0.6%
McHenry	Low	400	7%	21	0.3%
	High	1,200	20%	63	1.0%
McLean	Low	250	2.5%	13	0.1%
	High	1,400	15%	74	0.7%
Mercer	Low	36	0.7%	2	0.02%
	High	990	11%	52	0.6%
Renville	Low	-5	-0.2%	-0.3	-0.01%
	High	370	14%	19	0.7%
Slope	Low	-10	-1.3%	-0.5	-0.07%
	High	30	4%	2	0.2%
Ward	Low	6,260	9%	330	0.5%
	High	17,300	25%	911	1.2%

Service Population

Identifying and estimating service populations for western North Dakota have been key issues since the beginning of shale oil development (Bangsund et al. 2012; KLJ 2012; Hodur and Bangsund 2013, 2015; KLJ 2014). Several factors create the need to understand, measure, and respond to service populations in western North Dakota. First, shale oil development requires technical and complicated drilling and fracking techniques, much of the expertise in those processes is held by individuals that are not residents of North Dakota. Second, recent crude oil price volatility is an example of the uncertainty present in the oil and gas industry, and that uncertainty is sufficient for some workers to be hesitant to relocate or develop permanent residence in development areas. Third, some workers are simply unwilling to relocate to western North Dakota for personal, family, or other factors. Fourth, industry practices often have non-traditional work schedules with extended periods of working followed by extended periods of not working (Hodur and Bangsund 2016). Those types of work schedules enable workers to maintain commuting patterns that have workers return to their permanent residence during off work periods. Finally, still other workers might be willing to relocate but have had or are having difficulty finding the amenities necessary for them to consider permanent residence. Among the amenities identified by a recent study of the oil and gas industry workforce, housing was the number one reason cited as an impediment among workers that would consider or desire to relocate to western North Dakota (Hodur and Bangsund 2016).

Service populations result from many factors. Some of which can be addressed by stakeholders, leaders, and businesses, while other factors are beyond the control of local interests. One strategy, or perhaps the general strategy with the most efficacy, is for communities to address quality of life amenities, community livability, and housing cost and availability. Yet, those strategies must be implemented knowing that no matter what is done, not all workers will relocate (Hodur and Bangsund 2016). The importance of discussing service populations is that some of those individuals could become permanent residents, which is important for many community functions and institutions. Also, individuals present in western North Dakota that are not residents of the region will have impacts on public services and infrastructure, and those needs must be addressed by planners, civic leaders, and policymakers.

Service populations were evaluated by examining the trends in service population as a percentage of permanent population and by estimating the number of non-local workers to permanent population. Both approaches produced similar results and for sake of brevity, service populations will be presented as an average of both methods.

Service populations show a consistent presence in the study counties over the entire projection period (Figures 33 and 34). As would be expected, service populations largely parallel forecasts of permanent population. As a percentage of permanent population; however, the rate of growth in overall service populations declines slightly over the projection period. As populations grow, non-residents, representing the individuals added to permanent population to comprise the service population, generally become a smaller percentage of permanent population. Service populations represent 15 to 23 percent of permanent population in the core oil producing counties, and 7 to 10 percent of permanent population in the non-oil producing counties. Population for individual counties is available on the Vison West ND website www.visionwestnd.com .

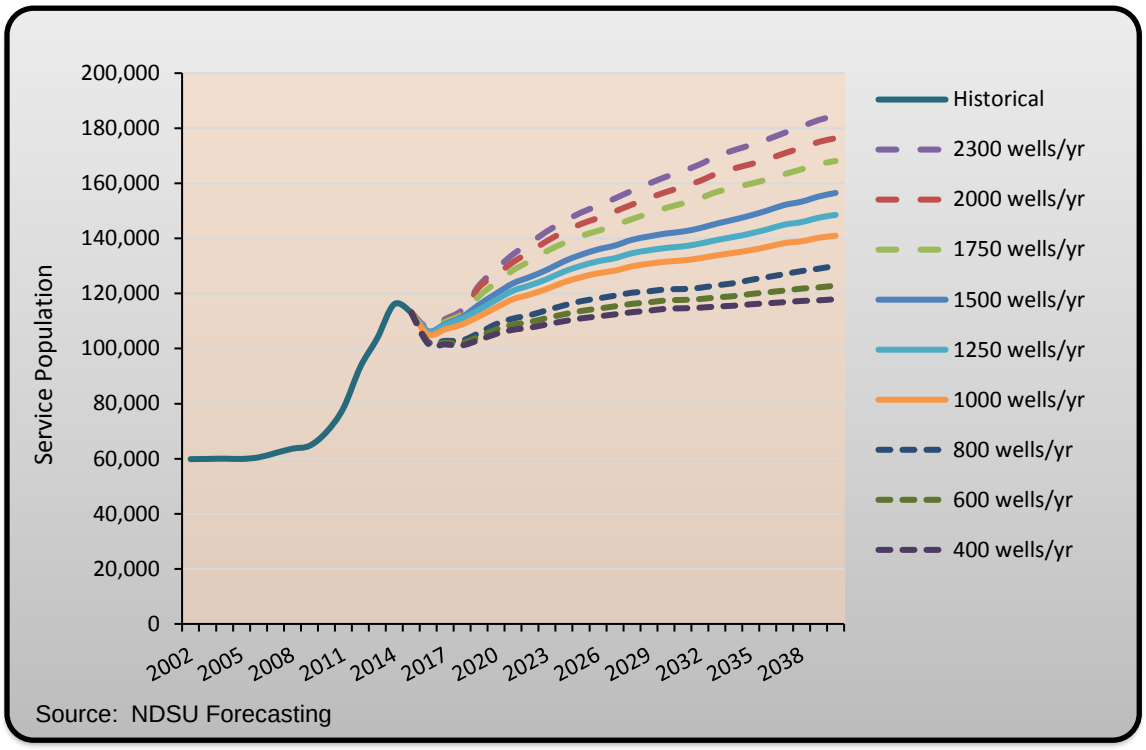

Figure 33. Historical and Projected Service Population, by Economic Scenario, Core Oil Producing Counties, North Dakota, 2002 through 2040

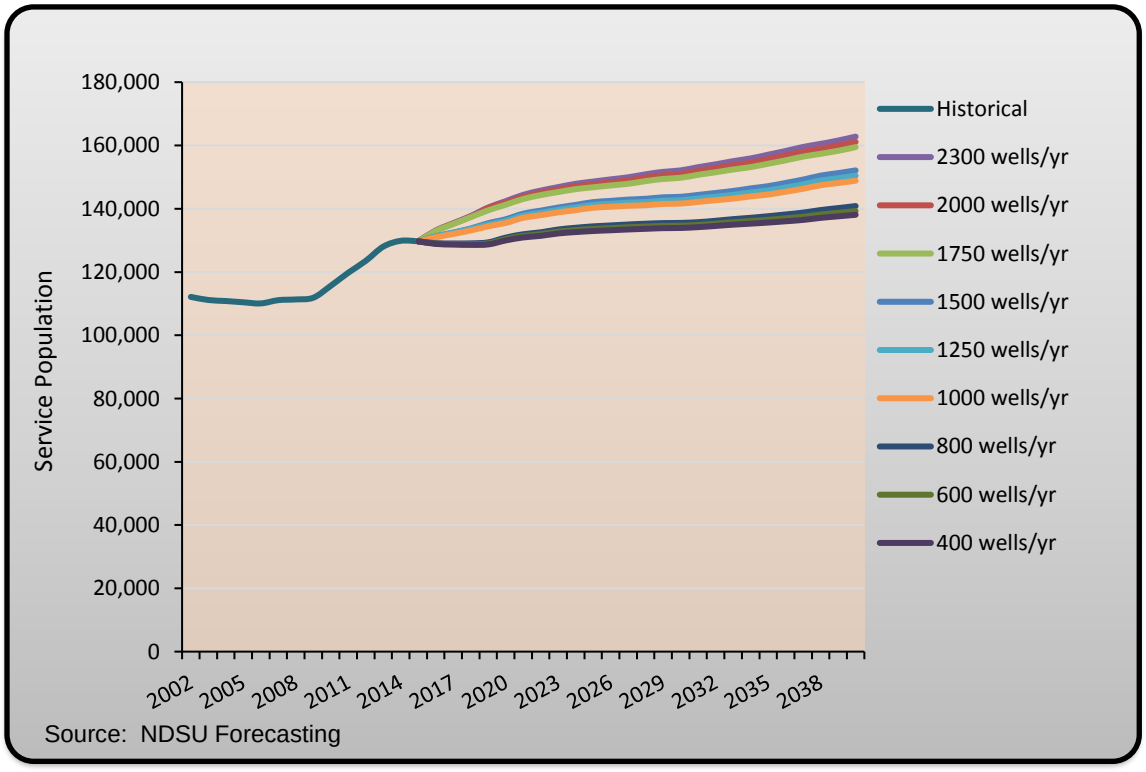

Figure 34. Historical and Projected Service Population, by Economic Scenario, Non-core Oil Producing Counties, North Dakota, 2002 through 2040

Population of Children

Cohort population modeling includes changes in the number of children by measuring births, deaths, and migration rates in those age cohorts. The primary factor linking population of children among the price scenarios in this study was the number of births. Birth *rates* were not adjusted, but those rates are applied to the population of child bearing females. As the analysis adjusts the population required to meet local supply of workforce, population of females of child-bearing age changes, those changes in turn produce changes in the number of births, which when extended over the next 20 years creates changes in the population of children.

This study lacked sufficient data to link future changes in workforce requirements to specific changes in historical migration rates of children. Alternatively, this study did not estimate how much departure from baseline migration rates for children would be expected in a low price versus moderate price versus high oil price environment.

The migration rates adopted in the 2016 North Dakota Statewide Housing Needs Assessment represented the baseline migration rates for this study. It is impossible to strongly suggest that the past migration rates for children are directly applicable to a specific oil price scenario because unique circumstances produced much of the growth from 2010 through 2014 and periods prior to shale oil development also are unlikely to match future conditions, especially in core oil producing counties. Evaluation of the 2016 North Dakota Statewide Housing Needs Assessment in oil and gas producing counties indicates that population projections correlate closely to the 2,000 to 2,300 wells per year scenarios (i.e., moderate and high range of the high price scenarios). If the baseline migration rates are reflective of those price environments, then population of children in this study are reflective of higher rates of oil field development.

Because of how the baseline migration rates were estimated (see Hodur et al. 2016), and the lack of adjustment in those rates across the price scenarios, projections of children in this study are likely to be overstated in the low and moderate price scenarios. Populations of children vary among the price scenarios due to changing population of females in child-bearing ages. However, migration also plays a key role in population of children even though migration rates were not adjusted in the price scenarios.

Population of children and teenagers in the core oil producing counties was projected to grow slightly over the next five years. Starting approximately within the 2022 through 2024 period, populations of children and teenagers level off for the low and moderate oil price scenarios. In the high price environment, population of children and teenagers exhibits steady growth over the entire projection period (Figure 35). The rate of population change of children and teenagers are similar for each of the core oil producing counties; however, the size of the population of children and teenagers varies among those counties (see Vision West ND website www.visionwestnd.com for estimates of school-age populations by county).

Population of children and teenagers in the non-core oil producing counties was forecasted to continue to increase slightly over the next decade, and then remain relatively stable (Figure 36). The magnitude of population change for children and teenagers exhibited small changes among all the price scenarios. The results of the population changes among the scenarios are largely influenced by the baseline migration rates and the lack of substantial changes in females of child-bearing ages. While population of children, when combined for all non-oil producing counties, exhibits minor changes, population changes among the individual counties are more pronounced (see Vision West ND website www.visionwestnd.com for estimates of school-age populations by county).

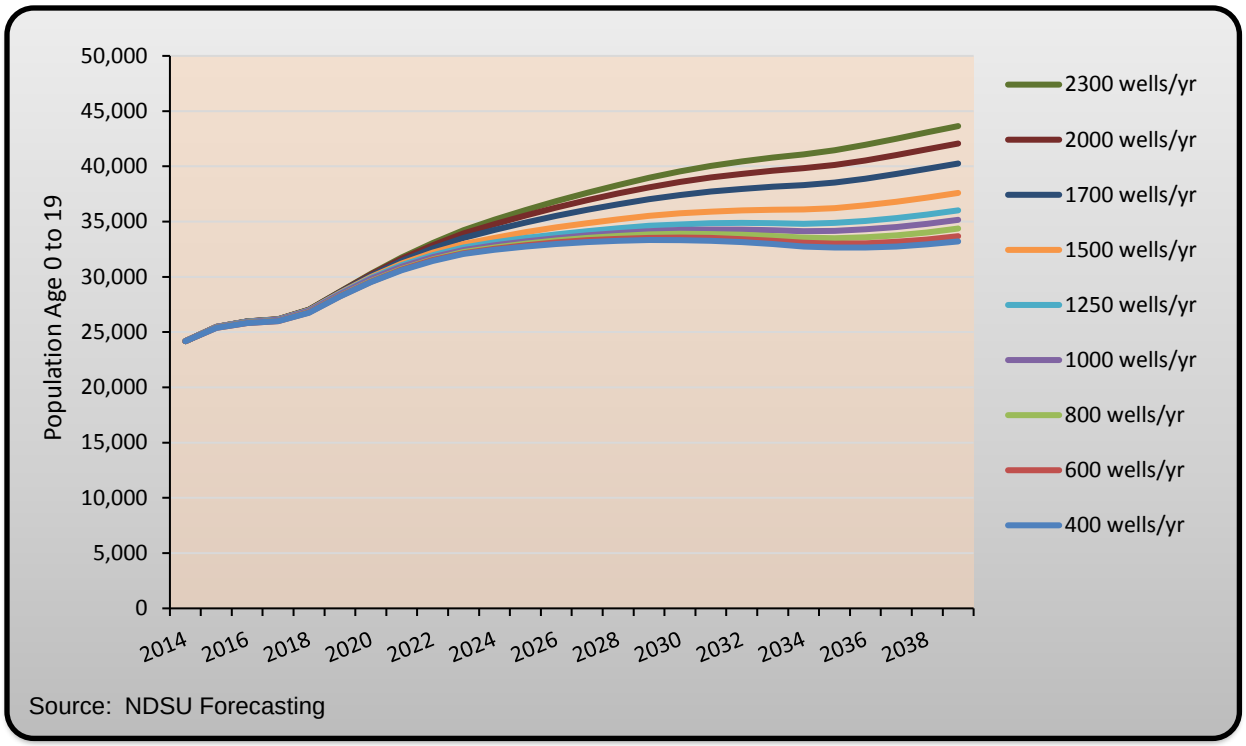

Figure 35. Projected Population, Ages 0 through 19, by Economic Scenario, Core Oil Producing Counties, North Dakota, 2014 through 2040

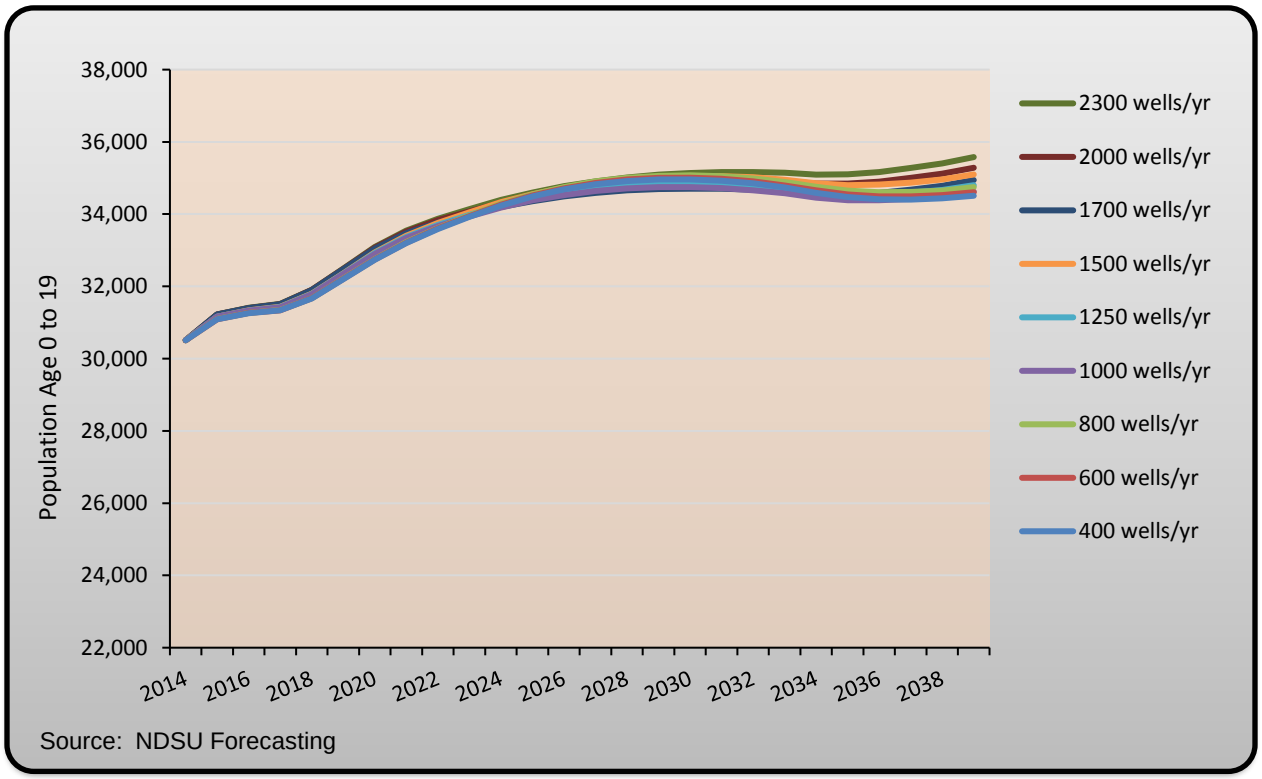

Figure 36. Projected Population, Ages 0 through 19, by Economic Scenario, Non-core Oil Producing Counties, North Dakota, 2014 through 2040

Housing projections

Housing projections were linked to conditions present in the study counties in 2015. The 2016 North Dakota Statewide Housing Needs Assessment updated (and corrected) published estimates of housing inventories using primary data collected from various agencies. The modeling process linked those updated housing inventories with estimates of permanent population by using the number of householders by age cohorts. This process allows for housing needs to vary as the age structure of the local population changes. However, the process does not alter the current proportion of housing types.

In all oil price scenarios, the expected increase in housing inventories are larger in the core oil producing counties than in the non-core oil producing counties (Figures 37 and 38). While total housing units required in the moderate and high price environments are substantial, those increases, at least in the near-term, are much less than the number of housing units added in the region from 2010 through 2015 (Tables 6 and 7). In the core oil producing counties, under a moderate price environment where the state adds 1,250 wells per year, annual rates of additional housing are less than one-third of the 2010 to 2015 rate. In the non-core oil producing counties the rate of growth in housing inventories is less than 20 percent of the 2010 through 2015 rate.

While the rates of change in expected housing inventories will likely remain less than the region experienced from 2010 through 2014, the number of housing units required will continue to present challenges in the core oil producing counties. The current projections suggest that in a sustained environment where the oil and gas industry adds 2,000 wells per year, core oil producing counties would need to collectively add 2,000 housing units per year. The challenges would be considerably less in the non-core oil producing counties under the same scenario as they were forecasted to collectively need less than 1,000 housing units per year.

The mix of housing in the core oil and gas producing counties is slightly weighted more towards rental units than in the non-core oil and gas producing counties. The mix of housing among the counties continues to shift, although the shifts are not uniform in the Williston Basin (2016 Statewide Housing Needs Assessment). The current mix of housing was fixed over the projection period, so the number of individual housing units by type can be easily estimated by applying the percentages in Figures 39 and 40 to the housing needs outlined in Table 6.

Housing requirements for individual counties are contained in the county supplement documents and in the individual county webinars available for use on the Vision West ND web site.

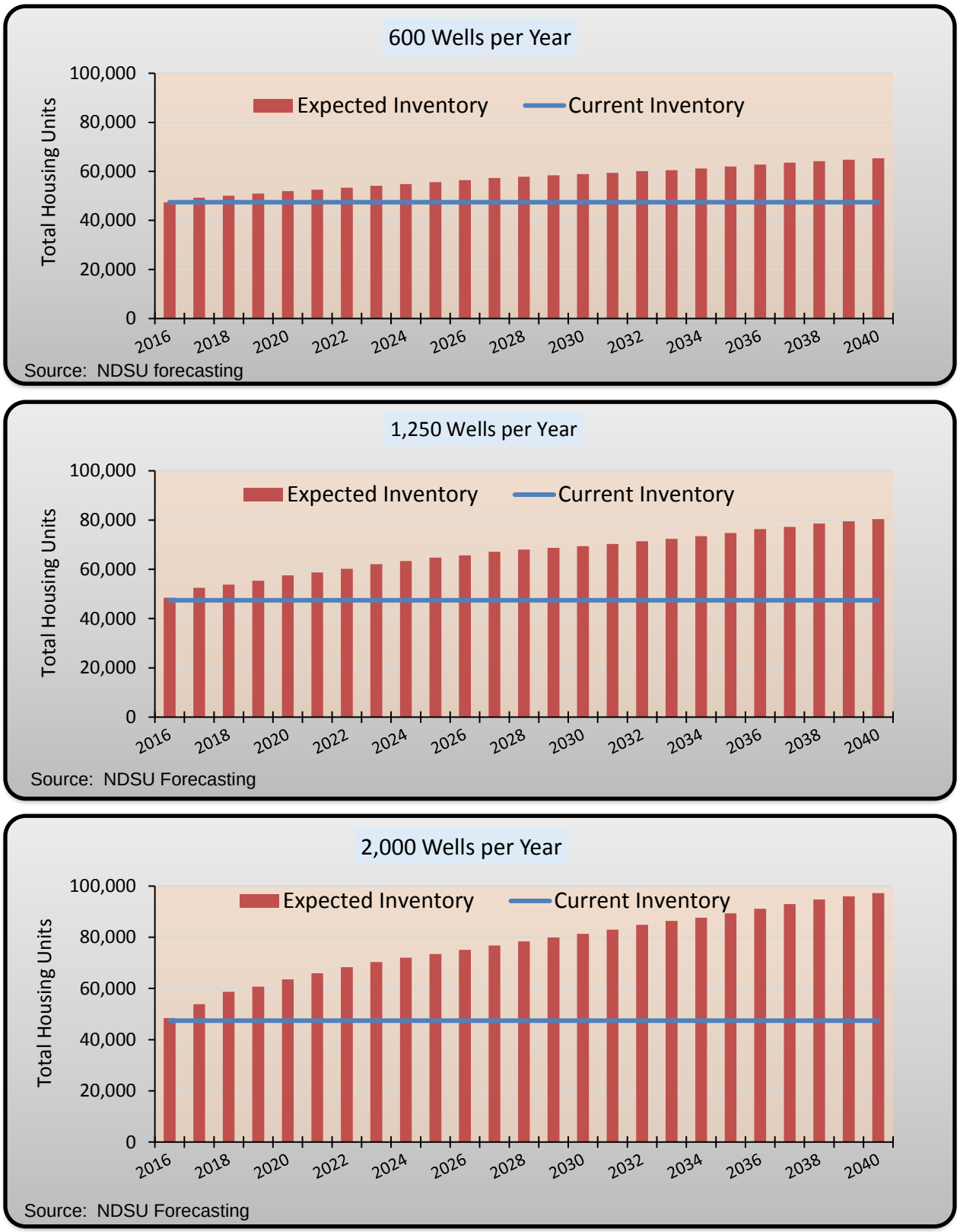

Figure 37. Expected Housing Inventory, by Economic Scenario, Core Oil Producing Counties, North Dakota, 2016 through 2040

Figure 38. Expected Housing Inventory, by Economic Scenario, Non-core Oil Producing Counties, North Dakota, 2016 through 2040

Table 6. Expected Changes in Housing Inventory, Core Oil Producing Counties and Non-core Oil Producing Counties, by Economic Scenario, North Dakota, 2016 through 2035

Periods	Annual Housing Units Required Above Current Inventory[1]					
	600 Wells per Year		1,250 Wells per Year		2,000 Wells per Year	
	Core Counties	Non-Core Counties	Core Counties	Non-Core Counties	Core Counties	Non-Core Counties
2016-2020	825	345	1,800	965	3,020	1,600
2021-2025	620	300	1,200	450	1,510	550
2026-2030	495	200	730	280	1,260	490
2031-2035	515	345	900	500	1,280	640
Total	14,170	7,170	26,400	13,600	40,850	18,860
Average Annual	700	360	1,300	630	2,040	940

[1]2015 inventory of housing units in the 2016 North Dakota Statewide Housing Needs Assessment (Hodur et al. 2016).

Table 7. Comparison of Recent Housing Inventory Change with Expected Housing Inventory Requirements for Moderate Oil Price Scenario of 1,250 Wells per Year, Core Oil Producing and Non-core Oil Producing Counties, North Dakota, 2016 through 2020

Change in Housing Inventories	Core Oil Producing Counties		Non-core Oil Producing Counties	
	2010-2014	2016-2020	2010-2014	2016-2020
Housing Units Added (total)[1]	23,625	-----	20,695	-----
Housing Units Added (average annual)[1]	5,900	-----	5,170	-----
Housing Units Required (additional over current inventory)[2]		9,000		4,800
Housing Units Required (average annual)[2]		1,800		965

[1]Based on 2010 Decennial Census reported inventory of permanent housing, adjusted by 2016 North Dakota Statewide Housing Needs Assessment.

[2]Based on using 2015 housing inventories reported in the 2016 North Dakota Statewide Housing Needs Assessment.

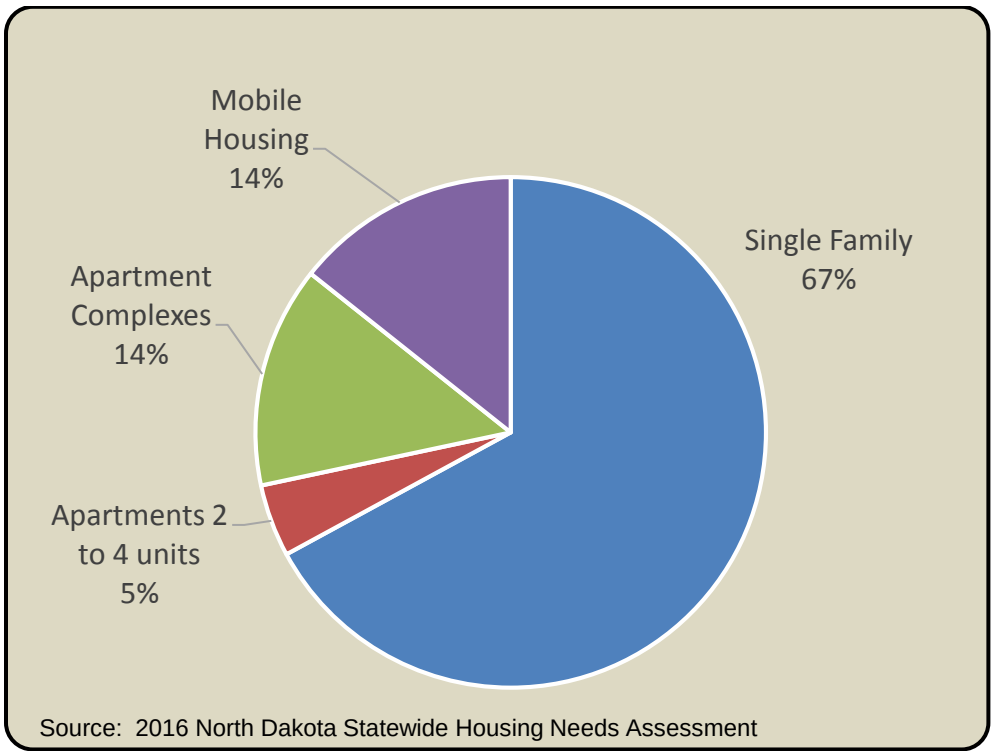

Figure 39. Housing Inventory, by Type, Core Oil Producing Counties, North Dakota, 2015

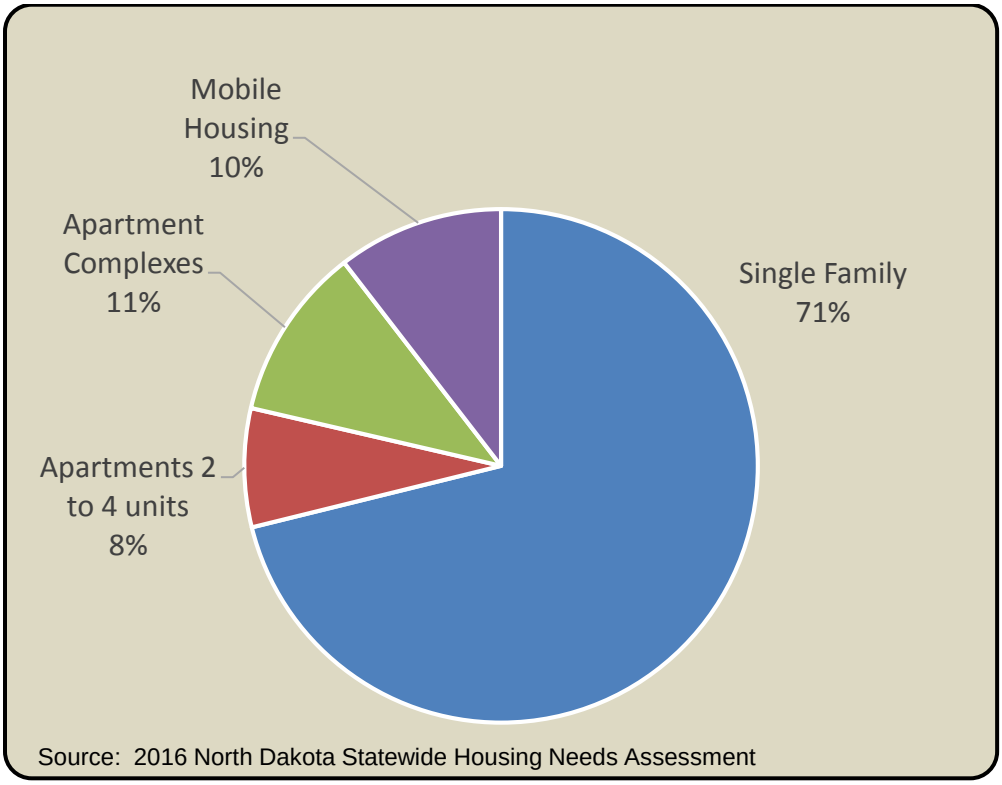

Figure 40. Housing Inventory, by Type, Non-core Oil Producing Counties, North Dakota, 2015

Study Limitations

Scenario-based population projections have been used in previous studies to frame a range of likely outcomes in the Williston Basin (Ondracek et al. 2010; Bangsund et al. 2012; Bentek 2012; Rathge et al. 2012; KLJ 2012; Hodur and Bangsund 2013, 2015; Vision West ND 2014a, 2014b; KLJ 2014). Despite all of the work to better understand what the future holds for oil and gas development in the Basin, it is impossible to forecast all of the economic, social, regulatory, and environmental factors that can influence how the industry develops and produces oil and gas in the Williston Basin. Therefore, deterministic scenarios developed using the best available data remain the primary strategy to frame a range of future possibilities, and highlight the uncertainty that remains in predicting future oil and gas activities.

Given the 2015/16 events in world and domestic oil markets, the study's approach was to present several viable potential futures without identifying or creating an 'expected' or 'consensus' prediction—this is slightly different than many previous studies associated with population change in the Williston Basin. The correct use of this study's material for future planning, strategizing, and positioning therefore falls on the stakeholders in the Williston Basin. The material presented is illustrative of a number of potential futures and stakeholders will need to evaluate the information as future circumstances warrant.

A positive attribute of the study was that a broad range of oil and gas industry development rates were modeled. In past studies, only three projections were presented; this study used nine economic scenarios. A broad range of potential activity was developed because the path forward for the oil and gas industry and the subsequent economic and socio-economic conditions in the Williston Basin are perhaps more uncertain after the price collapse than when prices were stable. Aside from the economic uncertainties, the two largest limitations of the population modeling are how future economic conditions change migration rates and commuter behavior (Table 8). Those elements are the two key factors linking employment and population. Hopefully, insights will be gained with the release of updated data identifying those behaviors in 2015 and 2016; however, those key data series for this study were current only through 2014.

The largest limitation with the housing forecasts is the question of what the long-term equilibrium will be between housing inventory and service population (i.e., supply and demand for housing, by type, for both temporary and permanent residents). Service population is an important distinction since only permanent population is traditionally linked to permanent housing. In many areas of the Williston Basin, components of the service population were occupying permanent housing making those equilibrium assessments difficult. Since so many factors were acting to make those determinations nearly impossible over the last several years, forecasts focused on how much total housing demand would be present in future economic scenarios, and then refined those estimates based on long-term and short-term employment. Making those determinations based on the tenure of the job was a necessary step to prevent over supplying permanent housing. However, not all individuals employed in long-term jobs have the characteristics of a long-term resident. Also, some individuals working in short term jobs may desire to obtain long-term employment and therefore would more closely align with housing needs for a permanent resident.

The issue of permanent housing was addressed in this study by examining commuter activity, rather than relying solely on classifying employment as short-term or long-term. While this adjustment or refinement in the modeling process improves upon previous studies, it does not completely satisfy how to determine permanent housing needs since commuter behavior may change over the projection

period due to changes in work schedules, industry worker recruitment, and the availability or lack of housing. This study did not examine the implications of substantial changes in commuter behavior on demand for permanent housing.

Observations of recently added housing in the region are showing shifts from single family units to apartment units. This study did not alter the current ratio of housing type in the forecasts of future housing inventories (Table 8). Further, it remains unclear if the supply of housing available in 2015 was equal to, less than, or greater than the demand for housing given the workforce requirements and local population. These issues are present due to a host of factors:

-) The general workforce is younger and more mobile than in previous decades

-) Housing costs, even after adjusting for inflation, are substantially higher than historically observed

-) The value (costs and amenities) of permanent housing has changed

-) Incomes, both in and outside of the oil and gas industry, have increased but those increases have not been uniform across all economic sectors.

-) The high cost of housing can alter market behavior. For example, someone may live in an apartment, camper, or other non-traditional arrangement because housing is not available or because housing is too expensive even though single family homes are available.

Table 8. Study Strengths and Limitations, Vision West ND Employment, Population, and Housing Projections, Williston Basin, 2017

Modeling	Strengths	Limitations
Employment	-) Broad range of future employment -) All employment is included (not just Oil and Gas) -) Captures dynamics with labor and industry efficiencies	-) Future price uncertainty -) Petroleum Industry behavior in the future
Population	-) Capture dynamics with cohort modeling -) Includes commuting activity of workers	-) Future commuting behavior unknown -) Linking commuters to economic sectors
Housing	-) Uses updated and verified housing inventories -) Housing inventory changes with size and composition of population	-) Key relationships remain unchanged over projection period -) Not a marketing study, does not address housing preferences, incomes, or locational factors -) Did not address specific needs to accommodate service population

Conclusions

Some of the findings of this study are acknowledged to be generally understood but have lacked specification or data to match the anecdotal observations. Other findings of this effort present new insights and new information for constituents in the Williston Basin.

Methods

Employment modeling is perhaps the most straight forward of the modeling processes, and those analyses benefit from having good secondary data to validate employment coefficients. However, recent employment reports from Job Service North Dakota are reporting larger employment in the oil and gas industry than what is produced with current modeling coefficients. This is not necessarily a problem as the difference is accounted for with adjustments to indirect employment factors (multipliers are modified to account for those differences). However, as the industry changes and becomes more efficient it may require a review or update of the employment coefficients to refine employment forecasting in the future.

This study broke new ground in developing a dynamic population model to more thoroughly forecast population change in the Williston Basin. The incorporation of dynamic changes to population migration rates, coupled with adjustments in the percentage of jobs filled by permanent residents, proved to be a substantial step forward from previous modeling efforts. The new population forecasting platform was designed to be flexible and will benefit from adjustments, refinement, and further testing. Specifically, the ability to target migration rates for age cohort and age/gender cohorts to different economic sectors would substantially improve the process. However, at present, data to incorporate those refinements is insufficient.

The ability to close the gap between housing requirements (i.e., the amount of housing needed for the number of individuals in the area) and market demands for housing remains elusive. The existing methods still rely heavily on current or past relationships which either 1) match householders as a percentage of current population to future population levels as a means to estimate housing needs or 2) assign housing requirements based on ratios of housing to employment or by dividing population by occupancy rates to estimate housing. The last two strategies were not employed in this study, which is a substantial departure from previous modeling efforts. While housing projections used new methods and new data, there is room for improvement in modeling housing needs by incorporating elements to demonstrate need based on income, age, housing characteristics, and location.

Projections

Several key conclusions can be gleaned from the study.

Workforce Behavior

-) Substantial change from historical patterns, new changes driven by recent economic expansion
-) Employment at a specific location may/may not translate to residents of that location
-) Employment in one location can affect population in another location
-) Workforce is not limited to those residing in the immediate area

These factors reinforce the need to realize that not all future employment growth will become permanent residents even when individuals are employed in long-term jobs.
Do not expect a repeat of employment explosion 2010 to 2014

Oil and Gas Employment

Employment in the oil and gas industry will continue to be a mix of jobs tied to oil field service and employment associated with oil field development. It is important to remember even in higher price environments, the industry does not need to build service roads, well pads, depots, office space, industrial facilities, and so on. Therefore, those jobs are not likely to be present in the future and as the industry becomes more efficient the region should not expect the same proportional growth in employment as was observed during the early stages of shale oil development.

-) Petroleum industry is in different economic position than few years ago, exact behavior difficult to forecast, efficiencies (both labor and $) will affect North Dakota
-) Total employment in low price environment continues to slowly expand (additional contraction was only observed in the lowest growth scenario of 400 wells per year)
-) Total employment growth in high price environment will bring about substantial challenges for local governments

The projections do not suggest a return to the pace of employment growth or a quick return to the peak employment experienced from 2010 through 2014. The projections do indicate that employment is likely to remain at levels observed at the end of 2016, even in most low price environments, which implies the region is not likely to return to pre-shale employment levels.

Population

-) Population has become younger
-) In low price environments, slow population growth
-) In high price environments, growth rates will challenge ability of communities to keep up, especially over longer periods
-) Substantial service populations will be present during moderate and high price environments

Housing

-) Housing inventories will need to continue to grow, and important that housing supply includes the needs to support service populations
-) Rate of growth will be less than experienced from 2010 to 2014, but will present challenges in moderate and high price growth environments
-) Probably of equal consideration is making sure the correct mix of housing is supplied, which would include provisions for affordability, ownership (rent versus own), and permanent and temporary accommodations.
-) Now that the housing availability crisis has abated to manageable levels, it will be critically important that planners, developers, and city administrators work to provide housing that meets the preferences of new workers.

Final Thoughts

-) This analysis suggests slower rates of population growth than previously forecasted and future populations smaller than previously forecasted

-) Future employment requirements for updating roads, expanding water and sewer facilities, building housing and commercial properties, building well pads, laying service roads and installing oil field gathering systems will be considerably less than what was needed when shale oil development started.

-) Drilling efficiencies have improved substantially, are likely to continue to improve, and will allow the oil and gas industry to use fewer rigs in the future to drill the same number of wells as in previous years. Expect fewer rigs in the future even if prices return to levels observed from 2010 through 2014.

-) Labor efficiencies will act to curb the growth in oil and gas industry employment even as the number of producing wells in the state increases.

Low oil price environments:

-) Population effects in the low price environments are mixed. At a pace of adding 400 wells per year population can continue to decline or will remain relatively stable. With a pace of 600 or more wells added per year, population is likely to grow slowly for the core oil producing counties. All but the worst price scenarios will act to stabilize long-term population trends.

Moderate oil price environments

-) Moderate price environments that produce 1,000 or more new wells per year will return the Williston Basin to healthy economic and demographic expansion. Growth will still present some challenges but is likely to remain at levels that are much more manageable than what was experienced from 2010 through 2014.

High Oil price environments

-) High price environments that produce 1,700 or more wells per year will bring about very challenging growth conditions. Sustained high prices are likely to reintroduce many of the issues local communities and government jurisdictions faced during the 2010 to 2014 period. However, within the range of likely outcomes evaluated the rates of growth are likely to be lower than those from 2010 to 2014.

This study's projections suggest the region will not see a return to the economic expansion of the 2010 to 2014 period. Nor do the projections suggest that a sustained low price environment will result in a contraction back to pre-shale oil levels.

Additional Resources

2016 Statewide Housing Needs Assessment

Link to report: https://www.ndhfa.org/Publications/HousingNeeds.html

NDSU Department of Agribusiness and Applied Economics

Links to departmental reports: http://ageconsearch.umn.edu/
https://www.ag.ndsu.edu/agecon/

NDSU Center for Social Research

Link to the Center: https://www.ndsu.edu/csr/

North Dakota Compass and North Dakota Kids Count

Links to programs: http://www.ndcompass.org/
http://www.ndkidscount.org/

Vision West ND

Link to their website: http://www.visionwestnd.com/

North Dakota Job Service

Links to Job Service North Dakota reports pertaining to oil and gas industry

North Dakota's Oil and Gas Economy
https://www.ndworkforceintelligence.com/gsipub/index.asp?docid=578

North Dakota Oil and Gas Industry Employment
https://www.ndworkforceintelligence.com/gsipub/index.asp?docid=586

Census on the Map

Link to data portal: http://onthemap.ces.census.gov/

N.D. Department of Commerce

Link to Census information https://www.commerce.nd.gov/census/

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Appendix A

Specification of Cohort Population Model and Workforce Supply and Demand Equilibrium Model

Cohort Population Model

Population projections are mathematical calculations that indicate potential future populations with certain conditions and assumptions. Projections help illustrate how economic, social, or political change affects the size and structure of a population over time. The accuracy of population projections rests on correctly identifying two important dimensions.

First, the events that directly affect population dynamics must be identified. This task involves only three basic events--births, deaths, and migration. Other factors, such as economics, values, or health, indirectly impact population change through one of these three basic events. For example, economic instability may force people to leave an area, thus inducing outmigration. Or, the desire by both spouses for careers may shift their values away from children, thus reducing the number of births. Also, medical advances help reduce many health risks and have resulted in a decreasing number of premature deaths and an increasing lifespan.

Second, shifts in the three basic components of population must be identified. Because of difficulties encountered in predicting the future, forecasters often rely on historical trends as a basic reference point for determining what is likely to occur in the future. However, a strict adherence to using only past trends has several important drawbacks.

One problem is that change occurs in a specific historical context. It is unlikely that the combined circumstances that produced shifts in births, deaths, or migration at some historical period will recur in the future. For example, the creation of the baby boomer generation was a result of the high level of fertility that dominated the 1950s, which was due largely to the unique mixture of economic prosperity and post-World War II modernization. While those conditions are unique and highly unlikely to be repeated, they represent an example of the difficulties in relying solely on historical context for population parameters.

A second important problem with utilizing historical trends is the continuous nature of time. How does one arbitrarily select which part of history to view as reflective of the future? For example, North Dakota's migration rates shifted dramatically from 2008 through 2014 due to shale oil development. However, prior to the advent of shale oil, most rural areas in western North Dakota were experiencing out-migration. As a result, the period between 2008 and 2014 reveals distinctly different pictures of migration than the late 1990s and early 2000s. An adherence to the trends observed during the period of rapid shale oil development will likely produce poor future projections since the economic drivers after 2015 changed dramatically.

The uncertainties regarding future population change lead demographers and researchers to conclude that no one prediction is reliable. A desirable alternative is the development of a series of population projections, which represent the effects of various assumptions concerning differing trends in births, deaths, and migration. These series can be viewed as benchmarks in developing differing strategies or policies that are most appealing given different population circumstances. For example, marketers could weigh the cost and benefits of expanding a product or service given the assumption of either population growth or decline. Similarly, planners could assess the impact of residential growth or decline on their projects. At the very least, the ability to compare various predictions of population change given differing assumptions offers stakeholders greater insight into how population shifts in response to changing events.

Components of Cohort Survival Model

The cohort-survival method of projecting population provides outputs at a significantly greater level of detail than many other methods (Barclay 1958; Bogue 1969; Shryock and Siegel 1973). The cohort-survival method of projecting population is used by applying a set of birth rates, death rates, and migration rates to a set of baseline population data for a specified point in time to determine the population at a later point in time. When applying these five factors, a series of adjustments must be made to account for the geographic area, data limitations, and other unique features of the projection process.

The cohort-survival method applied to a specific geographic area involves selecting or computing the following items:

1) a set of age-gender cohorts,
2) a set of age-specific fertility rates,
3) a set of age-gender-specific mortality rates,
4) a set of age-gender-specific migration rates, and
5) a computational procedure for applying the rates to the cohorts over the projection period.

Equation 1 is a standard generalization for estimating population over multiple periods using a survival-based methodology.

1) $$P_{t_2} = P_{t_1} + B_{t_1 t_2} - D_{t_1 t_2} - O_{t_1 t_2} + I_{t_1 t_2}$$

where:

t=0 (base year) to N periods
P=population in period (t)
B=births between periods (t)
D=deaths between periods (t)
O=out migration between periods (t)
I=in migration between periods (t)

Population at a projected time *(* P_{t_2} *)* is obtained by adding the number of persons born ($B_{t_1 t_2}$) between periods to population in the beginning period (P_{t_1}). The number of deaths *(* $D_{t_1 t_2}$ *)* between periods and the number of out-migrants ($O_{t_1 t_2}$) are subtracted from population (P_{t_1}) in the preceding period. Finally, the number in-migrants ($I_{t_1 t_2}$) are added, resulting in population in the future period *(* P_{t_2} *).*

Age-Gender Cohorts

A cohort is an aggregation of people who were born during the same year, or group of years. Standard cohort model architecture is typically based on five-year intervals beginning with ages 0 to 4 years, and going up to ages 80 to 84 years. The last cohort is a residual category comprised of individuals over the age of 84, which results in having 18 age cohorts.

A traditional cohort population model uses groups of 5-year cohorts, by gender, and computes a change in population for those cohorts in 5-year periods using migration and mortality rates, with 0-4 year-

old cohorts estimated using fertility and mortality rates. The population of any given 5-year cohort after the 5-year period becomes the starting population for the next age cohort. For example, the 21-25 year-old cohort after five years becomes the 26-30 year-old cohort.

Rather than using the total population figures as implied in Equation 1, the cohort-survival method employs data from age-gender cohorts, and rather than using the total number of births, deaths, and migrants, the cohort-survival method applies mortality, fertility, and migration rates specific to each of the age-gender cohorts (Equation 2).

2) $$P_{cgt_2} = P_{cgt_1} + B_{gt_1} - D_{cgt_1} + MR_{cgt_1}$$

where:

P,B,D are specified in Equation 1
c=5-year cohorts
g=male or female gender
MR=migration rate = $(O_{cgt_1} + I_{cgt_1})$

Age-Specific Fertility Rates

Age-specific fertility rates were obtained from the 2016 North Dakota Statewide Housing Needs Assessment and were derived from data obtained from the North Dakota State Department of Health. The age of childbearing for most American women is assumed, for statistical purposes, to range between ages 15 to 44, although some births do occur for women either above or below that range. Fertility rates or birth rates are based on dividing the number of births by population for selected female cohorts (Equation 3).

3) $$BR_c = \frac{B_c}{P_c} * 1000$$

where:

BR_c = birth rate for female cohort (c)

B_c = number of births for female cohort (c)

P = population of women in cohort (c)

c = cohorts of females aged 15-19 through 40-44 in 5-year groups

Mortality Rates

Mortality rates used in the model are statewide age-gender-cohort specific survival rates obtained from the 2016 North Dakota Statewide Housing Needs Assessment. Statewide survival rates were used in the model instead of county-specific rates, because overall mortality rates for the state are relatively low and little variability exists between counties. These statewide rates were assumed to apply throughout the projection period.

Migration Rates

Migration rates were calculated using a residual technique that compares population between periods by accounting for deaths and births (Equation 4).

4) $M_{t_1t_2} = P_{t_2} - P_{t_1} + B_{t_1t_2} - D_{t_1t_2}$

where:

t=years

$M_{t_1t_2}$ = migration between years t_1 and t_2

P_{t_1} = population in year t_1

P_{t_2} = population in year, t_2

$B_{t_1t_2}$ = births between years t_1 and t_2

$D_{t_1t_2}$ =deaths between years t_1 and t_2

In Equation 4 the number of deaths ($D_{t_1t_2}$) between periods are subtracted from the number of births ($B_{t_1t_2}$) during that period and added to the difference between the two base populations $(P_{t_2} - P_{t_1})$. The result is the net number of migrants ($M_{t_1t_2}$). To determine the rate of net migration ($MR_{cgt_1t_2}$) by gender- cohort, the number of migrants by gender-cohort are divided by the total population in those gender-cohorts (Equation 5):

5) $$MR_{cgt_1t_2} = \frac{M_{cgt_1t_2}}{P_{cgt_1}} * 1000$$

where:

$MR_{cgt_1t_2}$ = net migration rate per thousand in cohort (c) gender (g) between periods t_1, and t_2

$M_{cgt_1t_2}$ = net number of migrants in cohort (c) gender (g) between periods t_1, and t_2

P_{cgt_1} = population in cohort (c) gender (g) in period t_1

For a specified geographic area and period of time, population projections can be developed by identifying the mechanics of moving between 5-year periods (as indicated in Equation 2) and using gender and cohort designations as identified in Equations 3 through 5. Cohort rates for the projected period are applied to the population in each cohort to determine the future population for an area (Equation 6).

6) $P_{c_1 t_1} = P_{c_1 g_m t_1} + P_{c_1 g_f t_1}$

where:

$$P_{c_1 g_m t_1} = P_{c_1 t_1} * SBR_{g_m t_1} + MR_{c_1 g_m t_1}$$

$$P_{c_1 g_f t_1} = P_{c_1 t_1} * SBR_{g_f t_1} + MR_{c_1 g_f t_1}$$

where:

$$P_{c_1 t_1} = ((\sum_{c=4}^{9} P_{ct_0} * BR_{ct_0}) * SR_{c_1 t_1}) * 5$$

$$P_{c_2 t_1} = P_{c_2 g_m t_1} + P_{c_2 g_f t_1}$$

where:

$$P_{c_2 g_m t_1} = P_{c_1 g_m t_0} + (((P_{c_1 g_m t_0} * SR_{c_2 g_m t_1}) + MR_{c_2 g_m t_1}) * 5)$$

$$P_{c_2 g_f t_1} = P_{c_1 g_f t_0} + (((P_{c_1 g_f t_0} * SR_{c_2 g_f t_1}) + MR_{c_2 g_f t_1}) * 5)$$

$$P_{c_3 t_1} = P_{c_3 g_m t_1} + P_{c_3 g_f t_1}$$

where:

$$P_{c_3 g_m t_1} = P_{c_2 g_m t_0} + (((P_{c_2 g_m t_0} * SR_{c_3 g_m t_1}) + MR_{c_3 g_m t_1}) * 5)$$

$$P_{c_3 g_f t_1} = P_{c_2 g_f t_0} + (((P_{c_2 g_f t_0} * SR_{c_3 g_f t_1}) + MR_{c_3 g_f t_1}) * 5)$$

..
..
..

$$P_{c_{17} t_1} = P_{c_{17} g_m t_1} + P_{c_{17} g_f t_1}$$

where:

$$P_{c_{17} g_m t_1} = P_{c_{16} g_m t_0} + (((P_{c_{16} g_m t_0} * SR_{c_{17} g_m t_1}) + MR_{c_{17} g_m t_1}) * 5)$$

$$P_{c_{17} g_f t_1} = P_{c_{16} g_f t_0} + (((P_{c_{16} g_f t_0} * SR_{c_{17} g_f t_1}) + MR_{c_{17} g_f t_1}) * 5)$$

$$\begin{aligned} P_{c_{18} t_1} = {} & P_{c_{17} g_m t_0} - (((P_{c_{17} g_m t_0} * SR_{c_{17} g_m t_1}) + MR_{c_{17} g_m t_1}) * 5) \\ & + P_{c_{17} g_f t_0} - (((P_{c_{17} g_f t_0} * SR_{c_{17} g_f t_1}) + MR_{c_{17} g_f t_1}) * 5) \\ & + P_{c_{18} g_m t_0} * SR_{c_{18} g_m t_1} + MR_{c_{18} g_m t_1} \\ & + P_{c_{18} g_f t_0} * SR_{c_{18} g_f t_1} + MR_{c_{18} g_f t_1} \end{aligned}$$

where:

P=Population by cohort (c), period (t), and gender (m,f)
g=gender in (m) male and (f) female
c=cohort ages 0-4=1, 5-9=2, 10-14=3,……,80-84=17, 84+=18
t=0 (base year) to N periods (5-year blocks)
BR=birth rate by female cohort (c) in period (t)
SR=mortality rate by cohort (c), gender (m,f) in period (t)
BSR=birth sex ratio per gender (m,f) in period (t)
MR=migration rate by cohort (c), gender (m,f) in period (t)

Annualizing from Five-year Periods to One-year Periods

Several steps were required to convert a cohort population model based on cohorts of five ages with population projected in 5-year blocks to a cohort model using cohorts of single ages with population projected in one-year periods. The first step was to divide the 5-year cohorts into 1-year cohorts as indicated in Equation 7. This approach assumes equal distribution of single ages among the five ages within any particular cohort. For example, if the cohort aged 5-9 has 20 children at the start of the projection period, then 4 children would be age 5, 4 children age 6, and so on.

Converting 5-age Cohorts into Single-age Cohorts

7) $P_{cgt_0} = P_{cg_mt_0} + P_{cg_ft_0}$

where:

$$MR_{cgt_1t_2} = \frac{M_{cgt_1t_2}}{P_{cgt_1}} * 1000$$

$$FV = PV * (1+r)^n$$

$$P_{a_5c_2g_ft_0} = \frac{P_{c_2g_ft_0}}{5} = P_{a_6c_2g_ft_0} = P_{a_7c_2g_ft_0} = P_{a_8c_2g_ft_0} = P_{a_9c_2g_ft_0}$$

$$\vdots$$

$$P_{a_{80}c_{17}g_mt_0} = \frac{P_{c_{17}g_mt_0}}{5} = P_{a_{81}c_{17}g_mt_0} = P_{a_{82}c_{17}g_mt_0} = P_{a_{83}c_{17}g_mt_0} = P_{a_{84}c_{17}g_mt_0}$$

$$P_{a_{80}c_{17}g_mt_0} = \frac{P_{c_{17}g_mt_0}}{5} = P_{a_{81}c_{17}g_mt_0} = P_{a_{82}c_{17}g_mt_0} = P_{a_{83}c_{17}g_mt_0} = P_{a_{84}c_{17}g_mt_0}$$

$$P_{a_{84+}c_{18}g_mt_0} = P_{c_{18}g_mt_0}$$

$$P_{a_{84+}c_{18}g_ft_0} = P_{c_{18}g_ft_0}$$

where:

P=Population by age (a), cohort (c), period (t), and gender (m,f)
g=gender in (m) male and (f) female
c=cohort ages 0-4=1, 5-9=2, 10-14=3,……,80-84=17, 84+=18
t=0 (base year) to N periods
a=single ages 0 through 84, and age group 84+

Adjusting for Compounding

As identified in Equation 6, changes in population for any 5-year period (t) are first estimated using survival and migration rates, and the product of those calculations is multiplied by 5 to account for a 5-year period. However, that process requires adjustment when population change is estimated separately for 5, 1-year periods. Compounding effects occur if the computational process from a standard cohort model using 5-year periods is treated as the change in population for a single year.

For example, using a single cohort from Equation 6 shows that a 5-year population estimate is defined as $P_{C_2 g_m t_1} = P_{C_1 g_m t_0} + (((P_{C_1 g_m t_0} * SR_{C_2 g_m t_1}) + MR_{C_2 g_m t_1}) * 5)$. For a population of 1,000 at the beginning of the 5-year period with a 99.5 percent survival rate and a 3 percent migration rate would yield a population of 1,100=1,000 + ((-5+30) * 5) at the beginning of the subsequent 5-year period. However, using the above formula and replicating the computations 5 times (to simulate five separate annual calculations) would equal a population of 1,132.

Yr 1 = 1,000 -5.00 + 30.15 = 1,025
Yr 2 = 1,025 -5.13 + 30.10 = 1,051
Yr 3 = 1,051 -5.25 + 31.69 = 1,077
Yr 4 = 1,077 -5.39 + 32.48 = 1,104
Yr 5 = 1,104 -5.52 + 33.30 = 1,132

To correct for compounding, baseline survival rates and migration rates, obtained from the 2016 North Dakota Statewide Housing Needs Assessment, were adjusted using Equation 8.

8) $$r = \frac{FV^{(1/n)}}{PV} - 1$$

where:

FV = population in five years based on standard 5-year cohort methodology
PV = population at the start of the 5-year period
r = compounding rate (i.e, migration or survival rate)
n = number of compounding periods (years)

Equation 8 calculates the equivalent annual compounding rate for a specified present value, given a known future value and number of periods. This approach is often used in financial calculations, but in this application, the future value and present value are known populations and the number of periods is five. Using the 5-year standard cohort modeling process (as found in Equation 6), the future value (population) can be estimated for any migration rate or survival rate using procedures outlined in Equation 5. For example, if a present value population is 100 in year 1, and the migration rate is 5 percent (ignoring mortality) then the standard cohort population model would indicate that population in year 6 should be 125 = (100+((100*0.05)*5).

Equation 9 is a longhand proof given as support for the use of Equation 8 by applying 5 periods of compounding using only the present value of a known population and a migration rate, as applied in a standard cohort model.

9) FV=((((PV+(PV*r))+((PV+(PV*r))*r))+(((PV+(PV*r))+((PV+(PV*r))*r))*r))+(((PV+(PV*r))+((PV+(PV*r))*r))+(((PV+(PV*r))+((PV+(PV*r))*r))*r))*r)+((((PV+(PV*r))+((PV+(PV*r))*r))+(((PV+(PV*r))+((PV+(PV*r))*r))*r))*r)+(((PV+(PV*r))+((PV+(PV*r))*r))+(((PV+(PV*r))+((PV+(PV*r))*r))*r))*r)*r

where:

FV = future population
PV = present population
r = migration rate from standard cohort population model

Using the example above with a present value of 100 people and a future value of 125 people (estimated from Equation 6) then Equation 8 would suggest the migration rate should be 0.0456395525912732 if population is calculated annually using the standard cohort process.

Substituting 0.045 for 0.0456395525912732 for sake of brevity, then Equation 9 will yield a population of 125 which represents migration compounded over 5, 1-year periods given a starting population of 100 (Equation 10).

10) 125=((((100+(100*0.045))+((100+(100*0.045))*0.045))+(((100+(100*0.045))+((100+(100*0.045))*0.045))*0.045))+(((100+(100*0.045))+((100+(100*0.045))*0.045))+(((100+(100*0.045))+((100+(100*0.045))*0.045))*0.045))*0.045)+((((100+(100*0.045))+((100+(100*0.045))*0.045))+(((100+(100*0.045))+((100+(100*0.045))*0.045))*0.045))+(((100+(100*0.045))+((100+(100*0.045))*0.045))+(((100+(100*0.045))+((100+(100*0.045))*0.045))*0.045))*0.045)*0.045

Equation 8 can be rewritten into a more recognized form (Equation 11) often used to estimate a future value, given that the present value, compounding rate, and number of periods are known.

11) $FV = PV*(1+r)^n$

where:

FV = future value
PV = present value
r = compounding rate
n = number of compounding periods

Therefore, Equation 8 can be solved because the present and future values are known. The future value is known by using the present population and estimating the future population given the migration rate as it would be used in a standard cohort model. Alternatively, Equation 8 is the same as rewriting Equation 11 to solve for (r). Survival rates also underwent the same adjustments, identified in Equation 5, to eliminate compounding issues.

The process of adjusting for compounding requires some modifications when a migration rate is lower than -20 percent (e.g., -25 percent). A migration rate of -20 percent or greater will yield a future population of zero using a standard cohort methodology. When migration rates, obtained from the 2016 North Dakota Housing Needs Assessment, were lower than -20 percent they were adjusted so that future population would equal zero after five compounded periods. Survival rates less than 80 percent (alternatively, mortality is greater than 20 percent per year) also produce a future population of zero in a standard 5-year cohort computation. Those rates also were adjusted to produce the correct future population of zero after five compounded periods.

Workforce Supply and Demand

The supply of workforce for any single county can be estimated using the following empirical framework. Equation 1 defines the supply of workforce available in county (i) in year (t) as a function of population of ages 16 to 84+ (i,t), participation rate (i,t), and unemployment rate (i,t). Computationally, the analysis uses gender and age-cohorts for population and participation rate (see previous section on cohort modeling) even though those variables are delineated accordingly in the following equations.

1) $$SW_{it}^{i} = \left(WAPop_{it}^{i} * PR_{it}^{i}\right) - \left(\left(WAPop_{it}^{i} * PR_{it}^{i}\right) * UR_{it}^{i}\right) \equiv \left(WAPop_{it}^{i} * PR_{it}^{i}\right) * \left(1 - UR_{it}^{i}\right)$$

where:

i=study county, 1 to 19

t= year

SW_{it}^{i} is total workforce available (supply) in county (i) in year (t)

$WAPop_{it}^{i}$ is population of working age adults in county (i) in year (t)

PR_{it}^{i} is workforce participation rate by age cohorts in county (i) in year (t)

UR_{it}^{i} is unemployment rate in county (i) in year (t)

Rewriting Equation 1 as function of population of working age adults yields Equation 2.

2) $$WAPop_{it}^{i} = \frac{SW_{it}^{i}}{PR_{it}^{i} * \left(1 - UR_{it}^{i}\right)}$$

where:

$WAPop_{it}^{i}$ is population ages 16 through 84+ available (supplied) from county (i) in year (t)

The distribution of workers living in any single county is defined in Equation 3 as workers who live and work in the same county (i), workers who reside in county (i) but work in other study counties (j), and workers who reside in county (i) but work outside the study region (o).

3) $$SW_{it} = SE_{it}^{i} + SE_{it}^{j} + SE_{it}^{o}$$

where:

j= equals 19 – 1 counties for any given county (i)

SW_{it} is total supply of workforce for county (i) in year (t)

SE_{it}^{i} is the supply of workers who live and work in county (i) in year (t)

SE_{it}^{j} is the supply of workers who live in county (i) but work in counties (j) in year (t)

SE_{it}^{o} is the supply of workers who live in county (i) by work outside the study region in year (t)

Therefore, demand for employment in counties (j) will influence population in county (i) and is reflected as the supply of workers that live in county (i) but work in counties (j). This allows for each county's (i, j) population to be solved individually in year (t) as long as employment in all counties (i, j) and commuter factors (IOF matrix) are known for year (t).

Equations 3 through 6 define the workforce in county (i) supplied to county (i), supplied to study counties (j), and supplied elsewhere (o). As a point of clarification, wage and salary employment and farm and ranch proprietors (Appendix F) are used in Equation 4, whereas only wage and salary employment is used in Equation 5 since farmers and ranchers were assumed to live and work in the same county. Since employment in all locations outside of the study counties was not forecasted, the share of workforce from a study county that works outside of the study region could not be estimated using employment projections. Therefore, Equation 6 represents a ratio of total workforce to the percentage of workforce commuting outside of the study region. For example, a worker living in Ward County but working in Burleigh County.

4) $SE_{it}^{i} = f\left(E_{it}^{i} * IOF\ Matrix_{it}^{i}\right)$

5) $SE_{it}^{j} = f\left(E_{it}^{j} * IOF\ Matrix_{it}^{j}\right)$

6) $SE_{it}^{o} = f\left(W_{it}^{o} * IOF\ Matrix_{it}^{o}\right)$

where:

SE_{it}^{i}, SE_{it}^{j}, SE_{it}^{o} as defined in Equation 3

E_{it}^{i} is forecasted total employment in county (i) in year (t)

E_{it}^{j} is forecasted wage and salary employment in counties (j) in year (t)

W_{it}^{o} ratio of total workers living in county (i) in year (t) to number of workers working outside of study region but living in county (i)

$IOF\ Matrix$ are inflows and outflows of workers to and from various geographies

$IOF\ Matrix_{it}^{i}$ are coefficients to estimate workers who live and work in county (i) in year (t)

$IOF\ Matrix_{it}^{j}$ are coefficients to estimate workers who are living in county (i) but work in counties (j) in year (t)

$IOF\ Matrix_{it}^{o}$ are coefficients to estimate workers who are living in county (i) but work outside the study region in year (t)

The demand for workers for any single county can be estimated using the following empirical framework. Equation 7 defines demand for workers needed in county (i) as a function of workers who live and work in county (i), workers who reside in county (i) but are employed in counties (j), and workers who reside in county (i) but work outside the study region (e.g., elsewhere in ND, neighboring states, other U.S.).

7) $DW_{it} = f\left(DE_{it}^{i} + DE_{it}^{j} + DE_{it}^{o}\right)$

where:

DW_{it} is total demand for workforce in county (i) in year (t)

DE_{it}^{i} is demand for workers who live and work in county (i) in year (t)

DE_{it}^{j} is demand for workers who live in county (i) but work in counties (j) in year (t)

DE_{it}^{o} the demand for workers who live in county (i) by work outside the study region in year (t)

Equations 8 through 10 apply commuter data to the projections of employment to determine the demand for workforce.

8) $DE_{it}^{i} = f\left(E_{it}^{i} * IOF\ Matrix_{it}^{i}\right)$

9) $DE_{it}^{j} = f\left(E_{jt}^{j} * IOF\ Matrix_{it}^{j}\right)$

10) $DE_{it}^{o} = f\left(W_{it}^{o} * IOF\ Matrix_{it}^{o}\right)$

where: DE_{it}^{i}, DE_{it}^{j}, and DE_{it}^{o} as defined in Equation 7

E_{it}^{i} and E_{it}^{j}, as defined in Equations 4 and 5

W_{it}^{o} as defined in Equation 6

$IOF\ Matrix_{it}^{i}$, $IOF\ Matrix_{it}^{j}$, and $IOF\ Matrix_{it}^{o}$ as defined in Equations 4 through 6

The model solves for a supply of workforce in county (i) in year (t) that equals the demand for workforce in county (i) in year (t). Demand and supply are set to equilibrium in Equation 11. Substituting Equation 1 for SW_{it}^{i} allows the demand for workers to be expressed as a function of population.

11) $DW_{it}^{i} = SW_{it}^{i}$

12) $DW_{it}^{i} = \left(WAPop_{it}^{i} * PR_{it}^{i}\right) - \left(\left(WAPop_{it}^{i} * PR_{it}^{i}\right) * UR_{it}^{i}\right)$

Rewriting Equation 12 as function of population of working age adults yields Equation 13.

13) $WAPop_{it}^{i} = \dfrac{DD_{it}^{i}}{PR_{it}^{i} * \left(1 - UR_{it}^{i}\right)}$

where:

$WAPop_{it}^{i}$ is population ages 16 through 85+ available in county (i) in year (t) to meet demand for workforce in county (i) in year (t)

PR_{it}^{i} and UR_{it}^{i} as defined in Equation 1

Equation 14 combines all factors from Equations 1 through 10 indicating the population model is based on the demand for workers (employment=persons), supply of workers, workforce participation rates, unemployment rates, inflows/outflows of workers (commuting behavior of workforce), birth rates, survival rates, and migration rates.

14) $$WAPop_{it}^{i} = f\left(DW_{it}^{i}, SW_{it}^{i}, PR_{it}^{i}, UR_{it}^{i}, IOF\ Matrix_{it}^{i}, IOF\ Matrix_{it}^{j}, IOF\ Matrix_{it}^{o}, BR_{it}, SR_{it}, MR_{it}\right)$$

where:

$WAPop_{it}^{i}$ is population of working age adults in county (i) in year (t)

DW_{it}^{i} is total demand for workforce in county (i) in year (t)

SW_{it}^{i} is total workforce available (supply) in county (i) in year (t)

PR_{it}^{i} is workforce participation rate by gender and age cohorts in county (i) in year (t)

UR_{it}^{i} is unemployment rate in county (i) in year (t)

$IOF\ Matrix_{it}^{i}$, $IOF\ Matrix_{it}^{j}$, and $IOF\ Matrix_{it}^{o}$ factors for both outflows and inflows of workers to county (i) in year (t)

BR_{it} is birth rate in county (i), by female cohorts of child bearing age, in year (t)

SR_{it} is survival rate (mortality), by gender and age cohorts, in county (i) in year (t)

MR_{it} is net migration rate, by gender and age cohorts, in county (i) in year (t)

For any given year (t), the demand for workers can be expressed as a need for a sufficiently-sized population of working age adults to produce the necessary workforce, given that PR, UR, IOF, BR and SR are known (i.e., either baseline values or use of a predicted value – see Appendices C and D for forecasted values for PR and UR). The model treats PR, UR, IOF, BR and SR as exogenous variables and MR as an endogenous variable.

Initial baseline migration rates were obtained from the 2016 Statewide Housing Needs Assessment. Those migration rates represent both positive and negative net migration, which vary by age cohort and gender for each study county (see Appendix Tables B1 through B19). The model was programmed that all migration rates of working age adults are simultaneously adjusted by the same level of adjustment. For example, if the model estimates that migration rates need to change by +0.1 percent, then all migration rates of working age adults increase by 0.1 percent. The use of a consistent adjustment factor, and one that is not weighted by any additional inputs, prevents the model from raising population of only one gender or a single age cohort while not adjusting other migration rates. For example, if the working age population in County A needs to grow by 1,000 people to meet the labor requirements in the following year, the model cannot achieve that 1,000 person increase by only adjusting migration rates for males aged 31 to 35. As found in Appendix Tables B1 through B19, baseline net migration rates are negative for some age-gender cohorts in some counties. The adjustment factor lessens the size of the negative rates, thereby acting to reduce the number of out migrants from that age cohort even though net migration rates may remain negative. The reduction of out migrants is another means by which population in a county can increase the number of working age adults.

In a more complex empirical methodology, changes in participation rate and unemployment rate should be allowed to change with accompanying changes in migration rate, and with potentially changing factors for inflow/outflow of workers. In reality, an increased need for workforce may be small enough that employment growth is filled with existing workers (i.e., in situations when participation rates are not near

peak capacity and little unemployment exists), and migration rates do not require adjustment. These conceptual issues are discussed on pages 15 and 16; however, modeling those exogenous factors as endogenous variables, in a simultaneous capacity, was beyond the scope of this assessment.

An additional factor in the empirical model was the assumption that projected employment represents filled jobs (i.e., jobs with workers), and does not include periods when employment was available (job offerings) but those jobs remained unfilled. Accounting for a portion of unfilled employment would improve the empirical model.

Despite the use of several assumptions to alleviate modeling hurdles, this empirical framework lays the foundation for an expanded analysis that includes additional endogenous factors. Further refinements in the existing variables would include the distribution of workforce, by gender and age, by economic sector. In this study, the population model treats a job equally (or has the same effect on age/gender population) whether the job is in retail sales or oil field drilling. In reality, the vast majority of jobs in oil field drilling are likely to be filled by males of an age that are younger than the average worker. Some of this effect, however, is mitigated by using workforce participation rates based on gender and age cohorts from recent years and the use of commuter in-flows which likely act to reduce the effects of that assumption on population projections. Also, part of the question of how many female workers versus male workers are needed to fill overall workforce demand is handled by using recent participation rates, but as employment within the region shifts among economic sectors over time, gender and age composition may be different from current conditions and long-term commuter patterns also could be different from current conditions.

For any given year (t), the model solves for a sufficient population of working age adults to produce local workforce requirements given exogenous values for participation rate and unemployment rate. Another component of population is ages 0 to 15. However, ages 0 to 15 are not considered part of the workforce and migration rates for those ages are not part of the equilibrium adjustments performed for the working age cohorts. The migration rates derived in the 2016 North Dakota Statewide Housing Needs Assessment are used for ages 0 to 15 in the model.

The number of births is a function of birth rates and population of childbearing females. Workforce requirements include adjustments in migration rate of working age adults, which includes females of childbearing age. Therefore, in an environment where employment, workforce, and population grow, the "number" of births can increase even though birth "rates" (i.e, births per unit of population) do not change.

Appendix B

Default Migration Rates

Appendix Table B1. Default Migration Rates, by Gender, by 5-yr Age Cohort, Adams County, North Dakota, 2016 to 2040

Cohort	Female				Male			
	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.078961	0.078961	0.078961	0.078961	-0.052668	-0.052668	-0.052668	-0.052668
5 to 9	0.033908	0.033908	0.033908	0.033908	0.036364	0.036364	0.036364	0.036364
10 to 14	-0.001063	-0.001063	-0.001063	-0.001063	0.063997	0.063997	0.063997	0.063997
15 to 19	-0.091093	-0.091093	-0.091093	-0.091093	-0.058431	-0.058431	-0.058431	-0.058431
20 to 24	-0.047896	-0.047896	-0.047896	-0.047896	0.023482	0.023482	0.023482	0.023482
25 to 29	0.051191	0.051191	0.051191	0.051191	0.132232	0.132232	0.132232	0.132232
30 to 34	0.065700	0.065700	0.065700	0.065700	0.076625	0.076625	0.076625	0.076625
35 to 39	0.039244	0.039244	0.039244	0.039244	-0.018632	-0.018632	-0.018632	-0.018632
40 to 44	0.046296	0.046296	0.046296	0.046296	-0.013148	-0.013148	-0.013148	-0.013148
45 to 49	-0.000795	-0.000795	-0.000795	-0.000795	0.006173	0.006173	0.006173	0.006173
50 to 54	0.024741	0.024741	0.024741	0.024741	0.015920	0.015920	0.015920	0.015920
55 to 59	-0.008773	-0.008773	-0.008773	-0.008773	-0.004815	-0.004815	-0.004815	-0.004815
60 to 64	-0.017629	-0.017629	-0.017629	-0.017629	0.018285	0.018285	0.018285	0.018285
65 to 69	-0.049014	-0.049014	-0.049014	-0.049014	-0.043233	-0.043233	-0.043233	-0.043233
70 to 74	-0.032295	-0.032295	-0.032295	-0.032295	-0.003848	-0.003848	-0.003848	-0.003848
75 to 79	0.025180	0.025180	0.025180	0.025180	0.015319	0.015319	0.015319	0.015319
80 to 84	0.094982	0.094982	0.094982	0.094982	-0.024989	-0.024989	-0.024989	-0.024989
84 plus	0.011166	0.011166	0.011166	0.011166	0.138670	0.138670	0.138670	0.138670

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.

Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B2. Default Migration Rates, by Gender, by 5-yr Age Cohort, Billings County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.054257	-0.014044	-0.014044	-0.014044	0.020717	-0.010533	-0.010533	-0.010533
5 to 9	0.095720	0.052884	0.052884	0.052884	0.023781	0.016395	0.016395	0.016395
10 to 14	0.011397	-0.008593	-0.008593	-0.008593	-0.029046	-0.028982	-0.028982	-0.028982
15 to 19	-0.075938	-0.089431	-0.089431	-0.089431	-0.046840	-0.068108	-0.068108	-0.068108
20 to 24	-0.014282	-0.077766	-0.077766	-0.077766	-0.047309	-0.115069	-0.115069	-0.115069
25 to 29	0.058235	0.030214	0.030214	0.030214	0.055914	0.045433	0.045433	0.045433
30 to 34	0.090579	0.059888	0.059888	0.059888	0.041057	0.031672	0.031672	0.031672
35 to 39	0.044077	0.025918	0.025918	0.025918	0.022840	0.004997	0.004997	0.004997
40 to 44	-0.026314	-0.010881	-0.010881	-0.010881	0.006446	0.019215	0.019215	0.019215
45 to 49	-0.009365	-0.009255	-0.009255	-0.009255	0.001641	0.001981	0.001981	0.001981
50 to 54	0.000585	-0.004666	-0.004666	-0.004666	0.000797	-0.004583	-0.004583	-0.004583
55 to 59	0.007033	-0.006534	-0.006534	-0.006534	0.007065	0.000422	0.000422	0.000422
60 to 64	-0.038004	-0.036655	-0.036655	-0.036655	-0.019415	-0.032309	-0.032309	-0.032309
65 to 69	-0.018062	-0.070047	-0.070047	-0.070047	-0.042101	-0.073065	-0.073065	-0.073065
70 to 74	0.005904	-0.011576	-0.011576	-0.011576	-0.009694	-0.025264	-0.025264	-0.025264
75 to 79	-0.006647	0.020642	0.020642	0.020642	-0.055432	-0.037206	-0.037206	-0.037206
80 to 84	-0.164235	-0.226138	-0.226138	-0.226138	0.011475	0.000675	0.000675	0.000675
84 plus	-0.044840	0.226243	0.226243	0.226243	-0.190398	-0.156510	-0.156510	-0.156510

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.

Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B3. Default Migration Rates, by Gender, by 5-yr Age Cohort, Bottineau County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.042710	0.046476	0.046476	0.046476	0.081634	0.067426	0.067426	0.067426
5 to 9	0.035142	0.027227	0.027227	0.027227	0.059804	0.029693	0.029693	0.029693
10 to 14	0.042344	0.026759	0.026759	0.026759	0.018028	0.009890	0.009890	0.009890
15 to 19	0.014725	0.031946	0.031946	0.031946	0.108711	0.104163	0.104163	0.104163
20 to 24	-0.062031	-0.096287	-0.096287	-0.096287	-0.163372	-0.173258	-0.173258	-0.173258
25 to 29	0.081849	0.086682	0.086682	0.086682	0.066888	0.125738	0.125738	0.125738
30 to 34	0.054631	0.031177	0.031177	0.031177	0.064889	0.037939	0.037939	0.037939
35 to 39	0.024170	0.007404	0.007404	0.007404	-0.000250	0.004479	0.004479	0.004479
40 to 44	0.002591	0.029774	0.029774	0.029774	0.004347	0.008742	0.008742	0.008742
45 to 49	0.002743	-0.006839	-0.006839	-0.006839	-0.001532	-0.004332	-0.004332	-0.004332
50 to 54	-0.000592	0.005832	0.005832	0.005832	0.001270	0.005516	0.005516	0.005516
55 to 59	-0.023006	-0.008010	-0.008010	-0.008010	-0.020183	-0.008454	-0.008454	-0.008454
60 to 64	0.003865	0.015598	0.015598	0.015598	0.009544	0.003583	0.003583	0.003583
65 to 69	-0.018814	0.005454	0.005454	0.005454	-0.004430	-0.000965	-0.000965	-0.000965
70 to 74	-0.012067	0.008888	0.008888	0.008888	0.000787	0.025252	0.025252	0.025252
75 to 79	-0.031320	-0.068582	-0.068582	-0.068582	-0.063116	-0.051754	-0.051754	-0.051754
80 to 84	0.039503	0.109619	0.109619	0.109619	-0.031506	-0.005424	-0.005424	-0.005424
84 plus	-0.093247	-0.052050	-0.052050	-0.052050	-0.020890	-0.045662	-0.045662	-0.045662

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B4. Default Migration Rates, by Gender, by 5-yr Age Cohort, Bowman County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.062059	0.020290	0.020290	0.020290	-0.025305	-0.043269	-0.043269	-0.043269
5 to 9	0.058190	0.048445	0.048445	0.048445	0.021165	0.028912	0.028912	0.028912
10 to 14	0.047317	0.011232	0.011232	0.011232	0.056337	0.011217	0.011217	0.011217
15 to 19	-0.006305	-0.027605	-0.027605	-0.027605	-0.053875	-0.071874	-0.071874	-0.071874
20 to 24	0.069147	-0.006980	-0.006980	-0.006980	0.076025	-0.037388	-0.037388	-0.037388
25 to 29	0.010320	-0.055744	-0.055744	-0.055744	0.053274	-0.020937	-0.020937	-0.020937
30 to 34	0.014210	0.004179	0.004179	0.004179	0.034036	0.021928	0.021928	0.021928
35 to 39	0.045628	0.028943	0.028943	0.028943	0.017579	0.028693	0.028693	0.028693
40 to 44	0.050979	0.018218	0.018218	0.018218	0.025788	0.015561	0.015561	0.015561
45 to 49	-0.009560	0.011580	0.011580	0.011580	-0.056083	-0.023091	-0.023091	-0.023091
50 to 54	-0.015924	-0.019687	-0.019687	-0.019687	-0.009126	-0.009086	-0.009086	-0.009086
55 to 59	-0.001850	0.008579	0.008579	0.008579	0.007693	0.033541	0.033541	0.033541
60 to 64	0.000442	0.041681	0.041681	0.041681	-0.026062	0.000400	0.000400	0.000400
65 to 69	-0.011565	-0.037873	-0.037873	-0.037873	-0.011554	-0.012376	-0.012376	-0.012376
70 to 74	0.035423	0.048433	0.048433	0.048433	0.004340	0.010673	0.010673	0.010673
75 to 79	-0.067069	-0.069254	-0.069254	-0.069254	-0.034507	-0.009935	-0.009935	-0.009935
80 to 84	0.021673	0.024272	0.024272	0.024272	0.020091	0.092429	0.092429	0.092429
84 plus	-0.049119	0.036495	0.036495	0.036495	-0.137209	-0.060354	-0.060354	-0.060354

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B5. Default Migration Rates, by Gender, by 5-yr Age Cohort, Burke County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.056747	0.056747	0.056747	0.056747	0.029392	0.029392	0.029392	0.029392
5 to 9	0.026528	0.026528	0.026528	0.026528	0.008101	0.008101	0.008101	0.008101
10 to 14	0.004963	0.004963	0.004963	0.004963	0.001875	0.001875	0.001875	0.001875
15 to 19	-0.057413	-0.057413	-0.057413	-0.057413	-0.088095	-0.088095	-0.088095	-0.088095
20 to 24	-0.065127	-0.065127	-0.065127	-0.065127	-0.089301	-0.089301	-0.089301	-0.089301
25 to 29	0.078790	0.078790	0.078790	0.078790	0.095639	0.095639	0.095639	0.095639
30 to 34	0.042960	0.042960	0.042960	0.042960	0.036782	0.036782	0.036782	0.036782
35 to 39	-0.006895	-0.006895	-0.006895	-0.006895	0.004188	0.004188	0.004188	0.004188
40 to 44	-0.000283	-0.000283	-0.000283	-0.000283	0.014743	0.014743	0.014743	0.014743
45 to 49	0.018132	0.018132	0.018132	0.018132	-0.002255	-0.002255	-0.002255	-0.002255
50 to 54	0.006321	0.006321	0.006321	0.006321	0.007673	0.007673	0.007673	0.007673
55 to 59	-0.001441	-0.001441	-0.001441	-0.001441	-0.001324	-0.001324	-0.001324	-0.001324
60 to 64	-0.025245	-0.025245	-0.025245	-0.025245	-0.025134	-0.025134	-0.025134	-0.025134
65 to 69	-0.034518	-0.034518	-0.034518	-0.034518	-0.037898	-0.037898	-0.037898	-0.037898
70 to 74	-0.033962	-0.033962	-0.033962	-0.033962	-0.060918	-0.060918	-0.060918	-0.060918
75 to 79	-0.056100	-0.056100	-0.056100	-0.056100	-0.044435	-0.044435	-0.044435	-0.044435
80 to 84	-0.080443	-0.080443	-0.080443	-0.080443	-0.039925	-0.039925	-0.039925	-0.039925
84 plus	-0.056273	-0.056273	-0.056273	-0.056273	-0.036443	-0.036443	-0.036443	-0.036443

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B6. Default Migration Rates, by Gender, by 5-yr Age Cohort, Divide County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.085381	0.072913	0.072913	0.072913	0.057018	0.037393	0.037393	0.037393
5 to 9	0.038623	-0.006770	-0.006770	-0.006770	0.085555	-0.001402	-0.001402	-0.001402
10 to 14	0.021811	-0.000679	-0.000679	-0.000679	0.046734	0.004524	0.004524	0.004524
15 to 19	-0.021426	-0.086085	-0.086085	-0.086085	-0.092253	-0.093599	-0.093599	-0.093599
20 to 24	0.051126	-0.016786	-0.016786	-0.016786	0.078628	-0.049260	-0.049260	-0.049260
25 to 29	0.040936	0.079936	0.079936	0.079936	0.156645	0.137529	0.137529	0.137529
30 to 34	0.152913	0.075800	0.075800	0.075800	0.158612	0.078422	0.078422	0.078422
35 to 39	0.012180	-0.008936	-0.008936	-0.008936	0.041597	0.022954	0.022954	0.022954
40 to 44	0.033987	0.002080	0.002080	0.002080	0.011376	0.003772	0.003772	0.003772
45 to 49	0.019242	0.018018	0.018018	0.018018	0.045386	0.019519	0.019519	0.019519
50 to 54	0.015657	0.004857	0.004857	0.004857	0.002073	0.001650	0.001650	0.001650
55 to 59	0.029121	0.003030	0.003030	0.003030	0.037759	-0.003048	-0.003048	-0.003048
60 to 64	0.018278	-0.001677	-0.001677	-0.001677	-0.015750	-0.009303	-0.009303	-0.009303
65 to 69	-0.027295	-0.023418	-0.023418	-0.023418	-0.037076	-0.023324	-0.023324	-0.023324
70 to 74	-0.036403	-0.036147	-0.036147	-0.036147	-0.064807	-0.083952	-0.083952	-0.083952
75 to 79	-0.019729	-0.030348	-0.030348	-0.030348	-0.086290	-0.057367	-0.057367	-0.057367
80 to 84	-0.020081	-0.080524	-0.080524	-0.080524	0.050847	0.080269	0.080269	0.080269
84 plus	-0.169535	-0.100439	-0.100439	-0.100439	-0.201758	-0.172556	-0.172556	-0.172556

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B7. Default Migration Rates, by Gender, by 5-yr Age Cohort, Dunn County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.055760	0.030600	0.030600	0.030600	0.106200	0.026880	0.026880	0.026880
5 to 9	0.045300	0.023100	0.023100	0.023100	0.131870	0.022720	0.022720	0.022720
10 to 14	0.026700	0.013300	0.013300	0.013300	0.071620	0.020190	0.020190	0.020190
15 to 19	-0.055960	-0.066000	-0.066000	-0.066000	-0.094810	-0.084700	-0.084700	-0.084700
20 to 24	0.018330	-0.047400	-0.047400	-0.047400	0.173640	-0.047220	-0.047220	-0.047220
25 to 29	0.082620	0.037400	0.037400	0.037400	0.114000	0.049640	0.049640	0.049640
30 to 34	0.062620	0.037000	0.037000	0.037000	0.016950	0.047070	0.047070	0.047070
35 to 39	0.013540	0.024500	0.024500	0.024500	0.008120	0.021590	0.021590	0.021590
40 to 44	0.023860	0.012800	0.012800	0.012800	0.075200	0.013310	0.013310	0.013310
45 to 49	-0.000600	0.007200	0.007200	0.007200	0.022220	0.003150	0.003150	0.003150
50 to 54	-0.008260	0.007500	0.007500	0.007500	0.019630	0.001770	0.001770	0.001770
55 to 59	0.013240	0.002500	0.002500	0.002500	-0.006710	0.008590	0.008590	0.008590
60 to 64	0.007280	0.000700	0.000700	0.000700	-0.009080	0.008080	0.008080	0.008080
65 to 69	-0.009820	-0.034200	-0.034200	-0.034200	-0.079100	-0.010400	-0.010400	-0.010400
70 to 74	0.028550	-0.047600	-0.047600	-0.047600	-0.073530	0.003380	0.003380	0.003380
75 to 79	-0.016370	0.002700	0.002700	0.002700	0.006440	-0.037360	-0.037360	-0.037360
80 to 84	0.064760	0.015300	0.015300	0.015300	-0.059030	0.025910	0.025910	0.025910
84 plus	-0.055080	-0.083500	-0.083500	-0.083500	-0.087040	-0.045920	-0.045920	-0.045920

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.

Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B8. Default Migration Rates, by Gender, by 5-yr Age Cohort, Golden Valley County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.077586	0.077586	0.077586	0.077586	0.028846	0.028846	0.028846	0.028846
5 to 9	0.000000	0.000000	0.000000	0.000000	-0.054278	-0.054278	-0.054278	-0.054278
10 to 14	0.039683	0.039683	0.039683	0.039683	0.140423	0.140423	0.140423	0.140423
15 to 19	-0.123923	-0.123923	-0.123923	-0.123923	-0.154018	-0.154018	-0.154018	-0.154018
20 to 24	0.073307	0.073307	0.073307	0.073307	0.129478	0.129478	0.129478	0.129478
25 to 29	0.110587	0.110587	0.110587	0.110587	-0.012500	-0.012500	-0.012500	-0.012500
30 to 34	-0.030612	-0.030612	-0.030612	-0.030612	0.131818	0.131818	0.131818	0.131818
35 to 39	0.076082	0.076082	0.076082	0.076082	0.019231	0.019231	0.019231	0.019231
40 to 44	-0.007275	-0.007275	-0.007275	-0.007275	0.079167	0.079167	0.079167	0.079167
45 to 49	0.044278	0.044278	0.044278	0.044278	0.039616	0.039616	0.039616	0.039616
50 to 54	0.021463	0.021463	0.021463	0.021463	-0.004164	-0.004164	-0.004164	-0.004164
55 to 59	0.055405	0.055405	0.055405	0.055405	-0.061560	-0.061560	-0.061560	-0.061560
60 to 64	0.004795	0.004795	0.004795	0.004795	0.038601	0.038601	0.038601	0.038601
65 to 69	-0.063012	-0.063012	-0.063012	-0.063012	-0.088178	-0.088178	-0.088178	-0.088178
70 to 74	-0.046104	-0.046104	-0.046104	-0.046104	-0.045674	-0.045674	-0.045674	-0.045674
75 to 79	-0.174722	-0.174722	-0.174722	-0.174722	-0.107143	-0.107143	-0.107143	-0.107143
80 to 84	0.165197	0.165197	0.165197	0.165197	0.084284	0.084284	0.084284	0.084284
84 plus	-0.189595	-0.189595	-0.189595	-0.189595	-0.300868	-0.300868	-0.300868	-0.300868

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B9. Default Migration Rates, by Gender, by 5-yr Age Cohort, Hettinger County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.108500	0.056600	0.056600	0.056600	0.062550	0.033260	0.033260	0.033260
5 to 9	0.076600	0.027100	0.027100	0.027100	0.086850	0.027750	0.027750	0.027750
10 to 14	0.055800	0.011600	0.011600	0.011600	0.030220	0.005260	0.005260	0.005260
15 to 19	-0.057400	-0.047700	-0.047700	-0.047700	0.020430	-0.075210	-0.075210	-0.075210
20 to 24	0.117400	-0.045500	-0.045500	-0.045500	0.095900	-0.027260	-0.027260	-0.027260
25 to 29	0.099900	0.074400	0.074400	0.074400	0.054950	0.031090	0.031090	0.031090
30 to 34	0.110600	0.051400	0.051400	0.051400	0.012200	0.013950	0.013950	0.013950
35 to 39	-0.008000	0.009600	0.009600	0.009600	0.049760	0.006680	0.006680	0.006680
40 to 44	0.049800	0.010000	0.010000	0.010000	0.002860	-0.000150	-0.000150	-0.000150
45 to 49	0.040200	0.012300	0.012300	0.012300	-0.028220	-0.008220	-0.008220	-0.008220
50 to 54	-0.015800	-0.011400	-0.011400	-0.011400	-0.000060	-0.009040	-0.009040	-0.009040
55 to 59	-0.019800	-0.007300	-0.007300	-0.007300	-0.007910	-0.005260	-0.005260	-0.005260
60 to 64	-0.030900	-0.005000	-0.005000	-0.005000	-0.044780	-0.021430	-0.021430	-0.021430
65 to 69	-0.049600	-0.028600	-0.028600	-0.028600	-0.017540	-0.012010	-0.012010	-0.012010
70 to 74	0.003000	-0.005100	-0.005100	-0.005100	-0.023020	-0.007120	-0.007120	-0.007120
75 to 79	0.008100	-0.026900	-0.026900	-0.026900	-0.007020	-0.014490	-0.014490	-0.014490
80 to 84	0.058000	0.051400	0.051400	0.051400	0.001150	0.003170	0.003170	0.003170
84 plus	-0.024300	-0.030700	-0.030700	-0.030700	-0.029750	-0.024580	-0.024580	-0.024580

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B10. Default Migration Rates, by Gender, by 5-yr Age Cohort, McHenry County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.041866	0.041866	0.041866	0.041866	0.030169	0.030169	0.030169	0.030169
5 to 9	0.022143	0.022143	0.022143	0.022143	0.028641	0.028641	0.028641	0.028641
10 to 14	0.017449	0.017449	0.017449	0.017449	0.008149	0.008149	0.008149	0.008149
15 to 19	-0.073568	-0.073568	-0.073568	-0.073568	-0.098055	-0.098055	-0.098055	-0.098055
20 to 24	-0.004712	-0.004712	-0.004712	-0.004712	-0.056279	-0.056279	-0.056279	-0.056279
25 to 29	0.026595	0.026595	0.026595	0.026595	0.034158	0.034158	0.034158	0.034158
30 to 34	0.026567	0.026567	0.026567	0.026567	0.028354	0.028354	0.028354	0.028354
35 to 39	0.023323	0.023323	0.023323	0.023323	0.017686	0.017686	0.017686	0.017686
40 to 44	0.010767	0.010767	0.010767	0.010767	0.009902	0.009902	0.009902	0.009902
45 to 49	0.000741	0.000741	0.000741	0.000741	0.000475	0.000475	0.000475	0.000475
50 to 54	-0.002677	-0.002677	-0.002677	-0.002677	-0.006471	-0.006471	-0.006471	-0.006471
55 to 59	-0.002581	-0.002581	-0.002581	-0.002581	-0.010518	-0.010518	-0.010518	-0.010518
60 to 64	0.003060	0.003060	0.003060	0.003060	0.002783	0.002783	0.002783	0.002783
65 to 69	-0.027925	-0.027925	-0.027925	-0.027925	-0.020475	-0.020475	-0.020475	-0.020475
70 to 74	-0.031698	-0.031698	-0.031698	-0.031698	-0.017032	-0.017032	-0.017032	-0.017032
75 to 79	-0.026173	-0.026173	-0.026173	-0.026173	-0.033649	-0.033649	-0.033649	-0.033649
80 to 84	-0.029713	-0.029713	-0.029713	-0.029713	0.050140	0.050140	0.050140	0.050140
84 plus	-0.049559	-0.049559	-0.049559	-0.049559	-0.069239	-0.069239	-0.069239	-0.069239

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B11. Default Migration Rates, by Gender, by 5-yr Age Cohort, McKenzie County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.112088	0.045086	0.032797	0.032797	0.116899	0.055961	0.040401	0.040401
5 to 9	0.104870	0.021947	0.027101	0.027101	0.094366	0.019995	0.026481	0.026481
10 to 14	0.087414	0.003287	0.004023	0.004023	0.116951	0.004384	0.009694	0.009694
15 to 19	0.066742	-0.047531	-0.070301	-0.070301	0.024092	-0.065504	-0.088913	-0.088913
20 to 24	0.164898	0.006942	-0.027317	-0.027317	0.149290	-0.001424	-0.044889	-0.044889
25 to 29	0.119554	0.059816	0.058946	0.058946	0.137689	0.050574	0.043663	0.043663
30 to 34	0.150838	0.049658	0.047432	0.047432	0.103425	0.048917	0.045854	0.045854
35 to 39	0.085221	0.038246	0.031278	0.031278	0.103072	0.037929	0.023261	0.023261
40 to 44	0.093754	0.032232	0.023193	0.023193	0.077942	0.026209	0.019877	0.019877
45 to 49	0.076369	0.035447	0.028046	0.028046	0.089055	0.018732	0.009554	0.009554
50 to 54	0.071509	0.026817	0.011756	0.011756	0.062316	0.022545	0.006640	0.006640
55 to 59	0.071692	0.014106	0.009214	0.009214	0.044530	0.010604	0.003051	0.003051
60 to 64	0.025732	-0.010250	0.000034	0.000034	0.046884	-0.003319	0.001565	0.001565
65 to 69	0.001567	-0.048531	-0.031776	-0.031776	-0.039439	-0.034509	-0.021379	-0.021379
70 to 74	-0.021978	-0.020021	-0.012406	-0.012406	-0.020176	-0.011005	-0.006734	-0.006734
75 to 79	-0.069594	-0.054292	-0.037691	-0.037691	-0.035450	-0.041461	-0.035685	-0.035685
80 to 84	0.025709	0.026870	0.043413	0.043413	-0.005059	0.054299	0.061777	0.061777
84 plus	-0.072832	-0.138987	-0.113408	-0.113408	-0.061602	-0.100440	-0.056506	-0.056506

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B12. Default Migration Rates, by Gender, by 5-yr Age Cohort, McLean County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.024812	0.019624	0.019624	0.019624	0.066274	0.030313	0.030313	0.030313
5 to 9	0.050471	0.021815	0.021815	0.021815	0.062004	0.025769	0.025769	0.025769
10 to 14	0.039159	0.018413	0.018413	0.018413	0.054282	0.018386	0.018386	0.018386
15 to 19	-0.041495	-0.070272	-0.070272	-0.070272	-0.056353	-0.086749	-0.086749	-0.086749
20 to 24	0.077456	-0.060470	-0.060470	-0.060470	0.106082	-0.052024	-0.052024	-0.052024
25 to 29	0.062381	0.035081	0.035081	0.035081	0.077558	0.040311	0.040311	0.040311
30 to 34	0.065105	0.036126	0.036126	0.036126	0.058452	0.032441	0.032441	0.032441
35 to 39	0.039450	0.015786	0.015786	0.015786	0.040103	0.015743	0.015743	0.015743
40 to 44	0.009243	0.007298	0.007298	0.007298	0.015979	0.007045	0.007045	0.007045
45 to 49	0.024386	0.005462	0.005462	0.005462	-0.019444	-0.007780	-0.007780	-0.007780
50 to 54	0.005847	0.001414	0.001414	0.001414	0.019809	0.008950	0.008950	0.008950
55 to 59	-0.001677	0.005120	0.005120	0.005120	-0.000194	0.009448	0.009448	0.009448
60 to 64	-0.004511	0.002998	0.002998	0.002998	-0.020301	0.001072	0.001072	0.001072
65 to 69	0.011630	-0.001127	-0.001127	-0.001127	-0.012189	-0.002713	-0.002713	-0.002713
70 to 74	-0.011512	-0.002840	-0.002840	-0.002840	-0.023223	-0.014342	-0.014342	-0.014342
75 to 79	0.004589	-0.019566	-0.019566	-0.019566	-0.036354	-0.024013	-0.024013	-0.024013
80 to 84	-0.002821	-0.000334	-0.000334	-0.000334	0.064000	0.035481	0.035481	0.035481
84 plus	-0.048936	-0.028575	-0.028575	-0.028575	-0.116597	-0.055215	-0.055215	-0.055215

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B13. Default Migration Rates, by Gender, by 5-yr Age Cohort, Mercer County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.054885	0.079181	0.079181	0.079181	0.045065	0.064206	0.064206	0.064206
5 to 9	0.030470	0.012277	0.012277	0.012277	0.049868	0.024025	0.024025	0.024025
10 to 14	0.025198	-0.011068	-0.011068	-0.011068	-0.002050	-0.002957	-0.002957	-0.002957
15 to 19	-0.040317	-0.053252	-0.053252	-0.053252	-0.071642	-0.075456	-0.075456	-0.075456
20 to 24	0.066154	-0.023468	-0.023468	-0.023468	0.045944	-0.023336	-0.023336	-0.023336
25 to 29	0.056628	0.126597	0.126597	0.126597	0.028383	0.080582	0.080582	0.080582
30 to 34	0.050883	0.039065	0.039065	0.039065	0.058509	0.039173	0.039173	0.039173
35 to 39	0.037737	0.023411	0.023411	0.023411	0.022445	0.013579	0.013579	0.013579
40 to 44	-0.009521	-0.004864	-0.004864	-0.004864	0.015340	-0.008179	-0.008179	-0.008179
45 to 49	-0.016112	-0.017425	-0.017425	-0.017425	-0.019775	-0.012592	-0.012592	-0.012592
50 to 54	-0.013311	-0.009629	-0.009629	-0.009629	-0.023254	-0.016243	-0.016243	-0.016243
55 to 59	-0.007091	-0.014305	-0.014305	-0.014305	-0.020339	-0.011725	-0.011725	-0.011725
60 to 64	-0.030805	-0.019662	-0.019662	-0.019662	-0.024897	-0.012135	-0.012135	-0.012135
65 to 69	-0.002657	-0.031660	-0.031660	-0.031660	0.009061	0.016061	0.016061	0.016061
70 to 74	-0.019830	0.044658	0.044658	0.044658	-0.004922	-0.013195	-0.013195	-0.013195
75 to 79	0.017631	-0.008182	-0.008182	-0.008182	0.022221	0.005073	0.005073	0.005073
80 to 84	0.043114	0.125835	0.125835	0.125835	0.025790	-0.027684	-0.027684	-0.027684
84 plus	0.011651	-0.036050	-0.036050	-0.036050	-0.001365	-0.044841	-0.044841	-0.044841

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B14. Default Migration Rates, by Gender, by 5-yr Age Cohort, Mountrail County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.023770	0.010800	0.010800	0.010800	0.046680	0.011870	0.011870	0.011870
5 to 9	0.022370	0.013500	0.013500	0.013500	0.025520	0.016790	0.016790	0.016790
10 to 14	0.015850	0.018200	0.018200	0.018200	0.084300	0.015490	0.015490	0.015490
15 to 19	-0.019880	-0.030200	-0.030200	-0.030200	0.002080	-0.040090	-0.040090	-0.040090
20 to 24	-0.014900	-0.029500	-0.029500	-0.029500	0.110740	-0.037670	-0.037670	-0.037670
25 to 29	0.082250	0.051700	0.051700	0.051700	0.072990	0.065020	0.065020	0.065020
30 to 34	0.016710	0.026800	0.026800	0.026800	0.078680	0.017690	0.017690	0.017690
35 to 39	0.020580	0.010500	0.010500	0.010500	0.052840	0.012230	0.012230	0.012230
40 to 44	0.039460	0.024200	0.024200	0.024200	0.082070	0.016080	0.016080	0.016080
45 to 49	0.016400	-0.006000	-0.006000	-0.006000	0.062580	0.000540	0.000540	0.000540
50 to 54	0.017660	0.003000	0.003000	0.003000	0.058340	0.013890	0.013890	0.013890
55 to 59	0.005720	0.010900	0.010900	0.010900	0.017620	0.000450	0.000450	0.000450
60 to 64	-0.001610	-0.005300	-0.005300	-0.005300	-0.003210	-0.006190	-0.006190	-0.006190
65 to 69	0.003800	-0.023900	-0.023900	-0.023900	-0.034140	-0.011660	-0.011660	-0.011660
70 to 74	-0.018280	0.013200	0.013200	0.013200	-0.062370	-0.022850	-0.022850	-0.022850
75 to 79	0.000940	0.011600	0.011600	0.011600	-0.011990	0.030820	0.030820	0.030820
80 to 84	0.057250	-0.035600	-0.035600	-0.035600	0.017250	0.021150	0.021150	0.021150
84 plus	-0.046150	0.017200	0.017200	0.017200	-0.122450	-0.037600	-0.037600	-0.037600

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B15. Default Migration Rates, by Gender, by 5-yr Age Cohort, Renville County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.037974	0.037974	0.037974	0.037974	0.033241	0.033241	0.033241	0.033241
5 to 9	0.003508	0.003508	0.003508	0.003508	0.026981	0.026981	0.026981	0.026981
10 to 14	0.010657	0.010657	0.010657	0.010657	0.012834	0.012834	0.012834	0.012834
15 to 19	-0.061982	-0.061982	-0.061982	-0.061982	-0.080384	-0.080384	-0.080384	-0.080384
20 to 24	-0.009084	-0.009084	-0.009084	-0.009084	-0.062450	-0.062450	-0.062450	-0.062450
25 to 29	-0.000512	-0.000512	-0.000512	-0.000512	0.056660	0.056660	0.056660	0.056660
30 to 34	0.021087	0.021087	0.021087	0.021087	-0.000073	-0.000073	-0.000073	-0.000073
35 to 39	0.018018	0.018018	0.018018	0.018018	0.003824	0.003824	0.003824	0.003824
40 to 44	0.001100	0.001100	0.001100	0.001100	0.001451	0.001451	0.001451	0.001451
45 to 49	-0.002551	-0.002551	-0.002551	-0.002551	-0.018707	-0.018707	-0.018707	-0.018707
50 to 54	-0.005035	-0.005035	-0.005035	-0.005035	-0.000274	-0.000274	-0.000274	-0.000274
55 to 59	-0.012900	-0.012900	-0.012900	-0.012900	-0.008649	-0.008649	-0.008649	-0.008649
60 to 64	0.006098	0.006098	0.006098	0.006098	-0.001218	-0.001218	-0.001218	-0.001218
65 to 69	-0.041279	-0.041279	-0.041279	-0.041279	-0.034487	-0.034487	-0.034487	-0.034487
70 to 74	-0.018178	-0.018178	-0.018178	-0.018178	-0.025637	-0.025637	-0.025637	-0.025637
75 to 79	0.011329	0.011329	0.011329	0.011329	-0.022067	-0.022067	-0.022067	-0.022067
80 to 84	0.008286	0.008286	0.008286	0.008286	0.022535	0.022535	0.022535	0.022535
84 plus	-0.067541	-0.067541	-0.067541	-0.067541	-0.095385	-0.095385	-0.095385	-0.095385

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B16. Default Migration Rates, by Gender, by 5-yr Age Cohort, Slope County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.049517	-0.003526	-0.003526	-0.003526	0.111026	0.016056	0.016056	0.016056
5 to 9	0.052718	0.013022	0.013022	0.013022	-0.013095	-0.036831	-0.036831	-0.036831
10 to 14	0.013056	-0.013147	-0.013147	-0.013147	-0.004984	-0.011956	-0.011956	-0.011956
15 to 19	-0.050870	-0.060018	-0.060018	-0.060018	-0.132914	-0.104345	-0.104345	-0.104345
20 to 24	0.106061	0.028984	0.028984	0.028984	0.102778	0.013759	0.013759	0.013759
25 to 29	0.025658	0.010628	0.010628	0.010628	0.037500	0.013822	0.013822	0.013822
30 to 34	0.050000	0.019165	0.019165	0.019165	0.063981	0.027606	0.027606	0.027606
35 to 39	-0.002381	0.005735	0.005735	0.005735	-0.005769	0.013797	0.013797	0.013797
40 to 44	0.015625	0.012221	0.012221	0.012221	0.049230	0.027955	0.027955	0.027955
45 to 49	0.016079	0.010611	0.010611	0.010611	0.000687	-0.003583	-0.003583	-0.003583
50 to 54	-0.005814	-0.004608	-0.004608	-0.004608	-0.007416	-0.005010	-0.005010	-0.005010
55 to 59	0.000329	-0.002587	-0.002587	-0.002587	0.007197	0.000091	0.000091	0.000091
60 to 64	-0.021553	-0.001928	-0.001928	-0.001928	-0.005747	0.017366	0.017366	0.017366
65 to 69	-0.055325	-0.075567	-0.075567	-0.075567	-0.072115	-0.066854	-0.066854	-0.066854
70 to 74	-0.052642	-0.064182	-0.064182	-0.064182	-0.018092	-0.027589	-0.027589	-0.027589
75 to 79	-0.015064	-0.026975	-0.026975	-0.026975	-0.019022	-0.044763	-0.044763	-0.044763
80 to 84	-0.037911	-0.030817	-0.030817	-0.030817	-0.116220	-0.057904	-0.057904	-0.057904
84 plus	-0.080951	-0.129800	-0.129800	-0.129800	-0.035347	-0.044442	-0.044442	-0.044442

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B17. Default Migration Rates, by Gender, by 5-yr Age Cohort, Stark County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.062070	0.003887	0.002079	0.002079	0.051590	0.008649	0.005759	0.005759
5 to 9	0.046858	0.003411	0.003081	0.003081	0.054319	0.006183	0.005628	0.005628
10 to 14	0.045957	0.012445	0.011319	0.011319	0.036792	0.009699	0.009368	0.009368
15 to 19	0.054617	0.025663	0.021813	0.021813	0.062597	0.054475	0.052653	0.052653
20 to 24	0.062558	-0.001181	-0.005318	-0.005318	-0.003722	-0.056919	-0.058861	-0.058861
25 to 29	0.049843	-0.000769	-0.007667	-0.007667	0.044740	0.001174	-0.002064	-0.002064
30 to 34	0.061486	0.009582	0.010167	0.010167	0.038203	0.007272	0.008617	0.008617
35 to 39	0.046780	0.011203	0.009966	0.009966	0.038403	0.008843	0.009142	0.009142
40 to 44	0.047857	0.009320	0.005611	0.005611	0.031774	0.011538	0.008793	0.008793
45 to 49	0.036151	0.005807	0.003170	0.003170	0.019349	-0.000051	-0.002140	-0.002140
50 to 54	0.021538	-0.007075	-0.006923	-0.006923	0.012017	-0.002529	-0.004025	-0.004025
55 to 59	0.011652	-0.001243	-0.000032	-0.000032	0.001819	-0.001743	0.000102	0.000102
60 to 64	-0.005533	0.002972	0.005990	0.005990	-0.010520	-0.000925	-0.001117	-0.001117
65 to 69	-0.016341	-0.000023	-0.001259	-0.001259	-0.015615	0.010550	0.009229	0.009229
70 to 74	0.005284	0.017571	0.016875	0.016875	-0.019625	-0.007146	-0.005779	-0.005779
75 to 79	-0.019496	-0.015099	-0.013721	-0.013721	-0.003117	0.003443	0.002340	0.002340
80 to 84	0.027792	0.039351	0.039724	0.039724	0.074367	0.041924	0.044759	0.044759
84 plus	-0.008018	-0.031827	-0.025504	-0.025504	-0.055381	-0.026548	-0.033185	-0.033185

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B18. Default Migration Rates, by Gender, by 5-yr Age Cohort, Ward County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	-0.011287	-0.022187	-0.022187	-0.022187	0.000157	-0.016290	-0.016290	-0.016290
5 to 9	-0.003490	-0.018404	-0.018404	-0.018404	-0.001457	-0.015079	-0.015079	-0.015079
10 to 14	0.000934	-0.007994	-0.007994	-0.007994	-0.001186	-0.009773	-0.009773	-0.009773
15 to 19	0.231008	0.153107	0.153107	0.153107	0.105100	0.078101	0.078101	0.078101
20 to 24	0.044021	0.005440	0.005440	0.005440	0.041348	0.017574	0.017574	0.017574
25 to 29	0.014874	-0.026222	-0.026222	-0.026222	0.005386	-0.018100	-0.018100	-0.018100
30 to 34	0.018490	-0.003739	-0.003739	-0.003739	0.018385	-0.004310	-0.004310	-0.004310
35 to 39	0.030516	0.002589	0.002589	0.002589	0.002413	-0.007445	-0.007445	-0.007445
40 to 44	0.010991	-0.009208	-0.009208	-0.009208	0.003495	-0.010053	-0.010053	-0.010053
45 to 49	0.005956	-0.002993	-0.002993	-0.002993	0.008026	-0.003561	-0.003561	-0.003561
50 to 54	0.016035	0.001640	0.001640	0.001640	-0.003628	-0.006557	-0.006557	-0.006557
55 to 59	0.002100	-0.005608	-0.005608	-0.005608	-0.009220	-0.011435	-0.011435	-0.011435
60 to 64	-0.019547	-0.011291	-0.011291	-0.011291	-0.026481	-0.014090	-0.014090	-0.014090
65 to 69	-0.024599	-0.011932	-0.011932	-0.011932	-0.022746	-0.008058	-0.008058	-0.008058
70 to 74	-0.026554	-0.012445	-0.012445	-0.012445	-0.016501	-0.003141	-0.003141	-0.003141
75 to 79	-0.011000	0.000426	0.000426	0.000426	-0.003567	0.003151	0.003151	0.003151
80 to 84	0.009582	0.012658	0.012658	0.012658	0.038778	0.060875	0.060875	0.060875
84 plus	-0.016932	0.018669	0.018669	0.018669	-0.073042	-0.049253	-0.049253	-0.049253

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix Table B19. Default Migration Rates, by Gender, by 5-yr Age Cohort, Williams County, North Dakota, 2016 to 2040

	Female				Male			
Cohort	2016-2019	2020-2024	2025-2029	2030-2040	2016-2019	2020-2024	2025-2029	2030-2040
	---------- migration is expressed at rate per one person of existing population ----------							
0 to 4	0.074446	0.027532	0.027532	0.027532	0.070700	0.029286	0.029286	0.029286
5 to 9	0.068747	0.006400	0.006400	0.006400	0.070105	0.008768	0.008768	0.008768
10 to 14	0.051428	0.002234	0.002234	0.002234	0.060187	0.000876	0.000876	0.000876
15 to 19	0.065256	-0.031353	-0.031353	-0.031353	0.012966	-0.057571	-0.057571	-0.057571
20 to 24	0.138790	0.008464	0.008464	0.008464	0.134115	0.030002	0.030002	0.030002
25 to 29	0.111723	0.044388	0.044388	0.044388	0.101424	0.041051	0.041051	0.041051
30 to 34	0.081080	0.024262	0.024262	0.024262	0.062809	0.019143	0.019143	0.019143
35 to 39	0.078139	0.008936	0.008936	0.008936	0.055593	0.014002	0.014002	0.014002
40 to 44	0.066205	0.002643	0.002643	0.002643	0.057370	0.000164	0.000164	0.000164
45 to 49	0.061884	0.000988	0.000988	0.000988	0.051166	-0.000149	-0.000149	-0.000149
50 to 54	0.045181	0.001907	0.001907	0.001907	0.022811	-0.004446	-0.004446	-0.004446
55 to 59	0.026918	0.001145	0.001145	0.001145	0.001156	0.005769	0.005769	0.005769
60 to 64	-0.017113	-0.004067	-0.004067	-0.004067	-0.030241	-0.018832	-0.018832	-0.018832
65 to 69	-0.041061	-0.020250	-0.020250	-0.020250	-0.036751	-0.007328	-0.007328	-0.007328
70 to 74	-0.035659	-0.002704	-0.002704	-0.002704	-0.034417	-0.004909	-0.004909	-0.004909
75 to 79	-0.024469	-0.002570	-0.002570	-0.002570	-0.029075	-0.023797	-0.023797	-0.023797
80 to 84	-0.008873	0.006287	0.006287	0.006287	0.034146	0.049056	0.049056	0.049056
84 plus	-0.058091	-0.040238	-0.040238	-0.040238	-0.082897	-0.049770	-0.049770	-0.049770

Note: Migration rates for male and female 0 to 4, 5 to 9, and 10 to 14 year-old cohorts were not adjusted during the modeling process. As a result, those migration rates were not influenced by changes in employment levels or workforce commuter activity. All other migration rates were adjusted as the analysis adjusted migration rates to match the supply of local workforce with the demand for local workforce.
Source: 2016 North Dakota State Housing Needs Assessment, NDSU.

Appendix C

Historical and Projected Workforce Participation Rates

Appendix Table C1. Statewide Workforce Participation Rates, North Dakota, 2000-2014

Gender/Age Cohort	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	%														
Men															
16 to 19 years	61.8	54.6	55.3	55.8	56.2	51.8	50.8	59.8	66.2	45.6	48.0	52.9	50.5	50.5	50.5
20 to 24 years	87.8	83.1	85.8	83.1	84.9	88.3	85.1	85.8	86.1	81.3	86.0	79.5	82.3	82.4	84.4
25 to 34 years	95.7	95.0	94.1	93.3	94.7	95.0	94.4	95.8	94.8	92.0	94.7	95.7	92.1	92.3	94.6
35 to 44 years	94.6	94.4	94.7	93.3	94.3	95.9	94.3	95.1	94.0	93.9	94.2	96.3	95.9	93.1	93.7
45 to 54 years	91.2	93.6	92.7	92.6	91.6	91.4	93.2	91.8	92.1	92.7	93.5	92.0	93.8	92.4	91.5
55 to 64 years	74.2	75.4	74.3	78.7	79.5	78.8	79.0	79.7	79.8	80.6	82.1	81.6	80.6	78.4	81.5
65 yrs and over	13.5	17.5	19.0	21.4	27.0	24.7	29.5	31.0	36.6	34.0	25.7	27.4	31.0	31.5	31.2
Average[a]	75.3	75.1	75.5	76.2	77.1	77.6	77.4	79.4	79.7	77.3	77.7	77.9	77.6	77.9	78.6
Women															
16 to 19 years	61.3	61.7	62.1	57.3	55.7	58.5	61.6	61.3	59.4	57.5	55.9	54.4	55.2	55.2	55.2
20 to 24 years	81.1	80.7	83.3	76.8	82.8	77.6	84.1	81.3	81.4	83.7	77.1	79.5	76.6	79.8	79.5
25 to 34 years	88.8	87.1	83.4	79.5	82.1	87.6	86.3	84.1	83.9	83.2	83.3	83.8	81.3	80.2	81.2
35 to 44 years	87.8	87.4	83.9	85.8	87.0	86.5	86.9	85.5	86.0	84.7	85.5	86.2	86.6	82.7	84.7
45 to 54 years	87.3	85.9	87.4	86.6	86.9	86.0	85.9	88.1	91.3	87.0	85.5	85.4	84.7	83.3	83.6
55 to 64 years	64.8	60.9	66.4	70.4	68.7	67.3	74.4	71.1	72.5	73.7	76.7	77.2	72.5	70.3	67.1
65 yrs and over	15.5	20.3	18.0	17.0	17.2	17.4	20.7	26.0	27.0	19.0	17.4	25.0	26.0	30.0	28.0
Average[a]	67.0	67.0	65.5	65.5	67.6	66.6	69.0	69.3	70.1	67.7	68.4	68.9	67.6	67.7	67.1
Men and Women															
Average[a]	71.1	71.0	70.9	70.5	71.8	71.8	73.2	73.9	74.9	72.3	72.1	73.1	72.6	72.2	72.5

[a]Weighted by population in each cohort.

Source: U.S. Bureau of Labor Statistics

Appendix Table C2. Population, by Age-cohorts, North Dakota, 2000-2014

Gender/Age Cohort	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	---------- people ----------														
Men															
16 to 19 years	22,273	22,983	22,510	22,136	21,878	21,481	20,865	20,618	20,165	19,937	20,461	20,816	20,854	21,231	21,209
20 to 24 years	26,909	27,404	28,982	30,553	32,526	32,906	33,896	32,371	32,104	31,348	31,530	32,854	35,334	37,863	38,435
25 to 34 years	39,519	38,540	37,926	37,929	38,646	38,961	39,705	41,989	43,553	46,067	48,052	50,464	52,927	55,989	58,609
35 to 44 years	49,116	47,355	45,776	44,219	43,242	41,971	41,135	40,075	39,333	38,758	38,826	39,043	40,150	42,013	43,382
45 to 54 years	44,101	45,894	46,689	47,506	48,446	49,084	49,646	49,496	49,246	48,994	48,767	47,450	46,823	46,443	45,895
55 to 64 years	26,562	26,977	28,418	29,773	31,275	33,093	34,637	36,716	38,529	40,467	41,934	44,119	44,884	46,040	47,119
65 yrs and over	39,947	39,814	39,795	39,772	40,077	40,010	40,195	40,593	41,260	41,848	42,427	43,129	44,459	45,779	47,006
Women															
16 to 19 years	20,714	21,305	20,902	20,305	20,154	19,600	19,372	19,038	18,820	18,506	18,829	18,931	18,829	19,351	19,406
20 to 24 years	23,769	24,084	25,140	26,717	27,918	28,785	29,205	27,974	27,669	27,444	27,426	28,333	29,801	31,635	32,473
25 to 34 years	36,875	35,837	35,267	34,997	35,361	35,329	35,833	37,827	39,106	41,161	42,433	44,269	45,917	47,852	49,359
35 to 44 years	48,584	46,899	45,410	43,619	42,125	40,880	39,441	38,570	37,336	36,691	36,436	36,227	36,762	37,745	38,694
45 to 54 years	41,764	43,266	44,176	45,326	46,493	47,469	47,948	48,191	48,329	48,269	47,890	46,614	45,529	44,658	43,834
55 to 64 years	27,071	27,477	28,589	29,519	30,631	31,955	33,372	35,009	36,583	38,308	39,885	41,901	42,804	44,001	45,113
65 yrs and over	54,638	54,431	54,196	53,996	54,232	53,946	54,187	54,135	54,525	54,724	55,050	55,615	56,392	57,104	57,992
Men and Women	501,842	502,266	503,776	506,367	513,004	515,470	519,437	522,602	526,558	532,522	539,946	549,765	561,465	577,704	588,526

Source: U.S. Census Bureau

Appendix Table C3. Size of Workforce, by Age-cohorts, North Dakota, 2000-2014															
Gender/Age Cohort	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	---------- people ----------														
Men															
16 to 19 years	13,765	12,549	12,448	12,352	12,295	11,127	10,599	12,330	13,349	9,091	9,821	11,012	10,521	10,711	10,700
20 to 24 years	23,626	22,773	24,867	25,390	27,615	29,056	28,845	27,774	27,642	25,486	27,116	26,119	29,080	31,199	32,439
25 to 34 years	37,820	36,613	35,688	35,388	36,598	37,013	37,482	40,225	41,288	42,382	45,505	48,294	48,746	51,678	55,444
35 to 44 years	46,464	44,703	43,350	41,256	40,777	40,250	38,790	38,111	36,973	36,394	36,574	37,598	38,504	39,114	40,649
45 to 54 years	40,220	42,957	43,281	43,991	44,377	44,863	46,270	45,437	45,356	45,417	45,597	43,654	43,920	42,913	41,994
55 to 64 years	19,709	20,341	21,115	23,431	24,864	26,077	27,363	29,263	30,746	32,616	34,428	36,001	36,177	36,095	38,402
65 yrs and over	5,393	6,967	7,561	8,511	10,821	9,882	11,858	12,584	15,101	14,228	10,904	11,817	13,782	14,420	14,666
Women															
16 to 19 years	12,698	13,145	12,980	11,635	11,226	11,466	11,933	11,670	11,179	10,641	10,525	10,298	10,384	10,672	10,702
20 to 24 years	19,277	19,436	20,942	20,519	23,116	22,337	24,561	22,743	22,523	22,971	21,145	22,525	22,828	25,245	25,816
25 to 34 years	32,745	31,214	29,413	27,823	29,031	30,948	30,924	31,813	32,810	34,246	35,347	37,097	37,331	38,377	40,080
35 to 44 years	42,657	40,990	38,099	37,425	36,649	35,361	34,274	32,977	32,109	31,077	31,153	31,228	31,836	31,215	32,774
45 to 54 years	36,460	37,165	38,610	39,252	40,402	40,823	41,187	42,456	44,124	41,994	40,946	39,808	38,563	37,200	36,645
55 to 64 years	17,542	16,733	18,983	20,781	21,043	21,506	24,829	24,891	26,523	28,233	30,592	32,348	31,033	30,933	30,271
65 yrs and over	8,469	11,049	9,755	9,179	9,322	9,376	11,217	14,075	14,722	10,398	9,579	13,904	14,662	17,131	16,238
Men and Women	356,843	356,636	357,091	356,933	368,136	370,086	380,133	386,350	394,444	385,174	389,232	401,703	407,365	416,904	426,819

Appendix Table C4. Estimated Workforce Participation Rates, by County, Composite Average of Male and Female Working Age Cohorts, North Dakota, 2002-2015

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	%													
Adams County	50.9	51.6	56.6	57.5	61.3	58.2	59.3	64.3	64.1	77.1	84.7	83.7	77.5	76.1
Billings County	74.4	70.1	77.0	77.1	83.2	85.2	76.6	82.1	80.9	86.5	91.3	92.0	91.9	86.9
Bottineau County	53.6	51.0	48.5	57.3	56.6	56.9	59.5	60.0	63.1	65.5	66.9	64.5	65.7	62.8
Bowman County	70.6	67.7	70.4	75.5	73.7	74.0	72.2	76.5	74.5	78.1	76.3	83.5	83.7	78.3
Burke County	63.9	62.9	57.5	73.0	79.8	71.0	73.3	80.3	80.6	65.9	71.1	74.1	84.6	77.9
Divide County	60.7	60.0	62.4	58.5	57.4	53.7	52.4	61.8	66.0	63.7	63.8	62.0	66.3	74.7
Dunn County	47.6	44.7	41.9	41.7	44.3	41.2	41.7	45.0	48.2	54.1	56.5	59.2	54.2	48.1
Golden Valley County	44.8	42.1	45.9	55.3	55.7	53.0	53.3	60.8	61.6	84.4	84.6	86.7	78.3	71.7
Hettinger County	52.9	52.9	51.7	50.9	52.4	57.7	61.1	63.3	60.8	67.8	78.3	78.6	69.3	67.2
Mercer County	65.6	67.5	64.5	64.0	64.0	63.8	64.7	61.2	60.7	58.1	62.3	63.3	66.6	65.7
McHenry County	50.4	45.5	57.6	54.1	55.5	49.4	52.8	59.4	61.2	64.9	68.4	74.1	67.6	67.2
McLean County	44.8	44.8	44.0	47.2	48.5	45.6	48.5	53.0	51.4	44.7	47.4	47.6	52.0	51.0
McKenzie County	65.5	64.3	62.6	55.1	52.7	56.0	56.2	56.8	71.3	92.1	95.5	89.0	76.0	75.0
Mountrail County	47.4	46.1	46.9	47.5	46.6	42.8	42.3	60.9	65.8	54.4	56.5	53.6	54.5	49.0
Slope County	62.3	59.1	57.1	54.3	57.0	62.3	63.2	36.4	69.2	79.1	85.0	94.0	86.8	71.1
Stark County	56.4	56.8	56.7	59.2	60.4	60.9	62.0	59.6	61.0	65.4	71.1	70.9	75.0	68.6
Renville County	48.7	45.6	63.3	53.1	52.1	52.2	58.4	60.6	62.0	52.3	55.5	54.2	55.6	49.3
Ward County	57.7	59.4	56.3	57.6	58.0	56.6	58.3	55.4	55.0	59.5	63.9	63.0	63.4	60.4
Williams County	58.3	58.3	60.0	66.1	69.2	65.5	70.5	66.7	73.2	82.6	92.0	89.7	92.3	81.3

Participation rates for years 2002 through 2015 were estimated using census data, employment (QCEW and Farmer/Rancher), and commuter data.

Appendix Table C5. Future Workforce Participation Rates used in Population Forecasts, by County, Composite Average of Male and Female Working Age Cohorts, North Dakota, 2016-2040

Year	Adams	Billings	Bottineau	Bowman	Burke	Divide	Dunn	Golden Valley	Hettinger	McHenry
	%									
2016	76.13	86.88	62.82	78.28	77.89	74.71	48.13	71.68	67.23	67.23
2017	74.09	86.18	62.14	77.69	76.83	72.10	48.06	69.89	66.14	65.61
2018	72.05	85.49	61.46	77.11	75.76	69.49	47.98	68.10	65.06	64.00
2019	70.01	84.79	60.78	76.52	74.70	66.89	47.90	66.31	63.97	62.39
2020	67.97	84.10	60.10	75.93	73.63	64.28	47.83	64.51	62.88	60.77
2021	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2022	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2023	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2024	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2025	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2026	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2027	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2028	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2029	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2030	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2031	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2032	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2033	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2034	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2035	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2036	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2037	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2038	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2039	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16
2040	65.93	83.40	59.42	75.35	72.57	61.67	47.75	62.72	61.80	59.16

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Appendix Table C5. Continued

Year	McLean	McKenzie	Mercer	Mountrail	Renville	Slope	Stark	Ward	Williams
	---------- % ----------								
2016	50.97	96.63	65.68	48.97	49.34	71.11	68.59	60.37	81.32
2017	50.36	92.71	65.29	49.38	50.36	70.44	67.50	60.07	80.45
2018	49.74	88.78	64.89	49.79	51.39	69.76	66.41	59.77	79.59
2019	49.13	84.85	64.50	50.20	52.42	69.09	65.32	59.48	78.73
2020	48.51	80.93	64.11	50.61	53.45	68.42	64.24	59.18	77.86
2021	47.90	77.00	63.72	51.02	54.48	67.74	63.15	58.88	77.00
2022	47.90	75.25	63.72	51.02	54.48	67.74	63.15	58.88	76.75
2023	47.90	73.00	63.72	51.02	54.48	67.74	63.15	58.88	76.50
2024	47.90	71.60	63.72	51.02	54.48	67.74	63.15	58.88	76.25
2025	47.90	71.10	63.72	51.02	54.48	67.74	63.15	58.88	76.00
2026	47.90	69.50	63.72	51.02	54.48	67.74	63.15	58.88	75.75
2027	47.90	67.80	63.72	51.02	54.48	67.74	63.15	58.88	75.50
2028	47.90	66.90	63.72	51.02	54.48	67.74	63.15	58.88	75.25
2029	47.90	65.20	63.72	51.02	54.48	67.74	63.15	58.88	75.00
2030	47.90	64.73	63.72	51.02	54.48	67.74	63.15	58.88	74.75
2031	47.90	64.20	63.72	51.02	54.48	67.74	63.15	58.88	74.50
2032	47.90	64.50	63.72	51.02	54.48	67.74	63.15	58.88	74.25
2033	47.90	64.90	63.72	51.02	54.48	67.74	63.15	58.88	74.00
2034	47.90	64.90	63.72	51.02	54.48	67.74	63.15	58.88	73.75
2035	47.90	65.20	63.72	51.02	54.48	67.74	63.15	58.88	73.50
2036	47.90	65.30	63.72	51.02	54.48	67.74	63.15	58.88	73.25
2037	47.90	65.40	63.72	51.02	54.48	67.74	63.15	58.88	73.00
2038	47.90	65.50	63.72	51.02	54.48	67.74	63.15	58.88	72.75
2039	47.90	65.50	63.72	51.02	54.48	67.74	63.15	58.88	72.50
2040	47.90	65.80	63.72	51.02	54.48	67.74	63.15	58.88	73.00

Appendix D

Historical and Projected Unemployment Rates

Appendix Table D1. Unemployment Rates, by County, North Dakota, 2002-2015

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	%													
Adams County	3.50	3.03	2.57	3.28	2.98	2.47	2.38	3.23	2.96	2.89	2.93	2.56	2.89	2.89
Billings County	2.78	3.00	2.43	2.78	2.49	2.56	2.10	2.46	3.29	3.86	3.38	2.94	3.01	3.01
Bottineau County	4.52	4.79	4.03	4.04	3.71	3.59	3.25	3.85	4.06	3.83	3.47	3.97	3.66	3.66
Bowman County	2.46	2.28	2.42	2.37	2.20	2.04	2.07	2.99	2.63	2.21	1.85	2.02	1.85	1.85
Burke County	3.66	3.34	3.42	2.64	2.55	2.56	2.36	3.18	3.03	2.48	2.06	2.33	2.82	2.82
Divide County	3.58	3.43	3.44	3.27	3.76	3.33	3.16	3.64	2.23	1.86	1.56	1.45	1.54	1.54
Dunn County	4.06	3.78	3.56	3.35	3.35	3.84	3.20	4.21	3.18	2.08	1.54	1.40	1.27	1.27
Golden Valley County	2.77	2.41	3.10	3.18	3.18	2.74	2.76	3.48	2.74	2.64	2.52	2.33	2.18	2.18
Hettinger County	3.86	3.99	3.46	3.70	3.51	3.98	3.48	3.74	3.29	3.05	2.81	2.82	2.29	2.29
Mercer County	4.69	4.77	4.49	4.52	3.77	4.14	4.57	4.25	5.18	5.33	5.26	4.61	4.06	4.06
McHenry County	6.33	6.72	5.80	5.61	4.97	4.99	5.12	5.15	5.08	4.85	4.50	4.42	4.52	4.52
McLean County	5.61	5.94	5.56	4.90	4.53	4.61	4.51	4.70	5.10	4.80	4.49	4.29	4.20	4.20
McKenzie County	3.92	3.87	3.43	3.68	3.23	3.07	2.41	3.26	2.17	1.77	1.51	1.49	1.46	1.46
Mountrail County	5.52	5.40	5.29	5.92	5.99	5.75	4.18	3.94	2.64	2.16	1.63	1.54	1.31	1.31
Slope County	2.19	2.86	3.13	2.28	2.27	1.59	1.32	2.14	2.59	2.21	2.23	2.23	2.29	2.29
Stark County	2.19	2.86	3.13	2.28	2.27	1.59	1.32	2.14	2.59	2.21	2.23	2.25	2.29	2.29
Renville County	3.08	3.10	2.71	3.08	3.06	3.02	2.61	3.95	2.90	2.93	2.35	2.57	2.72	2.72
Ward County	3.46	3.38	3.16	2.93	2.61	2.48	2.35	3.19	2.74	2.16	1.79	1.68	1.63	1.63
Williams County	3.88	3.97	3.52	3.47	3.12	3.00	2.95	3.69	3.42	3.16	2.62	2.70	2.70	2.70

Sources: Job Service North Dakota; U.S. Bureau of Labor Statistics

Appendix Table D2. Future Unemployment Rates used in Population Forecasts, by County, North Dakota, 2016-2040

Year	Adams	Billings	Bottineau	Bowman	Burke	Divide	Dunn	Golden Valley	Hettinger	McHenry
	%									
2016	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2017	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2018	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2019	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2020	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2021	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2022	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2023	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2024	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2025	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2026	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2027	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2028	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2029	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2030	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2031	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2032	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2033	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2034	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2035	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2036	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2037	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2038	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2039	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52
2040	2.89	3.01	3.66	1.85	2.82	1.54	1.27	2.18	2.29	4.52

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Appendix Table D2. Continued

Year	McLean	McKenzie	Mercer	Mountrail	Renville	Slope	Stark	Ward	Williams
					%				
2016	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2017	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2018	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2019	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2020	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2021	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2022	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2023	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2024	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2025	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2026	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2027	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2028	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2029	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2030	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2031	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2032	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2033	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2034	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2035	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2036	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2037	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2038	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2039	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19
2040	4.20	1.46	4.06	1.31	2.72	2.29	1.63	2.70	1.19

Appendix E

Historical In-flows and Outflows Data for Workers by County

Appendix Table E1. In-flow Commuters (Where do People that Work in Adams County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Adams County												
Adams County	65.54	64.66	63.90	68.50	67.17	58.20	55.83	65.17	62.89	57.80	55.72	52.68	59.04
Billings County	0.00	0.00	0.00	0.00	0.10	0.40	0.00	0.09	0.00	1.00	0.71	0.70	0.70
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bowman County	3.16	3.23	3.90	4.18	2.23	4.25	4.08	4.01	5.27	5.30	7.50	5.27	4.62
Burke County	0.00	0.00	0.00	0.00	0.00	0.30	0.49	0.28	0.00	0.10	0.10	0.20	0.40
Divide County	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.20
Dunn County	1.74	1.62	1.44	1.22	1.11	1.38	1.84	2.52	1.46	2.20	1.52	1.79	1.31
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.39	2.00	2.43	1.79	0.90
Hettinger County	5.02	6.25	4.21	4.79	5.17	4.64	5.44	4.20	4.10	3.70	3.04	2.88	3.31
Mercer County	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.09	0.20	0.10	0.30	0.30	0.50
McHenry County	0.00	0.11	0.10	0.10	0.10	0.00	0.39	0.09	0.29	1.00	0.91	1.89	0.50
McLean County	0.00	0.11	0.10	0.00	0.10	0.10	0.29	0.00	0.00	0.10	0.00	0.20	0.20
McKenzie County	0.33	0.32	0.00	0.00	0.00	0.20	1.26	0.75	0.49	0.30	0.51	0.30	0.80
Mountrail County	0.00	0.00	0.00	0.00	0.00	0.20	0.19	0.00	0.29	0.10	0.41	0.40	0.60
Slope County	0.11	0.00	0.10	0.00	0.00	0.10	0.10	0.09	0.00	0.00	0.00	0.10	0.10
Stark County	0.55	0.00	1.13	0.41	0.51	1.28	0.58	0.09	0.88	1.40	1.52	1.29	0.30
Renville County	4.58	3.45	5.95	4.28	5.88	9.68	7.57	4.76	5.37	5.40	7.70	6.96	4.72
Ward County	2.94	2.80	3.08	2.45	3.75	1.88	2.62	1.12	0.88	1.60	1.11	0.89	0.70
Williams County	0.00	0.00	0.21	0.10	0.10	0.40	0.68	0.47	0.20	0.00	0.20	0.30	0.70
Other ND	4.03	4.31	3.79	2.75	4.26	3.95	5.63	6.54	5.86	7.60	7.19	7.95	7.73
MN, SD, MT	10.25	11.85	10.26	9.48	8.31	10.08	9.03	7.47	9.18	7.00	6.59	10.44	11.95
Elsewhere	1.74	1.29	1.85	1.73	1.22	2.87	3.69	2.05	2.25	3.30	2.53	3.68	0.70

Source: U.S. Census Bureau

Appendix Table E2. Outflow Commuters (Where do People that Live in Adams County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	65.54	64.66	63.90	68.50	67.17	58.20	55.83	65.17	62.89	57.80	55.72	52.68	59.04
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.30	3.48	3.53	2.51	2.48
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bowman County	2.45	3.46	3.55	2.76	2.61	3.79	4.39	3.94	3.65	7.19	7.10	5.03	3.96
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.34	0.13	0.28	0.55	0.33
Dunn County	0.66	1.74	2.35	2.14	3.83	2.42	2.84	2.61	2.38	2.66	1.80	2.62	1.79
Golden Valley County	0.00	0.00	0.00	0.35	0.17	0.00	0.15	0.72	0.45	5.52	6.47	6.79	2.40
Hettinger County	1.40	0.84	1.54	1.52	2.53	3.30	3.46	2.44	3.39	6.50	5.47	4.11	3.76
Mercer County	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.08
McHenry County	0.00	0.07	0.00	0.07	0.00	0.00	0.32	0.60	0.45	0.44	0.60	0.60	0.53
McLean County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.07	0.00	0.06
McKenzie County	0.14	0.09	0.07	0.07	0.06	0.43	0.32	0.10	0.11	0.28	0.25	0.15	0.17
Mountrail County	0.04	0.00	0.00	0.03	0.00	0.00	0.03	0.03	0.09	0.23	0.41	0.39	0.30
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stark County	0.00	0.00	0.00	0.91	4.30	2.06	0.93	0.00	0.00	4.31	5.28	7.91	1.49
Renville County	0.19	0.20	0.33	0.26	0.25	0.49	0.59	0.46	0.65	1.03	1.15	1.25	0.69
Ward County	0.06	0.00	0.00	0.00	0.00	0.02	0.01	0.07	0.10	0.06	0.09	0.12	0.08
Williams County	0.05	0.00	0.01	0.00	0.03	0.07	0.07	0.09	0.19	0.24	0.27	0.19	0.25

Source: U.S. Census Bureau

Appendix Table E3. In-flow Commuters (Where do People that Work in Billings County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Billings County												
Adams County	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.30	3.48	3.53	2.51	2.48
Billings County	41.46	35.23	43.96	33.70	34.71	30.65	25.24	40.00	33.33	20.89	16.88	17.73	16.67
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.60	0.63	0.56	0.67	0.17
Bowman County	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00	2.85	0.93	1.00	1.16
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunn County	1.22	1.70	0.00	1.10	2.94	3.52	0.95	0.00	2.98	10.44	4.82	3.34	3.96
Golden Valley County	2.44	3.41	1.10	1.10	2.35	1.51	2.38	1.15	0.00	7.59	7.79	6.19	3.80
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.48	3.53	3.85	1.16
Mercer County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.17
McHenry County	7.32	6.82	4.40	9.39	6.47	3.02	3.33	3.08	2.68	0.63	2.23	0.84	0.83
McLean County	0.00	0.00	0.00	0.00	1.76	0.00	0.00	0.00	0.30	0.32	0.19	0.33	0.66
McKenzie County	0.00	0.00	0.00	0.00	0.00	0.00	1.90	0.77	0.89	1.90	1.48	0.33	0.99
Mountrail County	7.32	9.66	6.04	6.08	6.47	2.51	2.86	1.54	5.06	0.63	0.37	0.17	0.17
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stark County	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.00	0.32	1.11	1.34	0.99
Renville County	24.39	24.43	14.84	26.52	23.53	32.66	31.43	28.85	32.74	28.16	28.57	29.60	30.86
Ward County	0.00	0.00	0.00	0.00	0.00	3.02	1.43	2.69	1.49	0.95	3.71	3.85	4.79
Williams County	0.00	0.00	1.65	0.00	1.18	1.01	13.33	8.85	6.85	0.63	2.41	2.01	3.14
Other ND	7.32	9.09	18.13	12.15	15.29	8.54	10.95	5.00	5.36	7.91	10.20	9.03	11.06
MN, SD, MT	2.44	0.00	0.00	0.00	0.00	6.53	2.38	2.69	2.98	4.43	5.94	5.52	9.90
Elsewhere	6.10	9.66	9.89	7.73	4.71	7.04	1.90	5.00	4.46	4.75	5.57	11.71	7.10

Source: U.S. Census Bureau

Appendix Table E4. Outflow Commuters (Where do People that Live in Billings County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.00	0.00	0.00	0.00	0.10	0.40	0.00	0.09	0.00	1.00	0.71	0.70	0.70
Billings County	41.46	35.23	43.96	33.70	34.71	30.65	25.24	40.00	33.33	20.89	16.88	17.73	16.67
Bottineau County	0.00	0.04	0.07	0.07	0.00	0.00	0.00	0.04	0.00	0.00	0.04	0.04	0.08
Bowman County	0.00	0.00	0.00	0.08	0.00	0.14	0.22	0.22	0.14	0.87	1.04	0.97	0.52
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.09	0.25
Dunn County	0.77	0.98	0.90	2.46	2.32	1.32	0.95	0.73	0.86	1.55	1.16	1.52	0.69
Golden Valley County	3.64	2.62	3.17	1.57	2.97	2.74	2.39	2.03	0.89	1.07	1.29	2.31	2.14
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.19	0.32	0.48	0.59	0.29	0.43
Mercer County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
McHenry County	0.36	0.00	0.00	0.00	0.13	0.92	1.11	0.42	0.19	0.22	0.53	0.60	0.39
McLean County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.09	0.03
McKenzie County	0.02	0.02	0.09	0.00	0.00	0.00	0.07	0.10	0.09	0.09	0.11	0.11	0.15
Mountrail County	0.30	0.32	0.19	0.13	0.31	0.00	0.07	0.09	0.12	0.19	0.23	0.20	0.24
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11	0.22	0.22	0.35
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	3.74	0.00	2.36	1.44	1.06	2.16	0.37
Renville County	0.82	0.80	0.62	0.97	0.85	0.93	0.74	0.70	0.76	1.18	1.10	1.06	0.85
Ward County	0.00	0.00	0.00	0.01	0.00	0.02	0.02	0.04	0.03	0.06	0.04	0.07	0.05
Williams County	0.03	0.09	0.17	0.15	0.24	0.13	0.12	0.15	0.11	0.08	0.15	0.15	0.10

Source: U.S. Census Bureau

Appendix Table E5. In-flow Commuters (Where do People that Work in Bottineau County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Bottineau County												
Adams County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Billings County	0.00	0.04	0.07	0.07	0.00	0.00	0.00	0.04	0.00	0.00	0.04	0.04	0.08
Bottineau County	74.93	69.66	67.11	74.81	74.22	68.57	68.55	69.26	69.57	59.52	56.62	57.95	59.64
Bowman County	0.07	0.15	0.30	0.11	0.00	0.04	0.00	0.00	0.09	0.04	0.15	0.08	0.04
Burke County	0.15	0.56	0.60	0.30	0.36	1.02	0.52	0.63	0.91	0.72	0.77	1.04	1.06
Divide County	0.00	0.04	0.04	0.00	0.00	0.04	0.04	0.00	0.09	0.00	0.38	0.21	0.12
Dunn County	0.30	0.60	0.49	0.30	0.24	0.62	0.00	0.13	0.00	0.21	0.31	0.29	0.12
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.09	0.04	0.00	0.00	0.12
Mercer County	0.86	1.12	2.28	1.57	1.63	1.72	2.03	1.97	2.38	3.55	4.22	4.94	3.92
McHenry County	0.48	0.00	0.00	0.00	0.00	0.47	0.28	0.18	0.30	0.85	0.73	0.66	0.59
McLean County	0.26	0.19	0.07	0.22	0.08	0.43	0.52	0.22	0.74	0.85	0.96	0.62	0.43
McKenzie County	0.00	0.45	0.49	0.34	0.48	0.51	0.04	0.18	0.52	0.21	0.27	0.29	0.12
Mountrail County	1.08	0.97	0.71	0.86	0.64	0.47	0.80	0.49	0.74	1.61	1.04	1.16	1.02
Slope County	0.60	1.79	1.94	1.12	1.23	1.33	1.63	3.26	2.42	1.73	1.84	2.16	2.47
Stark County	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Renville County	0.00	0.00	0.15	0.04	0.00	0.74	0.52	0.40	0.35	0.25	0.96	0.66	0.94
Ward County	5.17	6.27	5.67	4.83	5.36	5.82	6.28	7.33	7.66	13.66	12.08	12.41	10.70
Williams County	0.00	0.04	0.15	0.07	0.04	0.20	1.03	1.03	1.04	0.68	0.96	0.58	0.82
Other ND	14.13	15.78	17.62	14.15	13.91	15.19	16.02	13.05	11.34	14.21	15.46	13.70	15.36
MN, SD, MT	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.09	0.30	0.65	0.46	0.74
Elsewhere	1.97	2.35	2.31	1.20	1.83	2.73	1.75	1.74	1.69	1.57	2.57	2.74	1.68

Source: U.S. Census Bureau

Appendix Table E6. Outflow Commuters (Where do People that Live in Bottineau County Work), North Dakota, 2002-2014													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.60	0.63	0.56	0.67	0.17
Bottineau County	74.93	69.66	67.11	74.81	74.22	68.57	68.55	69.26	69.57	59.52	56.62	57.95	59.64
Bowman County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Burke County	0.23	2.12	1.67	2.53	0.95	0.69	1.65	1.60	0.31	2.92	2.07	1.77	1.91
Divide County	0.00	0.00	0.00	0.32	0.00	0.47	0.16	0.69	0.34	1.47	2.17	2.00	1.58
Dunn County	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.31	0.19	0.30	0.17	0.46	0.31
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.56	0.00	0.16	0.15	0.00	0.43
Mercer County	0.47	0.89	1.37	2.76	0.96	1.62	1.21	1.46	2.85	3.67	2.94	2.13	1.09
McHenry County	0.00	0.14	0.07	0.15	0.20	0.16	0.60	0.23	0.11	0.33	0.84	0.86	0.39
McLean County	2.00	1.66	1.07	0.67	0.80	0.34	0.20	0.07	0.16	0.32	0.33	0.38	0.45
McKenzie County	0.09	0.07	0.07	0.16	0.29	0.09	0.20	0.12	0.17	0.15	0.16	0.19	0.27
Mountrail County	0.85	0.82	0.58	0.95	0.86	0.54	0.26	0.32	0.44	1.69	2.15	1.91	0.82
Slope County	7.67	9.49	9.09	18.23	17.01	18.03	15.88	13.81	12.75	13.09	11.30	12.28	14.25
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renville County	0.03	0.08	0.08	0.03	0.09	0.09	0.13	0.21	0.27	0.34	0.42	0.35	0.37
Ward County	0.80	0.74	0.58	1.17	1.08	1.25	1.10	1.12	1.35	1.61	1.35	1.23	1.27
Williams County	0.33	0.29	0.13	0.26	0.35	0.32	0.41	0.39	0.42	0.61	0.52	0.41	0.34

Source: U.S. Census Bureau

Appendix Table E7. In-flow Commuters (Where do People that Work in Bowman County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Bowman County												
Adams County	2.45	3.46	3.55	2.76	2.61	3.79	4.39	3.94	3.65	7.19	7.10	5.03	3.96
Billings County	0.00	0.00	0.00	0.08	0.00	0.14	0.22	0.22	0.14	0.87	1.04	0.97	0.52
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bowman County	75.55	73.31	73.92	75.58	73.04	66.79	66.19	79.30	72.60	55.67	50.09	51.00	58.31
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.00	0.00	0.12	0.11	0.06
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.07	1.07	0.00	0.12	0.06	0.06
Dunn County	0.08	0.23	0.08	0.38	0.45	0.50	0.65	0.44	0.29	3.29	3.80	3.66	1.66
Golden Valley County	0.08	0.23	0.45	0.38	0.15	0.86	0.43	0.80	0.72	4.77	2.39	2.80	1.15
Hettinger County	0.55	0.83	0.91	1.00	1.42	1.79	0.65	0.58	0.57	2.01	2.88	1.14	1.15
Mercer County	0.00	0.00	0.00	0.00	0.00	0.14	0.07	0.15	0.14	0.00	0.06	0.00	0.06
McHenry County	0.08	0.98	0.45	0.38	0.52	0.29	0.22	0.15	0.00	0.81	0.55	0.63	1.72
McLean County	0.00	0.15	0.00	0.00	0.00	0.00	0.07	0.22	0.00	0.13	0.00	0.29	0.34
McKenzie County	0.00	0.00	0.23	0.00	0.00	0.29	0.29	0.58	0.43	0.54	0.37	0.46	0.46
Mountrail County	0.00	0.00	0.00	0.00	0.00	0.14	0.07	0.22	0.29	0.13	0.37	0.57	0.80
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.15	0.00	0.07	0.06	0.00	0.06
Stark County	3.96	4.66	4.23	3.76	5.60	4.87	3.96	0.15	4.22	4.03	3.80	3.83	3.38
Renville County	3.72	4.29	4.38	5.45	5.15	6.51	6.76	3.64	3.43	5.57	7.23	6.69	6.08
Ward County	1.58	0.60	1.28	1.15	0.90	0.43	0.43	1.17	0.50	0.67	1.59	1.83	1.66
Williams County	0.32	0.38	0.08	0.46	0.82	1.22	0.58	0.29	0.79	0.67	0.73	1.03	1.55
Other ND	3.32	3.08	2.57	2.38	2.99	2.00	3.02	2.19	2.58	4.30	5.14	5.37	4.87
MN, SD, MT	6.57	5.19	5.59	4.69	5.00	8.38	8.20	3.35	6.29	6.58	8.51	9.21	8.60
Elsewhere	1.74	2.63	2.27	1.54	1.34	1.86	3.31	2.33	2.29	2.69	4.04	5.32	3.56

Source: U.S. Census Bureau

Appendix Table E8. Outflow Commuters (Where do People that Live in Bowman County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	3.16	3.23	3.90	4.18	2.23	4.25	4.08	4.01	5.27	5.30	7.50	5.27	4.62
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00	2.85	0.93	1.00	1.16
Bottineau County	0.07	0.15	0.30	0.11	0.00	0.04	0.00	0.00	0.09	0.04	0.15	0.08	0.04
Bowman County	75.55	73.31	73.92	75.58	73.04	66.79	66.19	79.30	72.60	55.67	50.09	51.00	58.31
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Divide County	0.00	0.29	0.00	0.32	0.00	0.00	0.49	0.35	0.00	0.00	0.00	0.09	0.50
Dunn County	0.33	0.00	0.34	0.00	0.10	0.99	0.74	0.10	0.29	3.77	1.20	1.70	1.20
Golden Valley County	0.69	1.64	1.34	1.39	1.40	1.61	1.49	1.74	0.89	2.61	3.17	3.32	2.67
Hettinger County	2.10	0.51	0.85	1.18	1.81	0.82	0.65	2.44	2.42	3.65	3.99	4.55	2.03
Mercer County	0.76	0.65	0.59	0.48	0.77	0.00	0.00	0.07	0.21	0.16	0.08	0.08	0.16
McHenry County	0.00	0.00	0.00	0.00	0.00	0.38	1.66	0.69	0.57	0.88	0.32	0.43	0.66
McLean County	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.03	0.00	0.03	0.16	0.00	0.06
McKenzie County	0.21	0.18	0.27	0.31	0.17	0.05	0.27	0.02	0.11	0.11	0.16	0.23	0.27
Mountrail County	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.06	0.09	0.37	0.43	0.38	0.35
Slope County	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.12	0.11	0.22	0.11	0.22	0.35
Stark County	13.89	23.94	12.82	20.00	17.20	28.87	22.43	52.46	18.11	18.18	15.14	17.27	22.39
Renville County	0.37	0.60	0.58	0.29	0.45	0.58	0.72	0.76	0.80	1.09	0.97	0.90	0.60
Ward County	0.00	0.05	0.03	0.05	0.03	0.05	0.07	0.07	0.04	0.08	0.08	0.13	0.10
Williams County	0.02	0.00	0.00	0.01	0.01	0.12	0.15	0.14	0.27	0.34	0.27	0.36	0.27

Source: U.S. Census Bureau

Appendix Table E9. In-flow Commuters (Where do People that Work in Burke County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Burke County												
Adams County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bottineau County	0.23	2.12	1.67	2.53	0.95	0.69	1.65	1.60	0.31	2.92	2.07	1.77	1.91
Bowman County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Burke County	66.13	54.72	44.87	64.29	66.03	57.57	56.17	67.40	63.12	28.51	25.12	27.62	37.35
Divide County	1.60	1.18	4.77	2.76	2.38	5.05	3.70	4.40	7.25	4.73	3.00	1.99	3.26
Dunn County	2.06	2.59	1.19	0.92	1.19	1.38	1.23	0.40	0.00	0.00	0.35	1.99	0.67
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mercer County	0.00	0.00	0.72	0.00	0.48	0.00	1.44	1.00	0.77	8.62	8.87	10.50	4.84
McHenry County	2.06	3.07	3.34	1.15	1.66	1.61	0.62	0.00	0.31	2.36	1.84	2.43	1.46
McLean County	0.00	0.24	0.00	0.00	0.00	0.00	1.23	0.20	0.00	1.53	1.04	1.77	1.24
McKenzie County	0.00	0.47	0.00	0.00	0.00	1.38	0.00	1.20	0.46	0.56	2.42	1.33	1.69
Mountrail County	2.75	2.12	3.10	3.00	2.61	3.67	5.97	3.00	3.55	7.23	8.64	6.41	4.84
Slope County	0.00	0.00	1.67	1.84	0.95	0.92	0.21	0.40	0.93	0.56	1.84	2.32	0.79
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renville County	0.00	2.59	2.63	0.92	0.24	3.21	0.62	0.60	0.46	0.97	2.19	2.65	1.46
Ward County	10.98	13.21	16.47	8.06	10.93	9.63	11.73	9.60	12.65	30.18	26.96	24.42	20.81
Williams County	2.52	3.54	5.49	4.84	3.09	2.75	6.17	2.00	3.09	2.64	3.11	2.76	3.37
Other ND	10.30	12.74	14.08	8.29	9.50	9.17	3.09	4.60	4.32	5.29	7.37	5.41	9.45
MN, SD, MT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	1.99	2.47
Elsewhere	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.14	0.92	0.77	2.70

Source: U.S. Census Bureau

Appendix Table E10. Outflow Commuters (Where do People that Live in Burke County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.00	0.00	0.00	0.00	0.00	0.30	0.49	0.28	0.00	0.10	0.10	0.20	0.40
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bottineau County	0.15	0.56	0.60	0.30	0.36	1.02	0.52	0.63	0.91	0.72	0.77	1.04	1.06
Bowman County	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.00	0.00	0.12	0.11	0.06
Burke County	66.13	54.72	44.87	64.29	66.03	57.57	56.17	67.40	63.12	28.51	25.12	27.62	37.35
Divide County	0.81	0.15	0.79	4.47	6.29	5.00	8.31	3.63	4.14	3.20	5.18	4.55	4.59
Dunn County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.50
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mercer County	0.00	0.00	0.00	0.00	0.00	0.31	0.08	0.22	0.07	0.33	0.33	0.16	0.39
McHenry County	1.38	1.08	1.79	2.00	2.16	0.92	0.69	1.39	0.53	0.47	0.38	0.61	0.59
McLean County	0.76	0.61	0.75	0.67	0.42	0.27	0.13	0.10	0.13	0.13	0.20	0.34	0.21
McKenzie County	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.10	0.19	0.04	0.02	0.02	0.06
Mountrail County	2.26	1.74	2.16	1.74	2.09	1.45	2.35	1.40	1.59	1.32	1.16	1.17	1.10
Slope County	2.43	0.95	0.28	2.11	2.45	2.30	2.89	1.56	0.44	0.34	0.75	0.43	0.58
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renville County	0.01	0.05	0.05	0.03	0.08	0.06	0.02	0.06	0.02	0.03	0.13	0.11	0.10
Ward County	0.41	0.64	0.35	0.66	0.78	0.55	0.40	0.53	0.50	0.43	0.45	0.46	0.45
Williams County	0.52	0.66	0.55	0.93	0.91	0.63	0.76	0.89	0.69	0.59	0.50	0.53	0.55

Source: U.S. Census Bureau

Appendix Table E11. In-flow Commuters (Where do People that Work in Divide County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Divide County												
Adams County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.34	0.13	0.28	0.55	0.33
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.09	0.25
Bottineau County	0.00	0.00	0.00	0.32	0.00	0.47	0.16	0.69	0.34	1.47	2.17	2.00	1.58
Bowman County	0.00	0.29	0.00	0.32	0.00	0.00	0.49	0.35	0.00	0.00	0.00	0.09	0.50
Burke County	0.81	0.15	0.79	4.47	6.29	5.00	8.31	3.63	4.14	3.20	5.18	4.55	4.59
Divide County	81.10	79.33	85.13	77.83	75.66	56.25	54.23	73.40	83.45	51.13	35.91	37.58	45.62
Dunn County	0.00	0.00	0.00	0.00	0.00	0.78	0.33	0.17	0.17	0.00	1.79	1.18	0.92
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mercer County	0.00	0.15	0.16	0.00	0.00	3.44	1.79	1.55	0.34	2.54	3.20	2.37	1.58
McHenry County	0.65	0.88	0.63	0.48	0.66	2.34	0.16	0.00	0.69	9.21	4.62	5.82	4.42
McLean County	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.35	0.17	1.07	0.85	1.36	0.67
McKenzie County	0.00	0.00	0.00	0.00	0.00	0.31	0.81	0.00	0.00	0.13	0.09	0.36	0.50
Mountrail County	0.00	0.29	0.00	0.00	0.00	1.56	1.14	0.17	0.17	5.21	3.68	5.46	1.83
Slope County	0.00	3.52	2.37	2.23	1.66	0.47	1.63	1.21	0.00	0.67	0.38	0.27	0.25
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renville County	4.20	3.81	3.80	4.94	3.31	13.13	14.98	8.12	0.86	0.27	0.57	0.91	1.08
Ward County	2.26	0.59	0.47	0.00	0.00	0.94	0.98	1.21	0.86	11.62	22.43	15.47	8.17
Williams County	1.78	3.08	1.27	6.22	6.13	5.63	5.54	3.45	2.76	5.61	4.71	6.55	7.09
Other ND	1.78	1.17	1.58	0.32	1.32	2.03	2.77	2.25	1.90	3.07	4.05	4.28	4.59
MN, SD, MT	3.39	3.37	2.53	1.59	3.31	5.47	2.28	1.38	2.41	2.54	5.66	4.09	13.43
Elsewhere	4.04	3.37	1.27	1.28	1.66	1.72	4.40	1.73	1.38	2.14	4.43	7.01	2.59

Source: U.S. Census Bureau

Appendix Table E12. Outflow Commuters (Where do People that Live in Divide County Work), North Dakota, 2002-2014													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.20
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bottineau County	0.00	0.04	0.04	0.00	0.00	0.04	0.04	0.00	0.09	0.00	0.38	0.21	0.12
Bowman County	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.07	1.07	0.00	0.12	0.06	0.06
Burke County	1.60	1.18	4.77	2.76	2.38	5.05	3.70	4.40	7.25	4.73	3.00	1.99	3.26
Divide County	81.10	79.33	85.13	77.83	75.66	56.25	54.23	73.40	83.45	51.13	35.91	37.58	45.62
Dunn County	0.00	0.00	0.00	0.00	0.00	0.44	0.11	0.42	0.19	0.07	0.30	0.21	0.16
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.15	0.29
Mercer County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.57	0.66	0.08
McHenry County	0.07	0.22	0.14	0.22	0.33	0.38	0.42	1.43	0.15	0.36	0.63	0.37	0.45
McLean County	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.10	0.06	0.16	0.03	0.03	0.06
McKenzie County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mountrail County	0.07	0.04	0.10	0.23	0.14	0.44	0.30	0.15	0.47	1.46	1.35	0.70	0.69
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.56	0.54	0.54	0.58
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37
Renville County	0.03	0.03	0.01	0.04	0.04	0.04	0.03	0.10	0.05	0.05	0.03	0.08	0.06
Ward County	0.02	0.01	0.05	0.02	0.02	0.13	0.08	0.08	0.10	0.24	0.25	0.24	0.17
Williams County	0.41	0.62	0.71	0.55	0.36	0.51	0.53	0.61	0.63	0.44	0.40	0.43	0.44

Source: U.S. Census Bureau

Appendix Table E13. In-flow Commuters (Where do People that Work in Dunn County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Dunn County												
Adams County	0.66	1.74	2.35	2.14	3.83	2.42	2.84	2.61	2.38	2.66	1.80	2.62	1.79
Billings County	0.77	0.98	0.90	2.46	2.32	1.32	0.95	0.73	0.86	1.55	1.16	1.52	0.69
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.31	0.19	0.30	0.17	0.46	0.31
Bowman County	0.33	0.00	0.34	0.00	0.10	0.99	0.74	0.10	0.29	3.77	1.20	1.70	1.20
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.50
Divide County	0.00	0.00	0.00	0.00	0.00	0.44	0.11	0.42	0.19	0.07	0.30	0.21	0.16
Dunn County	55.16	53.54	47.93	49.57	48.19	44.62	45.47	59.77	55.86	38.58	29.32	28.46	25.31
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.88	0.53	0.63	0.29	3.47	2.91	3.12	1.32
Hettinger County	0.55	0.22	1.34	1.18	2.02	1.43	1.05	0.52	0.57	1.85	1.76	1.81	0.98
Mercer County	1.21	1.63	1.01	1.07	0.91	0.00	0.00	0.00	0.19	0.37	0.64	0.42	0.25
McHenry County	2.97	2.50	3.47	1.50	2.42	3.52	4.00	3.66	4.10	5.47	3.17	3.61	3.53
McLean County	1.43	1.31	1.12	0.64	1.21	0.44	0.74	0.42	0.48	0.59	0.99	0.88	1.04
McKenzie County	4.62	4.24	5.94	5.24	4.74	3.74	4.11	3.34	3.43	2.96	4.59	4.53	4.63
Mountrail County	1.54	1.20	1.23	1.07	1.21	0.55	0.53	0.42	0.00	0.15	0.60	1.06	1.07
Slope County	0.11	0.33	0.11	0.11	0.20	0.00	0.00	0.21	0.38	0.15	0.04	0.32	0.06
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.10	0.10	0.67	0.26	0.99	0.22
Renville County	16.04	16.54	20.94	19.23	19.76	24.95	24.00	16.82	17.92	17.66	17.83	17.84	21.47
Ward County	2.75	2.83	2.58	2.56	2.42	3.52	1.16	0.31	1.14	2.59	3.34	2.94	2.61
Williams County	0.66	0.33	0.78	1.92	0.71	1.54	1.58	0.94	1.53	2.14	3.51	3.96	3.87
Other ND	9.56	9.58	8.51	9.72	8.47	7.14	9.68	5.22	5.15	9.46	12.52	11.58	9.01
MN, SD, MT	1.21	1.74	1.34	1.50	0.81	2.09	1.26	1.99	2.29	3.25	9.77	7.43	9.51
Elsewhere	0.44	1.31	0.11	0.11	0.71	0.44	0.74	1.46	1.91	2.29	4.11	4.53	10.45

Source: U.S. Census Bureau

Appendix Table E14. Outflow Commuters (Where do People that Live in Dunn County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	1.74	1.62	1.44	1.22	1.11	1.38	1.84	2.52	1.46	2.20	1.52	1.79	1.31
Billings County	1.22	1.70	0.00	1.10	2.94	3.52	0.95	0.00	2.98	10.44	4.82	3.34	3.96
Bottineau County	0.30	0.60	0.49	0.30	0.24	0.62	0.00	0.13	0.00	0.21	0.31	0.29	0.12
Bowman County	0.08	0.23	0.08	0.38	0.45	0.50	0.65	0.44	0.29	3.29	3.80	3.66	1.66
Burke County	2.06	2.59	1.19	0.92	1.19	1.38	1.23	0.40	0.00	0.00	0.35	1.99	0.67
Divide County	0.00	0.00	0.00	0.00	0.00	0.78	0.33	0.17	0.17	0.00	1.79	1.18	0.92
Dunn County	55.16	53.54	47.93	49.57	48.19	44.62	45.47	59.77	55.86	38.58	29.32	28.46	25.31
Golden Valley County	0.17	0.00	0.00	0.87	1.40	0.16	1.64	0.00	0.30	4.91	3.17	2.46	1.34
Hettinger County	1.05	1.69	0.85	1.69	0.18	2.27	1.73	0.00	0.65	3.49	5.18	3.81	2.89
Mercer County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
McHenry County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.09	0.25
McLean County	0.77	0.98	0.90	2.46	2.32	1.32	0.95	0.73	0.86	1.55	1.16	1.52	0.69
McKenzie County	3.64	2.62	3.17	1.57	2.97	2.74	2.39	2.03	0.89	1.07	1.29	2.31	2.14
Mountrail County	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.19	0.32	0.48	0.59	0.29	0.43
Slope County	0.36	0.00	0.00	0.00	0.13	0.92	1.11	0.42	0.19	0.22	0.53	0.60	0.39
Stark County	0.02	0.02	0.09	0.00	0.00	0.00	0.07	0.10	0.09	0.09	0.11	0.11	0.15
Renville County	0.30	0.32	0.19	0.13	0.31	0.00	0.07	0.09	0.12	0.19	0.23	0.20	0.24
Ward County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Williams County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11	0.22	0.22	0.35

Source: U.S. Census Bureau

Appendix Table E15. In-flow Commuters (Where do People that Work in Golden Valley County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Golden Valley County												
Adams County	0.00	0.00	0.00	0.35	0.17	0.00	0.15	0.72	0.45	5.52	6.47	6.79	2.40
Billings County	3.64	2.62	3.17	1.57	2.97	2.74	2.39	2.03	0.89	1.07	1.29	2.31	2.14
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bowman County	0.69	1.64	1.34	1.39	1.40	1.61	1.49	1.74	0.89	2.61	3.17	3.32	2.67
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunn County	0.17	0.00	0.00	0.87	1.40	0.16	1.64	0.00	0.30	4.91	3.17	2.46	1.34
Golden Valley County	53.55	43.77	47.58	68.87	68.94	57.49	58.15	70.62	71.51	53.68	44.32	47.83	50.07
Hettinger County	0.00	0.16	0.00	0.00	0.00	0.00	1.35	0.00	0.74	2.30	2.73	2.60	1.07
Mercer County	0.00	0.00	0.00	0.00	0.00	0.32	0.15	0.14	0.00	0.00	0.00	0.14	0.27
McHenry County	4.33	6.07	3.67	2.61	1.40	0.00	0.15	0.29	0.15	1.53	1.15	1.16	1.60
McLean County	0.17	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.15	0.14	0.00	0.13
McKenzie County	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.43	0.74	1.23	0.72	0.58	0.67
Mountrail County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	1.53	2.45	2.17	1.47
Renville County	10.57	17.38	11.69	7.30	8.03	10.63	7.03	7.38	5.93	8.74	11.65	8.38	7.08
Ward County	1.91	4.59	5.51	1.74	3.66	2.74	1.05	0.72	1.34	1.53	1.01	1.01	1.74
Williams County	0.17	0.16	0.00	0.00	0.35	0.97	0.15	0.72	0.45	0.92	0.72	1.30	3.74
Other ND	3.81	3.28	3.17	2.26	2.44	6.44	10.46	5.07	2.82	5.21	5.18	4.62	6.68
MN, SD, MT	15.25	15.90	18.70	10.43	5.76	11.27	11.21	8.54	10.09	5.67	10.22	11.13	15.22
Elsewhere	5.72	4.43	5.18	2.61	3.32	5.64	4.19	1.59	3.71	3.37	5.61	4.19	1.74

Source: U.S. Census Bureau

Appendix Table E16. Outflow Commuters (Where do People that Live in Golden Valley County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	---------- Percentage of Jobs in Destination Counties ----------												
Adams County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.39	2.00	2.43	1.79	0.90
Billings County	2.44	3.41	1.10	1.10	2.35	1.51	2.38	1.15	0.00	7.59	7.79	6.19	3.80
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bowman County	0.08	0.23	0.45	0.38	0.15	0.86	0.43	0.80	0.72	4.77	2.39	2.80	1.15
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunn County	0.00	0.00	0.00	0.00	0.00	0.88	0.53	0.63	0.29	3.47	2.91	3.12	1.32
Golden Valley County	53.55	43.77	47.58	68.87	68.94	57.49	58.15	70.62	71.51	53.68	44.32	47.83	50.07
Hettinger County	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.16	2.85	2.22	1.76	1.59
Mercer County	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.21	0.00	0.08	0.41	0.16
McHenry County	1.02	2.23	2.36	1.78	2.62	0.60	0.42	0.23	0.53	0.94	0.60	0.60	0.74
McLean County	0.40	0.24	0.00	0.00	0.00	0.00	0.17	0.14	0.00	0.00	0.10	0.09	0.12
McKenzie County	0.00	0.00	0.00	0.00	0.04	0.25	0.09	0.04	0.00	0.02	0.46	0.23	0.21
Mountrail County	0.00	0.00	0.00	0.00	0.00	0.30	0.10	0.12	0.16	0.43	0.38	0.38	0.33
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stark County	1.39	4.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.78	3.87	2.88	0.75
Renville County	0.24	0.14	0.20	0.21	0.15	0.34	0.36	0.43	0.53	1.30	1.31	1.24	0.90
Ward County	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.07	0.06	0.04	0.04
Williams County	0.24	0.10	0.13	0.07	0.14	0.09	0.12	0.05	0.04	0.18	0.20	0.17	0.17

Source: U.S. Census Bureau

Appendix Table E17. In-flow Commuters (Where do People that Work in Hettinger County Live) North Dakota, 2002-2014													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Hettinger County												
Adams County	1.40	0.84	1.54	1.52	2.53	3.30	3.46	2.44	3.39	6.50	5.47	4.11	3.76
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.19	0.32	0.48	0.59	0.29	0.43
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.56	0.00	0.16	0.15	0.00	0.43
Bowman County	2.10	0.51	0.85	1.18	1.81	0.82	0.65	2.44	2.42	3.65	3.99	4.55	2.03
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.15	0.29
Dunn County	1.05	1.69	0.85	1.69	0.18	2.27	1.73	0.00	0.65	3.49	5.18	3.81	2.89
Golden Valley County	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.16	2.85	2.22	1.76	1.59
Hettinger County	72.50	72.30	72.14	70.61	67.81	67.42	67.17	76.74	70.81	57.37	54.29	57.04	56.58
Mercer County	0.00	0.00	0.00	0.00	0.00	0.21	0.43	0.56	0.00	0.00	0.30	0.00	0.29
McHenry County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.32	0.74	0.15	0.58
McLean County	1.40	3.38	1.54	1.52	1.99	0.00	0.43	0.56	0.32	0.48	0.15	0.59	0.14
McKenzie County	1.75	1.86	1.54	2.20	1.45	0.21	1.51	0.56	0.48	1.27	0.74	1.17	0.58
Mountrail County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stark County	1.05	0.00	0.85	1.52	2.17	1.86	1.30	0.19	3.06	2.06	3.55	3.81	3.18
Renville County	6.30	6.42	6.84	7.09	7.78	4.74	6.05	5.07	6.29	7.29	9.62	8.06	10.42
Ward County	1.05	1.35	1.03	0.17	0.54	1.44	0.00	0.75	0.16	0.63	0.89	1.47	1.45
Williams County	0.00	0.00	0.17	0.00	0.54	0.00	0.43	0.75	0.16	0.63	0.15	0.29	0.43
Other ND	5.43	5.07	4.10	4.90	7.05	8.66	7.34	5.63	7.58	8.40	6.66	9.09	11.14
MN, SD, MT	1.75	1.35	1.37	2.03	1.08	2.89	0.86	0.38	1.45	1.11	1.92	1.17	2.60
Elsewhere	4.20	5.24	6.67	5.57	5.06	6.19	7.99	3.19	2.58	3.33	3.11	2.49	1.16

Source: U.S. Census Bureau

Appendix Table E18. Outflow Commuters (Where do People that Live in Hettinger County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	5.02	6.25	4.21	4.79	5.17	4.64	5.44	4.20	4.10	3.70	3.04	2.88	3.31
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.48	3.53	3.85	1.16
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.09	0.04	0.00	0.00	0.12
Bowman County	0.55	0.83	0.91	1.00	1.42	1.79	0.65	0.58	0.57	2.01	2.88	1.14	1.15
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunn County	0.55	0.22	1.34	1.18	2.02	1.43	1.05	0.52	0.57	1.85	1.76	1.81	0.98
Golden Valley County	0.00	0.16	0.00	0.00	0.00	0.00	1.35	0.00	0.74	2.30	2.73	2.60	1.07
Hettinger County	72.50	72.30	72.14	70.61	67.81	67.42	67.17	76.74	70.81	57.37	54.29	57.04	56.58
Mercer County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.16	0.33	0.16	0.23
McHenry County	0.00	0.00	0.00	0.00	0.20	1.03	1.20	0.23	0.19	0.53	0.74	0.50	0.35
McLean County	0.08	0.00	0.00	0.00	0.00	0.24	0.03	0.10	0.10	0.36	0.23	0.34	0.18
McKenzie County	0.02	0.07	0.02	0.00	0.04	0.11	0.05	0.10	0.13	0.50	0.39	0.42	0.17
Mountrail County	0.00	0.00	0.00	0.00	0.00	0.07	0.20	0.03	0.14	0.19	0.35	0.31	0.25
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.11	0.32	0.12
Stark County	0.00	0.00	1.28	3.64	0.00	0.00	1.40	4.10	0.79	1.44	5.28	2.52	1.49
Renville County	1.19	1.29	1.35	1.19	1.26	1.43	1.86	1.90	1.43	1.63	1.89	1.83	1.30
Ward County	0.03	0.02	0.05	0.02	0.04	0.06	0.07	0.05	0.04	0.09	0.08	0.13	0.11
Williams County	0.07	0.02	0.00	0.01	0.01	0.07	0.07	0.04	0.15	0.20	0.31	0.28	0.13

Source: U.S. Census Bureau

Appendix Table E19. In-flow Commuters (Where do People that Work in McHenry County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in McHenry County												
Adams County	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.08
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bottineau County	0.47	0.89	1.37	2.76	0.96	1.62	1.21	1.46	2.85	3.67	2.94	2.13	1.09
Bowman County	0.76	0.65	0.59	0.48	0.77	0.00	0.00	0.07	0.21	0.16	0.08	0.08	0.16
Burke County	0.00	0.00	0.00	0.00	0.00	0.31	0.08	0.22	0.07	0.33	0.33	0.16	0.39
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.57	0.66	0.08
Dunn County	0.09	0.00	0.00	0.00	0.00	0.23	0.15	0.22	0.07	0.33	0.16	0.25	0.08
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.21	0.00	0.08	0.41	0.16
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.16	0.33	0.16	0.23
Mercer County	59.05	44.93	60.45	59.09	58.87	38.77	43.72	47.78	47.04	44.16	44.57	46.48	50.00
McHenry County	0.19	0.00	0.00	0.00	0.00	0.08	0.08	0.15	0.14	1.14	1.80	1.48	0.62
McLean County	1.14	1.22	1.18	1.62	1.63	2.62	2.27	2.04	2.49	1.71	2.29	1.15	3.18
McKenzie County	0.09	0.89	0.10	0.29	0.10	1.15	0.53	0.51	0.50	0.49	0.73	0.33	0.31
Mountrail County	0.09	0.16	0.00	0.00	0.10	0.77	0.23	0.29	0.14	1.96	1.80	1.64	1.86
Slope County	0.00	0.00	0.10	0.29	0.19	0.31	0.45	0.36	0.29	0.08	0.49	0.25	0.47
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renville County	0.19	0.08	0.39	0.10	0.29	0.23	0.30	0.87	0.43	0.33	0.65	0.16	0.23
Ward County	12.80	28.63	14.62	17.70	14.38	26.77	27.08	22.65	24.73	22.12	22.12	20.08	18.87
Williams County	0.00	0.00	0.00	0.00	0.19	0.08	0.15	0.15	0.29	1.22	0.65	0.57	0.54
Other ND	23.89	20.60	20.22	16.84	21.38	24.54	22.47	21.85	19.24	19.84	17.88	19.84	19.18
MN, SD, MT	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.00	0.00	0.08	0.08	0.82	1.16
Elsewhere	1.23	1.87	0.98	0.86	1.15	2.38	1.21	1.38	1.14	2.04	2.45	3.36	1.32

Source: U.S. Census Bureau

Appendix Table E20. Outflow Commuters (Where do People that Live in McHenry County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.09	0.20	0.10	0.30	0.30	0.50
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.17
Bottineau County	0.86	1.12	2.28	1.57	1.63	1.72	2.03	1.97	2.38	3.55	4.22	4.94	3.92
Bowman County	0.00	0.00	0.00	0.00	0.00	0.14	0.07	0.15	0.14	0.00	0.06	0.00	0.06
Burke County	0.00	0.00	0.72	0.00	0.48	0.00	1.44	1.00	0.77	8.62	8.87	10.50	4.84
Divide County	0.00	0.15	0.16	0.00	0.00	3.44	1.79	1.55	0.34	2.54	3.20	2.37	1.58
Dunn County	1.21	1.63	1.01	1.07	0.91	0.00	0.00	0.00	0.19	0.37	0.64	0.42	0.25
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.32	0.15	0.14	0.00	0.00	0.00	0.14	0.27
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.21	0.43	0.56	0.00	0.00	0.30	0.00	0.29
Mercer County	59.05	44.93	60.45	59.09	58.87	38.77	43.72	47.78	47.04	44.16	44.57	46.48	50.00
McHenry County	1.02	0.93	1.22	1.04	1.44	0.43	0.14	0.32	0.23	0.33	0.69	0.96	0.20
McLean County	0.36	0.28	0.24	0.45	0.46	0.93	0.50	0.62	0.23	1.13	1.21	1.50	0.66
McKenzie County	0.14	0.27	0.38	0.29	0.50	0.25	0.47	0.54	0.55	0.44	0.34	0.51	0.42
Mountrail County	5.52	6.30	4.59	5.32	3.06	2.62	2.29	1.84	1.54	2.00	1.80	2.08	1.45
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.24	0.00	0.34	0.11	0.32	0.12
Stark County	5.56	4.23	8.97	6.36	8.60	0.00	3.74	4.10	3.15	5.26	1.41	2.16	1.12
Renville County	0.19	0.25	0.27	0.16	0.23	0.05	0.20	0.16	0.14	0.21	0.26	0.29	0.34
Ward County	2.05	1.73	3.01	2.45	2.56	2.24	2.35	2.96	3.11	2.88	3.02	3.07	2.77
Williams County	0.29	0.37	0.34	0.22	0.20	0.21	0.26	0.43	0.46	0.36	0.31	0.55	0.45

Source: U.S. Census Bureau

Appendix Table E21. In-flow Commuters (Where do People that Work in McKenzie County Live) North Dakota, 2002-2014													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in McKenzie County												
Adams County	0.00	0.07	0.00	0.07	0.00	0.00	0.32	0.60	0.45	0.44	0.60	0.60	0.53
Billings County	0.36	0.00	0.00	0.00	0.13	0.92	1.11	0.42	0.19	0.22	0.53	0.60	0.39
Bottineau County	0.00	0.14	0.07	0.15	0.20	0.16	0.60	0.23	0.11	0.33	0.84	0.86	0.39
Bowman County	0.00	0.00	0.00	0.00	0.00	0.38	1.66	0.69	0.57	0.88	0.32	0.43	0.66
Burke County	1.38	1.08	1.79	2.00	2.16	0.92	0.69	1.39	0.53	0.47	0.38	0.61	0.59
Divide County	0.07	0.22	0.14	0.22	0.33	0.38	0.42	1.43	0.15	0.36	0.63	0.37	0.45
Dunn County	2.32	3.52	4.08	4.15	4.06	1.79	3.09	2.41	3.26	2.71	2.27	1.79	1.79
Golden Valley County	1.02	2.23	2.36	1.78	2.62	0.60	0.42	0.23	0.53	0.94	0.60	0.60	0.74
Hettinger County	0.00	0.00	0.00	0.00	0.20	1.03	1.20	0.23	0.19	0.53	0.74	0.50	0.35
Mercer County	1.02	0.93	1.22	1.04	1.44	0.43	0.14	0.32	0.23	0.33	0.69	0.96	0.20
McHenry County	68.31	64.15	62.30	57.89	51.90	47.83	45.89	54.21	55.34	43.41	32.07	28.77	27.54
McLean County	2.97	4.96	2.29	2.59	2.49	1.03	2.44	1.39	1.06	1.08	1.37	1.13	0.56
McKenzie County	0.51	0.86	1.93	1.04	1.44	1.57	1.66	1.62	0.83	1.08	1.23	1.47	1.52
Mountrail County	0.73	0.93	1.86	3.19	2.29	1.95	1.94	3.28	2.84	2.49	3.33	2.49	2.67
Slope County	0.15	0.00	0.43	0.22	0.07	0.33	0.37	0.32	0.30	0.47	0.45	0.22	0.19
Stark County	0.00	0.00	0.00	0.00	0.13	0.05	0.78	0.14	0.53	0.39	0.29	0.24	0.19
Renville County	4.35	3.02	5.65	3.34	5.70	9.76	9.82	7.35	5.72	5.23	7.26	6.51	6.62
Ward County	3.34	3.45	3.93	4.89	6.62	6.89	4.94	4.67	5.64	7.82	9.06	7.70	5.99
Williams County	4.28	4.89	5.22	8.67	8.85	8.46	8.63	6.52	7.46	12.19	10.29	10.14	8.87
Other ND	3.12	3.38	3.58	3.48	3.74	6.18	8.21	6.34	5.45	6.55	7.98	8.36	8.65
MN, SD, MT	5.73	6.03	2.79	5.11	4.98	8.24	5.30	5.37	7.87	10.64	15.06	18.33	18.56
Elsewhere	0.36	0.14	0.36	0.15	0.66	1.08	0.37	0.83	0.76	1.44	4.04	7.33	12.54

Source: U.S. Census Bureau

Appendix Table E22. Outflow Commuters (Where do People that Live in McKenzie County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.00	0.11	0.10	0.10	0.10	0.00	0.39	0.09	0.29	1.00	0.91	1.89	0.50
Billings County	7.32	6.82	4.40	9.39	6.47	3.02	3.33	3.08	2.68	0.63	2.23	0.84	0.83
Bottineau County	0.48	0.00	0.00	0.00	0.00	0.47	0.28	0.18	0.30	0.85	0.73	0.66	0.59
Bowman County	0.08	0.98	0.45	0.38	0.52	0.29	0.22	0.15	0.00	0.81	0.55	0.63	1.72
Burke County	2.06	3.07	3.34	1.15	1.66	1.61	0.62	0.00	0.31	2.36	1.84	2.43	1.46
Divide County	0.65	0.88	0.63	0.48	0.66	2.34	0.16	0.00	0.69	9.21	4.62	5.82	4.42
Dunn County	2.97	2.50	3.47	1.50	2.42	3.52	4.00	3.66	4.10	5.47	3.17	3.61	3.53
Golden Valley County	4.33	6.07	3.67	2.61	1.40	0.00	0.15	0.29	0.15	1.53	1.15	1.16	1.60
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.32	0.74	0.15	0.58
Mercer County	0.19	0.00	0.00	0.00	0.00	0.08	0.08	0.15	0.14	1.14	1.80	1.48	0.62
McHenry County	68.31	64.15	62.30	57.89	51.90	47.83	45.89	54.21	55.34	43.41	32.07	28.77	27.54
McLean County	0.00	0.04	0.16	0.15	0.00	0.17	0.20	0.28	0.39	0.74	0.65	0.34	0.33
McKenzie County	0.14	0.11	0.18	0.13	0.08	0.47	0.27	0.29	0.40	0.17	0.25	0.46	0.35
Mountrail County	4.04	4.63	5.10	3.65	4.33	7.03	7.09	5.54	5.55	7.66	6.86	6.37	6.00
Slope County	2.17	2.44	2.20	1.32	1.35	0.51	0.52	0.12	0.00	3.13	4.84	4.09	1.97
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	1.44	3.87	3.96	3.73
Renville County	0.72	0.74	0.76	0.56	0.45	0.30	0.37	0.38	0.85	0.78	1.05	1.15	1.18
Ward County	0.13	0.19	0.18	0.09	0.13	0.27	0.15	0.16	0.20	0.75	0.91	0.83	0.54
Williams County	1.89	1.68	1.66	1.17	1.21	1.76	1.93	1.70	2.37	4.54	4.47	4.27	2.81

Source: U.S. Census Bureau

Appendix Table E23. In-flow Commuters (Where do People that Work in McLean County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in McLean County												
Adams County	0.00	0.07	0.00	0.07	0.00	0.00	0.32	0.60	0.45	0.44	0.60	0.60	0.53
Billings County	0.36	0.00	0.00	0.00	0.13	0.92	1.11	0.42	0.19	0.22	0.53	0.60	0.39
Bottineau County	0.00	0.14	0.07	0.15	0.20	0.16	0.60	0.23	0.11	0.33	0.84	0.86	0.39
Bowman County	0.00	0.00	0.00	0.00	0.00	0.38	1.66	0.69	0.57	0.88	0.32	0.43	0.66
Burke County	1.38	1.08	1.79	2.00	2.16	0.92	0.69	1.39	0.53	0.47	0.38	0.61	0.59
Divide County	0.07	0.22	0.14	0.22	0.33	0.38	0.42	1.43	0.15	0.36	0.63	0.37	0.45
Dunn County	2.32	3.52	4.08	4.15	4.06	1.79	3.09	2.41	3.26	2.71	2.27	1.79	1.79
Golden Valley County	1.02	2.23	2.36	1.78	2.62	0.60	0.42	0.23	0.53	0.94	0.60	0.60	0.74
Hettinger County	0.00	0.00	0.00	0.00	0.20	1.03	1.20	0.23	0.19	0.53	0.74	0.50	0.35
Mercer County	1.02	0.93	1.22	1.04	1.44	0.43	0.14	0.32	0.23	0.33	0.69	0.96	0.20
McHenry County	68.31	64.15	62.30	57.89	51.90	47.83	45.89	54.21	55.34	43.41	32.07	28.77	27.54
McLean County	2.97	4.96	2.29	2.59	2.49	1.03	2.44	1.39	1.06	1.08	1.37	1.13	0.56
McKenzie County	0.51	0.86	1.93	1.04	1.44	1.57	1.66	1.62	0.83	1.08	1.23	1.47	1.52
Mountrail County	0.73	0.93	1.86	3.19	2.29	1.95	1.94	3.28	2.84	2.49	3.33	2.49	2.67
Slope County	0.15	0.00	0.43	0.22	0.07	0.33	0.37	0.32	0.30	0.47	0.45	0.22	0.19
Stark County	0.00	0.00	0.00	0.00	0.13	0.05	0.78	0.14	0.53	0.39	0.29	0.24	0.19
Renville County	4.35	3.02	5.65	3.34	5.70	9.76	9.82	7.35	5.72	5.23	7.26	6.51	6.62
Ward County	3.34	3.45	3.93	4.89	6.62	6.89	4.94	4.67	5.64	7.82	9.06	7.70	5.99
Williams County	4.28	4.89	5.22	8.67	8.85	8.46	8.63	6.52	7.46	12.19	10.29	10.14	8.87
Other ND	3.12	3.38	3.58	3.48	3.74	6.18	8.21	6.34	5.45	6.55	7.98	8.36	8.65
MN, SD, MT	5.73	6.03	2.79	5.11	4.98	8.24	5.30	5.37	7.87	10.64	15.06	18.33	18.56
Elsewhere	0.36	0.14	0.36	0.15	0.66	1.08	0.37	0.83	0.76	1.44	4.04	7.33	12.54

Source: U.S. Census Bureau

Appendix Table E24. Outflow Commuters (Where do People that Live in McLean County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.00	0.11	0.10	0.00	0.10	0.10	0.29	0.00	0.00	0.10	0.00	0.20	0.20
Billings County	0.00	0.00	0.00	0.00	1.76	0.00	0.00	0.00	0.30	0.32	0.19	0.33	0.66
Bottineau County	0.26	0.19	0.07	0.22	0.08	0.43	0.52	0.22	0.74	0.85	0.96	0.62	0.43
Bowman County	0.00	0.15	0.00	0.00	0.00	0.00	0.07	0.22	0.00	0.13	0.00	0.29	0.34
Burke County	0.00	0.24	0.00	0.00	0.00	0.00	1.23	0.20	0.00	1.53	1.04	1.77	1.24
Divide County	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.35	0.17	1.07	0.85	1.36	0.67
Dunn County	1.43	1.31	1.12	0.64	1.21	0.44	0.74	0.42	0.48	0.59	0.99	0.88	1.04
Golden Valley County	0.17	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.15	0.14	0.00	0.13
Hettinger County	1.40	3.38	1.54	1.52	1.99	0.00	0.43	0.56	0.32	0.48	0.15	0.59	0.14
Mercer County	1.14	1.22	1.18	1.62	1.63	2.62	2.27	2.04	2.49	1.71	2.29	1.15	3.18
McHenry County	2.97	4.96	2.29	2.59	2.49	1.03	2.44	1.39	1.06	1.08	1.37	1.13	0.56
McLean County	58.56	60.10	58.52	61.30	59.24	51.87	51.77	57.94	56.96	44.52	46.58	45.35	49.27
McKenzie County	3.73	2.85	2.94	3.26	3.52	4.04	3.76	5.06	3.85	3.86	3.93	4.31	4.55
Mountrail County	7.82	6.73	6.39	7.36	7.07	7.26	7.42	4.61	3.67	3.01	2.37	2.09	2.74
Slope County	0.77	0.14	0.14	0.00	0.00	0.77	1.44	0.24	0.33	1.12	0.65	0.65	0.35
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renville County	0.43	0.54	0.32	0.45	0.47	0.54	0.56	0.55	0.55	0.48	0.52	0.50	0.52
Ward County	0.52	0.61	0.63	0.81	1.05	0.87	0.97	1.28	1.17	1.08	1.18	1.15	1.23
Williams County	0.44	0.34	0.46	0.25	0.47	0.13	0.23	0.36	0.44	0.20	0.38	0.31	0.37

Source: U.S. Census Bureau

Appendix Table E25. In-flow Commuters (Where do People that Work in Mercer County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Mercer County												
Adams County	0.14	0.09	0.07	0.07	0.06	0.43	0.32	0.10	0.11	0.28	0.25	0.15	0.17
Billings County	0.02	0.02	0.09	0.00	0.00	0.00	0.07	0.10	0.09	0.09	0.11	0.11	0.15
Bottineau County	0.09	0.07	0.07	0.16	0.29	0.09	0.20	0.12	0.17	0.15	0.16	0.19	0.27
Bowman County	0.21	0.18	0.27	0.31	0.17	0.05	0.27	0.02	0.11	0.11	0.16	0.23	0.27
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.10	0.19	0.04	0.02	0.02	0.06
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunn County	0.95	0.87	1.47	0.86	0.85	0.90	0.81	1.50	1.49	1.33	1.53	1.03	1.66
Golden Valley County	0.00	0.00	0.00	0.00	0.04	0.25	0.09	0.04	0.00	0.02	0.46	0.23	0.21
Hettinger County	0.02	0.07	0.02	0.00	0.04	0.11	0.05	0.10	0.13	0.50	0.39	0.42	0.17
Mercer County	0.14	0.27	0.38	0.29	0.50	0.25	0.47	0.54	0.55	0.44	0.34	0.51	0.42
McHenry County	0.14	0.11	0.18	0.13	0.08	0.47	0.27	0.29	0.40	0.17	0.25	0.46	0.35
McLean County	3.73	2.85	2.94	3.26	3.52	4.04	3.76	5.06	3.85	3.86	3.93	4.31	4.55
McKenzie County	74.27	75.27	71.31	71.69	69.26	65.58	66.21	59.92	63.96	58.93	59.31	57.09	59.44
Mountrail County	0.35	0.50	0.45	0.29	0.21	0.16	0.11	0.35	0.26	0.13	0.09	0.27	0.33
Slope County	0.00	0.00	0.00	0.04	0.08	0.05	0.09	0.12	0.17	0.11	0.11	0.02	0.04
Stark County	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.00	0.00	0.04	0.00	0.04	0.02
Renville County	1.33	1.48	2.01	2.15	1.62	2.26	2.00	1.96	1.55	1.79	1.30	1.94	1.85
Ward County	2.47	2.65	2.83	2.84	3.15	2.62	2.23	2.35	2.15	1.85	1.85	1.56	1.87
Williams County	0.79	0.59	0.53	0.35	0.50	0.20	0.23	0.19	0.17	0.11	0.27	0.27	0.39
Other ND	14.88	14.77	17.05	17.29	18.81	21.43	21.81	25.46	23.45	28.41	27.64	28.89	25.44
MN, SD, MT	0.33	0.09	0.16	0.13	0.72	0.27	0.27	0.31	0.17	0.26	0.16	0.42	1.04
Elsewhere	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.12	0.06	0.22	0.23	0.42	1.31

Source: U.S. Census Bureau

Appendix Table E26. Outflow Commuters (Where do People that Live in Mercer County Work), North Dakota, 2002-2014													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.33	0.32	0.00	0.00	0.00	0.20	1.26	0.75	0.49	0.30	0.51	0.30	0.80
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	1.90	0.77	0.89	1.90	1.48	0.33	0.99
Bottineau County	0.00	0.45	0.49	0.34	0.48	0.51	0.04	0.18	0.52	0.21	0.27	0.29	0.12
Bowman County	0.00	0.00	0.23	0.00	0.00	0.29	0.29	0.58	0.43	0.54	0.37	0.46	0.46
Burke County	0.00	0.47	0.00	0.00	0.00	1.38	0.00	1.20	0.46	0.56	2.42	1.33	1.69
Divide County	0.00	0.00	0.00	0.00	0.00	0.31	0.81	0.00	0.00	0.13	0.09	0.36	0.50
Dunn County	4.62	4.24	5.94	5.24	4.74	3.74	4.11	3.34	3.43	2.96	4.59	4.53	4.63
Golden Valley County	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.43	0.74	1.23	0.72	0.58	0.67
Hettinger County	1.75	1.86	1.54	2.20	1.45	0.21	1.51	0.56	0.48	1.27	0.74	1.17	0.58
Mercer County	0.09	0.89	0.10	0.29	0.10	1.15	0.53	0.51	0.50	0.49	0.73	0.33	0.31
McHenry County	0.51	0.86	1.93	1.04	1.44	1.57	1.66	1.62	0.83	1.08	1.23	1.47	1.52
McLean County	3.97	4.94	3.76	4.94	4.85	6.63	5.50	4.36	4.11	5.65	6.32	5.29	4.96
McKenzie County	74.27	75.27	71.31	71.69	69.26	65.58	66.21	59.92	63.96	58.93	59.31	57.09	59.44
Mountrail County	2.78	2.60	2.62	1.94	1.24	3.63	3.51	0.70	0.89	0.58	0.68	0.64	0.95
Slope County	0.64	0.81	0.41	0.92	0.86	1.92	1.57	1.08	1.22	1.45	0.22	1.51	0.46
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renville County	0.59	0.43	0.46	0.47	0.43	0.61	0.52	0.49	0.74	0.85	0.80	0.71	0.70
Ward County	0.18	0.22	0.27	0.27	0.28	0.41	0.26	0.32	0.29	0.28	0.32	0.31	0.32
Williams County	0.60	0.60	0.49	0.32	0.39	0.21	0.25	0.21	0.23	0.23	0.28	0.39	0.41

Source: U.S. Census Bureau

Appendix Table E27. In-flow Commuters (Where do People that Work in Mountrail County Live) North Dakota, 2002-2014													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Mountrail County												
Adams County	0.04	0.00	0.00	0.03	0.00	0.00	0.03	0.03	0.09	0.23	0.41	0.39	0.30
Billings County	0.30	0.32	0.19	0.13	0.31	0.00	0.07	0.09	0.12	0.19	0.23	0.20	0.24
Bottineau County	0.85	0.82	0.58	0.95	0.86	0.54	0.26	0.32	0.44	1.69	2.15	1.91	0.82
Bowman County	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.06	0.09	0.37	0.43	0.38	0.35
Burke County	2.26	1.74	2.16	1.74	2.09	1.45	2.35	1.40	1.59	1.32	1.16	1.17	1.10
Divide County	0.07	0.04	0.10	0.23	0.14	0.44	0.30	0.15	0.47	1.46	1.35	0.70	0.69
Dunn County	5.52	6.30	4.59	5.32	3.06	2.62	2.29	1.84	1.54	2.00	1.80	2.08	1.45
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.30	0.10	0.12	0.16	0.43	0.38	0.38	0.33
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.07	0.20	0.03	0.14	0.19	0.35	0.31	0.25
Mercer County	0.15	0.11	0.23	0.39	0.07	0.37	0.30	0.41	0.58	4.35	3.21	3.01	1.67
McHenry County	4.04	4.63	5.10	3.65	4.33	7.03	7.09	5.54	5.55	7.66	6.86	6.37	6.00
McLean County	7.82	6.73	6.39	7.36	7.07	7.26	7.42	4.61	3.67	3.01	2.37	2.09	2.74
McKenzie County	2.78	2.60	2.62	1.94	1.24	3.63	3.51	0.70	0.89	0.58	0.68	0.64	0.95
Mountrail County	55.58	54.47	55.73	58.23	61.07	50.55	48.06	67.06	59.41	29.58	24.52	23.19	23.51
Slope County	0.33	0.21	0.36	0.16	0.21	0.20	0.40	0.38	0.51	1.05	1.20	0.99	0.51
Stark County	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.06	0.02	0.27	0.23	0.25	0.17
Renville County	0.37	0.93	0.68	1.38	1.30	1.55	1.95	1.11	2.69	4.66	4.32	4.11	4.36
Ward County	10.74	11.36	10.36	10.97	10.06	9.88	11.20	6.57	8.82	22.18	19.93	21.54	19.62
Williams County	2.70	3.35	2.74	2.96	3.57	4.13	3.25	2.89	3.65	4.74	4.56	4.56	5.62
Other ND	5.15	4.70	7.01	3.94	3.57	8.20	7.95	4.61	7.04	9.12	9.04	9.94	11.54
MN, SD, MT	0.52	0.53	0.55	0.30	0.65	1.08	1.52	0.44	0.80	2.37	8.44	8.70	7.98
Elsewhere	0.78	1.17	0.61	0.33	0.41	0.61	1.46	1.60	1.71	2.53	6.37	7.11	9.82

Source: U.S. Census Bureau

Appendix Table E28. Outflow Commuters (Where do People that Live in Mountrail County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.00	0.00	0.00	0.00	0.00	0.20	0.19	0.00	0.29	0.10	0.41	0.40	0.60
Billings County	7.32	9.66	6.04	6.08	6.47	2.51	2.86	1.54	5.06	0.63	0.37	0.17	0.17
Bottineau County	1.08	0.97	0.71	0.86	0.64	0.47	0.80	0.49	0.74	1.61	1.04	1.16	1.02
Bowman County	0.00	0.00	0.00	0.00	0.00	0.14	0.07	0.22	0.29	0.13	0.37	0.57	0.80
Burke County	2.75	2.12	3.10	3.00	2.61	3.67	5.97	3.00	3.55	7.23	8.64	6.41	4.84
Divide County	0.00	0.29	0.00	0.00	0.00	1.56	1.14	0.17	0.17	5.21	3.68	5.46	1.83
Dunn County	1.54	1.20	1.23	1.07	1.21	0.55	0.53	0.42	0.00	0.15	0.60	1.06	1.07
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mercer County	0.09	0.16	0.00	0.00	0.10	0.77	0.23	0.29	0.14	1.96	1.80	1.64	1.86
McHenry County	0.73	0.93	1.86	3.19	2.29	1.95	1.94	3.28	2.84	2.49	3.33	2.49	2.67
McLean County	1.32	1.30	1.27	0.82	0.61	0.38	0.47	0.35	0.42	0.42	0.33	0.34	0.57
McKenzie County	0.35	0.50	0.45	0.29	0.21	0.16	0.11	0.35	0.26	0.13	0.09	0.27	0.33
Mountrail County	55.58	54.47	55.73	58.23	61.07	50.55	48.06	67.06	59.41	29.58	24.52	23.19	23.51
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stark County	1.39	4.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.78	3.87	2.88	0.75
Renville County	0.24	0.14	0.20	0.21	0.15	0.34	0.36	0.43	0.53	1.30	1.31	1.24	0.90
Ward County	0.48	0.44	0.41	0.60	0.57	0.65	0.67	0.80	0.68	1.02	1.04	0.97	0.72
Williams County	2.25	2.14	1.95	1.73	1.69	1.65	1.73	2.16	2.16	1.77	1.66	1.45	1.39

Source: U.S. Census Bureau

Appendix Table E29. In-flow Commuters (Where do People that Work in Renville County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Renville County												
Adams County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11	0.22	0.22	0.35
Bottineau County	7.67	9.49	9.09	18.23	17.01	18.03	15.88	13.81	12.75	13.09	11.30	12.28	14.25
Bowman County	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.12	0.11	0.22	0.11	0.22	0.35
Burke County	2.43	0.95	0.28	2.11	2.45	2.30	2.89	1.56	0.44	0.34	0.75	0.43	0.58
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.56	0.54	0.54	0.58
Dunn County	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.24	0.00	0.34	0.11	0.32	0.12
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.11	0.32	0.12
Mercer County	2.43	3.39	2.20	1.59	1.84	1.41	1.97	2.16	3.33	6.04	8.07	7.76	5.56
McHenry County	2.17	2.44	2.20	1.32	1.35	0.51	0.52	0.12	0.00	3.13	4.84	4.09	1.97
McLean County	0.77	0.14	0.14	0.00	0.00	0.77	1.44	0.24	0.33	1.12	0.65	0.65	0.35
McKenzie County	0.64	0.81	0.41	0.92	0.86	1.92	1.57	1.08	1.22	1.45	0.22	1.51	0.46
Mountrail County	1.66	0.54	0.55	1.59	0.98	1.15	1.57	4.44	2.44	2.91	2.26	4.31	2.67
Slope County	56.65	49.46	61.43	53.24	51.29	40.92	43.83	49.10	47.78	29.87	24.11	24.78	31.29
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renville County	0.00	0.00	0.00	0.00	0.00	1.41	0.66	1.08	0.33	0.45	0.32	0.43	0.70
Ward County	18.80	22.76	16.39	15.72	17.14	17.26	19.55	14.77	15.85	30.20	30.14	30.82	28.04
Williams County	0.90	2.44	1.65	2.51	2.57	4.60	2.23	2.88	3.99	1.34	2.58	2.37	2.09
Other ND	5.88	7.45	5.65	2.64	4.53	6.39	4.07	5.52	6.76	6.15	8.61	6.14	8.00
MN, SD, MT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.23
Elsewhere	0.00	0.14	0.00	0.13	0.00	2.43	2.76	2.76	4.55	2.46	5.06	2.80	2.32

Source: U.S. Census Bureau

Appendix Table E30. Outflow Commuters (Where do People that Live in Renville County Work), North Dakota, 2002-2014													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.11	0.00	0.10	0.00	0.00	0.10	0.10	0.09	0.00	0.00	0.00	0.10	0.10
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bottineau County	0.60	1.79	1.94	1.12	1.23	1.33	1.63	3.26	2.42	1.73	1.84	2.16	2.47
Bowman County	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.15	0.00	0.07	0.06	0.00	0.06
Burke County	0.00	0.00	1.67	1.84	0.95	0.92	0.21	0.40	0.93	0.56	1.84	2.32	0.79
Divide County	0.00	3.52	2.37	2.23	1.66	0.47	1.63	1.21	0.00	0.67	0.38	0.27	0.25
Dunn County	0.11	0.33	0.11	0.11	0.20	0.00	0.00	0.21	0.38	0.15	0.04	0.32	0.06
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hettinger County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mercer County	0.00	0.00	0.10	0.29	0.19	0.31	0.45	0.36	0.29	0.08	0.49	0.25	0.47
McHenry County	0.15	0.00	0.43	0.22	0.07	0.33	0.37	0.32	0.30	0.47	0.45	0.22	0.19
McLean County	0.04	0.00	0.04	0.00	0.00	0.24	0.13	0.14	0.16	0.13	0.07	0.09	0.12
McKenzie County	0.00	0.00	0.00	0.04	0.08	0.05	0.09	0.12	0.17	0.11	0.11	0.02	0.04
Mountrail County	0.33	0.21	0.36	0.16	0.21	0.20	0.40	0.38	0.51	1.05	1.20	0.99	0.51
Slope County	56.65	49.46	61.43	53.24	51.29	40.92	43.83	49.10	47.78	29.87	24.11	24.78	31.29
Stark County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renville County	0.00	0.00	0.01	0.00	0.01	0.04	0.04	0.03	0.10	0.09	0.11	0.11	0.17
Ward County	0.84	0.61	1.45	1.04	0.82	0.93	1.09	1.02	1.03	0.90	0.86	0.89	0.84
Williams County	0.18	0.30	0.30	0.18	0.38	0.15	0.12	0.23	0.33	0.22	0.31	0.23	0.18

Source: U.S. Census Bureau

Appendix Table E31. In-flow Commuters (Where do People that Work in Slope County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	---------- Percentage of Jobs in Slope County ----------												
Adams County	0.00	0.00	0.00	0.91	4.30	2.06	0.93	0.00	0.00	4.31	5.28	7.91	1.49
Billings County	0.00	0.00	0.00	0.00	0.00	0.00	3.74	0.00	2.36	1.44	1.06	2.16	0.37
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bowman County	13.89	23.94	12.82	20.00	17.20	28.87	22.43	52.46	18.11	18.18	15.14	17.27	22.39
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37
Dunn County	5.56	4.23	8.97	6.36	8.60	0.00	3.74	4.10	3.15	5.26	1.41	2.16	1.12
Golden Valley County	1.39	4.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.78	3.87	2.88	0.75
Hettinger County	0.00	0.00	1.28	3.64	0.00	0.00	1.40	4.10	0.79	1.44	5.28	2.52	1.49
Mercer County	0.00	0.00	0.00	0.00	0.00	1.03	0.00	0.00	0.79	0.96	0.35	0.36	0.37
McHenry County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	1.44	3.87	3.96	3.73
McLean County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
McKenzie County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mountrail County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stark County	61.11	52.11	43.59	32.73	27.96	25.77	13.55	0.00	30.71	14.35	10.56	14.75	17.16
Renville County	0.00	0.00	6.41	12.73	7.53	7.22	17.29	26.23	25.98	27.75	26.76	18.35	24.25
Ward County	1.39	0.00	6.41	6.36	6.45	8.25	6.54	1.64	1.57	2.39	2.11	1.08	0.37
Williams County	4.17	1.41	5.13	2.73	4.30	0.00	1.40	0.00	0.00	0.48	1.06	0.36	0.37
Other ND	1.39	2.82	6.41	6.36	2.15	1.03	3.74	1.64	1.57	0.48	2.46	2.16	3.36
MN, SD, MT	9.72	1.41	3.85	4.55	7.53	15.46	9.35	5.74	3.94	8.61	12.32	17.99	20.15
Elsewhere	1.39	9.86	5.13	3.64	13.98	10.31	15.89	4.10	10.24	8.13	8.45	6.12	2.24

Source: U.S. Census Bureau

Appendix Table E32. Outflow Commuters (Where do People that Live in Slope County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.55	0.00	1.13	0.41	0.51	1.28	0.58	0.09	0.88	1.40	1.52	1.29	0.30
Billings County	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.00	0.32	1.11	1.34	0.99
Bottineau County	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Bowman County	3.96	4.66	4.23	3.76	5.60	4.87	3.96	0.15	4.22	4.03	3.80	3.83	3.38
Burke County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Divide County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunn County	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.10	0.10	0.67	0.26	0.99	0.22
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	1.53	2.45	2.17	1.47
Hettinger County	1.05	0.00	0.85	1.52	2.17	1.86	1.30	0.19	3.06	2.06	3.55	3.81	3.18
Mercer County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
McHenry County	0.00	0.00	0.00	0.00	0.13	0.05	0.78	0.14	0.53	0.39	0.29	0.24	0.19
McLean County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.06
McKenzie County	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.00	0.00	0.04	0.00	0.04	0.02
Mountrail County	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.06	0.02	0.27	0.23	0.25	0.17
Slope County	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stark County	61.11	52.11	43.59	32.73	27.96	25.77	13.55	0.00	30.71	14.35	10.56	14.75	17.16
Renville County	0.23	0.22	0.17	0.15	0.16	0.22	0.31	0.03	0.29	0.49	0.47	0.62	0.40
Ward County	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.02	0.02	0.03	0.04	0.03
Williams County	0.00	0.01	0.00	0.01	0.03	0.00	0.03	0.01	0.01	0.01	0.04	0.08	0.09

Source: U.S. Census Bureau

Appendix Table E33. In-flow Commuters (Where do People that Work in Stark County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	---------- Percentage of Jobs in Stark County ----------												
Adams County	0.19	0.20	0.33	0.26	0.25	0.49	0.59	0.46	0.65	1.03	1.15	1.25	0.69
Billings County	0.82	0.80	0.62	0.97	0.85	0.93	0.74	0.70	0.76	1.18	1.10	1.06	0.85
Bottineau County	0.03	0.08	0.08	0.03	0.09	0.09	0.13	0.21	0.27	0.34	0.42	0.35	0.37
Bowman County	0.37	0.60	0.58	0.29	0.45	0.58	0.72	0.76	0.80	1.09	0.97	0.90	0.60
Burke County	0.01	0.05	0.05	0.03	0.08	0.06	0.02	0.06	0.02	0.03	0.13	0.11	0.10
Divide County	0.03	0.03	0.01	0.04	0.04	0.04	0.03	0.10	0.05	0.05	0.03	0.08	0.06
Dunn County	2.62	2.91	2.31	2.23	1.98	2.13	1.66	2.40	2.36	2.49	2.68	2.50	2.18
Golden Valley County	0.24	0.14	0.20	0.21	0.15	0.34	0.36	0.43	0.53	1.30	1.31	1.24	0.90
Hettinger County	1.19	1.29	1.35	1.19	1.26	1.43	1.86	1.90	1.43	1.63	1.89	1.83	1.30
Mercer County	0.19	0.25	0.27	0.16	0.23	0.05	0.20	0.16	0.14	0.21	0.26	0.29	0.34
McHenry County	0.72	0.74	0.76	0.56	0.45	0.30	0.37	0.38	0.85	0.78	1.05	1.15	1.18
McLean County	0.43	0.54	0.32	0.45	0.47	0.54	0.56	0.55	0.55	0.48	0.52	0.50	0.52
McKenzie County	0.59	0.43	0.46	0.47	0.43	0.61	0.52	0.49	0.74	0.85	0.80	0.71	0.70
Mountrail County	0.31	0.21	0.14	0.26	0.20	0.13	0.15	0.26	0.30	0.46	0.63	0.61	0.57
Slope County	0.00	0.00	0.01	0.00	0.01	0.04	0.04	0.03	0.10	0.09	0.11	0.11	0.17
Stark County	0.23	0.22	0.17	0.15	0.16	0.22	0.31	0.03	0.29	0.49	0.47	0.62	0.40
Renville County	80.89	79.96	79.23	80.61	80.58	75.13	73.67	72.26	70.17	65.84	59.96	57.32	57.47
Ward County	1.00	0.96	1.19	1.10	1.08	2.19	2.71	2.59	2.50	2.82	2.71	3.40	4.29
Williams County	1.63	1.68	1.35	1.87	1.88	2.23	2.19	2.43	2.49	2.21	2.43	2.96	3.61
Other ND	6.76	6.99	8.75	7.53	8.14	9.75	10.41	11.03	11.11	10.43	11.54	11.22	11.30
MN, SD, MT	1.47	1.62	1.74	1.52	1.16	2.23	2.34	2.18	3.04	4.28	6.25	6.78	6.86
Elsewhere	0.29	0.30	0.07	0.08	0.04	0.48	0.41	0.58	0.85	1.92	3.59	5.00	5.54

Source: U.S. Census Bureau

Appendix Table E34. Outflow Commuters (Where do People that Live in Stark County Work), North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	4.58	3.45	5.95	4.28	5.88	9.68	7.57	4.76	5.37	5.40	7.70	6.96	4.72
Billings County	24.39	24.43	14.84	26.52	23.53	32.66	31.43	28.85	32.74	28.16	28.57	29.60	30.86
Bottineau County	0.00	0.00	0.15	0.04	0.00	0.74	0.52	0.40	0.35	0.25	0.96	0.66	0.94
Bowman County	3.72	4.29	4.38	5.45	5.15	6.51	6.76	3.64	3.43	5.57	7.23	6.69	6.08
Burke County	0.00	2.59	2.63	0.92	0.24	3.21	0.62	0.60	0.46	0.97	2.19	2.65	1.46
Divide County	4.20	3.81	3.80	4.94	3.31	13.13	14.98	8.12	0.86	0.27	0.57	0.91	1.08
Dunn County	16.04	16.54	20.94	19.23	19.76	24.95	24.00	16.82	17.92	17.66	17.83	17.84	21.47
Golden Valley County	10.57	17.38	11.69	7.30	8.03	10.63	7.03	7.38	5.93	8.74	11.65	8.38	7.08
Hettinger County	6.30	6.42	6.84	7.09	7.78	4.74	6.05	5.07	6.29	7.29	9.62	8.06	10.42
Mercer County	0.19	0.08	0.39	0.10	0.29	0.23	0.30	0.87	0.43	0.33	0.65	0.16	0.23
McHenry County	4.35	3.02	5.65	3.34	5.70	9.76	9.82	7.35	5.72	5.23	7.26	6.51	6.62
McLean County	0.36	0.28	0.71	0.67	0.61	2.09	2.23	1.56	1.06	1.29	1.04	1.22	1.08
McKenzie County	1.33	1.48	2.01	2.15	1.62	2.26	2.00	1.96	1.55	1.79	1.30	1.94	1.85
Mountrail County	0.37	0.93	0.68	1.38	1.30	1.55	1.95	1.11	2.69	4.66	4.32	4.11	4.36
Slope County	0.00	0.00	0.00	0.00	0.00	1.41	0.66	1.08	0.33	0.45	0.32	0.43	0.70
Stark County	0.00	0.00	6.41	12.73	7.53	7.22	17.29	26.23	25.98	27.75	26.76	18.35	24.25
Renville County	80.89	79.96	79.23	80.61	80.58	75.13	73.67	72.26	70.17	65.84	59.96	57.32	57.47
Ward County	0.39	0.29	0.35	0.37	0.33	0.80	0.90	1.03	0.98	0.90	1.42	1.37	1.53
Williams County	4.34	4.05	3.25	3.11	3.49	4.21	4.84	4.15	3.92	4.09	3.88	4.05	4.25

Source: U.S. Census Bureau

Appendix Table E35. In-flow Commuters (Where do People that Work in Ward County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Ward County												
Adams County	0.06	0.00	0.00	0.00	0.00	0.02	0.01	0.07	0.10	0.06	0.09	0.12	0.08
Billings County	0.00	0.00	0.00	0.01	0.00	0.02	0.02	0.04	0.03	0.06	0.04	0.07	0.05
Bottineau County	0.80	0.74	0.58	1.17	1.08	1.25	1.10	1.12	1.35	1.61	1.35	1.23	1.27
Bowman County	0.00	0.05	0.03	0.05	0.03	0.05	0.07	0.07	0.04	0.08	0.08	0.13	0.10
Burke County	0.41	0.64	0.35	0.66	0.78	0.55	0.40	0.53	0.50	0.43	0.45	0.46	0.45
Divide County	0.02	0.01	0.05	0.02	0.02	0.13	0.08	0.08	0.10	0.24	0.25	0.24	0.17
Dunn County	0.13	0.09	0.13	0.06	0.06	0.12	0.08	0.10	0.14	0.18	0.19	0.18	0.17
Golden Valley County	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.07	0.06	0.04	0.04
Hettinger County	0.03	0.02	0.05	0.02	0.04	0.06	0.07	0.05	0.04	0.09	0.08	0.13	0.11
Mercer County	2.05	1.73	3.01	2.45	2.56	2.24	2.35	2.96	3.11	2.88	3.02	3.07	2.77
McHenry County	0.13	0.19	0.18	0.09	0.13	0.27	0.15	0.16	0.20	0.75	0.91	0.83	0.54
McLean County	0.52	0.61	0.63	0.81	1.05	0.87	0.97	1.28	1.17	1.08	1.18	1.15	1.23
McKenzie County	0.18	0.22	0.27	0.27	0.28	0.41	0.26	0.32	0.29	0.28	0.32	0.31	0.32
Mountrail County	0.48	0.44	0.41	0.60	0.57	0.65	0.67	0.80	0.68	1.02	1.04	0.97	0.72
Slope County	0.84	0.61	1.45	1.04	0.82	0.93	1.09	1.02	1.03	0.90	0.86	0.89	0.84
Stark County	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.02	0.02	0.03	0.04	0.03
Renville County	0.39	0.29	0.35	0.37	0.33	0.80	0.90	1.03	0.98	0.90	1.42	1.37	1.53
Ward County	85.11	85.06	82.05	83.55	83.00	78.64	78.37	75.93	74.64	73.52	71.14	69.61	70.11
Williams County	0.45	0.49	0.36	0.68	0.66	1.58	1.50	1.55	1.58	1.55	1.47	1.77	2.04
Other ND	7.36	7.75	9.06	7.34	7.79	10.68	10.92	11.71	12.48	12.13	12.50	12.67	12.78
MN, SD, MT	0.78	0.77	0.72	0.60	0.55	0.59	0.71	0.76	0.98	1.38	2.05	2.50	2.28
Elsewhere	0.26	0.28	0.32	0.20	0.26	0.14	0.23	0.41	0.52	0.77	1.46	2.21	2.38

Source: U.S. Census Bureau

Appendix Table E36. Outflow Commuters (Where do People that Live in Ward County Work), North Dakota, 2002-2014													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	2.94	2.80	3.08	2.45	3.75	1.88	2.62	1.12	0.88	1.60	1.11	0.89	0.70
Billings County	0.00	0.00	0.00	0.00	0.00	3.02	1.43	2.69	1.49	0.95	3.71	3.85	4.79
Bottineau County	5.17	6.27	5.67	4.83	5.36	5.82	6.28	7.33	7.66	13.66	12.08	12.41	10.70
Bowman County	1.58	0.60	1.28	1.15	0.90	0.43	0.43	1.17	0.50	0.67	1.59	1.83	1.66
Burke County	10.98	13.21	16.47	8.06	10.93	9.63	11.73	9.60	12.65	30.18	26.96	24.42	20.81
Divide County	2.26	0.59	0.47	0.00	0.00	0.94	0.98	1.21	0.86	11.62	22.43	15.47	8.17
Dunn County	2.75	2.83	2.58	2.56	2.42	3.52	1.16	0.31	1.14	2.59	3.34	2.94	2.61
Golden Valley County	1.91	4.59	5.51	1.74	3.66	2.74	1.05	0.72	1.34	1.53	1.01	1.01	1.74
Hettinger County	1.05	1.35	1.03	0.17	0.54	1.44	0.00	0.75	0.16	0.63	0.89	1.47	1.45
Mercer County	12.80	28.63	14.62	17.70	14.38	26.77	27.08	22.65	24.73	22.12	22.12	20.08	18.87
McHenry County	3.34	3.45	3.93	4.89	6.62	6.89	4.94	4.67	5.64	7.82	9.06	7.70	5.99
McLean County	7.45	8.01	6.93	5.84	6.22	5.53	5.70	4.95	4.37	4.49	5.31	5.04	4.87
McKenzie County	2.47	2.65	2.83	2.84	3.15	2.62	2.23	2.35	2.15	1.85	1.85	1.56	1.87
Mountrail County	10.74	11.36	10.36	10.97	10.06	9.88	11.20	6.57	8.82	22.18	19.93	21.54	19.62
Slope County	18.80	22.76	16.39	15.72	17.14	17.26	19.55	14.77	15.85	30.20	30.14	30.82	28.04
Stark County	1.39	0.00	6.41	6.36	6.45	8.25	6.54	1.64	1.57	2.39	2.11	1.08	0.37
Renville County	1.00	0.96	1.19	1.10	1.08	2.19	2.71	2.59	2.50	2.82	2.71	3.40	4.29
Ward County	85.11	85.06	82.05	83.55	83.00	78.64	78.37	75.93	74.64	73.52	71.14	69.61	70.11
Williams County	2.58	2.74	2.77	2.18	2.37	3.65	4.24	5.47	5.56	7.29	7.14	7.24	6.57

Source: U.S. Census Bureau

Appendix Table E37. In-flow Commuters (Where do People that Work in Williams County Live) North Dakota, 2002-2014

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Williams County												
Adams County	0.05	0.00	0.01	0.00	0.03	0.07	0.07	0.09	0.19	0.24	0.27	0.19	0.25
Billings County	0.03	0.09	0.17	0.15	0.24	0.13	0.12	0.15	0.11	0.08	0.15	0.15	0.10
Bottineau County	0.33	0.29	0.13	0.26	0.35	0.32	0.41	0.39	0.42	0.61	0.52	0.41	0.34
Bowman County	0.02	0.00	0.00	0.01	0.01	0.12	0.15	0.14	0.27	0.34	0.27	0.36	0.27
Burke County	0.52	0.66	0.55	0.93	0.91	0.63	0.76	0.89	0.69	0.59	0.50	0.53	0.55
Divide County	0.41	0.62	0.71	0.55	0.36	0.51	0.53	0.61	0.63	0.44	0.40	0.43	0.44
Dunn County	0.23	0.11	0.11	0.13	0.24	0.35	0.38	0.38	0.43	0.50	0.50	0.42	0.37
Golden Valley County	0.24	0.10	0.13	0.07	0.14	0.09	0.12	0.05	0.04	0.18	0.20	0.17	0.17
Hettinger County	0.07	0.02	0.00	0.01	0.01	0.07	0.07	0.04	0.15	0.20	0.31	0.28	0.13
Mercer County	0.29	0.37	0.34	0.22	0.20	0.21	0.26	0.43	0.46	0.36	0.31	0.55	0.45
McHenry County	1.89	1.68	1.66	1.17	1.21	1.76	1.93	1.70	2.37	4.54	4.47	4.27	2.81
McLean County	0.44	0.34	0.46	0.25	0.47	0.13	0.23	0.36	0.44	0.20	0.38	0.31	0.37
McKenzie County	0.60	0.60	0.49	0.32	0.39	0.21	0.25	0.21	0.23	0.23	0.28	0.39	0.41
Mountrail County	2.25	2.14	1.95	1.73	1.69	1.65	1.73	2.16	2.16	1.77	1.66	1.45	1.39
Slope County	0.18	0.30	0.30	0.18	0.38	0.15	0.12	0.23	0.33	0.22	0.31	0.23	0.18
Stark County	0.00	0.01	0.00	0.01	0.03	0.00	0.03	0.01	0.01	0.01	0.04	0.08	0.09
Renville County	4.34	4.05	3.25	3.11	3.49	4.21	4.84	4.15	3.92	4.09	3.88	4.05	4.25
Ward County	2.58	2.74	2.77	2.18	2.37	3.65	4.24	5.47	5.56	7.29	7.14	7.24	6.57
Williams County	78.87	79.83	81.33	84.79	83.07	76.57	73.47	71.18	66.21	54.98	46.41	44.45	44.01
Other ND	3.34	3.18	2.88	1.88	2.19	4.57	5.34	5.23	6.36	6.70	6.89	6.88	7.08
MN, SD, MT	2.97	2.44	2.40	1.83	1.97	4.20	4.42	5.37	6.90	10.50	15.60	15.33	17.21
Elsewhere	0.33	0.43	0.37	0.21	0.24	0.40	0.51	0.78	2.11	5.96	9.52	11.84	12.57

Source: U.S. Census Bureau

Appendix Table E38. Outflow Commuters (Where do People that Live in Williams County Work), North Dakota, 2002-2014													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Percentage of Jobs in Destination Counties												
Adams County	0.00	0.04	0.15	0.07	0.04	0.20	1.03	1.03	1.04	0.68	0.96	0.58	0.82
Billings County	2.52	3.54	5.49	4.84	3.09	2.75	6.17	2.00	3.09	2.64	3.11	2.76	3.37
Bottineau County	0.00	0.00	0.21	0.10	0.10	0.40	0.68	0.47	0.20	0.00	0.20	0.30	0.70
Bowman County	0.00	0.00	0.00	0.00	0.19	0.08	0.15	0.15	0.29	1.22	0.65	0.57	0.54
Burke County	0.00	0.00	1.65	0.00	1.18	1.01	13.33	8.85	6.85	0.63	2.41	2.01	3.14
Divide County	1.78	3.08	1.27	6.22	6.13	5.63	5.54	3.45	2.76	5.61	4.71	6.55	7.09
Dunn County	2.70	3.35	2.74	2.96	3.57	4.13	3.25	2.89	3.65	4.74	4.56	4.56	5.62
Golden Valley County	0.36	0.00	0.00	0.00	0.00	0.18	0.17	0.60	0.52	0.48	0.78	0.62	0.76
Hettinger County	0.90	2.44	1.65	2.51	2.57	4.60	2.23	2.88	3.99	1.34	2.58	2.37	2.09
Mercer County	0.32	0.38	0.08	0.46	0.82	1.22	0.58	0.29	0.79	0.67	0.73	1.03	1.55
McHenry County	4.28	4.89	5.22	8.67	8.85	8.46	8.63	6.52	7.46	12.19	10.29	10.14	8.87
McLean County	0.12	0.36	0.36	0.04	0.42	0.34	0.90	0.76	0.61	0.39	0.39	0.38	0.36
McKenzie County	0.79	0.59	0.53	0.35	0.50	0.20	0.23	0.19	0.17	0.11	0.27	0.27	0.39
Mountrail County	0.66	0.33	0.78	1.92	0.71	1.54	1.58	0.94	1.53	2.14	3.51	3.96	3.87
Slope County	0.00	0.00	0.17	0.00	0.54	0.00	0.43	0.75	0.16	0.63	0.15	0.29	0.43
Stark County	0.51	0.83	0.00	0.82	0.00	0.37	0.62	0.09	0.09	0.16	0.18	0.16	0.14
Renville County	0.45	0.49	0.36	0.68	0.66	1.58	1.50	1.55	1.58	1.55	1.47	1.77	2.04
Ward County	1.63	1.68	1.35	1.87	1.88	2.23	2.19	2.43	2.49	2.21	2.43	2.96	3.61
Williams County	78.87	79.83	81.33	84.79	83.07	76.57	73.47	71.18	66.21	54.98	46.41	44.45	44.01

Source: U.S. Census Bureau

Appendix F

Historical and Projected Farm and Ranch Employment

Appendix Table F1. Farm and Ranch Operators, by Selected Counties, North Dakota, 2002-2014												
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	20
Adams County	392	399	350	342	342	338	337	354	352	347	344	3
Billings County	250	252	224	211	211	205	198	207	201	192	186	1
Bottineau County	891	908	810	771	771	753	731	762	764	759	758	7
Bowman County	376	378	334	314	314	305	290	299	304	305	306	3
Burke County	475	473	408	390	390	380	370	386	392	397	403	4
Divide County	549	551	488	456	456	436	409	419	415	407	401	3
Dunn County	624	620	540	507	507	488	467	485	496	511	527	5
Golden Valley County	240	238	208	199	199	195	194	206	208	210	213	2
Hettinger County	494	503	454	434	434	429	427	450	450	442	439	4
Mercer County	943	945	823	791	791	771	755	792	793	793	798	8
McHenry County	675	668	585	540	540	516	475	482	490	492	495	4
McLean County	976	968	842	811	811	803	797	839	828	807	791	7
McKenzie County	485	484	422	402	402	390	377	391	391	387	386	3
Mountrail County	744	734	636	595	595	573	541	557	564	568	576	5
Slope County	372	363	308	301	301	298	296	312	304	293	284	2
Stark County	270	270	243	222	222	212	194	196	199	197	196	1
Renville County	824	821	713	694	694	688	694	739	740	740	744	7
Ward County	1,092	1,050	880	835	835	807	774	801	809	813	819	8
Williams County	895	896	789	744	744	722	695	724	713	701	690	6

Source: U.S. Census Bureau

Appendix Table F2. Forecasts of Farm and Ranch Operators, by County, North Dakota, 2016-2040

Year	Adams	Billings	Bottineau	Bowman	Burke	Divide	Dunn	Golden Valley
2015	331	172	291	729	406	375	540	216
2016	330	170	290	726	403	371	536	215
2017	329	168	288	723	400	368	531	214
2018	328	166	287	720	397	365	526	212
2019	327	165	286	718	395	362	521	211
2020	326	163	284	715	392	360	517	210
2021	325	162	283	713	389	357	512	209
2022	325	160	282	711	386	355	507	208
2023	324	159	281	709	383	352	503	207
2024	323	157	280	707	380	350	498	206
2025	322	156	279	705	377	348	493	204
2026	322	155	278	703	374	346	489	203
2027	321	154	278	701	373	344	488	203
2028	320	153	277	700	373	342	487	203
2029	320	152	276	698	372	341	486	203
2030	319	151	275	696	371	339	485	202
2031	319	150	274	695	370	337	484	202
2032	318	149	274	693	370	336	483	202
2033	318	148	273	692	369	334	482	202
2034	317	147	272	691	368	333	481	202
2035	316	146	272	689	368	331	480	201
2036	316	145	271	688	367	330	480	201
2037	316	144	270	687	367	329	479	201
2038	315	143	270	685	366	327	478	201
2039	315	142	269	684	365	326	477	201
2040	314	142	269	683	365	325	477	201

- continued -

Appendix Table F2. Continued

Year	McLean	McKenzie	Mercer	Mountrail	Renville	Slope	Stark	War
2015	463	750	571	367	264	185	718	
2016	460	746	565	365	262	183	717	
2017	456	742	559	363	260	182	716	
2018	453	739	554	361	258	180	714	
2019	450	735	548	360	256	179	713	
2020	447	732	542	358	254	178	712	
2021	444	729	536	356	252	177	712	
2022	442	726	530	355	250	176	711	
2023	439	723	524	353	249	174	710	

2024	437	720	518	352	247	173	709
2025	435	717	513	351	246	172	708
2026	432	715	507	349	244	172	707
2027	430	712	504	348	243	171	707
2028	428	710	502	347	241	170	706
2029	426	708	500	346	240	169	705
2030	425	706	498	345	239	168	705
2031	423	704	496	344	238	167	704
2032	421	702	494	343	237	167	704
2033	419	700	492	342	235	166	703
2034	418	698	490	341	234	165	702
2035	416	696	488	340	233	165	702
2036	415	694	487	339	232	164	701
2037	413	692	485	338	231	163	701
2038	412	691	483	337	230	163	700
2039	411	689	482	337	229	162	700
2040	409	688	480	336	228	162	699