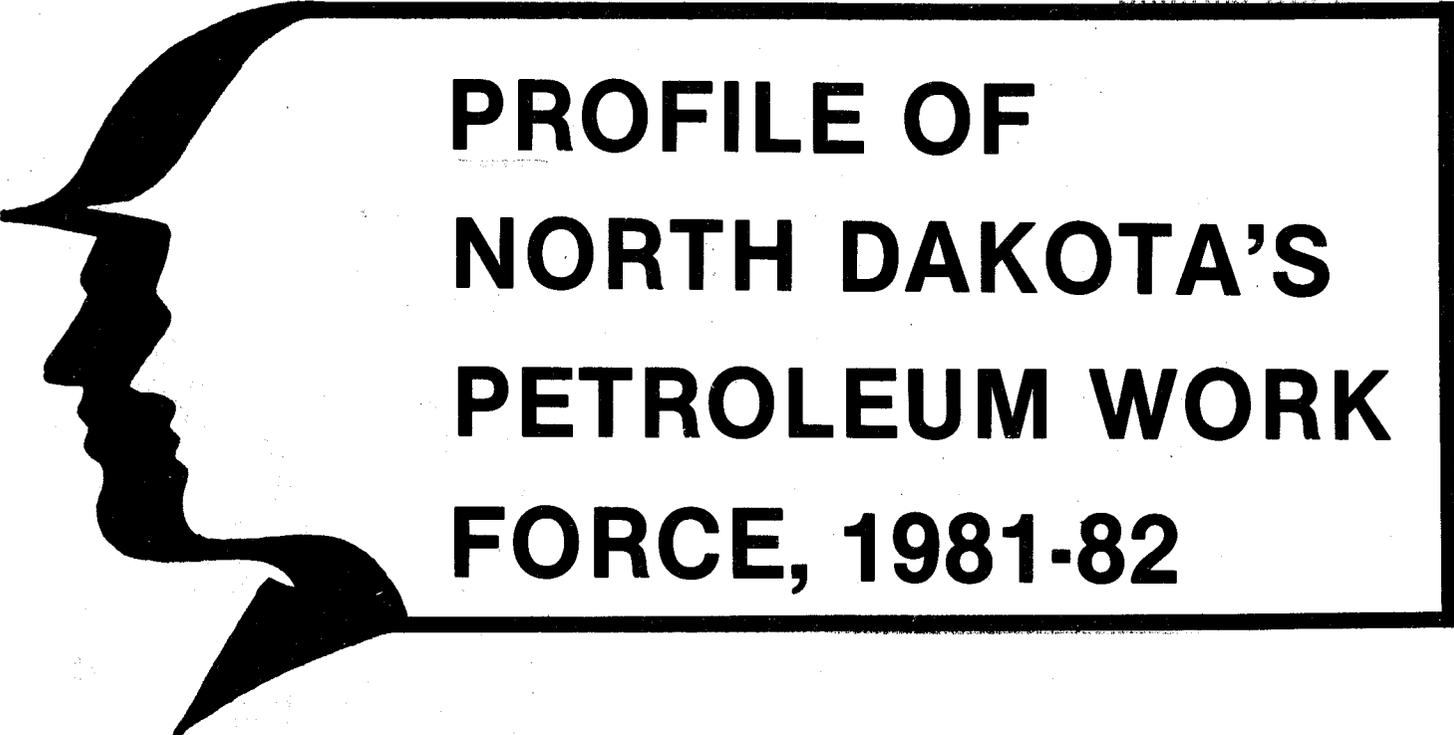


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**PROFILE OF
NORTH DAKOTA'S
PETROLEUM WORK
FORCE, 1981-82**

by

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FOREWORD

Rural areas in the western United States have experienced enormous social and economic changes due to the development of nearby energy resources. Since the late 1970s, such effects have been quite noticeable in western North Dakota, an area richly endowed in lignite coal and petroleum reserves.

This study was undertaken to assess the socioeconomic effects of rapid petroleum development in rural areas. Since the social and economic changes associated with energy resource developments depend in large measure on the nature of the work force, this report analyzes the characteristics of the petroleum industry's work force in North Dakota's Williston Basin.

The authors extend their appreciation to the petroleum workers and companies in western North Dakota for their cooperation and assistance in this study. Special thanks goes to Red Ridgeway and Dewey Heggins of the North Dakota Petroleum Council and Chuck Darden of the International Association of Geophysical Contractors. Without their support and cooperation, this study would not have been possible. We also wish to especially thank Delores Zieman, Gary Foss, Karen C. Maki, Connie L. Chase, Carlana Vocke, John Mittleider, Randy Coon, and Harvey Vreugdenhil for their valuable contributions to various aspects of the study. The authors gratefully acknowledge the manuscript reviews and valuable suggestions contributed by various faculty members of the Department of Agricultural Economics. Of course, the usual caveats apply-- errors and interpretations are solely the authors'. The financial support of the Bureau of Land Management is gratefully acknowledged.

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HIGHLIGHTS

Petroleum development in North Dakota's Williston Basin has been intense during the last two years. This recent burst of activity, which culminated in late 1981's peak of 130 drilling rigs and nearly 80 seismic crews, prompted the Oil and Gas Journal to declare the Williston Basin as the "most active oil and gas province in the United States." The rapid rise of petroleum development in North Dakota has created considerable interest regarding employment opportunities and population growth in rural communities within the western part of the state. An understanding of the various characteristics of the petroleum industry's work force may be valuable in assisting state and local policy officials plan for expanded or contracted oil activity. In order to identify such characteristics, a survey of oil and gas workers in the Williston Basin was conducted between November 1981 and May 1982. The objectives of this survey were (1) to determine the occupations, locational origins, housing requirements, commuting patterns, and family characteristics of workers; and (2) to provide the basic parameters in determining the public sector impacts of the in-migrating workers and their dependents. A questionnaire was administered to workers whose firms were located in either the regional oil cities of Dickinson and Williston, or the oil field development centers of Belfield, Bowman, Killdeer, and Watford City. A total of 1,377 workers from 167 different companies (around 35 percent response rate) returned the completed questionnaire. The returns provide a composite "snapshot" of the work force engaged in the various activities associated with petroleum exploration, development, and production.

Just over 50 percent of the work force completing the survey were nonlocal (a nonlocal or in-migrant worker is one whose previous residence was outside of North Dakota's 17 petroleum-producing counties). The average age for both in-migrant and local workers was around 30 years. Three out of five workers were married. Although the average household size of the in-migrant worker is significantly smaller than his local counterpart, both nonlocal and local workers have nearly three-fourths of their children in the pre- and primary school age categories.

The vast majority of both in-migrants and locals indicated that their opportunity to work in the Williston Basin "oil patch" was relatively recent--within the last two years. Most of the in-migrant workers have come from other parts of North Dakota, neighboring states, and other areas (e.g., Wyoming, Texas, Utah, Colorado, Alberta) experiencing petroleum development. Over three-fourths of these in-migrant workers had resided within the local area for less than two years.

The emerging commuting and housing patterns, important in determining the location and magnitude of community impacts, reveal that commuting distances for both local and nonlocal workers are surprisingly similar, while housing types differ a great deal. For instance, nearly 34 percent of the in-migrant workers compared with 27 percent of the local workers live in mobile homes. The type of dwelling is somewhat reflective of a worker's occupation. Workers with such occupations as truck drivers, mechanics, laborers, and well-drillers, most of which are nonlocals, reside in mobile homes. In contrast, the majority of supervisors, professionals, engineers, and sales representatives (composed mostly of locals) reside in single family dwellings. Such housing patterns have significant consequences for local communities--in the case of mobile homes, a substantial reduction in taxable value compared to single family dwellings.

PROFILE OF NORTH DAKOTA'S PETROLEUM WORK FORCE, 1981-82

by

Robert A. Chase and F. Larry Leistritz*

Since the 1970s, many rural areas in the western United States have been the sites for various energy resource developments. These large-scale development projects, whether uranium mining in New Mexico, coal-fired electrical generation plants in Wyoming, or oil shale processing facilities in Colorado, have created significant socioeconomic and environmental changes for their host areas. Energy developments in North Dakota have generally been in the form of coal extraction and conversion facilities to exploit the state's enormous reserves of recoverable lignite coal. The socioeconomic effects associated with the development of such facilities in North Dakota have been well-documented (Murdock and Leistritz, 1979; Toman et al., 1976; Leistritz et al., 1981; and Leistritz and Maki, 1981).

In recent years, the rapid rise in petroleum development in North Dakota's Williston Basin (Figure 1) has created considerable interest among residents and policy makers. The recent burst of activity, which culminated in late 1981's peak of 130 drilling rigs and nearly 80 seismic crews, prompted some industry trade journals to declare the Williston Basin as the "most active oil and gas province in the United States" (McCaslin, 1981). One immediate effect of this petroleum development in western North Dakota is the increase in local employment opportunities. Historically, rural areas have experienced a dearth of employment opportunities that has led to high levels of out-migration (Voelker, 1971). The rise in petroleum development has slowed this process of out-migration by providing employment for youth and formerly underemployed local workers (Riley, et al., 1982; and Smith and Vangness, 1981).

The expansion of the petroleum industry will not only involve local workers who are either underemployed or would otherwise migrate out of the area, but also includes an influx of large numbers of people migrating into the region's rural communities. A continued rise in petroleum activity could cause the population of some of these communities to double or triple in a few years. This rapid growth associated with petroleum activity requires careful planning and accurate estimates of both the direct and indirect effects of future development.

The economic and social changes associated with any type of energy development largely depends on the nature of the work forces that accompany the various energy projects. Information on the workers' characteristics, commuting and residential patterns, and family characteristics is needed for policy makers to make reasonable impact projections for required community services. The accuracy of these assessments will also critically depend on work force composition between local and nonlocal (i.e., in-migrating) workers. This report analyzes the characteristics of the petroleum industry's work force in

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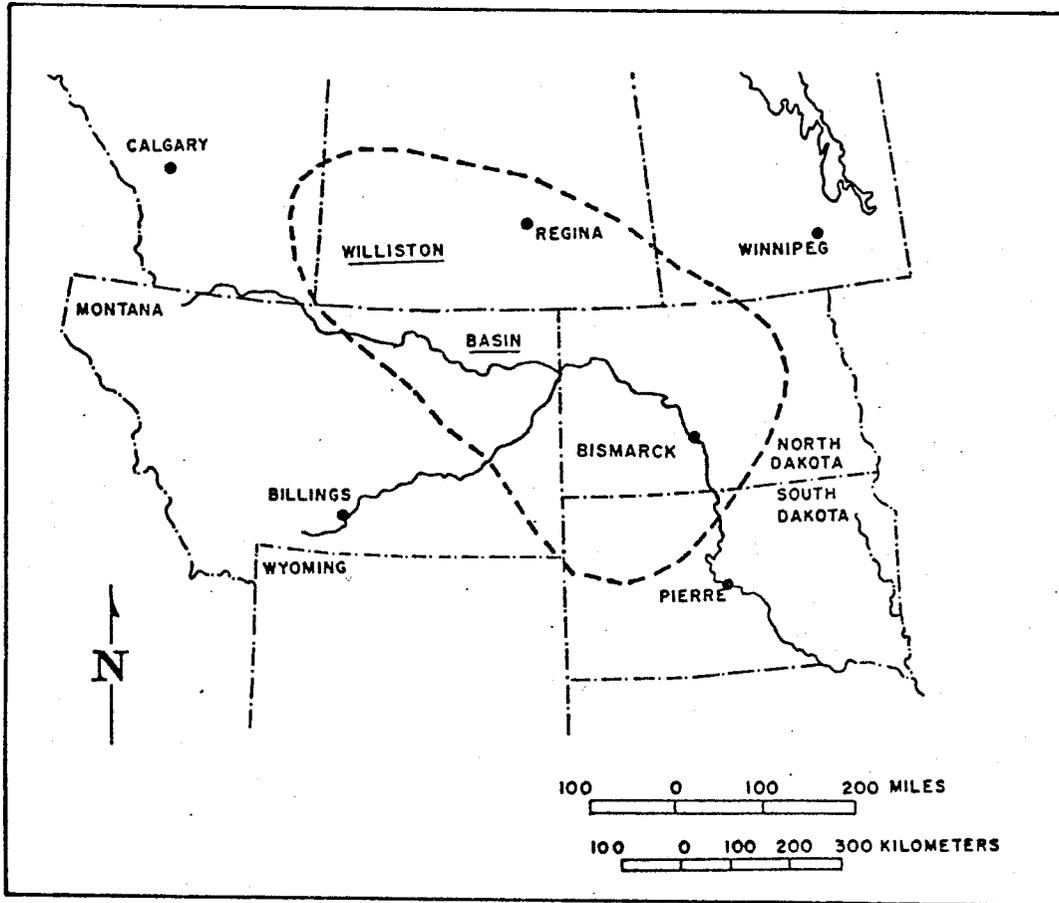


Figure 1. Location of Williston Basin

SOURCE: Gerhard and Anderson, 1981.

North Dakota's Williston Basin. The intention here is to present a composite "snapshot" of the industry's work force such that projections of future development, whether accelerated or decelerated, could be partially based on the patterns which have emerged during this development period in the region.

A considerable amount of documentation exists regarding energy work force profiles. Past studies provide insight on local participation rates, settlement and commuting patterns, family characteristics, and migration rates of energy workers. Much of this past work on energy work force characteristics has focused on the construction and/or operation workers of coal-fired electrical generation facilities (Leholm et al., 1976; Wieland et al., 1977, 1979; Mountain West Research, Inc., 1975), nuclear power plants (Malhotra and Manninen, 1981; Herzog et al., 1981), uranium mines (Dobbs and Kiner, 1974a, 1974b; Rapp, 1980; Murdock et al., 1981), water resource developments (Dunning, 1981; Mountain West Research, Inc., 1977), and offshore petroleum development (Fuchs, 1982; Storey, 1982; Husky, 1982; and Nebesky, 1982).

In contrast, very little documentation exists on the worker characteristics of onshore petroleum development.¹ This lack of adequate information is partially explained first, by the multifaceted nature of the petroleum industry and the general reluctance of operators to provide exploration, development, and production information; and second, by the dispersed nature of onshore petroleum development that has generally not been subjected to the requirements of environmental impact assessment regulations (Chase and Leistritz, 1982). Prior research on energy development work force profiles provides valuable insights, but due to special characteristics peculiar to the petroleum industry these studies do not address all of the problems and aspects unique to onshore petroleum development. The most notable difference is, unlike other types of energy resource developments which have a clearly defined transition between construction and operation phases, onshore petroleum development involves several different activities sequenced over time in loose relationship to one another. Another significant difference is petroleum development tends to be more labor and capital intensive during the exploration than the production phase. Such is the opposite with other energy resource and hard-rock mining developments.

The objectives of the study were: (1) to determine the locational origins, length of employment, housing requirements, commuting and residential patterns, and family characteristics of petroleum workers; and (2) to provide basic parameters for determining public sector impacts of the in-migrating population. For instance, housing preferences, average family size, and commuting patterns will influence the location of impacts and the type and quality of public services that will be required to meet the needs of the work force and their dependents.

This report is divided into five sections: (1) discussion of the historical development of petroleum activity in North Dakota's Williston Basin; (2) description of the methodology used in conducting the study; (3) presentation of general characteristics of the petroleum work force in North Dakota; (4) analysis of worker profiles by specific occupation type and communities of residence; and (5) summary and implications of findings.

Background Setting

Petroleum development began in North Dakota in 1951 when the Amerada Petroleum Corporation made a discovery in a geologic formation called the Nesson Anticline (Gerhard and Anderson, 1979, Campbell et al., 1958). This discovery coupled with attractive market conditions initiated the first boom within the Williston Basin. Most of the drilling activity was located in the northwestern portion of the state, with subsequent activity outlining a broad area of western and west central counties in North Dakota that currently produce oil and natural gas (Figure 2). This intensive development period began to level off during the early 1960s (Table 1), with much of the drilling activity concentrated on the

¹The only documented exception is a recent survey of construction workers at a natural gas processing plant in Wyoming's Overthrust Belt region (Skinner, 1982). In addition, a recently published volume discusses social change due to oil development in five Texas towns during the 1920s and 1930s (Olien and Olien, 1982).

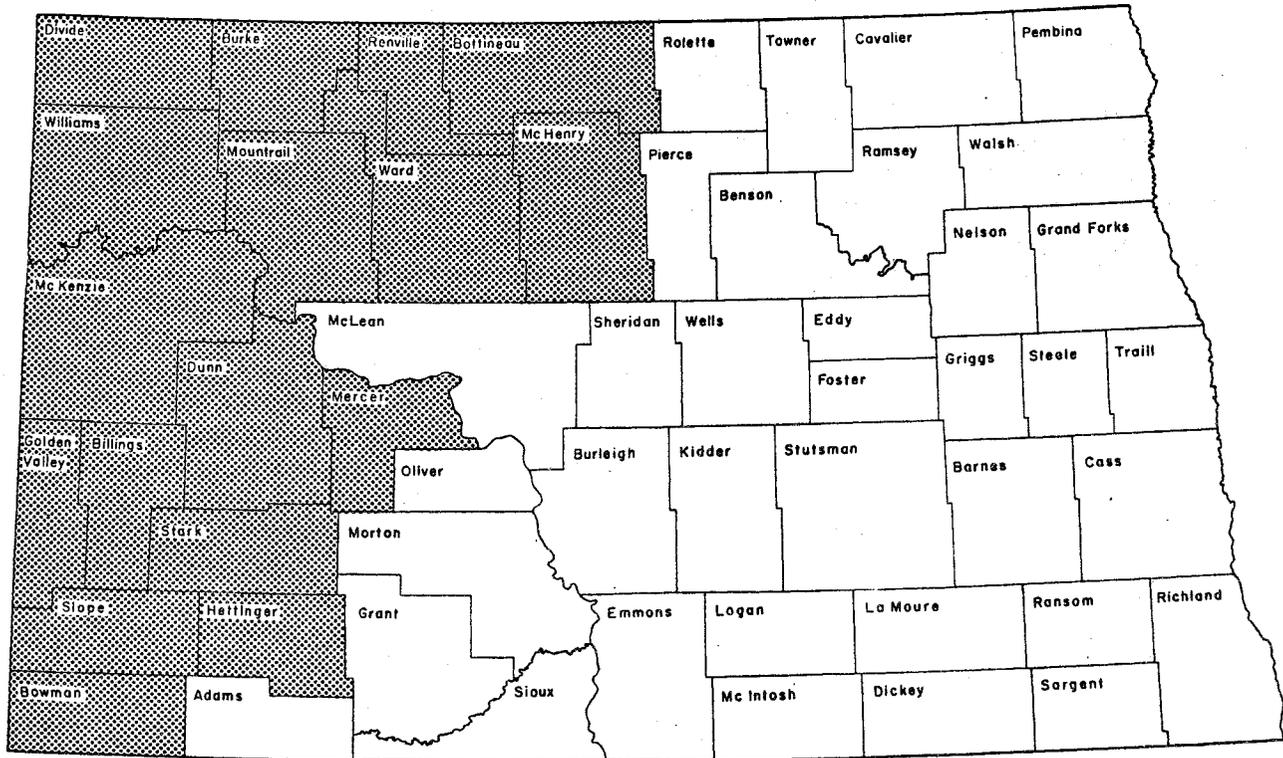


Figure 2. Oil Producing Counties in North Dakota, 1982

development of existing oil fields. In spite of a significant field discovery and development of the Red River formation in southwestern North Dakota, low domestic prices discouraged exploratory drilling within the state. After reaching a peak state production of 27 million barrels in 1966, crude oil production declined steadily thereafter until the mid-1970s.

During the 1970s, a number of factors combined to make the Williston Basin once again an attractive region for petroleum exploration and development. Factors most notable were the quadrupling of world petroleum prices following the OPEC embargo, technological advances within the petroleum exploration sector, and high success ratios of drilling in North Dakota. For instance, the significance of improved seismology becomes obvious when noting over two-thirds of the existing 454 pools in North Dakota have been discovered since 1974 (Anderson and Bluemle, 1982). The major producing fields in this latest boom lie in the western counties of McKenzie, Billings, Dunn, and Williams. Though this recent boom has been recognized since 1975, the rate of activity ballooned beyond all predictions. Indicative of such activity is the rapid buildup in drilling operations in the Williston Basin, where the 1982 totals in wells drilled (exploratory and development) represent a 294 percent increase over 1975 figures (Table 2). State production of petroleum has also experienced phenomenal growth in recent years. Although not a leading indicator as drilling activity, last year's (1982) production of 47.3 million barrels of oil represents an 83 percent increase over 1978 totals (American Petroleum Institute, 1983). In spite of the recent downturn in region-wide

TABLE 1. ANNUAL AVERAGE ROTARY RIG ACTIVITY IN NORTH DAKOTA, 1950-1982

Year	Rigs	Year	Rigs
1950	1	1967	11
1951	4	1968	13
1952	24	1969	12
1953	31	1970	9
1954	32	1971	9
1955	23	1972	7
1956	24	1973	10
1957	31	1974	12
1958	33	1975	17
1959	30	1976	19
1960	16	1977	24
1961	15	1978	39
1962	14	1979	56
1963	9	1980	83
1964	14	1981	119
1965	12	1982	69
1966	12		

SOURCE: American Petroleum Institute, Basic Petroleum Data Book, 1983.

TABLE 2. TOTAL WELLS DRILLED IN NORTH DAKOTA, 1967-1982

Year	Exploratory	Development	Total
1967	60	93	153
1968	121	62	183
1969	178	74	252
1970	109	58	167
1971	97	62	159
1972	65	34	99
1973	72	50	122
1974	74	53	127
1975	109	98	207
1976	116	118	234
1977	106	118	224
1978	163	164	327
1979	144	220	364
1980	242	343	585
1981	377	364	741
1982	448	367	815

SOURCE: American Petroleum Institute, Basic Petroleum Data Book, 1983.

petroleum activity (notably exploratory and drilling), the Williston Basin continues to be one of the most promising and least risky onshore hydrocarbon provinces in the United States.

Methodology

The importance of petroleum development to North Dakota can be underscored in many respects including additions to the state's general revenue fund, increases in personal income, and creation of jobs. Employment estimates, for instance, have varied from about 12,000 direct employment workers to 6,160 employees² (Hough, 1982; North Dakota Petroleum Council, 1983). Another study, which utilized the state's input-output model, estimated the 1982 direct petroleum work force at 4,150 workers with an employment multiplier of 2.54 (Leholm et al., 1982). The vast majority of these workers were located in the western region of the state.

The petroleum industry in North Dakota is essentially distributed between two distinct types of centers: (1) regional oil cities (e.g., Dickinson, Williston); and (2) field development centers (e.g., Belfield, Killdeer, and Watford City). In both types, location plays an important part in the town's emergence as an oil-related center. Regional oil cities contain significant agglomeration economies in commercial, financial, and business services from their prior development as regional retail centers. Less directly reliant on drilling and production in a single field than on area-wide activity, these regional cities have grown in response to regional petroleum development. Hence, many of the oil producers, drilling subcontractors, field service and equipment supply companies have located their region-wide offices in these centers. In contrast to the regional cities, field development centers are located near major producing fields. Tied more directly to the level of nearby petroleum activity, these centers tend to experience more dramatic population gains and when they occur, precipitous declines (Olien and Olien, 1982). As such, field development centers have developed into the logical locations for branch operations of oil producers and supporting field services and supplies as well as gas processing facilities (Chase and Rathge, 1982). These regional cities and field development centers became the principal sites within the study area for surveying the petroleum industry's work force (Figure 3).

A survey was conducted between November 1981 and May 1982 in the regional oil cities of Dickinson, Minot, and Williston; and the field development centers of Belfield, Bowman, Killdeer, Tioga, and Watford City. By using secondary data sources, it was predetermined that nearly 85 percent of the petroleum-related companies were located in centers (Western Oil Reporter, 1982).

After receiving endorsements by the various petroleum industry associations (notably the North Dakota Petroleum Council, American Petroleum Institute, and International Association of Geophysical Contractors), the survey questionnaire was first presented to company officials who later administered the questionnaire to their own employees at the work site.

²These direct workers are primarily engaged in exploratory and extractive activities.

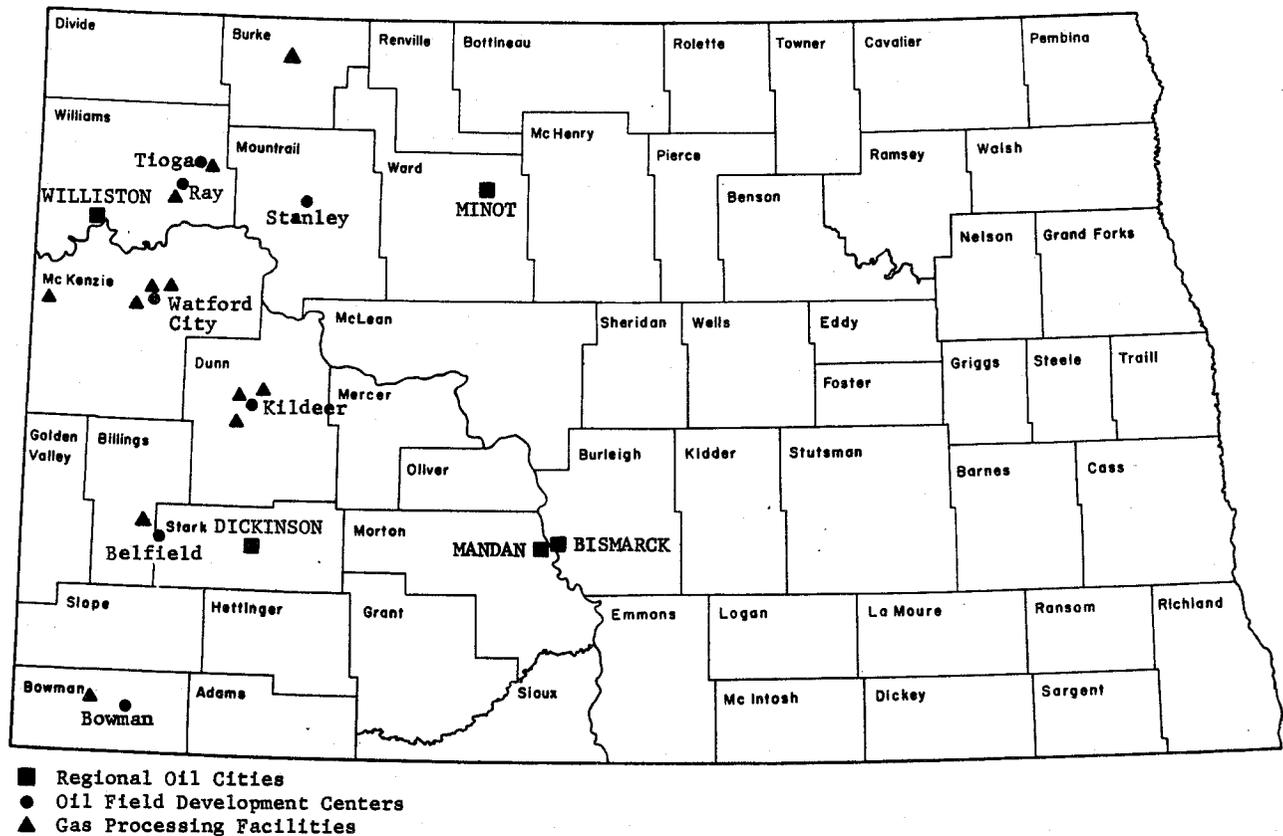


Figure 3. Regional Oil Cities and Oil Field Development Centers in North Dakota

A total of 1,377 workers representing 167 different petroleum-related companies returned the completed questionnaire for a 35 percent response rate. These returns provide a composite picture of the petroleum industry's work force in North Dakota engaged in various activities and occupations associated with petroleum exploration, development, and production. Workers represented such company types as the principal actors of oil and gas producing firms, oil well drilling contractors, and geophysical/shot hole operators, along with the host of ancillary oil field service and supply firms operating in the "oil patch" (Table 3).

General Socioeconomic Characteristics

One of the most critical factors in assessing the impacts of a large-scale energy development is the number of local and nonlocal workers in the project work force (Leistritz and Murdock, 1981). Characteristics of these workers and their families will affect the area's overall level of population growth. These worker characteristics will affect not only the magnitude but also the nature of impacts experienced in a community. For instance, various dimensions of the work force composition will affect the nature of community service demands.

TABLE 3. SURVEY COVERAGE OF NORTH DAKOTA'S PETROLEUM INDUSTRY, BY COMPANY TYPE

Type of Company ^a	Number Surveyed	Total in Region	Percent Surveyed
Oil & Gas Exploration/Production	15	114	13.2
Oil Refineries/Gas Processing	3	14	21.4
Drilling and Workover Contractors	14	35	40.0
Geophysical/Shot Hole Contractors	5	5	100.0
Equipment and Supplies	61	232	26.3
Services	60	236	25.4
Other	5	61	8.2
No Response	6	--	--
TOTAL	167	697	24.0

^aIncludes businesses and subsidiaries as well as separate establishments within North Dakota's Williston Basin. Firms listing Mandan or Bismarck as local addresses were excluded.

SOURCE: Western Oil Reporter, 1982.

Results of the survey indicate that slightly over half of the respondents were classified as in-migrants or nonlocal (Table 4). A nonlocal is defined as one whose previous residence (of five years or earlier) was outside of North Dakota's 17 petroleum-producing counties (see Figure 2). The underlying assumption was that most of these nonlocals did in-migrate for the purpose of employment within the petroleum industry.³ This is not to deny that locals moved within the region to take advantage of oil and gas employment. In fact, considerable movement did occur even within this designated "local" work force. Nearly 24 percent of the local workers indicated they had moved at least once during this five year period within the 17 county region.

Over 80 percent of all respondents were male, with the average age of both nonlocal and local workers around 30 years. Median ages, though indicating a slightly younger work force, also show a marginal difference between the two groups (26.3 years for in-migrants compared with 27.1 years for local workers (Table 5). Overall, workers for the petroleum industry in North Dakota were younger than their counterparts in the construction and operation of electrical generation plants (Leholm et al., 1976; Wieland et al., 1977). The age distribution of the work force affects the family composition and, consequently, is important for the assessment of community impacts.

Three out of five workers in both groups were married (Table 4). However, there were substantial differences in family composition between

³However, it is also possible that many "locals" had moved into the region during the first boom of 1951-55. Given the research design, this was essentially a nonissue.

TABLE 4. PERSONAL AND FAMILY CHARACTERISTICS OF NONLOCAL, LOCAL, AND TOTAL SURVEY WORK FORCE

Characteristic	Survey Work Force		
	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	91.3	77.5	83.0
Female	8.1	22.5	14.9
No Response ^a	0.6	0.0	2.1
Total	692	659	1,377
<u>Average Age of Respondents (Years)</u>			
	30.05	30.16	30.09
<u>Marital Status (Percent)</u>			
Married	61.9	65.4	62.6
Single	37.4	34.6	35.5
No Response ^a	0.7	0.0	1.9
<u>Dependents of Respondent (Percent)</u>			
One Dependent	17.6	16.7	16.8
Two Dependents	13.9	17.6	15.4
Three Dependents	16.6	19.7	17.8
Four Dependents	6.8	7.9	7.2
Five-Eight Dependents	2.9	5.6	4.1
Nine or More Dependents	0.1	0.3	0.2
Total with Dependents	402	446	848
Total without Dependents	285	210	495
No Response ^a	0.7	0.4	2.4
<u>Average Number of Dependents</u>			
	2.19	2.56	2.37
<u>Dependent Children (Percent)</u>			
Age 0-4 Years	41.0	31.7	35.8
Age 5-12 Years	39.3	39.0	39.1
Age 13-18 Years	15.6	21.3	18.8
Age 19+	4.1	8.0	6.3
Total Number of Children	563	728	1,291

^aNot all of the 1,377 respondents answered every question, thereby resulting in varying numbers.

TABLE 5. AGE DISTRIBUTION OF THE SURVEY WORK FORCE (IN PERCENTS)

Age	Nonlocal	Local	Total
18-21	11.15	15.20	12.94
22-25	28.33	23.99	25.86
26-30	25.78	21.64	23.27
31-35	14.26	17.55	15.44
36-40	7.50	7.06	7.13
41-45	4.93	5.56	5.12
46-50	3.84	2.79	2.90
51-55	1.46	2.99	2.42
56-60	1.64	1.28	1.45
61+	.37	1.28	0.77
No Response	.86	.91	2.61
Median Age	26.3	27.1	26.2

local and nonlocal workers. Nearly one in seven married in-migrant workers did not move their families to the Williston Basin "oil patch." This partially explains a household size of 3.19 for in-migrant workers compared with 3.56 for local workers.⁴ Both nonlocal and local workers had nearly three-fourths of their children in the pre- and primary school age categories. Nonlocal workers had fewer children in school grades 7-12 than did the local workers. Utilization of such data is important in planning for the possible expansion of school facilities.

Occupational Composition of the Work Force

Employment in the North Dakota petroleum industry was separated into 15 categories for the purposes of this study. Occupational types varied from firm to firm, depending upon the activity and the type of company (Appendix B). As can be seen from Table 6, the occupational type influenced the local/nonlocal composition of the work force. The occupational categories which represented the largest number of workers were managers and supervisors, well drillers, and truck drivers. In each case, a greater proportion of nonlocal workers filled these positions than did the local populace. This partially reflects the rapid buildup in drilling activity along with the associated requirement for skilled workers in these occupations. In contrast, professionals, clerical workers, and sales representatives were more likely to be from the local area. Table 7 shows the number and percentage of local and nonlocal workers in each occupation by company type. The variation among the various company types is clearly evident.⁵

⁴Household size includes both the number of dependents and the worker.

⁵For a more complete discussion of this table, see descriptive analyses of individual occupational types.

TABLE 6. JOB CLASSIFICATIONS OF SURVEY RESPONDENTS

Occupation Type	Survey Work Force (Percent)		
	Nonlocal	Local	Total
Professionals	2.9	7.6	5.2
Managers & Supervisors	19.7	19.1	19.2
Engineers	11.1	3.0	7.4
Engineer Technicians	3.5	4.4	3.9
Sales Representatives	6.5	8.2	7.2
Office Clerical	3.8	12.4	7.9
Plant Clerical	4.0	8.2	6.1
Mechanics/Repairmen	5.5	5.0	5.3
Heavy Equipment Operators	1.7	1.7	1.7
Truck Drivers	12.6	7.0	9.9
Drilling Rig/Tank Construction Workers	2.3	3.5	2.8
Well Drilling Workers	13.0	11.1	11.9
Well Servicing Personnel	3.5	2.0	2.8
Skilled Labor	5.8	3.3	4.6
Unskilled Labor	2.9	2.7	2.8
Other	0.3	0.2	0.2
No Response	0.6	1.1	0.9
Total Number	692	659	1,377

The survey work force was employed by a number of different types of companies (Table 8). Unlike other energy projects where the basic work force is hired and managed by a single or consortium of major investors, employment in petroleum development activities is widely distributed. In North Dakota, the companies include several major and minor operations, a continually fluctuating number of drilling and geophysical exploration contractors, as well as hundreds of service and supply firms, of which many have no more than 10 employees (Chase and Leistriz, 1982). The work force included in this survey reflects this pattern--three-fourths of the companies surveyed were either service or equipment and supply firms.⁶ Nearly 70 percent of the labor force surveyed worked for these service and supply establishments, and the remainder were divided among oil and gas producing, gas processing, geophysical, and well drilling companies.

Virtually all of the female respondents were employed in either clerical, managerial, or professional occupations. The majority (96 percent) of office clerical workers were female. When asked whether their wives were employed, male workers responded that nearly half of their spouses were either clerical or professional workers (Table 9). Another 25 percent of the spouses were employed in the service sectors, i.e., retail trade, personal and business services. Most of the wives, however, were not employed in the local

⁶See Appendix C for a complete description of these types of companies, as listed in Table 8.

TABLE 7. OCCUPATIONAL DISTRIBUTION OF SURVEY WORK FORCE, BY COMPANY TYPE

Occupation (Number) (Percent)	Oil & Gas Processing			Gas Processing/Refineries			Oil Well Drilling			Geophysical/Shot Hole		
	NL	L	Total	NL	L	Total	NL	L	Total	NL	L	Total
Professional	11 55.0	28 56.0	41 56.9	0 --	0 --	0 --	0 --	1 2.0	1 1.4	1 5.0	2 4.0	3 4.2
Managers and Supervisors	24 17.6	13 10.3	37 14.0	4 2.9	3 2.4	7 2.6	12 8.8	13 10.3	25 9.4	2 1.5	2 1.6	4 1.5
Engineers	14 18.2	2 10.0	17 16.7	1 1.3	0 --	1 1.0	3 3.9	0 --	3 2.9	0 --	0 --	0 --
Engineer Technicians	1 4.2	9 31.0	10 18.5	2 8.3	3 10.3	5 9.3	0 --	0 --	0 --	6 25.0	4 13.8	10 18.5
Sales Representatives	1 2.2	0 --	1 1.0	0 --	1 1.8	1 1.0	0 --	0 --	0 --	0 --	0 --	0 --
Office Clerical	1 3.8	13 15.8	14 12.8	0 --	3 3.7	3 2.8	3 11.5	5 6.1	9 8.3	1 3.8	2 2.4	3 2.8
Plant Clerical	5 17.9	3 5.6	8 9.5	1 3.6	0 --	1 1.2	1 3.6	3 5.6	4 4.8	1 3.6	0 --	1 1.2
Mechanics/Repairmen	1 2.6	7 21.2	9 12.3	3 7.9	2 6.1	5 6.8	4 10.5	3 9.1	7 9.6	1 2.6	1 3.0	2 2.7
Heavy Equipment Operators	1 8.3	4 36.4	5 21.7	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --
Truck Drivers	0 --	2 4.4	2 1.5	0 --	0 --	0 --	3 3.4	5 10.9	8 5.8	4 4.6	1 2.2	5 3.6
Drilling Rig/Tank Construction Workers	6 37.5	16 69.6	22 56.4	0 --	1 4.4	1 2.6	4 25.0	1 4.4	5 12.8	0 --	0 --	0 --
Well Drilling Workers	0 --	3 3.3	3 1.8	0 --	0 --	0 --	57 63.3	36 49.3	93 56.7	3 3.3	1 1.4	4 2.4
Well Servicing Personnel	8 33.3	7 53.8	15 39.5	2 8.3	0 --	12 5.3	1 4.2	1 7.7	2 5.3	0 --	0 --	0 --
Skilled Labor	4 10.0	4 18.2	8 12.5	0 --	0 --	0 --	0 --	1 4.6	1 1.6	11 27.5	2 9.1	13 20.3
Unskilled Labor	1 5.0	0 --	1 2.6	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --
Other	1 50.0	0 --	1 33.3	0 --	1 100.0	1 33.3	0 --	0 --	0 --	0 --	0 --	0 --
No Response	0 --	1 25.0	1 8.3	0 --	0 --	0 --	1 14.3	1 25.0	2 16.7	0 --	1 25.0	1 8.3
TOTAL	82 (11.8)	109 (16.5)	195 (14.2)	13 (1.9)	13 (2.0)	26 (1.9)	89 (12.9)	71 (10.8)	161 (11.7)	30 (4.3)	16 (2.4)	46 (3.4)

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TABLE 7. OCCUPATIONAL DISTRIBUTION OF SURVEY WORK FORCE, BY COMPANY TYPE (CONTINUED)

Occupation (Number) (Percent)	Equipment and Supplies									Safety Equipment Services		
	Muds/Fluids			Oilfield			Other			NL	L	Total
	NL	L	Total	NL	L	Total	NL	L	Total			
Professional	1 5.0	1 2.0	2 2.8	0 --	0 --	0 --	1 5.0	0 --	1 1.4	0 --	0 --	0 --
Managers and Supervisors	10 7.4	10 7.9	20 7.6	8 5.9	7 5.6	15 5.7	24 17.6	22 17.5	46 17.4	7 5.2	10 7.9	17 6.4
Engineers	13 16.9	9 45.0	24 23.5	1 1.3	0 --	1 1.0	11 14.3	3 15.0	15 14.7	0 --	0 --	0 --
Engineer Technicians	1 4.2	0 --	1 1.8	0 --	1 3.4	1 1.8	2 8.3	3 10.3	5 9.3	2 8.3	3 10.3	5 9.3
Sales Representatives	3 6.7	2 3.7	5 5.0	6 13.3	11 20.4	17 17.2	22 48.9	28 51.8	50 50.0	0 --	3 5.6	3 3.0
Office Clerical	1 3.8	4 4.9	5 4.6	1 3.8	8 9.8	9 8.3	7 26.9	15 18.3	22 20.2	0 --	1 1.2	1 0.9
Plant Clerical	4 14.3	4 7.4	8 9.5	3 10.7	5 9.3	8 9.5	13 46.4	7 13.0	21 25.0	0 --	0 --	0 --
Mechanics/Repairmen	0 --	0 --	0 --	2 5.3	0 --	2 2.7	5 13.2	0 --	5 6.8	0 --	1 3.0	1 1.4
Heavy Equipment Operators	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --
Truck Drivers	2 2.3	2 4.4	4 2.9	2 2.3	0 --	2 1.5	1 1.2	6 --	7 --	0 --	0 --	0 --
Drilling Rig/Tank Construction Workers	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --
Well Drilling Workers	0 --	2 2.7	2 1.2	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --
Well Servicing Personnel	0 --	0 --	0 --	0 --	0 --	0 --	0 --	1 7.7	1 2.6	0 --	0 --	0 --
Skilled Labor	0 --	0 --	0 --	0 --	0 --	0 --	9 22.5	3 13.6	12 30.8	0 --	0 --	0 --
Unskilled Labor	0 --	0 --	0 --	1 5.0	2 11.1	3 7.7	1 5.0	8 44.4	9 23.1	0 --	0 --	0 --
Other	0 --	0 --	0 --	0 --	0 --	0 --	1 50.0	0 --	1 33.3	0 --	0 --	0 --
No Response	1 14.3	0 --	1 8.3	1 14.3	0 --	1 8.3	0 --	0 --	0 --	0 --	0 --	0 --
TOTAL	36 (5.2)	34 (5.2)	72 (5.2)	25 (3.6)	34 (5.2)	59 (4.3)	87 (12.6)	105 (15.9)	194 (14.1)	9 (1.3)	18 (2.7)	27 (2.0)

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TABLE 7. OCCUPATIONAL DISTRIBUTION OF SURVEY WORK FORCE, BY COMPANY TYPE (CONTINUED)

Occupation (Number) (Percent)	Trucking Services			Oilfield Services			Services--Other			Wireline Services		
	NL	L	Total	NL	L	Total	NL	L	Total	NL	L	Total
Professional	1 5.0	8 16.0	9 12.5	0 --	0 --	0 --	2 10.0	0 --	2 2.8	1 5.0	0 --	1 1.4
Managers and Supervisors	8 5.9	9 7.1	17 6.4	9 6.6	7 5.6	16 6.0	18 13.3	17 13.5	38 14.3	3 2.4	7 5.2	10 3.8
Engineers	1 1.3	0 --	1 1.0	3 3.9	0 --	3 2.9	11 14.3	2 10.0	13 12.7	18 23.4	3 15.0	22 21.6
Engineer Technicians	0 --	0 --	0 --	1 4.2	0 --	1 1.8	2 8.3	0 --	2 3.7	5 20.8	1 3.4	7 13.0
Sales Representatives	2 4.4	3 5.6	5 5.0	5 11.1	2 3.7	7 7.1	4 8.9	2 3.7	6 6.0	1 2.2	2 3.7	3 3.0
Office Clerical	4 15.4	7 8.5	11 10.1	1 3.8	2 2.4	3 2.8	2 7.6	8 9.7	10 9.2	1 3.8	7 8.5	8 7.3
Plant Clerical	3 10.7	10 18.5	13 15.5	2 7.1	1 1.8	3 3.6	0 --	10 18.5	11 13.1	1 3.6	3 5.6	4 4.8
Mechanics/Repairmen	6 15.8	8 24.2	15 20.6	6 15.8	1 3.0	7 9.6	10 26.3	7 21.2	17 23.3	0 --	3 9.1	3 4.1
Heavy Equipment Operators	2 16.7	1 9.1	3 13.0	0 --	0 --	0 --	4 33.3	4 36.4	8 34.7	5 41.7	2 18.2	7 30.4
Truck Drivers	49 56.3	21 45.6	73 53.3	0 --	0 --	0 --	18 20.6	1 2.2	19 13.9	2 2.1	1 2.2	3 2.2
Drilling Rig/Tank Construction Workers	0 --	0 --	0 --	0 --	0 --	0 --	6 37.5	5 21.7	11 28.2	0 --	0 --	0 --
Well Drilling Workers	8 8.9	5 6.8	13 7.9	1 1.1	0 0	1 0.6	3 3.3	5 6.8	9 5.5	15 16.7	22 30.1	37 22.6
Well Servicing Personnel	1 4.2	1 7.7	2 5.3	2 2	2 2	4 4	10 41.7	0 --	10 26.3	0 --	0 --	0 --
Skilled Labor	1 2.5	2 9.1	3 4.7	1 2.5	1 4.6	2 3.1	17 42.5	6 27.3	25 39.1	0 --	0 --	0 --
Unskilled Labor	2 10.0	2 11.1	4 10.3	1 5.0	1 5.6	2 5.1	14 70.0	5 27.8	20 51.3	0 --	0 --	0 --
Other	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --	0 --
No Response	0 --	1 25.0	1 8.3	1 14.3	0 --	1 8.3	1 14.3	0 --	1 8.3	1 14.3	0 --	1 8.3
TOTAL	88 (12.7)	78 (11.8)	170 (12.4)	33 (4.8)	17 (2.6)	51 (3.7)	123 (17.8)	72 (10.9)	204 (14.8)	57 (8.2)	47 (7.1)	106 (7.7)

- continued -

TABLE 7. OCCUPATIONAL DISTRIBUTION OF SURVEY WORK FORCE, BY COMPANY TYPE (CONTINUED)

Occupation (Number) (Percent)	Other			No Response			Total		
	NL	L	Total	NL	L	Total	NL	L	Total
Professional	2 10.0	4 8.0	6 8.3	0 --	6 12.0	6 8.3	20 27.8	50 69.4	72
Managers and Supervisors	1 0.74	2 1.6	3 1.1	3 2.2	8 6.4	11 4.2	136 51.3	126 47.6	265
Engineers	0 --	1 5.0	1 1.0	1 1.3	0 --	1 1.0	77 75.5	20 19.6	102
Engineer Technicians	2 8.3	5	7 13.0	0 --	0 --	0 --	24 44.4	29 53.7	54
Sales Representatives	0 --	0 --	0 --	1 2.2	0 --	1 1.0	45 45.4	54 54.5	99
Office Clerical	1 3.8	1 1.2	2 1.8	3 11.5	6 7.3	9 8.3	26 23.8	82 75.2	109
Plant Clerical	0 --	0 --	0 --	0 --	2 3.7	2 2.4	28 33.3	54 64.3	84
Mechanics/Repairmen	0 --	0 --	0 --	0 --	0 --	0 --	38 52.0	33 45.2	73
Heavy Equipment Operators	0 --	0 --	0 --	0 --	0 --	0 --	12 52.2	11 47.8	23
Truck Drivers	0 --	0 --	0 --	6 6.9	7 15.2	14 10.2	87 63.5	46 33.6	137
Drilling Rig/Tank Construction Workers	0 --	0 --	0 --	0 --	0 --	0 --	16 41.0	23 59.0	39
Well Drilling Workers	0 --	0 --	0 --	0 --	2 2.7	2 1.2	90 54.9	73 44.5	164
Well Servicing Personnel	0 --	0 --	0 --	0 --	1 7.7	1 2.6	24 63.2	13 34.2	38
Skilled Labor	0 --	0 --	0 --	0 --	0 --	0 --	40 62.5	22 34.4	64
Unskilled Labor	0 --	0 --	0 --	0 --	0 --	0 --	20 51.3	18 46.2	39
Other	0 --	0 --	0 --	0 --	0 --	0 --	2 66.7	1 33.3	3
No Response	0 --	0 --	0 --	0 --	0 --	0 --	7 58.3	4 33.3	12
TOTAL	6 (0.9)	13 (2.0)	19 (1.4)	32 (4.6)	14 (2.1)	47 (3.4)	692 (50.3)	659 (47.9)	1,377

TABLE 8. SURVEY WORK FORCE BY COMPANY TYPE

Type of Company	Number of Companies	Survey Work Force (Percent)		
		Nonlocal	Local	Total
Oil & Gas Producing	15	11.8	16.5	14.2
Gas Processing/Refineries	3	1.9	2.0	1.9
Oil Well Drilling	14	12.9	10.8	11.7
Geophysical/Shot Hole	5	4.3	2.4	3.4
Equip. & Supplies--Muds/Fluids	10	5.2	5.2	5.2
Equip. & Supplies--Oil Field	13	3.6	5.2	4.3
Equip. & Supplies--Other	38	12.6	15.9	14.1
Safety Equipment Services	6	1.3	2.7	2.0
Trucking Services	11	12.7	11.8	12.4
Oil Field Services	9	4.8	2.6	3.7
Wireline Services	8	8.2	7.1	7.7
Services--Other	26	17.8	10.9	14.8
Other	5	0.9	2.0	1.4
No Response	6	4.6	2.1	3.4
Total Number	167	692	659	1,377

TABLE 9. SPOUSE* EMPLOYED OUTSIDE HOME, BY OCCUPATION

Type of Occupation	Spouses (Percent)		
	Nonlocal	Local	Total
Professional	8.1	10.4	9.2
Managers & Administrators	3.6	3.5	3.5
Sales Workers	1.8	2.3	2.0
Clerical Workers	7.6	15.6	11.5
Service Workers	7.9	9.8	8.8
Other	0.8	1.7	1.2
Not Employed	58.0	54.0	56.2
No Response	12.2	2.6	7.7
Total Number	393	346	742

*Only spouses of male workers are included.

economies. This is most evident with the nonlocal workers, whose wives were either not employed or living elsewhere outside the region.

Previous Residence of Nonlocal Work Force

The majority of nonlocal workers in the Williston Basin came from one of three regions: (1) nonpetroleum producing counties of North Dakota

(18.1 percent); (2) neighboring states of Minnesota, Montana, and South Dakota (34.2 percent); and (3) other areas experiencing petroleum development (31.5 percent) (Table 10).

TABLE 10. PREVIOUS RESIDENCE OF NONLOCAL SURVEY WORK FORCE

State	Nonlocal Work Force (Percents)
<u>North Dakota</u>	18.1
<u>Neighboring States</u> (Montana, Minnesota, South Dakota)	34.2
<u>Major Oil Producing States/Provinces</u> (Alaska, California, Colorado, Kansas, Louisiana, New Mexico, Oklahoma, Texas, Utah, Wyoming, Alberta)	31.5
<u>Other States/Countries</u> (Arizona, Arkansas, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Michigan, Mississippi, Missouri, Nebraska, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee, Virginia, Washington, Wisconsin, District of Columbia, Canada, West Germany)	13.9
No Response	2.3
Total Number	692

The increased level of petroleum development has created additional employment opportunities for residents of North Dakota. When including the 125 North Dakota nonlocal workers, the labor force was composed largely of North Dakotans (56.9 percent). Most of these workers (56 percent) have come from the major population centers of Bismarck-Mandan, Fargo, and Grand Forks (Figure 4).

Petroleum development has also attracted a significant share of workers from those states bordering North Dakota. The large number of Montana workers (139 workers) is due, in part, to the geographical extent of oil activity in the Williston Basin, which extends into the eastern half of Montana, as well as the northwestern portion of South Dakota and the southern regions of Manitoba and Saskatchewan (Gerhard and Anderson, 1979) (see Figure 1). As a consequence, many petroleum-related companies operate on both sides of the North Dakota border, especially the Montana-North Dakota state line. If one reinterprets the survey data to include those workers who formerly resided within the Montana portion of the Williston Basin, the result is a slight majority (51.2 percent) of "local" Williston Basin workers.

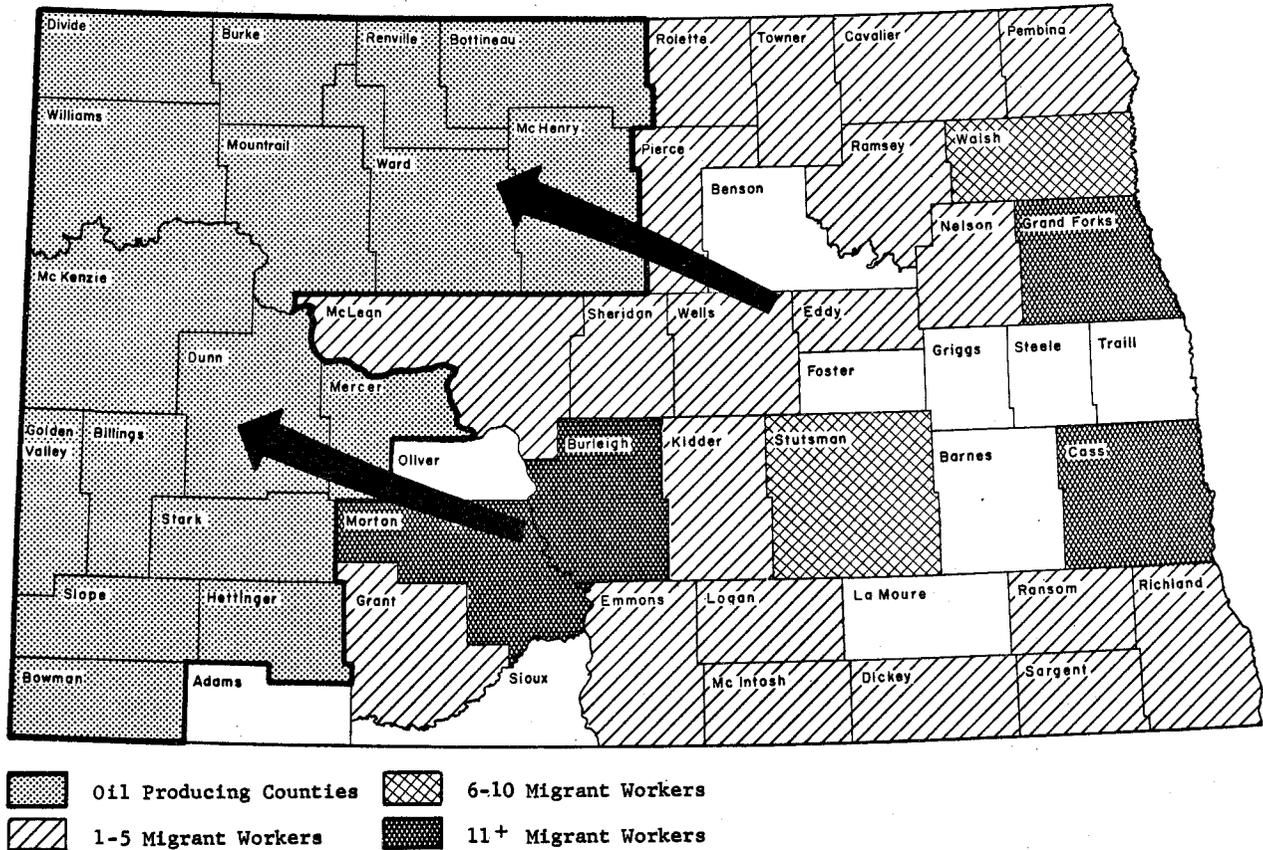


Figure 4. Prior Residence of North Dakota Nonlocal Workers

Since many petroleum-related firms in the Williston Basin are branch operations of parent companies headquartered elsewhere,⁷ a substantial portion of workers have relocated from other major oil development regions. For instance, over 70 percent of the workers in this category moved from the Rocky Mountain petroleum region (Western Oil Reporter, 1982). The greatest portion of these workers formerly resided in the Overthrust Belt region--an extremely active development province spanning southwestern Wyoming and northeastern Utah. The Williston Basin has attracted workers from other established petroleum development areas such as the Texas-Oklahoma oil fields, the Outer Continental Shelf (OCS) regions of Louisiana and California, the Prudhoe Bay in Alaska, and the Canadian oil producing province of Alberta.

The remainder of the nonlocal workers formerly resided in a variety of places--encompassing the four corners of the continental United States. All total, workers relocated from 36 different states, four Canadian provinces, and one Western European country (West Germany) (Figure 5).

⁷Nearly 26 percent of the 167 petroleum-related survey firms are listed as district or regional branch operations.

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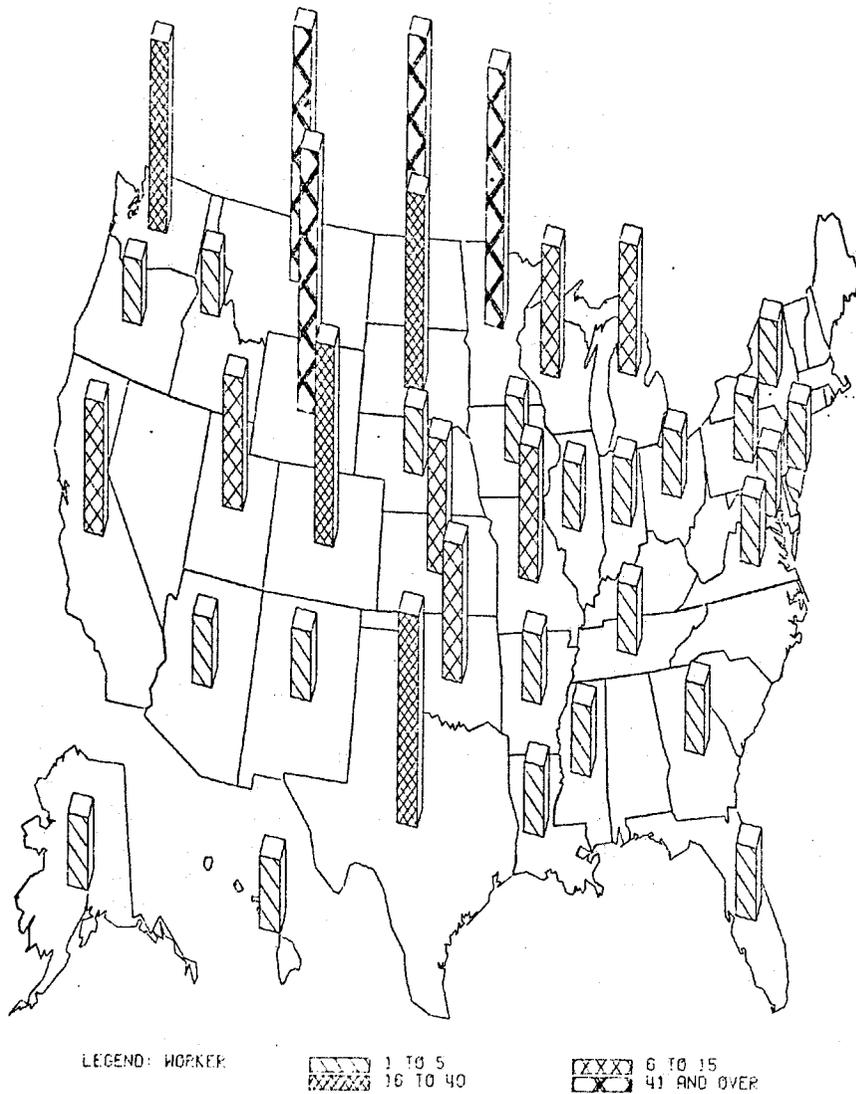


Figure 5. Prior Residence of Williston Basin Nonlocal Workers

Residential and Commuting Patterns

For most energy developments, the project-related work force (in-migrants) tend to settle in larger centers and those communities closer to the project site rather than the smaller and more distant places (Wieland, 1977). The settlement pattern for the petroleum-related work force, however, was more widely distributed within the development region. In an earlier article, Chase and Leistriz (1982) explained that settlement patterns of the petroleum work force are largely determined by the spatial distribution of the petroleum industry, the number of transient workers, and the historical direction of petroleum development within the region. Respondents indicated current residences were in 15 different communities within the Williston Basin (Table 11). Nearly 60 percent of the workers lived in the regional centers of

TABLE 11. PLACE OF RESIDENCE FOR SURVEY WORK FORCE

Community	Survey Work Force (Percent)		Total
	Nonlocal	Local	
Williston	29.6	32.2	30.6
Dickinson	27.5	25.0	26.2
Watford City	15.9	9.3	13.1
Belfield	3.2	2.9	3.0
Minot	0.4	4.4	2.3
New Town	2.0	2.7	1.6
Killdeer	2.0	0.8	1.4
South Heart	1.2	1.4	1.2
Others*	8.8	9.0	9.4
Not Applicable	10.4	12.3	11.3
No Response	0.6	0.2	0.4
Total Number	692	659	1,377

*Includes Alexander, Beach, Bowman, Gladstone, Hebron, North Dakota; and Glendive and Wibaux, Montana.

Dickinson and Williston. This corresponds to the location of the majority of companies surveyed (74.8 percent) (Table 12).⁸ Of those workers residing in either Dickinson or Williston, slightly over half were in-migrants. The significance of this level of immigration is further exhibited by population estimates for selected communities in the Williston Basin. As Table 13 indicates, substantial population growth occurred in these communities between 1976 and 1980 when portions of the Williston Basin were experiencing a frenetic pace of petroleum activity.

During this same period, population grew at an average annual rate of 3.6 percent in the field development centers of Belfield, Killdeer, and Watford City. These centers were primarily impacted due to their proximity to both existing development fields and new field discoveries (Figure 6). In contrast, other field development centers of Ray, Stanley, and Tioga all declined in population during the 1970s due to a shift in the direction of petroleum development. During the first boom of the 1950s, these three communities experienced substantial population growth as service centers in the "oil patch" (Campbell et al., 1958).

Over 65 percent of the local workers and 63 percent of the nonlocal workers commuted less than 10 miles to work (Table 14). On average, local workers commuted 16.3 miles to work daily (one way) while nonlocal workers commuted 19.3 miles.

⁸Of the 697 establishments in the Williston Basin, 62.3 percent have operations in either Williston or Dickinson.

TABLE 12. COMPANY LOCATION OF SURVEY WORK FORCE

Location of Company	Number of Companies	Survey Work Force		
		Nonlocal	Local	Total
<u>Regional Oil Centers</u>				
Dickinson	41	162	161	327 (23.8)
Minot	2	3	37	40 (2.9)
Williston	84	261	244	510 (37.0)
Total	127	426	442	877 (63.7)
<u>Oil Field Development Centers</u>				
Belfield	9	59	38	101 (7.3)
Killdeer	4	36	30	67 (4.9)
Watford City	14	138	95	243 (17.6)
Others*	12	32	43	77 (5.6)
Total	39	265	206	488 (35.4)
No Response	1	1	11	12 (0.9)
Total Number	167	692	659	1,377

*Includes Tioga, Bowman, Keene, Stanley, Fairfield, Alexander, Beach.

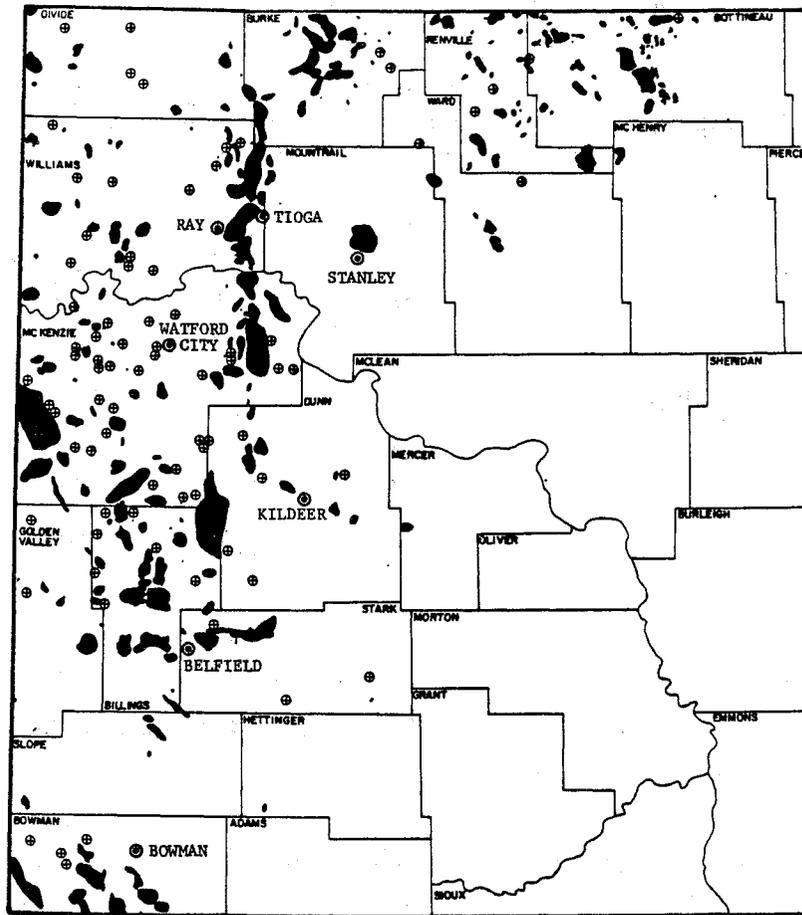
TABLE 13. POPULATION ESTIMATES FOR SELECTED COMMUNITIES IN THE WILLISTON BASIN

Community	Population			Percent Change		
	1970	1976	1980	70-80	70-76	76-80
Belfield	1,130	1,101	1,274	12.7	-2.6	15.7
Dickinson	12,405	12,509	15,924	28.4	0.8	27.3
Killdeer	615	651	790	28.5	5.9	21.4
Watford City	1,768	1,800	2,119	19.8	1.8	17.7
Williston	11,280	11,692	13,336	14.1	3.7	18.2

SOURCE: U.S. Bureau of the Census.

Duration of Residence and Employment

Compared with other energy development work forces, the workers associated with petroleum development tend to be highly mobile. Among the reasons for the high degree of worker mobility are the resource nature of petroleum, the phase of petroleum development, the type of petroleum-related company, and the occupation type. Consequently, the location and duration of residence and employment will reflect their mobility. Table 15 shows the duration of local residence for the survey work force in the Williston Basin.



⊕ - NEW FIELD DISCOVERIES - 1981

Figure 6. North Dakota Oil Fields, 1981

SOURCE: Bluemle and Anderson, 1982.

TABLE 14. DISTANCE TRAVELED TO WORK BY SURVEY WORK FORCE

Miles (One Way)	Survey Work Force (Percent)		
	Nonlocal	Local	Total
0-10	63.0	66.5	63.6
11-20	6.5	9.3	7.7
21-30	5.2	5.5	5.3
31-40	4.3	3.5	3.9
41-50	4.6	4.9	4.7
51-60	4.0	4.6	4.2
61+	7.9	4.1	6.0
No Response	4.3	1.8	4.7
Total Number	692	659	1,377

TABLE 15. DURATION OF RESIDENCE FOR SURVEY WORK FORCE

Months	Survey Work Force (Percent)		
	Nonlocal	Local	Total
1-12	58.5	17.1	38.3
13-24	19.8	12.3	15.9
25-36	9.2	9.4	9.2
37-48	3.6	6.8	5.2
49-60	2.6	5.8	4.1
61-120	0.0	14.1	7.7
121+	0.0	33.1	16.1
No Response	5.2	3.3	3.3
Total Number	692	659	1,377
Average Length of Residence (Months)	19.8	112.9	65.3

Particularly evident is that nearly 80 percent of the nonlocal work force had lived in their respective communities for less than two years. In contrast, a lesser share of local workers had lived in their communities for two years or less.⁹ Overall, the local work force was more established. The average local worker had lived in his respective community for 9.4 years, with a third of the workers having lived within the community for over ten years.

Although the in-migrant work force on average resided locally for about a year and a half, they had worked in the Williston Basin oil and gas related industry for an average of two years (Table 16). As stated previously, the Williston Basin extends into both eastern Montana and northwestern South Dakota. Many in-migrants moved to their current location after working in other parts of the Williston Basin "oil patch." The majority of nonlocals (70.1 percent), however, were recent in-migrants to the Williston Basin, having come to the region within two years. A significant share of the local work force (27.5 percent) had been employed in the Williston Basin with petroleum-related firms for more than four years. But again, the vast majority of the overall work force were recent entrants to the "oil play" activity in the Williston Basin. More than 60 percent had been employed in the Basin for less than three years.

Nearly 80 percent of the survey work force had worked for their present companies for less than three years. Among other reasons, this indicates a highly competitive market for labor. A number of local entrepreneurs founded companies during this period, while other petroleum-related firms set up branch operations in the region. Although many of the latter companies hired locally, it is apparent that significant numbers of their workers relocated from other petroleum development regions. On average, nonlocal workers had

⁹These workers, however, kept their "local" designation because their movement (albeit between communities) was within the 17 county region in North Dakota.

TABLE 16. DURATION OF EMPLOYMENT FOR SURVEY WORK FORCE

Months Working in the Williston Basin	Nonlocal	Local	Total
1-12	48.0	25.3	37.0
13-24	22.1	19.9	21.1
25-36	11.1	16.2	13.7
37-48	5.9	10.0	7.6
49-60	4.8	8.2	6.5
61-120	5.2	9.3	7.1
121-240	1.0	6.2	3.6
241+	1.2	3.8	2.4
No Response	0.9	1.4	1.1
Average Length of Employment in Williston Basin	25.5	51.3	38.1
<u>Months Working with Present Company</u>			
1-12	53.8	40.5	47.4
13-24	20.4	21.9	21.1
25-36	9.4	12.9	11.3
37-48	4.9	7.6	6.1
49-60	1.9	3.9	2.9
61-120	4.8	6.1	5.3
121-240	3.2	2.9	3.1
241+	2.0	1.8	2.0
No Response	1.2	0.9	1.0
Total Number	692	659	1,377
Average Length of Employment with Company	30.2	32.9	31.6

been with their respective companies longer (2.5 years), than they had worked in the Williston Basin (2.1 years).

Housing

The type of housing utilized by petroleum industry workers reflects their demand for and impact on local supply. Housing decisions often have significant consequences for the host community. For instance, mobile homes have a lower taxable value than a comparable single family house, yet require similar public services. Table 17 shows the distribution of the local and nonlocal work force by housing type to be quite different. Over a third of the in-migrants lived in a mobile home while nearly another third lived in single family dwellings. Many nonlocal workers (25.9 percent) lived in either apartments, townhouses, or condominiums. The remaining in-migrant workers

TABLE 17. PRESENT HOUSING OF SURVEY WORK FORCE

Type of Housing	Survey Work Force (Percent)		
	Nonlocal	Local	Total
Single Family	32.4	54.0	42.6
Apartment	21.7	13.5	17.9
Townhouse/Condominium	4.2	2.6	3.5
Mobile Home	33.7	27.0	30.5
Motel	1.9	0.3	1.1
Boarding/Sleeping Room	1.7	0.3	1.1
Travel Trailer	2.0	0.8	1.4
Work Camp	1.4	0.0	0.7
Other	0.7	1.4	1.0
No Response	0.3	0.2	0.3
Total	692	659	1,377

(7.7 percent) lived in such transient quarters as motels, boarding rooms, travel trailers, and work camps. To a large extent, the nonlocal's choice of housing reflects the short duration of certain petroleum-related activities, namely well drilling and geophysical/shot hole operations, at any one site. Nearly 70 percent of those respondents listing transient housing as their lodging had occupations (i.e., truck drivers, well drillers, engineer technicians, and skilled labor) connected with such short-term activities (Table 18). Reasons why truck drivers and well drillers require temporary lodging are obvious--the time for drilling varies from two to five months depending on well depth, resource potential, etc. (Hough, 1982). According to survey results, the other occupations of engineer technicians and skilled labor were primarily employed by geophysical/seismic companies. These seismic survey companies are highly mobile (and often elusive) with a coverage, under normal conditions, of between three to five miles each day (Chase et al., 1981). Most of these workers appear to seek lodging as close to the work site area as possible (Darden, 1981). This usually places a heavy strain on the local transient housing supply, especially motels and trailer/RV parks/campgrounds.

In contrast, most of the local workers (54 percent) lived in single family dwellings, with significant numbers residing in mobile homes (27 percent) and apartments (13.5 percent). Though the choice of housing varied with occupation, the type of local housing utilized did not always reflect the type of petroleum activity. Nearly two-thirds of the local managers and supervisors, professionals, engineers, and sales representatives resided in single family housing. Although significant numbers of local well drillers, truck drivers, and engineer technicians lived in mobile homes, nearly half (46.0 percent) resided in more permanent dwellings--single family homes.

Specific Occupation Profiles

The opening of petroleum development within any region will follow a recognizable pattern of sequential events including the arrival of certain

TABLE 18. PRESENT HOUSING OF SURVEY WORK FORCE BY OCCUPATION

Occupation Type	Type of Housing																				Total	
	Single Family		Apartment		Townhouse/ Condominium		Mobile Home		Work Camp		Boarding/ Sleeping Room		Travel Trailer		Motel		Other		No Response			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
<u>Managers & Supervisors</u>	154	58.1	28	10.6	12	4.5	65	24.5	1	0.4	1	0.4	2	0.8	0	--	0	--	2	0.8	265	100.0
Nonlocal	67	49.3	19	14.0	8	5.9	39	28.7	1	0.7	1	0.7	1	0.7	0	--	0	--	0	--	136	51.3
Local	87	69.1	9	7.1	4	3.2	24	19.1	0	--	0	--	1	0.8	0	--	0	--	1	0.8	126	47.6
<u>Professionals</u>	39	54.2	11	15.3	3	4.2	19	26.3	0	--	0	--	0	--	0	--	0	--	2	2.8	72	100.0
Nonlocal	13	65.0	4	20.0	1	5.0	2	10.0	0	--	0	--	0	--	0	--	0	--	0	--	20	27.8
Local	26	52.0	7	14.0	2	4.0	15	30.0	0	--	0	--	0	--	0	--	0	--	0	--	50	69.4
<u>Engineers/Sales Engineers</u>	46	45.1	29	28.4	10	9.8	14	13.7	0	--	2	2.0	0	--	0	--	1	1.0	5	4.9	102	100.0
Nonlocal	33	42.9	23	29.9	8	10.4	10	13.0	0	--	2	2.6	0	--	0	--	1	1.3	0	--	77	75.5
Local	12	60.0	4	20.0	0	--	4	20.0	0	--	0	--	0	--	0	--	0	--	0	--	20	19.6
<u>Engineer Technicians</u>	18	33.3	11	20.4	3	5.6	14	25.9	0	--	1	1.8	3	5.6	1	1.8	3	5.6	1	1.8	54	100.0
Nonlocal	4	16.7	6	25.0	3	12.5	8	33.3	0	--	0	--	2	8.3	1	1.8	0	--	0	--	24	44.4
Local	14	48.3	4	13.8	0	--	6	20.7	0	--	1	3.4	1	3.4	0	--	3	10.3	0	--	29	53.7
<u>Sales Representatives</u>	57	57.6	14	14.1	2	2.0	21	21.2	1	1.0	0	--	0	--	3	3.0	1	1.0	0	--	99	100.0
Nonlocal	18	40.0	10	22.2	1	2.2	12	26.7	1	2.2	0	--	0	--	3	6.7	0	--	0	--	45	45.4
Local	39	72.2	4	7.4	1	1.8	9	16.7	0	--	0	--	0	--	0	--	1	1.8	0	--	54	54.6
<u>Office Clerical</u>	48	44.0	22	20.2	7	6.4	31	28.4	0	--	0	--	0	--	0	--	1	0.9	0	--	109	100.0
Nonlocal	9	34.6	8	30.8	2	7.7	7	26.9	0	--	0	--	0	--	0	--	0	--	0	--	26	23.8
Local	38	46.3	14	17.1	5	6.1	24	29.3	0	--	0	--	0	--	0	--	1	1.2	0	--	82	75.2
<u>Plant Clerical</u>	35	41.7	21	25.0	3	3.6	25	29.8	0	--	0	--	0	--	0	--	0	--	2	2.4	84	100.0
Nonlocal	9	32.4	7	25.0	3	10.7	9	32.1	0	--	0	--	0	--	0	--	0	--	0	--	28	33.3
Local	25	46.3	13	24.1	0	--	16	29.6	0	--	0	--	0	--	0	--	0	--	0	--	54	64.3
<u>Mechanics/Repairmen</u>	25	34.2	6	8.2	0	--	36	49.3	0	--	2	2.7	3	4.1	0	--	0	--	2	2.7	73	100.0
Nonlocal	7	18.4	5	13.2	0	--	21	55.3	0	--	2	5.3	2	5.3	0	--	0	--	1	2.6	38	52.0
Local	16	48.5	1	3.0	0	--	15	45.4	0	--	0	--	3	3.0	0	--	0	--	0	--	33	45.2

TABLE 18. PRESENT HOUSING OF SURVEY WORK FORCE BY OCCUPATION (CONTINUED)

Occupation Type	Type of Housing																		Total No.	%				
	Single Family		Apartment		Townhouse/ Condominium		Mobile Home		Work Camp		Boarding/ Sleeping Room		Travel Trailer		Motel		Other				No Response			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			No.	%		
<u>Heavy Equipment Operators</u>	14	60.9	2	8.7	1	4.4	6	26.1	0	--	0	--	0	--	0	--	0	--	0	--	0	--	23	100.0
Nonlocal	8	66.7	1	8.3	0	--	3	25.0	0	--	0	--	0	--	0	--	0	--	0	--	0	--	12	52.2
Local	6	54.6	1	9.1	1	9.1	3	27.3	0	--	0	--	0	--	0	--	0	--	0	--	0	--	11	47.8
<u>Truck Drivers</u>	33	24.1	24	17.5	3	2.2	61	44.5	1	0.7	6	4.4	4	2.9	2	1.5	3	2.2	0	--	0	--	137	100.0
Nonlocal	12	13.8	17	19.5	3	3.4	43	49.4	1	1.2	5	5.8	3	3.4	2	2.3	1	1.2	0	--	0	--	87	63.5
Local	20	43.5	6	13.0	0	--	16	34.8	0	--	1	2.2	1	2.2	0	--	2	4.4	0	--	0	--	46	33.6
<u>Rig & Tank Construction</u>	20	51.3	6	15.4	0	--	12	30.8	0	--	0	--	0	--	0	--	1	2.6	0	--	0	--	39	100.0
Nonlocal	7	43.8	3	18.8	0	--	6	37.5	0	--	0	--	0	--	0	--	0	--	0	--	0	--	16	41.0
Local	13	56.5	3	13.0	0	--	6	26.1	0	--	0	--	0	--	0	--	1	4.4	0	--	0	--	23	59.0
<u>Well Drilling</u>	58	35.4	34	20.7	2	1.2	54	32.9	7	4.3	1	0.6	3	1.8	3	1.8	2	1.2	0	--	0	--	164	100.0
Nonlocal	24	26.7	12	23.3	0	--	31	34.4	7	7.8	1	1.1	2	2.2	3	3.3	1	1.1	0	--	0	--	90	54.9
Local	34	46.6	13	17.8	2	2.7	22	30.1	0	--	0	--	1	1.4	0	--	1	1.4	0	--	0	--	73	44.5
<u>Well Servicing</u>	13	34.2	3	7.9	0	--	21	5.5	0	--	0	--	0	--	0	--	1	2.6	0	--	0	--	38	100.0
Nonlocal	3	12.5	2	8.3	0	--	18	75.0	0	--	0	--	0	--	0	--	1	4.2	0	--	0	--	24	63.2
Local	10	76.9	1	7.7	0	--	2	15.4	0	--	0	--	0	--	0	--	0	--	0	--	0	--	13	34.2
<u>Skilled Labor</u>	13	20.3	18	28.1	1	1.6	21	32.8	0	--	1	1.6	4	6.2	5	7.8	1	1.6	0	--	0	--	64	100.0
Nonlocal	6	15.0	13	32.5	0	--	12	30.0	0	--	0	--	4	10.0	4	6.2	1	2.5	0	--	0	--	40	62.5
Local	7	31.8	4	18.2	1	4.6	9	40.9	0	--	0	--	0	--	1	4.6	0	--	0	--	0	--	22	34.4
<u>Unskilled Labor</u>	10	25.6	11	28.2	1	2.6	16	41.0	0	--	1	2.6	0	--	0	--	0	--	0	--	0	--	39	100.0
Nonlocal	1	5.0	6	30.0	0	--	12	60.0	0	--	1	5.0	0	--	0	--	0	--	0	--	0	--	20	51.3
Local	8	44.4	5	27.8	1	5.6	4	22.2	0	--	0	--	0	--	0	--	0	--	0	--	0	--	18	46.2
<u>Other</u>	1	33.3	1	33.3	0	--	1	33.3	0	--	0	--	0	--	0	--	0	--	0	--	0	--	3	100.0
Nonlocal	1	50.0	0	--	0	--	1	50.0	0	--	0	--	0	--	0	--	0	--	0	--	0	--	2	66.7
Local	0	--	1	100.0	0	--	0	--	0	--	0	--	0	--	0	--	0	--	0	--	0	--	1	33.1
<u>No Response</u>	3	25.0	5	41.7	0	--	2	16.7	0	--	0	--	0	--	1	8.3	0	--	1	8.3	0	--	12	100.0
Nonlocal	2	28.6	4	57.1	0	--	0	--	0	--	0	--	0	--	0	--	0	--	1	14.3	0	--	7	58.3
Local	1	25.0	0	--	0	--	2	50.0	0	--	0	--	0	--	1	25.0	0	--	0	--	0	--	4	33.3
<u>Total</u>	587	42.6	246	17.9	48	3.5	419	30.5	10	0.7	15	1.1	19	1.4	15	1.1	14	1.0	4	0.3	1,377	100.0		
Nonlocal	224	32.4	150	21.7	29	4.2	233	33.7	10	1.4	12	1.7	14	2.0	13	1.9	5	0.7	2	0.3	692	50.2		
Local	356	54.0	89	13.5	17	2.6	178	27.0	0	--	2	0.3	5	0.8	2	0.3	9	1.4	1	0.2	659	47.8		

kinds of oil-related workers. Most commonly, onshore development begins with lease and land speculation in advance of the discovery of commercial production. Early lease campaigns, conducted by lease agents or landmen, often cover large regions in short periods. Given the nature of their work, these lease agents tend to be highly transient. Other workers are engaged in exploratory activity to assess the hydrocarbon potential in the region. When an oil field is opened, drillers and assistants arrive along with rig builders, roustabouts, and teamsters. Once production begins, crews of tank and pipeline builders arrive. Accompanying all of these workers are supply and service workers, oil operators, mechanics, truck drivers, and others. In order to gain a more complete understanding of the petroleum work force characteristics, further analysis of each of these individual worker categories is provided below.

Professional

Professional workers, which made up 5 percent of the survey work force, are defined as those who perform a variety of support duties usually within an office setting. Examples of those professional workers surveyed include accountants, purchasing and billing agents, computer programmers, and personnel specialists. Geologists and landmen are also included in this category, even though much of their duties are out of the office.

As Table 19 notes, a significant portion of professionals were women.¹⁰ Nearly seven out of every ten professionals were local residents, who had been in the locale for over nine years. In contrast, nonlocal professionals had resided in the area for nearly two years. This is significantly less than either their average duration of working in the Basin or duration with their current companies, implying a number of nonlocals were transferred to district/branch offices in North Dakota.

Most professionals surveyed worked for oil and gas producing companies located in the regional centers of Dickinson and Williston. Although most nonlocal professionals brought their families when relocating to North Dakota, nearly 80 percent of the spouses had not entered the local labor market. A partial explanation is many wives were of the child-rearing age, and cared for their children, a third of which were under the age of five.

As noted above (Table 18), most professionals resided in single-family homes (54.2 percent) and the remainder resided in either mobile homes, apartments, or townhouses.

Managers and Supervisors

The largest set of survey respondents were managers and supervisors (19.2 percent). Predominantly male, these managers/supervisors are responsible in varying degrees for the overall operation of the business.

¹⁰From the survey, nine out of ten women are either professionals, managers, or clerical workers.

TABLE 19. CHARACTERISTICS OF SURVEY WORK FORCE: PROFESSIONALS

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	70.0	58.0	61.1
Female	25.0	42.0	36.1
No Response	5.0	0.0	2.8
Total Number	20	50	72
<u>Average Age of Respondents (Years)</u>			
	32.1	29.8	30.9
<u>Marital Status (Percent)</u>			
Married	70.0	64.0	65.3
Single	25.0	36.0	31.9
No Response	5.0	0.0	2.8
<u>Average Number of Dependents</u>			
	2.60	2.20	2.25
<u>Average Length of Residence (Months)</u>			
	23.3	111.5	84.4
<u>Average Duration of Working in Williston Basin (Months)</u>			
	35.2	34.3	33.6
<u>Average Duration of Working With Present Company (Months)</u>			
	55.6	19.6	29.1
<u>Average Distance Traveled to Work (Miles)</u>			
	12.0	21.0	17.9

Examples include plant and business managers, production foremen, and toolpushers (i.e., drilling rig supervisors).

The manager and supervisor category was composed of slightly more than half nonlocals. These respondents (both local and nonlocal) represented all the company types identified in the survey (Tables 20 and 7). Both local and nonlocal managers/supervisors had generally been with their present companies for more than five years. This duration is more than twice as long as the average for all workers. Such employment longevity is common for managers and supervisors across industries.

TABLE 20. CHARACTERISTICS OF SURVEY WORK FORCE: MANAGERS AND SUPERVISORS

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	92.6	90.5	90.9
Female	6.6	9.5	7.9
No Response	0.7	--	1.1
Total Number	136	126	265
<u>Average Age of Respondents (Years)</u>			
	33.4	33.7	33.2
<u>Marital Status (Percent)</u>			
Married	74.3	84.9	78.9
Single	25.7	15.1	20.4
No Response	0.0	0.0	0.8
<u>Average Number of Dependents</u>			
	2.56	2.78	2.65
<u>Average Length of Residence (Months)</u>			
	26.6	101.4	61.9
<u>Average Duration of Working in Williston Basin (Months)</u>			
	41.7	91.2	64.7
<u>Average Duration of Working With Present Company (Months)</u>			
	68.6	61.0	64.2
<u>Average Distance Traveled to Work (Miles)</u>			
	12.8	12.6	12.7

As in the case with professionals, the majority of managers/supervisors were employed with companies located in the regional oil centers of Dickinson and Williston. Given the regional dominance of these two centers in the Williston Basin, most of the companies have their regional district headquarters in either (or both) of these cities.

Four of every five managers/supervisors were married, with an average number of 2.65 dependents per worker. Of those managers/supervisors that are married, 41 percent of their spouses were employed in various occupations (primarily clerical and service workers) within the local area. Over 60 percent of their children (total number of 359) were of primary and/or secondary school age.

Housing for managers and supervisors was mostly single family dwellings (58.1 percent). Nearly a quarter resided in mobile homes and the remainder largely in apartments and townhouses. Nonlocal workers had resided in their current dwellings for more than two years, while local workers had resided for almost eight and a half years.

Engineers

Fifteen of every 20 engineers in the Williston Basin survey were nonlocal (Table 21). These engineers were involved in various tasks ranging

TABLE 21. CHARACTERISTICS OF SURVEY WORK FORCE: ENGINEERS

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	93.5	100.0	91.2
Female	5.2	0.0	5.2
No Response	1.5	0.0	4.9
Total Number	77	20	102
<u>Average Age of Respondents (Years)</u>			
	28.1	29.4	27.2
<u>Marital Status (Percent)</u>			
Married	52.0	75.0	54.9
Single	46.8	25.0	40.2
No Response	1.3	0.0	4.9
<u>Average Number of Dependents</u>			
	2.15	2.47	2.21
<u>Average Length of Residence (Months)</u>			
	20.4	104.9	35.7
<u>Average Duration of Working in Williston Basin (Months)</u>			
	23.2	39.2	25.2
<u>Average Duration of Working With Present Company (Months)</u>			
	21.8	21.0	20.5
<u>Average Distance Traveled to Work (Miles)</u>			
	36.6	44.8	36.3

from devising new methods to increase oil and gas production, to providing technical advice to achieve satisfactory progress in operations. Most engineers were employed with oil and gas producing companies. Though over three-fourths of these firms are located in the regional centers, the average daily travel to work was extensive (36.3 miles) compared with the average worker. In fact, 40 percent of these engineers commuted over 50 miles to work.

Compared with professionals and managers/supervisors, engineers as a whole had worked for their present companies for a short duration--less than two years, but had worked in the Basin for more than two years. This would suggest that a significant number of engineers had changed companies recently.

Predominantly male, over half of these engineers were married and had an average of 2.2 dependents at the time of the survey. Nearly half of their spouses were employed in professional, clerical, and service occupations. Most of their children (61.7 percent) were in the preschool age category. Engineers resided, to a great extent, in either single-family dwellings or apartments, and to a lesser degree in townhouses and mobile homes.

Engineer Technicians

Engineer technicians assist engineers in such tasks as seismograph analysis, surveying, core analysis, and drafting. Technicians were employed by either oil and gas producers, field services, or geophysical/shot hole contractors.

Table 22 shows the local and nonlocal distribution for various characteristics of engineer technicians. These technicians were predominantly male, in their late twenties/early thirties, and married. Slightly more than half of the technicians were local. Local technicians averaged 3.3 dependents per worker; more than one dependent greater than for nonlocal workers.

Most local technicians resided in single family dwellings, mobile homes, and apartments for over eight years. The order was nearly reversed with nonlocal technicians dwelling in mobile homes, apartments, and single family dwellings. Local workers were employed with their current companies twice as long as their nonlocal counterparts. Nonlocal workers, in general, had worked and lived in the Williston Basin for about two years.

Sales Representatives

Sales representatives sell goods and/or services for primarily equipment and supply firms and service companies. Local labor dominated the sales occupation, as in other office-related occupations (Table 23). These sales representatives were almost exclusively male.

Seven of every ten of the sales representatives were married. For those that were married, 40 percent of their spouses were employed locally. The average family size for sales representatives was 3.25 people, with 80 percent of their children of the pre- or primary school age.

TABLE 22. CHARACTERISTICS OF SURVEY WORK FORCE: ENGINEER TECHNICIANS

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	91.7	89.7	88.9
Female	8.3	10.3	9.3
No Response	0.0	0.0	1.9
Total Number	24	29	54
<u>Average Age of Respondents (Years)</u>			
	29.0	30.3	29.2
<u>Marital Status (Percent)</u>			
Married	58.3	62.1	59.3
Single	41.7	37.9	38.9
No Response	0.0	0.0	1.8
<u>Average Number of Dependents</u>			
	2.08	3.28	2.77
<u>Average Length of Residence (Months)</u>			
	23.6	97.7	63.0
<u>Average Duration of Working in Williston Basin (Months)</u>			
	25.2	73.0	50.4
<u>Average Duration of Working With Present Company (Months)</u>			
	23.0	53.1	38.8
<u>Average Distance Traveled to Work (Miles)</u>			
	20.6	24.8	22.5

Nonlocal sales representatives had worked longer in the Williston Basin compared with their duration of residence. On average, nonlocal sales people were recent in-migrants to the local area. Both local and nonlocal workers were employed with their present companies for less than two years.

Office Clerical

Office clerical workers were almost exclusively female in the survey (Table 24). Respondents were employed by every type of petroleum company (Table 7).

TABLE 23. CHARACTERISTICS OF SURVEY WORK FORCE: SALES REPRESENTATIVES

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	100.0	98.2	99.0
Female	0.0	1.8	1.0
No Response	0.0	0.0	0.0
Total Number	45	54	99
<u>Average Age of Respondents (Years)</u>			
	29.9	31.9	31.0
<u>Marital Status (Percent)</u>			
Married	64.4	77.8	71.7
Single	35.6	22.2	28.3
No Response	0.0	0.0	0.0
<u>Average Number of Dependents</u>			
	2.30	2.19	2.25
<u>Average Length of Residence (Months)</u>			
	13.4	115.5	69.4
<u>Average Duration of Working in Williston Basin (Months)</u>			
	20.0	55.3	39.2
<u>Average Duration of Working With Present Company (Months)</u>			
	18.6	22.2	20.6
<u>Average Distance Traveled to Work (Miles)</u>			
	22.5	17.5	19.7

More than seven of every ten were local workers. The average age of office clerical workers was in the mid/late twenties. A sizeable number were single. Of those that were married, the average family size was rather high compared to other worker groups--4.12 members for nonlocals and 3.41 members for local workers. Over two-thirds of their children were of the pre- and primary school age, implying a potential need for services such as day-care facilities. Perhaps many of these married clerical workers took such jobs to support their bigger families.

Nearly 65 percent of the office clerical workers were employed with companies located in the regional cities of Dickinson and Williston. Of all

TABLE 24. CHARACTERISTICS OF SURVEY WORK FORCE: OFFICE CLERICAL

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	7.7	2.4	3.7
Female	92.3	97.6	96.3
No Response	0.0	0.0	0.0
Total Number	26	82	109
<u>Average Age of Respondents (Years)</u>			
	26.8	30.0	29.0
<u>Marital Status (Percent)</u>			
Married	61.3	58.5	58.7
Single	38.5	41.5	41.3
No Response	0.0	0.0	0.0
<u>Average Number of Dependents</u>			
	3.12	2.41	2.57
<u>Average Length of Residence (Months)</u>			
	34.6	135.5	109.5
<u>Average Duration of Working in Williston Basin (Months)</u>			
	17.5	23.1	21.6
<u>Average Duration of Working With Present Company (Months)</u>			
	15.5	18.7	17.8
<u>Average Distance Traveled to Work (Miles)</u>			
	9.8	5.0	6.0

groups, office clerical workers had the shortest daily commute (6 miles). Both local and nonlocal workers were relatively new entrants into the petroleum-related labor force, having worked in the Williston Basin for less than two years.

Plant Clerical

Workers who maintain records pertaining to the shipping and receiving of merchandise were designated as plant clerical. This occupation type also includes stock clerks and dispatchers. Though respondents in this category

were less numerous than office clerical, most company types were also represented in the survey.

Slightly over 73 percent of the plant clerical workers were local (Table 25). Nearly three of every five workers were married, and had an

TABLE 25. CHARACTERISTICS OF SURVEY WORK FORCE: PLANT CLERICAL

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	67.9	61.1	61.9
Female	32.1	38.9	35.7
No Response	0.0	0.0	2.4
Total Number	28	54	84
<u>Average Age of Respondents (Years)</u>			
	31.4	28.0	28.4
<u>Marital Status (Percent)</u>			
Married	64.3	59.3	59.5
Single	35.7	40.7	38.1
No Response	0.0	0.0	2.4
<u>Average Number of Dependents</u>			
	1.58	2.50	2.17
<u>Average Length of Residence (Months)</u>			
	20.0	99.4	70.8
<u>Average Duration of Working in Williston Basin (Months)</u>			
	32.5	28.1	28.9
<u>Average Duration of Working With Present Company (Months)</u>			
	39.0	25.6	29.4
<u>Average Distance Traveled to Work (Miles)</u>			
	11.3	10.3	10.4

average of 2.17 dependents. Compared with other occupational categories, the average family size for plant clerical workers was the lowest.

Although the average duration of residence was less than two years, nonlocals had worked both in the Basin and with their current companies for 32

and 39 months, respectively. Such results suggest that some of these workers had been transferred to the local area from elsewhere. On the other hand, locals had lived in the area for more than eight years while working for their current companies for about two years.

Mechanics and Repairmen

As in many of the occupations, mechanics and repairmen were almost exclusively male. Mechanics and repairmen represent most company types located in both the regional centers and the field development centers (notably Killdeer, Belfield, and Watford City).

Table 26 indicates that the majority of this category were nonlocal. On the average, these nonlocal workers were employed in the Williston Basin for about one-and-a-half years. Local workers, on the other hand, were more established having been employed by petroleum-related companies for over six years and by their present companies for over four years. One possible explanation is the difference in average age between nonlocal and local workers. Nonlocal workers were significantly younger than their local counterparts.

Nearly seven of ten mechanics/repairmen were married, with an average family size of 3.36 members. As in other occupational types, mechanics and repairmen had children of mostly the pre- and primary school age (63.8 percent). Nearly one-half of mechanics/repairmen resided in mobile homes, especially nonlocal workers.

Heavy Equipment Operators

The local/nonlocal distribution of heavy equipment operators is nearly equivalent in numbers but quite dissimilar in characteristics. Nonlocals, for instance, were more likely to be older and unmarried compared with local counterparts (Table 27). Local workers were employed in both the Williston Basin "oil patch" and their present companies for much longer durations than the in-migrants--the difference is nearly a factor of four. As expected, locals had resided in their current residences for almost eight years compared to less than a year for nonlocals.

Heavy equipment operators were generally employed by oil and gas producers and service firms located in Dickinson, Williston, or Watford City. Other than office clerical, these workers commuted the shortest distance to work (7.7 miles).

Truck Drivers

Nearly 10 percent of the survey respondents were listed as truck drivers (Table 28). Most of these workers were employed with trucking service firms, while the rest were divided among various equipment and supply companies, oil well drilling companies, seismic firms, and other service companies located in both regional oil centers and oil field development centers.

TABLE 26. CHARACTERISTICS OF SURVEY WORK FORCE: MECHANICS/REPAIRMEN

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	94.7	90.9	90.4
Female	2.6	9.1	5.5
No Response	2.6	0.0	4.1
Total Number	38	33	73
<u>Average Age of Respondents (Years)</u>			
	28.6	33.2	30.7
<u>Marital Status (Percent)</u>			
Married	71.1	66.7	67.1
Single	26.3	33.3	28.8
No Response	2.6	0.0	4.1
<u>Average Number of Dependents</u>			
	2.38	2.33	2.36
<u>Average Length of Residence (Months)</u>			
	11.7	141.2	69.9
<u>Average Duration of Working in Williston Basin (Months)</u>			
	19.2	75.7	44.8
<u>Average Duration of Working With Present Company (Months)</u>			
	22.5	51.8	35.1
<u>Average Distance Traveled to Work (Miles)</u>			
	8.5	10.9	9.6

Almost two-thirds of the respondents were nonlocal. Although seven of ten nonlocal workers were married, a significant portion were not accompanied by their wives (32.2 percent of married workers). Such a factor could result in lessening the overall effects of population pressure on various public services. The choice of housing also reflects such decisions--nearly two-thirds of the nonlocal workers lived in transient quarters compared with the local workers.

Local truck drivers had worked in the "oil patch" and for their present companies twice as long as the nonlocal workers. Truck drivers' commuting distance was relatively short compared with other occupational categories.

TABLE 27. CHARACTERISTICS OF SURVEY WORK FORCE: HEAVY EQUIPMENT OPERATORS

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	100.0	81.8	91.3
Female	0.0	18.2	8.7
No Response	0.0	0.0	0.0
Total Number	12	11	23
<u>Average Age of Respondents (Years)</u>			
	37.3	29.9	33.6
<u>Marital Status (Percent)</u>			
Married	50.0	72.7	60.9
Single	50.0	27.3	39.1
No Response	0.0	0.0	0.0
<u>Average Number of Dependents</u>			
	2.33	2.75	2.36
<u>Average Length of Residence (Months)</u>			
	11.8	105.7	53.4
<u>Average Duration of Working in Williston Basin (Months)</u>			
	16.3	66.3	40.2
<u>Average Duration of Working With Present Company (Months)</u>			
	13.8	41.6	27.5
<u>Average Distance Traveled to Work (Miles)</u>			
	3.6	14.6	7.7

Drilling Rig and Tank Construction Workers

Most drilling rig and tank construction workers were local in origin (Table 29). Although many of these construction workers were employed with oil and gas producing firms based out of the regional centers, the majority were employed with firms located in the field development centers of Watford City, Bowman, Belfield, and Killdeer. These firms were generally oil well drilling contractors and service companies.

A higher percentage of local workers were married. Over half of their spouses were employed in various local businesses, whereas none of the nonlocal spouses were employed. The low average number of dependents for

TABLE 28. CHARACTERISTICS OF SURVEY WORK FORCE: TRUCK DRIVERS

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	100.0	100.0	97.1
Female	0.0	0.0	0.0
No Response	0.0	0.0	2.9
Total Number	87	46	137
<u>Average Age of Respondents (Years)</u>			
	31.6	30.3	31.1
<u>Marital Status (Percent)</u>			
Married	67.8	58.7	62.8
Single	32.2	41.3	34.3
No Response	0.0	0.0	2.9
<u>Average Number of Dependents</u>			
	2.40	2.88	2.58
<u>Average Length of Residence (Months)</u>			
	21.3	108.3	50.3
<u>Average Duration of Working in Williston Basin (Months)</u>			
	22.0	47.1	29.9
<u>Average Duration of Working With Present Company (Months)</u>			
	14.2	29.1	18.5
<u>Average Distance Traveled to Work (Miles)</u>			
	10.0	7.4	9.1

construction workers can be attributed to their age--only the unskilled worker was younger.

Well Drilling Workers

The personal characteristics of well drilling workers were exclusively male, generally young in age, and single (Table 30). Eleven out of every 20 workers were classified as nonlocal in origin. Of those nonlocal workers that were married, nearly a third had not brought their spouses to their current local residence. Reasons for such a high percentage relate to the rigors of the occupation and the short duration of drilling at any one site. Both local

TABLE 29. CHARACTERISTICS OF SURVEY WORK FORCE: DRILLING RIG/TANK CONSTRUCTION WORKERS

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	100.0	95.6	97.4
Female	0.0	4.4	2.6
No Response	0.0	0.0	0.0
Total Number	16	23	39
<u>Average Age of Respondents (Years)</u>			
	26.2	27.8	27.1
<u>Marital Status (Percent)</u>			
Married	50.0	65.2	59.0
Single	50.0	34.8	41.0
No Response	0.0	0.0	0.0
<u>Average Number of Dependents</u>			
	2.12	2.33	2.26
<u>Average Length of Residence (Months)</u>			
	15.9	186.8	114.8
<u>Average Duration of Working in Williston Basin (Months)</u>			
	27.3	38.8	34.0
<u>Average Duration of Working With Present Company (Months)</u>			
	14.1	22.1	18.8
<u>Average Distance Traveled to Work (Miles)</u>			
	24.0	35.8	31.0

and nonlocal spouses were generally not employed outside of the home. Of those who were working, most were employed in either clerical or service occupations. Well drilling workers had an average 2.67 dependents, with over 80 percent of their children of the pre- or primary school age.

Most of these well drilling workers were employed with drilling contractors operating out of the regional centers of Dickinson and Williston. Nonlocals were employed in the Williston Basin and for their present companies for a relatively short time period. The average well driller had been in the "oil patch" longer than with his present company, suggesting that some

TABLE 30. CHARACTERISTICS OF SURVEY WORK FORCE: WELL DRILLING WORKERS

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	100.0	100.0	99.4
Female	0.0	0.0	0.0
No Response	0.0	0.0	0.6
Total Number	90	73	164
<u>Average Age of Respondents (Years)</u>			
	27.9	26.2	27.1
<u>Marital Status (Percent)</u>			
Married	48.9	49.3	48.8
Single	48.9	50.7	49.4
No Response	2.2	0.0	1.8
<u>Average Number of Dependents</u>			
	2.70	2.63	2.67
<u>Average Length of Residence (Months)</u>			
	17.4	112.5	60.2
<u>Average Duration of Working in Williston Basin (Months)</u>			
	21.9	40.2	29.9
<u>Average Duration of Working With Present Company (Months)</u>			
	20.2	32.0	25.4
<u>Average Distance Traveled to Work (Miles)</u>			
	39.0	27.7	33.7

nonlocals were transferred from other oil development regions or had changed companies since moving to the Williston Basin.

Well Servicing Personnel

Unlike well drilling workers, well servicing personnel are involved in various aspects of servicing oil wells including acidizing, caulking, repairing, and testing. The majority of respondents in this occupation were employed by oil and gas producers primarily based out of field development centers (e.g., Belfield, Bowman, Watford City).

Local workers, though fewer in number, were older than their nonlocal counterparts (Table 31). Three out of every four well servicing workers were

TABLE 31. CHARACTERISTICS OF SURVEY WORK FORCE: WELL SERVICING PERSONNEL

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	95.8	92.3	92.1
Female	4.2	7.7	5.3
No Response	0.0	0.0	2.6
Total Number	24	13	38
<u>Average Age of Respondents (Years)</u>			
	26.8	29.6	27.8
<u>Marital Status (Percent)</u>			
Married	79.2	76.9	76.3
Single	20.8	23.1	21.1
No Response	0.0	0.0	2.6
<u>Average Number of Dependents</u>			
	2.78	3.40	2.90
<u>Average Length of Residence (Months)</u>			
	13.0	106.5	47.1
<u>Average Duration of Working in Williston Basin (Months)</u>			
	18.6	66.2	27.6
<u>Average Duration of Working With Present Company (Months)</u>			
	15.8	59.1	21.0
<u>Average Distance Traveled to Work (Miles)</u>			
	9.3	26.0	15.2

married, with about 45 percent of their spouses employed outside the home. These workers had a high average number of dependents, with most of their children in the pre- and primary school age.

Local workers had been employed in the Williston Basin for over 5-1/2 years and with their present companies for nearly five years. In contrast, in-migrants had worked in the "oil patch" for about a year and a half and with their present companies for over a year. Most nonlocal well servicing workers lived in mobile homes, whereas local workers resided in single family homes.

Skilled Labor

Skilled workers include other craftsmen and kindred workers in various occupations--a "residual" category for those workers who have either served apprenticeships or completed training periods. Skilled laborers, most of whom were nonlocal were employed with various service companies (Table 32).

TABLE 32. CHARACTERISTICS OF SURVEY WORK FORCE: SKILLED LABOR

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	100.0	100.0	96.9
Female	0.0	0.0	0.0
No Response	0.0	0.0	3.1
Total Number	40	22	64
<u>Average Age of Respondents (Years)</u>			
	28.8	25.5	27.6
<u>Marital Status (Percent)</u>			
Married	50.0	40.9	45.3
Single	50.0	59.1	51.6
No Response	0.0	0.0	3.1
<u>Average Number of Dependents</u>			
	2.52	2.00	2.39
<u>Average Length of Residence (Months)</u>			
	13.2	67.3	29.3
<u>Average Duration of Working in Williston Basin (Months)</u>			
	17.2	34.0	22.4
<u>Average Duration of Working With Present Company (Months)</u>			
	26.4	19.2	23.0
<u>Average Distance Traveled to Work (Miles)</u>			
	20.7	12.4	17.8

Skilled laborers were generally younger than the overall average of the survey work force. Many of these workers were single. Those that were married had an average number of dependents of 2.39 members. Over a third of their

spouses were employed, mostly as clerical and service workers with local businesses.

Nonlocal workers had been employed with their present company twice as long as their time of residence in the local area, indicating that many had been transferred from other areas. Local workers, in contrast, had been employed in the "oil patch" almost twice as long as with their present companies.

Unskilled Labor

Warehousemen, janitors, and cleaners were classified as unskilled laborers. Similar to skilled workers, most unskilled laborers were employed by equipment and supply firms and service companies.

Slightly over half of these unskilled workers were nonlocal. Compared with other occupational groups, unskilled laborers were the youngest in average age and had the lowest percentage that were married (Table 33).

Local workers had resided in the area longer than their nonlocal counterparts--by a factor of ten. Survey results indicate that nonlocal laborers were relatively recent in-migrants to the area, having been employed in the oil patch and with their present companies for less than a year.

Work Force Impacts on Specific Communities

The nature of oil activity in any one development region is a spatially diffuse phenomenon. The location of establishments, their place of work (e.g., drilling sites, areas of seismic activity), and the residence of their workers are generally scattered across the entire region. Although this is aptly illustrated in the Williston Basin, an orderly regional hierarchy of cities can be ascertained. Alluded to earlier in the report is this hierarchal order, composed of regional centers and field development centers.

Regional centers, by virtue of their regional trade center status, are cities where significant agglomeration economies exist for the petroleum-related industry. Oil exploration and development companies (including multinationals) set up district operations here for the region, along with geophysical/seismic firms and well drilling contractors. Other subcontractors which perform the actual exploration and development tasks and the host of field services and material and equipment suppliers that support these field activities tend to be located in a few central places. For the Williston Basin, these central places are primarily Williston and Dickinson, and to a lesser extent, Minot and Bismarck-Mandan.¹¹

Since oil field activities of exploration and development take place throughout the development region, companies involved in the development and production phases (e.g., oil producers and supporting field services) tend to

¹¹Minot and Bismarck-Mandan are located on the eastern edge of the Basin, while much of the activity is occurring west of these centers, i.e., close to Williston and Dickinson.

TABLE 33. CHARACTERISTICS OF SURVEY WORK FORCE: UNSKILLED LABOR

Characteristic	Nonlocal	Local	Total
<u>Sex of Respondents (Percent)</u>			
Male	95.0	94.4	92.3
Female	5.0	5.6	5.1
No Response	0.0	0.0	2.6
Total Number	20	18	39
<u>Average Age of Respondents (Years)</u>			
	23.5	26.9	25.1
<u>Marital Status (Percent)</u>			
Married	45.0	33.3	38.5
Single	55.0	66.7	59.0
No Response	0.0	0.0	2.6
<u>Average Number of Dependents</u>			
	1.80	2.50	2.18
<u>Average Length of Residence (Months)</u>			
	11.2	110.9	58.1
<u>Average Duration of Working in Williston Basin (Months)</u>			
	10.2	42.1	24.2
<u>Average Duration of Working With Present Company (Months)</u>			
	7.8	16.5	11.6
<u>Average Distance Traveled to Work (Miles)</u>			
	14.0	12.2	13.1

be located near major development fields. Often these major fields are in remote places (i.e., considerable distance from regional oil centers) and necessitate that field operations be established. These field development centers of Belfield, Bowman, Killdeer, Tioga, and Watford City often become the locations for companies and their workers engaged in the development drilling, production, and servicing of oil and gas wells.

The ensuing discussion analyzes survey results of those workers and companies located in the regional centers of Williston and Dickinson, and the field development center of Watford City.

Williston

The regional center of Williston earlier experienced an economic boom created by heightened oil activity. In the 1950s, Williston became the principal center of service and supply to western North Dakota and eastern Montana petroleum operations when oil was discovered in its immediate vicinity. During that period, oil development induced numerous socioeconomic changes in the local area. Similar changes have occurred in the city as a result of the revived petroleum development--growth in employment opportunities, increases in incomes and sales, population pressure on existing public and private services, and social changes.

When Williston developed as a service and supply center during that first surge in oil activity, it also became headquarters for a number of local operations. Williston remains as the principal center for petroleum-related operations in North Dakota. Of the total number of petroleum-related establishments in North Dakota's Williston Basin, over a third have set up operations in Williston (Western Oil Reporter, 1982). About 40 percent of these 262 Williston establishments are headquartered in the regional center. The majority of firms which participated in the survey were equipment and material supply and service companies (Table 35).

The profile of petroleum-related work force in Williston is based on the responses of 422 survey workers. Of these respondents, more than half were local residents,¹² indicating an established local petroleum-related labor pool (Table 34). The majority of these local workers were employed with equipment and supply companies and service firms, in such capacities as sales representatives, clerical workers, repairmen, and truck drivers (Table 35). Although not dominant, a substantial number of managers and supervisors and well drilling workers were local. Overall, these local workers have been employed in the "oil patch" twice as long as their nonlocal counterparts (4.6 years versus 2.2 years).

More than eight of every ten workers were male in the survey. Most of the female workers were employed in clerical positions. Compared with other community-specific work force surveys, the petroleum-related work force in Williston was younger. The average age for nonlocal workers was 28.9 years compared with 30.2 years for local workers.

A sizeable portion of the survey work force was single. Of those that were married, over half of their spouses were employed in such occupations as clerical workers, retail trade and service workers, and professionals. The average number of dependents was less for in-migrants than for locals, in part due to the nonlocals' younger average age. Over three-quarters of the workers' children were of the pre- or primary school age. The addition of large numbers of school-aged children will obviously place pressure on existing local schools.

Most of the nonlocals were relatively recent in-migrants to the city--nearly 60 percent had moved to Williston within the year. Local workers, on

¹²Since the definition used for local workers is area-specific (i.e., workers whose prior residence was within the 17 petroleum-producing counties), the number of community-specific local workers is probably overestimated.

TABLE 34. WILLISTON: PERSONAL AND FAMILY CHARACTERISTICS OF SURVEY WORK FORCE

Characteristic	Williston Work Force		Total
	Nonlocal	Local	
<u>Sex of Respondents</u>			
Male	89.8	80.7	84.4
Female	9.8	19.4	14.7
No Response	0.5	0.0	1.0
Total Number	205	212	422
<u>Average Age of Respondent</u>	28.9	30.2	29.2
<u>Marital Status</u>			
Married	52.7	61.3	56.4
Single	45.9	38.7	42.2
No Response	1.0	0.0	
<u>Average Number of Dependents</u>	2.08	2.43	2.27
<u>Number of Dependent Children</u>			
0- 4 Years	55 (39.9)	67 (32.4)	122 (35.4)
5-12 Years	65 (47.1)	82 (39.6)	147 (42.6)
13-18 Years	14 (10.1)	39 (18.8)	53 (15.4)
19+ Years	4 (2.9)	19 (9.2)	23 (6.7)
Total Number of Children	138 (40.0)	207 (60.0)	345

average, had lived in Williston for nearly 10 years compared with less than two years for nonlocals.

In the survey, a majority of the local respondents indicated they were currently residing in single family dwellings, whereas nonlocals were either dwelling in apartments or mobile homes (Table 36). The percent of workers living in mobile homes is similar to that reported in a community attitude and housing survey conducted in December 1981. In this survey, more respondents who worked in the oil-related industry resided in mobile homes (21.6 percent) than did nonoil-related workers (9.9 percent) (Clausen and Gilmour, 1982).

Dickinson

Though a regional trade center for southwestern North Dakota, Dickinson was an field development center during the oil boom of the 1950s and 1960s. Dickinson's importance as an oil center grew immeasurably during the 1970s when a number of significant oil fields were discovered nearby, notably the "elephant" Little Knife field. As of 1982, 144 firms had operations in Dickinson with over a quarter headquartered in the city. Like Williston, the

TABLE 35. WILLISTON: OCCUPATIONAL CHARACTERISTICS OF SURVEY WORK FORCE

Type of Company	Number of Firms	Williston Work Force (Percent)		
		Nonlocal	Local	Total
Oil and Gas Producing	4	6.0	4.3	5.0
Oilwell Drilling	8	18.0	12.0	14.9
Geophysical/Shot Hole	2	1.7	0.5	0.9
Equip. & Supplies--Muds/Fluids	6	7.7	4.9	6.2
Equip. & Supplies--Oil Field	10	4.7	10.9	7.8
Equip. & Supplies--Other	23	22.3	23.4	22.7
Safety Equipment Services	3	3.4	2.7	3.3
Trucking Services	3	3.9	4.4	4.0
Oil Field Services	5	3.0	3.8	3.8
Wireline Services	5	11.2	14.7	13.0
Services--Other	10	14.2	8.7	11.4
Other	4	2.6	6.0	4.3
No Response	1	1.2	3.8	2.6
Total Number	84	205	212	422
 <u>Occupation Type</u>				
Professionals		3.9	3.3	3.6
Managers & Supervisors		27.0	21.7	23.9
Engineers		9.4	3.3	6.6
Engineer Technicians		3.0	4.4	3.6
Sales Representatives		10.7	13.0	11.8
Office Clerical		6.0	14.1	10.4
Plant Clerical		3.4	8.7	6.2
Mechanics/Repairmen		2.6	4.4	3.3
Heavy Equipment Operators		2.6	1.6	1.9
Truck Drivers		6.0	6.0	5.9
Well Drilling Workers		16.3	12.5	14.2
Skilled Labor		6.0	3.8	5.0
Unskilled Labor		1.7	3.3	2.6
Other		0.8	0.0	0.5
No Response		0.0	0.5	0.5
Average Months Working in Williston Basin		26.6	55.4	39.2
Average Months Working with Present Company		25.0	30.1	27.1
Average Distance Traveled to Work (Miles)		12.7	13.6	13.2

TABLE 36. WILLISTON: PRESENT HOUSING OF SURVEY WORK FORCE

Type of Housing	Williston Work Force (Percent)		
	Nonlocal	Local	Total
Single Family	34.3	57.1	46.0
Apartment	30.0	15.8	22.7
Townhouse/Condominium	4.3	3.7	4.0
Mobile Home	25.3	21.2	23.0
Motel	2.6		1.2
Boarding/Sleeping Room	0.9	0.5	0.7
Trailer	1.7	1.1	1.2
Other	0.9	1.1	0.9
No Response		0.5	0.2
Total Number	205	212	422
Average Length of Residence (Months)	22.7	118.5	65.5

majority of these establishments (79.9 percent) provide equipment, supplies, and services. Nearly 30 percent of the total number of establishments had their workers fill out survey questionnaires.

Unlike Williston, most of the survey respondents in Dickinson were in-migrants (Table 37), suggesting that the local labor force was unable to meet the requisite labor needs of petroleum-related companies. Nonlocals dominated such occupations as managers and supervisors, engineers, and engineer technicians, whereas locals filled professional, clerical, and construction positions (Table 38). Local workers had been employed in the Williston Basin petroleum industry for a relatively short duration compared with local Williston workers. On the average, nonlocals had been employed longer with their current companies than locals had worked in the "oil patch." Given such results, it is presumed that a number of nonlocals had been transferred by their companies from other petroleum development regions.

Like Williston, over 80 percent of the survey respondents were male. Most of the female respondents were of local origin. Both local and nonlocal groups have equivalent averages in age--29.3 years.

Over six of every ten workers were married, and 42 percent of their spouses were employed locally. Although most spouses were employed as retail sales, service, and clerical workers, a significant portion (41.5 percent) were professionals and managers.

Dickinson workers had a slightly higher average number of dependents compared with Williston. Given the average age of workers, it is not surprising that most of their children were of the pre- and primary school age.

TABLE 37. DICKINSON: PERSONAL AND FAMILY CHARACTERISTICS OF SURVEY WORK FORCE

Characteristic	Dickinson Work Force (Percent)		
	Nonlocal	Local	Total
<u>Sex of Respondents</u>			
Male	90.5	74.5	82.6
Female	9.0	25.5	15.5
No Response	0.5	0.0	1.9
Total Number	210	145	361
<u>Average Age of Respondents</u>			
(Years)	29.3	29.3	29.3
<u>Marital Status</u>			
Married	61.4	65.5	62.0
Single	38.1	34.5	36.0
No Response	0.5	0.0	1.9
<u>Average Number of Dependents</u>			
	2.15	2.44	2.29
<u>Number of Dependent Children</u>			
0- 4 Years	40.0	42.5	41.3
5-12 Years	39.3	32.9	35.9
13-18 Years	16.6	15.6	16.0
19+ Years	4.1	9.0	6.7
Total Number of Children	145	167	312

Most of the local workers indicated they currently resided in single family homes (Table 39). Though the highest percentage of nonlocals lived in single-family dwellings, significant numbers resided in apartments and mobile homes.

Watford City

Watford City has been a center of oil activity in the Williston Basin since the 1950s. Lacking the regional trade status of a Dickinson or Williston, Watford City became a logical location as a supply and service center for the petroleum industry given its proximity to significant oil and gas fields. Although other oil field development centers (e.g., Ray, Stanley) have since been bypassed by the direction of petroleum development, Watford City remains in the center of an active exploration and development area. A number of production facilities including gas processing plants are located nearby. As in the regional centers, service and supply operations dominate the local petroleum industry in Watford City. However, unlike Williston and Dickinson, Watford City has few oil producers and drilling contractors.

TABLE 38. DICKINSON: OCCUPATIONAL CHARACTERISTICS OF SURVEY WORK FORCE

Type of Company	Number	Dickinson Work Force (Percent)		
		Nonlocal	Local	Total
Oil and Gas Producing	2	16.2	19.3	17.4
Oilwell Drilling	3	5.7	5.5	5.5
Geophysical/Shot Hole	2	8.1	2.8	5.8
Equip. & Supplies--Muds/Fluids	2	7.6	4.8	6.9
Equip. & Supplies--Oil Field	3	5.2	5.5	5.3
Equip. & Supplies--Pump Systems	2	2.4	3.4	2.8
Equip. & Supplies--Other	8	8.6	18.6	12.5
Trucking Services	2	7.1	5.5	6.6
Oil Field Services	3	9.0	5.5	7.5
Wireline Services	3	12.4	6.9	10.3
Services--Other	10	15.2	21.4	18.0
No Response	1	0.0	0.0	1.7
Total Number	41	210	145	361
<u>Occupation Type</u>				
Professionals		3.3	9.0	5.8
Managers & Supervisors		24.3	20.0	22.2
Engineers		18.1	4.8	13.0
Engineer Technicians		6.2	2.8	5.0
Sales Representatives		6.7	9.7	7.8
Office Clerical		3.3	15.2	8.0
Plant Clerical		6.7	9.7	8.0
Mechanics/Repairmen		3.3	1.4	2.8
Truck Drivers		5.2	3.4	4.4
Rig and Tank Construction		2.4	5.5	3.6
Well Drilling Workers		9.0	8.3	8.6
Skilled Labor		6.2	2.8	4.7
Unskilled Labor		0.5	3.4	1.7
Other		2.8	4.1	3.3
No Response		1.9	0.0	1.1
Average Months Working in Williston Basin		22.5	29.5	25.5
Average Months Working with Present Company		30.4	25.9	28.0
Average Distance Traveled to Work (Miles)		18.8	17.2	17.7

TABLE 39. DICKINSON: PRESENT HOUSING OF SURVEY WORK FORCE

Type of Housing	Dickinson Work Force (Percent)		
	Nonlocal	Local	Total
Single Family	39.5	56.6	46.0
Apartment	29.0	21.4	26.3
Townhouse, Condominium	10.0	4.1	7.8
Mobile Home	14.8	15.9	15.2
Motel	2.4	0.0	1.4
Other	4.3	2.1	3.3
Total Number	210	145	361
Average Length of Residence (Months)	13.9	112.9	53.5

The petroleum-related work force in Watford City was predominantly composed of in-migrants who were generally older, married, and more experienced compared with nonlocals in the regional centers (Tables 40 and 41). Of those workers who were married, a greater percentage of local spouses than nonlocal spouses were employed outside the home, mostly in clerical and service positions. The average number of dependents for nonlocal workers was unusually low, explained in part by a number of workers' families living elsewhere. Such decisions in the aggregate have an attenuating effect on the population-induced impacts on the area's public and private facilities (e.g., schools, housing).

Most of the respondents were employed by oil and gas producers, trucking services, and other services¹³ as managers and supervisors, truck drivers, or laborers (skilled and unskilled). These workers in Watford City had more petroleum-related experience overall than their counterparts in Williston or Dickinson. On average, Watford City workers had been employed in the "oil patch" for about four years.

Given that a number of their families were living elsewhere, most in-migrant workers resided in mobile homes (Table 42). As in other communities, the highest percentage of local workers resided in single family homes.

¹³Other services, a "catch-all" category is composed of construction, repair, and hot oil fracturing. For a description of these and other industry groupings see Appendix C.

TABLE 40. WATFORD CITY: PERSONAL AND FAMILY CHARACTERISTICS OF SURVEY WORK FORCE

Characteristic	Watford City Work Force (Percent)		
	Nonlocal	Local	Total
<u>Sex of Respondents</u>			
Male	96.0	73.9	85.6
Female	4.0	26.1	9.4
No Response	0.0	0.0	5.0
Total Number	124	46	180
<u>Average Age of Respondents</u>			
(Years)	31.8	30.4	30.9
<u>Marital Status</u>			
Married	68.6	69.6	65.6
Single	31.4	30.4	29.4
No Response	0.0	0.0	5.0
<u>Average Number of Dependents</u>			
	1.97	2.59	2.19
<u>Number of Dependent Children</u>			
0- 4 Years	37.5	22.7	30.7
5-12 Years	35.2	46.7	40.5
13-18 Years	21.6	28.0	24.5
19+ Years	5.7	2.7	4.3
Total Number of Children	88	75	163

TABLE 41. WATFORD CITY: OCCUPATIONAL CHARACTERISTICS OF SURVEY WORK FORCE

Type of Company	Number	Watford City Work Force (Percent)		
		Nonlocal	Local	Total
Oil and Gas Producing	2	13.7	32.6	18.9
Oilwell Drilling	1	4.8	8.7	5.6
Equip. & Supplies--Other	4	10.5	15.0	10.6
Trucking Service	2	37.1	32.6	35.6
Service--Other	4	33.0	10.9	28.4
Other	1	0.8	0.0	0.6
No Response	-	0.0	2.2	0.6
Total Number	14	124	46	180
<u>Occupation Type</u>				
Professionals		0.8	13.0	3.9
Managers & Supervisors		10.5	21.7	3.3
Engineers		4.0	2.2	3.9
Engineer Technicians		3.2	4.4	3.3
Office Clerical		1.6	13.0	4.4
Plant Clerical		3.2	8.7	4.4
Mechanics/Repairmen		7.3	6.5	7.2
Truck Drivers		29.8	4.4	3.3
Rig and Tank Construction		1.6	10.9	3.9
Well Drilling Workers		9.7	8.7	9.4
Skilled Labor		8.1	2.2	7.2
Unskilled Labor		12.1	2.2	9.4
Other		8.1	2.2	6.1
Average Months Working in Williston Basin		38.2	67.6	45.5
Average Months Working with Present Company		32.8	38.3	34.4
Average Distance Traveled to Work (Miles)		13.8	17.3	13.9

TABLE 42. WATFORD CITY: PRESENT HOUSING OF SURVEY WORK FORCE

Type of Housing	Watford City Work Force (Percent)		
	Nonlocal	Local	Total
Single Family	21.0	7.8	27.8
Apartment	13.7	8.7	13.3
Mobile Home	53.2	1.3	48.9
Boarding/Sleeping Room	4.8	0.0	3.9
Trailer	4.8	0.0	3.3
Other	2.4	2.2	2.2
No Response	0.0	0.0	0.6
Total Number	124	46	180
Average Length of Residence (Months)	29.8	143.5	59.6

Summary and Implications

Employment in the petroleum-related industry in North Dakota is highly dependent on such exogenous factors as (1) the world market price for crude oil; (2) prevailing interest rates; (3) the level of development activity elsewhere; (4) ongoing technical innovation; and (5) government regulation. Such factors make projecting future activity a rather dubious undertaking. This uncertainty is aptly shown in a headline of a recent Wall Street Journal article--"More or Less Oil Will Go Up or Down or Maybe It Won't" (Getschow, 1982). In view of such a state of flux and the recent downturn in petroleum activity in the Williston Basin, how reliable is information on the work force collected during an expansionary development period? Obviously, the impacts of the current contracted development state require appropriate policies just as the effects of heightened development activity demand mitigation. One of the keys in understanding the impacts of decline in petroleum development lies in comprehending the effects of earlier stages of activity. Whether expansion or contraction, an understanding of the nature of the petroleum-related work force becomes an important prerequisite to the formulation of appropriate policies.

The objectives of this study were to estimate the occupation, locational origin, housing requirements, commuting patterns, and other socioeconomic characteristics of the petroleum-related work force in North Dakota during 1981 and 1982. As such, this study becomes the first comprehensive work force profile of an onshore petroleum development area.

Data were collected through a questionnaire administered to workers in the most active centers of petroleum activity: Belfield, Bowman, Dickinson, Killdeer, Tioga, Watford City, and Williston. Information was obtained from a total of 1,377 workers, 17 percent of the existing North Dakota petroleum work force.

Slightly over half of the respondents were nonlocal workers, moving into the region at a migration rate of 503 per 1,000 workers. The remainder had resided in the area prior to working for a petroleum-related establishment. Nonlocal workers came from eastern portions of North Dakota, 36 different states, four Canadian provinces, and a Western European country. Of every 100 in-migrant workers, 18 previously lived in eastern North Dakota, 34 came from neighboring states, and 32 moved from other petroleum development areas. The average age for both local and in-migrant worker groupings was 30 years.

Predominantly male, 63 of every 100 workers were married. In contrast to the construction of large-scale projects, 86 of every 100 married nonlocal workers brought their families with them to the field development communities. Each of these workers brought an average of 2.2 dependents with him to the area.

Workers were employed by a wide assortment of companies involved in various petroleum-related activities--from geophysical exploration and development drilling, to production and processing of petroleum. Over 15 occupational groups were represented in the survey, with managers and supervisors, well drilling workers, truck drivers, and clerical worker groups garnering the most respondents.

The regional centers of Dickinson and Williston were the places of residence for 57 of every 100 workers. Most of the remainder lived in the smaller field development centers near active exploration and development fields. Substantial numbers of workers resided in Watford City, Belfield, New Town, and Killdeer. The workers commuted an average distance (one way) of 18 miles to work.

Overall, workers had been employed with their present companies for about two-and-a-half years. Local workers had been employed in the Williston Basin "oil patch" twice as long as in-migrant workers. The difference suggests that a number of nonlocals had been transferred by their company from other petroleum development areas.

Local workers had lived, on average, in their present residence for over nine years. For every 100 local workers, 54 resided in single family homes. In contrast, only 32 of every 100 nonlocals lived in single family homes. The majority of those workers (60 percent) lived in either multiple housing or mobile homes.

In light of the uncertain future of petroleum development in North Dakota, this study has several implications for manpower and community planning. Expansion of the industry may further enhance employment opportunities for the state's rural labor force, and vocational and technical training may result in local workers qualifying for more of the higher skilled jobs. Expanded exploitation of the state's petroleum reserves also may lead to a substantial influx of workers with their dependents into the Williston Basin. Information on worker characteristics, residential requirements, commuting patterns, and family characteristics may provide state and local policy officials with the appropriate basis of planning for this new population.

On the other hand, contraction of the industry raises questions regarding the employment impacts of declining drilling activity and production. Will local residents, who were crossovers to petroleum-related employment, return to their former occupations? Will nonlocal workers migrate out of the region to other producing areas? What effect will the decrease in employment have on the region? Will there be a corresponding decrease in population? Most research in socioeconomic impact analysis is decidedly growth-oriented--assessing the impacts resulting from the construction/operation of large facilities. The pivotal question is whether the reverse is valid in declining conditions brought about by facility closures, cancellations, or slowdowns.

A monitoring system would assist in alleviating uncertainty (Leistriz and Chase, 1982). This system, which involves the periodic collection of data, would provide accurate and timely information as the basis for rational planning in the host communities and region. Such an endeavor would require extensive surveying of producing firms and well drilling contractors to determine current operations and short-term plans. On the basis of such information, impact projections (whether expansion or contraction is the current state) could be established to provide policy officials with clearer guidance for planning purposes.

Appendix A

OIL WORKERS QUESTIONNAIRE

The information on this form is needed to help in planning for the community service needs associated with expanding oil and gas activity in the Williston Basin.

Oil and gas firms are handing out these questionnaires to their workers all over the Basin. By filling out this short questionnaire, you will be providing information that will be very useful to communities near the major exploration and production areas. No names or other identification are asked; your answers cannot be traced back to you.

THANK YOU FOR YOUR HELP.

1. What is your occupation (job title)? _____
_____ (please be specific)

2. (a) How long have you been working in the Williston Basin for the oil and gas related industry? ____ Years ____ Months
(b) How long have you been working for this company? ____ Years ____ Months
(c) During the last six weeks, what has been your principal work site?
_____ County _____ Town (or name of nearest town)

3. (a) Where is your local place of residence? _____
_____ Town

(b) If not in town, what is name of nearest town and your approximate distance from town?
_____ (Name of nearest town and county)
_____ (Approximate distance)
(c) How long have you been living there? ____ Years ____ Months

NOTE: Your local place of residence is the place from which you commute daily to your job. It may not be your permanent address or the address at which your family is located.

4. What is your current local place of residence? (Check One)

_____ Single family house	_____ Motel
_____ Apartment	_____ Boarding, sleeping room
_____ Town house, condominium	_____ Travel trailer, camper, van
_____ Mobile home	_____ Other (Please specify:)
_____ Work camp	_____

Appendix B

Title Description of Petroleum Industry Work Force Categories

Job descriptions of the petroleum industry work force were condensed into 15 different categories. These categories are defined as follows:

Professional--one who performs a variety of different support functions, whether as an accountant, purchasing agent, systems analyst, statistician, landman, chemist, geologist, or personal specialist.

Manager and Supervisor--one who performs a supervisory or managerial function and is responsible to various degrees for the overall operation of the business. Examples include plant and business managers, as well as production foremen and toolpushers (drilling rig supervisors).

Engineer--one who performs a variety of engineering functions from devising methods to improve oil and gas production and modifying drilling tool designs, to providing technical advice to achieve economical and satisfactory progress.

Engineering Technician--one who assists engineer in both laboratory and production types of activities. Normally, a technician works under the direct supervision of an engineer as a core analyst, draftsman, surveyor, and chainman.

Sales Representative--one who is primarily concerned with selling of a company's goods and/or services.

Office Clerical Worker--one who performs a variety of clerical functions. Typical examples would be typists, secretaries, cashiers, receptionists, switchboard operators, and bookkeepers.

Plant Clerical Worker--one who compiles stock records and keeps records pertaining to the shipping and receiving of merchandise.

Mechanic/Repairman--one who repairs, overhauls, and maintains machinery, motor vehicles, and/or buildings.

Heavy Equipment Operator--one who operates several different types of power construction equipment, such as compressors, bulldozers, graders, shovels, front-end loaders, and tractors.

Truck Driver--one who drives truck or tractor-trailer to transport materials to and from specified destinations. Examples include transporting crude oil and natural gas, fuel oil, and heavy equipment.

Drilling Rig/Tank Construction Worker--one who erects and repairs steel rigs (derricks), oil field equipment, and/or metal tanks for crude oil storage. Examples include rig-builder, tank builder, and roustabout or "roughneck."

Well Drilling Worker--one who performs various duties related to drilling oil and gas wells such as setting up and operating draw works and related machinery; installing steel casing; operating mud pumps, power pumps, and oil treatment units; and charting drilling and producing operations. Typical examples include directional man, rotary drill operator, casing, derrickman, perforator operator, oil pumper, and mud-plant operator.

Well Servicing Personnel--one who performs various duties related to servicing oil and gas wells such as treating wells with acid, caulking casings in wells, repairing damaged wells, and formation testing. Example occupations include acidizer, bulk station operator, cementer, clean-out driller, service-unit operator, oil well shooter, and well puller.

Skilled Labor--includes all other skilled craftsmen and kindred workers in petroleum production, maintenance, construction, repair, and material handling occupations that require comprehensive knowledge achieved through serving apprenticeships or completing extensive training periods.

Unskilled Labor--includes all other occupations that involve the performance of simple duties that may be learned within a short period of time and require limited independent judgement. Example occupations include hand trucker, warehouseman, janitors, and cleaners.

Appendix C

Description of Petroleum Industry Company Types

Descriptions of the various types of companies engaged in the exploration, development, and production of petroleum are provided below:

Oil and Gas Producing. Companies, whether corporations, partnerships, or proprietorships engaged in operations including petroleum exploration and production, geologic and engineering consulting, and mineral lease acquisition and brokerage.

Gas Producing/Refineries. Includes natural gas transmission (e.g., pipeline) companies, oil refineries, and natural gas processing plants.

Oil Well Drilling. Companies engaged in the direct activity of drilling and completing an oil well. Also includes workover contractors which clean, repair, reopen, drill deeper, or plug back a well to secure continued or additional production.

Geophysical/Shot Hole. Companies primarily engaged in geological exploration activities utilizing such sensitive recording devices as magnetometers, gravimeters, and seismographs. The latter, which detects earth tremors in the prospection of probable oil bearing structures by recording man-made shock waves (i.e., "shot holes"), is the most common method used in the Williston Basin.

Equipment and Supplies. Companies that furnish equipment and supply materials (including manufacturers' representatives, and suppliers of oil, diesel, and LPG) for the exploration, development, and production of petroleum. Equipment and supply firms are further subdivided into the following types:

Chemicals. Supply companies specializing in materials to assist in the drilling and completion of an oil well. (For instance, chemicals are used to treat or stimulate the producing zone and thus increase the flow of gas or oil.)

Muds/Fluids. Supply companies specializing in drilling fluids or muds. Such fluids lubricate and cool the drill bit and string, and carry drill cuttings to the surface.

Compressors. Companies which sell equipment employed for various tasks such as moving natural gas through pipelines, and circulating mud/fluids during the drilling operation.

Pump Systems. Equipment companies which specialize in selling mechanical devices that lift oil to the surface.

Drilling Bits. Equipment companies which sell specialized devices used for cutting into rock formations during drilling.

Tools. Equipment companies which sell various materials used in drilling.

Oil Field. Equipment and supply companies that provide a range of materials for exploration, drilling, and production of oil wells.

Services. Companies that perform services for the exploration, development, and production of petroleum. As in the case of equipment and supply firms, services companies are further subdivided according to the following specialties:

Construction. Contractors that prepare a site for drilling operations by constructing an access road, leveling and grading the proposed well site, and digging and diking reserve and waste pits.

Trucking. Companies that transport equipment and supply materials to/from the well drilling site.

Logging. Companies that gather and record data on porosity, permeability, types of fluids, fluid content, and lithography of drilling wells.

Fracturing. Companies that service wells by artificially opening up a formation to increase permeability and the flow of oil. Methods utilized include acidizing, explosive, and hydraulic fracturing.

Perforating. Companies that specialize in a well service where the well casing and cement is pierced to enable oil and gas to flow from the formation.

Wireline. Companies that provide steel wire cable for the purposes of formation testing.

Welding. Firms that specialize in oil field welding, fabrication, and repair, including pipeline welding, derrick repair, wellhead welding, and assorted custom work.

Safety. Service companies that provide hydrogen sulfide safety equipment rentals, on-site safety inspection, and safety certification programs.

Oil Field. Companies that perform a variety of services in the oil field including construction, pipeline trenching, repair and maintenance, well site service, and hauling.

Literature Cited

- American Petroleum Institute. 1983. Basic Petroleum Data Book. Washington, D.C.: American Petroleum Institute.
- Anderson, Sidney B. and John P. Bluemle. 1982. Oil Exploration and Development in the North Dakota Williston Basin: 1981 Update. Miscellaneous Series No. 62. Grand Forks: North Dakota Geological Survey.
- Campbell, Robert B.; Samuel C. Kelley Jr.; Ross B. Talbot; and Bernt L. Wills. 1958. The Williston Report: The Impact of Oil on the Williston Area of North Dakota. Grand Forks: University of North Dakota.
- Chase, Robert A. and F. Larry Leistritz. 1982. "Socioeconomic Impact Assessment of Onshore Petroleum Activity." Proceedings of the Second International Conference on Oil and the Environment. Halifax, Nova Scotia: Technical University of Nova Scotia.
- Chase, Robert A. and Richard W. Rathge. 1982. "Petroleum Development Impacts on North Dakota's Small Cities: A Preliminary Socioeconomic Analysis." Proceedings of the Conference on the Small City and Regional Community. Stevens Point: University of Wisconsin-Stevens Point.
- Clausen, Tracy and Jim Gilmour. 1982. Regional Housing Study: Region 1. Williston, North Dakota: Williston Basin Regional Council.
- Dobbs, Thomas L. and Phil E. Kiner. 1974a. Profile of a Rural Area Work Force: Wyoming Uranium Industry. Research Journal No. 79. Laramie: Wyoming Agricultural Experiment Station.
- Dobbs, Thomas L. and Phil E. Kiner. 1974b "Two Manpower Location Aspects of Energy Resource Development: Case of Wyoming Uranium Industry." The Annals of Regional Science 8:118-130.
- Dunning, C. Mark. 1981. Report of Survey of Corps of Engineers Construction Work Force. Research Report No. 81-R05. Ft. Belvoir, Virginia: U.S. Army Corps of Engineers, Institute for Water Resources.
- Herzog, H. W. Jr.; A. M. Schottman; and W. R. Schriver. 1981. Projecting Labor Demand and Worker In-migration at Nuclear Power Plant Construction Sites: An Evaluation of Methodology. NUREG/CR-2421. Washington, D.C.: U.S. Department of Labor.
- Husky, Lee. 1982. "Rural Labor Participation and OCS Development in Alaska." In Economic and Demographic Structural Change in Alaska. Edited by Lee Husky; Will Nebesky; Bradford Tuck; and Gunnar Knapp. Technical Report No. 73. Anchorage: U.S. Bureau of Land Management, Alaska Outer Continental Shelf Office.
- Fuchs, Richard P. 1981. "Rural Residents in the Exploration Phase of Newfoundland's Offshore Oil Industry, 1981." Proceedings of the Second International Conference on Oil and the Environment. Halifax, Nova Scotia: Technical University of Nova Scotia.

- Getschow, G. 1982. "More or Less Oil Will Go Up or Down or Maybe It Won't." Wall Street Journal 62(183):May 5.
- Leholm, Arlen G.; F. Larry Leistritz; and James S. Wieland. 1976. Profile of Electric Power Plant Construction Work Force. Agricultural Economics Statistical Series No. 22. Fargo: North Dakota State University, Department of Agricultural Economics.
- Leistritz, F. Larry and Robert A. Chase. 1982. "Socioeconomic Impact Monitoring Systems: A Review and Evaluation." Journal of Environmental Management 15:333-349.
- Leistritz, F. Larry; Thor A. Hertsgaard; Steve H. Murdock; and Donald M. Senechal. 1981. Policy Making for Resource Development: The Case of Coal Development in North Dakota. AE81008, Fargo: North Dakota State University, Department of Agricultural Economics.
- Leistritz, F. Larry and Karen C. Maki. 1981. Socioeconomic Effects of Large-Scale Resource Development Projects in Rural Areas: The Case of McLean County, North Dakota. Agricultural Economics Report No. 151, Fargo: North Dakota State University, Department of Agricultural Economics.
- McCaslin, John C. 1981. "Williston Basin--Most Active U.S. Oil Region." Oil and Gas Journal 79(6):151-152.
- Malhotra, Suresh and Diane Manninen. 1981. Migration and Residential Location of Workers at Nuclear Power Plant Construction Sites. Seattle, Washington: Battelle Memorial Institute, HARC.
- Mountain West Research, Inc. 1975. Construction Worker Profile. Washington, D.C.: Old West Regional Commission.
- Mountain West Research, Inc. 1977. Bureau of Reclamation Construction Worker Survey. Denver, Colorado: U.S. Bureau of Reclamation.
- Murdock, Steve H.; Pamela Hopkins; John de Montel; Rita Hamm; Tom Brown; Margaret Bauer; and Richard Bullock. 1981. Employment, Population and Community Services Impacts of Uranium Development in South Texas. Technical Report No. 81-1. College Station: Texas A&M University, Department of Rural Sociology.
- Murdock, Steve H. and F. Larry Leistritz. 1979. Energy Development in the Western United States: Impact on Rural Areas. New York: Praeger Publishers.
- Nebesky, Will. 1982. "Patterns of Resident Employment in Alaska's Outer Continental Shelf Industry." In Economic and Demographic Structural Change in Alaska. Edited by Lee Husky, Will Nebesky, Bradford Tuck, and Gunnar Knapp. Technical Report No. 73. Anchorage: U.S. Bureau of Land Management, Alaska Outer Continental Shelf Office.
- Olien, Roger M. and Diana D. Olien. 1982. Oil Booms: Social Change in Five Texas Towns. Lincoln: University of Nebraska Press.

- Rapp, Donald A. 1980. Uranium Mining and Milling Work Force Characteristics in the Western United States. LA-8656-MS. Los Alamos, New Mexico: Los Alamos Scientific Laboratory.
- Riley, Marvin P.; Linda L. Baer; and Texas S. Swanjord. 1982. "Changes in Direction and Level of Migration in the North Central States: 1950-1980 (Revised)." Paper presented at the Rural Sociological Association Annual Meeting, San Francisco, September.
- Skinner, Jan. 1982. Personal communication. Denver, Colorado: Environmental Research and Technology, Inc.
- Smith, John P. and Elmer C. Vangsness. 1981. Net Migration and Population Change in North Dakota, 1970-1980. Report No. 12-AECO-6. Fargo: North Dakota Cooperative Extension Service, Department of Agricultural Economics.
- Storey, Keith. 1982. "Offshore Oil and Gas Employment and Demographic Impacts in Newfoundland." In Studies in Marine and Coastal Geography: No. 1 Coastal Studies in Canadian Geography. Halifax, Nova Scotia: St. Mary's University.
- Toman, Norman E.; Norman L. Dalsted; Arlen G. Leholm; Randal C. Coon; and F. Larry Leistritz. 1976. Economic Impacts of Construction and Operation of the Coal Creek Electrical Generation Complex and Related Mine. Fargo: North Dakota Agricultural Experiment Station.
- Voelker, Stanley W. 1971. Population Change and Net Migration by Counties in the Great Plains States, 1960-1970. Great Plains Agricultural Council Report No. 52. Fargo: North Dakota Agricultural Experiment Station.
- Western Oil Reporter. 1982. Rocky Mountain Petroleum Directory. Denver, Colorado: Hart Publications, Inc.
- Wieland, James S.; F. Larry Leistritz; and Steve H. Murdock. 1977. Characteristics and Settlement Patterns of Energy Related Operational Workers in the Northern Great Plains. Agricultural Economics Report No. 123. Fargo: North Dakota Agricultural Experiment Station.
- Wieland, James S.; F. Larry Leistritz; and Steve H. Murdock. 1979. "Characteristics and Residential Patterns of Energy Related Work Forces in the Northern Great Plains." Western Journal of Agricultural Economics 4(1):57-68.