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RECOVERY OF BYPASSED OIL IN THE DUNDEE FORMATION USING HORIZONTAL DRAINS

Annual Report for the Period
April 1994 to June 1995

By
J. Wood

August 1995

Performed Under Contract No. DE-FC22-94BC14983

Michigan Technological University
Houghton, Michigan

Bartlesville Project Office
U. S. DEPARTMENT OF ENERGY
Bartlesville, Oklahoma

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Prepared for
U.S. Department of Energy
Assistant Secretary for Fossil Energy

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ABSTRACT

Devonian rocks have been the most prolific hydrocarbon producers in the Michigan Basin. The Traverse, Dundee, and Lucas Formations have produced more than half of Michigan's oil since the late 1920's. The Dundee Formation is Michigan's all-time leader with 352 million barrels of oil and 42 billion cubic feet of gas. About 30% of the original oil in place and 80 % of the original gas in place is usually recovered from hydrocarbon reservoirs during the initial production phase. Because most of Michigan's Dundee reservoirs were only developed with "primary" production techniques and most were discovered and developed before 1960, recoveries are much lower, perhaps only 10-15%. Many fields were badly mismanaged during initial development, especially in the early 1930's and 1940's, with the result that much producible oil was bypassed when development wells were pumped at excessively high rates and watered out prematurely.

Crystal Field in Montcalm County, MI, which was selected as a field trial site for this project, is such a field. Analysis of production data for Crystal Field suggests that an additional 200,000 bbls of oil can be produced using one strategically located horizontal well. Total addition production from the Crystal Field could be as much as 6-8 MMBO. Application of the technology developed in this project to other Dundee fields in the area has the potential to increase Dundee production in Michigan by 35%, adding 80-100 MMBO to ultimate recovery.

This project will demonstrate through a field trial that horizontal wells can substantially increase oil production in older reservoirs that are at or near their economic limit. To maximize the potential of the horizontal well and to ensure that a comprehensive evaluation can be made, extensive reservoir characterization will be performed. In addition to the proposed field trial at Crystal Field, 29 additional Dundee fields in a seven-county area have been selected for study in the reservoir characterization portion of this project.

Most Dundee Fields are so old (ca. 1930-1940) that it is not possible to adequately characterize them using existing records and logs. Part of the proposed drilling program is designed to recover a full core from a vertical well through the complete reservoir interval (50-60 feet). The horizontal well will be a sidetrack from this vertical characterization well. Reservoir characterization is a key component of this project, not only because it is necessary to have a model that accurately reflects the volume and distribution of hydrocarbons in the reservoir, but also because it aids in optimizing the locations of the horizontal wells. We believe that if the Crystal Field horizontal well proves economically successful, it will encourage independent operators to drill similar wells in the other 29 Dundee fields that we are also characterizing. Upon completion of the project, a post-mortem study will be conducted to monitor the success of the horizontal well.

Details of the project's first year accomplishments are summarized in the Executive Summary.

EXECUTIVE SUMMARY

The following is a chronological description of project meetings and activities for the period 2nd quarter FY 1994 to 2nd quarter FY 1995:

- Throughout the year, teams at WMU and MTU worked on various aspects of the project. Very significant technical contributions were made in the areas of data gathering, map and cross section construction, and log evaluation by W. Harrison and his WMU team.

- Approximately every six weeks, Wood traveled from USF to MTU to coordinate project efforts and work on the project.

- A meeting of project personnel from, MTU, WMU, and Terra Energy, Inc. was held in Traverse City, MI, on June 8, 1994 to initiate the DOE contract. Each task and subtask was reviewed and individual responsibilities were clarified and agreed upon. The drilling program was discussed in detail.

- In October and early November, Allan and Nigrini traveled to USF, MTU, and WMU to meet with project members and work on the project.

- In January, 1995, all members of this project and of our California DOE Class II reservoir project met at USF in Tampa for our Annual Project Review Meeting.

- In March, 1995, project members ran a booth in the Exhibits Hall at the AAPG National Meeting in Houston. The booth included a poster display which described project goals and progress to date and a computer demonstration.

- In late March and early April, 1995, Wood and Allan met at USF in Tampa to work on the project.

Well data, including drillers' logs, wireline logs, and seismic data, from the Crystal and 30 other Dundee oil fields in the Michigan basin have been acquired. Digitized logs of 336 wells that currently produce or have produced from the Dundee Formation in the seven-county study area have been purchased from Maness Petroleum Company. The data-gathering phase of the well-log program is now complete. Well-log analysis using TerraSciences TerraStation software has begun. Detailed analyses of wells with modern logs are being made using density/porosity and Pickett crossplots. Water saturations were calculated for several wells in the past month.

Production data have been added to the well-file database. We now have the capability of mapping production as well as geology. Well-location basemaps with permit numbers were constructed for all 30 fields. Contour maps were completed for all 30 fields during the last quarter, including maps: on the top of the Dundee Formation, the top of the Dundee porosity zone (which is well below the top of the Dundee and varies in stratigraphic position throughout most fields), Dundee to Traverse isopachs, and initial production values before and after well treatment. At least two simple computer-generated cross sections were constructed for each field.

S. Chittick has completed his M.S. thesis on Winterfield Field, which possesses more modern log data than most other Dundee Fields. The purpose of the Winterfield study was to delineate possible economic zones of by-passed oil in the Dundee by characterizing the structural, stratigraphic, and lithological components of the Dundee utilizing well data (drillers' logs and scout tickets), petrophysical log data, and production data. Corrected porosity values were calculated for all wells with available CNL and density well log data using the KOBRA:XPLOT algorithm of TerraSciences' TerraStation software, which is based on Schlumberger cross plots. Water saturation values were calculated and averaged over the top sixty feet of the reservoir. Water saturation values were subtracted from 1 to get the oil saturation. These values were plotted as contours.

About 50 cores of the Dundee Formation from throughout the state of Michigan have been identified and are currently available in public repositories. Each of these cores will be described and samples will be taken for thin section, Xray diffraction, and SEM analyses to determine mineralogy and porosity characteristics. Cuttings samples from 60 to 100 Michigan wells are also available. Analysis of selected samples from the Western Michigan University Core Research Lab has begun. W. Harrison currently has the porosity, permeability, and oil saturation data for all of the Dundee cores from wells in a seven-county area surrounding Crystal Field in his possession. When all available core material has been identified, samples will be collected from each core. This phase of the project has just begun. Samples are being selected to provide good coverage of all of the lithofacies and porosity types present in the Dundee Formation.

Xray diffraction analyses of approximately 200 samples will be performed to determine the proportion of calcite, dolomite, other major and accessory minerals. To help estimate paleotemperatures and salinities and to determine the origin of the porosity-producing dolomitizing fluid, fluid inclusion temperature and salinity measurements will be made on 40 to 60 samples. Paired oxygen-carbon isotope measurements will be made on 100 to 200 samples. Point counts for mineralogy and porosity will be performed on approximately 60 to 100 polished thin sections of core and cuttings samples using optical methods. Conventional SEM analyses will be performed on many of these same samples. SEM analyses of selected samples are currently being performed.

Project personnel at WMU are using Terrasciences' TerraStation software to analyze and archive project data. The MTU group participating in another DOE project with the specific goal of developing and demonstrating an integrated system for database management and reservoir visualization. A Spatial Database Manager (SDBM) shell/interface and a Multi-Media Program (MMP) are currently being developed in this project using Microsoft Visual Basic 3.0.

The SDBM is a Windows shell that provides access to an underlying database engine (Microsoft Access), a well-log interpretation program (Crocker Data Processing Petrolog), mapping and cross-section software (the GeoGraphix Exploration System Workbench) and a volume visualization application (yet to be determined). The SDBM will have the added benefit of online help and tutorial information. This system, and all of its components, is available for use in the Dundee project. We intend to use the MMP as a technology transfer mechanism. All data and information associated with the project will be stored on hard disk and will be accessible via the MMP. At the end of the project, all data, graphics, tutorials, manuals, etc., will be stored on CD ROM for distribution to DOE and to our target audience within the petroleum industry.

Drilling was delayed pending completion of an environmental site assessment. Terra Energy was reluctant to commence drilling before receiving a covenant from the Department of Natural Resources, State of Michigan, protecting them from lawsuits for pre-existing environmental contamination. Terms of an agreement were recently agreed upon by Terra and the State of Michigan and the covenant is now awaiting signature in the Michigan State Attorney General's office. We expect that the document will soon be signed and drilling can commence in the summer of 1995. Cronus Development Corp., under contract to Terra Energy, will drill the well.

Meetings of the Michigan Oilfield Research Consortium (MOFRC), open to all interested parties, will be conducted by the project staff. Various aspects of the project will be discussed through poster or oral presentations. J. Huntoon and A. Hein have put together a newsletter which will be mailed to independent oil producers and other interested parties. The initial mailing list of potential members of the Michigan Oilfield Research Consortium is now complete.

Project members ran a booth in the Exhibits Hall at the AAPG National Meeting in Houston, March 5 to 8, 1995. Considerable interest was generated in our project. Several independents asked to be kept abreast of project developments and to have quarterly reports mailed to them. We gained the impression that if our horizontal well is commercially successful, we will have little trouble finding independents who are interested in drilling horizontal wells in areas that coned water and left behind bypassed oil in other Dundee fields.

On January 19 and 20, 1995 we held a meeting at the University of South Florida in Tampa to review both of our DOE projects. Each project member made a presentation on his or her work. The meeting afforded project members an opportunity to learn what everyone else was doing and to discuss project plans and accomplishments in an open forum. The meeting was very successful at accomplishing these goals.

Although the Modeling Task is not scheduled to begin until the Budget Period 2, acquisition of software has begun. At present, all of the major hardware and software purchasing decisions have been made and purchases are in progress. Because the target audience for technology transfer in this project consists mainly of small independent oil exploration and production companies, price and flexibility are critically important. During the last quarter, the following purchases were agreed upon: HP650C Color Plotter, GeoGraphix Data Management and Visualization Software, BasinMod 1-D Basin Modeling Software, and Akcess.basin 2-D,3-D Basin Modeling Software.

SUMMARY OF TECHNICAL PROGRESS BY TASK

BUDGET PERIOD 1

TASK 1.1 PROJECT MANAGEMENT

This task involves the management and administration of all Budget Period I activities. The cooperative agreement requirements are being performed in conjunction with the administrative functions necessary to coordinate with producing partners, vendors, subcontractors, consultants, and suppliers. A detailed Project Management Plan encompassing both Phase I and II, including cost, labor and milestone plans was prepared in accordance with the Reporting Requirements. All required reports are being prepared and submitted to the DOE in accordance with the Reporting Requirements.

Although project members are located at four sites (Tampa, FL; Houghton, MI; Kalamazoo, MI; and Los Angeles, CA) project coordination has been very successful. Allan and Nigrini make quarterly trips to Michigan Technological University (MTU) in Houghton and occasional trips to Western Michigan University (WMU) in Kalamazoo and the University of South Florida (USF) in Tampa to work on project tasks with Wood, Harrison, Pennington, Huntoon, and their students. Wood travels from USF to MTU every 6 weeks on project business. Chittick travels to WMU on a regular basis to work with the database and core repository there. Allan and Nigrini generally meet at least every other week to coordinate their work on the project. The computer network and server at MTU is a critical link in the communications network.

<u>Project Coordination</u>

The following is a chronological description of project meetings and activities for the period 2nd quarter FY 1994 to 2nd quarter FY 1995:

- Throughout the year, teams at WMU and MTU worked on various aspects of the project. Very significant technical contributions were made in the areas of data gathering, map and cross section construction, and log evaluation by W. Harrison and his WMU team.

- Approximately every six weeks, Wood traveled from USF to MTU to coordinate project efforts and work on the project.

- A meeting of project personnel from, MTU, WMU, and Terra Energy, Inc. was held in Traverse City, MI, on June 8, 1994 to initiate the DOE contract. Each task and subtask was reviewed and individual responsibilities were clarified and agreed upon. The drilling program was discussed in detail.

- In October and early November, Allan and Nigrini traveled to USF, MTU, and WMU to meet with project members and work on the project.

- In January, 1995, all members of this project and of our California DOE Class II reservoir project met at USF in Tampa for our Annual Project Review Meeting.

- In March, 1995, project members ran a booth in the Exhibits Hall at the AAPG National Meeting in Houston. The booth included a poster display which described project goals and progress to date and a computer demonstration.

- In late March and early April, 1995, Wood and Allan met at USF in Tampa to work on the project.

Personnel

The following management changes occurred during the past year:

J. Wood has taken a 9 month leave of absence from MTU to teach at USF but has continued his duties on the project. He will return to MTU in the summer of 1995,

W. Pennington has taken a position as Professor of Geology at MTU and has agreed to take an active role in the project,

M. Gruener has accepted a part-time position as a Research Project Coordinator in the Geology Department and is assisting Wood in coordinating this project.

In general, all parties seem to be satisfied with the present management structure and implementation. Contacts are frequent enough, and permit sufficient time for discussions and problem-solving, without being overly intrusive. All team members so far appear to be functioning well with this management style.

1.1.2 BUDGET MANAGEMENT AND QUARTERLY REPORTS

S. Milligan reprogrammed the project budgets and has set up a system for logging, recording and archiving all invoices related to this project. She developed a convenient way to visualize the project budgets by monthly expenditures, cumulative expenditures, and projected expenditures using Lotus graphics. M. Gruener and A. Hein have now assumed responsibility for daily management of the budget and expenditures. J. Allan is responsible for quarterly and annual technical reports.

TASK 1.2 RESERVOIR CHARACTERIZATION

The goal of this task is to quantify reservoir heterogeneities and controls on producibility in the Dundee Formation. Geologic, geophysical, hydrologic and engineering techniques are being used. The Crystal Field is the focus of the characterization effort, but up 30 other Dundee fields are being studied. Well and log data sets and production data sets for all 30 fields are now complete. Tops have been picked on all formations in all wells. The well location and formation tops data sets are also now complete. Table 1 lists all of the oil and gas fields which produce or have produced from the Dundee Formation in Michigan. Table 2 lists those Dundee fields which are included in this study.

1.2.1 WELL LOG ACQUISITION, DIGITIZATION, ANALYSIS

Well-log analysis and regional geological studies are being carried out by W. Harrison and his graduate students at WMU. Well data, including drillers' logs, wireline logs, and seismic data, from the Crystal and 30 other Dundee oil fields in the Michigan basin have been acquired (Figures 1 and 2). Digitized logs of 336 wells that currently produce or have produced from the Dundee Formation in the seven-county study area have been purchased from Maness Petroleum Company. Multiple logs exist for each well. They include gamma ray, caliper, lithodensity, neutron porosity, various resistivity, and some sonic logs. The logs total about 3 million linear feet of digitized data. All deep wells in the area are included in the log suite. The data-gathering phase of the well-log program is now complete. We recently acquired several hundred old SP/Resistivity logs (mostly of the Dundee Formation) from the mid-1940's and 1950's. These are in addition to the above logs. These old logs will be digitized in the coming quarter. SP on these old logs is particularly good for calculating R_w values for formation waters.

Well-log analysis using TerraSciences TerraStation software has begun. Detailed analyses of wells with modern logs are being made using density/porosity and Pickett crossplots. Water saturations were calculated for several wells in the past month.

<u>Regional Studies</u>

Production data has been added to the well-file database. We now have the capability of mapping production as well as geology. Well-location basemaps with permit numbers were constructed for all 30 fields. Contour maps were completed for all 30 fields during the last quarter, including maps: on the top of the Dundee Formation, the top of the Dundee porosity zone (which is well below the top of the Dundee and varies in stratigraphic position throughout most fields), Dundee to Traverse isopachs, and initial production values before and after well treatment (Figures 3, 4, and 5). At least two simple computer-generated cross sections were constructed for each field (Figure 6). All these maps have been plotted on 81/2x11 pages and have been compiled by field into single "folio" sized poster sheets. More detailed cross sections are being constructed on field and regional scales.

Now that we have production data for all of the fields in our database, cumulative production maps can be constructed. Interval isopach maps of top Dundee to top Dundee porosity zone (which will map the number of feet one must drill beneath the top of the Dundee to hit pay) will also be constructed. Net pay isopachs will be more difficult. Most wells are drilled to the top of Dundee porosity and completed without ever crossing the oil/water contact. Therefore the positions of oil/water contacts can only be estimated from off-structure dry holes. However, it appears that we may be able to reasonably estimate the positions of oil/water contacts in about

25% of the fields, which will allow us to construct volumetric maps for those fields. All of these maps will be constructed after completion of the basic contour maps for each field.

Pressure data is also hard to come by in many of these old fields. We expect that we will be able to produce pressure decline curves for a few wells, though, and with the volumetric maps for our most tightly constrained fields, will be able to estimate recovery factors and other engineering parameters in a few locations. These values can then be extrapolated to other fields with poor data.

<u>Winterfield Field</u>

S. Chittick has completed his M.S. thesis on Winterfield Field (Figure 7), which possesses more modern log data than most other Dundee Fields. In Winterfield Field, several wells penetrate the entire Dundee porosity zone, allowing a more thorough evaluation of the reservoir than could be done elsewhere. The purpose of the Winterfield study was to delineate possible economic zones of by-passed oil in the Dundee by characterizing the structural, stratigraphic, and lithological components of the Dundee utilizing well data (driller's logs and scout tickets), petrophysical log data, and production data.

The initial well data set used to create maps and plots was obtained from Petroleum Information Corporation (PI). Geophysical logs from Winterfield field were obtained in digital form from Maness Petroleum. Production data were obtained from the Michigan Department of Natural Resources, Geological Survey Division. Contour plots of formation tops and top porosity were constructed with CoPlot by CoHort Software.

Porous dolomite above the oil-water contact, capped by either the Bell Shale or tight Dundee limestone, is the producing lithology within the Dundee. The producing zones can be discriminated quite readily from a suite of geophysical logs containing gamma ray (GR), photoelectric log (PEF), and deep laterolog (LLD) logs (Figure 8). These logs can be further enhanced with the addition of the CNL and density logs to determine corrected porosity values in the producing interval. Corrected porosity values were calculated for all wells with available CNL and density well log data using the KOBRA:XPLOT algorithm of TerraSciences' TerraStation software, which is based on Schlumberger cross plots. Water saturation values were calculated and averaged over the top sixty feet of the reservoir. Water saturation values were subtracted from 1 to get the oil saturation. These values were plotted as contours.

Figure 9 is a cross section of the western section of Winterfield Field. The lower half of the figure illustrates the extreme variability in production that is so characteristic of these Dundee fields. Figure 10 shows how the Dundee porosity zone varies in thickness across the field. The top of dolomite porosity drops below the oil/water contact in places, leading to discontinuities in the reservoir which may result in bypassed oil. Thus, understanding Dundee dolomitization is important to enhanced oil recovery operations.

Although Chittick has not yet been able to accurately quantify the amount of bypassed oil in Winterfield Field, potential areas for further exploration can be delineated by looking for leases that appear to be underachievers relative to structural position, initial production tests and relative production compared to surrounding areas that produce from similar lithologies. Dart Oil and Gas drilled 3 wells in the mid 1980's with the Richfield Formation as the target zone and inadvertently discovered oil in the Dundee in the western part of Winterfield Field, where reservoir quality was previously thought too poor to produce. The discovery shows that pockets of economically produceable oil still exist in this field, and perhaps in many others.

Chittick's M.S. thesis, which is included as Attachment 1 to this report, represents a major technical contribution of this project.

1.2.2 CORE ACQUISITION AND ANALYSIS

About 50 cores of the Dundee Formation from throughout the state of Michigan have been identified and are currently available in public repositories (i.e., the Western Michigan University Core Research Lab, the University of Michigan Subsurface Lab, the Wayne State University core facility, the Central Michigan University core facility, and the Michigan Geological Survey core repository in Lansing). Each of these cores will be described and samples will be taken for thin section, Xray diffraction, and SEM analyses to determine mineralogy and porosity characteristics. Cuttings samples from 60 to 100 Michigan wells are also available. Additional materials will be obtained from private sources. WMU graduate student M. Foley is using a database called COREDAT, provided to us by Maness Petroleum, to search the drillers' reports and core analysis files for cores we have missed. Analysis of selected samples from the Western Michigan University Core Research Lab has begun.

There are no cores in Crystal Field, the site of the field trial in this study. The closest Dundee core is in an outpost well 8 to 10 miles away from Crystal Field. Thus, acquisition of a good vertical core through the Dundee in Crystal Field is an essential element of the reservoir characterization study. Porosity (p), permeability (k), fluid saturation (s) and formation factor (f) data are being gathered from core analysis reports and entered into the database. P,k,s,f analyses will be performed on the core from the well drilled at Crystal Field as discussed in Task 1.4. W. Harrison currently has the porosity, permeability, and oil saturation data for all of the Dundee cores from wells in a seven-county area surrounding Crystal Field in his possession. This includes data from some cores that are no longer available to be sampled.

When all available core material has been identified, samples will be collected from each core. This phase of the project has just begun. Samples are being selected to provide good coverage of all of the lithofacies and porosity types present in the Dundee Formation. Samples from both producing and non-producing intervals will be gathered and an attempt will be made to link lithology to petrophysics, so that different "petrophysical facies" can be identified.. In areas where no cores are available, drill cuttings will be sampled. Ideally, we would like to map "petrophysical facies", because this approach leads to a better understanding of lithologic controls on variability in production rate, but sample coverage is sparse in these old fields and this type of mapping may not be possible.

Xray diffraction analyses of approximately 200 samples will be performed to determine the proportion of calcite, dolomite, other major and accessory minerals. To help estimate paleotemperatures and salinities and to determine the origin of the porosity-producing dolomitizing fluid, fluid inclusion temperature and salinity measurements will be made on 40 to 60 samples. Paired oxygen-carbon isotope measurements will be made on 100 to 200 samples.

Point counts for mineralogy and porosity will be performed on approximately 60 to 100 polished thin sections of core and cuttings samples using optical methods. Identification and quantification of major mineral phases, clay mineral phases, pore space, and hydrocarbons will be determined, where possible. Conventional SEM analyses will be performed on many of these same samples, and, if needed, SEM image analysis will be used to determine shape factor and rock texture and to supplement identification of phases. SEM analyses of selected samples from the nearest cored well to Crystal Field (Leonard Oil Co., Lee #1, Montcalm County, MI) are currently being performed by W. Harrison and his graduate students at WMU to investigate microtextures in the Dundee reservoir, including intercrystalline porosity and fractures.

1.2.3 FTIR SPECTROSCOPY

Fourier transform infrared spectroscopy (FTIR) analyses have begun. D. Popko at MTU is developing techniques for performing quantitative analyses of rock samples using FTIR as part of his M.S. thesis research. Sample preparation, accumulation of a suite of mineral standards, and development of reliable analytical techniques are critical to this endeavor. Popko has recently collected spectral data on mineral standards. Spectral data from standards will be input to a mathematical program which will generate non-negative least-squares (NNLS) fits. The NNLS fits will be applied to FTIR spectral data gathered on core samples from Dundee wells and will be used for identification of mineral assemblages. Popko will attend a one-week Inductively Coupled Plasma Spectroscopy (ICP) workshop in April and will use ICP analyses will then be performed on samples and standards to cross-check the FTIR results.

1.2.4 FLUID SAMPLES

Hydrocarbon and produced-water samples from the Crystal Field have yet to be collected and analyzed. If possible, arrangements will be made to sample fluids from other Dundee fields as well. Inorganic geochemical analyses of produced brines will be used in conjunction with isotope and fluid inclusion analyses of core and cuttings to determine the origin and history of the porosity-producing dolomitizing fluid.

Initial production (IP) maps show that a number of the Dundee fields have two markedly different producing regimes: a dolomite reservoir rock that comes on production at a few hundred BOPD and a vuggy dolomite reservoir rock that comes on production at 1000-2000 BOPD. Early wells in the fields, drilled in the 1930's and 1940's, were produced imprudently at very high flow rates, coned water, and watered out in a matter of months. The best locations for spotting horizontal wells to recover bypassed oil may be in between wells that coned water in these high IP areas.

The low IP dolomites may have formed by a regional process, while the high IP dolomites may represent zones of locally enhanced porosity where cross-formational fluid flow dolomitized fracture zones. If this is true, the two dolomitizing fluids could have very different chemistries, which may be reflected in the chemistry of present-day connate waters. Since fluid flow may provide the key to understanding the origin of high production-rate areas, we intend to sample formation fluids from high and low IP dolomite areas and use inorganic chemistry to interpret dolomite origin.

TASK 1.3 DATABASE MANAGEMENT

Currently, project personnel at WMU are using TerraSciences' TerraStation software to analyze and archive project data. The MTU group participating in another DOE project with the specific goal of developing and demonstrating an integrated system for database management and reservoir visualization. A Spatial Database Manager (SDBM) shell/interface and a Multi-Media Program (MMP) are currently being developed in this project using Microsoft Visual Basic 3.0.

The SDBM is a Windows shell that provides access to an underlying database engine (Microsoft Access), a well-log interpretation program (Crocker Data Processing Petrolog), mapping and cross-section software (the GeoGraphix Exploration System Workbench) and a volume visualization application (yet to be determined). The SDBM will have the added benefit of online help and tutorial information. This system, and all of its components, is available for use in the Dundee project. A. Nigrini is in charge of database management for both contracts and will coordinate software needs.

Thirty Dundee fields are being studied in this project. Well data (drillers' logs and scout tickets), log data, and production data sets for all 30 fields are now complete. The data are currently stored in the TerraSciences' database at WMU. Digitized well logs from selected wells were read into the database during the last quarter. Specific intervals are now being evaluated for S_w and other calculated parameters.

TASK 1.4 DRILLING

Drilling was delayed pending completion of an environmental site assessment. Terra Energy was reluctant to commence drilling before receiving a covenant from the Department of Natural Resources, State of Michigan, protecting them from lawsuits for pre-existing environmental contamination. Terms of an agreement were recently agreed upon by Terra and the State of Michigan and the covenant is now awaiting signature in the Michigan State Attorney General's office. We expect that the document will soon be signed and drilling can commence in the summer of 1995. Cronus Development Corp., under contract to Terra Energy, will drill the well. A basemap showing the surface location and subsurface trajectory of the horizontal well is shown in Figure 10. A schematic cross section showing the expected geometry of the intersection of the well bore with the top of the Dundee porosity zone is shown in Figure 11. A more detailed description of the drilling plan is included in the following paragraphs:

First a vertical well will be drilled. The well will be cored through the producing interval of the Dundee Formation and the cores analyzed for porosity, permeability, and fluid saturations. A full set of well logs will be run, including gamma ray, porosity, and resistivity logs. A horizontal leg will be drilled as a sidetrack from the vertical test well. The data from the vertical well will be incorporated into the existing database for the project area and used to calibrate the MWD (Measurement While Drilling) logs which will be run during the drilling of a horizontal leg. Cuttings from the horizontal leg will be collected and analyzed and input to the reservoir model. As full a suite of well logs as is permitted by the hole geometry will be run on the horizontal leg. If commercial amounts of hydrocarbon are encountered, the horizontal well will be completed and placed on production. Specifics of the coring and logging operation are as follows:

A 4-inch core, approximately 60 ft in length, will be cut vertically through the Dundee reservoir. The coring point will be the base of the Bell Shale. The core itself will include the reservoir interval (approximately 20 ft thick) and the overlying caprock interval, both within the Dundee Formation. A full log suite will be run on the vertical well. The well will then be plugged back to the top of the Dundee, and a horizontal well will be drilled along the top of the reservoir interval. The vertical core and log suite will be used to pick the optimum depth for the horizontal leg. The lateral leg will be 1700 ft long and will drop downsection by 10 ft over the 1700 ft lateral distance. At the very least, a Measurement While Drilling (MWD) Gamma Ray log and cuttings will be recovered from the horizontal well.

TASK 1.5 TECHNOLOGY TRANSFER

This task focuses on technology transfer of information derived in this study through academic, technical, and commercial channels. J. Allan is responsible for preparation of technical reports to DOE, for coordination of communication between project members, for coordination of technical publications and workshops, and for most other technology transfer activities.

1.5.1 MEETINGS

Meetings of the Michigan Oilfield Research Consortium (MOFRC), open to all interested parties, will be conducted by the project staff. Various aspects of the project will be discussed through poster or oral presentations. Efforts will be made to make interested parties aware of these meetings. J. Huntoon and A. Hein have put together a newsletter which will be mailed to independent oil producers and other interested parties.

The initial mailing list of potential members of the Michigan Oilfield Research Consortium is now complete. Potential members were identified either through personal contact or through their inclusion in the Michigan Oil and Gas News, 51st Annual Edition of the Michigan Petroleum Directory/Almanac. All potential members will receive the first MOFRC newsletter. Subsequent mailings will be sent primarily to interested parties (i.e., those that respond to J.E. Huntoon or A.M. Hein after the first mailing and indicate that they are interested in continuing to receive information.

The final draft of the first MOFRC newsletter is included as Attachment 2. Potential MOFRC members are listed in Attachment 3. The first mailing will be completed by 5/15/95.

1.5.2 REPORTS

Multimedia Presentations on CD-ROM

D. Schueller and B. Watkins designed and developed a Multi-Media Program (MMP) shell/interface in Visual Basic 3.0 for this project and for another DOE project that the MTU staff are participating in. We intend to use this shell as a technology transfer mechanism. All data and information associated with the project will be stored on hard disk and will be accessible via the MMP. At the end of the project, all data, graphics, tutorials, manuals, etc., will be stored on CD ROM for distribution to DOE and to our target audience within the petroleum industry.

The MMP serves several purposes: (1) it archives all project reports, tables, maps, photographs, animations, etc., either within the shell itself or as files opened from other applications that can be launched from the shell (e.g., Lotus 1-2-3, Excel); (2) it provides tutorials and manuals to help less knowledgeable users access and interpret each type of information; (3) it provides user-defined pathways to, and sample data files for, some commonly used spreadsheet applications so users can integrate their own data within the shell. Figure 12 is a screen print of some of the material from our other DOE project that can be accessed and displayed in separate windows from within the MMP and Figure 13 summarizes the kinds of information available via pull-down menus in the archival mode. The MMP is operational at present. We anticipate entering results from the Michigan project into it in the next quarter.

1.5.3 PROFESSIONAL MEETINGS AND PUBLICATIONS

AAPG National Meeting

Project members ran a booth in the Exhibits Hall at the AAPG National Meeting in Houston, March 5 to 8, 1995. The booth included a poster display which described project goals and progress to date. We ran two adjacent booths, one for this project and one for our California DOE Advanced Process and Technology Program project. Wood, Huntoon, Allan, Nigrini, and Chittick operated the booth for this project. Other MTU faculty and graduate students affiliated with the California DOE project helped run the other booth. Considerable interest was generated in both projects. Several independents asked to be kept abreast of project developments and to have quarterly reports mailed to them. We gained the impression that if our horizontal well is commercially successful, we will have little trouble finding independents who are interested in drilling horizontal wells in areas that coned water and left behind bypassed oil in other Dundee fields.

1.5.4 WORKSHOPS

Tampa Workshop/Conference

On January 19 and 20, 1995 we held a meeting at the University of South Florida in Tampa to review both of our DOE projects. The Michigan project was discussed on January 19 and our California project was discussed on January 20. Each project member made a presentation on his or her work. The meeting afforded project members an opportunity to learn what everyone else was doing and to discuss project plans and accomplishments in an open forum. The meeting was very successful at accomplishing these goals. A meeting agenda is attached (Table 3).

Workshops

Workshops will be held at the MTU Subsurface Studies Laboratory (SSL) to familiarize interested parties with the computational hardware and software made available by this project and to demonstrate the reservoir characterization methodologies being developed. After training, attendees may later visit MTU to use the SSL computational facilities or may access the facility over an Ethernet network.

Later in the project, short courses and workshops will be run through professional societies (e.g., AAPG). Other, less-formal workshops may be run either in conjunction with a local geological or engineering society meeting or independently. A list of "customers" will be prepared and publicity will be generated to make these customers aware of workshops that are run independently of professional organizations.

TASK 1.6 PROJECT CONTINUATION

A Project Evaluation Report describing in detail the project status will be prepared and submitted in accordance with the Reporting Requirements.

TASK 2.3 MODELING

2.3.2 BASIN MODELING

Although the Modeling Task is not scheduled to begin until the Budget Period 2, acquisition of software has begun. At present, all of the major hardware and software purchasing decisions have been made and purchases are in progress. Purchasing decisions were made with serious attention given to cost/benefit ratios. Because the target audience for technology transfer in this project consists mainly of small independent oil exploration and production companies, price and flexibility are critically important. During the last quarter, the following purchases were agreed upon:

1) HP650C - Color Plotter: The HP650C color plotter is a versatile, widebed continuous (roll) feed plotter that produces high-quality graphics output for display or analysis. This type of plotter is used by several small oil companies that were surveyed prior to making the purchase decision. At the current time it will be used to print postscript files, so an HP postscript card was also purchased. Software to make the printer compatible with many different types of graphics files is available. Such software was not purchased at this time. Due to the expense involved, we

will attempt to use only the relatively inexpensive postscript card throughout the project, so that our methods of output generation can be easily transferred to small operators.

2) GeoGraphix - Data Management and Visualization Software: GeoGraphix Exploration System (GES) is designed to facilitate data management and visualization. It uses the same type of Geographic Information System technology that is common in more expensive types of software (e.g. ArcInfo, Intergraph),but is tailored to the needs of oil companies working with subsurface, rather than surface, data. It runs on PCs which makes it attractive to smaller, independent oil companies.

3) BasinMod - 1-D Basin Modeling Software: The BasinMod system provides users with a relatively simple, user-friendly method for modeling the evolution of single wells. Multiple well histories can also be modeled to investigate variations in basin evolution that occur from one geographic locality to another. BasinMod allows modeling of burial histories, compaction, temperature histories, lithology, heat flow, hydrocarbon maturities, and pressures, and allows for multiwell mapping of variables. It is commonly used by both small and large oil companies. We will use it in conjunction with software that has been developed in-house.

4) Akcess.basin - 2-D,3-D Basin Modeling Software: This is an extremely powerful basin modeling system that is based on work performed as part of a DOE Class I project (Enhanced Dynamic Recovery Technologies {field site located in the Eugene Island area of the Gulf of Mexico, Offshore Louisiana}) that several MTU faculty members and graduate students participated in. The software uses a finite-element formulation to examine the effects of thermal processes (conduction, convection, advection), fluid flow processes (compaction-driven, hydraulic-head driven), sealing mechanisms, and sedimentation/ erosion during the development of a sedimentary basin. The program also predicts hydrocarbon generation (timing, location, and rate) and migration patterns. Although this software may be rather expensive for small operators, we have it in our possession as a result of the DOE Class I program and decided to use it to perform regional modeling studies in the Michigan Basin. No other software offers the power and flexibility of Akcess.basin. Computational Mechanics Corporation (COMCO) has installed the software at Michigan Technological University.

FIGURE CAPTIONS

Figure 1. Basemap of Michigan showing all fields that produce from the Dundee Formation and the location of the DOE Dundee Project study area. Crystal Field, where a horizontal well will be drilled, and Riverside Field, which is featured in some of the maps in this report, are identified by arrows. Winterfield Field, which is also featured in this report, is located to the northeast of the main study area.

Figure 2. Location map for the fields in the Dundee Project study area. The project has acquired digitized well logs from 336 wells in 30 fields within the 7-count study area.

Figure 3. Structure map on top of the Dundee Formation, Riverside Field. Maps such as this have been prepared for all 30 fields within the study area using TerraSciences TerraStation computer system.

Figure 4. Structure map on top of the Traverse Lime, Riverside Field. The Traverse Lime overlies the Dundee Formation and has been mapped in all study area fields to gain a better understanding of structure.

Figure 5. Initial production map for the Dundee Formation, Riverside Field. Production data have been added to the well-file database and initial production maps, before and after well treatment, have been constructed for all fields in the study area.

Figure 6. Simple structural cross section, Crystal Field, constructed from formation tops taken from scout tickets. At least two simples cross sections such as this have been constructed for each field in the study area.

Figure 7. Structure map on top of the Dundee Formation, Winterfield Field. The +'s are well locations used to create the plot. Numbered dots are production lease locations. Note the saddle that separates the field into eastern and western halves.

Figure 8. PEF-LLD crossplot for the Dart-Austin well from the top 100' of the Dundee interval, Winterfield Field. Economic oil accumulations within the Dundee occur in dolomite reservoir rock while limestone tends to be tight. The PEF log can be used to distinguish dolomite (PEF of about 3) from limestone (PEF of about 5). The LLD log response is controlled by oil/water saturation. The LLD log, in particular, can be used to distinguish oil-wet from water-wet reservoir rock.

Figure 9. Structural cross section across the western half of Winterfield Field (upper figure). Each column represents a well on the cross section. The Dundee dolomite is the productive interval in Winterfield Field, and is overlain by a tight limestone cap. The lower figure shows the same wells and illustrates the extreme variability in Dundee production from one well to the next.

Figure 10. Structural cross section through the western portion of Winterfield Field showing the Dundee production interval. The Dundee porosity zone varies in thickness across the field. The top of dolomite porosity drops below the oil/water contact in places, leading to discontinuities in the reservoir which may result in bypassed oil. Thus, understanding Dundee dolomitization is important to enhanced oil recovery operations.

Figure 11. Well-location basemap for the Dundee Formation, Crystal Field. Line shows location of horizontal well that will be drilled to the top of the Dundee.

Figure 12. Initial production (IP) map for the Dundee Formation, Crystal Field. Comparison of the location of the horizontal well (Figure 11) to IP contours (this map) reveal that the well was spotted within the "sweet spot" in the field. The horizontal leg runs between six wells that came on production at high rates, but coned water and went off production in <2 years.

Figure 13. Schematic cross section showing trajectory of horizontal well to be drilled to the top of the Dundee Formation in Crystal Field. Well is expected to recover oil that was bypassed as a result of severe water coning in adjacent wells and oil that is trapped in irregular topography on the top of the Dundee porosity zone.

Figure 14. Screen print of the Table Relationship Window in the Microsoft Access database. Data tables for geochemical and petrographic data, well logs, well header information, well production data, formation tops, fault trace data, etc., are shown.

Figure 15. Through the Multi-Media Program archive/tutorial shell authored in Visual Basic, the user will be able to access a variety of text, graphics, and animations generated by or related to the project. The kinds of information available via pull-down menus in the archival mode are shown here.

TABLE 1. MICHIGAN BASIN DUNDEE OIL AND GAS FIELDS

FIELD NAME	COUNTY	LOCATION	DATE	DEPTH	AREA	PAY	OIL BBLS	GAS MCF
ADAMS	ARENAC	26-19N-03E	1937	2958	350	15	1685976	0
AKRON	TUSCOLA	26-14N-07E	1936	2678	1200	17	2473671	0
ARBELA	TUSCOLA	33-10N-07E	1946	2557	450	7	382290	0
ASHTON	OSCEOLA	05-18N-10W	1945	3645	200	5	526505	0
BARD	GLADWIN	06-17N-02W	1949	3933	170	6	598674	0
BEAVERTON	GLADWIN	11-17N-02W	1934	3929	330	12	904832	0
BEAVERTON WEST	GLADWIN	19-17N-02W	1943	3876	260	2	251898	0
BEAVERTON-SOUTH	GLADWIN	36-17N-02W	1936	3845	720	12	1862335	0
BELLY ACHERS	MONTCALM	14-12N-06W	1944	3470	220	1	361510	0
BENTLEY	GLADWIN	29-17N-02E	1937	3510	1920	13	3287155	0
BILLINGS SOUTH	GLADWIN	12-17N-01E	1957	3540	80	5	248401	0
BILLINGS	GLADWIN	02-17N-01E	1949	3549	400	6	946334	0
BIRCH-BELA	SAGINAW	25-10N-06E	1951	2504	350	7	431248	0
BIRCH RUN	SAGINAW	20-10N-05E	1954	2536	480	10	643657	0
BRINTON	ISABELLA	05-16N-06W	1967	4082	40	3	27496	0
BROOMFIELD	ISABELLA	09-14N-06W	1979	3752	520	3	411299	0
BUCKEYE NORTH	GLADWIN	11-18N-01W	1936	3615	3160	14	20722296	9781
BUCKEYE SOUTH	GLADWIN	25-18N-01W	1936	3570	2490	11	5338937	0
BURDELL	OSCEOLA	19-20N-10W	1959	3678	120	4	161004	0
CAT CREEK	OSCEOLA	04-17N-09W	1968	3696	300	4	510123	0
CATO	MONTCALM	06-12N-12W	1944	3542	670	3	1199173	0
CEDAR	OSCEOLA	28-18N-09W	1943	3810	420	2	1216297	0
CLAYTON	OGEMAW	31-21N-04E	1935	2465	1290	12	6854751	0
COLDWATER	ISABELLA	08-15N-06W	1944	3692	3200	25	22274752	6277030
CRANBERRY LAKE	CLARE	01-20N-06W	1943	3835	70	2	2243869	0
CRANBERRY LK. E	CLARE	08-20N-05W	1963	3760	16	6	848224	0
CRYSTAL VALLEY	OCEANA	19-16N-16W	1971	2222	180	11	4002	0
CRYSTAL	MONTCALM	02-10N-05W	1935	3187	2000	4	7916742	0
CURRIE	ISABELLA	05-16N-04W	1936	3918	40	2	212286	0
DAY	MONTCALM	36-11N-06W	1954	3337	20	20	16239	0
DAY SEC. 13	MONTCALM	13-11N-06W	1971	3414	20	15	29722	0
DEEP RIVER	ARENAC	08-19N-04E	1944	2795	1060	145	27189771	0
DOUGLASS	MONTCALM	01-11N-07W	1945	3400	120	2	260276	0
EDEN	MASON	26-17N-16W	1948	2240	380	8	3129640	***330378
EDENVILLE	MIDLAND	27-16N-01W	1938	3790	370	8	1392721	0
EDWARDS	OGEMAW	15-21N-01E	1951	3362	90	10	43690	0
ELMWOOD	TUSCOLA	21-14N-11E	1945	2740	90	80	113084	0
ENTRICAN	MONTCALM	21-11N-07W	1967	3312	200	2	159206	0
ESSEXVILLE	BAY	07-14N-06E	1944	2835	1730	17	3815456	3249
EVART	OSCEOLA	23-18N-08W	1970	3755	1100	6	3812127	0
FORK	MECOSTA	05-16N-07W	1942	3845	2700	8	7777026	0
FREEMAN-REDDING	CLARE	04-18N-06W	1938	3885	2800	19	16957088	1945432
FREEMAN-LINCOLN	CLARE	18-18N-05W	1980	3975	120	2	37666	0
GENEVA SEC 4	MIDLAND	04-15N-02W	1975	3718	40	32	10112	0
GENEVA	MIDLAND	19-15N-02W	1935	3671	70	2	63143	0
GIBSON SEC 20	BAY	20-18N-03E	1951	3097	30	11	40464	0
GILMORE	ISABELLA	30-16N-05W	1955	3803	160	3	420067	0
GOODWELL EAST	NEWAYGO	26-14N-11W	1978	3294	440	20	81418	****16793
GOODWELL	NEWAYGO	08-14N-11W	1982	3404	120	8	6195	0
HARDY DAM	MECOSTA	05-13N-10W	1966	3351	920	5	1203629	0

FIELD NAME	COUNTY	LOCATION	DATE	DEPTH	AREA	PAY	OIL BBLS	GAS MCF
HARRISON	CLARE	07-18N-04W	1945	4190	80	13	179767	0
HATTON	CLARE	31-18N-04W	1941	3945	160	2	139272	0
HOME SEC 26	MONTCALM	27-12N-06W	1970	3513	200	7	115982	0
HUBBARDSTON	IONIA	04-08N-05W	1947	3028	50	5	48479	0
ISABELLA	ISABELLA	07-15N-04W	1948	3783	410	9	831459	137806
JEROME	MIDLAND	07-15N-01W	1947	3743	260	10	262440	0
KAWKAWLIN	BAY	01-14N-04E	1938	2830	6360	45	16089347	4565
LAKE GEORGE	CLARE	06-18N-05W	1954	3968	100	2	392270	0
LAKEFIELD	SAGINAW	01-11N-01E	1937	3185	10	12	36656	0
LEATON	ISABELLA	25-15N-04W	1929	3657	510	8	1863346	0
LEROY	OSCEOLA	27-19N-10W	1965	3796	80	4	50331	0
LINCOLN SEC 27	ISABELLA	27-13N-04W	1974	3577	80	10	16688	0
LUTHER NORTH	LAKE	08-19N-11W	1970	3518	160	17	17418	0
MARATHON	LAPEER	18-09N-09E	1979	2629	80	5	33985	0
MCBAIN	MISSAUKEE	19-21N-07W	1959	3969	920	15	3458435	0
MILLS SEC 01	MIDLAND	01-16N-02E	1957	3450	10	2	8363	0
MINERAL SPRINGS	OSCEOLA	20-20N-09W	1951	3854	240	7	315700	0
MOFFATT SEC 34	ARENAC	34-20N-03E	1953	2984	10	4	9426	0
MT. PLEASANT	MIDLAND	18-14N-02W	1928	3545	5890	15	28649460	7965509
MT. FOREST	BAY	13-17N-03E	1947	3025	960	9	979810	0
MT. HALEY	MIDLAND	28-13N-01E	1934	3477	10	3	36069	0
NELLSVILLE	ROSCOMMON	17-22N-04W	1957	3710	10	6	16528	0
NORTH FORK	OSCEOLA	33-17N-07W	1951	3788	120	3	153661	0
NORTH ADAMS	ARENAC	22-19N-03E	1940	2905	520	15	9539161	0
OTISVILLE	GENESSEE	06-09N-08E	1944	2450	50	3	38256	0
PINCONNING	BAY	02-16S-04E	1944	2898	100	7	902037	0
PINE RIVER	GRATIOT	31-12N-03W	1942	3280	90	2	13285	0
PORTER	MIDLAND	22-13N-01W	1933	3415	6740	12	50458739	4965878
PROSPER SOUTH	MISSAUKEE	36-22N-06W	1967	3798	280	8	1040445	0
PROSPER	MISSAUKEE	26-22N-06W	1942	3837	520	4	1892033	0
REED CITY	OSCEOLA	31-18N-10W	1940	3490	5000	3	42899940	0
REYNOLDS	MONTCALM	01-12N-10W	1954	3343	2100	2	4799625	0
RIVERSIDE	MISSAUKEE	14-21N-07W	1942	3944	220	3	223378	0
ROBINSON SEC 3	OTTAWA	03-07N-15W	1956	2107	20	7	10630	0
ROLLAND	ISABELLA	24-13N-06W	1979	3560	200	6	50591	0
SAGE	GLADWIN	12-19N-02W	1971	3867	120	2	73914	0
SANFORD	MIDLAND	13-15N-01W	1951	3755	260	3	225808	0
SECORD	GLADWIN	11-19N-01E	1937	3437	20	5	12024	0
SHERMAN	ISABELLA	04-14N-06W	1936	3650	1020	4	4797158	637734
SKEELS	GLADWIN	30-20N-02W	1950	3840	50	7	1008455	0
STERLING	ARENAC	18-19N-04E	1947	2872	200	17	488261	0
STERLING SEC 30	ARENAC							
SYLVAN	OSCEOLA	09-18N-07W	1948	3925	440	14	1215711	0
VERNON-ROSEBUSH	ISABELLA	07-15N-04W	1933	3690	2060	6	7970701	435378
VOGEL CENTER	MISSAUKEE	32-21N-06W	1966	3892	80	3	52430	0
WEST BRANCH	OGEMAW	27-22N-02E	1933	2650	3630	20	11974587	0
WHEATLAND	MECOSTA	07-14N-07W	1945	3690	100	2	141631	0
WHITE RIVER	MUSKEGON	15-12N-18W	1950	2053	20	2	7061	0
WINFIELD	MONTCALM	20-12N-09W	1936	3340	120	1	119312	0
WINTERFIELD	CLARE	35-20N-06W	1940	3794	2740	3	5024265	0
WISE	ISABELLA	28-16N-03W	1938	3700	1620	11	4087240	0

Table 1

Table 2

Specifications of Dundee Formation Michigan Oil and Gas Fields

Field Name	County	Location	Date	Depth	Area	Pay	Oil bbls	Gas MCF
Cranberry Lake	Clare	01-20N-06W	1943	3835	70	2	2243869	0
Cranberry Lake East	Clare	08-20N-05W	1963	3760	16	6	848224	0
Freeman-Redding	Clare	04-18N-06W	1938	3885	2800	19	16957088	1945432
Lake George	Clare	06-18N-05W	1954	3968	100	2	392270	0
Winterfield	Clare	35-20N-06W	1940	3794	2740	3	5024265	0
Skeels	Gladwin	30-20N-02W	1950	3840	50	7	1008455	0
Broomfield	Isabella	09-14N-06W	1979	3752	520	3	411299	0
Coldwater	Isabella	08-15N-06W	1944	3692	3200	25	22274752	3277030
Currie	Isabella	05-16N-04W	1936	3918	40	2	212286	0
Gilmore	Isabella	30-16N-05W	1955	3803	160	3	420067	0
Isabella	Isabella	07-15N-04W	1948	3783	410	9	831459	137806
Leaton	Isabella	25-15N-04W	1929	3657	510	8	1863346	0
Sherman	Isabella	04-14N-06W	1936	3650	1020	4	4797158	637734
Vernon-Rosebush	Isabella	07-15N-04W	1933	3690	2060	6	7970701	435378
Wise	Isabella	28-16N-03W	1938	3700	1620	11	4087240	0
Fork	Mecosta	05-16N-07W	1942	3845	2700	8	7777026	0
Hardy Dam	Mecosta	05-13N-10W	1966	3351	920	5	1203629	0
McBain	Missaukee	19-21N-07W	1959	3969	920	15	3458435	0
Prosper	Missaukee	26-22N-06W	1942	3837	520	4	1892033	0
Prosper South	Missaukee	36-22N-06W	1967	3798	280	8	1040445	0
Riverside	Missaukee	14-21N-07W	1942	3944	220	3	223378	0
Belly Achers	Missaukee	14-21N-06W	1944	3470	220	1	361510	0
Cato	Missaukee	06-12N-12W	1944	3542	670	3	1199173	0
Crystal	Montcalm	02-10N-05W	1935	3187	2000	4	7916742	0
Douglass	Montcalm	01-11N-07W	1945	3400	120	2	260276	0
Reynolds	Montcalm	01-12N-10W	1954	3343	2100	2	4799625	0
Cat Creek	Osceola	04-17N-09W	1968	3696	300	4	510123	0
Ceder	Osceola	28-18N-09W	1943	3810	420	2	1216297	0
Evart	Osceola	23-18N-08W	1970	3755	1100	6	3812127	0
Sylvan	Osceola	09-18N-07W	1948	3925	440	14	1215711	0

Tampa Meeting

Agenda

Thursday, January 19

CRYSTAL FIELD

Agenda	TITLE	SPEAKER
Thursday, January 19	Introduction	M. Gruener
	Crystal Field Project - Overview	J. Wood
9:00	Database Management	A. Nigrini
9:20	Geology of Crystal Field	W. Harrison
9:40	Horizontal Well	Terra Energy (?)
10:00	Log Analysis	W. Harrison/ W. Pennington
10:20	Break	
10:40	Modeling	J. Huntoon
11:00	Technology Transfer	J. R. Allan
11:20	CD ROM Project Archive	D. Schueller
11:40	open	
12:00	**LUNCH**	
1:00	Winterfield Field	S. D. Chittick
1:20	PIA	J. Boles
1:40	(open)	
2:00	Pore Fluid Chemistry	J. R. Wood
2:20	(open)	
2:40	Thermal modeling	M. Luo
3:00	BREAK	
3:10	Discussion	
4:00	Adjourn	

Table 3

Tampa Meeting

Agenda

Friday, January 20

PIONEER FIELD

TIME	TITLE	SPEAKER
8:30	Introduction	M. Gruener
8:40	Pioneer Field Project - Overview	J. Wood
9:00	Database Management	A. Nigrini
9:20	Geology of Pioneer Field	DPI
9:40	Log Analysis	DPI
10:00	Break	
10:20	Bulk Analysis	J. Ryan
10:40	X-ray Mineralogy	J. Compton
11:00	FTIR	N. Popko
11:20	PIA	R. Kramer
11:40	open	
12:00	**LUNCH**	
1:00	Modeling	J. P. Suchoski
1:20	Technology Transfer	J. R. Allan
1:40	CD ROM Project Archive	D. Schueller
2:00	Pore Fluid Chemistry	J. R. Boles (?)
2:20	open	
2:40	Summary	J. Wood
3:00	BREAK	
3:10	Discussion	
4:00	Adjourn	

Table 3

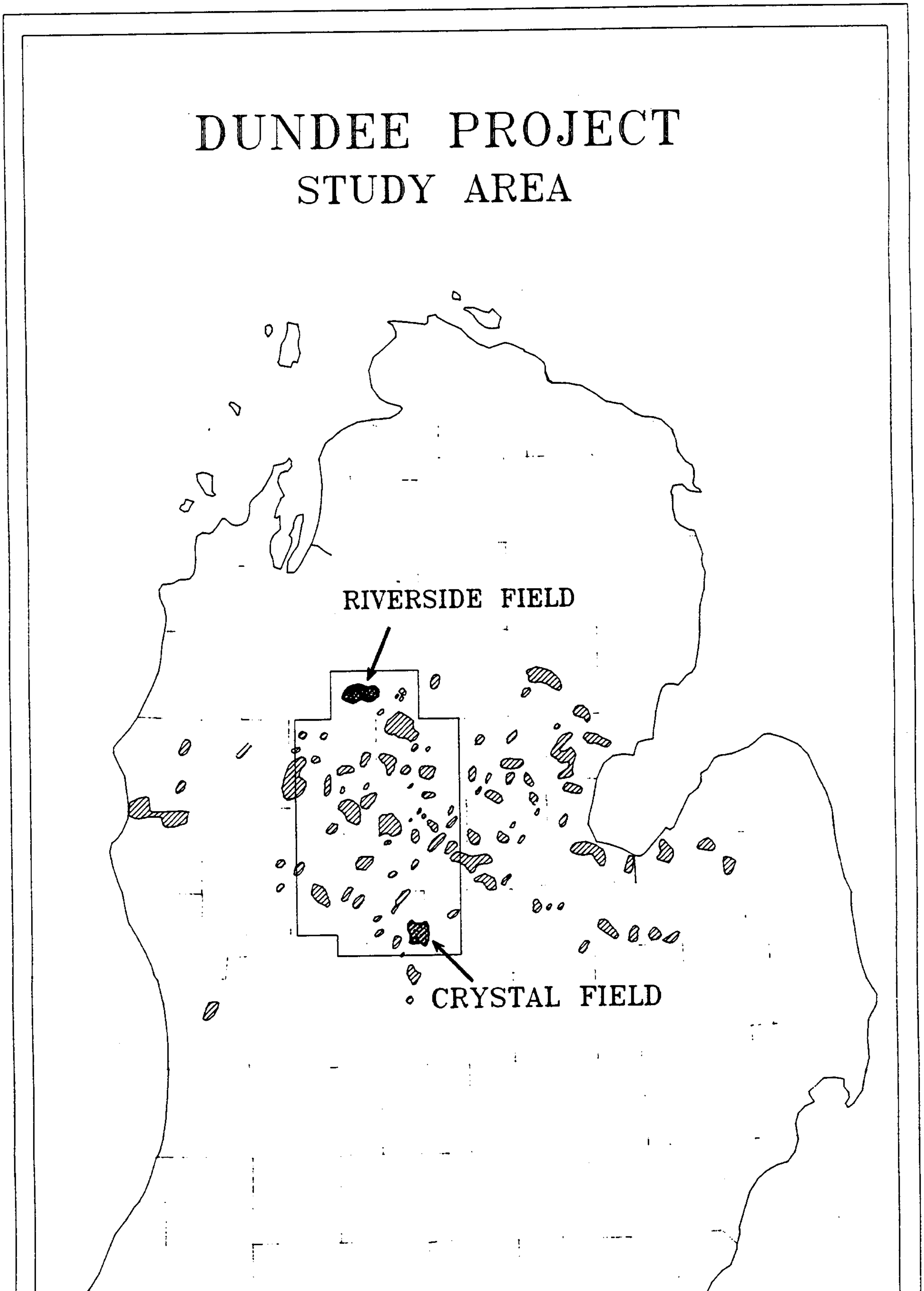
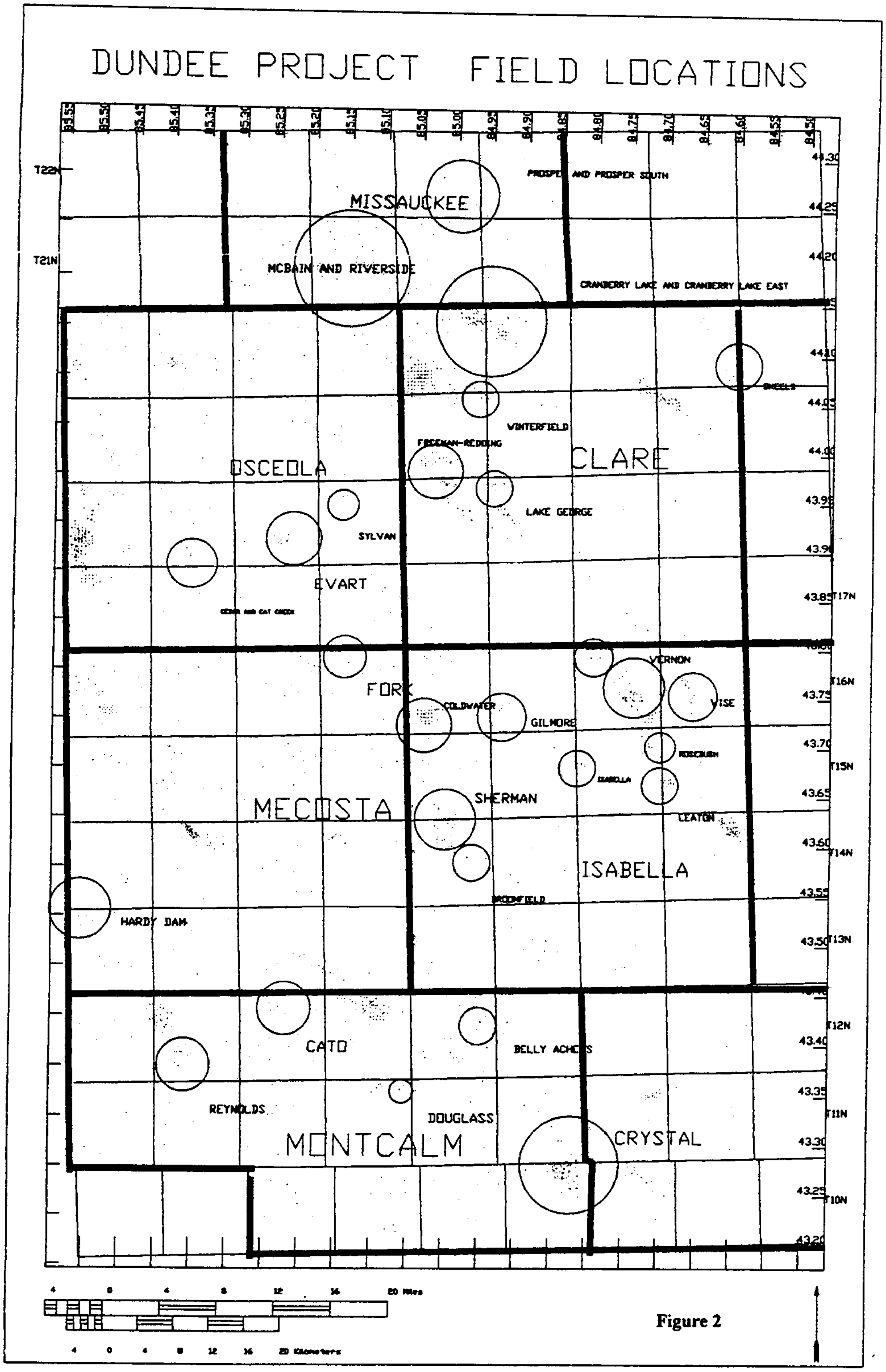


Figure 1


DUNDEE PROJECT FIELD LOCATIONS
T22N
T21N
MISSAUCKEE
PROSPER AND PROSPER SOUTH
MCBAIN AND RIVERSIDE
CRANBERRY LAKE AND CRANBERRY LAKE EAST
WINTERFIELD
FREEMAN-REDDING
CLARE
OSCEOLA
LAKE GEORGE
SYLVAN
EVART
VERNON
FORK
COLDWATER
GILMORE
VISE
ROSEBUSH
MECOSTA
SHERMAN
LEATON
ISABELLA
BROOMFIELD
HARDY DAM
CATO
BELLY ACHES
REYNOLDS
DOUGLASS
MONTCALM
CRYSTAL
T17N
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T15N
T14N
T13N
T12N
T11N
T10N
20 Miles
20 Kilometers

Figure 2

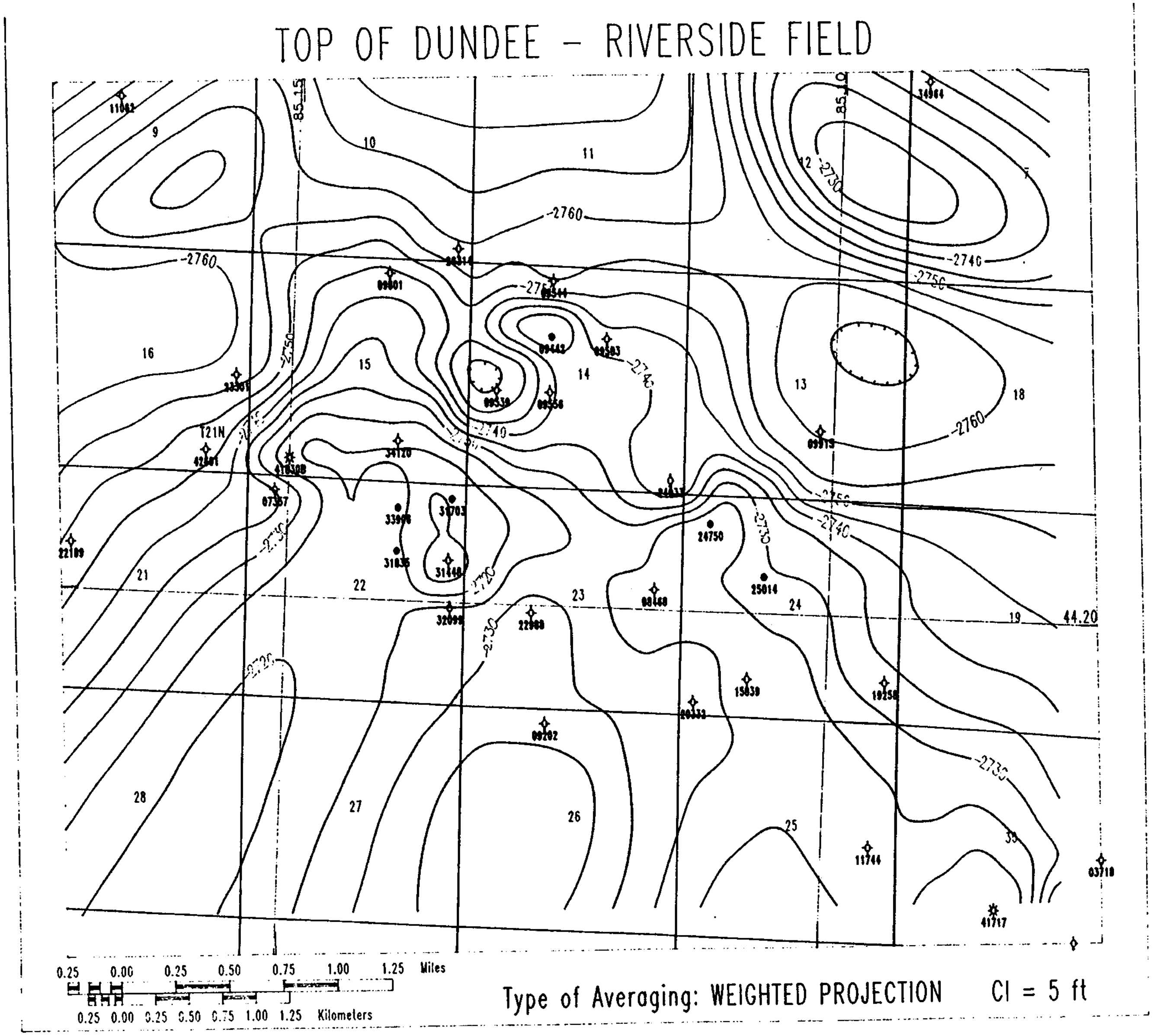

TOP OF DUNDEE - RIVERSIDE FIELD
-2760
-2750
-2740
-2730
-2720
T21N
85.15
85.10
44.20
0.25 0.00 0.25 0.50 0.75 1.00 1.25 Miles
0.25 0.00 0.25 0.50 0.75 1.00 1.25 Kilometers
Type of Averaging: WEIGHTED PROJECTION
CI = 5 ft

Figure 3

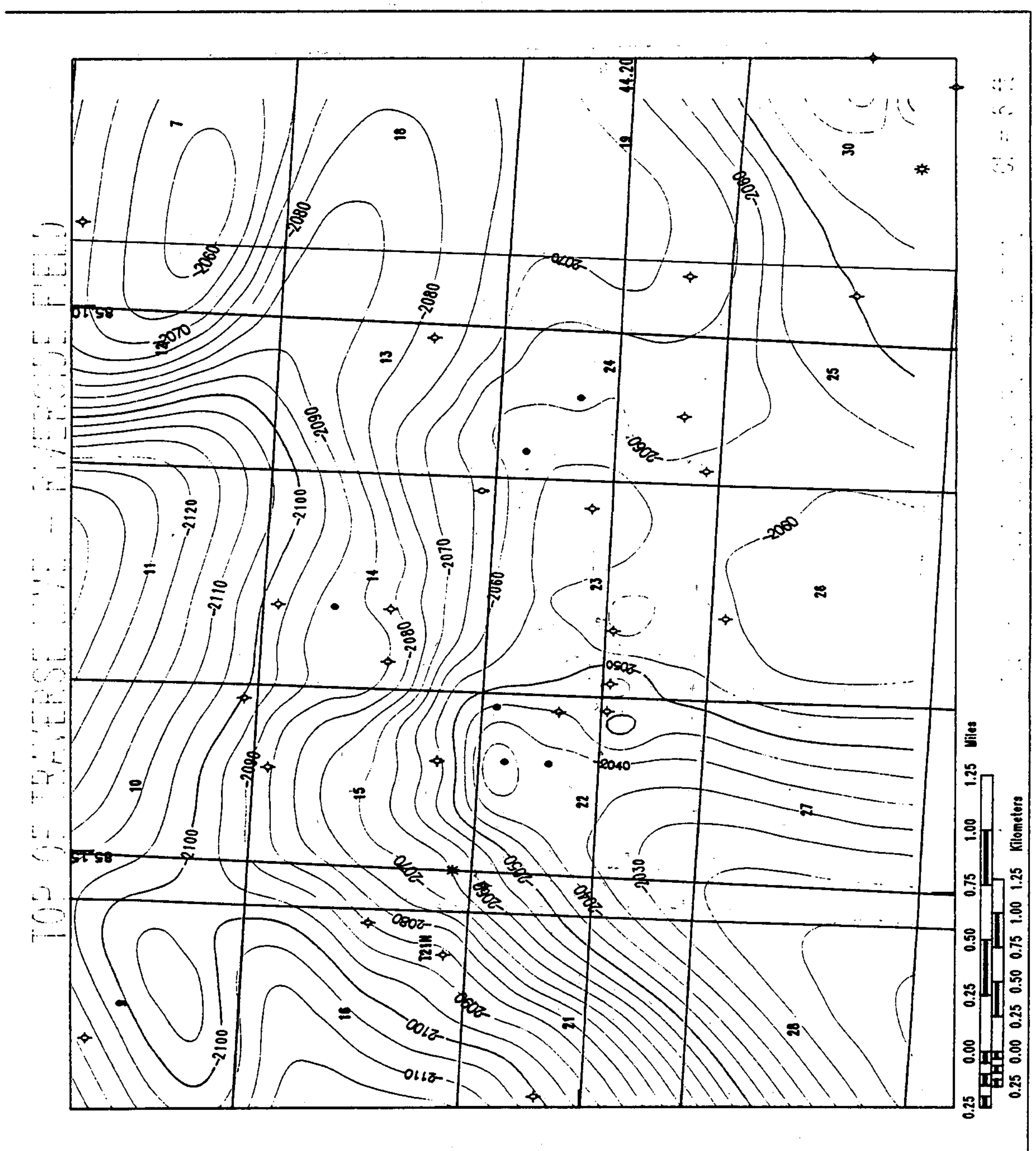


Figure 4

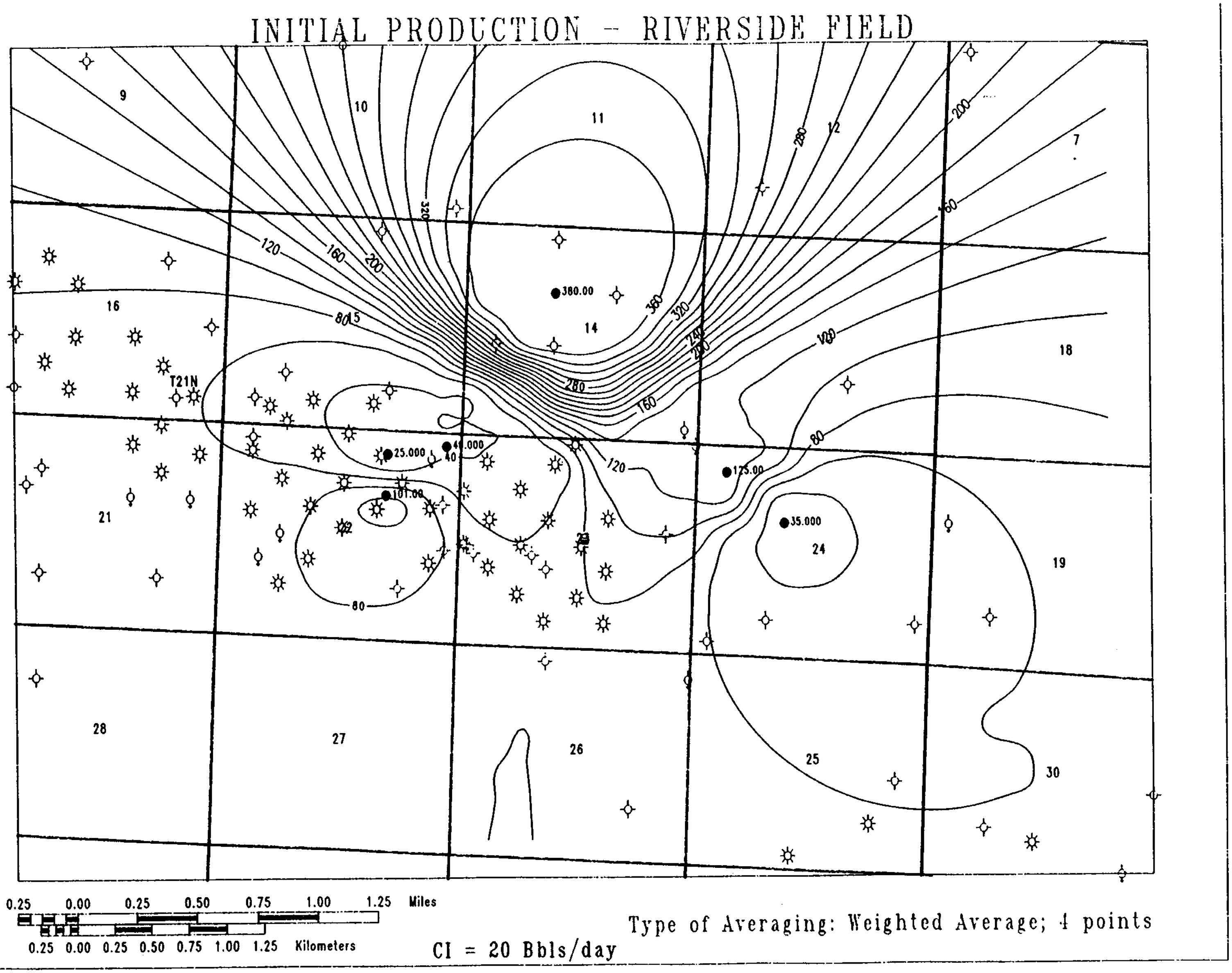

INITIAL PRODUCTION -- RIVERSIDE FIELD
9
10
11
12
7
14
16
18
19
21
24
25
26
27
28
30
T21N
380.00
25.000
175.00
35.000
101.00
120
160
200
240
280
320
360
80
0.25 0.00 0.25 0.50 0.75 1.00 1.25 Miles
0.25 0.00 0.25 0.50 0.75 1.00 1.25 Kilometers
CI = 20 Bbls/day
Type of Averaging: Weighted Average; 4 points

Figure 5

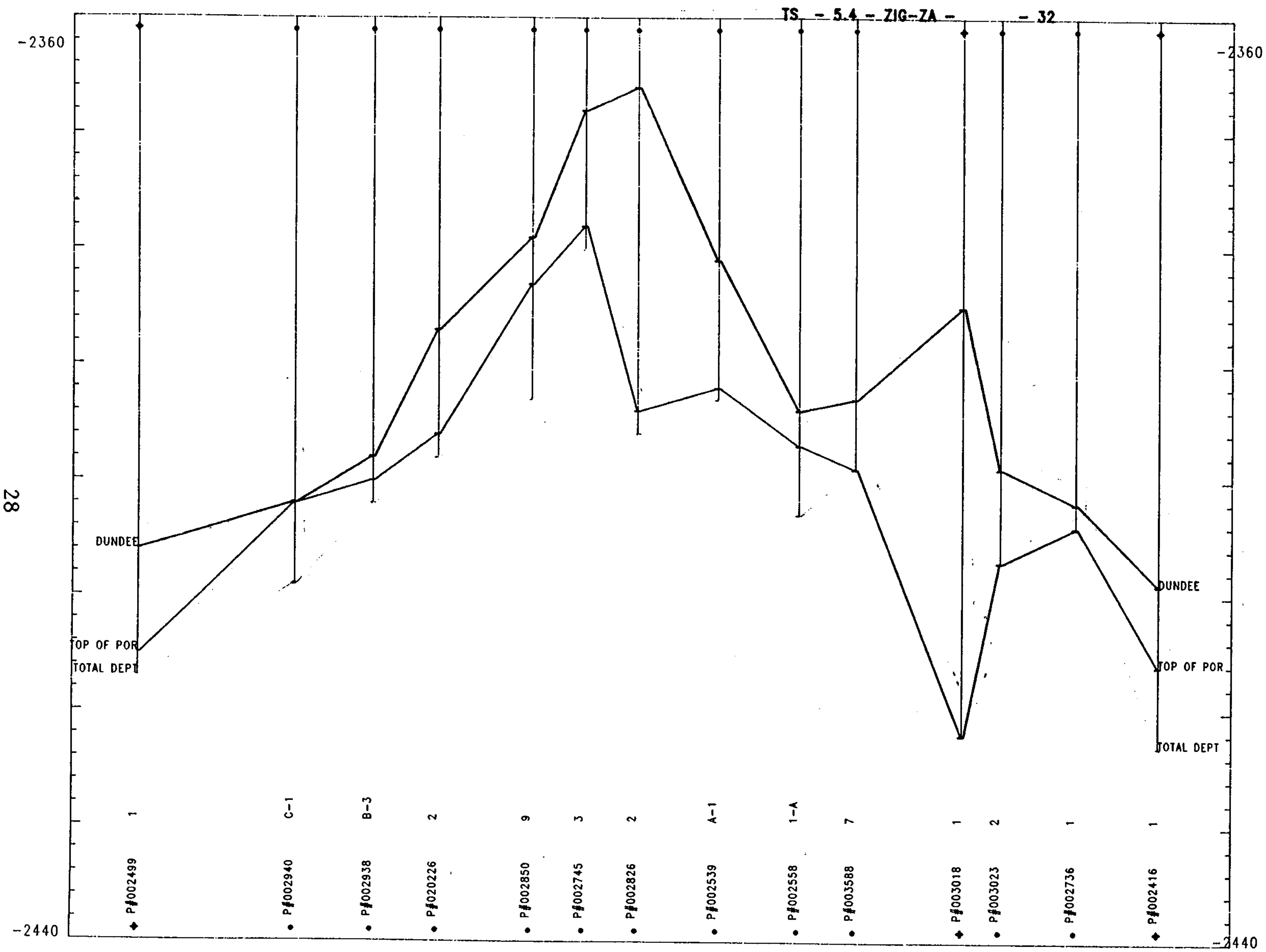


Figure 6 STRUCTURAL CROSS SECTION – CRYSTAL FIELD

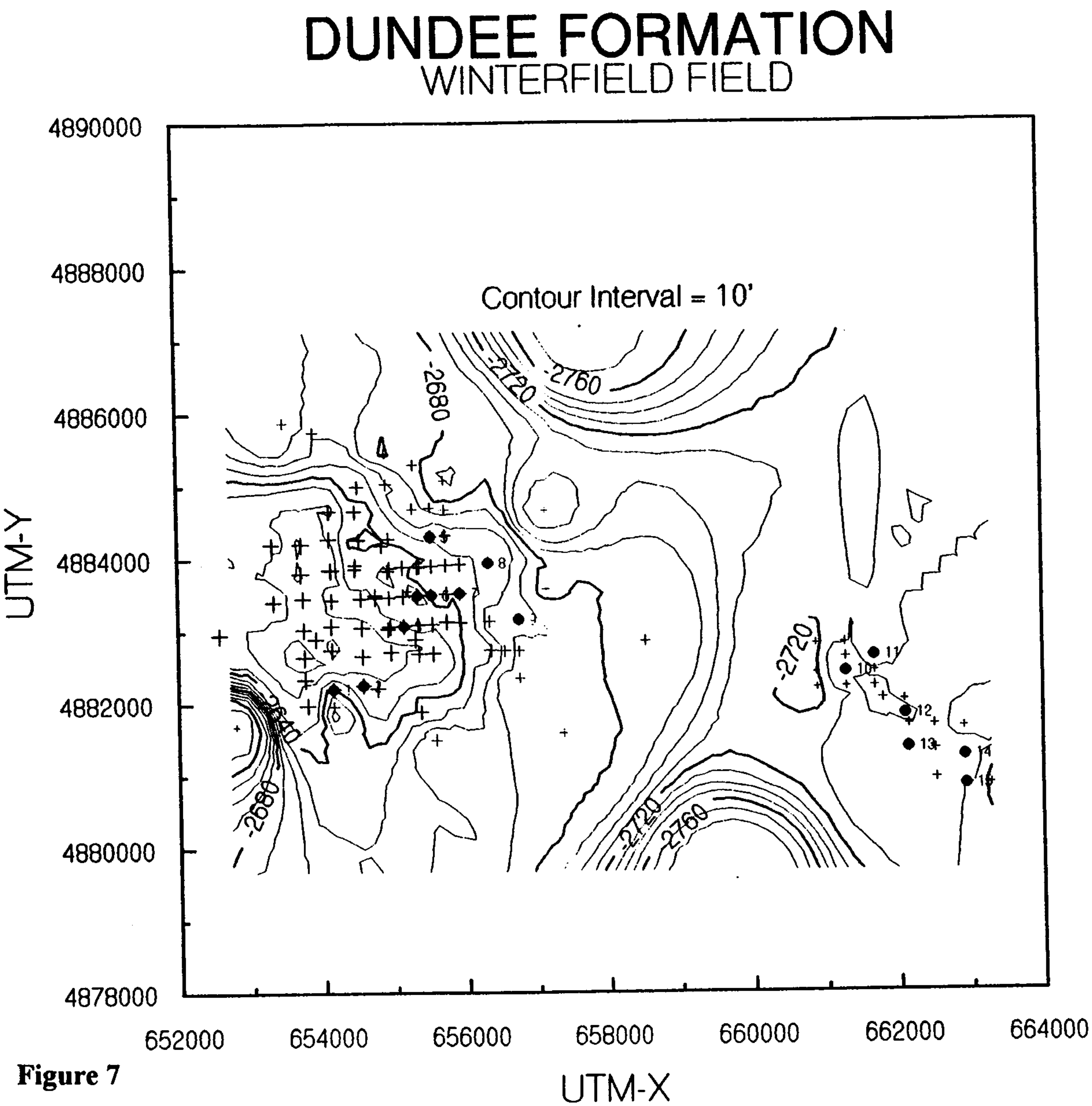

DUNDEE FORMATION
WINTERFIELD FIELD
Contour Interval = 10'
-2680
-2720
-2760
-2640
UTM-Y
UTM-X
4890000
4888000
4886000
4884000
4882000
4880000
4878000
652000
654000
656000
658000
660000
662000
664000

Figure 7

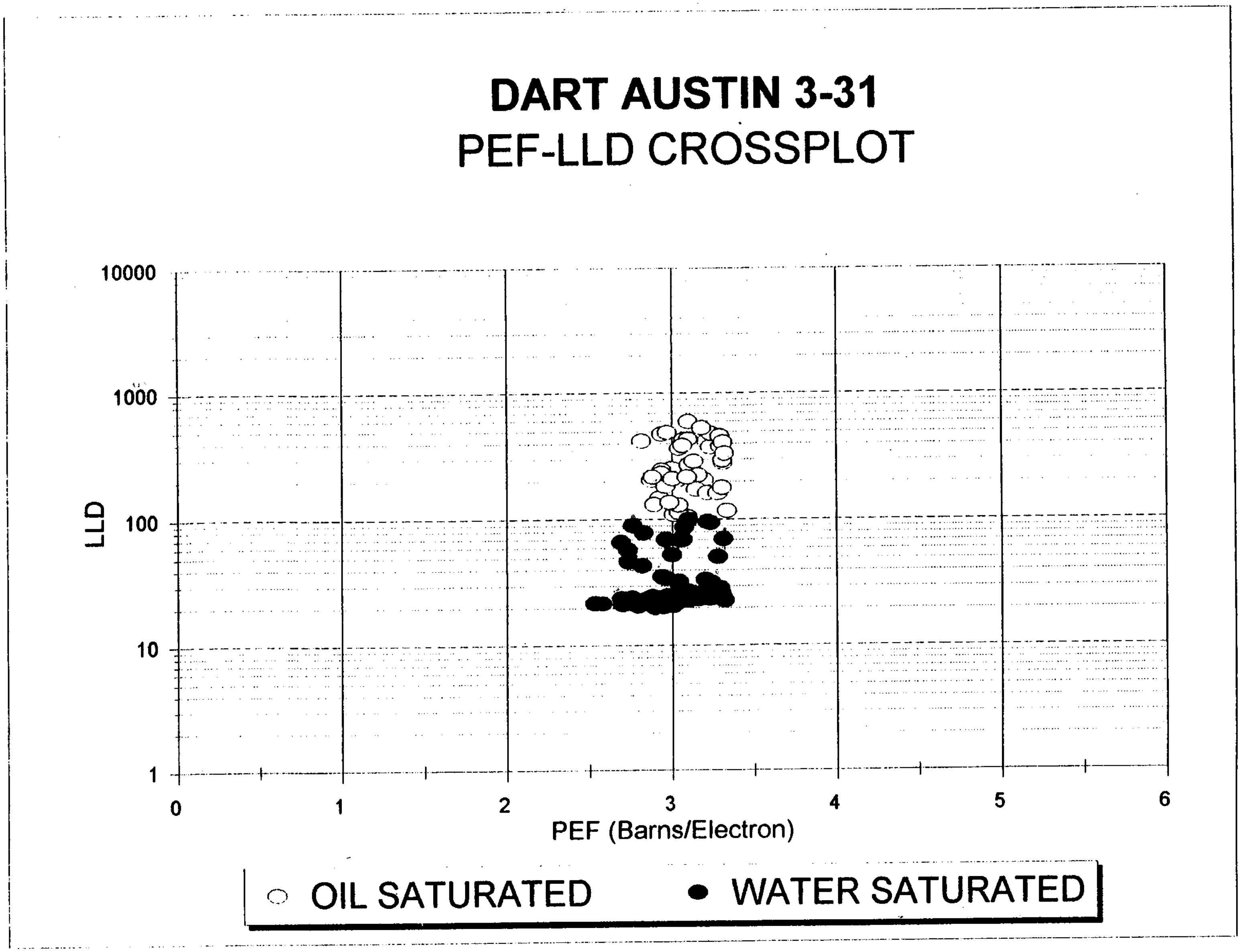
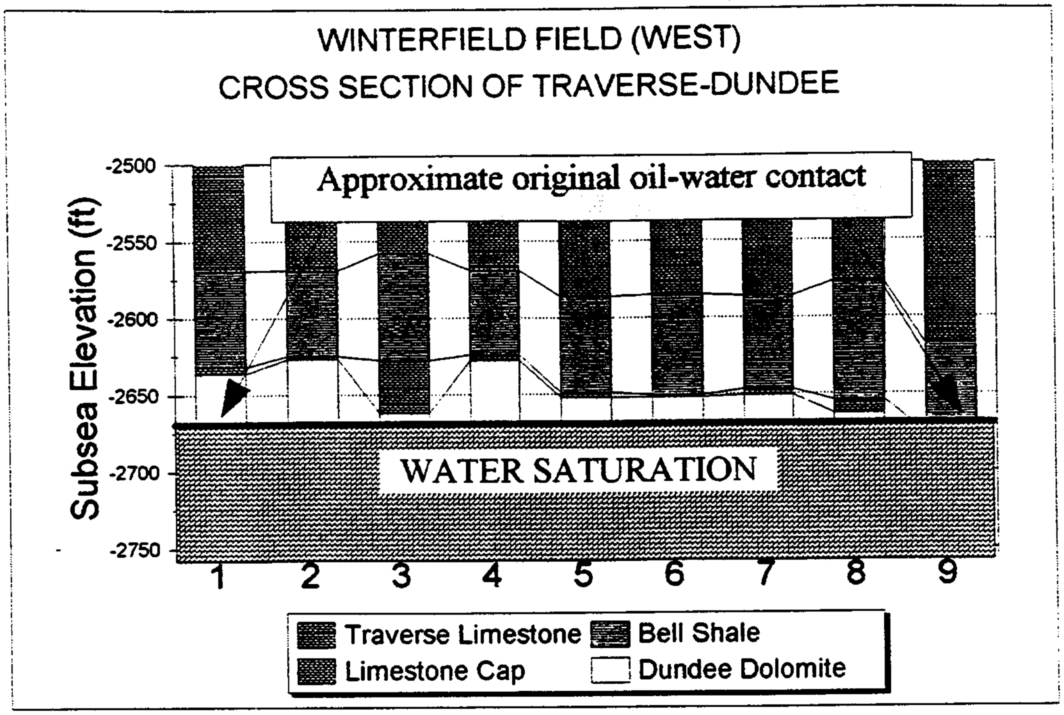

DART AUSTIN 3-31
PEF-LLD CROSSPLOT
LLD
10000
1000
100
10
1
0
1
2
3
4
5
6
PEF (Barns/Electron)
OIL SATURATED
WATER SATURATED

Figure 8


WINTERFIELD FIELD (WEST)
CROSS SECTION OF TRAVERSE-DUNDEE
Approximate original oil-water contact
WATER SATURATION
Subsea Elevation (ft)
-2500
-2550
-2600
-2650
-2700
-2750
1
2
3
4
5
6
7
8
9
Traverse Limestone
Bell Shale
Limestone Cap
Dundee Dolomite

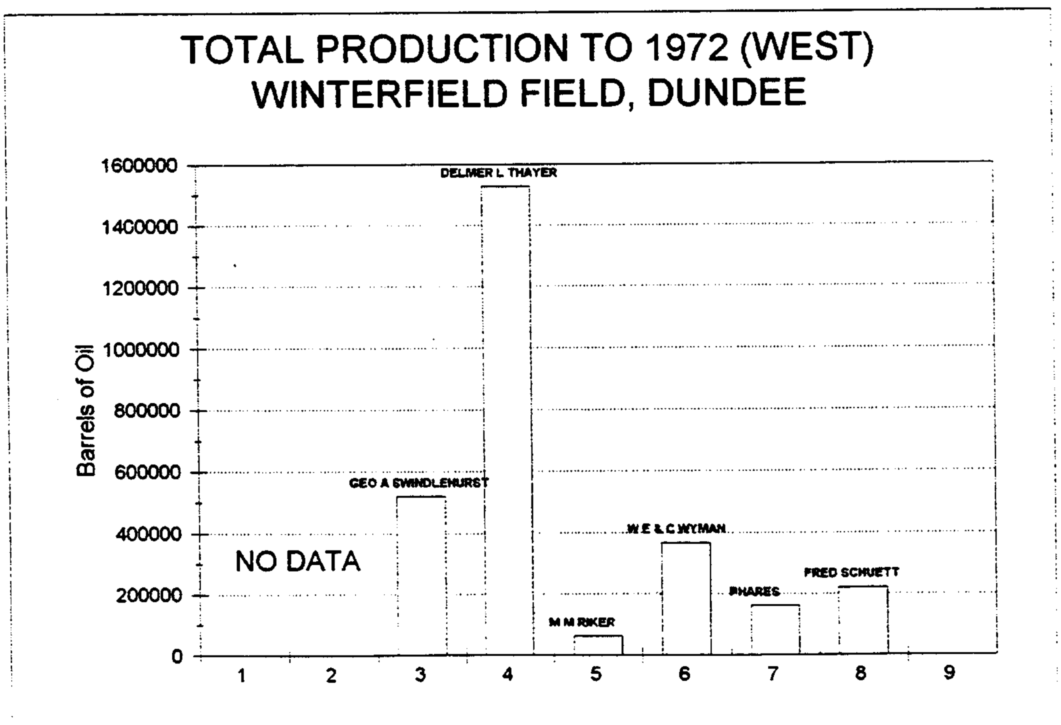

TOTAL PRODUCTION TO 1972 (WEST)
WINTERFIELD FIELD, DUNDEE
Barrels of Oil
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
NO DATA
GEO A SWINDLEHURST
DELMER L THAYER
M M RIKER
W E & C WYMAN
PHARES
FRED SCHUETT
1
2
3
4
5
6
7
8
9

Figure 9

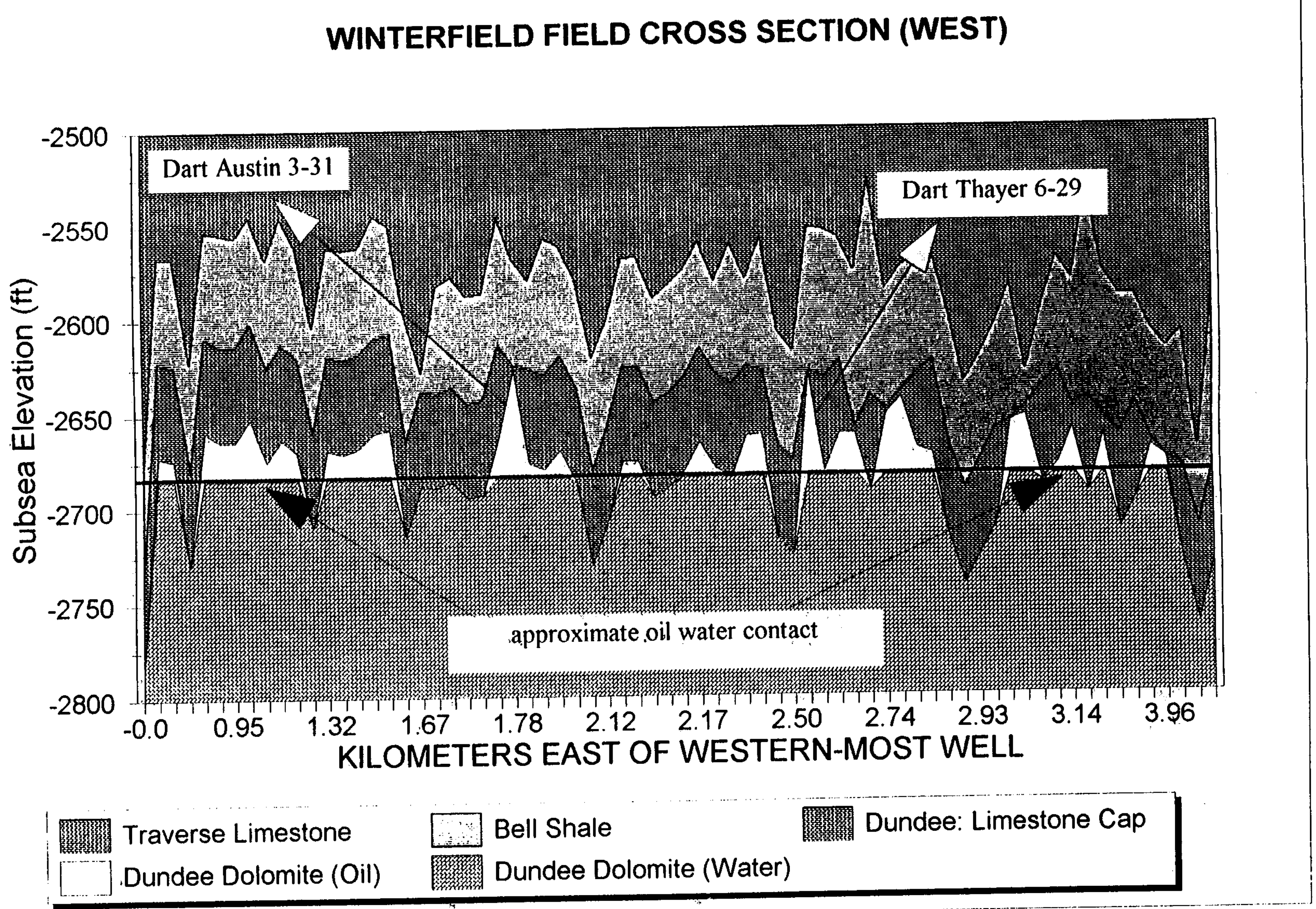

WINTERFIELD FIELD CROSS SECTION (WEST)
Subsea Elevation (ft)
-2500
-2550
-2600
-2650
-2700
-2750
-2800
Dart Austin 3-31
Dart Thayer 6-29
approximate oil water contact
-0.0
0.95
1.32
1.67
1.78
2.12
2.17
2.50
2.74
2.93
3.14
3.96
KILOMETERS EAST OF WESTERN-MOST WELL
Traverse Limestone
Bell Shale
Dundee: Limestone Cap
Dundee Dolomite (Oil)
Dundee Dolomite (Water)

Figure 10

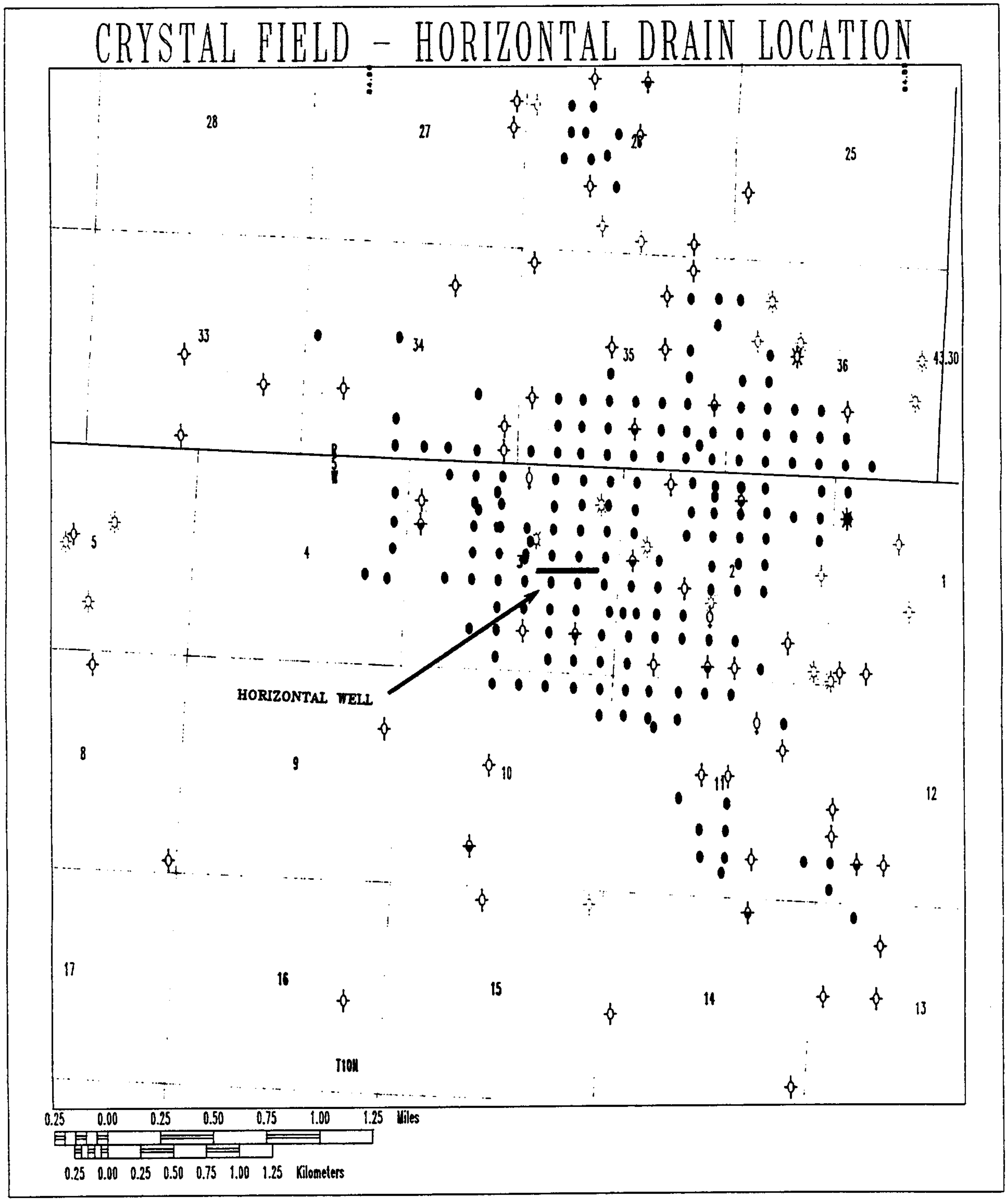
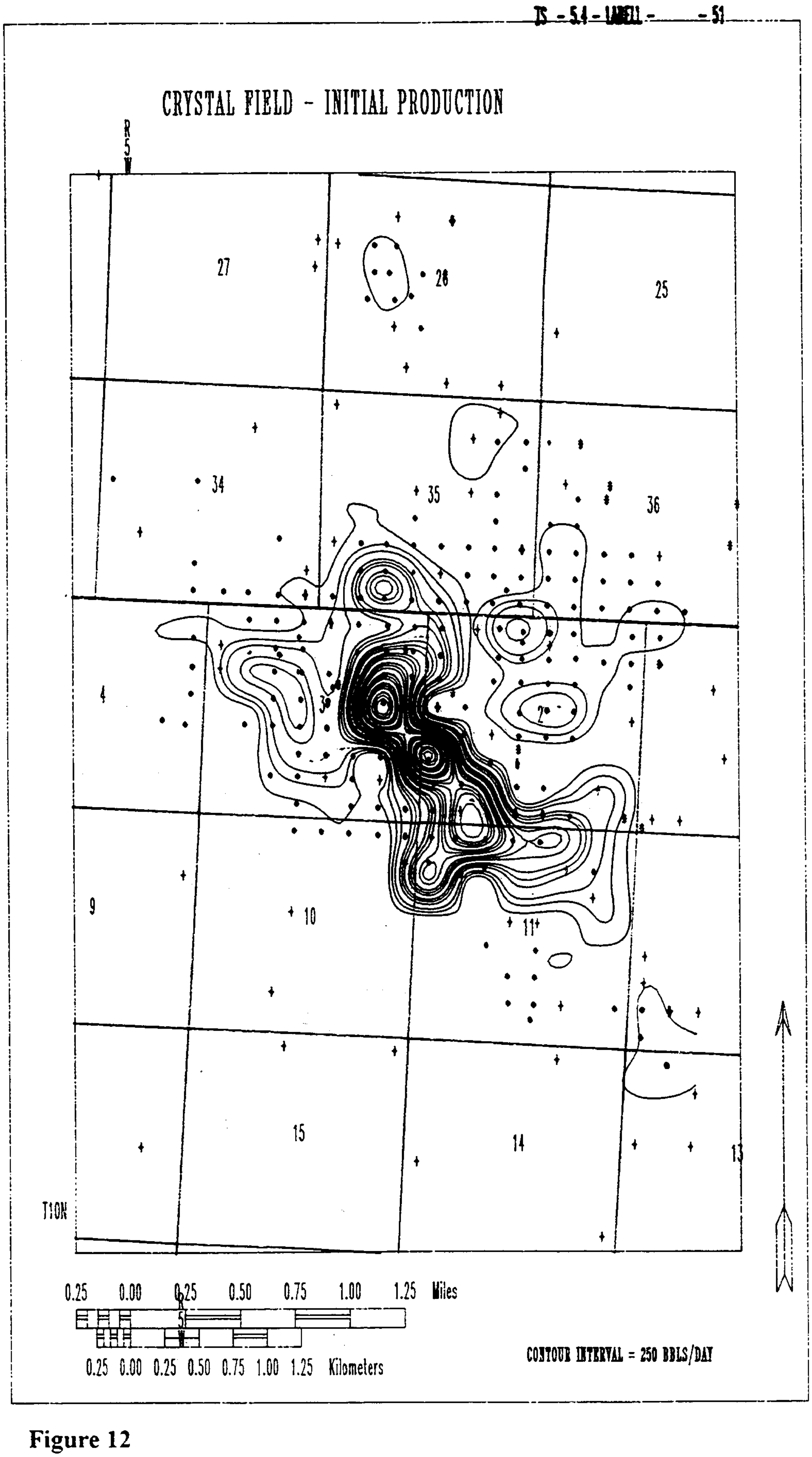

CRYSTAL FIELD - HORIZONTAL DRAIN LOCATION
28
27
26
25
33
34
35
36
5
4
3
2
1
HORIZONTAL WELL
8
9
10
11
12
17
16
15
14
13
T10N
0.25 0.00 0.25 0.50 0.75 1.00 1.25 Miles
0.25 0.00 0.25 0.50 0.75 1.00 1.25 Kilometers

Figure 11



CRYSTAL FIELD - INITIAL PRODUCTION
R 5 W
27
28
25
34
35
36
4
3
2
9
10
11
15
14
13
T10N
0.25 0.00 0.25 0.50 0.75 1.00 1.25 Miles
0.25 0.00 0.25 0.50 0.75 1.00 1.25 Kilometers
CONTOUR INTERVAL = 250 BBLS/DAY

Figure 12

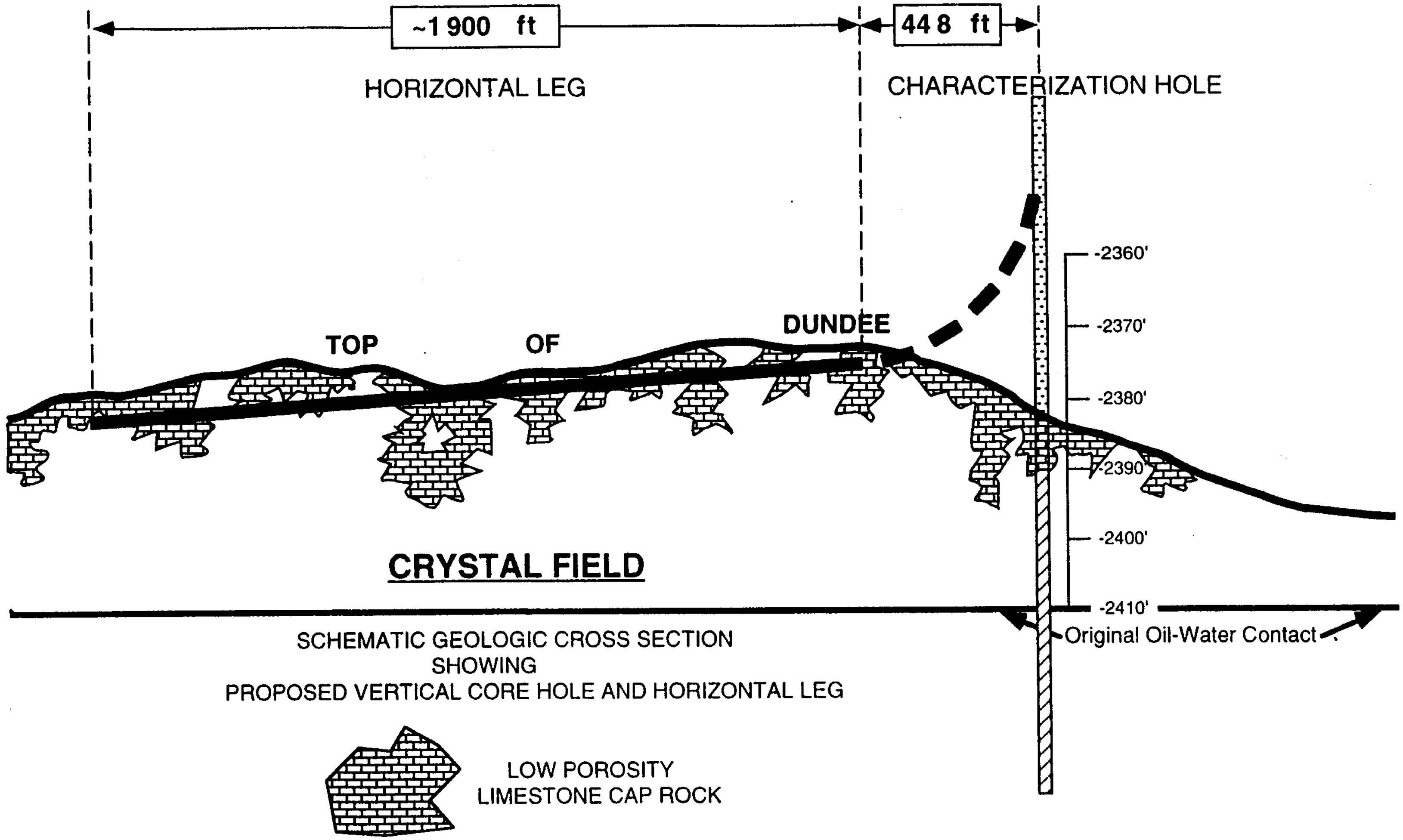

~1 900 ft
44 8 ft
HORIZONTAL LEG
CHARACTERIZATION HOLE
TOP OF DUNDEE
-2360'
-2370'
-2380'
-2390'
-2400'
-2410'
CRYSTAL FIELD
Original Oil-Water Contact
SCHEMATIC GEOLOGIC CROSS SECTION
SHOWING
PROPOSED VERTICAL CORE HOLE AND HORIZONTAL LEG
LOW POROSITY
LIMESTONE CAP ROCK

Figure 13

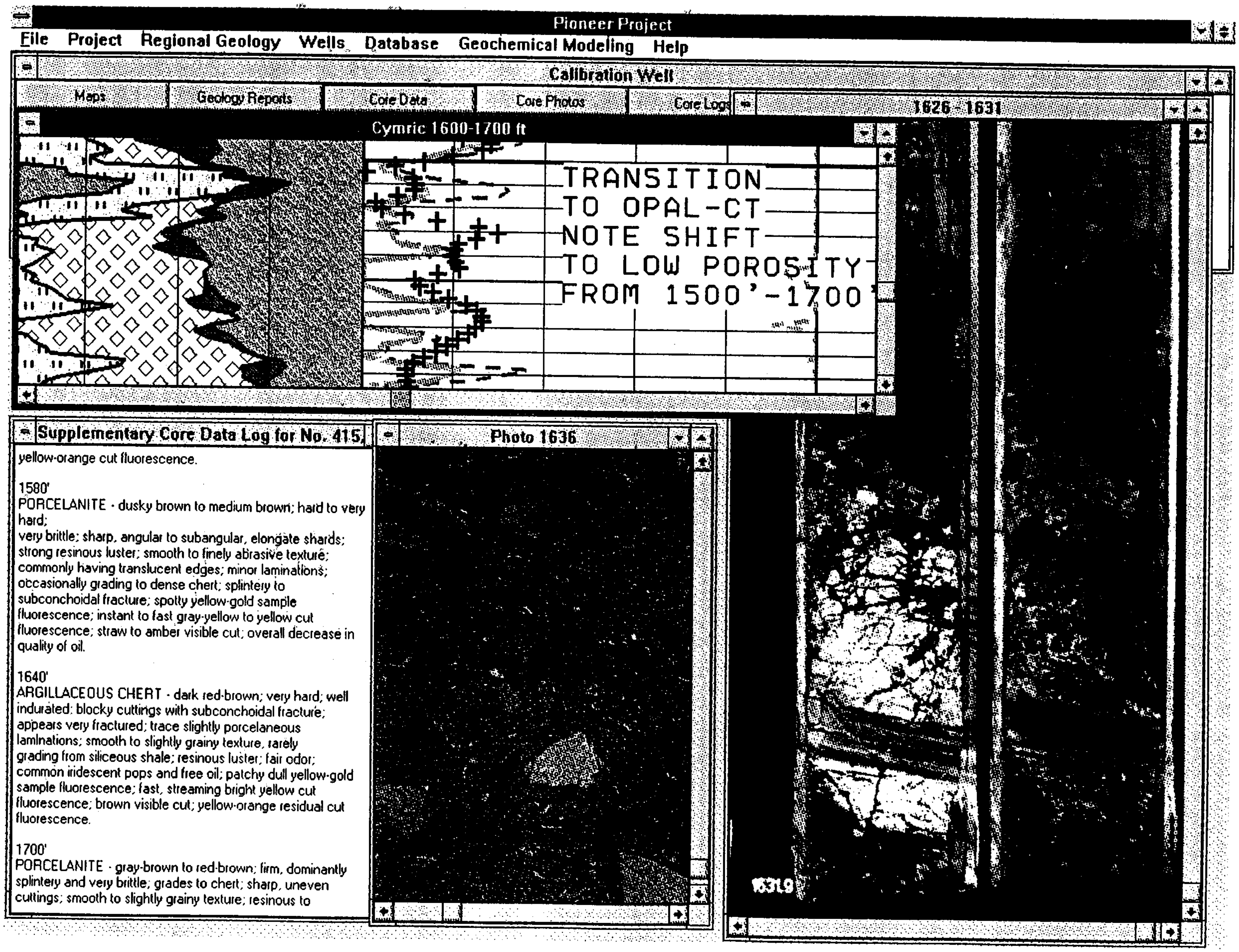

Pioneer Project
File Project Regional Geology Wells Database Geochemical Modeling Help
Calibration Well
Maps
Geology Reports
Core Data
Core Photos
Core Logs
1626 - 1631
Cymric 1600-1700 ft
TRANSITION
TO OPAL-CT
NOTE SHIFT
TO LOW POROSITY
FROM 1500'-1700
Supplementary Core Data Log for No. 415
yellow-orange cut fluorescence.
1580'
PORCELANITE - dusky brown to medium brown; hard to very hard;
very brittle; sharp, angular to subangular, elongate shards; strong resinous luster; smooth to finely abrasive texture; commonly having translucent edges; minor laminations; occasionally grading to dense chert; splintery to subconchoidal fracture; spotty yellow-gold sample fluorescence; instant to fast gray-yellow to yellow cut fluorescence; straw to amber visible cut; overall decrease in quality of oil.
1640'
ARGILLACEOUS CHERT - dark red-brown; very hard; well indurated; blocky cuttings with subconchoidal fracture; appears very fractured; trace slightly porcelaneous laminations; smooth to slightly grainy texture, rarely grading from siliceous shale; resinous luster; fair odor; common iridescent pops and free oil; patchy dull yellow-gold sample fluorescence; fast, streaming bright yellow cut fluorescence; brown visible cut; yellow-orange residual cut fluorescence.
1700'
PORCELANITE - gray-brown to red-brown; firm, dominantly splintery and very brittle; grades to chert; sharp, uneven cuttings; smooth to slightly grainy texture; resinous to
Photo 1636
1631.9

Figure 14

Visual Display of Reservoir Parameters Affecting EOR
(multimedia shell using Visual Basic Professional)

File
- Intro
- Exit

Project
- Public Abstract
- Participants
- Location
- Tasks and timeline
- Quarterly reports

Regional Geology
- Maps ➥
- Cross Sections ➥
- 3D Views ➥

(Maps)
- aerial photo
- map view of structure
- Munger maps
- DEM ➥ (?)
- CA G&O ➥ (?)

(Cross sections)
- horizon 1
- horizon 2
- ...

(horizon info window)
- lithologic description
- core information
- core photos

(3D views)
- topography
- simple structure
- volume model of reservoir

(volume model window)
- porosity
- permeability
- oil saturation
- water saturation
- clays
- geochemical information

Wells
- All Wells
- Calibration Well
- Well 1

(well data)
- general well data
- production history
- petro data
    - thin sections
    - other analytical

Databases
- XRD
- SEM
- etc.

Geochemical Modeling
- burial histories ➥
- geochemical models ➥

(burial)
- discussion of how generated
- example wells

(geochemical models)
- fluid-rock ➥
- 2ndary porosity ➥
- steam flood models ➥

(fluid-rock)
- statement of problem
- x-y plots
- other visuals

(2ndary porosity)

(steam flood)
- reactions
- EOR processes

Help
- map
- index

Users will be able to access the files in two ways:
1) as archival material
2) as a tutorial

Figure 15

ATTACHMENT 1

Characterization Of The Dundee Formation,

Winterfield Field,

Clare County, Michigan

by
STEVEN D. CHITTICK

A THESIS

Submitted in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE IN GEOLOGY

MICHIGAN TECHNOLOGICAL UNIVERSITY

April 4, 1995

This thesis, "Characterization of the Dundee Formation, Winterfield field, Clare County, Michigan", is hereby approved in partial fulfillment of the requirements for the Degree of MASTER OF SCIENCE IN GEOLOGY.

DEPARTMENT: Geological Engineering
and Sciences

Thesis advisor ____________________

Head of Department ______________

Date __________________________

Characterization of the Dundee Formation, Winterfield Field, Clare County, Michigan

Steve Chittick, Charles Salotti, James R. Wood, Wayne Pennington, S. Douglas McDowell, Jacqueline Huntoon: Michigan Technological University, William Harrison III: Western Michigan University

ABSTRACT

The Devonian Dundee Formation of the Winterfield field was originally developed in the late 1930's and early 1940's and rapid production helped support the U.S. war effort. Poor completion and production practices may have caused the field to have been inefficiently developed, and wells prematurely watered out due to water coning. There were several competing producing companies on the western side of the field, which may have influenced rapid production.

Production occurs in porous dolomitized "chimneys" where they extend above the oil-water contact within the otherwise "tight" limestone. Cross plots of the PEF (Photoelectric) log and the LLD (deep lateral) log separate the porous, oil-saturated dolomite from water-saturated dolomites and the "tight" limestone. The PEF distinguishes the lithologies (dolomite and limestone) and the LLD separates the fluids (water and oil); other useful logs are the CNL and GR to indicate porous and shale zones respectively. The dolomite "chimneys" are small in scale, less than 60' high and can be laterally discontinuous between wells on 40 acre spacings. The dolomite zones tend to have good porosity and permeability; the API gravity of the oil is 44.2 and the reservoir is produced by a strong, constant water drive. Initial production tests on some wells indicate the ability to produce up to nearly 2000 barrels per day (BOPD).

Wells drilled in the 1980's to the deeper Richfield intercepted an isolated oil pocket in the Dundee off structure, prompting further drilling activity; subsequent production has significantly added to the cumulative production in the field. We believe that due to the heterogeneity of the reservoir, the strong water drive, the low density of the oil and the relatively high permeabilities, this reservoir and others like it are ideal candidates for horizontal drain technology. The horizontal wells could link "chimneys" that have previously been untapped, significantly adding to the total production of these Dundee fields.

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Objectives

The purpose of this study is to delineate zones of possible economic supplies of by-passed oil remaining in the Devonian Dundee Formation (Dundee) by characterizing the structural, stratigraphical, and lithological components of the Dundee within the Winterfield field utilizing well data (driller's logs and scout tickets), petrophysical well log data, and production data.

Background

Oil exploration began in Michigan in Port Huron in 1886-87 with the drilling of 3 wells which all had oil shows in the Dundee (Smith, R.A. 1912). The true economic potential of petroleum in Michigan, however, wasn't realized until the discovery and development of the Saginaw field in the mid to late 1920's (Catacosinos, Daniels and Harrison, 1991). The Dundee overall has produced over 350 million barrels of oil (BO) within the Michigan Basin.

The first recorded wells penetrating the Dundee in the Winterfield field, Clare County, Michigan were drilled in 1939 . The wells produced from dolomitized limestone capped either by the overlying Bell shale or by tight

Dundee limestone. Subsequent wells were drilled through the present time with the majority of producing oil and/or gas wells in the Mississippian Michigan "Stray" sand (gas), the Devonian Age Traverse Limestone (oil), the Dundee (oil), the Richfield Member of Lucas Formation of the Detroit River Group (Richfield) (oil), and the Ordovician Prairie Du Chien (PDC) (gas).

In the Winterfield field nearly sixty-eight percent of the oil produced from the Dundee (Table 1, Figure 1), and eight-five percent of the wells drilled to total depth (TD) in the Dundee (Figure 2), were during the period 1939 to 1945, which incidentally coincides with most of the United States involvement in WWII. This may indicate rapid production of the field, creating conditions that by-passed producible oil.

Most oil production has historically been from the Dundee and the Richfield while the Stray and PDC are shallow and deep gas plays, respectively. In Figure (3), the total well depth versus year drilled shows the historical transition of drilling deeper plays with time.

Location

The Winterfield field (Figure 4) is located primarily in Winterfield and Redding Townships, Clare County, Michigan and the eastern part of Middle Branch Township, NE Osceola County. The Devonian Dundee

Formation, the target oil producing horizon of this study, is approximately 3675' to 3800' below the surface in this area (from about -2600 to -2725 subsea elevation). Most of the Middle and Upper Devonian section are represented in the Michigan Basin at this location. Production from the Devonian has occurred in the Traverse Limestone, Dundee Formation, Richfield and Amherstburg members of the Lucas Formation (Figure 5).

2 GEOLOGY

Regional Geology of the Michigan Basin

A good general reference for the petroleum geology of the Michigan Basin is Catacosinos, Daniels, and Harrison, (1991). It covers many of the essential aspects of the petroleum geology of the Michigan Basin and is a good source of recent and early references.

Location

The Michigan Basin (Figure 6) is a large nearly circular intracratonic basin with an areal extent between 80,000 and 85,000 square miles primarily centered on the southern peninsula of Michigan. The basin is contained by the Wisconsin Arch on the west, Kankakee, Findlay, and

Algonquin Arches on the south and southeast, and by the Canadian Shield and Superior Province in the north and northwest.

Structure

The central Michigan Basin has an accumulated Phanerozoic sedimentary rock thickness (mostly marine sediments) of greater than 14,000 feet (Hinze and Merritt, 1969) at the basin center, forming an appearance of stacked bowls in three dimensions and a bulls-eye pattern in two dimensional bedrock surface map.

The beginnings of the basin formation can be traced back to at least the Late Cambrian as shown by isopach maps of the Munising group by Catacosinos (1973). Howell and van der Pluijm (1990) have proposed that the down warping and basin formation are related to Appalachian tectonics and have developed episodically. Sediments, mostly of marine origin, accumulated during the invasion of many shallow inland (epeiric) seas throughout the Paleozoic, derived from the erosion of continental highlands of the Adirondacks, Wisconsin and the Canadian Shield. A cover of glacial deposits, and glacially created lakes blanket most of the basin, making the geology only remotely accessible.

A positive Bouguer gravity anomaly, the Mid-Michigan gravity high (Figure 7), traverses the state from northern Lake Michigan to northern Lake Erie, trending NW-SE. This anomaly appears to indicate basement structure important to the development of oil field structures within the state, including the producing Dundee fields. Many oil field structures, Paleozoic anticlines, faults and fractures also trend NW-SE parallel to the gravity trend.

The Mid-Michigan gravity high has been theorized to be related to the Keweenaw rifting event (Hinze with others, 1975) with rock assemblages similar to that of the Keweenaw Peninsula rift-fill sequence in the Lake Superior region. Some rock samples from the 17,766' deep McClure-Sparks et al 1-8 located in Gratiot County, T10N, R2W, contain minor amounts of native copper along with some copper sulfides (McCallister with others, 1978). The basin structure probably didn't develop during the Keweenaw rifting event due to the seemingly unrelated position of the depocenter. A COCORP seismic line tied into the McClure-Sparks et al 1-8 well, suggests a Precambrian basement of complexly faulted horst and graben structures (Fisher, 1990).

Oil Production

Oil and gas were first discovered in Port Huron in 1886 with gas shows above the Devonian Antrim shale and oil in the Dundee Limestone. Since then major oil and gas fields have been developed in Mississippian sands, Devonian carbonates, fractured Ordovician limestone, Silurian carbonate reefs, Ordovician clastics and currently the shallow, black, Devonian Antrim shale. The Antrim shale is producing gas and is the current "hot spot" of drilling activity.

The Devonian

The Devonian Depositional Environment

The Devonian is represented by 3700 feet of marine sedimentary rocks (mainly marine shales, carbonates and evaporites with some sandstone in the lower middle Devonian) in the structural center of the Michigan Basin (Sanford, 1967) which were deposited in epieric seas during periods of transgression and regression.

Figure 8 shows transition of Devonian lithologies from the central Michigan Basin to Pennsylvania. From east to west the basin generally goes from more open water lithologies to more restricted environments. The Rogers City and the Dundee are generally indistinguishable in the subsurface while the Reed City member is an evaporitic member mainly confined to the western "lagoonal" area of the basin.

The Dundee

The Dundee is distinguishable in the subsurface throughout most of the lower peninsula from driller's logs as a carbonate underlying the Bell

Shale and produces from a variety of facies throughout Michigan. The Dundee is divided into two members, the Rogers City Formation and the Dundee Formation, but in this paper the two will be addressed as the Dundee. The Dundee is a mostly transgressive series of carbonates and evaporites overlying the regressive Detroit River Group. The deepening of the sea during transgression caused deposition of deeper water open marine shelf carbonates, except where patch reefs and intertidal islands developed (Montgomery, 1986). Dolomitic reservoirs are common and important within the Dundee (e.g., Winterfield field). Several theories have been expounded to account for this dolomitization, but it is commonly perceived that the central basin dolomitization (Winterfield field) occurred as solutions migrating up from the Detroit River Group invading and reacting with the Dundee limestone through fractures after deep burial. Sabkha type (evaporative) dolomite and mixing zone dolomite probably best explain the formation of dolomite in the western "lagoonal" part of the Dundee basin (Montgomery, 1986).

Dundee exposures stretch across the northern part of the southern peninsula of the state from Emmet County on Lake Michigan east to Presque Isle County on Lake Huron (Figures 9 & 10). Dundee exposures in the southern part of the basin extend from southeastern Wayne County through Monroe and Lenawee Counties and on into Ohio.

Isopach maps created by Cohee and Underwood (1945), and Gardner (1974) (Figure 9) indicate the thickest part of the Dundee occurs around the Saginaw Bay area with a thickness of about 400 feet. The Dundee ranges in depth from outcrop exposure to nearly 4000 feet in the center of the basin (Figure 10).

The Dundee in the Michigan Basin is characterized by gradation of nearly pure shallow open marine limestone, (Cohee and Underwood, 1945, Gardner, 1974, Catacosinos, Daniels and Harrison, 1991) in the eastern part of the basin, to nearly pure lagoonal dolostone in the west and southwest. Gardner's depositional interpretation (1974), (Figure 11) shows shell banks located along structure parallel to the Mid-Michigan gravity high in the northern part of the basin separating the lagoonal western environment from the eastern open marine environment. The Winterfield field is along the Mid-Michigan gravity high in the vicinity of Gardner's proposed shell banks.

3 DATA ACQUISITION

Well Data and Driller's Logs

The initial well data set used to create the following maps and plots was obtained from Petroleum Information Corporation (PI) as an ASCII file. This data set is a compilation of wells in the Winterfield field that at least penetrate the Dundee. The data was first extracted from the ASCII file with a program written in QuickBasic by Steve Chittick (Appendix A); this program reads the PI data file, then exports the data to several ASCII files that are easily imported into spreadsheet and database programs. The data used from PI consists of well tops, initial production (IP) tests, and completion information; this data was checked against actual drillers' logs and scout tickets from Western Michigan University's Michigan Basin Core Research Laboratory and modifications were made as necessary. Figure 12 shows the locations of wells used in this study. Table 2 lists the general data for these wells.

All subsequent contour plots and surface plots were completed with CoPlot by CoHort Software. All the data for the plots were gridded using the nearest neighbor search (four points) and inverse distance squared weighting. The gridded data were then reprocessed with a 3 point smoothing algorithm. The effects of the smoothing algorithm can be observed on surface plots as the difference between the actual data (black dots) and the gridded surface.

The PI data contained X,Y locations as decimal latitude and longitude. To plot the data on a rectangular grid, all the latitudes and longitudes were converted to Universal Transverse Mercator Projection (UTM) by the method of Davies, et al., 1981. The conversion was done within the spreadsheet Quattro Pro 5 for Windows and the conversion table can be found in Appendix B.

Geophysical Well Log Data

All available geophysical logs from the Winterfield field were obtained in digital form from Maness Petroleum, Mt. Pleasant along with Terra Sciences geophysical well log manipulation software Terra Station. Table 3 lists wells with geophysical data available.

Historical Production Data

Historical production data from the Dundee, Winterfield field (Table 1) was obtained from the Michigan Department of Natural Resources (MDNR), Geological Survey Division. Production records cover individual leases from 1939-1972. All fifteen past and present producing leases within the Dundee, Winterfield field are represented in this thesis. They are generally indicated with black dots and a number; a lease comprises one or more wells, usually the wells from a specific horizon on one land owner's property. Production data from 1939-1945 is recorded as the total production for each lease between the specified years. Production data from 1945-1972 is separated by year and by lease. Production data between the years 1973-1986 is only given by production interval for each field (e.g., Dundee, Winterfield field, see Appendix C). Some production and technical information was obtained by personal communication with Mr. Dick Hinckley and Mr. Mike Barrett of Dart Oil and Gas Corporation (The main producer in the Winterfield field).

4 WINTERFIELD FIELD STRUCTURAL ELEMENTS

Mid-Michigan Gravity High

The Mid-Michigan Gravity High appears to have been important in the development of the structure and stratigraphy of the Winterfield field. Figure 7 shows the Bouger gravity map of lower Michigan with Dundee oil fields overlaid; note the position of the Winterfield field in relation to the Mid-Michigan anomaly. Structure contour and structure surface maps (Appendix d) show the consistency of the structure in the western part of the field with depth. Continuity of the structures with depth may indicate the structures are linked with the deep seated sources apparent as the Mid-Michigan anomaly on the gravity map of the Michigan Basin. The formation tops that were chosen to be plotted were tops that appeared to be fairly consistent in the driller's description and relationship to other easily identifiable formations.

Dundee

The Dundee Formation has two main structural highs on the east and west ends of the field (Figure 13). The eastern side of the field is a long linear structure plunging SE. It is proposed that saline solutions migrated up along a fracture preferentially dolomitizing this area of the field, providing increased permeability and porosity, providing a flow path and storage for migrating oil. The western side of the field appears domal. There is a low area between the two parts of the field in the form of a tilted saddle. An isopach map of the Dundee Formation in the Winterfield Field (Figure 14) shows increased thickness at structurally high areas.

5 WINTERFIELD FIELD PRODUCTION

Historical Production

The Winterfield Field produced over 6.6 million of barrels of oil from all horizons with over 5.1 million barrels of 44.2^0 API (specific gravity of .81 at 60^0 F) "light" oil from the Dundee up to 1986. The Dundee has produced about 6600 barrels of oil per acre.

Production is pushed by a strong water drive. The reservoir pressure is derived by multiplying the depth to production by a pressure gradient of .39-.41 psi/ft for a constant reservoir pressure of approximately 1500 psi (Dick Hinckley, personal communication). Relative historical production (Table 1) decline for the twelve oldest producing leases within the field are shown in (Figures 15a-c) and the historical production decline curves in Figure 16 for years between 1939-1972 (1939-1945 is illustrated as 1945 because available production numbers are given as total production over this period of time). These figures show the relative consistency of the production between leases. If the reservoir is primarily homogeneous, then relative abnormal production fluctuations between producing leases may indicate wells watering out, poor well completion, or perhaps poor production practices. The numbers on the x axis are lease locations shown as numbered black dots on Figure 14; again leases consist of one or more producing wells on an individuals property. Lease locations with numbers are presented in Table 4.

The oil-water contact in the western side of the field is about -2680 subsea elevation according to Dick Hinckley (personal communication) and from geophysical well logs. There must have been a lower oil-water contact (-2725 ?) in the eastern side of the field due to the position of the producing interval (Figure 17).

Figures 18 & 19 and Figures 20 & 21 show the correlation between producing structure (dolomite thickness above the oil-water contact) and production in the Dundee interval. Figures 18 & 19 (western part of the field) do not visually correlate and linearly the producing structure correlates poorly with production, however the producing structure is a one dimensional number and total volume is a three dimensional number; if the thickness of the producing structure is cubed the total volume of oil produced correlates well with structure, this perhaps indicates that the producing structures in this part of the field are more three dimensional. Figures 20 & 21 (eastern part of the field) on the other hand do show a good linear correlation between producing structure and total volumes of oil produced, indicating a long narrow linear structure where the volume changes only with height of producing structure.

Three general lithologic and structural conditions exist within Dundee in the Winterfield field that affects oil production:

1. Porous dolomite less than 50 feet below the Bell Shale, capped by the Bell Shale or tight Dundee limestone, containing producible quantities of oil. The producing wells have thin limestone caps generally less than 50 feet thick and are relatively high structurally.

2. Porous, permeable dolomite below the oil-water contact, capped by a tight limestone generally greater than 50 feet thick, putting the porous zone into 100% water saturation.

3. Porous permeable dolomite directly below the Bell Shale but structurally below the oil water contact and into 100% water saturation.

Completion Practices

Early wells to produce from the Dundee in the Winterfield field were either drilled with mud rotary past the "Stray Sand" and then completed with cable tool or cable tool drilled to TD. Many times different drilling companies were used to drill the first leg of the hole with rotary and then another company drilled to TD (total depth drilled) with a cable tool rig. Wells were only completed to about one foot into the producing zone and relied on a strong water drive for interval production. Cable tool drilling just a little way into the formation may be desirable due to minimal formation damage, however, wells may not have been vertically and hydraulically connected to all the potential producing zones within the Dundee.

Production Rates

Initial production rates varied widely from almost 1800 barrels of oil per day (BOPD)to less than 10 BOPD. IP tests are a general indication of the permeability of the producing formation around the well. In general, the wells which had high production rates and longevity also had high IP test (Table 6). Initial production test data is presented as graphically in Figures 22 & 23.

Lease Practices

Between 1939 and 1945 when the Dundee in the Winterfield field was originally developed, the lease holders in the western part of the field varied from majors such as Sun Oil Company to companies like Rowmor Corp. & D.E. Hughes. There were at least eight different lease holders within this part of the field, but Sun Oil and Pure Oil company were the biggest players in the field (Figures 24 & 25). Sun Oil controlled the most productive lease in the western part of the field, Delmer Thayer #1, #2, #4, #6 (Table 1) which produced about one third of the volume of oil from the field up to 1972, and they almost exclusively controlled the structurally lower eastern part of the field. The Thayer wells were completed in 1941 and wells #1 and #6 still had a combined production of over 10,000 barrels in 1972 (averaging over 27 BOPD together), and are still producing at the current time. Recent oil activity in the field appears to be controlled by Dart Oil and Gas Corporation, who now own the producing wells: Thayer #1 and #6, Dart Austin 3-31, Dart Benchley 5-31, Dart Mosher 5-30 and BWAB Marion 33-22-1.

6 GEOPHYSICAL WELL LOG INTERPRETATIONS

Wells with geophysical logs available

Table 3 lists the wells and their associated geophysical logs within the Winterfield field as included in the Maness Petroleum dataset. From this table it can be seen that every well that was logged recorded a gamma ray log (GR)(for lithologic correlation) and most wells have available a density log, compensated neutron (CNL) (this combination is used to determine a corrected porosity and to some extent lithology) and caliper (hole width). Only a few wells have available side-wall neutron porosity (similar to CNL), and sonic logs. About half of the wells have available a combination of a micro laterolog (MLL) and a deep laterolog (LLD). The micro spherically focused log (MSFL) is available about 25% of the time and always with the MLL and the LLD; these combinations of resistivity logs allows for determination of the resistive properties of the mudcake and flushed zones around the borehole to correct the signal from the deep laterolog which records the resistive properties out into the virgin or uninvaded zone, theoretically giving the actual resistivity of the formation. The photoelectric log (PEF) was recorded in about 25% of the wells (always with density tool) with logs and was used for lithologic determination.

Gamma ray interactions with formation materials are generally dependent on energy; higher energy interactions are governed by Compton scattering (Doveton, 1986),(Schlumberger, 1989). Return of gamma rays in the higher energy spectrum is inversely proportional to the electron density or bulk density. Lower energy gamma rays are more affected by absorption, and gamma rays returning to the detector in the lower energy spectrum are not only inversely proportional to density but also photoelectric absorption which is related to the sum effect of the absorption of all the elements in a compound. Thus measurements in the high energy spectrum of gamma rays returning to the detector give density information only and gamma rays measured in a low energy window of the gamma ray spectrum gives both density and lithology information. The photoelectric log is desirable for lithologic identification because absorption values between minerals is distinct and absorption value differences between minerals and pore fluids are of an order of magnitude (primarily negating the effects of porosity, Doveton, 1986). The difference between the PEF response of the pore fluid and the response of minerals primarily negates the effects of porosity in lithology determination. The photoelectric log was used in this study to determine if the makeup of the Dundee was limestone or dolomite which is important to oil accumulation in the Winterfield field; the PEF value in Barns/electron for a pure limestone is about 5 whereas the PEF value for a pure dolomite is about 3, the PEF value for shales is about 3 also but the GR log distinguishes between shale and dolomite intervals.

Figure 26-a shows a log suite from the Dart Austin 3-31, a Dundee production well. The Dundee is at the base of the Bell shale (apparent as the GR value drops below 50 and the CNL drops below about .10 or 10%). The GR response is used for formation correlation and in this case distinguishes the top of the Dundee nicely. The PEF log for this well shows the Dundee to be mostly dolomite (low GR response and PEF about 3) from the Bell Shale all the way to the bottom of the trace shown. The LLD trace indicates oil saturation (production zone) as resistivity responses greater than 100 ohm-m within the dolomitized Dundee. The resistivity (LLD) decreases rapidly at about a depth of 3797 feet; this

indicates a thin oil-water transition zone, which indicates little oil suspension in water and relatively high permeability. The thickness of this zone is due to capillary effects, primarily pore throat size (which is related to permeability), all other things being constant. The relationship between the transition zone thickness and pore throat thickness can be shown from the capillary equation

$\gamma_o - \gamma_w = rh(\rho_w - \rho_o)g/2 \cos\theta$ (Calhoun, 1982)

rearranged to form the equation:

$h = 2\cos\theta\,(\gamma_o - \gamma_w)/r(\rho_w - \rho_o)g$

h is height of water above the oil-water contact, θ is the meniscus angle from the perpendicular to the fluid surface, ρ is density, *r* is capillary radius, *g* is the gravitational force

This equation shows that an increase in capillary radius (assumed to be related to pore throat size and thus permeability) decreases the height of rise of water due to capillary forces; basically, the thinner the oil-water transition zone the higher the permeability (Schlumberger, 1989), all other parameters remaining constant. Dick Hinckley of Dart Oil & Gas indicates that the permeability in the producing zones is fairly homogeneous and therefore this relatively high permeability may be able to be extrapolated to the rest of the western portion of the field (see Figure 14 and Table 4 for the location of this well).

Figure 26-b shows a crossplot of the PEF with the LLD log within the Dundee. The PEF indicates dolomite and the oil-water transition is at about 100 ohm-m, with values above this number in the oil producing horizon and values below into approximately 100% water saturation. The colors of the data points are the same as the related lithologies in the previous figure.

Figure 27-a, BWAB Inc., Johnson 4-31, does not produce from the Dundee. Although the resistivity is above 100 ohm-m within the Dundee the PEF is about 5 (limestone) and the CNL porosity is flat at 0; oil in this rock would be hard to produce. This log suite shows a "tight" resistive Dundee limestone below the Bell Shale; Dundee dolomite doesn't occur above water saturation; indicating a lack of producible oil within the Dundee at this location. The PEF-LLD plot (Figure 27-b) of the Dundee of this well show the separation of the "tight" highly resistive limestone from the water saturated dolomite and dolomite\limestone zones. The string of points between a PEF value of 5 and a PEF value of around 3 may indicate the amount of dolomitiztion and/or the shaliness of the rock. There exists a linear relationship of degree of dolomitization (amount of limestone compared to dolomite) and the PEF response if only these two

minerals exist, therefore in this dual mineral system a PEF response of about 4 should indicate 50% dolomitie and 50% limestone. Shaliness would be indicated by GR response.

From the GR, PEF, and the LLD logs, the BWAB Inc., Marion 33-21-1, a salt water disposal well (Figure 28-a) shows water saturated dolomite just below the Bell Shale, indicating that the top of the Dundee itself is below the oil-water contact. Figure 28-b illustrates this also as the dolomite indicated by the PEF around 3 and nearly all LLD resistivity values less than 100 ohm-m. The combination of these two figures may indicate a small zone of oil (3758'-3760' depth) at the very top of the Dundee.

Dart Thayer 3-29 was originally drilled in the early 1940's to produce from the Dundee but was pulled off line probably due to low production or watering out. Dart Oil and Gas later redrilled the well to the Richfield to be used as an injection well. From Figures 29a & b the presence of oil is indicated by the favorable combination of the PEF and LLD logs (dolomite and high resistivity). This does indicate that oil had been by-passed, however, Dart Oil and Gas believes that they can produce the oil indicated at Thayer 3-29 from proximal producing wells (Thayer 1-29 & Thayer 6-29). The large resistivity spike at 3810' depth on Figure 29a has been suggested by Craig Tester of Terra Energy in Traverse City (personal communication) to be a tar mat created at a previous oil-water interface, however there is no proof of this and the interval may be an untapped vertically isolated oil saturated zone. This zone of the well should be further investigated.

Other wells with the same and similar log suites are displayed and described in Appendix E.

Dundee Formation Porosity

Corrected porosity values were calculated for all wells with available CNL and density well log data. The corrected porosity was determined using limestone based crossplots of CNL and density logs by KOBRA:XPLOT algorithm of the TerraStation based on Schlumberger cross plots. Figure 30 shows the contoured data for the average porosity in the top sixty feet of the Dundee. Most of the older wells in the Winterfield field (before 1945) drilled to produce from the Dundee do not have associated well log data, and therefore the corrected porosity values calculated and extrapolated for the Dundee interval are probably a very conservative estimate of actual porosity in the field. The average porosity of the Dundee production zone in the western part of the field is approximately 8.5% with a standard deviation of about 2% as determined from available geophysical well logs.

Dundee Formation Water Saturation

Water saturation values were calculated using the Terra Station software. Water saturation values were subtracted from 1 to get the oil saturation and these values plotted as a contour map (Figure 32). The water saturation is the fractional amount of the pore space filled with formation waters (low resistivity). Therefore, oil saturation (high resistivity) would be 1 minus the water saturation in a two component system. The water saturation was calculated using 1 for a (tortuosity correction term) and (2) for m (cementation factor) in calculation of the formation factor (F) in the form: $F = \frac{a}{\phi^m}$, which is the most common form of the Archie equation used when calculating F for limestones and dolomites (Doveton, 1986). The water saturation equation, $S_w = \frac{\sqrt[n]{FR_w}}{\sqrt{R_t}}$, is calculated using the above parameters to first determine F assuming $n = 2$ (the most commonly used number but n ranges from 1.8-2.5, Doveton,1986), and using LLD resistivity log for formation resistivity, R_t. Each well with resistivity logs also includes the temperature dependent water resistivity, R_w measured at a specific temperature and then extrapolated down the well according to the well temperature gradient. The average water saturation for the top 60' of the Dundee in the producing area was calculated to be 68% and therefore the calculated average oil saturation is 32%; however, the average oil saturation from the production zone of BWAB Bass 3-33 is approximately 65% as derived from a Pickett plot of the well and this value will be used later to determine original oil in place.

7 BY-PASSED OIL

Remaining Oil in Place

From maps and data generated from this project the original amount of oil in the Dundee on the western side of Winterfield field was calculated to be between 8.96 million barrels and 14.6 million barrels. Total production from the western side of the field is about 3.42 million barrels and still producing. This represents between 24% and 38% recovery of calculated total oil in place. According to Selley, 1985 primary recovery is usually between 10% and 30%; Winterfield field is either at or near its total primary production limits. The producing rock volume was determined by calculating the positive volume between production surface and an oil water contact of -2680 subsea elevation (from Dart Austin 3-31 geophysical well logs and personal communication with Dick Hinckley, Dart Oil & Gas) using Simpson's rule and the Trapezoidal rule within Surfer. The average oil saturation from BWAB Bass and the average porosity from the dolomite oil zones of Dart Austin 3-31, BWAB Bass 3-33 and Dart Thayer 3-29 was used to determine original oil in place of the Dundee Formation, Winterfield field. Original oil in place (stock tank barrels) = Rock volume * porosity * oil saturation * expansion factor (reservoir barrels to stock tank barrels).

The M.M. Riker, the Phares and Wyman leases had good early production but didn't have the longevity of the neighboring wells of Fred Schuett, Delmer Thayer and George Swindlehurst. This may be due to several of reasons: the wells plugged up due to influx of fines, the production of the nearby Thayer lease drained oil preferentially from these areas, the producing structure was small and isolated. The eastern half of the western part of the Winterfield field seems the most likely area of the field to have bypassed/remaining oil resulting from poor production or completion practices, but again according to the amount of production compared to the calculated original oil in place, only a small fraction of oil is left in these produced areas, if any at all.

The eastern part of the field is structurally lower than the western part, was controlled primarily by one production company and production appears to match relatively well with producing structure and initial production and therefore probably not a good target for by-passed oil.

If a horizontal test well needed to be drilled, the best location from the data presented would be near location 5, on Figure 14 and drilled southeastward due to the production inconsistencies in this area.

8 CONCLUSIONS

Overall the Dundee in the Winterfield field appears to be an efficient producer; with its light oil, strong water drive and relatively high permeability, it is not likely that much by-passed oil remains. However, untapped oil structures similar to those shown in Figure 32 most likely exist and are a large potential source for increasing the reserves in a field. Figure 33 shows the cumulative production of the Winterfield field; the first part of the curve represents oil discovered in the Dundee in the early 1940's, and the second section of the curve indicates inadvertent production discovered in the early to mid 1980's while drilling to produce the deeper Richfield horizon. This extra new production could produce perhaps 30% more oil over the history of the field.

Significant amounts of by-passed oil probably do not occur in the Dundee Formation within the Winterfield field. However due to the heterogeneity of the reservoir, undiscovered, isolated pockets of producible oil probably exist (e.g., Dart Austin 3-31).

Porous Dundee dolomite above the oil-water contact and capped by either the Bell Shale or tight Dundee limestone is the producing lithology within the Dundee.

The producing zones can be discriminated quite readily from a suite of geophysical logs containing GR, PEF, and LLD logs; these logs can be further enhanced with the addition of the CNL and density logs to determine corrected porosity values in the producing interval.

The data used for research in this paper is not sufficient to determine accurately the amounts of by-passed oil in the Winterfield field. In this particular field it would be of great benefit to have more oil-water contact levels (PEF-LLD logs), well by well production data, pressure data, and the gas oil ratio within the producing area of the Dundee in order to more accurately calculate remaining oil volumes.

Potential areas for further exploration can be delineated by looking for leases that appear to be underachievers relative to structural position, initial production tests and relative production when compared to surrounding and similar wells. Well by well company production data may be of more use for determining areas of potential by-passed oil than the data used, because production assessments could be done at a higher resolution; the State of Michigan's production data is sparse after 1972. Data, such as geophysical well logs, which would be useful for this determination are scarce within the boundaries of the production zones of the original producing Dundee, other than current production.

Dart Oil and Gas drilled 3 wells, the Dart Austin 3-31, Dart Benchley 5-31 and the Dart Mosher 5-30 in the mid 1980's with the Richfield as the target zone and inadvertently discovered oil in the Dundee (Dick Hinckley, personal communication) in a structure on the western side of the western part of the field. The discovery shows that oil pockets still existed in the field. While not by-passed oil, this oil contributes to potential reserves. Pressure data from individual leases within the field would determine whether the reservoir is one system or compartmentalized. Development of geophysical techniques of sufficient resolution to remotely detect the type of producing structure noted in this thesis may greatly increase the known reserves within this class of fields.

Dart Oil and Gas has given thought to drilling a horizontal well in the Winterfield field but have reservations because the end result may just to produce the known reserves faster, rather than producing significantly more new oil over time (Dick Hinckley, personal communication). They believe that the wells in place could have the potential to drain the remaining known reserves in the field (see remaining oil in place).

Seismic data was not acquired or within the scope of this paper, but should certainly be addressed by subsequent studies.

9 REFERENCES

Addison, C.A., 1940, Buckeye Oil Field, Gladwin County, Michigan: American Association of Petroleum Geologists, p. 1950-1982.

Bassett, C.F., 1935, Stratigraphy and paleontology of the Dundee Limestone of southeastern Michigan: Geol. Society of America Bull, v. 46, p. 425-461.

Calhoun, John C. Jr., 1982, Fundamentals of Reservoir Engineering, An Oil and Gas Journal Book, University of Oklahoma Press.

Catacosinos, Paul A., 1973, Cambrian Lithostratigraphy of Michigan Basin: AAPG Bulletin, vol. 57, no. 12, pp. 2404-2418.

Catacosinos, Paul A., 1981, Origin and Stratigraphic Assessment of Pre-Mount Simon Clastics (Precambrian) of Michigan Basin: AAPG Bulletin, vol. 65,no. 9, pp. 1617-1620.

Catacosinos, P.A., Daniels, P.A., Harrison, W.B.,III, 1991, Structure, Stratigraphy and Petroleum Geology of the Michigan Basin. Amer. Assoc. Petrol. Geol. Petroleum Basins Series: Interior Cratonic Basins , Chapter 30, p.561-601.

Cercone, K.R., 1984, Thermal history of Michigan basin: A.A.P.G., v.68, p.130-36.

Cohee, G.V., 1944, Thickness and character of Traverse Group and Dundee Formation in southwest Michigan: United States Geological Survey, Oil and Gas Preliminary Chart 4.

Davies, Raymond, Foote, F., Anderson, J., Mikhail, E., Surveying: Theory and Practice, Sixth Edition, Chapter 14 (p.564-613).

DeWitt, W.,Jr., 1960, Geology of the Michigan basin with reference to subsurface disposal of radioactive wastes; U.S. Geological Survey, Trace Elements Investigations Report 771.

Dorr, John A. Jr., and Eschmann, Donald F., Geology of Michigan: Ann Arbor, the University of Michigan Press, 476 pp.

Doveton, John, H., 1986, Log Analysis of Subsurface Geology, Concepts and Computer Methods. John Wiley and Sons, New York, 273 p.

Droste, J.B. and Shaver, R.H., 1977, Synchronization of Deposition: Silurian Reef-Bearing Rocks on Wabash Platform with Cyclic Evaporites of Michigan Basin: In Fisher, J.H., ed., Reefs and Evaporites-Concepts and Depositional Models: A.A.P.G. Studies in Geology, No. 5, p. 93-109.

Ehlers, G. M., and Kesling, R. V., 1970. Devonian strata of Alpena and Presque Isle Counties, Michigan: Field Excursions Guidebook, Michigan Basin Geological Society and Geological Society of America, North- Central Section, pp. 1-177.

Ells, G.D.; Howell, S.H.; Landes, K.K.; Lindburg, G.D.; Matthews, R.D.; Shea, J.C.; and Briggs, L.I., 1964, Report on the Geologic Potential of Atomic Waste Disposal in the Michigan Basin: Michigan Department of Natural Resources-Geological Survey, In House Report, 61 pp.

Ells, G.D., 1969, Architecture of the Michigan Basin, in Studies of the Precambrian, Michigan Basin Geological Society Annual Field Excursion: Michigan Basin Geological Society, p. 60-88.

Ells, G. D., 1979. Stratigraphic cross sections extending from Devonian Antrim Shale to Mississippian Sunbury Shale in the Michigan Basin. Michigan Geological Survey, Report of Investigation 22.

Fisher, J. H., 1980. Stratigraphy of the Upper Devonian-Lower Mississippian of Michigan. U.S. DOE Topical Report FE-2346-80, 21 p.

Fisher, J.H., 1969, Early Paleozoic history of the Michigan Basin, in Michigan Basin Geological Society Annual Field Excursion: Michigan Basin Geological Society, p. 89-93.

Fisher, J. H., and Barratt, M. W., Droste, J.B. and Shaver, R.H., 1988, Michigan basin: in Sloss, Larry, (ed.) Sedimentary cover- North American Craton, U.S, Geol. Soc. Amer., DNAG volume D-2.

Fowler, J.H., and Kuenzi, W.D., 1978, Keweenawan Turbidites in Michigan (Deep Borehole Red Beds): A Foundered Basin Sequence Developed During Evolution of a Protoceanic Rift System, Jour. Geophys. Research, v. 83, no. B12, p.5833-5843.

Gardner, W.C., 1974, Middle Devonian Stratigraphy and Depositional Environments in the Michigan Basin, Michigan Basin Geological Society, Special Papers no.1, 138p.

Gill, D., 1979, Differential Entrapment of Oil and Gas in Niagaran Pinnacle-Reef Belt in Northern Michigan: A.A.P.G. Bull., v. 63, no. 4, p. 608-620.

Gutschick, R.C. and Sandberg, C.A., 1991, Late Devonian History of Michigan Basin, Geological Society of America, Special Paper 256, p.181-202.

Harrison, W.B. III, 1987, Michigan's "deep" St. Peter gas play continues to expand, World Oil Magazine, April, 1987, p. 56-61

Hinze, William J., Kellogg, Richard L., and O'Hara, Norbert W., 1975, Geophysical Studies of Basement Geology of Southern Peninsula of Michigan: AAPG Bulletin, vol. 59, no. 9, pp. 1562-1584.

Howell, P.D., and van der Pluijm, B.A., 1990, Early History of the Michigan Basin: Subsidence and Appalachian Tectonics, Geology, v. 18, p. 1195-1198.

Kesling, R. V., Segall, R. T., and Sorensen, H. O., 1974. Devonian strata of Emmet and Charlevoix Counties, Michigan. Papers on Paleontology: No. 7.

Lillienthal, R.T., 1978, Stratigraphic Cross-sections of the Michigan basin: Michigan Geol. Survey Rept. Inv. 19, 36 p.

McGuire, D. R., and S. J. P. Oliver, 1988. Devonian Shale Gas Production in the Michigan Basin. Gas Research Institute Bulletin, v. 5, no. 2 and 3. p. 28-40.

Montgomery, Eric, 1986, Facies development and porosity relationships in the Dundee Limestone of Gladwin County, Michigan. Master's Thesis, Western Michigan University, 89 p.

Newcombe, R. B., 1933. Oil and gas fields of Michigan. Publication 38, Michigan Geological Survey, Geol. Series 32.

Nunn, J.A., Sleep, N.H., and Moore, W.E., 1984, Thermal Subsidence and Generation of Hydrocarbons in the Michigan Basin, AAPG Bulletin, v. 68, no. 3, p. 296-315.

Prouty, C.E., 1983, Tectonic development of the Michigan Basin infrastuctures, in Tectonics, Structure, and Karst in Northern Lower Michigan, Richard Kimmel, ed.: Michigan Basin Geological Society 1983 Field Conference, p. 36-81.

Sanford, B.V., 1967, Devonian of Ontario and Michigan in The Alberta Society of Petroleum Geolgists International Symposium on the Devonian System, Calgary, 1967, Volume I, D.H. Oswald, editor

Schlumberger Educational Services, 1989, Schlmberger Log Interpretation Principles/Applications

Schlumberger Educational Services, 1991, Schlumberger Log Interpretation Charts

Selley, Richard C., 1985, Elements of Petroleum Geology. W.H. Freeman and Company, New York, 449 p.

Sleep, N.H., and Sloss, L.L., 1978, A Deep Borehole in the Michigan Basin, Jour. Geophys. Research, v. 83, no. B12, p. 5815-5819.

Smith, R.A., 1912, The Occurrence of oil and gas in Michigan, Publication 14, Geological Series 11, Michigan Geological and Biological Survey, 281p.

Stonehouse, H.B., 1969, Studies of the Precambrian of the Michigan Basin, Michigan Basin Geological Society Annual Field Excursion for 1969, Field Trip Guidebook, 95p.

Tarbell, E., 1941. Antrim-Ellsworth-Coldwater shale formations in Michigan. AAPG vol. 25, n. 4, pp. 724-733.

FIGURES

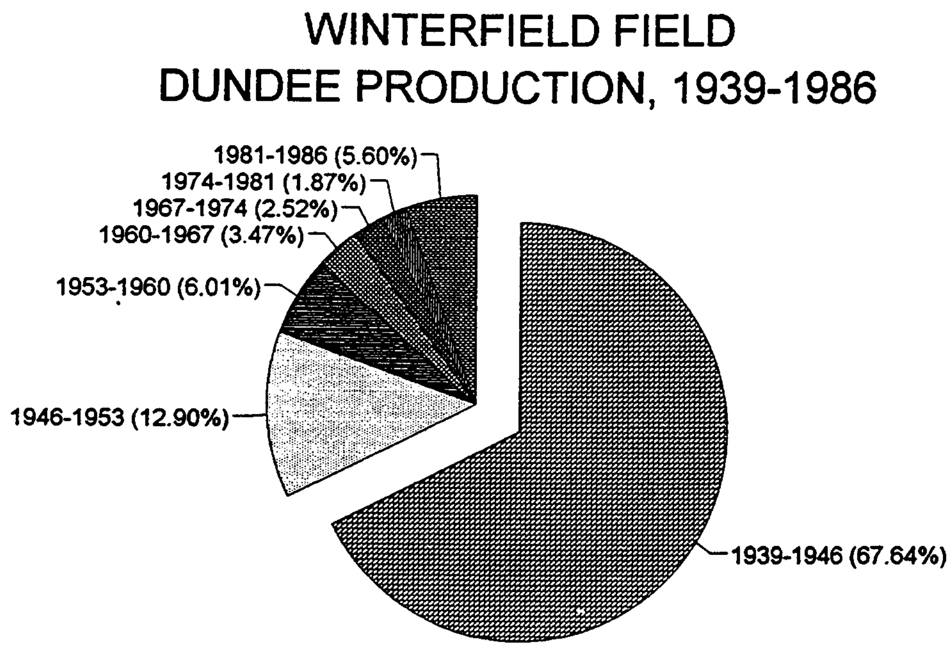


FIGURE 1 This chart shows that the majority of production in the Winterfield Field occurred before 1946.

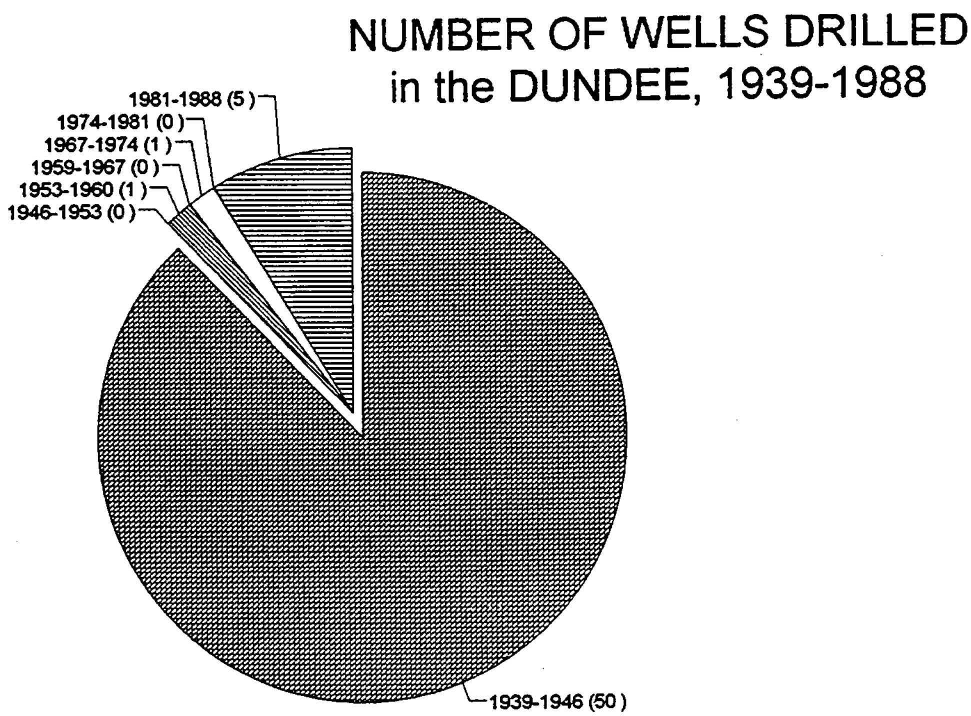


FIGURE 2 Chart showing dominance of drilling activity between 1939 and 1946.

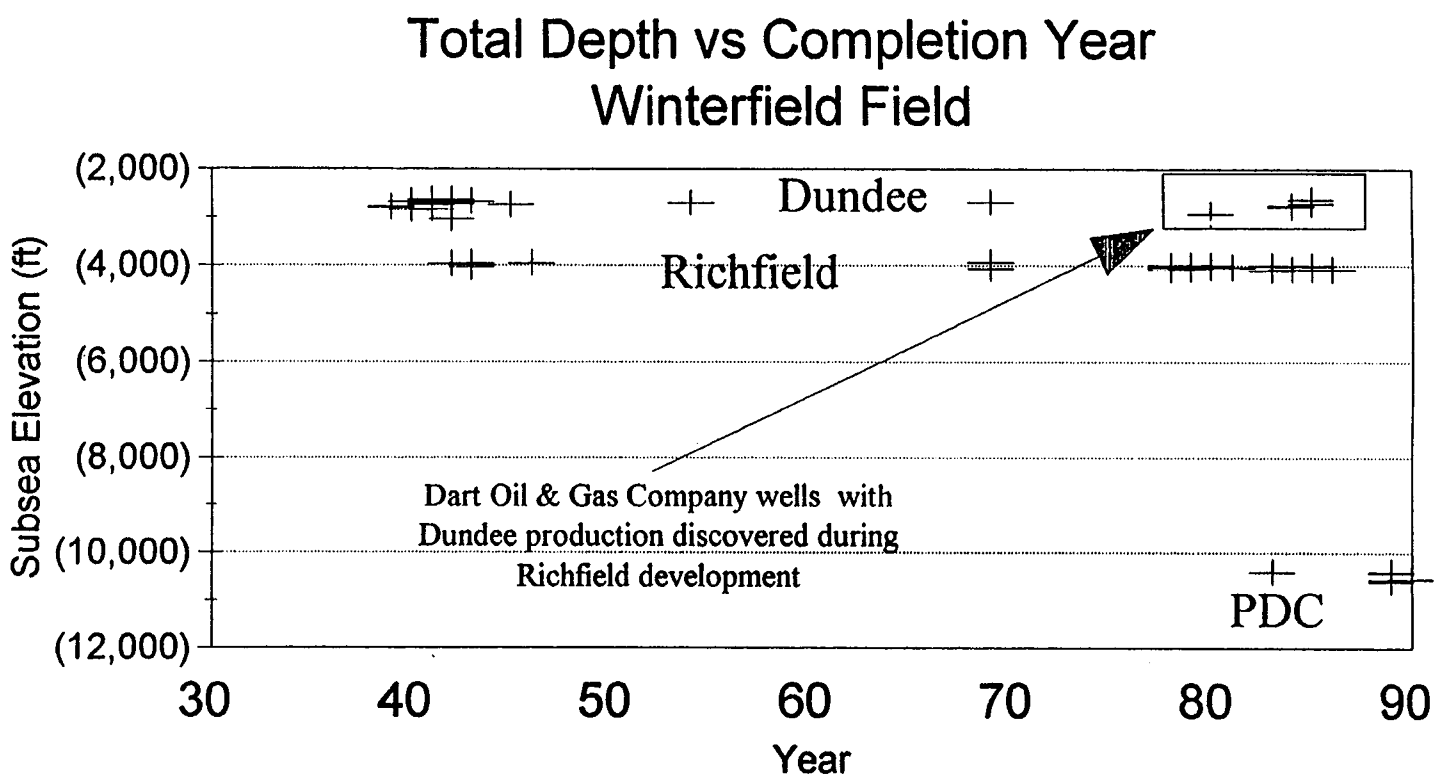


FIGURE 3 Note clustering of drilling activity.

DUNDEE FORMATION OIL FIELDS

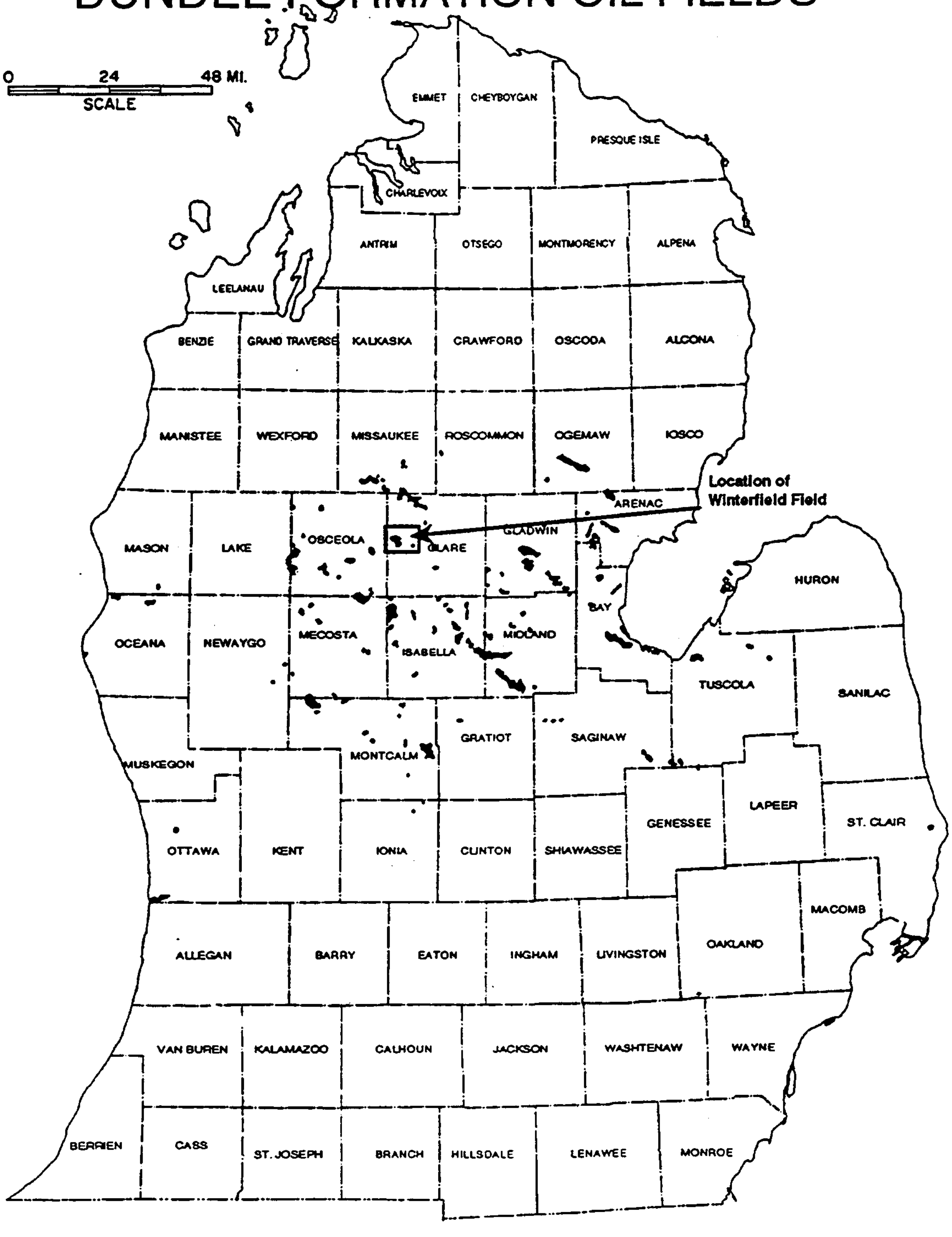
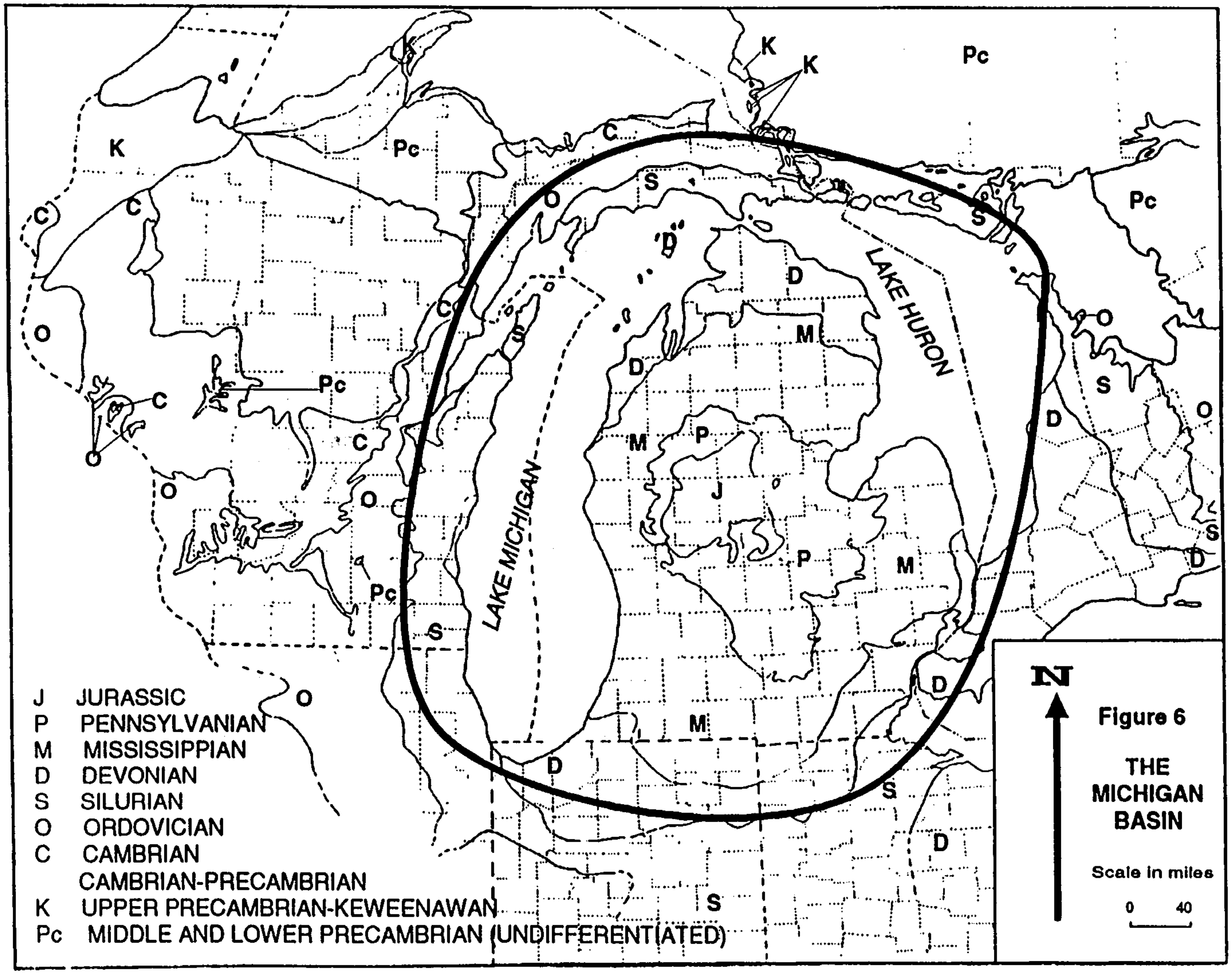


Figure 4 Map of Dundee oil fields in Michigan, note NW-SE lineations of fields. (adapted from Gardner, 1974)

Dart Benchley 1-29

Time*	Period	Group	Unit Name	Depth
135	Quaternary		Glacial Drift	
280	Jurassic		Kimmeridgian	560
	Mississippian/ Pennsylvanian		Saginaw/Bayport/ Michigan	
			Stray Sand & Marshall SS.	1319
			Coldwater Shale	1560
			Sunbury/Berea-Bedford shale	2400
345	Upper Devonian		Antrim Shale	2459
			"Traverse Formation" (undifferentiated)	3050
	Middle Devonian	Traverse	Traverse Limestone	3127
			Bell Shale	3722
			Dundee Formation	3779
		Detroit River		4057
			Richfield Member of the Lucas Formation	4902
			Amherstburg	

Figure 5 Stratigraphic Column in the Winterfield field.
*million of years before present.



From inside the cover of The Michigan Basin Geological Society Annual Field Excursion, Studies of the Precambrian of the Michigan Basin, 1969

BOUGUER ANOMALY MAP OF THE MICHIGAN BASIN

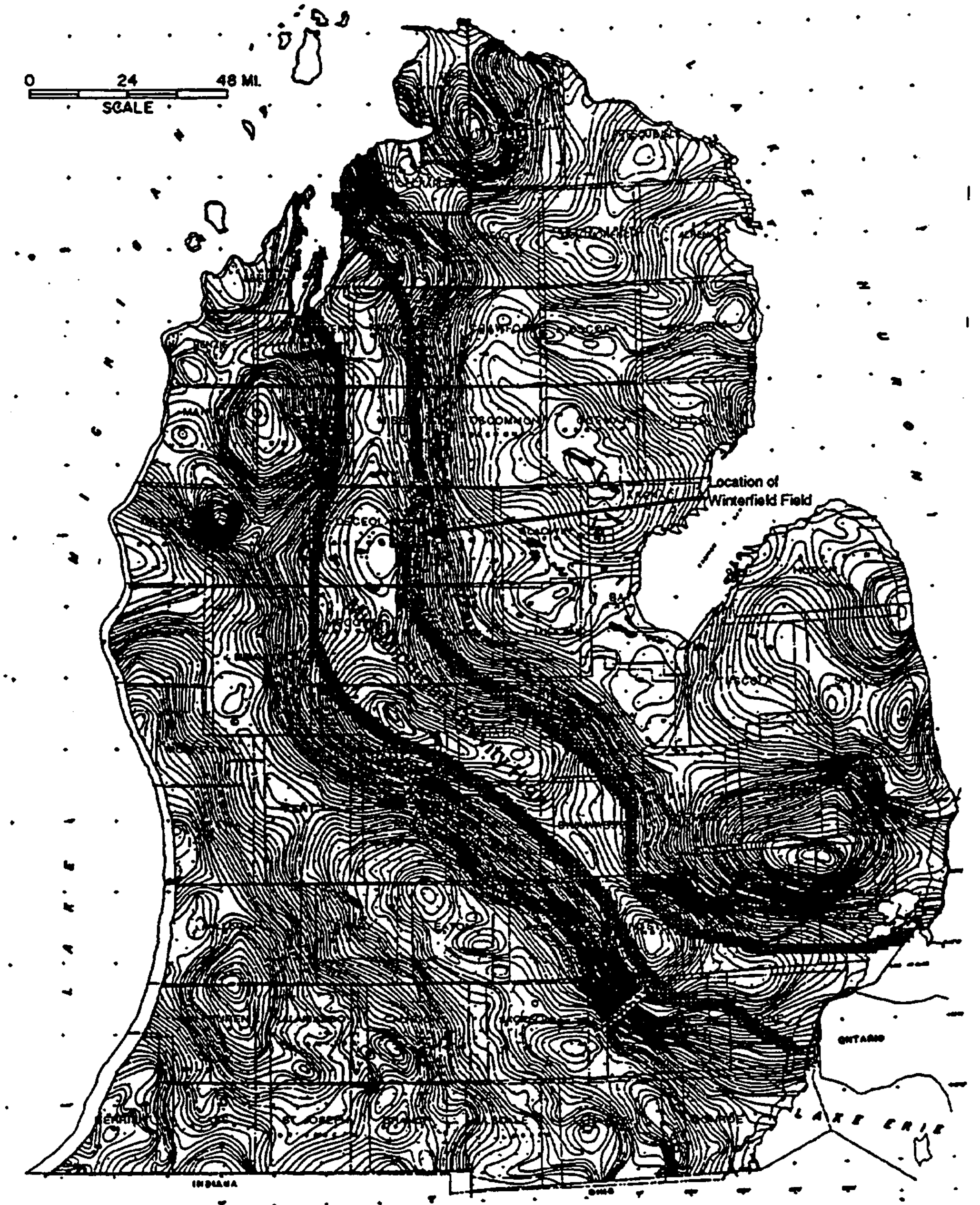


Figure 7 Bouguer Anomaly Map outlining the Mid-Michigan Gravity High with overlay of Dundee oil fields. (after Hinze and others, 1975, and Gardner, 1974)

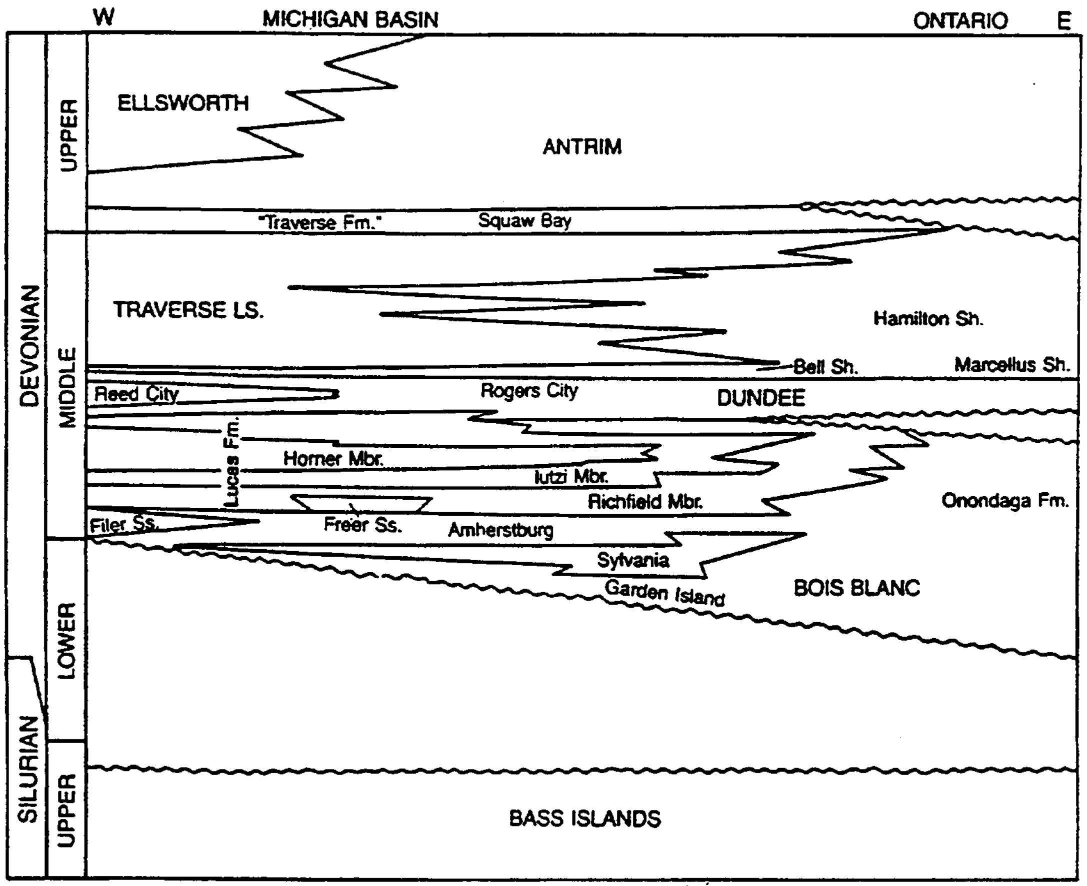


Figure 8. Time-length distance diagram from west-central Michigan to Pennsylvania (slightly modified by Catacosinos, Daniels, and Harrison, 1991 after Gardner, 1974)

DUNDEE FORMATION ISOPACH CONTOUR MAP

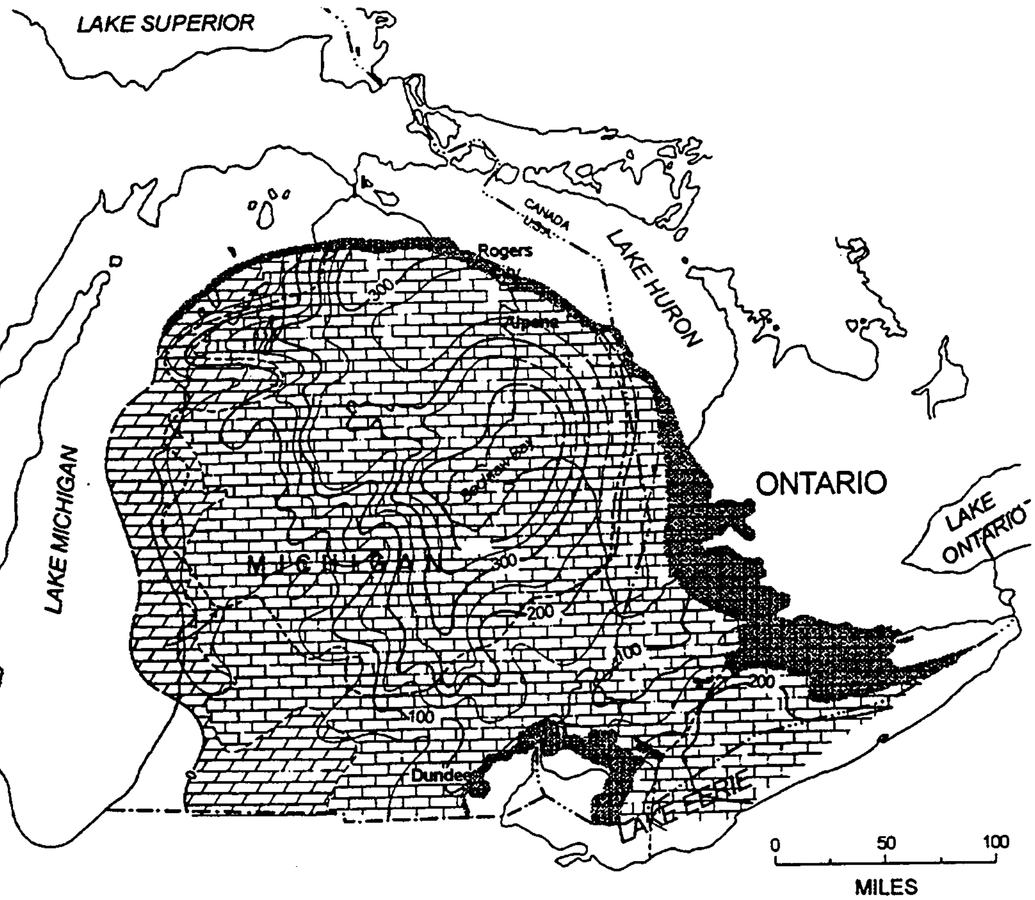


Figure 9 Isopach map of the Dundee within the Michigan Basin; shaded area is outcrop or drift covered outcrop. (from Sanford, 1967 after Cohee and Underwood, 1945)

DUNDEE FORMATION
STRUCTURAL CONTOUR MAP

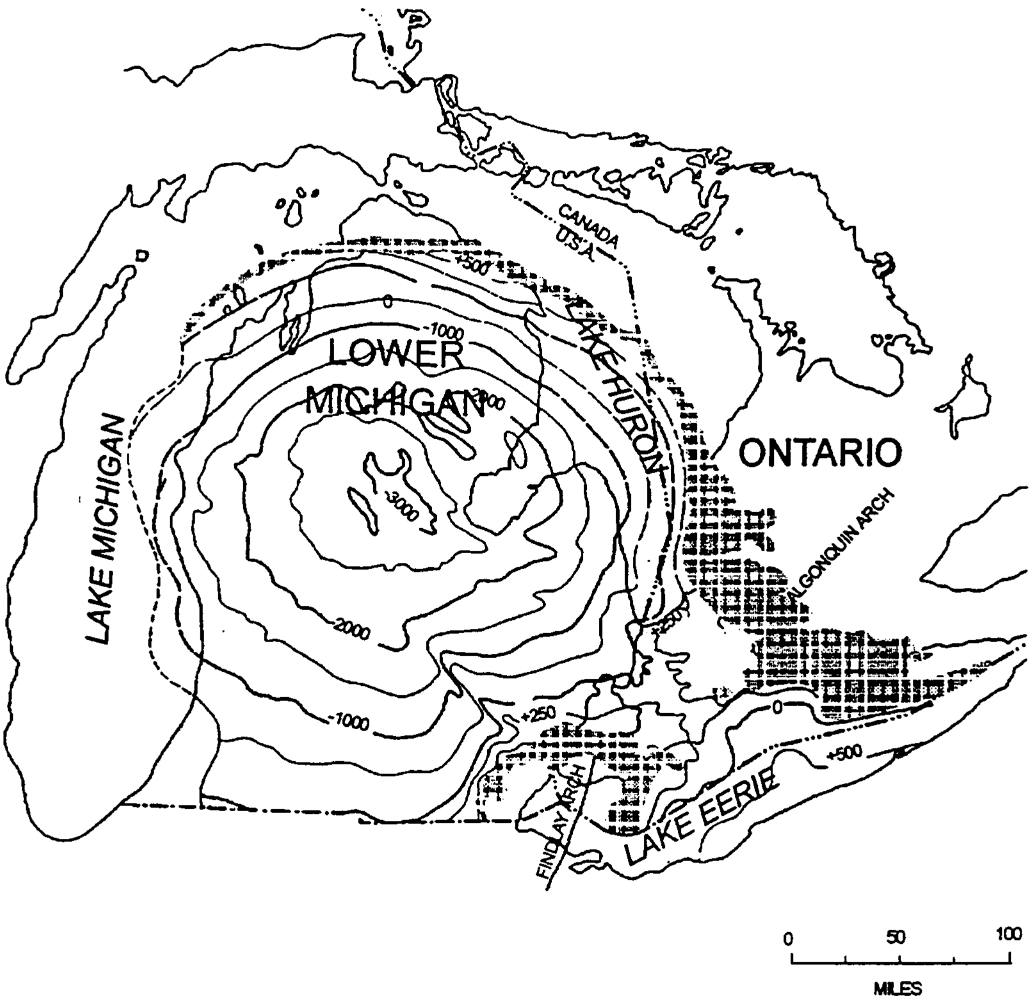
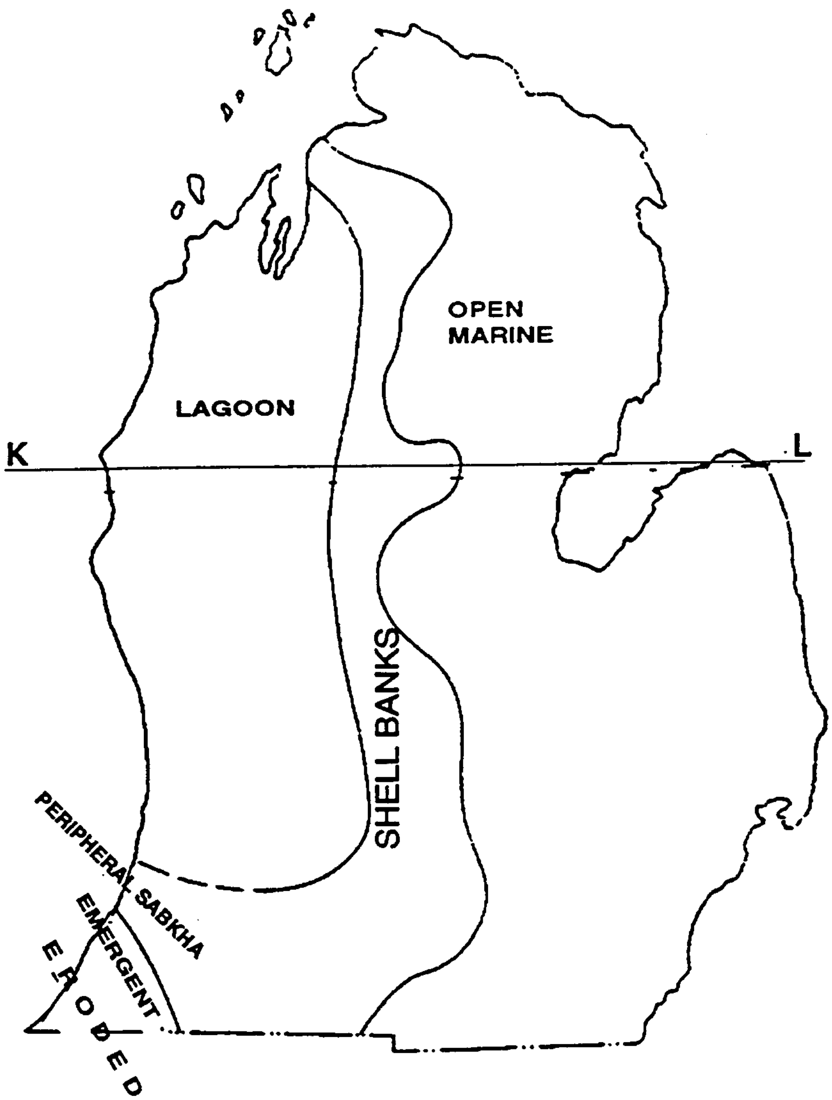
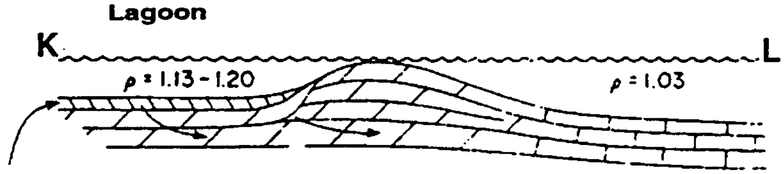


Figure 10 Dundee Formation in the Michigan Basin ; shaded area is outcrop or drift covered (from Sanford, 1967 after Cohee and Underwood 1945).

DUNDEE FORMATION



DUNDEE REGRESSIVE



LAMINATED $CaSO_4$ PRECIPITATE. DOLOMITIZATION BY SEEPAGE REFLUXION THROUGH POROUS, TRANSGRESSIVE, BIOSTROMAL DEPOSITS

BIOCALCARENITES & CALCISILTITES DECREASING GRAIN SIZE AND INCREASING DARK COLOR SEAWARD

Figure 11 Dundee depositional setting showing lagoonal and open water areas (Gardner, 1974).

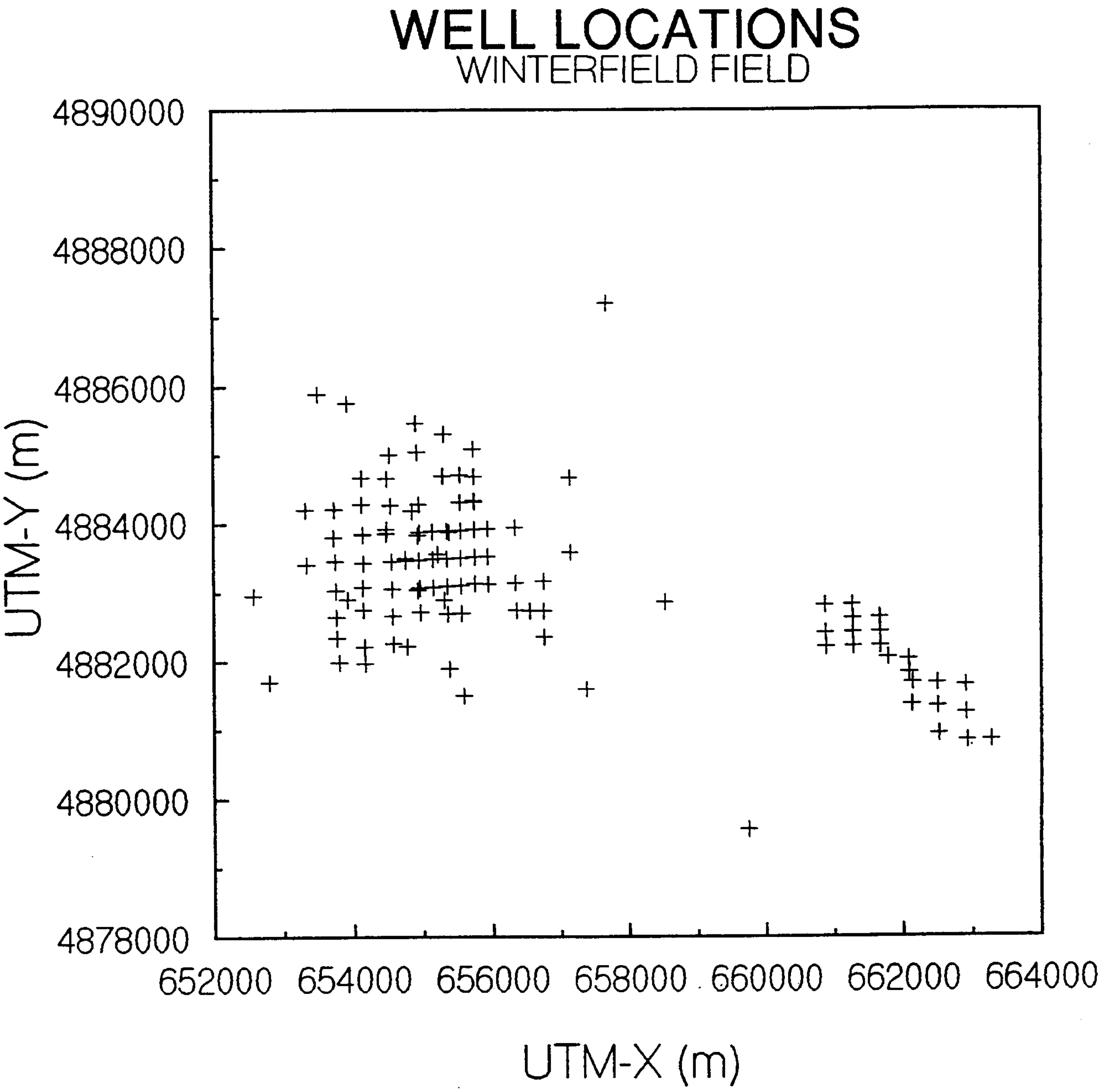


Figure 12 Well Locations, wells in the Winterfield Field that penetrate the Dundee Formation or deeper.

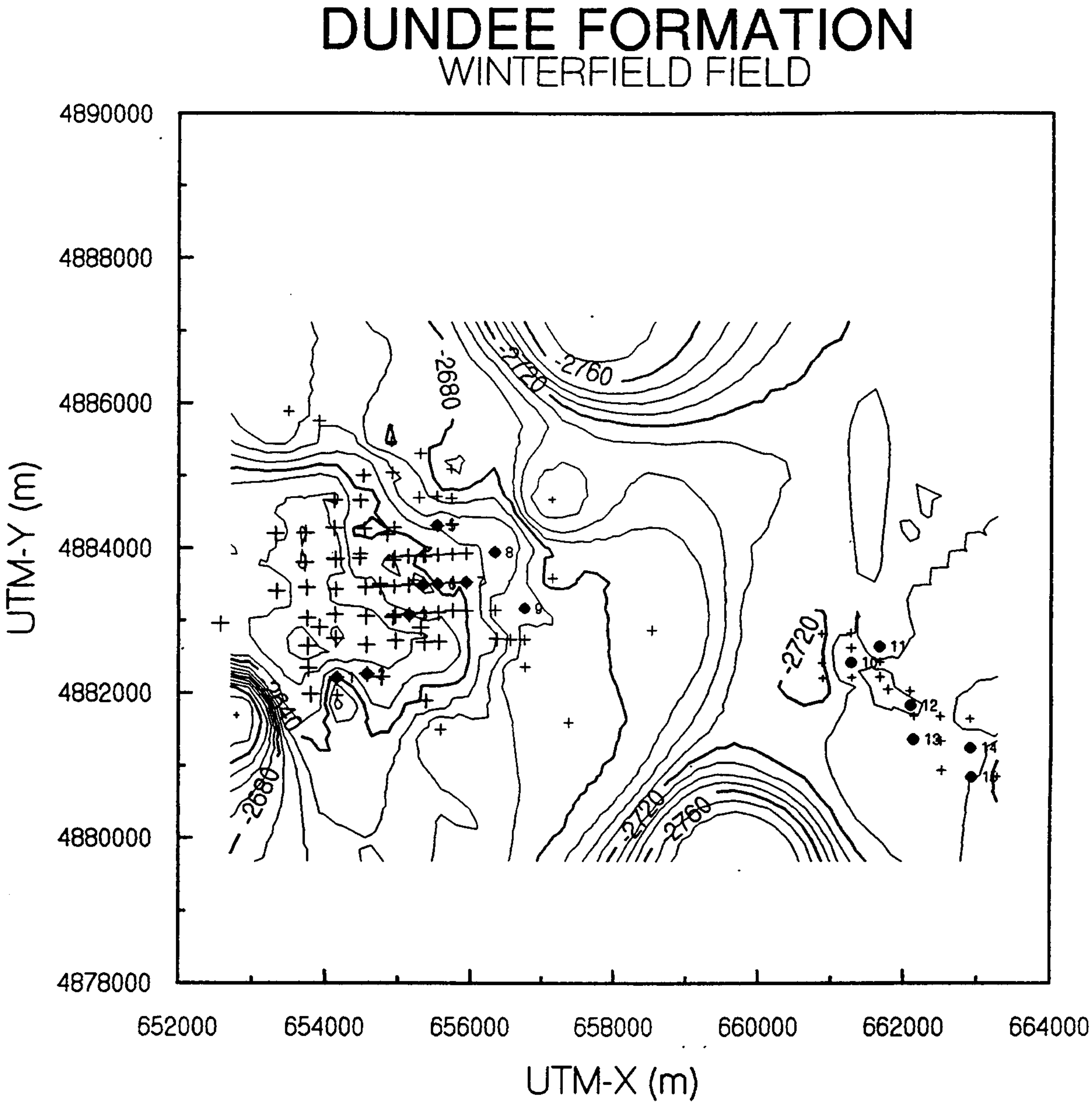


Figure 13 Dundee Structure Contour Map.

+'s are well locations, black dots with numbers are lease locations.

Contour Interval = 10'

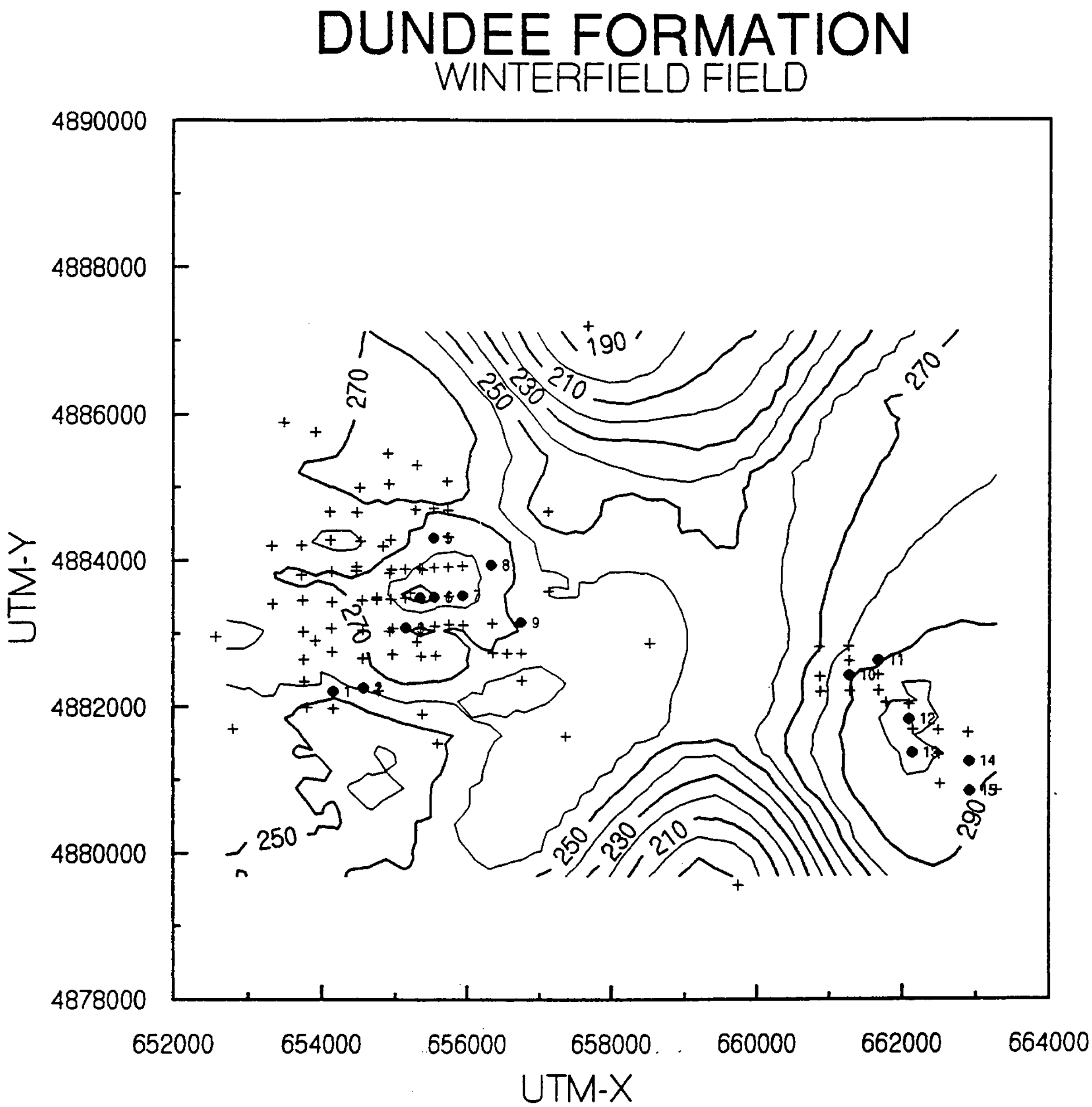


Figure 14 Contoured Isopach Map of the Dundee Formation created by subtracting the Detroit River Group surface from the Dundee Formation surface. Dundee producing leases are numbered (see Table 5 for names and production volumes). Contour Interval = 10'

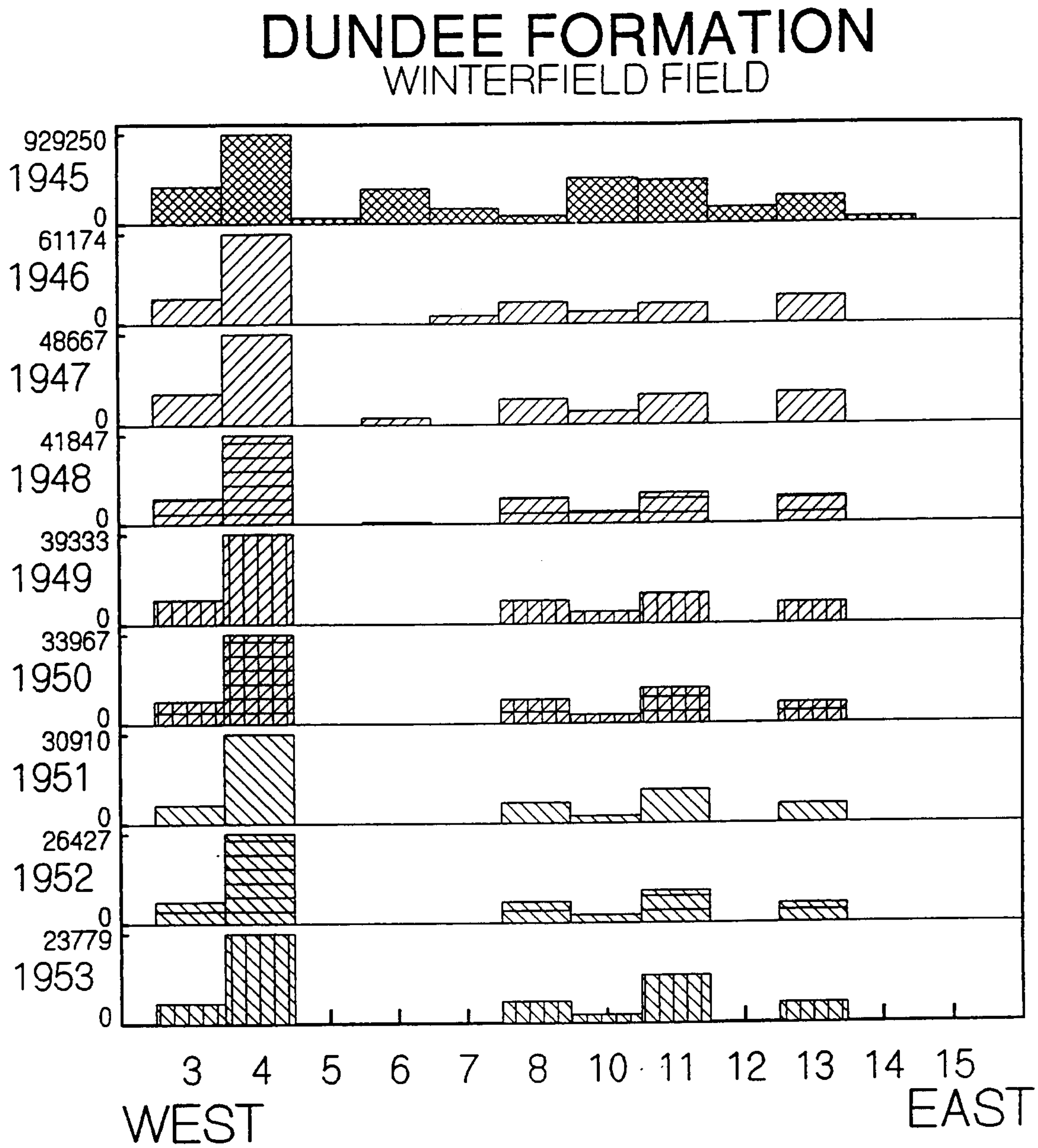


Figure 15(a) Yearly production data, 1945 includes all production data prior to 1945. X axis numbers are well leases presented in Table 4.

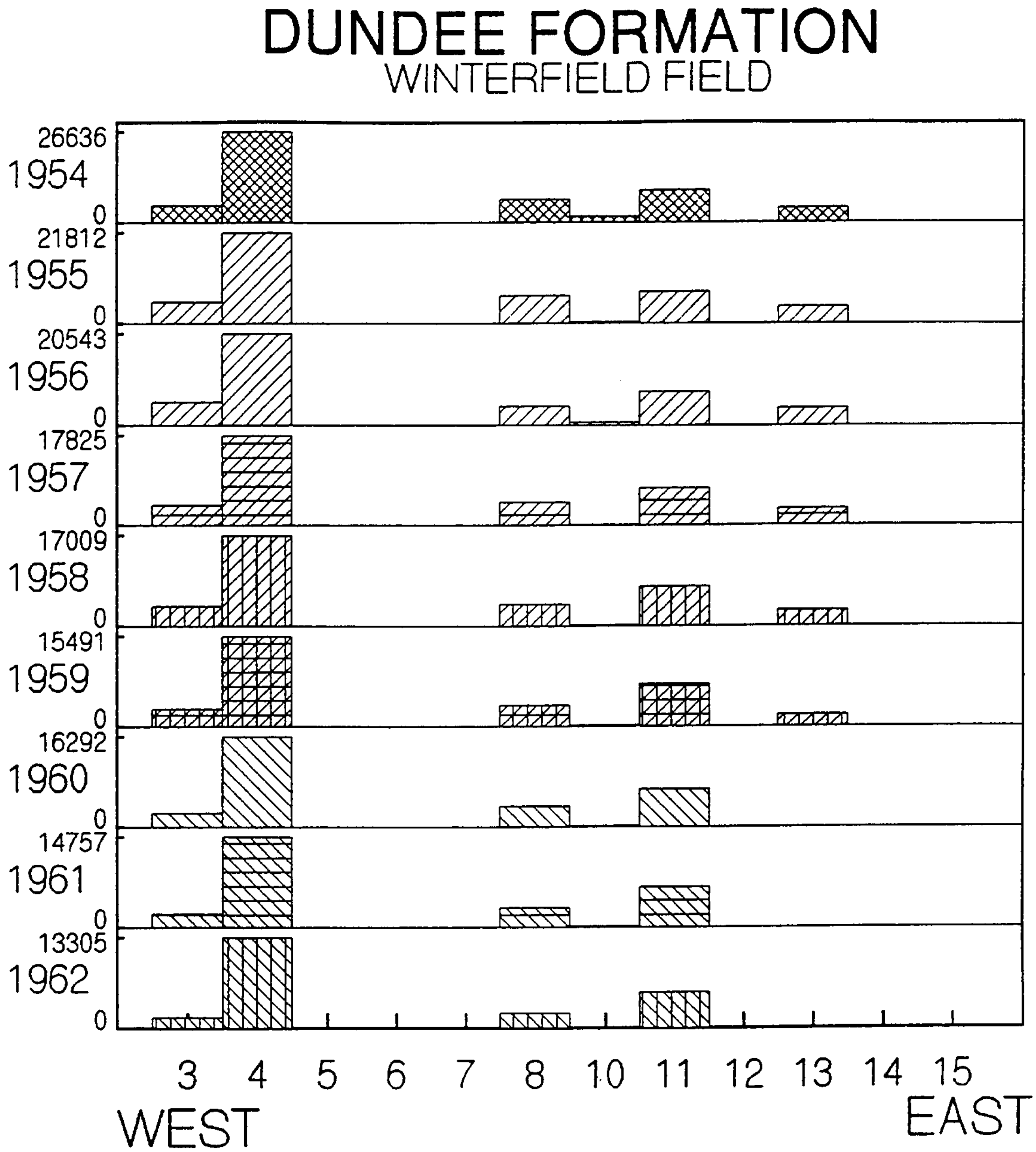


Figure 15(b) Yearly production data, 1954-1962.
X axis numbers are well leases presented in Table 4.

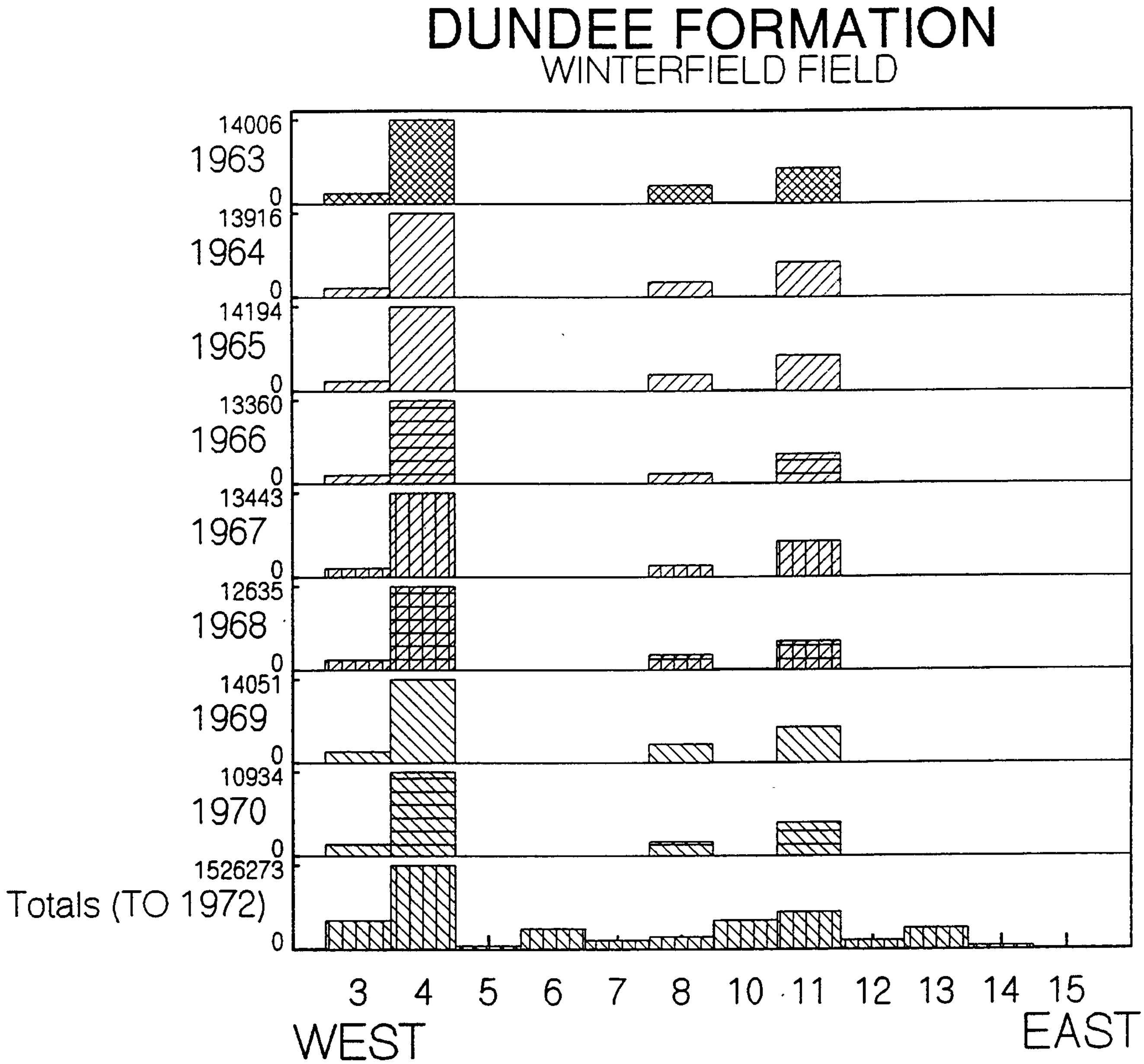


Figure 15(C) Yearly production data.
X axis numers are well leases presented in Table 4.

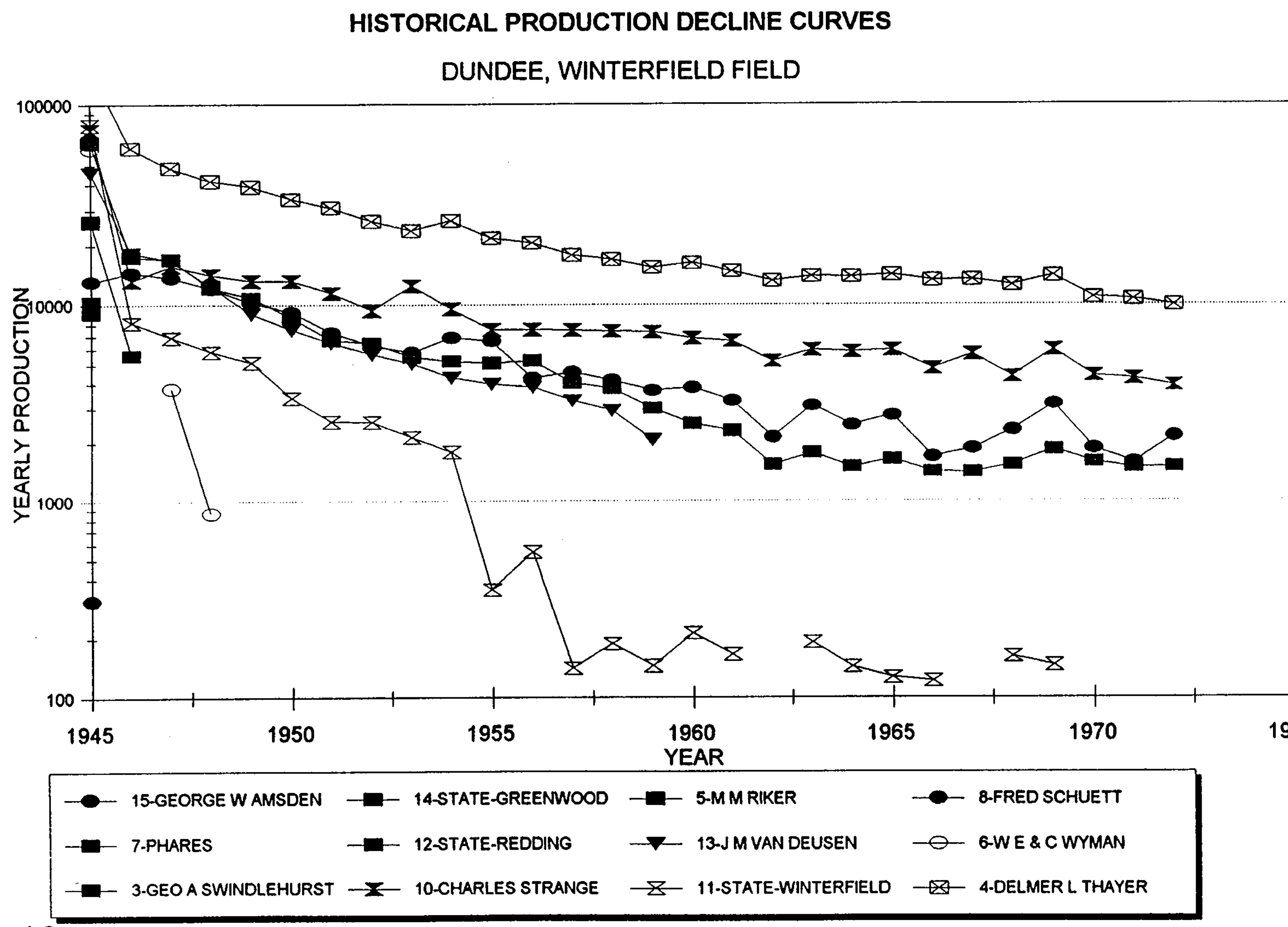

HISTORICAL PRODUCTION DECLINE CURVES
DUNDEE, WINTERFIELD FIELD
YEARLY PRODUCTION
100000
10000
1000
100
1945
1950
1955
1960
1965
1970
1975
YEAR
15-GEORGE W AMSDEN
14-STATE-GREENWOOD
5-M M RIKER
8-FRED SCHUETT
7-PHARES
12-STATE-REDDING
13-J M VAN DEUSEN
6-W E & C WYMAN
3-GEO A SWINDLEHURST
10-CHARLES STRANGE
11-STATE-WINTERFIELD
4-DELMER L THAYER

Figure 16

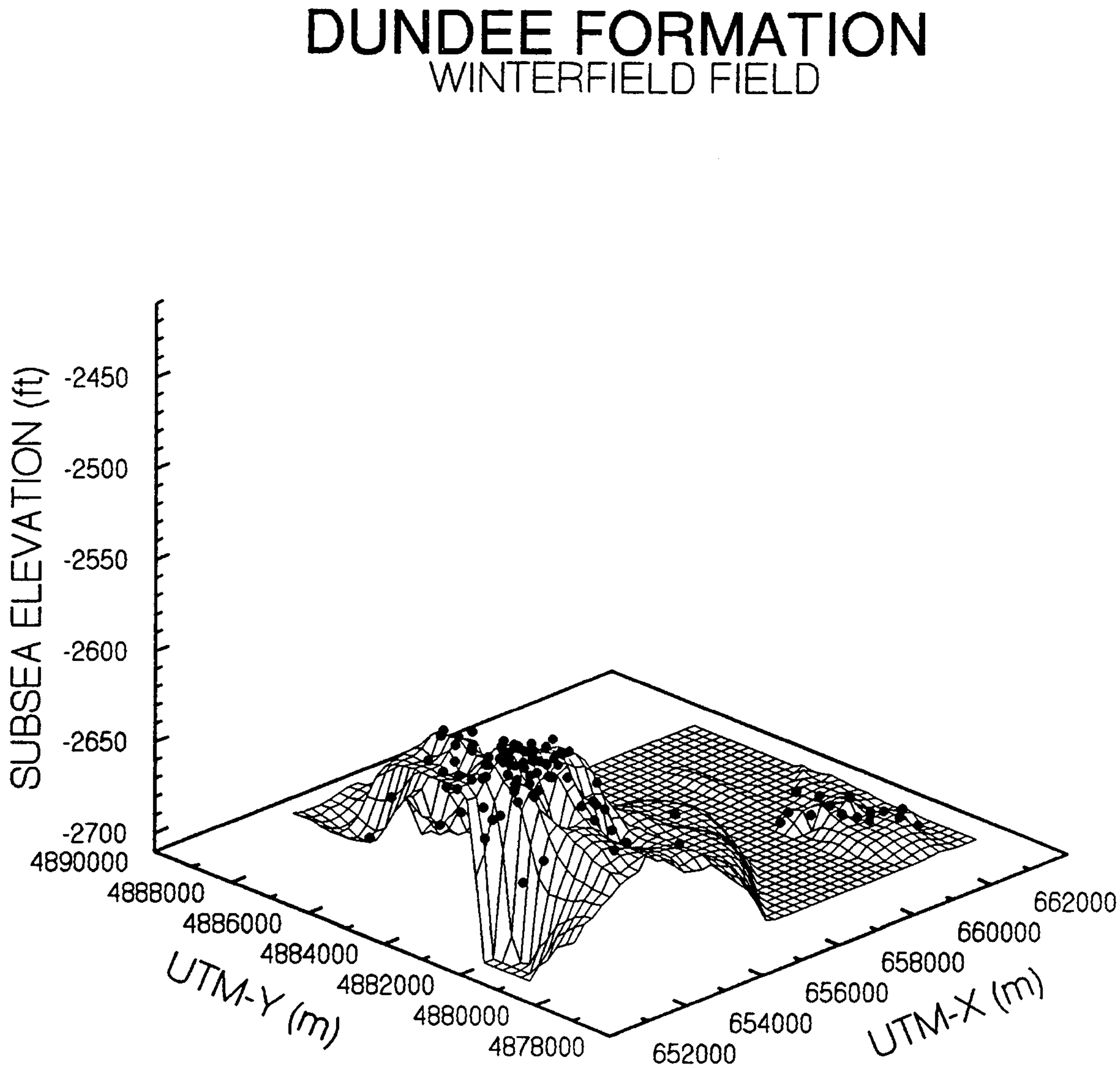


Figure 17 Dundee Structure Surface Map.
x-y plane is the approximate water level for the eastern side of the field.

Black dots indicate well locations.

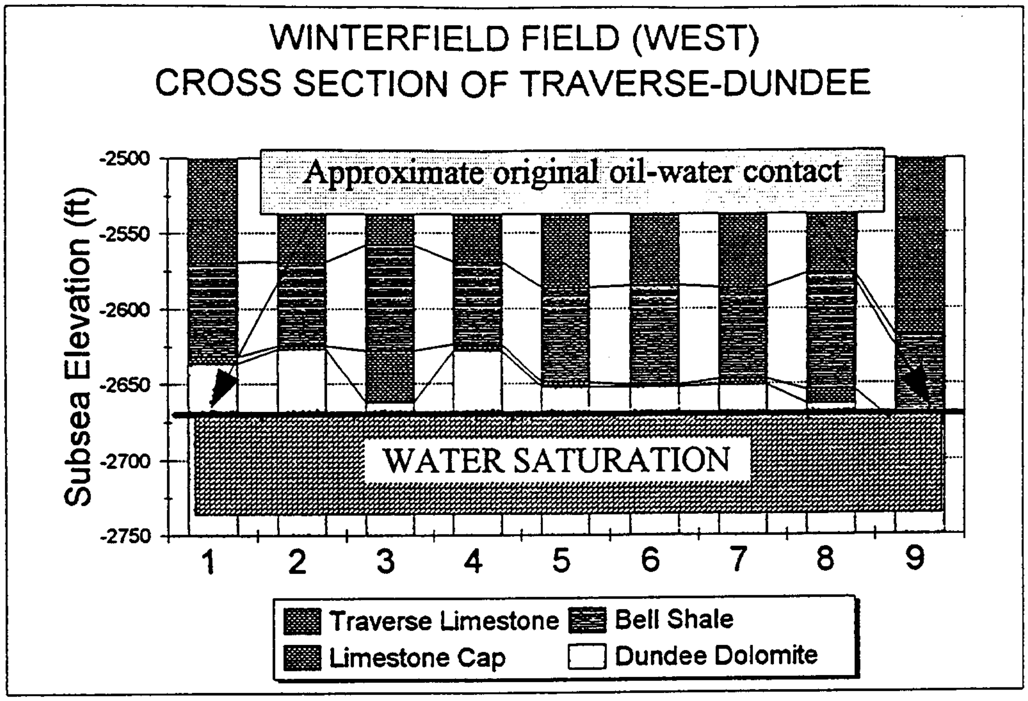


Figure 18 Equidistant east-west structure cross section, Winterfield field

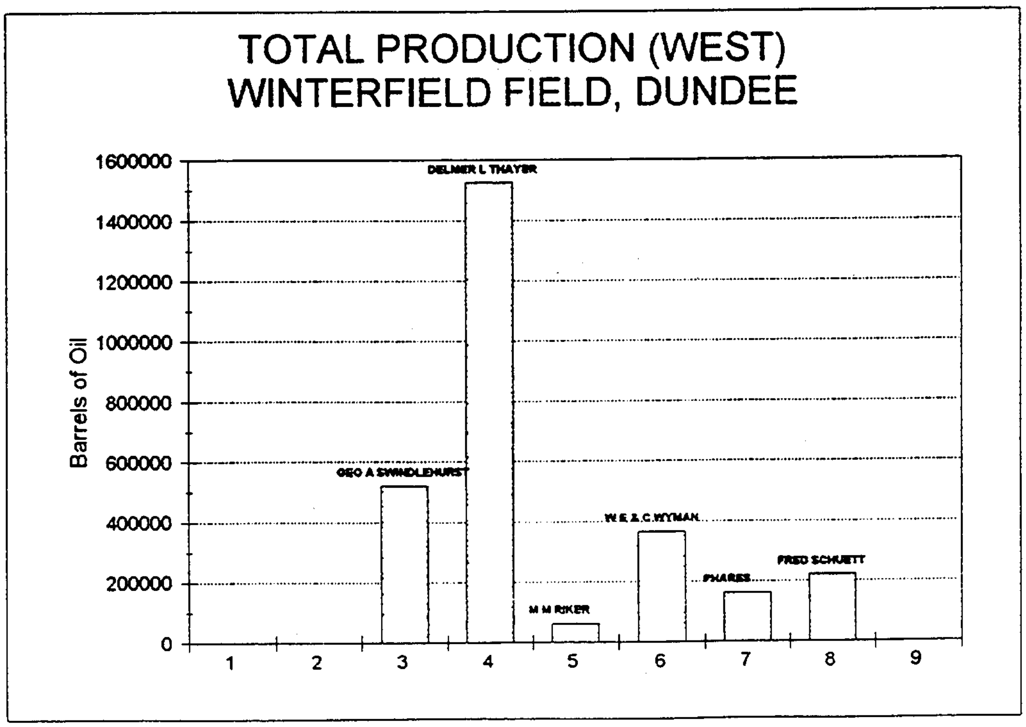


Figure 19 Equidistant production cross section of the Dundee.

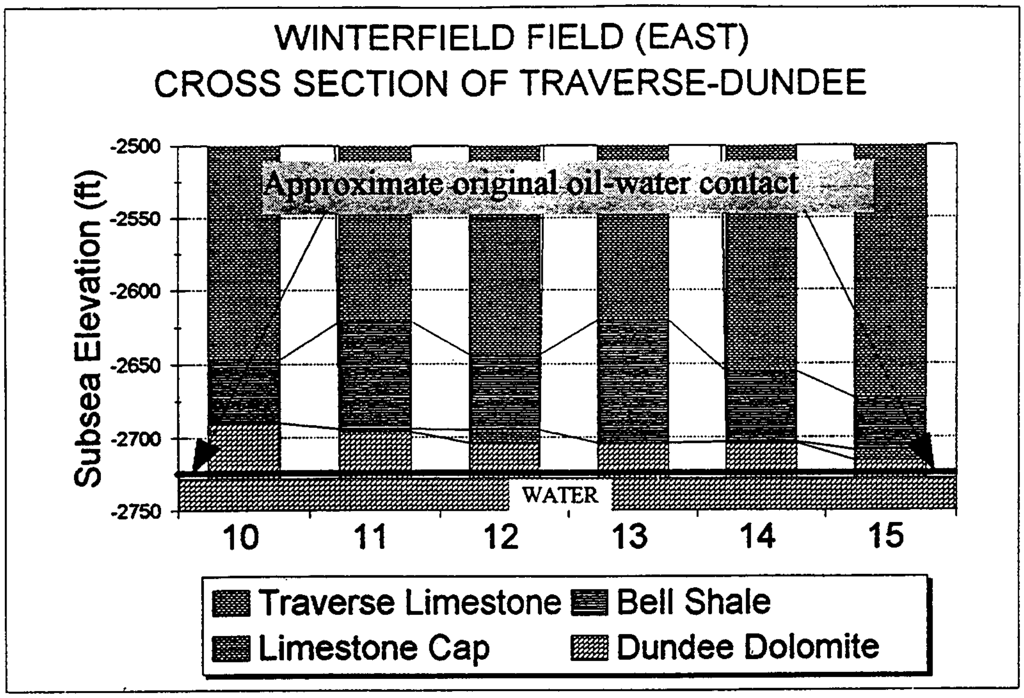


Figure 20 Equidistant east-west structure cross section, Winterfield field

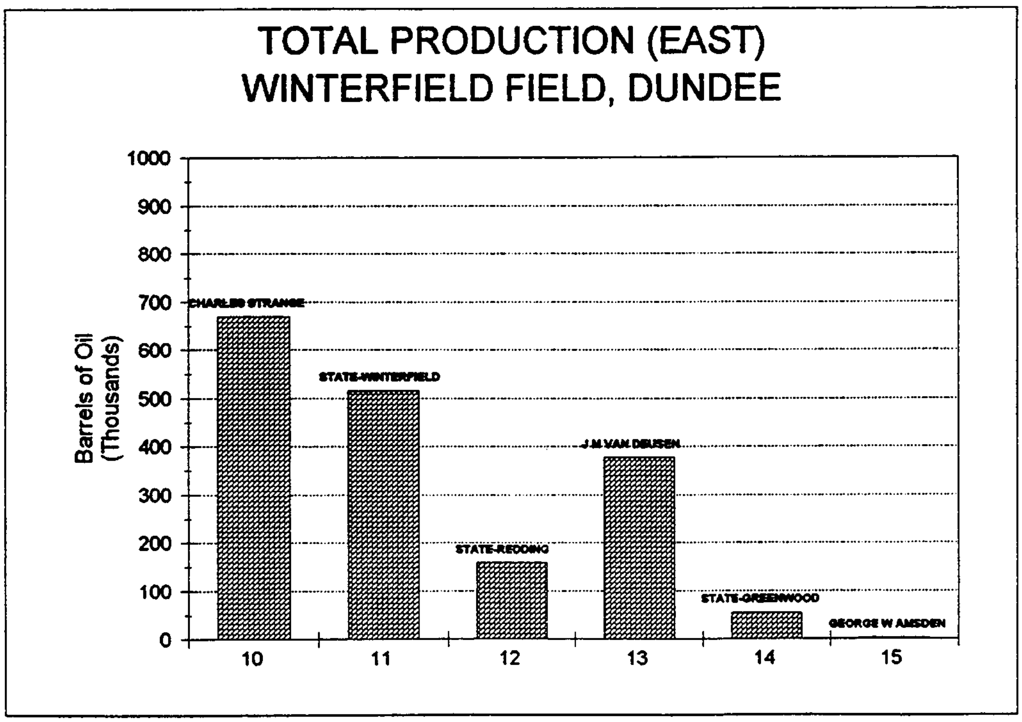


Figure 21 Equidistant production cross section of the Dundee.

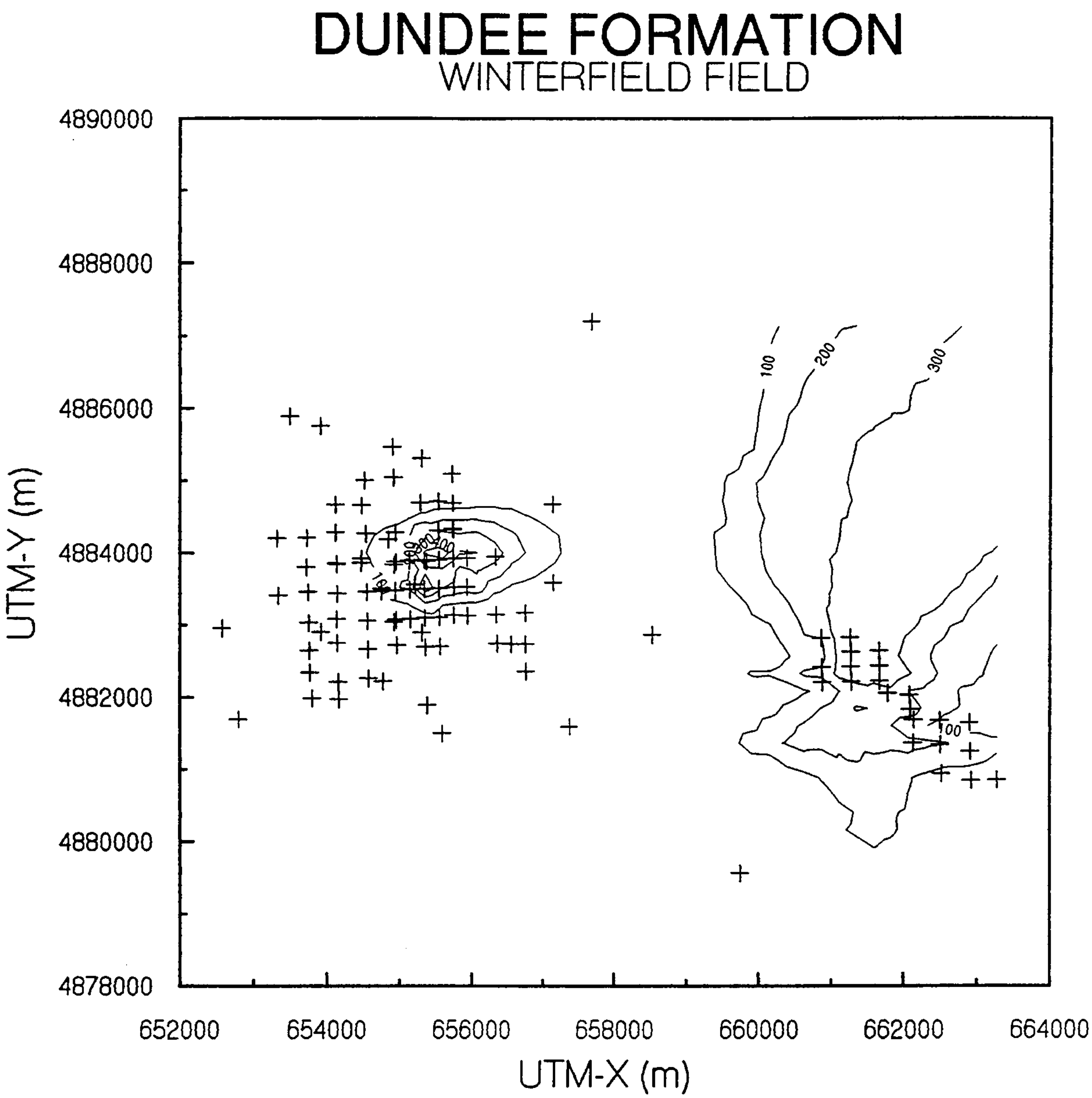


Figure 22 Dundee Initial Production Test Contour Map. +'s are well locations.

Contour interval = 100 BOPD.

DUNDEE FORMATION
WINTERFIELD FIELD

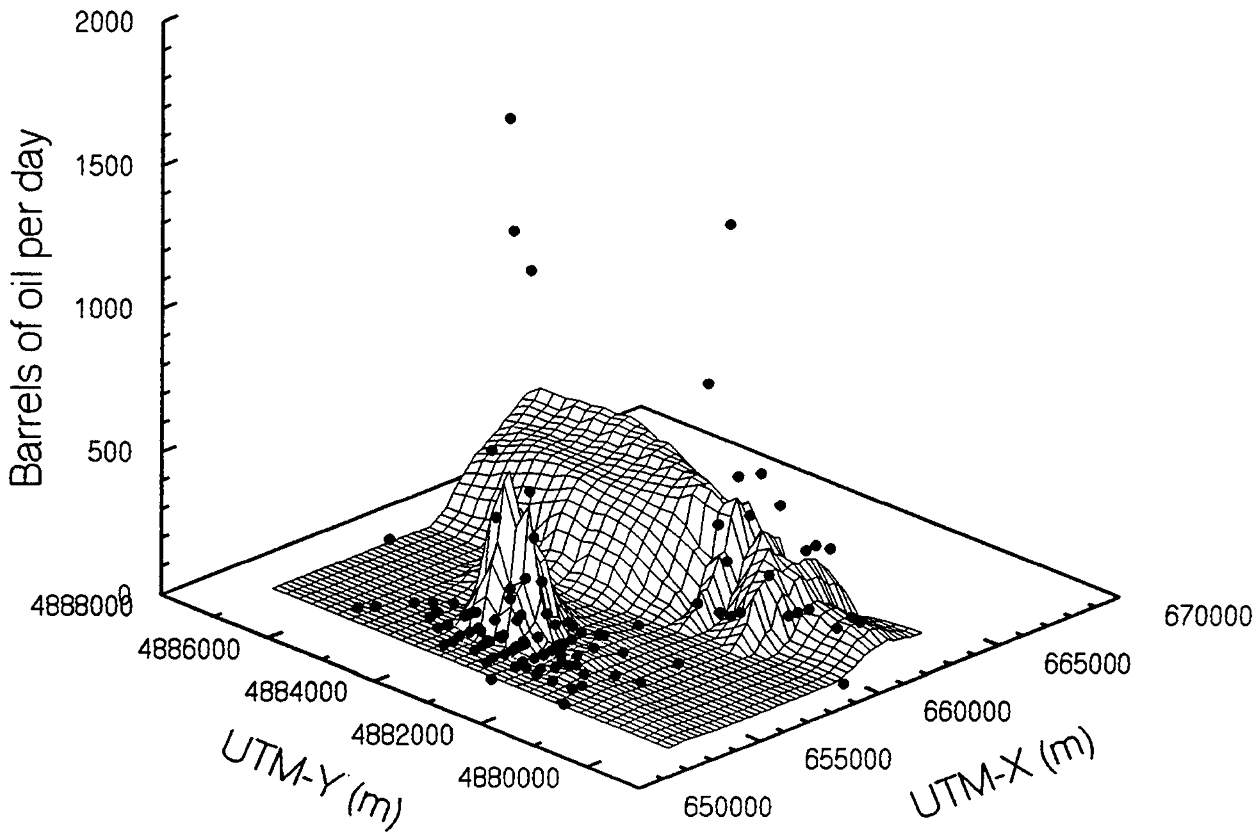


Figure 23 Dundee Initial Production Test Surface Map. Black dots represent original data values at well locations.

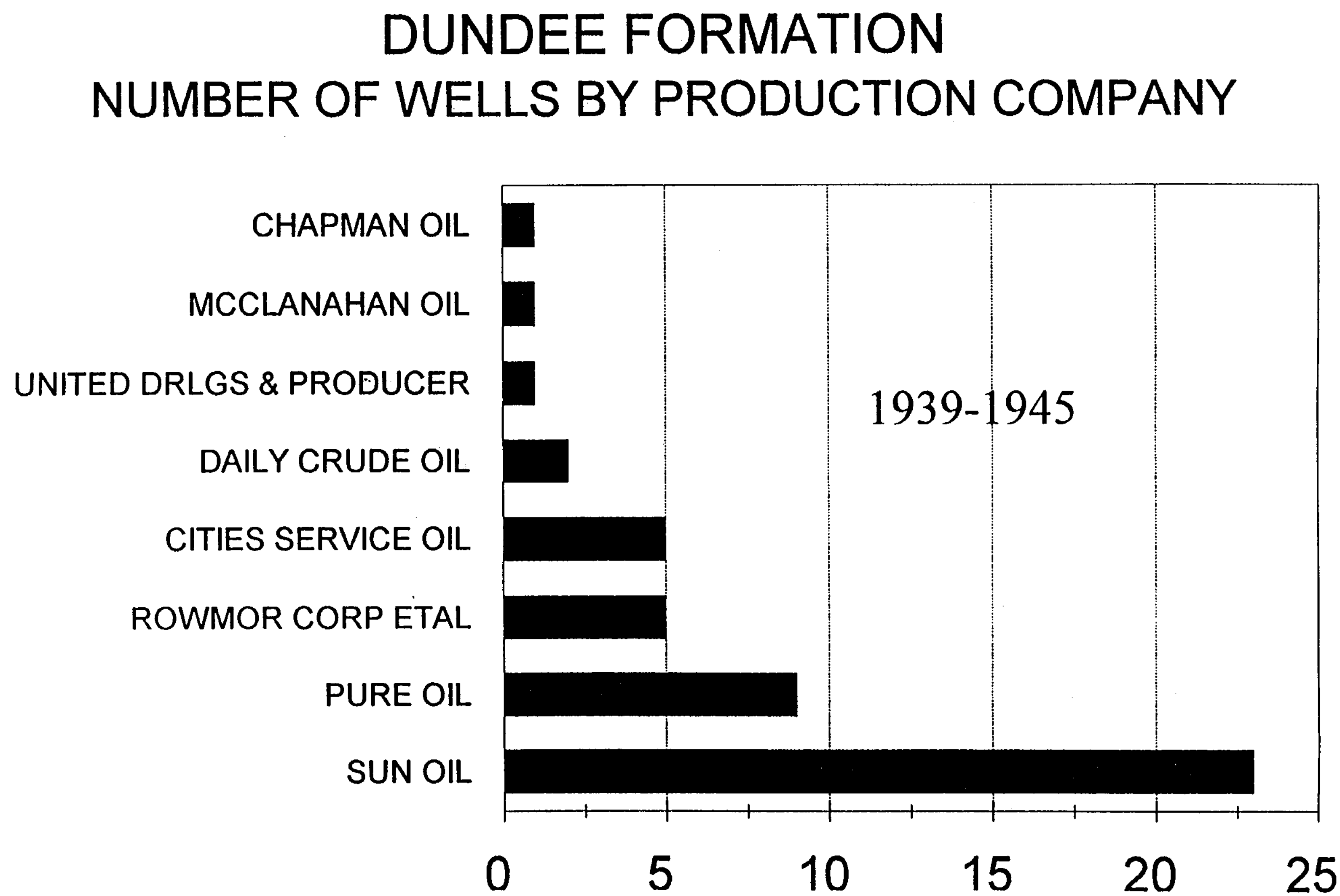


Figure 24 Sun Oil controlled the east part of the field and the Thayer lease on the west.

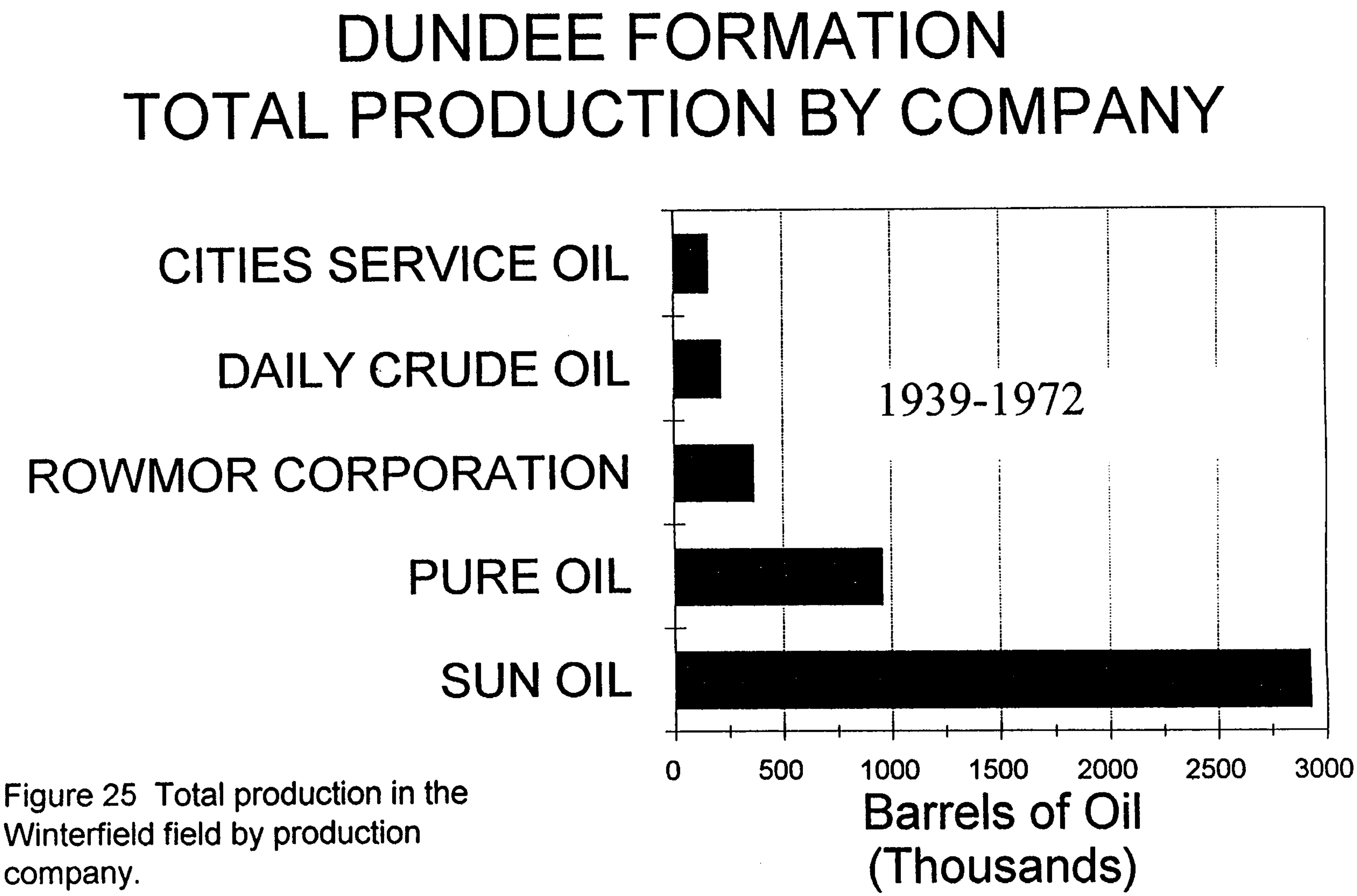


Figure 25 Total production in the Winterfield field by production company.

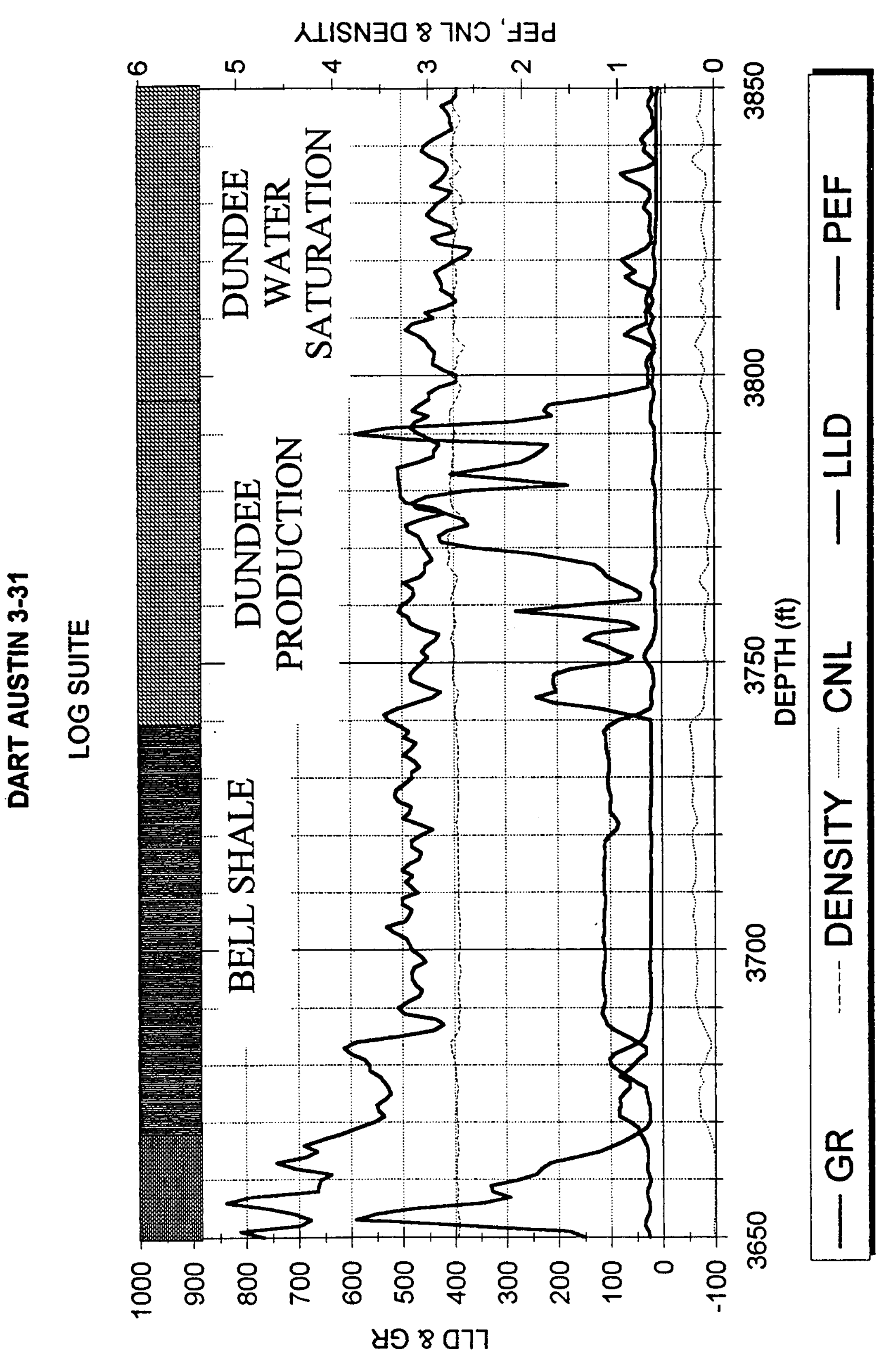

DART AUSTIN 3-31
LOG SUITE
BELL SHALE
DUNDEE PRODUCTION
DUNDEE WATER SATURATION
LLD & GR
PEF, CNL & DENSITY
DEPTH (ft)
3650
3700
3750
3800
3850
1000
900
800
700
600
500
400
300
200
100
0
-100
6
5
4
3
2
1
0
GR
DENSITY
CNL
LLD
PEF

Figure 26 a

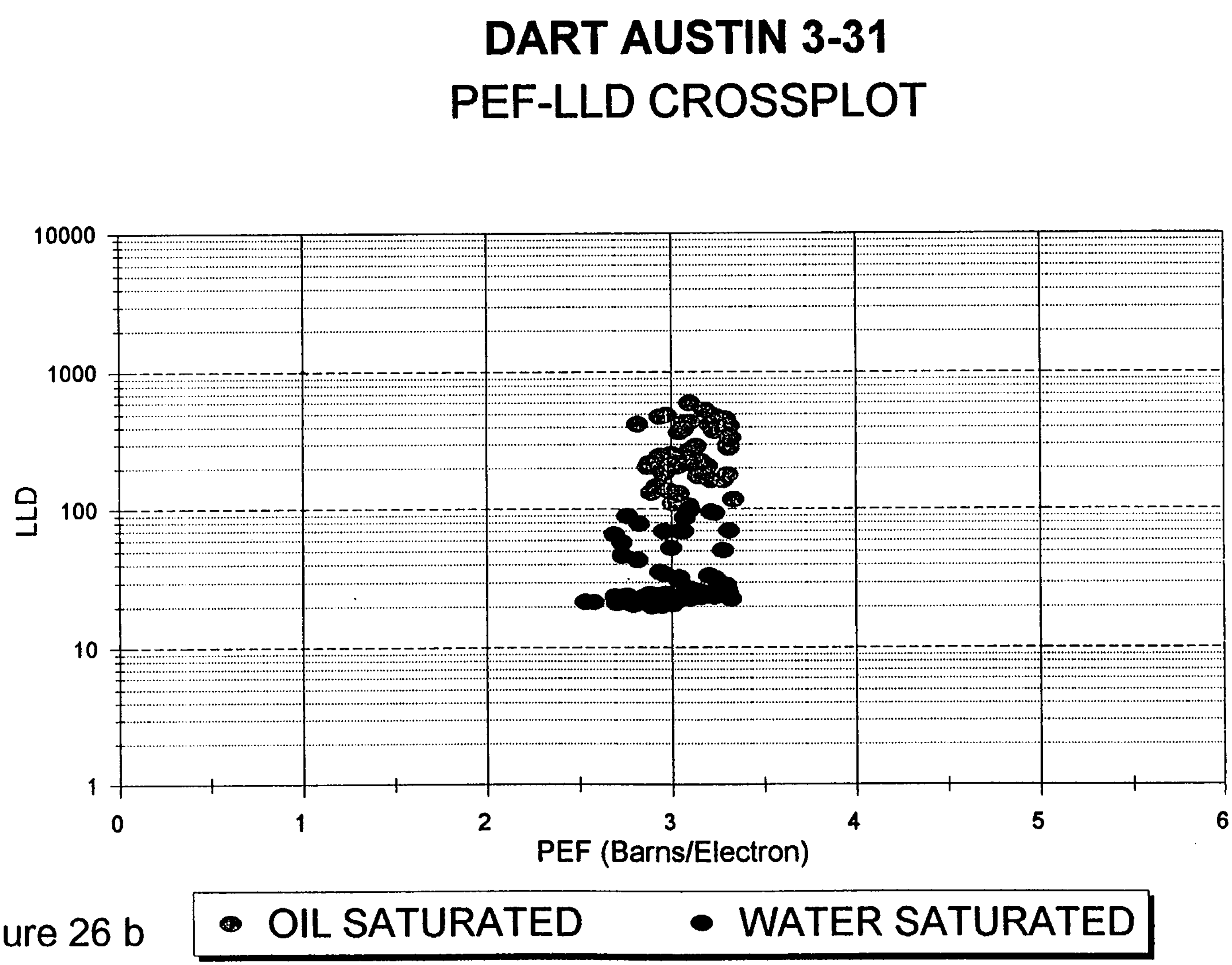

DART AUSTIN 3-31
PEF-LLD CROSSPLOT
10000
1000
100
10
1
LLD
0
1
2
3
4
5
6
PEF (Barns/Electron)
OIL SATURATED
WATER SATURATED

Figure 26 b

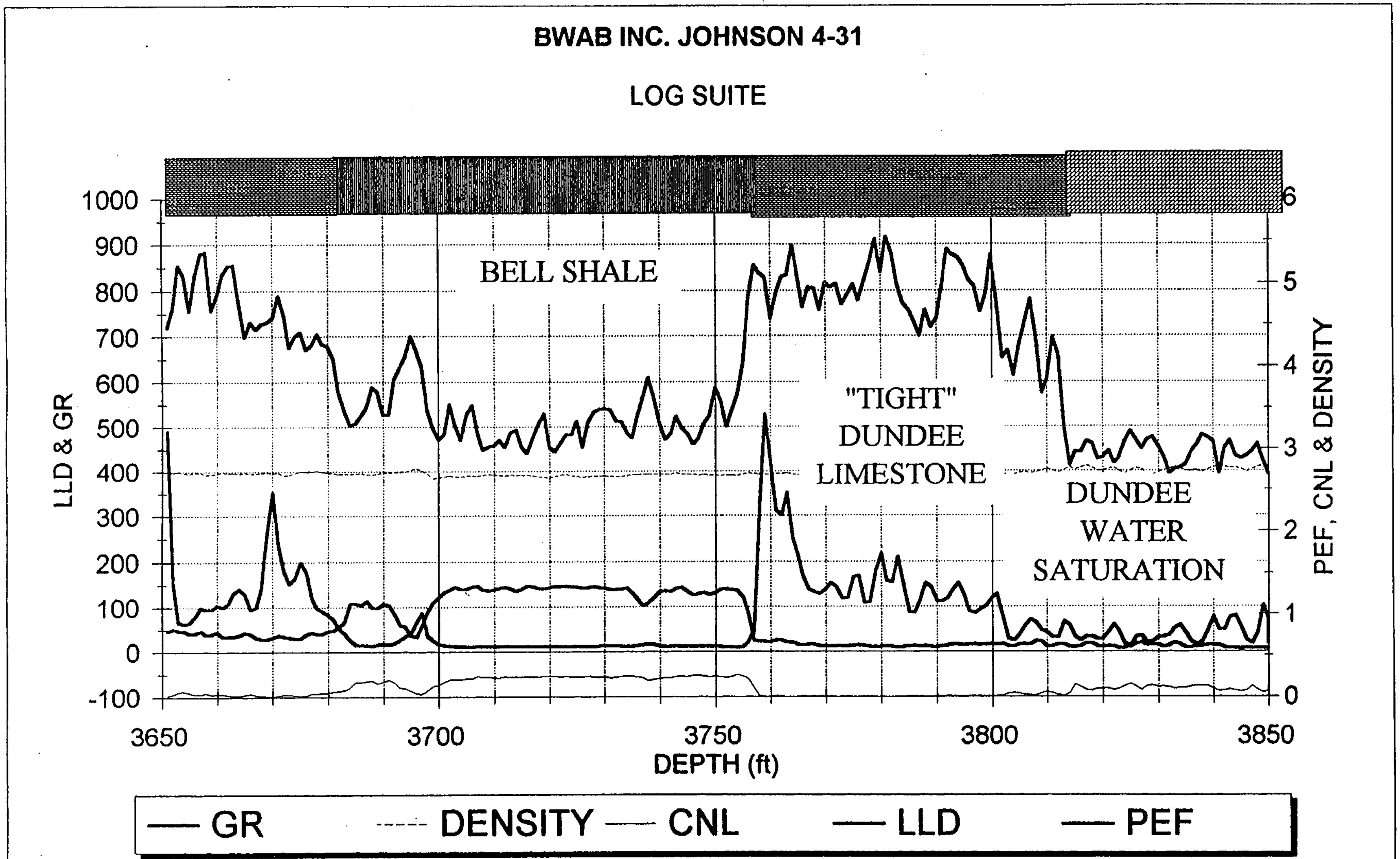

BWAB INC. JOHNSON 4-31
LOG SUITE
BELL SHALE
"TIGHT" DUNDEE LIMESTONE
DUNDEE WATER SATURATION
LLD & GR
PEF, CNL & DENSITY
DEPTH (ft)
3650
3700
3750
3800
3850
1000
900
800
700
600
500
400
300
200
100
0
-100
6
5
4
3
2
1
0
GR
DENSITY
CNL
LLD
PEF

Figure 27 a

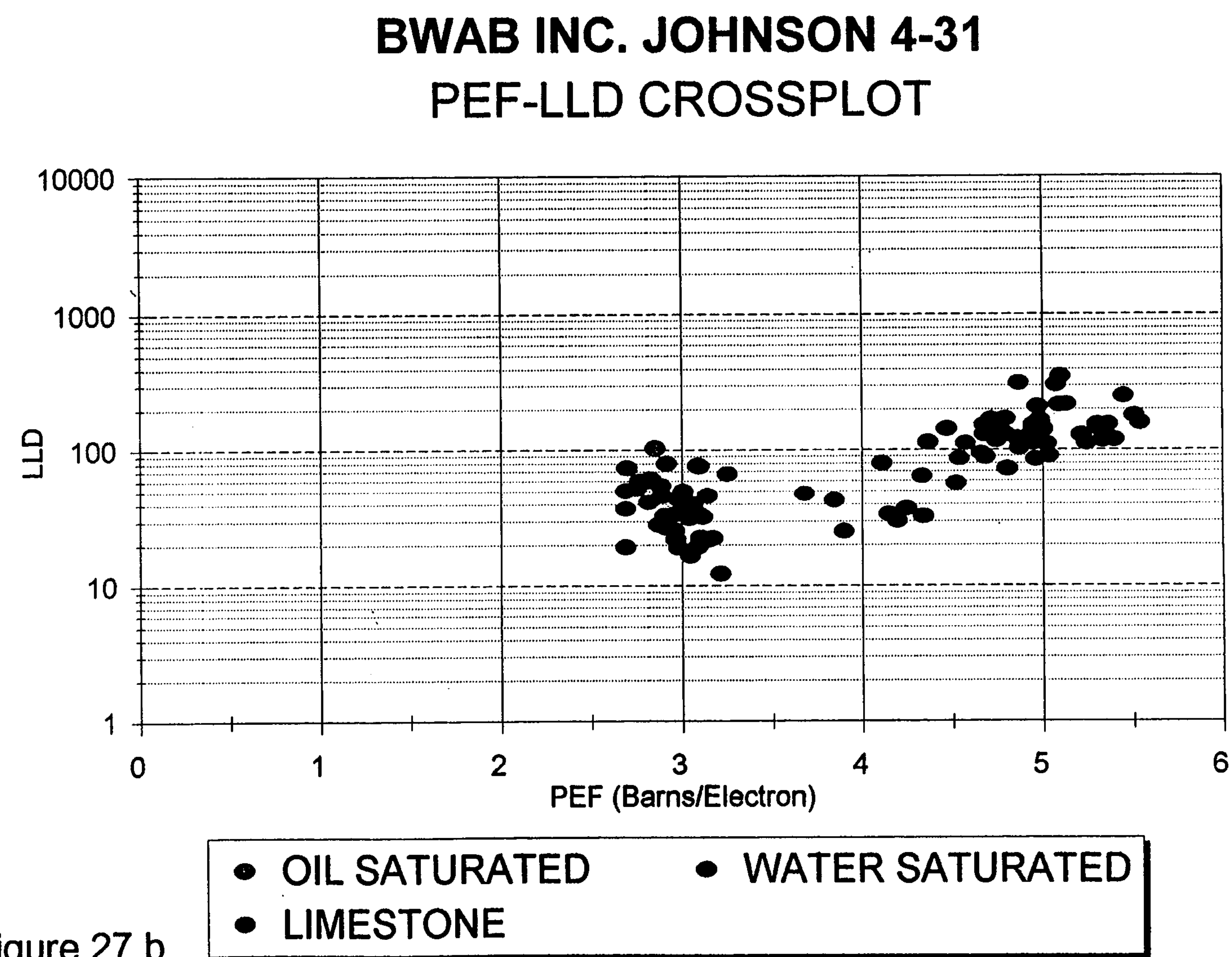
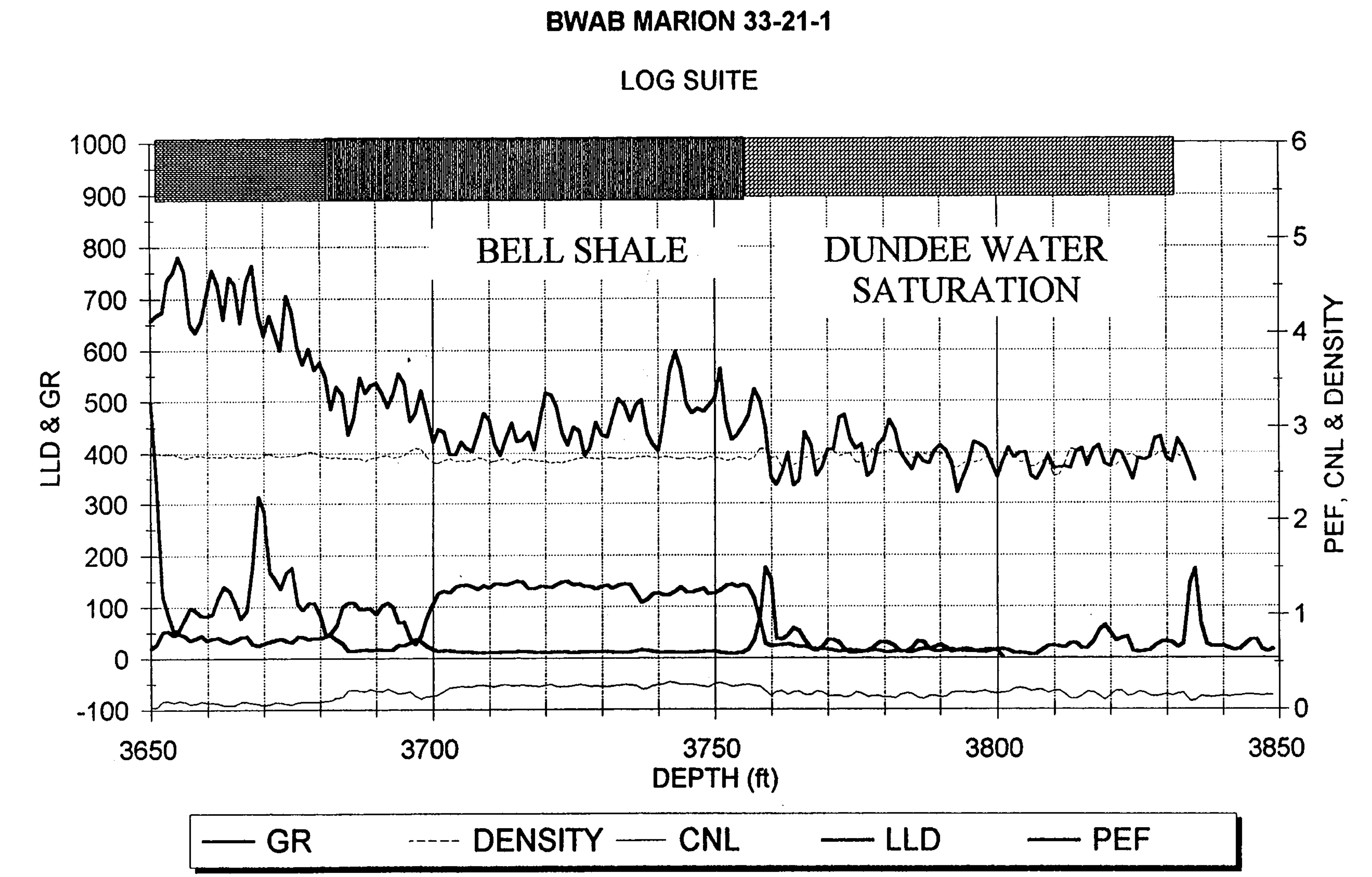

BWAB INC. JOHNSON 4-31
PEF-LLD CROSSPLOT
10000
1000
100
10
1
LLD
0
1
2
3
4
5
6
PEF (Barns/Electron)
OIL SATURATED
WATER SATURATED
LIMESTONE

Figure 27 b


BWAB MARION 33-21-1
LOG SUITE
BELL SHALE
DUNDEE WATER SATURATION
LLD & GR
1000
900
800
700
600
500
400
300
200
100
0
-100
PEF, CNL & DENSITY
6
5
4
3
2
1
0
3650
3700
3750
3800
3850
DEPTH (ft)
GR
DENSITY
CNL
LLD
PEF
Figure 28 a

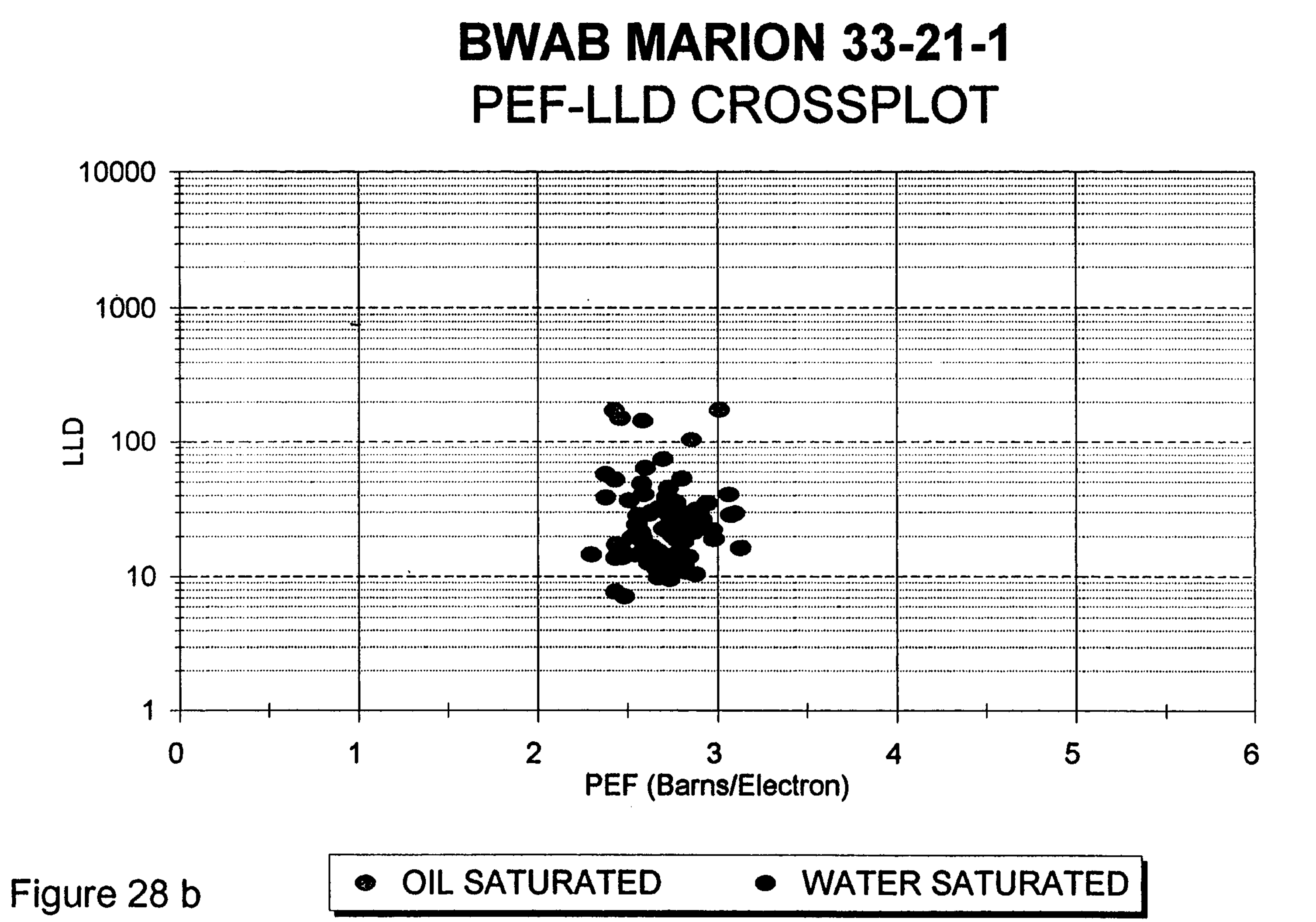

BWAB MARION 33-21-1
PEF-LLD CROSSPLOT
10000
1000
100
10
1
LLD
0
1
2
3
4
5
6
PEF (Barns/Electron)
OIL SATURATED
WATER SATURATED

Figure 28 b

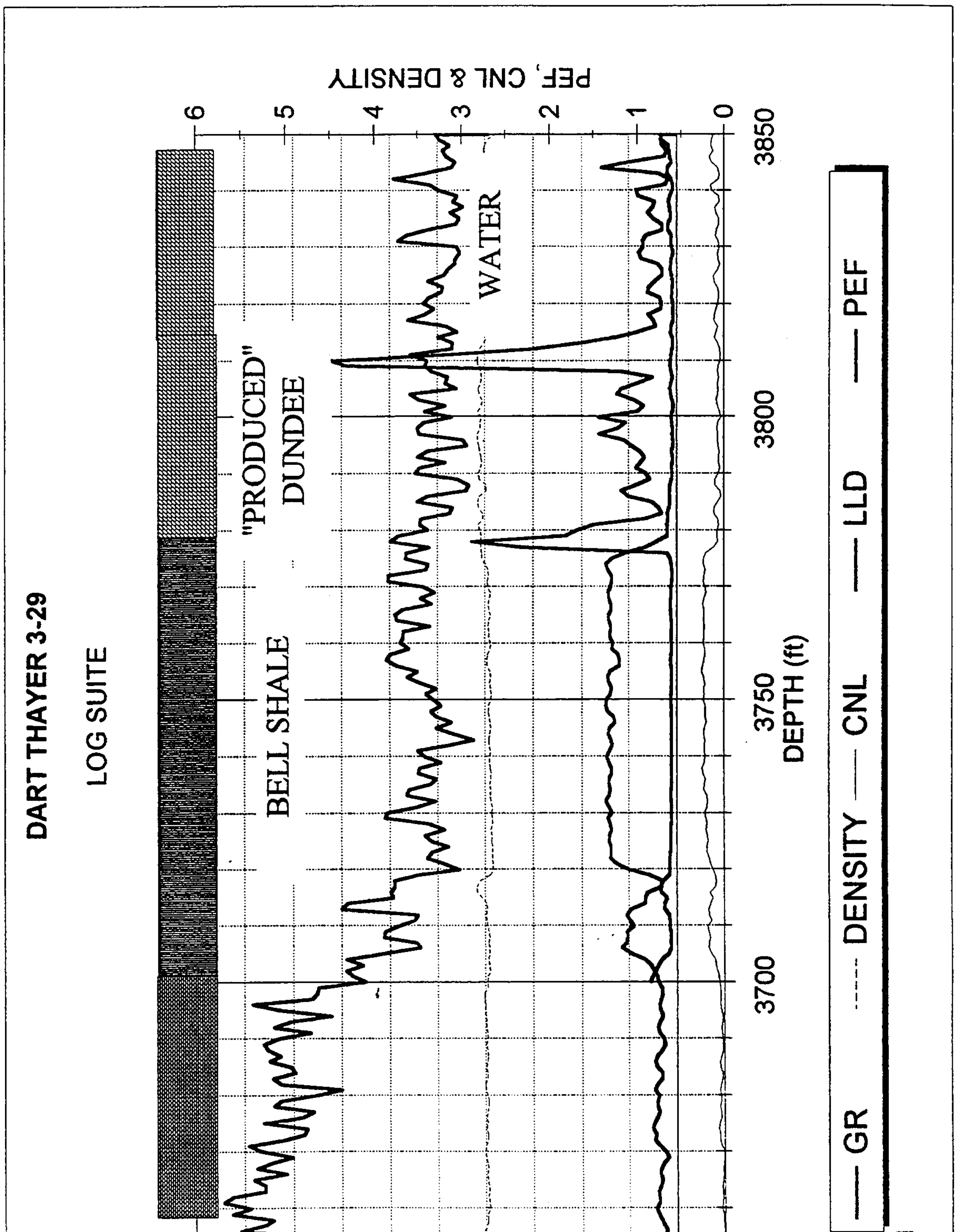

DART THAYER 3-29
LOG SUITE
LLD & GR
PEF, CNL & DENSITY
DEPTH (ft)
BELL SHALE
"PRODUCED" DUNDEE
WATER
GR
DENSITY
CNL
LLD
PEF

Figure 29 a

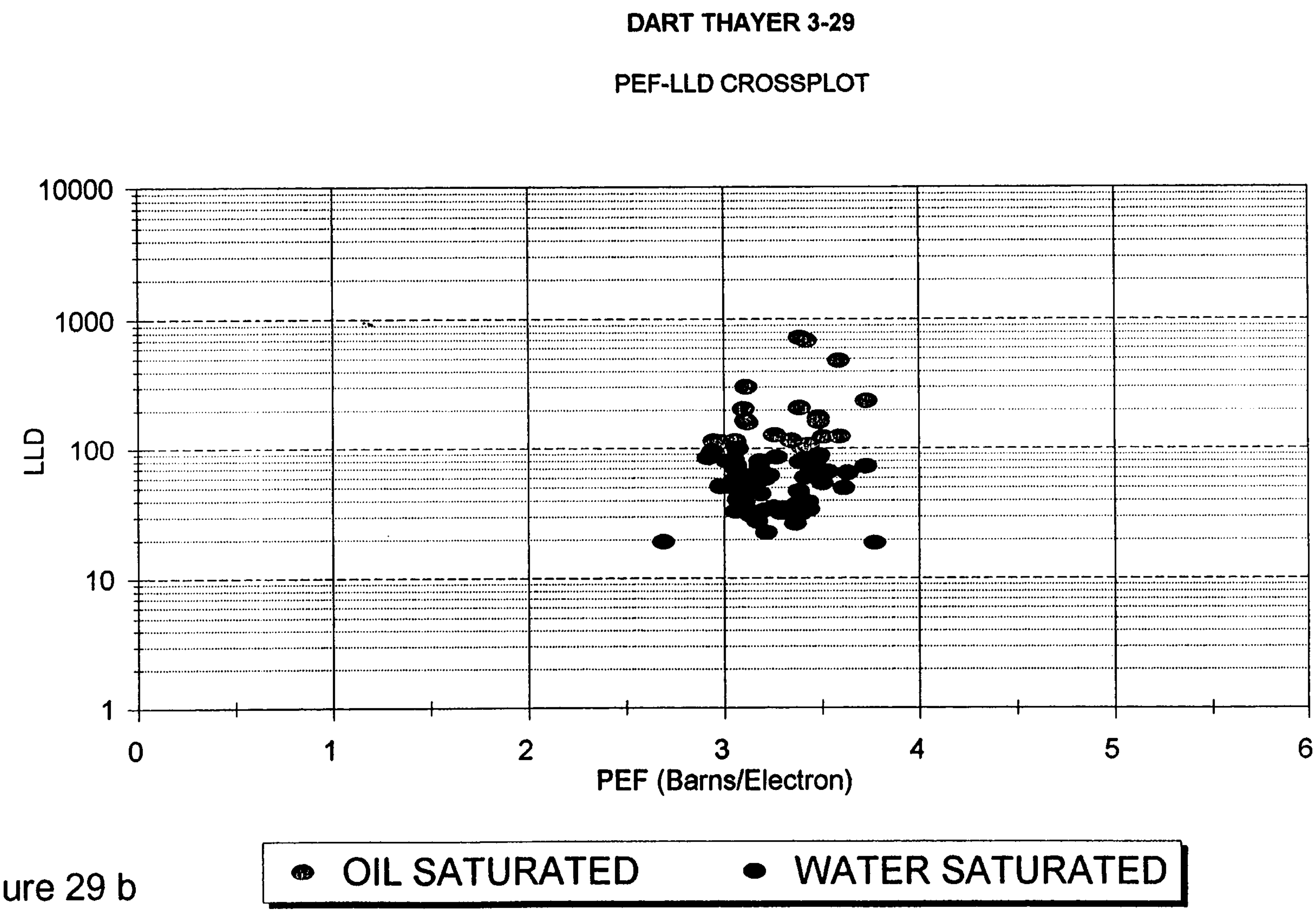

DART THAYER 3-29
PEF-LLD CROSSPLOT
LLD
10000
1000
100
10
1
0
1
2
3
4
5
6
PEF (Barns/Electron)
OIL SATURATED
WATER SATURATED

Figure 29 b

DUNDEE FORMATION
WINTERFIELD FIELD

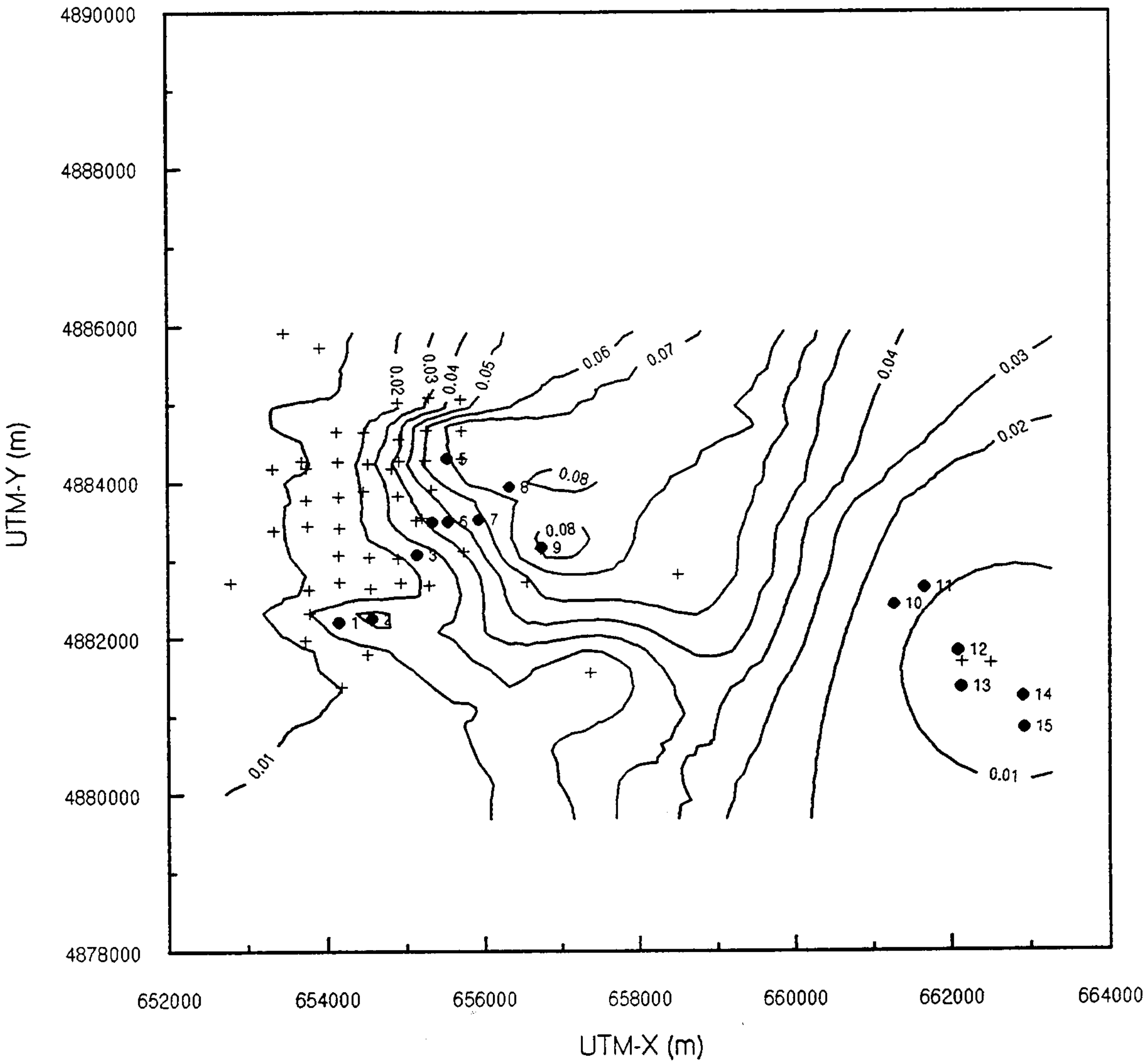


Figure 30 Porosity Contour Map, data calculated from crossplot of compensated neutron log porsity (CNL) and density log, for each well file that contained this log suite. Numbered black dots are well leases presented in Table 4. +' are well locations.

Contour Interval = .01

DUNDEE FORMATION
WINTERFIELD FIELD

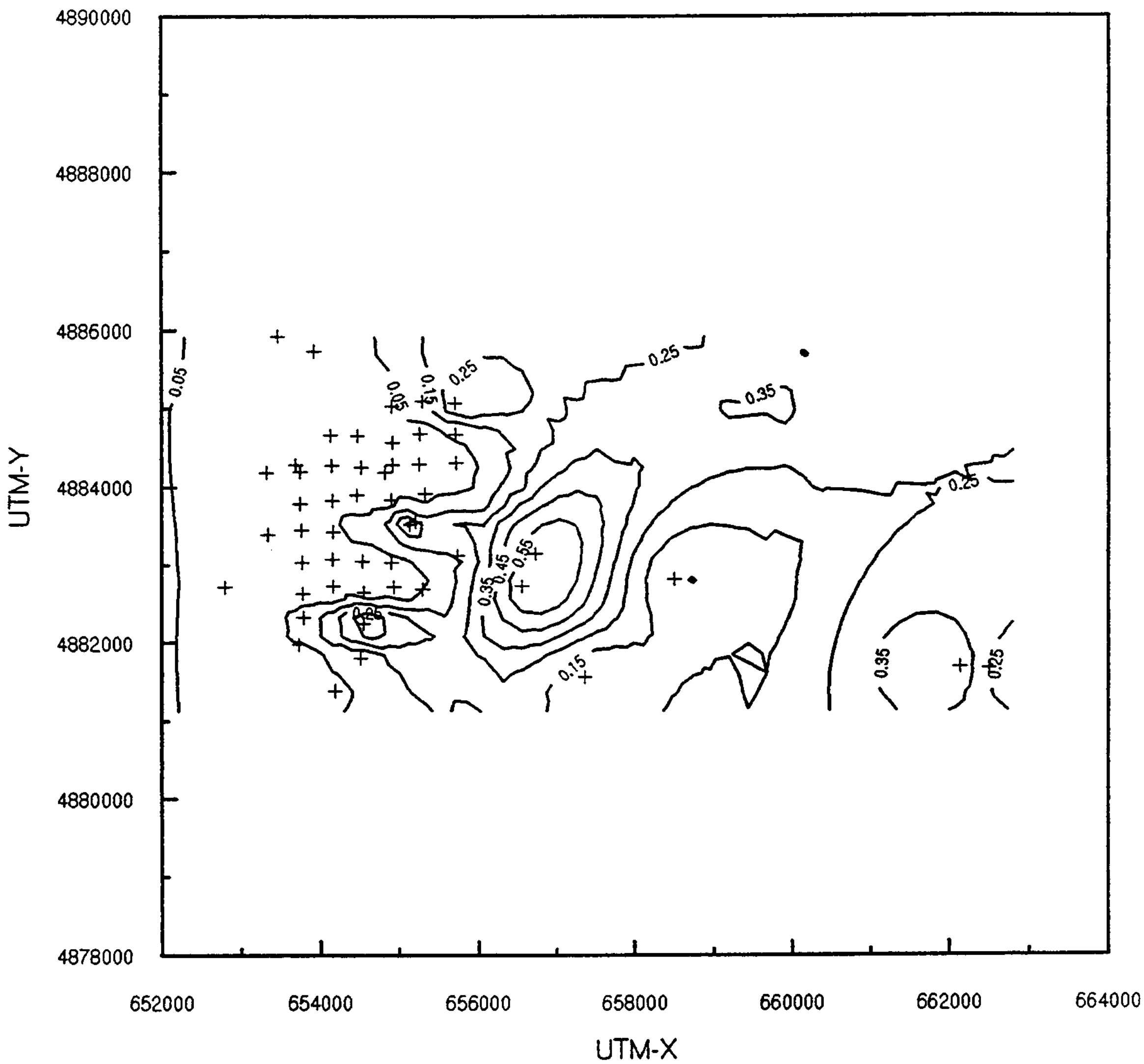


Figure 31 Oil Saturation Contour Map of the top sixty feet of the Dundee. +'s are well locations.

Contour Interval = .1

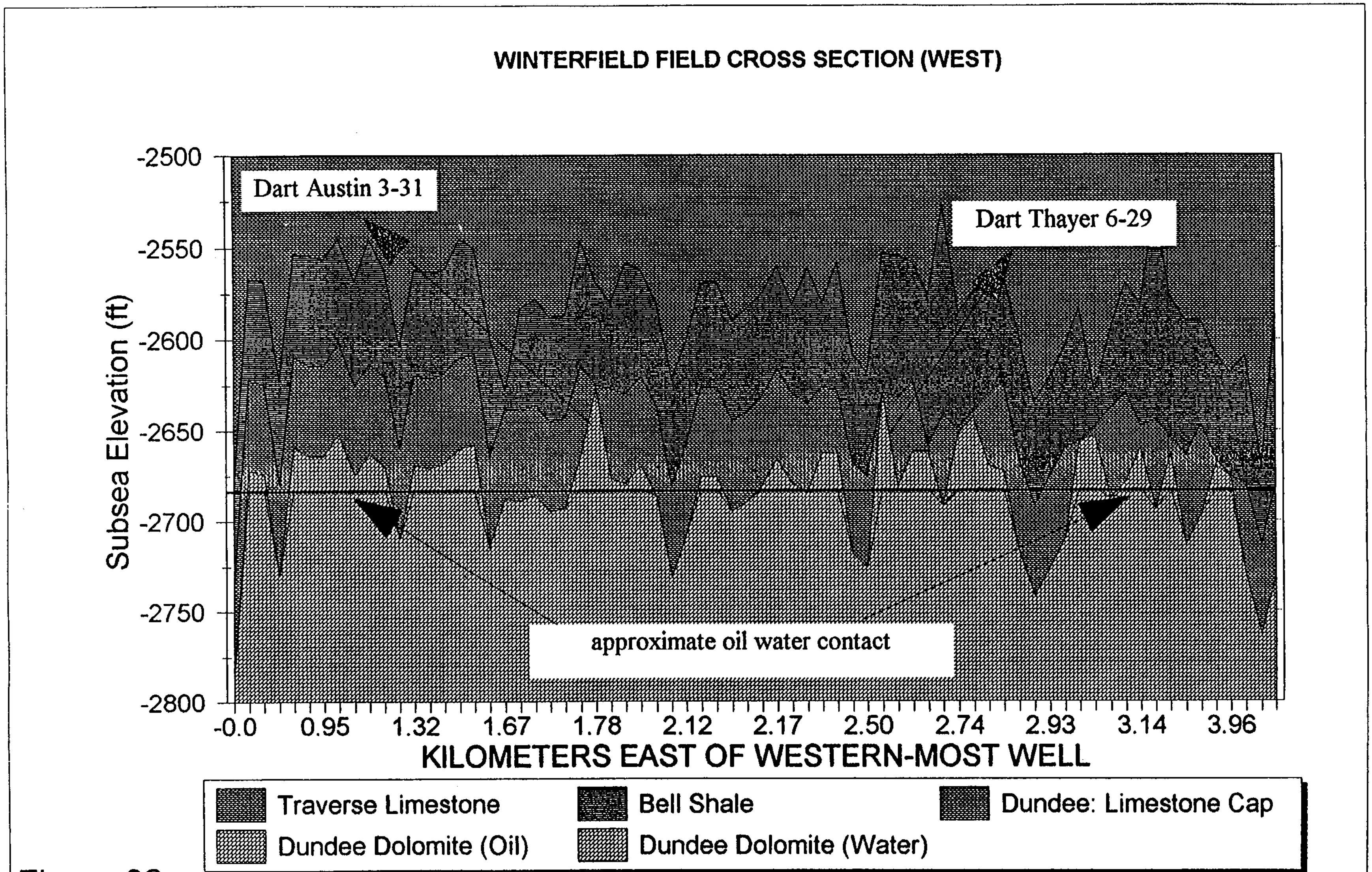

WINTERFIELD FIELD CROSS SECTION (WEST)
Subsea Elevation (ft)
-2500
-2550
-2600
-2650
-2700
-2750
-2800
Dart Austin 3-31
Dart Thayer 6-29
approximate oil water contact
-0.0
0.95
1.32
1.67
1.78
2.12
2.17
2.50
2.74
2.93
3.14
3.96
KILOMETERS EAST OF WESTERN-MOST WELL
Traverse Limestone
Bell Shale
Dundee: Limestone Cap
Dundee Dolomite (Oil)
Dundee Dolomite (Water)

Figure 32

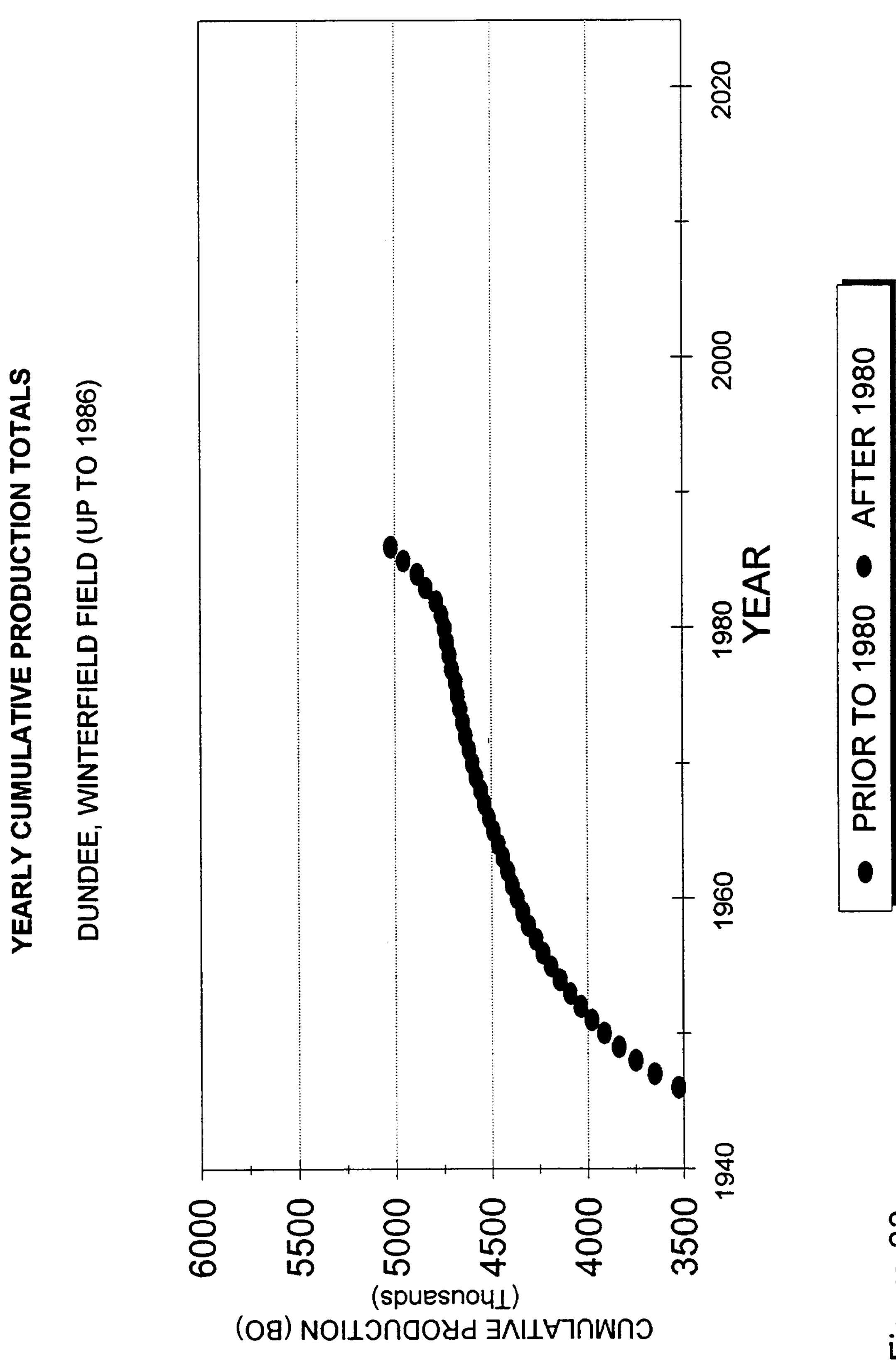

YEARLY CUMULATIVE PRODUCTION TOTALS
DUNDEE, WINTERFIELD FIELD (UP TO 1986)
CUMULATIVE PRODUCTION (BO)
(Thousands)
6000
5500
5000
4500
4000
3500
1940
1960
1980
2000
2020
YEAR
PRIOR TO 1980
AFTER 1980

Figure 33

TABLES

Table 1
YEARLY PRODUCTION DATA FOR THE DUNDEE, WINTERFIELD FIELD

Well	X	Y	Lease	Number	to 1945	1946	1947	1948	1949	1950	1951	1952
77	654578.07	4882259.6	AUSTIN	3-31								
101	656556.97	4882730.8	BASS	3-33								
82	654164.16	4882213.2	BENCHLEY	5-31								
80	654167.45	4881969.9	BENCHLEY	6-31								
102	656752.59	4883162.2	BWAB MARION	33-21-1								
100	656760.39	4882733.4	BWAB MARION	33-22-1								
109	661275.1	4882622.3	CHARLES STRANGE	1-B	449987	13303	15784	14200	13303	13294	11506	9404
113	661280.02	4882421.3	CHARLES STRANGE	2								
45	655349.39	4883491.3	DELMER L THAYER	1								
32	655147.78	4883481	DELMER L THAYER	2	929250	61174	48667	41847	39333	33967	30910	26427
47	654947.02	4883468.5	DELMER L THAYER	3								
36	655344.75	4883892.4	DELMER L THAYER	6								
25	656343.81	4883543.7	FRED SCHUETT	1	78673	14511	13705	12093	10283	9199	7271	6282
27	656342.33	4883943.8	FRED SCHUETT	2								
89	655154.85	4883078.9	GEO A SWINDLEHURST	2	387116	17453	16995	12208	10841	8666	6691	6416
91	655365.84	4882691.5	GEO A SWINDLEHURST	3								
3	662923.78	4880844.6	GEORGE W AMSDEN	1	1860							
6	662505.21	4881342.2	J M VAN DEUSEN	1	275385	18246	16809	12478	9068	7516	6470	5653
8	662136.85	4881364.3	J M VAN DEUSEN	2								
49	655541.63	4884306	M M RIKER	1	62223							
50	655743.22	4884316.3	M M RIKER	2								
88	655558.07	4883100.6	PHARES	1	155886	5562						
35	655939.11	4883924.2	PHARES	2								
53	655941.39	4883523.1	PHARES	3								
4	662912.24	4881246.7	STATE-GREENWOOD	2-A	54734							
9	662093.43	4881826.6	STATE-REDDING	2-A	158689							
108	661670.64	4882632	STATE-WINTERFIELD	2-A	474795	8166	6860	5827	5146	3392	2563	2547
114	661270.98	4882823.4	STATE-WINTERFIELD	3-A								
112	661675.57	4882431	STATE-WINTERFIELD	5-A								
110	661680.72	4882221	STATE-WINTERFIELD	6-A								
115	662089.29	4882027.7	STATE-WINTERFIELD	8-A								
116	661785.81	4882052.5	STATE-WINTERFIELD	9-A								
51	655550.98	4883502.7	W E & C WYMAN	1	361438		3769	866				
39	655546.32	4883903.8	WYMAN	2								
40	655747.92	4883914.1	WYMAN	3								
			YEARLY TOTALS		3390036	138415	122589	99519	87974	76034	65411	56729

Table 1
YEARLY PRODUCTION DATA FOR THE DUNDEE, WINTERFIELD FIELD

Well	X	Y	Lease	Number	1953	1954	1955	1956	1957	1958	1959	1960
77	654578.07	4882259.6	AUSTIN	3-31								
101	656556.97	4882730.8	BASS	3-33								
82	654164.16	4882213.2	BENCHLEY	5-31								
80	654167.45	4881969.9	BENCHLEY	6-31								
102	656752.59	4883162.2	BWAB MARION	33-21-1								
100	656760.39	4882733.4	BWAB MARION	33-22-1								
109	661275.1	4882622.3	CHARLES STRANGE	1-B	12548	9562	7556	7557	7490	7421	7305	6788
113	661280.02	4882421.3	CHARLES STRANGE	2								
45	655349.39	4883491.3	DELMER L THAYER	1								
32	655147.78	4883481	DELMER L THAYER	2	23779	26636	21812	20543	17825	17009	15491	16292
47	654947.02	4883468.5	DELMER L THAYER	3								
36	655344.75	4883892.4	DELMER L THAYER	6								
25	656343.81	4883543.7	FRED SCHUETT	1	5774	6884	6602	4282	4593	4181	3682	3810
27	656342.33	4883943.8	FRED SCHUETT	2								
89	655154.85	4883078.9	GEO A SWINDLEHURST	2	5458	5218	5114	5255	4043	3799	2995	2498
91	655365.84	4882691.5	GEO A SWINDLEHURST	3								
3	662923.78	4880844.6	GEORGE W AMSDEN	1								
6	662505.21	4881342.2	J M VAN DEUSEN	1	5093	4311	3989	3838	3267	2922	2055	
8	662136.85	4881364.3	J M VAN DEUSEN	2								
49	655541.63	4884306	M M RIKER	1								
50	655743.22	4884316.3	M M RIKER	2								
88	655558.07	4883100.6	PHARES	1								
35	655939.11	4883924.2	PHARES	2								
53	655941.39	4883523.1	PHARES	3								
4	662912.24	4881246.7	STATE-GREENWOOD	2-A								
9	662093.43	4881826.6	STATE-REDDING	2-A								
108	661670.64	4882632	STATE-WINTERFIELD	2-A	2138	1794	354	550	141	188	145	213
114	661270.98	4882823.4	STATE-WINTERFIELD	3-A								
112	661675.57	4882431	STATE-WINTERFIELD	5-A								
110	661680.72	4882221	STATE-WINTERFIELD	6-A								
115	662089.29	4882027.7	STATE-WINTERFIELD	8-A								
116	661785.81	4882052.5	STATE-WINTERFIELD	9-A								
51	655550.98	4883502.7	W E & C WYMAN	1								
39	655546.32	4883903.8	WYMAN	2								
40	655747.92	4883914.1	WYMAN	3								
			YEARLY TOTALS		54790	54405	45427	42025	37359	35520	31673	29601

Table 1
YEARLY PRODUCTION DATA FOR THE DUNDEE, WINTERFIELD FIELD

Well	X	Y	Lease	Number	1961	1962	1963	1964	1965	1966	1967	1968
77	654578.07	4882259.6	AUSTIN	3-31								
101	656556.97	4882730.8	BASS	3-33								
82	654164.16	4882213.2	BENCHLEY	5-31								
80	654167.45	4881969.9	BENCHLEY	6-31								
102	656752.59	4883162.2	BWAB MARION	33-21-1								
100	656760.39	4882733.4	BWAB MARION	33-22-1								
109	661275.1	4882622.3	CHARLES STRANGE	1-B	6606	5225	5968	5821	5952	4807	5674	4347
113	661280.02	4882421.3	CHARLES STRANGE	2								
45	655349.39	4883491.3	DELMER L THAYER	1								
32	655147.78	4883481	DELMER L THAYER	2	14757	13305	14006	13916	14194	13360	13443	12635
47	654947.02	4883468.5	DELMER L THAYER	3								
36	655344.75	4883892.4	DELMER L THAYER	6								
25	656343.81	4883543.7	FRED SCHUETT	1	3269	2129	3092	2464	2761	1698	1870	2306
27	656342.33	4883943.8	FRED SCHUETT	2								
89	655154.85	4883078.9	GEO A SWINDLEHURST	2	2292	1542	1771	1506	1649	1424	1410	1542
91	655365.84	4882691.5	GEO A SWINDLEHURST	3								
3	662923.78	4880844.6	GEORGE W AMSDEN	1								
6	662505.21	4881342.2	J M VAN DEUSEN	1								
8	662136.85	4881364.3	J M VAN DEUSEN	2								
49	655541.63	4884306	M M RIKER	1								
50	655743.22	4884316.3	M M RIKER	2								
88	655558.07	4883100.6	PHARES	1								
35	655939.11	4883924.2	PHARES	2								
53	655941.39	4883523.1	PHARES	3								
4	662912.24	4881246.7	STATE-GREENWOOD	2-A								
9	662093.43	4881826.6	STATE-REDDING	2-A								
108	661670.64	4882632	STATE-WINTERFIELD	2-A	166		191	144	127	122		162
114	661270.98	4882823.4	STATE-WINTERFIELD	3-A								
112	661675.57	4882431	STATE-WINTERFIELD	5-A								
110	661680.72	4882221	STATE-WINTERFIELD	6-A								
115	662089.29	4882027.7	STATE-WINTERFIELD	8-A								
116	661785.81	4882052.5	STATE-WINTERFIELD	9-A								
51	655550.98	4883502.7	W E & C WYMAN	1								
39	655546.32	4883903.8	WYMAN	2								
40	655747.92	4883914.1	WYMAN	3								
			YEARLY TOTALS		27090	22201	25028	23851	24683	21411	22397	20992

Table 1
YEARLY PRODUCTION DATA FOR THE DUNDEE, WINTERFIELD FIELD

Well	X	Y	Lease	Number	1969	1970	1971	1972	Totals
77	654578.07	4882259.6	AUSTIN	3-31					0
101	656556.97	4882730.8	BASS	3-33					0
82	654164.16	4882213.2	BENCHLEY	5-31					0
80	654167.45	4881969.9	BENCHLEY	6-31					0
102	656752.59	4883162.2	BWAB MARION	33-21-1					0
100	656760.39	4882733.4	BWAB MARION	33-22-1					0
109	661275.1	4882622.3	CHARLES STRANGE	1-B	5972	4395	4246	3924	669945
113	661280.02	4882421.3	CHARLES STRANGE	2					0
45	655349.39	4883491.3	DELMER L THAYER	1					0
32	655147.78	4883481	DELMER L THAYER	2	14051	10934	10685	10025	1526273
47	654947.02	4883468.5	DELMER L THAYER	3					0
36	655344.75	4883892.4	DELMER L THAYER	6					0
25	656343.81	4883543.7	FRED SCHUETT	1	3137	1869	1591	2156	220167
27	656342.33	4883943.8	FRED SCHUETT	2					0
89	655154.85	4883078.9	GEO A SWINDLEHURST	2	1844	1595	1494	1501	520336
91	655365.84	4882691.5	GEO A SWINDLEHURST	3					0
3	662923.78	4880844.6	GEORGE W AMSDEN	1					1860
6	662505.21	4881342.2	J M VAN DEUSEN	1					377100
8	662136.85	4881364.3	J M VAN DEUSEN	2					0
49	655541.63	4884306	M M RIKER	1					62223
50	655743.22	4884316.3	M M RIKER	2					0
88	655558.07	4883100.6	PHARES	1					161448
35	655939.11	4883924.2	PHARES	2					0
53	655941.39	4883523.1	PHARES	3					0
4	662912.24	4881246.7	STATE-GREENWOOD	2-A					54734
9	662093.43	4881826.6	STATE-REDDING	2-A					158689
108	661670.64	4882632	STATE-WINTERFIELD	2-A	146				515877
114	661270.98	4882823.4	STATE-WINTERFIELD	3-A					0
112	661675.57	4882431	STATE-WINTERFIELD	5-A					0
110	661680.72	4882221	STATE-WINTERFIELD	6-A					0
115	662089.29	4882027.7	STATE-WINTERFIELD	8-A					0
116	661785.81	4882052.5	STATE-WINTERFIELD	9-A					0
51	655550.98	4883502.7	W E & C WYMAN	1					366073
39	655546.32	4883903.8	WYMAN	2					0
40	655747.92	4883914.1	WYMAN	3					0
			YEARLY TOTALS		25150	18793	18016	17606	4634725

Table 2
GENERAL PRODUCTION DATA

Well Number	X UTM(m)	Y UTM(m)	Lease	Well I.D. Num	TD Formation	Producing Formation	Type of Well	Datum Elevation
1	662899	4881644	STATE GREENWOOD	1-A	Dundee		D&A	1095
2	663281	4880853	GEO W AMSDEN	2	Dundee		D&A-OG	1096
3	662924	4880845	GEORGE W AMSDEN	1	Dundee	Dundee	OIL	1097
4	662912	4881247	STATE-GREENWOOD	2-A	Dundee	Dundee	OIL	1099
5	662517	4880940	STATE-REDDING	4-A	Dundee		D&A	1093
6	662505	4881342	J M VAN DEUSEN	1	Dundee	Dundee	OIL	1095
7	662495	4881674	STATE-REDDING	1-1	Black Lime		D&A-G	1107
8	662137	4881364	J M VAN DEUSEN	2	Dundee	Dundee	OIL	1093
9	662093	4881827	STATE-REDDING	2-A	Dundee	Dundee	OIL	1091
10	662146	4881683	STATE REDDING	1-1	Dundee		D&A-OG	1107
11	657378	4881597	JOHNSON	4-31	Amherstberg		D&A-OG	1077
12	655596	4881499	STATE REDDING	1-B	Dundee	Traverse Formation	OIL	1078
13	659745	4879563	STATE-REDDING	1-A	Dundee		D&A-OG	1082
14	659745	4879563	STATE-REDDING	1-A	Dundee	Michigan Formation	OIL-WO	1082
15	657686	4887189	FRANK C DAVIS	1	Dundee		D&A-O	1125
16	653495	4885883	WINTERFIELD	1-19	Monroe	Prairie Du Chien	GAS	1165
17	654526	4884997	E BLACKLEDGE	1-19	Black Lime	Richfield	OIL	1148
18	653918	4885750	GERNAAT ET AL	2-19	Munising		D&A-G	1166
19	655308	4885300	BLACKLEDGE DAN	1-20	Black Lime	Richfield	OIL	1151
20	654911	4885461	LAUGHLIN	2-20	Amherstberg	Richfield	OIL	1131
21	655730	4885083	BLACKLEDGE DAN	2-20	Black Lime		D&A-G	1115
22	654926	4885039	MCLACHLAN	1-20	Black Lime	Richfield	OIL	1145
23	657137	4884671	THOMAS-RAND ETAL	1	Dundee		D&A-O	1105
24	657146	4883582	DAVISON	1	Dundee		D&A-OG	1093
25	656344	4883544	FRED SCHUETT	1	Dundee	Dundee	OIL	1113
26	656342	4883944	FRED SCHUETT	2	Dundee		SERVICE	1116
27	656342	4883944	FRED SCHUETT	2	Dundee	Dundee	OIL-WO	1116
28	655380	4883873	D L THAYER	8	Black Lime	Black Lime	OIL	1123

Table 2
GENERAL PRODUCTION DATA

Well Number	X UTM(m)	Y UTM(m)	Lease	Well I.D. Num	TD Formation	Producing Formation	Type of Well	Datum Elevation
29	654952	4883872	H D EGTS	B-1	Monroe	Traverse Formation	OIL	1128
30	655143	4883882	DELMER L THAYER	4	Monroe	Traverse Formation	OIL	1118
31	654757	4883461	DELMER L THAYER	5	Monroe		D&A-O	1125
32	655148	4883481	DELMER L THAYER	2	Dundee	Dundee	OIL	1111
33	655148	4883481	THAYER	2	Dundee		D&AWO	1111
34	654944	4884274	BENCHLEY	2-29	Richfield	Richfield	OIL	1135
35	655939	4883924	PHARES	2	Dundee	Dundee	OIL	1083
36	655345	4883892	DELMER L THAYER	6	Dundee	Dundee	OIL	1109
37	655740	4884332	BEULAH JUNE	5-29	Richfield	Richfield	OIL	1122
38	655537	4884706	BERTHA TYLER	1	Dundee		D&A-OG	1128
39	655546	4883904	WYMAN	2	Dundee	Dundee	OIL	1115
40	655748	4883914	WYMAN	3	Dundee	Dundee	OIL	1098
41	655217	4883555	THAYER O L	9	Amherstberg	Richfield	OIL	1118
42	655290	4884693	RW & TJ BLACKLEDGE	4-29	Richfield	Richfield	OIL	1149
43	655737	4884686	MICH GAS STORAGE	6-29	Black Lime	Richfield	OIL	1129
44	654927	4883828	EGTS	7-29	Richfield	Richfield	OIL	1135
45	655349	4883491	DELMER L THAYER	1	Dundee	Dundee	OIL-WO	1100
46	654847	4884185	WINTERFIELD SWDW	8-29	Detroit River		SERVICE	1149
47	654947	4883468	THAYER DELMER L	3	Dundee	Dundee	OIL	1126
48	654947	4883468	THAYER	3	Amherstberg	Richfield	OIL-WO	1137
49	655542	4884306	M M RIKER	1	Dundee	Dundee	OIL	1125
50	655743	4884316	M M RIKER	2	Dundee	Dundee	OIL	1107
51	655551	4883503	W E & C WYMAN	1	Dundee	Dundee	OIL	1106
52	655752	4883513	WYMAN	4	Dundee	Michigan Formation	OIL	1090
53	655941	4883523	PHARES	3	Dundee	Dundee	OIL	1075
54	655941	4883523	PHARES	3	Dundee		SERVICE	1075
55	654757	4883491	DELMER L THAYER	7	Richfield	Richfield	OIL	1125
56	654557	4883453	HAROLD MCCLAIN	1	Black Lime	Richfield	OIL-WO	1132

Table 2
GENERAL PRODUCTION DATA

Well Number	X UTM(m)	Y UTM(m)	Lease	Well I.D. Num	TD Formation	Producing Formation	Type of Well	Datum Elevation
57	654483	4883914	G L & E JOHNSON	3-30	Richfield	Richfield	OIL	1145
58	653727	4883799	R L-R M MOSHER ETAL	2	Richfield	Traverse Limestone	GAS	1152
59	654536	4884257	ALLIE L MOSHER	1-30	Richfield	Richfield	OIL	1144
60	653748	4883449	R L & R M MOSHR ETL	1	Dundee	Traverse Formation	OIL	1144
61	654487	4884655	ALLIE L MOSHER	2-30	Richfield	Massive Anhydrite	OIL	1144
62	654120	4884665	BLACKLEDGE	4-30	Black Lime	Richfield	OIL	1152
63	654477	4883853	BULMAN	A-1	Black Lime		D&A-OG	1127
64	654126	4884276	DALE L BRAY ET AL	1-30	Amherstberg	Richfield	OIL	1156
65	654142	4883845	IRA BARHITE	1	Dundee		D&A-OG	1139
66	654138	4883838	BARHITTE FAY E	6-30	Richfield	Richfield	OIL	1144
67	653730	4884206	BRAY DALE L ET AL	2-30	Amherstberg	Richfield	OIL	1160
68	653325	4884196	DALE L BRAY ET AL	3-30	Amherstberg	Richfield	OIL	1156
69	654148	4883428	MOSHER ROLAND	8-30	Black Lime	Richfield	OIL	1142
70	653339	4883400	JACKSON	10-30	Black Lime	Richfield	GAS	1137
71	654564	4883051	BENCHLEY	1-31	Niagaran	Richfield	OIL	1119
72	653753	4883029	BENCHLEY-HOTCHKISS	1	Richfield	Richfield	OIL	1129
73	654569	4882661	BENCHLEY	3-31	Richfield	Richfield	OIL	1136
74	653770	4882343	V J WILLIAMS	A-1	Dundee		D&A-OG	1122
75	653770	4882343	WILLIAMS	7-31	Amherstberg	Richfield	OIL-WO	1132
76	654142	4883074	BENCHLEY	2-31	Amherstberg	Richfield	OIL	1137
77	654578	4882260	AUSTIN	3-31	Amherstberg	Dundee	OIL	1117
78	653803	4881986	STATE WINTERFIELD	1-31	Prarie Du Chien	Prairie Du Chien	OIL	1120
79	654148	4882746	BENCHLEY	4-31	Amherstberg	Richfield	OIL	1132
80	654167	4881970	BENCHLEY	6-31	Amherstberg	Dundee	OIL	1115
81	653762	4882643	CALVERT ET AL	2-31	Richfield	Richfield	OIL	1140
82	654164	4882213	BENCHLEY	5-31	Dundee	Dundee	OIL	1125
83	653920	4882904	WINTERFIELD	2-31	Prarie Du Chien	Prairie Du Chien	GAS	1159
84	655356	4883089	G A SWINDELHURST	1	Monroe	Monroe Formation	OIL	1095

Table 2
GENERAL PRODUCTION DATA

Well Number	X UTM(m)	Y UTM(m)	Lease	Well I.D. Num	TD Formation	Producing Formation	Type of Well	Datum Elevation
85	654967	4883069	HUGH D EGTS	1-A	Monroe		D&A-OG	1122
86	655385	4881892	CARLOS H GOODRICH	1	Detroit River	Traverse Limestone	OIL	1081
87	655947	4883121	W H P HARES	4	Monroe		D&A	1081
88	655558	4883101	PHARES	1	Monroe	Dundee	OIL	1109
89	655155	4883079	GEO A SWINDLEHURST	2	Monroe	Dundee	OIL	1107
90	655155	4883079	GEO A SWINDLEHURST	2	Monroe	Traverse Formation	OIL-WO	1107
91	655366	4882692	GEO A SWINDLEHURST	3	Monroe	Dundee	OIL	1082
92	655755	4883131	NICHOLAS DORIS F	1-32	Richfield		D&A	1101
93	655312	4882889	SWINDLEHURST GEORG	4-32	Black Lime	Detroit Rv. Salt	GAS	1097
94	654970	4882718	FOX JOE	3-32	Black Lime	Richfield	OIL	1107
95	654930	4883035	FOX JOE	2-32	Amherstberg	Richfield	OIL	1132
96	654783	4882219	GOODRICH	7-32	Dundee		D&A	1116
97	655567	4882702	CHARLES H GOODRICH	1	Monroe	Monroe Formation	OIL	1085
98	656761	4882358	HARRY TOPE	1	Monroe		SERVICE	1071
99	656350	4883142	F R NEARHOOD	1	Dundee		D&A-OG	1085
100	656760	4882733	BWAB MARION	33-22-1	Dundee	Dundee	OIL	1084
101	656557	4882731	BASS	3-33	Richfield	Dundee	OIL	1095
102	656753	4883162	BWAB MARION	33-21-1	Dundee	Dundee	OIL	1092
103	656361	4882740	BASS	33-12-2	Dundee		D&A-O	1094
104	658530	4882864	MICH GAS	34-22-1	Black Lime		D&A-OG	1083
105	660882	4882204	STATE-WINTERFIELD	1	Dundee		D&A-O	1070
106	660877	4882409	STATE-WINTERFIELD	4-A	Monroe		SERVICE	1080
107	660868	4882811	STATE-WINTERFIELD	7-A	Dundee		D&A-OG	1080
108	661671	4882632	STATE-WINTERFIELD	2-A	Dundee	Dundee	OIL	1071
109	661275	4882622	CHARLES STRANGE	1-B	Dundee	Dundee	OIL	1081
110	661681	4882221	STATE-WINTERFIELD	6-A	Dundee	Dundee	OIL	1068
111	661285	4882212	STATE-WINTERFIELD	1-B	Dundee		D&A-O	1066
112	661676	4882431	STATE-WINTERFIELD	5-A	Dundee	Dundee	OIL	1071

Table 2
GENERAL PRODUCTION DATA

Well Number	X UTM(m)	Y UTM(m)	Lease	Well I.D. Num	TD Formation	Producing Formation	Type of Well	Datum Elevation
113	661280	4882421	CHARLES STRANGE	2	Dundee	Dundee	OIL	1074
114	661271	4882823	STATE-WINTERFIELD	3-A	Dundee	Dundee	OIL	1085
115	662089	4882028	STATE-WINTERFIELD	8-A	Dundee	Dundee	OIL	1074
116	661786	4882052	STATE-WINTERFIELD	9-A	Dundee	Dundee	OIL	1068
117	652577	4882959	MARION	1-36	Prarie Du Chien	Prairie Du Chien	GAS	1146
118	652803	4881697	MARION	2-36	Prarie Du Chien	Prairie Du Chien	GAS	1030

D&A = Dry and abandoned

Table 3
GEOPHYSICAL WELL LOGS

Dundee Wells / Log type	Gamma Ray	Density	Sonic	SNP	CNL	MSFL	LLD	MLL	Caliper	PEF
OKLAHOMA DRL BLACKLEDGE 2-20	x	x			x		x	x	x	
DART BENCHLEY 3-29	x	x			x		x	x	x	
DART JUNE 5-29	x	x			x	x	x	x	x	
SUN THAYER 8-29	x	x			x	x	x	x	x	
SUN THAYER 9-29	x	x			x		x	x	x	
BWAB BASS 3-33	x	x			x	x	x	x	x	x
PETROSTAR ST REDDING 1-1	x	x	x		x	x	x	x	x	x
NO MI EXP ET AL GERNAAT ET AL	x	x	x		x	x	x	x	x	x
HUNT ENERGY BRAY ET AL 3-30	x	x			x		x	x	x	
HUNT ENERGY BENCHLEY 1-31	x	x			x		x	x	x	
HUNT ENERGY BENCHLEY 3-31	x	x			x	x	x	x	x	
DART SNEARY 4-31	x	x			x	x	x	x	x	
DART OIL & GAS AUSTIN 3-31	x	x			x	x	x	x	x	x
BWAB INC. JOHNSON 4-31	x	x			x	x	x	x	x	x
DART NICHOLAS 1-32	x	x			x		x	x	x	
HUNT BRAY ET AL 1-30	x	x	x		x	x	x	x	x	
DART EGTS 7-29	x	x			x		x	x	x	
BWAB ST-FEDERAL 6-31 (6)	x	x			x				x	x
PETROSTAR ST-WINTERFIELD 1-19	x	x			x	x	x	x	x	x
DART WILLIAMS 7-31	x	x			x				x	
DART MOSHER 2-30	x	x			x		x	x	x	
DART BENCHLEY 2-29	x	x			x				x	
DART SWINDLEHURST 4-32	x	x			x		x	x	x	
MUSKEGON ST-REDDING 1-1	x			x					x	
DART LAUGHLIN 1-20	x	x			x				x	
HUNT BENCHLEY 2-31	x	x			x				x	
DART JACKSON 10-30	x	x			x				x	
DART LAUGHLIN 2-20	x	x			x				x	x
DART BARHITTE 6-30	x	x			x				x	
BWAB MICH GAS 34-22-1	x	x			x				x	x
DART FOX 2-32	x	x			x				x	
BWAB MARION 33-21-1	x	x			x	x	x	x	x	x
DART MICH GAS 6-29	x	x			x		x	x	x	
DART THAYER 3-29	x	x			x		x	x	x	x

WINTERFIELD FIELD

Table 3
GEOPHYSICAL WELL LOGS

Dundee Wells / Log type	Gamma Ray	Density	Sonic	SNP	CNL	MSFL	LLD	MLL	Caliper	PEF
DART MOSHER 5-30	x	x			x				x	
DART MOSHER 8-30	x	x			x				x	
DART BLACKLEDGE 4-30	x	x			x				x	
OKLAHOMA DRL BLACKLEDGE 2-20	x	x			x		x	x	x	
HUNT BRAY ETAL 3-30	x	x			x		x	x	x	
BWAB BASS 3-33	x	x			x		x	x	x	x
PETROSTAR MARION 1-36	x	x			x				x	x
DART AUSTIN 3-31	x	x			x	x	x	x	x	x
PETROSTAR ST WINTERFIELD 1-31	x	x			x				x	x
HUNT BENCHLEY 4-31	x	x			x				x	
HUNT BRAY ETAL 2-30	x	x			x				x	
DART BENCHLEY 1-29	x			GNT	PHIN					
DART BLACKLEDGE 4-29	x	x			x				x	
DART CALVERT 2-31	x	x			x				x	
DART JACKSON-MOSHER 7-30	x	x			x				x	
DART BENCHLEY 8-31	x	x			x				x	x
DART FOX 3-32	x	x			x				x	
MILLS-DEAN BENCHLEY ETAL 1-31	x									
HUNT WINTERFIELD DEEP 1-30	x	x	x	x	x	x	x	x	x	
MUSKEGON ST-REDDING 1-1	x								x	
OKLAHOMA DRLG BLACKLEDGE 1-20	x	x			x				x	
DART JOHNSON 3-30	x				x				x	
DART WINTERFIELD SWD 8-29	x	x			x				x	
DART MOSHER 1-30	x			GNT	PHIN					

WINTERFIELD FIELD

Table 4
PRODUCING LEASE IDENTIFICATIONS

Production Company	Lease	I.D.	Drift+ Thickness (ft)	Coldwater Shale Thickness (ft)	Traverse Limestone Thickness (ft)	Bell Shale Thickness (ft)	Limestone Cap Dundee Thickness (ft)	Dundee Dolomite Production Interval Arbitrary Thickness (ft)	Dundee Total Oil Production (to 1972) (Barrels of Oil)
DART OIL AND GAS	DART BENCHLEY 3-31	1	-402	-1566	-601	-63	-4	-227	
DART OIL AND GAS	DART AUSTIN 3-31	2	-403	-1574	-592	-56	-2	-229	
PURE OIL COMPANY	GEO A SWINDLEHURST	3	-493	-1510	-555	-70	-34	-208	520336
SUN OIL COMPANY	DELMER L THAYER	4	-460	-1516	-593	-55	-4	-227	1526273
PURE OIL COMPANY	M M RIKER	5	-419	-1590	-577	-63	-3	-211	62223
ROWMOR ET AL	W E & C WYMAN	6	-370	-1631	-584	-66	-1	-214	366073
CITIES SERVICE OIL	PHARES	7	-505	-1470	-611	-61	-4	-210	161448
DAILY CRUDE OIL	FRED SCHUETT	8	-472	-1525	-580	-77	-9	-214	220167
BWAB	BWAB MARION 33-22-1	9	-471	-1543	-604	-58	0	-182	
SUN OIL COMPANY	CHARLES STRANGE	10	-501	-1554	-592	-43	0	-153	669945
SUN OIL COMPANY	STATE-WINTERFIELD	11	-516	-1535	-570	-73	-2	-177	515877
SUN OIL COMPANY	STATE-REDDING	12	-474	-1583	-587	-51	-9	-147	158689
PURE OIL COMPANY	J M VAN DEUSEN	13	-475	-1562	-583	-84	0	-180	377100
SUN OIL COMPANY	STATE-GREENWOOD	14	-454	-1610	-591	-48	-1	-144	54734
SUN OIL COMPANY	GEORGE W AMSDEN	15	-492	-1581	-600	-36	-7	-120	1860

Table 5
DUNDEE INITIAL PRODUCTION TEST DATA

Well #	X UTM	Y UTM	Lease	Well	Production Top Depth (ft)	IP-test Volume	Unit*	Total Production(BO)	Datum Elevation(ft)	Subsea Elevation (ft)
3	662923.78	4880844.6	GEORGE W AMSDEN	1	3813	32	BO	1860	1097	-2716
4	662912.24	4881246.7	STATE-GREENWOOD	2-A	3803	240	BO	54734	1099	-2704
6	662505.21	4881342.2	J M VAN DEUSEN	1	3797	258	BO	377100	1095	-2702
8	662136.85	4881364.2	J M VAN DEUSEN	2	3797	250	BO		1093	-2704
9	662093.43	4881826.6	STATE-REDDING	2-A	3795	375	BO	158689	1091	-2704
25	656342.33	4883943.7	FRED SCHUETT	1	3776	456	BO	220167	1113	-2663
27	655379.64	4883873.2	FRED SCHUETT	2	3778	154	BO		1116	-2662
32	655147.78	4883481	DELMER L THAYER	2	3783	227	BO		1111	-2672
35	655939.11	4883924.2	PHARES	2	3743	40	BO		1083	-2660
36	655344.75	4883892.4	DELMER L THAYER	6	3738	1791	BO	1526273	1109	-2629
39	655546.32	4883903.8	WYMAN	2	3758	1394	BO	366073	1115	-2643
40	655747.92	4883914.1	WYMAN	3	3751	30	BO		1098	-2653
45	655349.39	4883491.3	DELMER L THAYER	1	3728	1292	BO		1100	-2628
49	655541.63	4884306	M M RIKER	1	3777	600	BO	62223	1125	-2652
50	655743.22	4884316.3	M M RIKER	2	3763	358	BO		1107	-2656
51	655550.98	4883502.7	W E & C WYMAN	1	3758	353	BO		1106	-2652
53	655941.39	4883523.1	PHARES	3	3726	185	BO	161448	1075	-2651
77	654578.07	4882259.6	AUSTIN	3-31	3744	35	BOPD		1117	-2627
82	654164.16	4882213.2	BENCHLEY	5-31	3761	50	BOPD		1125	-2636
88	655558.07	4883100.6	PHARES	1	3779	80	BO		1109	-2670
89	655154.85	4883078.9	GEO A SWINDLEHURST	2	3769	133	BO	520336	1107	-2662
91	655365.84	4882691.5	GEO A SWINDLEHURST	3	3757	113	BO		1082	-2675
100	656760.39	4882733.4	BWAB MARION	33-22-1	3760	32	BOPD		1084	-2676
101	656556.97	4882730.8	BASS	3-33	3760	40	BOPD		1095	-2665
102	656752.59	4883162.2	BWAB MARION	33-21-1	3762	9	BOPD		1092	-2670
108	661670.64	4882632	STATE-WINTERFIELD	2-A	3793	135	BO	515877	1071	-2722
109	661275.1	4882622.3	CHARLES STRANGE	1-B	3788	277	BO		1081	-2707
110	661680.72	4882221	STATE-WINTERFIELD	6-A	3763	325	BO		1068	-2695
112	661675.57	4882431	STATE-WINTERFIELD	5-A	3778	445	BO		1071	-2707
113	661280.02	4882421.3	CHARLES STRANGE	2	3764	1339	BO	669945	1074	-2690
114	661270.98	4882823.4	STATE-WINTERFIELD	3-A	3795	752	BO		1085	-2710
115	662089.29	4882027.7	STATE-WINTERFIELD	8-A	3783	116	BO		1074	-2709
116	661785.81	4882052.5	STATE-WINTERFIELD	9-A	3768	480	BO		1068	-2700

*BO = Barrels of Oil
BOPD = Barrels of Oil Per Day

APPENDIX A

THIS PROGRAM READS IN PETROLEUM INFORMATION
COMPANY FILES AND REDISTRIBUTES THE INFORMATION
TO SMALLER FILES WHICH CAN THEN BE READILY PROCESSED
BY SPREADSHEETS AND RELATIONAL DATABASES.

```
DECLARE SUB utmspreadsheet (utmx!(), utmy!())
DECLARE SUB idout (wellcount%, lat!(), longitude!(), oper$(), Lease$(), wellidnum$(),
elev%(), trvlimed%(), belld%(), dundeed%(), coldwatered%(), richfld%(), detroit%(), td%(),
cdyr%(), cdmnth%(), cdday%())
DECLARE SUB surfout (wellcount%, elev%(), dundeed%(), lat!(), longitude!(), trvlimed%(),
belld%(), coldwatered%(), richfld%())
DECLARE SUB topsout (wellcount%, elev%(), dundeed%(), lat!(), longitude!(), trvlimed%(),
belld%(), coldwatered%(), richfld%())
DECLARE SUB generalinformation (q%, api#(), line$, lat!(), longitude!(), oper$(), Lease$(),
formtd$(), prodform$(), typewell$(), elev%(), wellcount%, td%(), cdyr%(), cdmnth%(),
cdday%())
DECLARE SUB b ()
DECLARE SUB location (q%, line$, oper$(), Lease$(), wellidnum$())
DECLARE SUB D ()
DECLARE SUB tops (line$, form$, x!, z, q%, dundeed%(), depth$(), trvlimed%(), belld%(),
coldwatered%(), richfld%(), detroit%())
DECLARE SUB iptests (q%, line$, testform$(), testtop%(), testbottom%(), oilvol%(), oilunit$(),
gasvol%(), watervol%())
DECLARE SUB productionout (wellcount%, utmx!(), utmy!(), wellidnum$(), Lease$(),
testform$(), testtop%(), testbottom%(), oilvol%(), oilunit$(), gasvol%(), watervol%())
DECLARE SUB generalout (q%, line$, utmx!(), utmy!(), oper$(), Lease$(), formtd$(),
prodform$(), typewell$(), elev%(), wellcount%, td%(), cdyr%())
DECLARE SUB utmsreadsheet (utmx!(), utmy!())
CLS
x = 0
z = 0
q% = 0
maxlines% = 1620
wellnum% = 120
wellcount% = 0
DIM formtd$(wellnum%)
DIM prodform$(wellnum%)
DIM typewell$(wellnum%)
DIM elev%(wellnum%)
```

```
DIM form$(wellnum%)
DIM dundeed%(wellnum%)
DIM depth$(wellnum%)
DIM api#(wellnum%)
DIM lat!(wellnum%)
DIM longitude!(wellnum%)
DIM trvlimed%(wellnum%)
DIM belld%(wellnum%)
DIM coldwatered%(wellnum%)
DIM richfld%(wellnum%)
DIM detroit%(wellnum%)
DIM oper$(wellnum%)
DIM Lease$(wellnum%)
DIM wellidnum$(wellnum%)
DIM cdyr%(wellnum%)
DIM cdmnth%(wellnum%)
DIM cdday%(wellnum%)
DIM td%(wellnum%)
DIM testform$(wellnum%)
DIM testtop%(wellnum%)
DIM testbottom%(wellnum%)
DIM oilvol%(wellnum%)
DIM oilunit$(wellnum%)
DIM gasvol%(wellnum%)
DIM utmx!(wellnum%)
DIM utmy!(wellnum%)
DIM watervol%(wellnum%)


filename$ = "D:\thesis\data\michtech.wel"
utmfile$ = "D:\thesis\tables\utmxutmy.prn"


OPEN filename$ FOR INPUT AS #1
OPEN utmfile$ FOR INPUT AS #11

'OPEN "D:\thesis\tops\dun-top.dat" FOR OUTPUT AS #2
'OPEN "D:\thesis\tops\tcl-top.dat" FOR OUTPUT AS #3
'OPEN "D:\thesis\tops\bel-top.dat" FOR OUTPUT AS #4
'OPEN "D:\thesis\tops\cld-top.dat" FOR OUTPUT AS #5
'OPEN "D:\thesis\tops\alltops.dat" FOR OUTPUT AS #6

'OPEN "D:\thesis\surfaces\dun-surf.dat" FOR OUTPUT AS #22
'OPEN "D:\thesis\surfaces\tcl-surf.dat" FOR OUTPUT AS #23
'OPEN "D:\thesis\surfaces\bel-surf.dat" FOR OUTPUT AS #24
```

```
'OPEN "D:\thesis\surfaces\cld-surf.dat" FOR OUTPUT AS #25
'OPEN "D:\thesis\surfaces\rch-surf.dat" FOR OUTPUT AS #26

OPEN "D:\thesis\tables\table1.prn" FOR OUTPUT AS #105
OPEN "D:\thesis\tables\prodtion.prn" FOR OUTPUT AS #106

OPEN "D:\thesis\general\general.dat" FOR OUTPUT AS #8


CALL utmspreadsheet(utmx!(), utmy!())

    DO WHILE NOT EOF(1)
    line$ = ""
        x = x + 1
        LINE INPUT #1, line$

        lead$ = LEFT$(line$, 1)

        IF lead$ = "A" THEN
            CALL generalinformation(q%, api#(), line$, lat!(), longitude!(), oper$(),
Lease$(), formtd$(), prodform$(), typewell$(), elev%(), wellcount%, td%(), cdyr%(),
cdmnth%(), cdday%())
        END IF
        IF lead$ = "B" THEN
            CALL b
        END IF
        IF lead$ = "C" THEN
            CALL location(q%, line$, oper$(), Lease$(), wellidnum$())
        END IF
        IF lead$ = "D" THEN
            CALL D
        END IF
        IF lead$ = "E" THEN
            CALL tops(line$, form$, x, z, q%, dundeed%(), depth$(), trvlimed%(), belld%(),
coldwatered%(), richfld%(), detroit%())
        END IF

        IF lead$ = "F" THEN
            CALL iptests(q%, line$, testform$(), testtop%(), testbottom%(), oilvol%(),
oilunit$(), gasvol%(), watervol%())
        END IF
        'PRINT "line number    ", x; "line$    ", line$


    LOOP
```

```
CALL idout(wellcount%, lat!(), longitude!(), oper$(), Lease$(), wellidnum$(), elev%(),
trvlimed%(), belld%(), dundeed%(), coldwatered%(), richfld%(), detroit%(), td%(), cdyr%(),
cdmnth%(), cdday%())
CALL topsout(wellcount%, elev%(), dundeed%(), lat!(), longitude!(), trvlimed%(), belld%(),
coldwatered%(), richfld%())
CALL surfout(wellcount%, elev%(), dundeed%(), lat!(), longitude!(), trvlimed%(), belld%(),
coldwatered%(), richfld%())
CALL productionout(wellcount%, utmx!(), utmy!(), wellidnum$(), Lease$(), testform$(),
testtop%(), testbottom%(), oilvol%(), oilunit$(), gasvol%(), watervol%())



CLOSE #1, #2, #3, #4, #5, #6, #22, #23, #24, #25, #26, #8, #105, #106, #11
END

SUB b
"print "it got here too"
END SUB

SUB D
"print "we're on our way"
END SUB

SUB generalinformation (q%, api#(), line$, lat!(), longitude!(), oper$(), Lease$(), formtd$(),
prodform$(), typewell$(), elev%(), wellcount%, td%(), cdyr%(), cdmnth%(), cdday%())



q% = q% + 1

api#(q%) = VAL(MID$(line$, 2, 14))

lat!(q%) = VAL(MID$(line$, 16, 7)) / 100000
'WRITE "latitude", lat!(q%)

longitude!(q%) = VAL(MID$(line$, 23, 8)) / 100000
'WRITE "longitude", longitude!(q%)

formtd$(q%) = MID$(line$, 31, 8)

prodform$(q%) = MID$(line$, 39, 8)

typewell$(q%) = MID$(line$, 49, 6)
```

```
elev%(q%) = VAL(MID$(line$, 55, 5))

td%(q%) = VAL(MID$(line$, 62, 5))

cdyr%(q%) = VAL(MID$(line$, 67, 2))
cdmnth%(q%) = VAL(MID$(line$, 69, 2))
cdday%(q%) = VAL(MID$(line$, 71, 2))

IF prodform$(q%) = "302DNDE " THEN
prodform$(q%) = "Dundee          "
END IF

IF prodform$(q%) = "302RCFD " THEN
prodform$(q%) = "Richfield       "
END IF

IF prodform$(q%) = "201PRDC " THEN
prodform$(q%) = "Prairie Du Chien  "
END IF

IF prodform$(q%) = "302TRVR " THEN
prodform$(q%) = "Traverse Formation"
END IF

IF prodform$(q%) = "302TRVRL" THEN
prodform$(q%) = "Traverse Limestone"
END IF

IF prodform$(q%) = "353MCGN " THEN
prodform$(q%) = "Michigan Formation"
END IF

IF prodform$(q%) = "302AMBG " THEN
prodform$(q%) = "Amherstburg      "
END IF

IF prodform$(q%) = "302MONR " THEN
prodform$(q%) = "Monroe Formation  "
END IF

IF prodform$(q%) = "302BKLM " THEN
prodform$(q%) = "Black Lime       "
END IF

IF prodform$(q%) = "302DRRVS" THEN
```

```
prodform$(q%) = "Detroit Rv. Salt  "
END IF

IF prodform$(q%) = "302MSAD " THEN
prodform$(q%) = "Massive Anhydrite "
END IF

IF prodform$(q%) = "201FSTR " THEN
prodform$(q%) = "                "
END IF

IF prodform$(q%) = "153MNSG " THEN
prodform$(q%) = "Munising         "
END IF

IF prodform$(q%) = "201BRZS " THEN
prodform$(q%) = "                "
END IF

IF prodform$(q%) = "202GLND " THEN
prodform$(q%) = "Grass Island     "
END IF




'wRITE #8, q%, api#(q%), longitude!(q%), lat!(q%), oper$(q%), Lease$(q%), formtd$(q%),
prodform$(q%), typewell$(q%), elev%(q%)
'WRITE q%, api#(q%), longitude!(q%), lat!(q%), oper$(q%), Lease$(q%), formtd$(q%),
prodform$(q%), typewell$(q%), elev%(q%)
wellcount% = wellcount% + 1

END SUB

SUB generalout (q%, line$, utmx!(), utmy!(), oper$(), Lease$(), formtd$(), prodform$(),
typewell$(), elev%(), wellcount%, td%(), cdyr%())

      FOR h% = 1 TO wellcount%
            WRITE h%, utmx!(h%), utmy!(h%), oper$(h%), Lease$(h%), formtd$(h%),
prodform$(h%), typewell$(h%), elev%(h%), td%(h%), cdyr%(h%)
      NEXT h%


END SUB
```

```
SUB idout (wellcount%, lat!(), longitude!(), oper$(), Lease$(), wellidnum$(), elev%(),
trvlimed%(), belld%(), dundeed%(), coldwatered%(), richfld%(), detroit%(), td%(), cdyr%(),
cdmnth%(), cdday%())
ar% = 0
'write "It's getting here but not executing"
      WRITE #105, " ", " ", " ", " ", " ", " Well ", " ", "Coldwater", "Traverse", "Bell", "Dundee",
"Richfield", "Detroit", "Total", "Completion", "Completion", "Completion"
      WRITE #105, "Well Number", "Longitude", "Latitude", "Operator", "Lease", "I.D. Num",
"Elevation", "Shale", "Lime", "Shale", "Limestone", "Member", "River", "Depth", "Year",
"Month", "Day"

FOR ar% = 1 TO wellcount%
      WRITE #105, ar%, longitude!(ar%), lat!(ar%), oper$(ar%), Lease$(ar%),
wellidnum$(ar%), elev%(ar%), coldwatered%(ar%), trvlimed%(ar%), belld%(ar%),
dundeed%(ar%), richfld%(ar%), detroit%(ar%), td%(ar%), cdyr%(ar%), cdmnth%(ar%),
cdday%(ar%)
      'write ar%, lat!(ar%), Longitude!(ar%), oper$(ar%), Lease$(ar%), wellidnum$(ar%),
elev%(ar%), coldwatered%(ar%), trvlimed%(ar%), belld%(ar%), dundeed%(ar%),
richfld%(ar%), detroit%(ar%), td%(ar%), cdyr%(ar%), cdmnth%(ar%), cdday%(ar%)
NEXT ar%
END SUB

SUB iptests (q%, line$, testform$(), testtop%(), testbottom%(), oilvol%(), oilunit$(), gasvol%(),
watervol%())
IF LEFT$(line$, 2) = "F " THEN
      testform$(q%) = MID$(line$, 3, 8)
      testtop%(q%) = VAL(MID$(line$, 11, 5))
      testbottom%(q%) = VAL(MID$(line$, 16, 5))
      oilvol%(q%) = VAL(MID$(line$, 21, 4))
      oilunit$(q%) = (MID$(line$, 25, 4))
      gasvol%(q%) = VAL(MID$(line$, 29, 5))

      watervol%(q%) = VAL(MID$(line$, 38, 4))

END IF

END SUB

SUB location (q%, line$, oper$(), Lease$(), wellidnum$())

oper$(q%) = MID$(line$, 2, 23)
Lease$(q%) = MID$(line$, 25, 19)
wellidnum$(q%) = MID$(line$, 44, 10)
"print oper$(q%), lease$(q%), wellidnum$(q%)
```

```
END SUB

SUB productionout (wellcount%, utmx!(), utmy!(), wellidnum$(), Lease$(), testform$(),
testtop%(), testbottom%(), oilvol%(), oilunit$(), gasvol%(), watervol%())

     WRITE "Well number", "UTM-X", "UTM-Y", "Lease", "Well number", "Prod. test form.",
"Test top", "Test bottom", "Oil volume", "Oil unit", "Gas Volume", "Water volume"
     WRITE #106, "Well number", "UTM-X", "UTM-Y", "Lease", "Well number", "Prod. test
form.", "Test top", "Test bottom", "Oil volume", "Oil unit", "Gas Volume", "Gas unit", "Water
volume"

     FOR pz% = 1 TO wellcount%

          WRITE pz%, utmx!(pz%), utmy!(pz%), Lease$(pz%), wellidnum$(pz%),
testform$(pz%), testtop%(pz%), testbottom%(pz%), oilvol%(pz%), oilunit$(pz%),
gasvol%(pz%), watervol%(pz%)

          WRITE #106, pz%, utmx!(pz%), utmy!(pz%), Lease$(pz%), wellidnum$(pz%),
testform$(pz%), testtop%(pz%), testbottom%(pz%), oilvol%(pz%), oilunit$(pz%),
gasvol%(pz%), watervol%(pz%)

     NEXT pz%
END SUB

SUB surfout (wellcount%, elev%(), dundeed%(), lat!(), longitude!(), trvlimed%(), belld%(),
coldwatered%(), richfld%())

     'write wellcount%
     FOR ak% = 1 TO wellcount%
          IF dundeed%(ak%) > 0 THEN
               dundeed%(ak%) = elev%(ak%) - dundeed%(ak%)
               'write "Dundee Surface----->", longitude!(ak%), lat!(ak%), dundsurf%(ak%)
               'write #22, longitude!(ak%), lat!(ak%),dundeed%(ak%)

          END IF

          IF trvlimed%(ak%) > 0 THEN
               trvlimed%(ak%) = elev%(ak%) - trvlimed%(ak%)
               'write "T. C. Limestone Surface----->", longitude!(ak%), lat!(ak%),
trvlimed%(ak%)
               'write #23, longitude!(ak%), lat!(ak%), trvlimed%(ak%)
          END IF

          IF belld%(ak%) > 0 THEN
```

```
            belld%(ak%) = elev%(ak%) - belld%(ak%)
            'write "Bell Shale Surface----->", longitude!(ak%), lat!(ak%), belld%(ak%)
            'write #24, longitude!(ak%), lat!(ak%), belld%(ak%)
        END IF

        IF coldwatered%(ak%) > 0 THEN
            coldwatered%(ak%) = elev%(ak%) - coldwatered%(ak%)
            'write "Coldwater Shale Surface----->", longitude!(ak%), lat!(ak%),
coldwatered%(ak%)
            'write #25, longitude!(ak%), lat!(ak%), coldwatered%(ak%)
        END IF

        IF richfld%(ak%) > 0 THEN
            richfld%(ak%) = elev%(ak%) - richfld%(ak%)
            'write "Richfield member Surface----->", longitude!(ak%), lat!(ak%),
richfld%(ak%)
            'write #26, longitude!(ak%), lat!(ak%), richfld%(ak%)
        END IF


    NEXT ak%
END SUB

SUB tops (line$, form$, x, z, q%, dundeed%(), depth$(), trvlimed%(), belld%(), coldwatered%(),
richfld%(), detroit%())

start% = 2
j$ = "open "

FOR ai% = z TO z + 5

    z = z + 1
    form$ = MID$(line$, start%, 8) 'multiple production formations on the same data line,
start% changes.


    start% = start% + 8            'increments to the next formation top
    depth$ = MID$(line$, start%, 5)  'depth to formation top


    '**********************************************
    '**********************************************

      Names the formation tops from coded input
```

```
'***********************************************
'***********************************************

IF form$ = "351CLDR " OR form$ = "351CLDRR" THEN
coldwatered%(q%) = VAL(depth$)
"print "COLDWATER SHALE DEPTH      ---------> ", coldwatered%(q%)
END IF


IF form$ = "302TRVRL" THEN
trvlimed%(q%) = VAL(depth$)
"print "TRAVERSE LIMESTONE DEPTH   ---------> ", trvlimed%(q%)
END IF

IF form$ = "302BELL " THEN
belld%(q%) = VAL(depth$)
"print "BELL SHALE DEPTH           ---------> ", belld%(q%)
END IF


IF form$ = "302DNDE " THEN
dundeed%(q%) = VAL(depth$)
"print "DUNDEE DEPTH               ---------> ", dundeed%(q%)
END IF

IF form$ = "302RCFD " THEN
richfld%(q%) = VAL(depth$)
'print "RICHFIELD DEPTH            ---------> ", richfld%(q%)
END IF

IF form$ = "302DRRV " OR form$ = "302DRRVA" THEN
detroit%(q%) = VAL(depth$)
'PRINT "DETROIT RIVER GROUP", q%, detroit%(q%)
END IF


'***********************************************************
'***********************************************************

start% = start% + 5              'reading at the end of the line
source$ = MID$(line$, start%, 1)  '"                "
start% = start% + 1              '"                "
show$ = MID$(line$, start%, 1)    '"                "
start% = start% + 1              '"                "
```

```
'$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
'$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

                Test print routine

'$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
'$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

NEXT ai%
'print q%, dundeed%(q%)
'print "DUNDEE DEPTH    ---------> ", q%, dundeed%(q%)
'print #2, "DUNDEE DEPTH    ---------> ", q%, dundeed%(q%)

'$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
'$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

END SUB

SUB topsout (wellcount%, elev%(), dundeed%(), lat!(), longitude!(), trvlimed%(), belld%(),
coldwatered%(), richfld%())

    FOR aj% = 1 TO wellcount%
        IF dundeed%(aj%) > 0 THEN
        'write Longitude!(aj%), lat!(aj%), dundeed%(aj%), trvlimed%(aj%), belld%(aj%),
coldwatered%(aj%)
        'WRITE #2, longitude!(aj%), lat!(aj%), dundeed%(aj%)
        END IF

        IF trvlimed%(aj%) > 0 THEN
        'write "T.C. Limestone Top----->", Longitude!(aj%), lat!(aj%), trvlimed%(aj%)
        'WRITE #3, longitude!(aj%), lat!(aj%), dundeed%(aj%), trvlimed%(aj%), belld%(aj%),
coldwatered%(aj%)
        END IF

        IF belld%(aj%) > 0 THEN
        'write "Bell Shale Top----->", Longitude!(aj%), lat!(aj%), belld%(aj%)
        'WRITE #4, longitude!(aj%), lat!(aj%), belld%(aj%)
        END IF

        IF coldwatered%(aj%) > 0 THEN
        'write "Coldwater Shale Top----->", Longitude!(aj%), lat!(aj%), coldwatered%(aj%)
        'WRITE #5, longitude!(aj%), lat!(aj%), coldwatered%(aj%)
        END IF
```

```
        'WRITE #6, aj%, elev%(aj%), dundeed%(aj%), trvlimed%(aj%), belld%(aj%),
coldwatered%(aj%)

    NEXT aj%

END SUB

SUB utmspreadsheet (utmx!(), utmy!())
wellnumber% = 1
    DO WHILE NOT EOF(11)
        INPUT #11, utmxloc, utmyloc
        utmx!(wellnumber%) = utmxloc
        utmy!(wellnumber%) = utmyloc
        WRITE utmx!(wellnumber%), utmy!(wellnumber%)
        wellnumber% = wellnumber% + 1
    LOOP


END SUB
```

APPENDIX B

degrees	minutes	seconds	degrees	minutes	seconds	λ(0)	λ(0)	Decimal Degrees		radians	radians	UTM	UTM					ε	η	N
φ	φ	φ	λ	λ	λ	degrees	radians	φ	λ	φ	λ	X	Y	a	t	t sq'd	ε	sq'd	sq'd	meters
44.0718	0.000	0.000	84.9658	0.000	0.000	87.000	1.518	44.072	84.968	0.769	1.483	662899	4881644	6378206	0.968	0.937	0.082	0.007	0.004	6388675
44.0646	0.000	0.000	84.9613	0.000	0.000	87.000	1.518	44.065	84.961	0.769	1.483	663281	4880853	6378206	0.968	0.937	0.082	0.007	0.004	6388673
44.0646	0.000	0.000	84.9657	0.000	0.000	87.000	1.518	44.065	84.966	0.769	1.483	662924	4880845	6378206	0.968	0.937	0.082	0.007	0.004	6388673
44.0682	0.000	0.000	84.9658	0.000	0.000	87.000	1.518	44.068	84.966	0.769	1.483	662912	4881247	6378206	0.968	0.937	0.082	0.007	0.004	6388674
44.0656	0.000	0.000	84.9708	0.000	0.000	87.000	1.518	44.066	84.971	0.769	1.483	662517	4880940	6378206	0.968	0.937	0.082	0.007	0.004	6388673
44.0692	0.000	0.000	84.9708	0.000	0.000	87.000	1.518	44.069	84.971	0.769	1.483	662505	4881342	6378206	0.968	0.937	0.082	0.007	0.004	6388674
44.0722	0.000	0.000	84.9708	0.000	0.000	87.000	1.518	44.072	84.971	0.769	1.483	662495	4881674	6378206	0.968	0.937	0.082	0.007	0.004	6388676
44.0695	0.000	0.000	84.9754	0.000	0.000	87.000	1.518	44.069	84.975	0.769	1.483	662137	4881364	6378206	0.968	0.937	0.082	0.007	0.004	6388675
44.0736	0.000	0.000	84.9758	0.000	0.000	87.000	1.518	44.074	84.976	0.769	1.483	662093	4881827	6378206	0.968	0.937	0.082	0.007	0.004	6388676
44.0723	0.000	0.000	84.9752	0.000	0.000	87.000	1.518	44.072	84.975	0.769	1.483	662146	4881683	6378206	0.968	0.937	0.082	0.007	0.004	6388676
44.0726	0.000	0.000	85.0347	0.000	0.000	87.000	1.518	44.073	85.035	0.769	1.484	657378	4881597	6378206	0.968	0.937	0.082	0.007	0.004	6388676
44.0721	0.000	0.000	85.057	0.000	0.000	87.000	1.518	44.072	85.057	0.769	1.485	655596	4881499	6378206	0.968	0.937	0.082	0.007	0.004	6388676
44.0538	0.000	0.000	85.0058	0.000	0.000	87.000	1.518	44.054	85.006	0.769	1.484	659745	4879563	6378206	0.968	0.936	0.082	0.007	0.004	6388669
44.0538	0.000	0.000	85.0058	0.000	0.000	87.000	1.518	44.054	85.006	0.769	1.484	659745	4879563	6378206	0.968	0.936	0.082	0.007	0.004	6388669
44.1228	0.000	0.000	85.0292	0.000	0.000	87.000	1.518	44.123	85.029	0.770	1.484	657686	4887189	6378206	0.970	0.941	0.082	0.007	0.004	6388695
44.112	0.000	0.000	85.0819	0.000	0.000	87.000	1.518	44.112	85.082	0.770	1.485	653495	4885883	6378206	0.969	0.940	0.082	0.007	0.004	6388691
44.1038	0.000	0.000	85.0693	0.000	0.000	87.000	1.518	44.104	85.069	0.770	1.485	654526	4884997	6378206	0.969	0.939	0.082	0.007	0.004	6388688
44.1107	0.000	0.000	85.0767	0.000	0.000	87.000	1.518	44.111	85.077	0.770	1.485	653918	4885750	6378206	0.969	0.940	0.082	0.007	0.004	6388690
44.1064	0.000	0.000	85.0595	0.000	0.000	87.000	1.518	44.106	85.059	0.770	1.485	655308	4885300	6378206	0.969	0.940	0.082	0.007	0.004	6388689
44.1079	0.000	0.000	85.0644	0.000	0.000	87.000	1.518	44.108	85.064	0.770	1.485	654911	4885461	6378206	0.969	0.940	0.082	0.007	0.004	6388689
44.1043	0.000	0.000	85.0543	0.000	0.000	87.000	1.518	44.104	85.054	0.770	1.484	655730	4885083	6378206	0.969	0.939	0.082	0.007	0.004	6388688
44.1041	0.000	0.000	85.0643	0.000	0.000	87.000	1.518	44.104	85.064	0.770	1.485	654926	4885039	6378206	0.969	0.939	0.082	0.007	0.004	6388688
44.1003	0.000	0.000	85.0368	0.000	0.000	87.000	1.518	44.100	85.037	0.770	1.484	657137	4884671	6378206	0.969	0.939	0.082	0.007	0.004	6388686
44.0905	0.000	0.000	85.037	0.000	0.000	87.000	1.518	44.091	85.037	0.770	1.484	657146	4883582	6378206	0.969	0.938	0.082	0.007	0.004	6388683
44.0903	0.000	0.000	85.0471	0.000	0.000	87.000	1.518	44.090	85.047	0.770	1.484	656344	4883544	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0939	0.000	0.000	85.047	0.000	0.000	87.000	1.518	44.094	85.047	0.770	1.484	656342	4883944	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0939	0.000	0.000	85.047	0.000	0.000	87.000	1.518	44.094	85.047	0.770	1.484	656342	4883944	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0935	0.000	0.000	85.059	0.000	0.000	87.000	1.518	44.094	85.059	0.770	1.485	655380	4883873	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0936	0.000	0.000	85.0643	0.000	0.000	87.000	1.518	44.094	85.064	0.770	1.485	654952	4883872	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0936	0.000	0.000	85.0619	0.000	0.000	87.000	1.518	44.094	85.062	0.770	1.485	655143	4883882	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0899	0.000	0.000	85.0669	0.000	0.000	87.000	1.518	44.090	85.067	0.770	1.485	654757	4883461	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.09	0.000	0.000	85.062	0.000	0.000	87.000	1.518	44.090	85.062	0.770	1.485	655148	4883481	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.09	0.000	0.000	85.062	0.000	0.000	87.000	1.518	44.090	85.062	0.770	1.485	655148	4883481	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0972	0.000	0.000	85.0643	0.000	0.000	87.000	1.518	44.097	85.064	0.770	1.485	654944	4884274	6378206	0.969	0.939	0.082	0.007	0.004	6388685
44.0938	0.000	0.000	85.052	0.000	0.000	87.000	1.518	44.094	85.052	0.770	1.484	655939	4883924	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0937	0.000	0.000	85.0594	0.000	0.000	87.000	1.518	44.094	85.059	0.770	1.485	655345	4883892	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0976	0.000	0.000	85.0544	0.000	0.000	87.000	1.518	44.098	85.054	0.770	1.484	655740	4884332	6378206	0.969	0.939	0.082	0.007	0.004	6388685
44.101	0.000	0.000	85.0568	0.000	0.000	87.000	1.518	44.101	85.057	0.770	1.485	655537	4884706	6378206	0.969	0.939	0.082	0.007	0.004	6388686
44.0937	0.000	0.000	85.0569	0.000	0.000	87.000	1.518	44.094	85.057	0.770	1.485	655546	4883904	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0938	0.000	0.000	85.0544	0.000	0.000	87.000	1.518	44.094	85.054	0.770	1.484	655748	4883914	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0907	0.000	0.000	85.0611	0.000	0.000	87.000	1.518	44.091	85.061	0.770	1.485	655217	4883555	6378206	0.969	0.938	0.082	0.007	0.004	6388683
44.1009	0.000	0.000	85.0599	0.000	0.000	87.000	1.518	44.101	85.060	0.770	1.485	655290	4884693	6378206	0.969	0.939	0.082	0.007	0.004	6388686
44.1007	0.000	0.000	85.0543	0.000	0.000	87.000	1.518	44.101	85.054	0.770	1.484	655737	4884686	6378206	0.969	0.939	0.082	0.007	0.004	6388686
44.0932	0.000	0.000	85.0647	0.000	0.000	87.000	1.518	44.093	85.065	0.770	1.485	654927	4883828	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0901	0.000	0.000	85.0595	0.000	0.000	87.000	1.518	44.090	85.059	0.770	1.485	655349	4883491	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0964	0.000	0.000	85.0656	0.000	0.000	87.000	1.518	44.096	85.066	0.770	1.485	654847	4884185	6378206	0.969	0.939	0.082	0.007	0.004	6388685
44.09	0.000	0.000	85.0645	0.000	0.000	87.000	1.518	44.090	85.065	0.770	1.485	654947	4883468	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.09	0.000	0.000	85.0645	0.000	0.000	87.000	1.518	44.090	85.065	0.770	1.485	654947	4883468	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0974	0.000	0.000	85.0568	0.000	0.000	87.000	1.518	44.097	85.057	0.770	1.485	655542	4884306	6378206	0.969	0.939	0.082	0.007	0.004	6388685
44.0974	0.000	0.000	85.0543	0.000	0.000	87.000	1.518	44.097	85.054	0.770	1.484	655743	4884316	6378206	0.969	0.939	0.082	0.007	0.004	6388685

degrees	minutes	seconds	degrees	minutes	seconds	λ(0)	λ(0)	Decimal Degrees		radians	radians	UTM	UTM					ε	η	N
φ	φ	φ	λ	λ	λ	degrees	radians	φ	λ	φ	λ	X	Y	a	t	t sq'd	ε	sq'd	sq'd	meters
44.0901	0.000	0.000	85.057	0.000	0.000	87.000	1.518	44.090	85.057	0.770	1.485	655551	4883503	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0902	0.000	0.000	85.0545	0.000	0.000	87.000	1.518	44.090	85.054	0.770	1.484	655752	4883513	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0902	0.000	0.000	85.0521	0.000	0.000	87.000	1.518	44.090	85.052	0.770	1.484	655941	4883523	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0902	0.000	0.000	85.0521	0.000	0.000	87.000	1.518	44.090	85.052	0.770	1.484	655941	4883523	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0902	0.000	0.000	85.0669	0.000	0.000	87.000	1.518	44.090	85.067	0.770	1.485	654757	4883491	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0899	0.000	0.000	85.0694	0.000	0.000	87.000	1.518	44.090	85.069	0.770	1.485	654557	4883453	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0941	0.000	0.000	85.0702	0.000	0.000	87.000	1.518	44.094	85.070	0.770	1.485	654483	4883914	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0932	0.000	0.000	85.0797	0.000	0.000	87.000	1.518	44.093	85.080	0.770	1.485	653727	4883799	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0971	0.000	0.000	85.0694	0.000	0.000	87.000	1.518	44.097	85.069	0.770	1.485	654536	4884257	6378206	0.969	0.939	0.082	0.007	0.004	6388685
44.09	0.000	0.000	85.0795	0.000	0.000	87.000	1.518	44.090	85.079	0.770	1.485	653748	4883449	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.1007	0.000	0.000	85.0699	0.000	0.000	87.000	1.518	44.101	85.070	0.770	1.485	654487	4884655	6378206	0.969	0.939	0.082	0.007	0.004	6388686
44.1009	0.000	0.000	85.0745	0.000	0.000	87.000	1.518	44.101	85.074	0.770	1.485	654120	4884665	6378206	0.969	0.939	0.082	0.007	0.004	6388686
44.0935	0.000	0.000	85.0703	0.000	0.000	87.000	1.518	44.094	85.070	0.770	1.485	654477	4883853	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0974	0.000	0.000	85.0745	0.000	0.000	87.000	1.518	44.097	85.075	0.770	1.485	654126	4884276	6378206	0.969	0.939	0.082	0.007	0.004	6388685
44.0935	0.000	0.000	85.0745	0.000	0.000	87.000	1.518	44.094	85.074	0.770	1.485	654142	4883845	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0935	0.000	0.000	85.0745	0.000	0.000	87.000	1.518	44.093	85.075	0.770	1.485	654138	4883838	6378206	0.969	0.939	0.082	0.007	0.004	6388684
44.0968	0.000	0.000	85.0795	0.000	0.000	87.000	1.518	44.097	85.079	0.770	1.485	653730	4884206	6378206	0.969	0.939	0.082	0.007	0.004	6388685
44.0968	0.000	0.000	85.0846	0.000	0.000	87.000	1.518	44.097	85.085	0.770	1.485	653325	4884196	6378206	0.969	0.939	0.082	0.007	0.004	6388685
44.0898	0.000	0.000	85.0745	0.000	0.000	87.000	1.518	44.090	85.075	0.770	1.485	654148	4883428	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0897	0.000	0.000	85.0846	0.000	0.000	87.000	1.518	44.090	85.085	0.770	1.485	653339	4883400	6378206	0.969	0.938	0.082	0.007	0.004	6388682
44.0863	0.000	0.000	85.0694	0.000	0.000	87.000	1.518	44.086	85.069	0.769	1.485	654564	4883051	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0863	0.000	0.000	85.0796	0.000	0.000	87.000	1.518	44.086	85.080	0.769	1.485	653753	4883029	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0828	0.000	0.000	85.0695	0.000	0.000	87.000	1.518	44.083	85.069	0.769	1.485	654569	4882661	6378206	0.968	0.938	0.082	0.007	0.004	6388680
44.0801	0.000	0.000	85.0795	0.000	0.000	87.000	1.518	44.080	85.080	0.769	1.485	653770	4882343	6378206	0.968	0.938	0.082	0.007	0.004	6388679
44.0801	0.000	0.000	85.0795	0.000	0.000	87.000	1.518	44.080	85.080	0.769	1.485	653770	4882343	6378206	0.968	0.938	0.082	0.007	0.004	6388679
44.0866	0.000	0.000	85.0747	0.000	0.000	87.000	1.518	44.087	85.075	0.769	1.485	654142	4883074	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0792	0.000	0.000	85.0695	0.000	0.000	87.000	1.518	44.079	85.069	0.769	1.485	654578	4882260	6378206	0.968	0.938	0.082	0.007	0.004	6388678
44.0769	0.000	0.000	85.0792	0.000	0.000	87.000	1.518	44.077	85.079	0.769	1.485	653803	4881986	6378206	0.968	0.938	0.082	0.007	0.004	6388677
44.0836	0.000	0.000	85.0747	0.000	0.000	87.000	1.518	44.084	85.075	0.769	1.485	654148	4882746	6378206	0.969	0.938	0.082	0.007	0.004	6388680
44.0766	0.000	0.000	85.0747	0.000	0.000	87.000	1.518	44.077	85.075	0.769	1.485	654167	4881970	6378206	0.968	0.938	0.082	0.007	0.004	6388677
44.0828	0.000	0.000	85.0796	0.000	0.000	87.000	1.518	44.083	85.080	0.769	1.485	653762	4882643	6378206	0.968	0.938	0.082	0.007	0.004	6388680
44.0788	0.000	0.000	85.0747	0.000	0.000	87.000	1.518	44.079	85.075	0.769	1.485	654164	4882213	6378206	0.968	0.938	0.082	0.007	0.004	6388678
44.0851	0.000	0.000	85.0775	0.000	0.000	87.000	1.518	44.085	85.077	0.769	1.485	653920	4882904	6378206	0.969	0.938	0.082	0.007	0.004	6388680
44.0865	0.000	0.000	85.0595	0.000	0.000	87.000	1.518	44.086	85.060	0.769	1.485	655356	4883089	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0864	0.000	0.000	85.0644	0.000	0.000	87.000	1.518	44.086	85.064	0.769	1.485	654967	4883069	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0757	0.000	0.000	85.0595	0.000	0.000	87.000	1.518	44.076	85.060	0.769	1.485	655385	4881892	6378206	0.968	0.937	0.082	0.007	0.004	6388677
44.0866	0.000	0.000	85.0521	0.000	0.000	87.000	1.518	44.087	85.052	0.769	1.484	655947	4883121	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0865	0.000	0.000	85.057	0.000	0.000	87.000	1.518	44.087	85.057	0.769	1.485	655558	4883101	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0864	0.000	0.000	85.062	0.000	0.000	87.000	1.518	44.086	85.062	0.769	1.485	655155	4883079	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0864	0.000	0.000	85.062	0.000	0.000	87.000	1.518	44.086	85.062	0.769	1.485	655155	4883079	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0829	0.000	0.000	85.0595	0.000	0.000	87.000	1.518	44.083	85.060	0.769	1.485	655366	4882692	6378206	0.968	0.938	0.082	0.007	0.004	6388680
44.0867	0.000	0.000	85.0545	0.000	0.000	87.000	1.518	44.087	85.055	0.769	1.484	655755	4883131	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0847	0.000	0.000	85.0601	0.000	0.000	87.000	1.518	44.085	85.060	0.769	1.485	655312	4882889	6378206	0.969	0.938	0.082	0.007	0.004	6388680
44.0832	0.000	0.000	85.0644	0.000	0.000	87.000	1.518	44.083	85.064	0.769	1.485	654970	4882718	6378206	0.968	0.938	0.082	0.007	0.004	6388680
44.0861	0.000	0.000	85.0649	0.000	0.000	87.000	1.518	44.086	85.065	0.769	1.485	654930	4883035	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0787	0.000	0.000	85.0669	0.000	0.000	87.000	1.518	44.079	85.067	0.769	1.485	654783	4882219	6378206	0.968	0.938	0.082	0.007	0.004	6388678
44.0829	0.000	0.000	85.057	0.000	0.000	87.000	1.518	44.083	85.057	0.769	1.485	655567	4882702	6378206	0.968	0.938	0.082	0.007	0.004	6388680
44.0796	0.000	0.000	85.0422	0.000	0.000	87.000	1.518	44.080	85.042	0.769	1.484	656761	4882358	6378206	0.968	0.938	0.082	0.007	0.004	6388678
44.0867	0.000	0.000	85.0471	0.000	0.000	87.000	1.518	44.087	85.047	0.769	1.484	656350	4883142	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.083	0.000	0.000	85.0421	0.000	0.000	87.000	1.518	44.083	85.042	0.769	1.484	656760	4882733	6378206	0.968	0.938	0.082	0.007	0.004	6388680

degrees ϕ	minutes ϕ	seconds ϕ	degrees λ	minutes λ	seconds λ	$\lambda(0)$ degrees	$\lambda(0)$ radians	Decimal Degrees ϕ	λ	radians ϕ	radians λ	UTM X	UTM Y	a	t	t sq'd	ε	ε sq'd	η sq'd	N meters
44.083	0.000	0.000	85.0446	0.000	0.000	87.000	1.518	44.083	85.045	0.769	1.484	656557	4882731	6378206	0.968	0.938	0.082	0.007	0.004	6388680
44.0868	0.000	0.000	85.0421	0.000	0.000	87.000	1.518	44.087	85.042	0.769	1.484	656753	4883162	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0831	0.000	0.000	85.0471	0.000	0.000	87.000	1.518	44.083	85.047	0.769	1.484	656361	4882740	6378206	0.968	0.938	0.082	0.007	0.004	6388680
44.0837	0.000	0.000	85.02	0.000	0.000	87.000	1.518	44.084	85.020	0.769	1.484	658530	4882864	6378206	0.969	0.938	0.082	0.007	0.004	6388680
44.0773	0.000	0.000	84.9908	0.000	0.000	87.000	1.518	44.077	84.991	0.769	1.483	660882	4882204	6378206	0.968	0.938	0.082	0.007	0.004	6388678
44.0791	0.000	0.000	84.9908	0.000	0.000	87.000	1.518	44.079	84.991	0.769	1.483	660877	4882409	6378206	0.968	0.938	0.082	0.007	0.004	6388678
44.0828	0.000	0.000	84.9908	0.000	0.000	87.000	1.518	44.083	84.991	0.769	1.483	660868	4882811	6378206	0.968	0.938	0.082	0.007	0.004	6388680
44.081	0.000	0.000	84.9808	0.000	0.000	87.000	1.518	44.081	84.981	0.769	1.483	661671	4882632	6378206	0.968	0.938	0.082	0.007	0.004	6388679
44.081	0.000	0.000	84.9858	0.000	0.000	87.000	1.518	44.081	84.986	0.769	1.483	661275	4882622	6378206	0.968	0.938	0.082	0.007	0.004	6388679
44.0773	0.000	0.000	84.9808	0.000	0.000	87.000	1.518	44.077	84.981	0.769	1.483	661681	4882221	6378206	0.968	0.938	0.082	0.007	0.004	6388678
44.0773	0.000	0.000	84.9858	0.000	0.000	87.000	1.518	44.077	84.986	0.769	1.483	661285	4882212	6378206	0.968	0.938	0.082	0.007	0.004	6388678
44.0792	0.000	0.000	84.9808	0.000	0.000	87.000	1.518	44.079	84.981	0.769	1.483	661676	4882431	6378206	0.968	0.938	0.082	0.007	0.004	6388678
44.0792	0.000	0.000	84.9858	0.000	0.000	87.000	1.518	44.079	84.986	0.769	1.483	661280	4882421	6378206	0.968	0.938	0.082	0.007	0.004	6388678
44.0828	0.000	0.000	84.9858	0.000	0.000	87.000	1.518	44.083	84.986	0.769	1.483	661271	4882823	6378206	0.968	0.938	0.082	0.007	0.004	6388680
44.0754	0.000	0.000	84.9758	0.000	0.000	87.000	1.518	44.075	84.976	0.769	1.483	662089	4882028	6378206	0.968	0.937	0.082	0.007	0.004	6388677
44.0757	0.000	0.000	84.9796	0.000	0.000	87.000	1.518	44.076	84.980	0.769	1.483	661788	4882052	6378206	0.968	0.938	0.082	0.007	0.004	6388677
44.0859	0.000	0.000	85.0942	0.000	0.000	87.000	1.518	44.086	85.094	0.769	1.485	652577	4882959	6378206	0.969	0.938	0.082	0.007	0.004	6388681
44.0745	0.000	0.000	85.0918	0.000	0.000	87.000	1.518	44.074	85.092	0.769	1.485	652803	4881697	6378206	0.968	0.937	0.082	0.007	0.004	6388676

λ(0)−λ seconds	λ(0)−λ minutes	λ(0)−λ radians	k(0)	X'	p	p^2	p^3	p^4	A(0)	A(1)	A(2)	A(3)	Sf	IVp	Vp(3)	B(5)	I	IIp(2)	IIIp(4)
7323	2.034	0.036	1.000	162899	0.732	0.536	0.393	0.288	0.998	0.003	0.000	0.000	4881585	162898	1.171	-0.006	4879632	2011.366	0.447
7339	2.039	0.036	1.000	163281	0.734	0.539	0.395	0.290	0.998	0.003	0.000	0.000	4880785	163280	1.187	-0.006	4878833	2020.297	0.451
7323	2.034	0.036	1.000	162924	0.732	0.536	0.393	0.288	0.998	0.003	0.000	0.000	4880785	162923	1.180	-0.006	4878833	2011.467	0.447
7323	2.034	0.036	1.000	162912	0.732	0.536	0.393	0.288	0.998	0.003	0.000	0.000	4881187	162911	1.175	-0.006	4879235	2011.437	0.447
7305	2.029	0.035	1.000	162517	0.731	0.534	0.390	0.285	0.998	0.003	0.000	0.000	4880891	162516	1.170	-0.006	4878938	2001.495	0.442
7305	2.029	0.035	1.000	162505	0.731	0.534	0.390	0.285	0.998	0.003	0.000	0.000	4881293	162504	1.165	-0.006	4879340	2001.465	0.442
7305	2.029	0.035	1.000	162495	0.731	0.534	0.390	0.285	0.998	0.003	0.000	0.000	4881625	162494	1.162	-0.006	4879672	2001.432	0.442
7289	2.025	0.035	1.000	162137	0.729	0.531	0.387	0.282	0.998	0.003	0.000	0.000	4881324	162136	1.157	-0.006	4879371	1992.421	0.438
7287	2.024	0.035	1.000	162093	0.729	0.531	0.387	0.282	0.998	0.003	0.000	0.000	4881787	162092	1.151	-0.006	4879835	1991.644	0.438
7289	2.025	0.035	1.000	162146	0.729	0.531	0.387	0.282	0.998	0.003	0.000	0.000	4881643	162145	1.154	-0.006	4879690	1992.841	0.438
7075	1.965	0.034	1.000	157378	0.708	0.501	0.354	0.251	0.998	0.003	0.000	0.000	4881672	157377	1.055	-0.005	4879719	1877.384	0.389
6995	1.943	0.034	1.000	155596	0.699	0.489	0.342	0.239	0.998	0.003	0.000	0.000	4881616	155595	1.020	-0.005	4879663	1835.076	0.372
7179	1.994	0.035	1.000	159745	0.718	0.515	0.370	0.266	0.998	0.003	0.000	0.000	4879582	159744	1.124	-0.006	4877630	1933.019	0.413
7179	1.994	0.035	1.000	159745	0.718	0.515	0.370	0.266	0.998	0.003	0.000	0.000	4879582	159744	1.124	-0.006	4877630	1933.019	0.413
7095	1.971	0.034	1.000	157686	0.709	0.503	0.357	0.253	0.998	0.003	0.000	0.000	4887255	157685	1.008	-0.005	4885300	1888.055	0.392
6905	1.918	0.033	1.000	153495	0.691	0.477	0.329	0.227	0.998	0.003	0.000	0.000	4886048	153494	0.940	-0.005	4884094	1788.352	0.352
6950	1.931	0.034	1.000	154526	0.695	0.483	0.336	0.233	0.998	0.003	0.000	0.000	4885138	154525	0.968	-0.005	4883184	1811.927	0.362
6924	1.923	0.034	1.000	153918	0.692	0.479	0.332	0.230	0.998	0.003	0.000	0.000	4885906	153917	0.950	-0.005	4883952	1798.134	0.356
6986	1.941	0.034	1.000	155308	0.699	0.488	0.341	0.238	0.998	0.003	0.000	0.000	4885423	155307	0.980	-0.005	4883469	1830.468	0.369
6968	1.936	0.034	1.000	154911	0.697	0.486	0.338	0.236	0.998	0.003	0.000	0.000	4885594	154910	0.971	-0.005	4883640	1821.239	0.365
7005	1.946	0.034	1.000	155730	0.700	0.491	0.344	0.241	0.998	0.003	0.000	0.000	4885196	155729	0.990	-0.005	4883242	1840.306	0.373
6968	1.936	0.034	1.000	154926	0.697	0.486	0.338	0.236	0.998	0.003	0.000	0.000	4885172	154925	0.975	-0.005	4883218	1821.343	0.366
7067	1.963	0.034	1.000	157137	0.707	0.499	0.353	0.249	0.998	0.003	0.000	0.000	4884751	157136	1.021	-0.005	4882797	1873.454	0.387
7067	1.963	0.034	1.000	157146	0.707	0.499	0.353	0.249	0.998	0.003	0.000	0.000	4883662	157145	1.032	-0.005	4881708	1873.013	0.387
7031	1.953	0.034	1.000	156344	0.703	0.494	0.348	0.244	0.998	0.003	0.000	0.000	4883643	156343	1.016	-0.005	4881689	1853.940	0.379
7031	1.953	0.034	1.000	156342	0.703	0.494	0.348	0.244	0.998	0.003	0.000	0.000	4884043	156341	1.012	-0.005	4882089	1854.137	0.379
7031	1.953	0.034	1.000	156342	0.703	0.494	0.348	0.244	0.998	0.003	0.000	0.000	4884043	156341	1.012	-0.005	4882089	1854.137	0.379
6988	1.941	0.034	1.000	155380	0.699	0.488	0.341	0.238	0.998	0.003	0.000	0.000	4883995	155379	0.994	-0.005	4882041	1831.346	0.370
6968	1.936	0.034	1.000	154952	0.697	0.486	0.338	0.236	0.998	0.003	0.000	0.000	4884004	154951	0.986	-0.005	4882050	1821.284	0.366
6977	1.938	0.034	1.000	155143	0.698	0.487	0.340	0.237	0.998	0.003	0.000	0.000	4884010	155142	0.989	-0.005	4882056	1825.784	0.368
6959	1.933	0.034	1.000	154757	0.696	0.484	0.337	0.235	0.998	0.003	0.000	0.000	4883597	154756	0.986	-0.005	4881644	1816.480	0.364
6977	1.938	0.034	1.000	155148	0.698	0.487	0.340	0.237	0.998	0.003	0.000	0.000	4883608	155147	0.993	-0.005	4881655	1825.663	0.368
6977	1.938	0.034	1.000	155148	0.698	0.487	0.340	0.237	0.998	0.003	0.000	0.000	4883608	155147	0.993	-0.005	4881655	1825.663	0.368
6968	1.936	0.034	1.000	154944	0.697	0.486	0.338	0.236	0.998	0.003	0.000	0.000	4884406	154943	0.982	-0.005	4882452	1821.329	0.366
7013	1.948	0.034	1.000	155939	0.701	0.492	0.345	0.242	0.998	0.003	0.000	0.000	4884033	155938	1.005	-0.005	4882079	1844.580	0.375
6986	1.941	0.034	1.000	155345	0.699	0.488	0.341	0.238	0.998	0.003	0.000	0.000	4884015	155344	0.993	-0.005	4882061	1830.535	0.369
7004	1.946	0.034	1.000	155740	0.700	0.491	0.344	0.241	0.998	0.003	0.000	0.000	4884445	155739	0.997	-0.005	4882491	1840.121	0.373
6996	1.943	0.034	1.000	155537	0.700	0.489	0.342	0.239	0.998	0.003	0.000	0.000	4884824	155536	0.990	-0.005	4882870	1835.535	0.371
6995	1.943	0.034	1.000	155546	0.700	0.489	0.342	0.239	0.998	0.003	0.000	0.000	4884022	155545	0.997	-0.005	4882068	1835.293	0.371
7004	1.946	0.034	1.000	155748	0.700	0.491	0.344	0.241	0.998	0.003	0.000	0.000	4884027	155747	1.001	-0.005	4882074	1840.056	0.373
6980	1.939	0.034	1.000	155217	0.698	0.487	0.340	0.237	0.998	0.003	0.000	0.000	4883681	155216	0.994	-0.005	4881727	1827.342	0.368
6984	1.940	0.034	1.000	155290	0.698	0.488	0.341	0.238	0.998	0.003	0.000	0.000	4884817	155289	0.985	-0.005	4882863	1829.702	0.369
7005	1.946	0.034	1.000	155737	0.700	0.491	0.344	0.241	0.998	0.003	0.000	0.000	4884800	155736	0.994	-0.005	4882846	1840.241	0.373
6967	1.935	0.034	1.000	154927	0.697	0.485	0.338	0.236	0.998	0.003	0.000	0.000	4883961	154926	0.986	-0.005	4882007	1820.681	0.365
6986	1.941	0.034	1.000	155349	0.699	0.488	0.341	0.238	0.998	0.003	0.000	0.000	4883614	155348	0.997	-0.005	4881661	1830.414	0.369
6964	1.934	0.034	1.000	154847	0.696	0.485	0.338	0.235	0.998	0.003	0.000	0.000	4884320	154846	0.981	-0.005	4882366	1818.995	0.365
6968	1.935	0.034	1.000	154947	0.697	0.485	0.338	0.236	0.998	0.003	0.000	0.000	4883601	154946	0.989	-0.005	4881647	1820.937	0.366
6968	1.935	0.034	1.000	154947	0.697	0.485	0.338	0.236	0.998	0.003	0.000	0.000	4883601	154946	0.989	-0.005	4881647	1820.937	0.366
6995	1.943	0.034	1.000	155542	0.700	0.489	0.342	0.239	0.998	0.003	0.000	0.000	4884424	155541	0.993	-0.005	4882470	1835.414	0.371
7004	1.946	0.034	1.000	155743	0.700	0.491	0.344	0.241	0.998	0.003	0.000	0.000	4884430	155742	0.997	-0.005	4882476	1840.178	0.373

λ(0)-λ seconds	λ(0)-λ minutes	λ(0)-λ radians	k(0)	X'	p	p^2	p^3	p^4	A(0)	A(1)	A(2)	A(3)	Sf	IVp	Vp(3)	B(5)	I	IIp(2)	IIIp(4)
6995	1.943	0.034	1.000	155551	0.699	0.489	0.342	0.239	0.998	0.003	0.000	0.000	4883621	155550	1.001	-0.005	4881687	1835.172	0.371
7004	1.946	0.034	1.000	155752	0.700	0.491	0.344	0.241	0.998	0.003	0.000	0.000	4883626	155751	1.005	-0.005	4881673	1839.916	0.373
7013	1.948	0.034	1.000	155941	0.701	0.492	0.345	0.242	0.998	0.003	0.000	0.000	4883632	155940	1.008	-0.005	4881678	1844.402	0.375
7013	1.948	0.034	1.000	155941	0.701	0.492	0.345	0.242	0.998	0.003	0.000	0.000	4883632	155940	1.008	-0.005	4881678	1844.402	0.375
6959	1.933	0.034	1.000	154757	0.696	0.484	0.337	0.235	0.998	0.003	0.000	0.000	4883627	154756	0.986	-0.005	4881674	1816.481	0.364
6950	1.931	0.034	1.000	154557	0.695	0.483	0.336	0.233	0.998	0.003	0.000	0.000	4883594	154556	0.982	-0.005	4881641	1811.766	0.362
6947	1.930	0.034	1.000	154483	0.695	0.483	0.335	0.233	0.998	0.003	0.000	0.000	4884057	154482	0.976	-0.005	4882104	1810.311	0.361
6913	1.920	0.034	1.000	153727	0.691	0.478	0.330	0.228	0.998	0.003	0.000	0.000	4883960	153726	0.963	-0.005	4882006	1792.568	0.354
6950	1.931	0.034	1.000	154536	0.695	0.483	0.336	0.233	0.998	0.003	0.000	0.000	4884398	154535	0.974	-0.005	4882445	1811.744	0.362
6914	1.921	0.034	1.000	153748	0.691	0.478	0.330	0.228	0.998	0.003	0.000	0.000	4883610	153747	0.967	-0.005	4881656	1792.860	0.354
6948	1.930	0.034	1.000	154487	0.695	0.483	0.335	0.233	0.998	0.003	0.000	0.000	4884797	154486	0.970	-0.005	4882843	1810.813	0.361
6932	1.926	0.034	1.000	154120	0.693	0.481	0.333	0.231	0.998	0.003	0.000	0.000	4884816	154119	0.963	-0.005	4882862	1802.249	0.358
6947	1.930	0.034	1.000	154477	0.695	0.483	0.335	0.233	0.998	0.003	0.000	0.000	4883996	154476	0.977	-0.005	4882043	1810.123	0.361
6932	1.925	0.034	1.000	154126	0.693	0.480	0.333	0.231	0.998	0.003	0.000	0.000	4884427	154125	0.966	-0.005	4882474	1802.148	0.358
6932	1.926	0.034	1.000	154142	0.693	0.481	0.333	0.231	0.998	0.003	0.000	0.000	4883996	154141	0.971	-0.005	4882043	1802.289	0.358
6932	1.925	0.034	1.000	154138	0.693	0.480	0.333	0.231	0.998	0.003	0.000	0.000	4883990	154137	0.971	-0.005	4882036	1802.196	0.358
6914	1.921	0.034	1.000	153730	0.691	0.478	0.330	0.228	0.998	0.003	0.000	0.000	4884366	153729	0.960	-0.005	4882412	1792.874	0.354
6896	1.915	0.033	1.000	153325	0.690	0.475	0.328	0.226	0.998	0.003	0.000	0.000	4884366	153324	0.952	-0.005	4882412	1783.439	0.351
6932	1.925	0.034	1.000	154148	0.693	0.480	0.333	0.231	0.998	0.003	0.000	0.000	4883578	154147	0.974	-0.005	4881625	1802.188	0.358
6895	1.915	0.033	1.000	153339	0.690	0.475	0.328	0.226	0.998	0.003	0.000	0.000	4883570	153338	0.959	-0.005	4881616	1783.331	0.351
6950	1.931	0.034	1.000	154564	0.695	0.483	0.336	0.233	0.998	0.003	0.000	0.000	4883192	154563	0.986	-0.005	4881238	1811.721	0.362
6914	1.920	0.034	1.000	153753	0.691	0.478	0.330	0.228	0.998	0.003	0.000	0.000	4883189	153752	0.970	-0.005	4881236	1792.740	0.354
6950	1.931	0.034	1.000	154569	0.695	0.483	0.336	0.233	0.998	0.003	0.000	0.000	4882802	154568	0.989	-0.005	4880849	1811.601	0.362
6914	1.920	0.034	1.000	153770	0.691	0.478	0.330	0.228	0.998	0.003	0.000	0.000	4882503	153769	0.977	-0.005	4880550	1792.764	0.355
6914	1.920	0.034	1.000	153770	0.691	0.478	0.330	0.228	0.998	0.003	0.000	0.000	4882503	153769	0.977	-0.005	4880550	1792.764	0.355
6931	1.925	0.034	1.000	154142	0.693	0.480	0.333	0.231	0.998	0.003	0.000	0.000	4883225	154141	0.977	-0.005	4881272	1801.863	0.358
6950	1.931	0.034	1.000	154578	0.695	0.483	0.336	0.233	0.998	0.003	0.000	0.000	4882401	154577	0.993	-0.005	4880448	1811.593	0.362
6915	1.921	0.034	1.000	153803	0.691	0.478	0.331	0.229	0.998	0.003	0.000	0.000	4882145	153802	0.980	-0.005	4880192	1793.336	0.355
6931	1.925	0.034	1.000	154148	0.693	0.480	0.333	0.231	0.998	0.003	0.000	0.000	4882897	154147	0.980	-0.005	4880944	1801.801	0.358
6931	1.925	0.034	1.000	154167	0.693	0.480	0.333	0.231	0.998	0.003	0.000	0.000	4882121	154166	0.988	-0.005	4880168	1801.823	0.358
6914	1.920	0.034	1.000	153762	0.691	0.478	0.330	0.228	0.998	0.003	0.000	0.000	4882803	153761	0.974	-0.005	4880850	1792.732	0.355
6931	1.925	0.034	1.000	154164	0.693	0.480	0.333	0.231	0.998	0.003	0.000	0.000	4882364	154163	0.985	-0.005	4880411	1801.884	0.358
6921	1.923	0.034	1.000	153920	0.692	0.479	0.332	0.229	0.998	0.003	0.000	0.000	4883061	153920	0.975	-0.005	4881107	1796.585	0.356
6986	1.940	0.034	1.000	155356	0.699	0.488	0.341	0.238	0.998	0.003	0.000	0.000	4883212	155355	1.001	-0.005	4881258	1830.350	0.370
6968	1.936	0.034	1.000	154967	0.697	0.486	0.338	0.236	0.998	0.003	0.000	0.000	4883201	154966	0.993	-0.005	4881247	1821.174	0.366
6986	1.940	0.034	1.000	155385	0.699	0.488	0.341	0.238	0.998	0.003	0.000	0.000	4882014	155384	1.012	-0.005	4880061	1830.327	0.370
7012	1.948	0.034	1.000	155947	0.701	0.492	0.345	0.242	0.998	0.003	0.000	0.000	4883229	155946	1.012	-0.005	4881276	1844.299	0.375
6995	1.943	0.034	1.000	155558	0.699	0.489	0.342	0.239	0.998	0.003	0.000	0.000	4883218	155557	1.005	-0.005	4881265	1835.107	0.371
6977	1.938	0.034	1.000	155155	0.698	0.487	0.340	0.237	0.998	0.003	0.000	0.000	4883206	155154	0.997	-0.005	4881253	1825.599	0.368
6977	1.938	0.034	1.000	155155	0.698	0.487	0.340	0.237	0.998	0.003	0.000	0.000	4883206	155154	0.997	-0.005	4881253	1825.599	0.368
6986	1.940	0.034	1.000	155366	0.699	0.488	0.341	0.238	0.998	0.003	0.000	0.000	4882814	155365	1.005	-0.005	4880861	1830.342	0.370
7004	1.945	0.034	1.000	155755	0.700	0.491	0.344	0.241	0.998	0.003	0.000	0.000	4883244	155754	1.008	-0.005	4881291	1839.776	0.373
6984	1.940	0.034	1.000	155312	0.698	0.488	0.341	0.238	0.998	0.003	0.000	0.000	4883013	155311	1.002	-0.005	4881060	1829.177	0.369
6968	1.936	0.034	1.000	154970	0.697	0.486	0.338	0.236	0.998	0.003	0.000	0.000	4882849	154969	0.997	-0.005	4880896	1821.055	0.366
6967	1.935	0.034	1.000	154930	0.697	0.485	0.338	0.236	0.998	0.003	0.000	0.000	4883167	154929	0.993	-0.005	4881214	1820.289	0.365
6959	1.933	0.034	1.000	154783	0.696	0.484	0.337	0.235	0.998	0.003	0.000	0.000	4882355	154782	0.997	-0.005	4880402	1816.363	0.364
6995	1.943	0.034	1.000	155567	0.699	0.489	0.342	0.239	0.998	0.003	0.000	0.000	4882819	155566	1.008	-0.005	4880866	1835.099	0.371
7048	1.958	0.034	1.000	156761	0.705	0.497	0.350	0.247	0.998	0.003	0.000	0.000	4882447	156760	1.035	-0.005	4880494	1863.155	0.383
7030	1.953	0.034	1.000	156350	0.703	0.494	0.347	0.244	0.998	0.003	0.000	0.000	4883241	156349	1.020	-0.005	4881287	1853.856	0.379
7048	1.958	0.034	1.000	156760	0.705	0.497	0.350	0.247	0.998	0.003	0.000	0.000	4882823	156759	1.032	-0.005	4880870	1863.352	0.383

λ(0)-λ seconds	λ(0)-λ minutes	λ(0)-λ radians	k(0)	X'	p	p^2	p^3	p^4	A(0)	A(1)	A(2)	A(3)	Sf	IVp	Vp(3)	B(5)	I	IIp(2)	IIIp(4)
7039	1.955	0.034	1.000	156557	0.704	0.496	0.349	0.246	0.998	0.003	0.000	0.000	4882825	156556	1.028	-0.005	4880872	1858.521	0.381
7049	1.958	0.034	1.000	156753	0.705	0.497	0.350	0.247	0.998	0.003	0.000	0.000	4883252	156752	1.028	-0.005	4881298	1863.418	0.383
7031	1.953	0.034	1.000	156361	0.703	0.494	0.348	0.244	0.998	0.003	0.000	0.000	4882838	156360	1.024	-0.005	4880885	1853.886	0.379
7128	1.980	0.035	1.000	158530	0.713	0.508	0.362	0.258	0.998	0.003	0.000	0.000	4882911	158529	1.066	-0.006	4880957	1905.715	0.401
7233	2.009	0.035	1.000	160882	0.723	0.523	0.378	0.274	0.998	0.003	0.000	0.000	4882194	160880	1.122	-0.006	4880241	1962.224	0.425
7233	2.009	0.035	1.000	160877	0.723	0.523	0.378	0.274	0.998	0.003	0.000	0.000	4882399	160875	1.119	-0.006	4880447	1962.229	0.425
7233	2.009	0.035	1.000	160868	0.723	0.523	0.378	0.274	0.998	0.003	0.000	0.000	4882802	160866	1.115	-0.006	4880849	1962.257	0.425
7269	2.019	0.035	1.000	161671	0.727	0.528	0.384	0.279	0.998	0.003	0.000	0.000	4882603	161670	1.134	-0.006	4880650	1981.775	0.433
7251	2.014	0.035	1.000	161275	0.725	0.526	0.381	0.276	0.998	0.003	0.000	0.000	4882603	161274	1.126	-0.006	4880650	1972.090	0.429
7269	2.019	0.035	1.000	161681	0.727	0.528	0.384	0.279	0.998	0.003	0.000	0.000	4882192	161680	1.138	-0.006	4880239	1981.766	0.433
7251	2.014	0.035	1.000	161285	0.725	0.526	0.381	0.276	0.998	0.003	0.000	0.000	4882193	161284	1.130	-0.006	4880240	1972.081	0.429
7269	2.019	0.035	1.000	161676	0.727	0.528	0.384	0.279	0.998	0.003	0.000	0.000	4882402	161674	1.136	-0.006	4880449	1981.771	0.433
7251	2.014	0.035	1.000	161280	0.725	0.526	0.381	0.276	0.998	0.003	0.000	0.000	4882402	161279	1.128	-0.006	4880449	1972.085	0.429
7251	2.014	0.035	1.000	161271	0.725	0.526	0.381	0.276	0.998	0.003	0.000	0.000	4882804	161270	1.124	-0.006	4880851	1972.113	0.429
7287	2.024	0.035	1.000	162089	0.729	0.531	0.387	0.282	0.998	0.003	0.000	0.000	4881988	162088	1.149	-0.006	4880036	1991.667	0.438
7274	2.020	0.035	1.000	161786	0.727	0.529	0.385	0.280	0.998	0.003	0.000	0.000	4882021	161785	1.142	-0.006	4880068	1984.237	0.434
6861	1.906	0.033	1.000	152577	0.686	0.471	0.323	0.222	0.998	0.003	0.000	0.000	4883146	152577	0.949	-0.005	4881193	1765.418	0.344
6870	1.908	0.033	1.000	152803	0.687	0.472	0.324	0.223	0.998	0.003	0.000	0.000	4881879	152802	0.964	-0.005	4879927	1769.936	0.346

APPENDIX C

Sohio Oil Corp.	Russell & Tope	NE-29-19N-6W	556
Turner Petro. Co.	Chas. Wheeler	NW-34-19N-6W	2,214
Union Dev. Co.	Flora Coyne #1	NW-4-18N-6W	23,572
TOTAL FREEMAN & REDDING FIELD			162,695

Harrison Field (Hatton Twp.)

Pure Oil Co.	L. G. Powell	NW-7-18N-4W	4,510
" " "	B. J. Sanford A-1	SW-7-18N-4W	2,844
TOTAL HARRISON FIELD			7,354

North Hamilton Field (Hamilton Twp. & Hayes Twp.)

Sun Oil Co.	R. J. Frodey	NE-1-19N-4W	1,411
" " "	E. G. Huber	NW-6-19N-3W	1,833
TOTAL NORTH HAMILTON FIELD			3,244

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Chapman Oil Co.	Chester & P. Sample	SE-32-20N-6W	3,863
Cities Service	W. Phares #1	NE-32-20N-6W	1,147
Daily Crude	F. Schuett	SW-28-20N-6W	7,271
Pure Oil Co.	H. Egts A-1	NW-32-20N-6W	1,747
" " "	" " B-1	SW-29-20N-6W	591
" " "	Harold McClain	SE-30-20N-6W	4,863
" " "	I. E. Snyder	NE-29-20N-6W	2,545
" " "	Geo.A.Swindelhurst	NW-32-20N-6W	6,691
" " "	J. M. VanDeuson	NE-1-19N-6W	6,470
Sun Oil Co.	Carlos E. Goodrich	SW-32-20N-6W	1,014
" " "	State-Winterfield	SE-35-20N-6W	2,563
" " "	Chas. Strange	SW-36-20N-6W	11,506
" " "	Delmer L. Thayer	SW-29-20N-6W	30,910
TOTAL WINTERFIELD FIELD			81,181

1951

Pure Oil Co.	S. J. VanHorn	NW-34-19N-6W	1704
" " "	J. Zink	SE-27-19N-6W	3034
Socony-Vacuum	L. G. Fell 1B	NE-33-19N-6W	6743
" "	Oliver Goldsmith	SE-34-19N-6W	2701
" "	A. E. VanHorn	NW-3-18N-6W	2419
Sohio Oil Corp.	Percy E. Barlow	SE-3-18N-6W	120
" " "	Flora Coyne #3	NE-4-18N-6W	2844
" " "	Flora Coyne #4	NE-4-18N-6W	2605
" " "	O.Goldsmith & R.Wine	SE-34-19N-6W	1271
Turner Petro. Co.	Chas. Wheeler	NW-34-19N-6W	2191
Union Dev. Co.	Flora Coyne #1	NW-4-18N-6W	14162
TOTAL FREEMAN & REDDING FIELD			137151

Section 11, Greenwood Twp.

Lud Segerlund	E. L. Caner et al #1	NE-11-19N-5W	920

Harrison Field (Hatton Twp.)

Pure Oil Co.	L. G. Powell	NW-7-18N-4W	4585
" " "	B. J. Sanford A-1	SW-7-18N-4W	2536
TOTAL HARRISON FIELD			7121

North Hamilton Field (Hamilton, Hayes & Frost Twps.)

Sun Oil Co.	Walter Ehle #1	SW-5-19N-3W	8497
" " "	R. J. Frodey	NE-1-19N-4W	1257
" " "	Francis Fry et al #1	SE-5-19N-3W	91
" " "	H. G. Huber	NW-6-19N-3W	2090
" " "	A. Iutzi et al #1	SW-5-19N-3W	12448
" " "	" " " " B-1	SE-6-19N-3W	2038
" " "	Iutzi-Kuepper et al #1	SE-6-19N-3W	1592
" " "	Kuepper-Holdeman	NW-8-19N-3W	2272
" " "	Miniger-Church Unit #1	NW-8-19N-3W	6507
TOTAL NORTH HAMILTON FIELD			36792

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude	F. Schuett	SW-28-20N-6W	6282
W. J. Grisdale	Chester & P. Sample	SE-32-20N-6W	3798
Pure Oil Co.	H. Egts A-1	NW-32-20N-6W	1642
" " "	" " B-1	SW-29-20N-6W	454
" " "	Harold McClain	SE-30-20N-6W	5176
" " "	I. E. Snyder	NE-29-20N-6W	2305
" " "	Geo.A.Swindelhurst	NW-32-20N-6W	6416
" " "	J. M. VanDeuson	NE-1-19N-6W	5653
Sun Oil Co.	Carlos H. Goodrich	SW-32-20N-6W	838
" " "	State-Winterfield	SE-35-20N-6W	2547
" " "	Chas. Strange	SW-36-20N-6W	9404
" " "	Delmer L. Thayer	SW-29-20N-6W	26427
TOTAL WINTERFIELD FIELD			70942

(1952)

Pure Oil Co.	A. E. VanHorn	SW-3-18N-6W	4598
" " "	S. J. VanHorn	NW-34-19N-6W	1434
" " "	J. Zink	SE-27-19N-6W	3019
Socony-Vacuum	L. G. Fell 1B	NE-33-19N-6W	5188
" "	Oliver Goldsmith	SE-34-19N-6W	2711
" "	A. E. VanHorn	NW-3-18N-6W	2462
Sohio Oil Corp.	Flora Coyne #3	NE-4-18N-6W	2072
" " "	Flora Coyne #4	NE-4-18N-6W	2913
" " "	O.Goldsmith & R. Wine	SE-34-19N-6W	888
Turner Petro. Co.	Chas. Wheeler	NW-34-19N-6W	2027
Union Dev. Co.	Flora Coyne #1	NW-4-18N-6W	10466

TOTAL FREEMAN-REDDING FIELD 120131

Section 11, Greenwood Twp.

Lud Segerlund	E. L. Caner et al #1	NE-11-19N-5W	404

TOTAL SECTION 11 404

Harrison Field (Hatton Twp.)

Pure Oil Co.	L. G. Powell	NW-7-18N-4W	4486
" " "	B. J. Sanford A-1	SW-7-18N-4W	2067

TOTAL HARRISON FIELD 6553

North Hamilton Field (Hamilton, Hayes & Frost Twps.)

Sun Oil Co.	Buerge et al #1	NE-7-19N-3W	4543
" " "	Walter Ehle #1	SW-5-19N-3W	10469
" " "	R. J. Frodey	NE-1-19N-4W	173
" " "	Francis Fry et al #1	SE-5-19N-3W	1773
" " "	Fanny Holdeman	NE-8-19N-3W	505
" " "	H. G. Huber	NW-6-19N-3W	2117
" " "	A. Iutzi et al #1	SW-5-19N-3W	8897
" " "	" " " " B-1	SE-6-19N-3W	4214
" " "	Iutzi-Kuepper et al #1	SE-6-19N-3W	7568
" " "	Kuepper-Holdeman	NW-8-19N-3W	22980
" " "	John Litwiller	NE-7-19N-3W	12224
" " "	Lytle-Miminger	NW-8-19N-3W	7954
" " "	Miniger-Church Unit #1	NW-8-19N-3W	20773

TOTAL HAMILTON FIELD 110155

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude	F. Schuett	SW-28-20N-6W	5774
W. J. Grisdale	Chester & P. Sample	SE-32-20N-6W	3004
Pure Oil Co.	H. Egts A-1	NW-32-20N-6W	1565
" " "	" " B-1	SW-29-20N-6W	418
" " "	Harold McClain	SE-30-20N-6W	4384
" " "	I. E. Snyder	NE-29-20N-6W	1957
" " "	Geo.A.Swindelhurst	NW-32-20N-6W	5458
" " "	J. M. VanDeuson	NE-1-19N-6W	5093

(1953)

Sun Oil Co.	Carlos H. Goodrich	SW-32-20N-6W	798
" " "	State-Winterfield	SE-35-20N-6W	2138
" " "	Chas. Strange	SW-36-20N-6W	12548
" " "	Delmer L. Thayer	SW-29-20N-6W	23779

TOTAL WINTERFIELD FIELD 66916

(1953)

Lake George Field (Lincoln Twp.)

Basin Oil & Wm. B. Stewart	Isabella Robertson Estate #1	SW-6-18N-5W	2997	3125
Stewart & Basin Oil	State - Lincoln #1	SW-6-18N-5W		9212
" " " "	Magdalene Tolson #1	SE-6-18N-5W		23393
TOTAL LAKE GEORGE FIELD			2997	35730

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude Oil Company	Fred Schuett #1, #2	SW-28-20N-6W	6884	6602
Long	Chester & P. Sample #1, #2	SE-32-20N-6W	2905	2285
Pure Oil Company	Hugh D. Egts #A-1	NW-32-20N-6W	1499	1415
" " "	H. D. Egts #B-1	SW-29-20N-6W	431	557
" " "	Harold McClain #1	SE-30-20N-6W	4451	4138
" " "	I. E. Snyder #1	NE-29-20N-6W	2155	1385
" " "	Geo. A. Swindelhurst #1,2,3	NW-32-20N-6W	5218	
" " "	Geo. A. Swindelhurst #1, #2	NW-32-20N-6W		5114
" " "	J. M. VanDeusen #1	NE-1-19N-6W	4311	3989
" " "	Carlos H. Goodrich #1	SW-32-20N-6W	720	
" " "	State-Winterfield A-3,A-5,A-6, and A-9	SE-35-20N-6W	1794	
" " "	State-Winterfield A-6	SE-35-20N-6W		354
" " "	Charles Strange #1, #2	SW-36-20N-6W	9562	7556
" " "	Delmer L. Thayer #1,2,3,4,6	SW-29-20N-6W	26636	
" " "	" " " #1, 2, 4, 6	SW-29-20N-6W		21812
TOTAL WINTERFIELD FIELD			66566	55207

1954 & 55

Harrison Field (Hatton Twp.)

Pure Oil Company	L. G. Powell #1	NW- 7-18N-4W	3755
" " "	B. J. Sanford #A-1	SW- 7-18N-4W	1536
TOTAL HARRISON FIELD			5291

Lake George Field (Lincoln Twp.)

Basin Oil & Wm. B. Stewart	Alberta M. Bicknell #2	NW- 6-18N-5W	10541
" " " " " "	Donald Holbrook et al #1	SW- 6-18N-5W	2713
" " " " " "	Isabella Robertson Estate #1	SW- 6-18N-5W	1280
" " " " " "	State - Lincoln #1	SW- 6-18N-5W	51583
" " " " " "	" " #2, #3, #4	SW- 6-18N-5W	6447
" " " " " "	Magdalene Tolson #1, #2, #4	SE- 6-18N-5W	38164
TOTAL LAKE GEORGE FIELD			110728

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude Oil Company	Fred Schuett #1, #2	SW-28-20N-6W	4282
Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	2605
Pure Oil Company	Hugh D. Egts #A-1	NW-32-20N-6W	1338
" " "	" " " #B-1	SW-29-20N-6W	443
" " "	Harold McClain #1	SE-30-20N-6W	4167
" " "	I. E. Snyder #1	NE-29-20N-6W	1501
" " "	George A. Swindelhurst #1, #2	NW-32-20N-6W	5255
" " "	J. M. VanDeusen #1	NE- 1-19N-6W	3838
Sun Oil Company	State-Winterfield #A-6	SE-35-20N-6W	550
" " "	Charles Strange #2	SW-36-20N-6W	7557
" " "	Delmer L. Thayer #1, #2, #4, #6	SW-29-20N-6W	20543
TOTAL WINTERFIELD FIELD			52079

1954

Lake George Field (Lincoln Twp.)

Basin Oil & W. B. Stewart	Alberta M. Bicknell #2	NW- 6-18N-5W	4082
" " " " " "	Donald Holbrook et al #1	NE- 6-18N-5W	314
" " " " " "	Isabella Robertson Estate #1	SW- 6-18N-5W	516
" " " " " "	State-Lincoln #1, #3	SW- 6-18N-5W	19017
" " " " " "	State-Lincoln #2, #4	SW- 6-18N-5W	2647
" " " " " "	Magdalene Tolson #1, #2, #4	SE- 6-18N-5W	20842
TOTAL LAKE GEORGE FIELD			47418

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude Oil Company	Fred Schuett #1, #2	SW-28-20N-6W	4593
Long	Chester & Priscilla Sample #1,#2	SE-32-20N-6W	2567
Pure Oil Company	Hugh D. Egts #A-1	NW-32-20N-6W	1245
" " "	Hugh D. Egts #B-1	SW-29-20N-6W	446
" " "	Harold McClain #1	SE-30-20N-6W	3961
" " "	I. E. Snyder #1	NE-29-20N-6W	289
" " "	George A. Swindelhurst #1, #2	NW-32-20N-6W	4043
" " "	J. M. VanDeusen #1	NE- 1-19N-6W	3267
Sun Oil Company	State-Winterfield #A-6	SE-35-20N-6W	141
" " "	Charles Strange #2	SW-36-20N-6W	7490
" " "	Delmer L. Thayer #1,#2,#4,#6	SW-29-20N-6W	17825
TOTAL WINTERFIELD FIELD			45867

1957

Sun Oil Company	Hamilton Tract #11		3738
" " "	" " #12		7703
" " "	" " #13		5382
" " "	" " #14		4897
" " "	" " #15		2811
" " "	" " #16		1910
" " "	" " #17		256
" " "	" " #18		5767
" " "	" " #19		1786
" " "	" " #20		1910
" " "	" " #21		4377
" " "	" " #22		30
" " "	" " #23		2855
" " "	" " #24		1669
" " "	" " #25		1538
" " "	" " #26		2242
" " "	" " #27		1538
" " "	" " #28		7276
TOTAL HAMILTON FIELD			159016

Harrison Field (Hatton Twp.)

Pure Oil Company	L. G. Powell #1	NW- 7-18N-4W	2979
" " "	B. J. Sanford #A-1	SW- 7-18N-4W	1405
TOTAL HARRISON FIELD			4384

Lake George Field (Lincoln Twp.)

W. B. Stewart	Alberta M. Bicknell #2	NW- 6-18N-5W	1885
" " "	Donald Holbrook et al #1	NE- 6-18N-5W	54
" " "	Isabella Robertson Estate #1	SW- 6-18N-5W	138
" " "	State - Lincoln #1, #3	SW- 6-18N-5W	13114
" " "	State - Lincoln #2	SW- 6-18N-5W	847
" " "	Magdalene Tolson #1, #2, #4	SE- 6-18N-5W	11518
TOTAL LAKE GEORGE FIELD			27556

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude Oil Company	Fred Schuett #1, #2	SW-28-20N-6W	4181
Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	3043
Pure Oil Company	Hugh D. Egts #A-1	NW-32-20N-6W	1276
" " "	Hugh D. Egts #B-1	SW-29-20N-6W	388
" " "	Harold McClain #1	SE-30-20N-6W	3930
" " "	George A. Swindelhurst #1, #2	NW-32-20N-6W	3799
" " "	J. M. VanDeusen #1	NE- 1-19N-6W	2922
Sun Oil Company	State - Winterfield #A-6	SE-35-20N-6W	188
" " "	Charles Strange #2	SW-36-20N-6W	7421
" " "	Delmer L. Thayer #1, #2, #4, #6	SW-29-20N-6W	17009
TOTAL WINTERFIELD FIELD			44157

1958

Lake George Field (Lincoln Twp.)

W. B. Stewart	Alberta M. Bicknell #2	NW- 6-18N-5W	1071
" " "	Isabella Robertson Estate #1	SW- 6-18N-5W	54
" " "	State-Lincoln #1, #3	SW- 6-18N-5W	15368
" " "	State-Lincoln #2	SW- 6-18N-5W	34
" " "	Magdalene Tolson #1, #2, #4	SE- 6-18N-5W	9666
Stewart & Basin	Donald Holbrook et al #1	NE- 6-18N-5W	10
TOTAL LAKE GEORGE FIELD			26203

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude Oil Company	Fred Schuett #1, #2	SW-28-20N-6W	3682
Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	3045
Pure Oil Company	Hugh D. Egts #A-1 RICHFIELD	NW-32-20N-6W	1183
" " "	Hugh D. Egts #B-1 " "	SW-29-20N-6W	386
" " "	Harold McClain #1	SE-30-20N-6W	3687
" " "	George A. Swindelhurst #1, #2	NW-32-20N-6W	2995
" " "	J. M. VanDeusen #1	NE- 1-19N-6W	2055
Sun Oil Company	State-Winterfield #A-6	SW-36-20N-6W	145
" " "	Charles Strange #2	SW-36-20N-6W	7305
" " "	Delmer L. Thayer #1, #2, #4, #6	SW-29-20N-6W	15491
TOTAL WINTERFIELD FIELD			39974

1959

Hamilton Field (Hamilton, Hayes & Frost Twps.)

1960

Sun Oil Company	Hamilton Tract # 1
" " "	" " # 2
" " "	" " # 3
" " "	" " # 4
" " "	" " # 5
" " "	" " # 6
" " "	" " # 7
" " "	" " # 8
" " "	" " # 9
" " "	" " #10
" " "	" " #11
" " "	" " #12
" " "	" " #13
" " "	" " #14
" " "	" " #15
" " "	" " #16
" " "	" " #17
" " "	" " #18
" " "	" " #19
" " "	" " #20
" " "	" " #21
" " "	" " #22
" " "	" " #23
" " "	" " #24
" " "	" " #25
" " "	" " #26
" " "	" " #27
" " "	" " #28

TOTAL HAMILTON FIELD

Harrison Field (Hatton Twp.)

The Pure Oil Company	L. G. Powell #1	NW- 7-18N-4W
" " " "	B. J. Sanford #A-1	SW- 7-18N-4W

TOTAL HARRISON FIELD

Lake George Field (Lincoln Twp.)

W. B. Stewart	Alberta M. Bicknell #2	NW- 6-18N-5W
" " "	State-Lincoln #1, #3	SW- 6-18N-5W
" " "	Magdalene Tolson #1, #2, #4	SE- 6-18N-5W

TOTAL LAKE GEORGE FIELD

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude Oil Company	Fred Schuett #1, #2	SW-28-20N-6W ✓
Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W
Pure Oil Company	Hugh D. Egts #A-1	NW-32-20N-6W
" " "	Hugh D. Egts #B-1	SW-29-20N-6W
" " "	Harold McClain #1	SE-30-20N-6W

Pure Oil Company	George A. Swindelhurst #1, #2	NW-32-20N-6W	2498
Sun Oil Company	State-Winterfield #A-6	SW-36-20N-6W	213
" " "	Charles Strange #2	SW-36-20N-6W	6788
" " "	Delmer L. Thayer #1, #2, #4, #6	SW-29-20N-6W	16292
TOTAL WINTERFIELD FIELD			38654

(1960)

Hamilton Field (Hamilton, Hayes & Frost Twps.)

Sun Oil Company	Hamilton Tract # 1	1772
" " "	" " # 2	9914
" " "	" " # 3	20529
" " "	" " # 4	3659
" " "	" " # 5	8271
" " "	" " # 6	19131
" " "	" " # 7	9914
" " "	" " # 8	9485
" " "	" " # 9	12658
" " "	" " #10	6096
" " "	" " #11	5240
" " "	" " #12	10797
" " "	" " #13	7544
" " "	" " #14	6864
" " "	" " #15	3941
" " "	" " #16	2678
" " "	" " #17	358
" " "	" " #18	8085
" " "	" " #19	2504
" " "	" " #20	2678
" " "	" " #21	6136
" " "	" " #22	41
" " "	" " #23	4001
" " "	" " #24	2340
" " "	" " #25	2169
" " "	" " #26	3143
" " "	" " #27	2156
" " "	" " #28	10200
TOTAL HAMILTON FIELD		182304

Harrison Field (Hatton Twp.)

Pure Oil Company	L. G. Powell #1	NW- 7-18N-4W	2431
" " "	B. J. Sanford #A-1	SW- 7-18N-4W	1045
TOTAL HARRISON FIELD			3476

Lake George Field (Lincoln Twp.)

W. B. Stewart	Alberta M. Bicknell #2	NW- 6-18N-5W	512
" " "	Isabella Robertson Estate #1	SW- 6-18N-5W	59
" " "	State-Lincoln #1, #3	SW- 6-18N-5W	14022
" " "	Magdalene Tolson #1, #2, #4	SE- 6-18N-5W	4572
TOTAL LAKE GEORGE FIELD			19165

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude Oil Company	Fred Schuett #1, #2 ✓	SW-28-20N-6W	3269
Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	3049
Pure Oil Company	Hugh D. Egts #A-1	NW-32-20N-6W	1090

1961

Pure Oil Company	Hugh D. Egts #B-1	SW-29-20N-6W	397
" " "	Harold McClain #1	SE-30-20N-6W	3379
" " "	George A. Swindelhurst #1	NW-32-20N-6W	2292
Sun Oil Company	State-Winterfield #A-6	SW-36-20N-6W	166
" " "	Charles Strange #2	SW-36-20N-6W	6606
" " "	Delmer L. Thayer #1, #2, #4, #6	SW-29-20N-6W	14757
TOTAL WINTERFIELD FIELD			35005

1961

Harrison Field (Hatton Twp.)

Denton & Denton Oil Well Servicing (Pure Oil Co.)(Hope Oil Co.)	L. G. Powell #1	NW- 7-18N-4W	2138
Denton & Denton Oil Well Servicing (Pure Oil Co.)(Hope Oil Co.)	B. J. Sanford #A-1	SW- 7-18N-4W	545
TOTAL HARRISON FIELD			2683

Lake George Field (Lincoln Twp.)

Lease Management, Inc. & Basin Oil Co. (W. B. Stewart)	State-Lincoln #1, #3, #4	SW- 6-18N-5W	4223
TOTAL LAKE GEORGE FIELD			4223

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	1424
Sun Oil Company	Charles Strange #2	SW-36-20N-6W	5225
" " "	Delmer L. Thayer #1, #6	SW-29-20N-6W	13305
Chester VanDellen(Oil Producers, Inc.)	Harold McClain #1 RICHFIELD	SE-30-20N-6W	1517
Walhalla Oil Company TELIME	Benchley-Hotchkiss et al	NW-31-20N-6W	4468
" " "	Mosher et al ?	SW-30-20N-6W	3768
Wolverine Gas & Oil Co.(Oil Producers)	Hugh D. Egts #A-1 Hugh D. Egts #B-1	NW-32-20N-6W) SW-29-20N-6W)	1285
" " " " " (" ")	Fred Schuett #1	SW-28-20N-6W	2129
" " " " " (" ")	George A. Swindelhurst #2	NW-32-20N-6W	1542
TOTAL WINTERFIELD FIELD			34663

1962

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude Oil Company	Fred Schuett #1, #2	SW-28-20N-6W	3092
Hope Oil Company (Pure Oil)	Hugh D. Egts #A-1	NW-32-20N-6W	1174
" " " (" ")	Hugh D. Egts #B-1	SW-29-20N-6W	372
" " " (" ")	Harold McClain #1	SE-30-20N-6W	3465
" " " (" ")	George A. Swindelhurst #2	NW-32-20N-6W	1771
Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	4372
Sun Oil Company	State-Winterfield #A-6	SW-36-20N-6W	191
" " "	Charles Strange #2	SW-36-20N-6W	5968
" " "	Delmer L. Thayer #1, #2, #4, #6	SW-29-20N-6W	14006

TOTAL WINTERFIELD FIELD 34411

1963

Harrison Field (Hatton Twp.)

Hope Oil Company (Pure Oil Co.)	L. G. Powell #1	NW- 7-18N-4W	2188
" " " (" " ")	B. J. Sanford #A-1	SW- 7-18N-4W	728
TOTAL HARRISON FIELD			2916

Lake George Field (Lincoln Twp.)

W. B. Stewart	State-Lincoln #1, #3	SW- 6-18N-5W	7029
" " "	Magdalene Tolson #1, #2, #4	SE- 6-18N-5W	714
TOTAL LAKE GEORGE FIELD			7743

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Hope Oil Company (Pure Oil Co.)	George A. Swindelhurst #2	NW-32-20N-6W	1503
Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	1909
Oil Producers, Inc. (Hope Oil Co.)	Hugh D. Egts #A-1	NW-32-20N-6W	887
" " " (" " ")	Hugh D. Egts #B-1	SW-29-20N-6W	375
" " " (" " ")	Harold McClain #1	SE-30-20N-6W	4213
" " " (Daily Crude Oil)	Fred Schuett #1, #2	SW-28-20N-6W	2464
Sun Oil Company	State-Winterfield #A-6	SW-36-20N-6W	144
" " "	Charles Strange #2	SW-36-20N-6W	5821
" " "	Delmer L. Thayer #1, #2, #4, #6	SW-29-20N-6W	13916
TOTAL WINTERFIELD FIELD			31232

1964

Harrison Field (Hatton Twp.)

Hope Oil Company (Pure Oil Co.)	L. G. Powell #1	NW- 7-18N-4W	2266
" " " (" " ")	B. J. Sanford #A-1	SW- 7-18N-4W	784
TOTAL HARRISON FIELD			3050

Lake George Field (Lincoln Twp.)

W. B. Stewart	State-Lincoln #1, #3	SW- 6-18N-5W	11227
" " "	Magdalene Tolson #1, #2, #4	SE- 6-18N-5W	1940
TOTAL LAKE GEORGE FIELD			13167

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude Oil Company	Fred Schuett #1, #2	SW-28-20N-6W	2761
Hope Oil Company (Pure Oil Co.)	Hugh D. Egts #A-1	NW-32-20N-6W	981
" " " (" " ")	Hugh D. Egts #B-1	SW-29-20N-6W	422
" " " (" " ")	Harold McClain #1	SE-30-20N-6W	4108
" " " (" " ")	George A. Swindelhurst #2	NW-32-20N-6W	1649
Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	2156
Sun Oil Company	State-Winterfield #A-6	SW-36-20N-6W	127
" " "	Charles Strange #2	SW-36-20N-6W	5952
" " "	Delmer L. Thayer #1, #2, #4, #6	SW-29-20N-6W	14194
TOTAL WINTERFIELD FIELD			32350

1965

Harrison Field (Hatton Twp.)

Denton & Denton Oil Well Servicing (Pure Oil Co.)(Hope Oil Co.)	L. G. Powell #1	NW- 7-18N-4W	2186
Denton & Denton Oil Well Servicing (Pure Oil Co.)(Hope Oil Co.)	B. J. Sanford #A-1	SW- 7-18N-4W	671
	TOTAL HARRISON FIELD		2857

Lake George Field (Lincoln Twp.)

W. B. Stewart	State-Lincoln #1, #3	SW- 6-18N-5W	6539
	TOTAL LAKE GEORGE FIELD		6539

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	1974
Oil Producers, Inc. (Hope Oil Co.)	Hugh D. Egts #A-1	NW-32-20N-6W	871
" " " (" " ")	Hugh D. Egts #B-1	SW-29-20N-6W	305
" " " (" " ")	Harold McClain #1	SE-30-20N-6W	3625
" " "(Daily Crude Oil)	Fred Schuett #1, #2 ✓	SW-28-20N-6W	1698
" " (Pure Oil)(Hope Oil Co.)	George A. Swindelhurst #2✓	NW-32-20N-6W	1424
Sun Oil Company	State-Winterfield #A-6 ✓	SW-36-20N-6W	122
" " "	Charles Strange #2 ✓	SW-36-20N-6W	4807
" " "	Delmer L. Thayer #1, #4, #6	SW-29-20N-6W	13360
	TOTAL WINTERFIELD FIELD		28186

1966

Harrison Field (Hatton Twp.)

Denton & Denton Oil Well Servicing (Pure Oil Co.)(Hope Oil Co.)	L. G. Powell #1	NW- 7-18N-4W	2239
Denton & Denton Oil Well Servicing (Pure Oil Co.)(Hope Oil Co.)	B. J. Sanford #A-1	SW- 7-18N-4W	596
TOTAL HARRISON FIELD			2835

Lake George Field (Lincoln Twp.)

Lease Management, Inc. & Basin Oil Co. (W. B. Stewart)	State-Lincoln #1, #3, #4	SW- 6-18N-5W	4705
Lease Management, Inc. & Basin Oil Co. (W. B. Stewart)	Magdalena Tolson #1, #2, #4	SE- 6-18N-5W	66
TOTAL LAKE GEORGE FIELD			4771

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	1628
Sun Oil Company	Charles Strange #2 ✓	SW-36-20N-6W	5674
" " "	Delmer L. Thayer #1, #6 ✓	SW-29-20N-6W	13443
Chester VanDellen(Oil Producers, Inc.)	Harold McClain #1	SE-30-20N-6W	406
Wolverine Gas & Oil Co.(Oil Producers)	Hugh D. Egts #A-1	NW-32-20N-6W)	
" " " " " (" ")	Hugh D. Egts #B-1 ✓	SW-29-20N-6W)	952
" " " " " (" ")	Fred Schuett #1 ✓	SW-28-20N-6W	1870
" " " " " (" ")	George A. Swindelhurst #2 ✓	NW-32-20N-6W	1410
TOTAL WINTERFIELD FIELD			25382

1967

Harrison Field (Hatton Twp.)

Denton & Denton Oil Well Servicing (Pure Oil Co.)(Hope Oil Co.)	L. G. Powell #1	NW- 7-18N-4W	2274
Denton & Denton Oil Well Servicing (Pure Oil Co.)(Hope Oil Co.)	B. J. Sanford #A-1	SW- 7-18N-4W	637
TOTAL HARRISON FIELD			2911

Lake George Field (Lincoln Twp.)

Lease Management, Inc. (W. B. Stewart)	State-Lincoln #1, #3	SW- 6-18N-5W	5718
" " "(" " ")	Magdalena Tolson	SE- 6-18N-5W	126
TOTAL LAKE GEORGE FIELD			5844

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Long	Chester & Priscilla Sample #1, #2	SE-32-2	
Oil Producers, Inc.(Hope Oil Co.)	Harold McClain #1	SE-30-2	
Sun Oil Company	State-Winterfield #A-6	SW-36-2	
" " "	Charles Strange #2	SW-36-2	
" " "	Delmer L. Thayer #1, #4, #6	SW-29-2	
Wolverine Gas & Oil Company (Oil Producers)(Hope Oil Co.)	Hugh D. Egts #A-1	NW-32-2	
Wolverine Gas & Oil Company (Oil Producers)(Hope Oil Co.)	Hugh D. Egts #B-1	SW-29-20N-6W	384
Wolverine Gas & Oil Company (Oil Producers)(Daily Crude)	Fred Schuett #1, #2	SW-28-20N-6W	2306
Wolverine Gas & Oil Company (Oil Producers)(Hope Oil Co.)	George A. Swindelhurst #2	NW-32-20N-6W	1542
TOTAL WINTERFIELD FIELD			24929

1-136

1968

Hamilton Field (Hamilton, Hayes & Frost Twps.)

Sun Oil Company	Hamilton Tract # 1		2469
" " "	" " # 2		13187
" " "	" " # 3		28609
" " "	" " # 4		5099
" " "	" " # 5		11526
" " "	" " # 6		26661
" " "	" " # 7		13817
" " "	" " # 8		13219
" " "	" " # 9		17640
" " "	" " #10		8496
" " "	" " #11		7303
" " "	" " #12		15047
" " "	" " #13		10514
" " "	" " #14		9566
" " "	" " #15		5492
" " "	" " #16		3732
" " "	" " #17		499
" " "	" " #18		11267
" " "	" " #19		3489
" " "	" " #20		3732
" " "	" " #21		8551
" " "	" " #22		58
" " "	" " #23		5576
" " "	" " #24		3261
" " "	" " #25		3004
" " "	" " #26		4380
" " "	" " #27		3004
" " "	" " #28		14214
TOTAL HAMILTON FIELD			254042

Harrison Field (Hatton Twp.)

Pure Oil Company	L. G. Powell #1	NW- 7-18N-4W	2217
" " "	B. J. Sanford #A-1	SW- 7-18N-4W	879
TOTAL HARRISON FIELD			3096

Lake George Field (Lincoln Twp.)

W. B. Stewart	Alberta M. Bicknell #2	NW- 6-18N-5W	79
" " "	State-Lincoln #1, #3	SW- 6-18N-5W	8528
" " "	Magdalene Tolson #1, #2, #4	SE- 6-18N-5W	4525
TOTAL LAKE GEORGE FIELD			13132

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Daily Crude Oil Company	Fred Schuett #1, #2	SW-28-20N-6W	3137
Long	Chester & Priscilla Sample #1, #2	SE-32-20N-6W	2539
Pure Oil Company	Hugh D. Egts #A-1	NW-32-20N-6W	998
" " "	Hugh D. Egts #B-1	SW-29-20N-6W	415

 1969

Pure Oil Company	Harold McClain #1	SE-30-20N-6W	3819
" " "	George A. Swindelhurst #2	NW-32-20N-6W	1844
Sun Oil Company	State-Winterfield #A-6	SW-36-20N-6W	146
" " "	Charles Strange #2	SW-36-20N-6W	5972
" " "	Delmer L. Thayer #1, #2, #4, #6	SW-29-20N-6W	14051
TOTAL WINTERFIELD FIELD			32921

1969

1969

Lake George Field (Lincoln Twp.)

Lease Management, Inc. & Basin Oil Co. (W.B. Stewart)	State-Lincoln #1 #3 #4	SW- 6-18N-5W	4084	3201
TOTAL LAKE GEORGE FIELD			4084	3201

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Long	Chester & Priscilla Sample #1 #2	SE-32-20N-6W	1854	1887
Sun Oil Company	Charles Strange #2	SW-36-20N-6W	4395	4246
" " "	Delmer L. Thayer #1 #6	SW-29-20N-6W	10934	10685
Chester VanDellen (Wolverine Gas & Oil) (Oil Producers, Inc.)	Harold McClain #1	SE-30-20N-6W	1732	1510
Walhalla Oil Company	Benchley-Hotchkiss et al	NW-31-20N-6W	6266	6593
" " "	Mosher et al	SW-30-20N-6W	60	
Wolverine Gas & Oil Co. (Oil Producers)	Hugh D. Egts #A-1 Hugh D. Egts #B-1	NW-32-20N-6W) SW-29-20N-6W)	983	1089
Wolverine Gas & Oil Co. (Oil Producers)	Fred Schuett #1	SW-28-20N-6W	1869	1591
Wolverine Gas & Oil Co. (Oil Producers)	George A. Swindelhurst #2	NW-32-20N-6W	1595	1494
TOTAL WINTERFIELD FIELD			29688	29095

1970 & 71

TOTAL LAKE GEORGE FIELD			3211

Winterfield Field (Winterfield, Redding & Greenwood Twps.)

Long	C. & P. Sample #1 #2	SE-32-20N-6W	1604
Sun Oil Company	Charles Strange #2	SW-36-20N-6W	3924
Sun Oil Company	Delmer L. Thayer #1 #6	SW-29-20N-6W	10025
Chester Van Dellen (Wolverine Gas & Oil - Oil Producers)	Harold McClain #1	SE-30-20N-6W	1401
Walhalla Oil Company	Benchley-Hotchkiss et al	NW-31-20N-6W	4900
Walhalla Oil Company	Mosher et al	SW-30-20N-6W	-0-
Wolverine Gas & Oil Company (Oil Producers)	Hugh D. Egts #A-1	NW-32-20N-6W)	
	Hugh D. Egts #B-1	SW-29-20N-6W)	1243
	Fred Schuett #1	SW-28-20N-6W	2156
	George Swindelhurst #2	NW-32-20N-6W	1501
TOTAL WINTERFIELD FIELD			26754

C R A W F O R D   C O U N T Y

1972

NAME OF OPERATOR		FARM NAME	DESCRIPTION OF LEASE	1972 PRODUCTION BARRELS

Beaver Creek Field (Beaver Creek Twp., Crawford Co., Garfield Twp., Kalkaska Co.)

State-Beaver Creek Unit:

	Tract			
Pure Oil Company	# 1	George Garden #A-1 #A-2 #A-3	SE-12-25N-5W	
		George Garden #A-4 #A-5 #A-6 #A-7	SW-12-25N-5W	-0-
	# 2	George Garden #B-2 #B-4	NE-12-25N-5W	
		George Garden #B-2	NW-12-25N-5W	-0-
	# 2-A	George Garden #B-1	SE-12-25N-5W	-0-
	# 3	State-Beaver Creek #A-8 A-9	NE-29-25N-4W	-0-
	# 3-A	State-Beaver Creek #A-10	SW-28-25N-4W	-0-
	# 3-B	State-Beaver Creek #A-5 A-6	NE-19-25N-4W	-0-
	# 4	State-Garfield #A-1 A-2 A-3	NE-13-25N-5W	
		State-Garfield #A-4 #A-5	SE-13-25N-5W	-0-
	# 5	State-Garfield #a-1 #A-2 #A-3 #A-4	NW-13-25N-5W	-0-
	# 6	State-Garfield #B-1 (State of Michigan #1)	NE-13-25N-5W	-0-
	# 7	Wm. & Fred Schneider #1	NW-28-25N-4W	3725
	# 8	State-Beaver-Creek #B-1	NW-28-25N-4W-	4551
	# 9	H. H. Joseph #2 #6	SW- 7-25N-4W	
		H. H. Joseph #4	SE- 7-25N-4W	
		H. H. Joseph #7	NW- 7-25N-4W	-0-
	#10	State Beaver-Creek #E-1 #E-2 #E-4 #E-5	NW-18-25N-4W	
		State-Beaver Creek #E-3 #E-6 #E-7	SW-18-25N-4W	-0-
	#11	State Beaver Creek #M-1 #M-2 #M-3 #M-4	NE-18-25N-4W	-0-

POOL CLASSIFICATION: ● ACTIVE OIL FIELD OR POOL; ABANDONED OIL FIELD OR POOL; ACTIVE GAS FIELD OR POOL; ABANDONED GAS FIELD OR POOL; GAS-CONDENSATE FIELD OR POOL; ABANDONED GAS-CONDENSATE FIELD OR POOL; ⊕ GAS STORAGE RESERVOIR; ⊖ UNDEVELOPED GAS STORAGE RESERVOIR

Pool Class.	FIELD NAME	PRODUCING FORMATION OR POOL	YEAR OF DISC.	COUNTY / TOWNSHIP / PRODUCING SECTIONS	PAY ZONE: DEPTH IN FEET	PAY ZONE: THICKNESS AND LITHOLOGY	PAY ZONE: OIL GRAVITY A.P.I.	DEEPEST FORMATION OR POOL TESTED	DEPTH IN FEET	NUMBER OF WELLS 1973: TO END	COMP IN	ABAND. IN	ACTIVE AT END	DRILLED ACRES	OIL PRODUCTION—BBLS. PRODUCED IN 1973	OIL CUMULATIVE THROUGH 1973	GAS PRODUCTION—Mcf. PRODUCED IN 1973	GAS CUMULATIVE THROUGH 1973	RECOVERY PER ACRE DRILLED (BBLS.)	TOTAL BARRELS BRINE PER DAY
Active oil	WAYLAND, NORTH	TRAVERSE	1957	ALLEGAN	1,696	7 L		TRAVERSE	1,712	15	0	0	5	150	1,825	110,354			737	
				WAYLAND TWP., 3N-11W, SECTIONS 6, 7, AND 8																
Abandoned oil	WEARE	TRAVERSE	1961	OCEANA	1,681	2 L		TRAVERSE	1,737	3	ABANDONED 1964			30		6,919			231	
				WEARE TWP., 16N-17W, SECTIONS 12, 13																
Abandoned oil	WEARE, SEC. 14	TRAVERSE	1952	OCEANA	1,674	1 L	41.4	DUNDEE	2,217	1	ABANDONED 1954			10		1,096			110	
				WEARE TWP., 16N-17W, SECTION 14																
Active oil	WEST BRANCH	TRAVERSE	1933	OGEMAW	1,796	2 L		CAMBRO-ORDOVICIAN	11,012						PRODUCTION COMBINED WITH WEST BRANCH DUNDEE		SOME TRAVERSE OIL PRODUCED IN CONNECTION WITH WATER FLOOD PROJECT			
Active oil		DUNDEE	1933		2,650	20 L	36.8			277	0	1	162	2,750	133,343	9,084,464			3,303	1,300
Active oil		DETROIT RIVER SZ	1951		3,585	9 D	38.9						THE 162 WELLS INCLUDE 160 DUNDEE AND 2 TRAVERSE							
Active oil		RICHFIELD	1952		4,127		33.0			63	0	0	61	2,520	62,749	2,976,908		61,430	1,181	4
													THE 61 WELLS INCLUDE 30 RICHFIELD, 26 SOUR ZONE, AND 5 RICHFIELD & SOUR ZONE							
				WEST BRANCH TWP., 22N-2E, SECTIONS 18, 19, 20, 21, 26, 27, 28, 29, 34, 35, 36 OGEMAW TWP., 22N-1E, SECTIONS 10, 13, 14, 23, 24 CHURCHILL TWP., 22N-3E, SECTION 31																
				NORTON TWP., 21N-2E, SECTIONS 1, 2 MILLS TWP., 21N-3E, SECTIONS 5, 6																
Gas-condensate	WEXFORD 9-24N-12W	NIAGARAN REEF	1973	WEXFORD	6,232	4 D		NIAGARAN	6,265	1	1	0	1	160	240	240			2	
				WEXFORD TWP., 24N-12W, SECTION 9																
Gas-condensate	WEXFORD 9-24N-12W POOL A	NIAGARAN REEF	1973	WEXFORD	6,041	101 D	69.8	NIAGARAN	6,414	1	1	0	1	160						
				WEXFORD TWP., 24N-12W, SECTION 9																
Gas-condensate	WEXFORD 10-24N-12W	NIAGARAN REEF	1972	WEXFORD	6,124	107 D		NIAGARAN	6,352	1	0	0	1	160	1,054	1,185	21,643	21,643	7	
				WEXFORD TWP., 24N-12W, SECTION 10																
Gas-condensate	WEXFORD 18-24N-12W	NIAGARAN	1973	WEXFORD	5,842	96 D		NIAGARAN	6,130	2	2	0	2	320	55	55				
				WEXFORD TWP., 24N-12W, SECTION 18																
Active gas	WHEATLAND	MICHIGAN STRAY	1947	MECOSTA	1,399	3 S		DETROIT RIVER	3,849	4	0	0	1	160				506,369	DOMESTIC USE	
Abandoned oil		DUNDEE	1945		3,690	2 L	43.0			6	ABANDONED 1960			100		141,631			1,416	
				WHEATLAND TWP., 14N-7W, SECTIONS 7, 8, 9																
Abandoned oil	WHITE CLOUD	TRAVERSE	1963	NEWAYGO	2,537	1 L		TRAVERSE	2,540	1	ABANDONED 1964			40		1,295			32	
				WILCOX TWP., 14N-12W, SECTION 19																
Active oil	WHITE OAK 32-2N-2E	SALINA-NIAGARAN REEF	1973	INGHAM	3,970	6 D		CATARACT	4,515	1	1	0	1	30	7,350	7,350			92	
				WHITE OAK TWP., 2N-2E, SECTION 32																
Abandoned oil	WHITE RIVER	DUNDEE	1950	MUSKEGON	2,053	2 L	26.0	DUNDEE	2,055	1	ABANDONED 1951			20		7,061			353	
				WHITE RIVER TWP., 12N-18W, SECTION 15																
Gas-condensate	WHITEWATER 22-27N-9W	NIAGARAN REEF	1973	GRAND TRAVERSE				NIAGARAN		1	1	0	1	160	8,469	8,469				
				WHITEWATER TWP., 27N-9W, SECTION 22																
Active oil	WHITEWATER 32-27N-9W	NIAGARAN REEF	1972	GRAND TRAVERSE	6,100	10 D	44.3	NIAGARAN	6,260	1	0	0	1	80	52,331	58,714	34,787	34,787	734	
				WHITEWATER TWP., 27N-9W, SECTION 32																
Active oil	WHITEWATER 34-27N-9W	NIAGARAN REEF	1972	GRAND TRAVERSE	6,292	16 D	44.9	NIAGARAN	6,580	1	0	0	1	80	18,573	25,321	3,191	3,191	317	
				WHITEWATER TWP., 27N-9W, SECTION 34																
Active oil	WHITEWATER 35-27N-9W	NIAGARAN REEF	1972	GRAND TRAVERSE	6,270	60 D	39	NIAGARAN	6,770	1	0	0	1	80	30,391	36,549	5,657	5,657	457	
				WHITEWATER TWP., 27N-9W, SECTION 35																
Gas-condensate	WHITEWATER 36-27N-9W	NIAGARAN REEF	1971	GRAND TRAVERSE	6,560	40 D	66	NIAGARAN	6,750	1	0	0	1	160	29,441	60,313	2,522,365	3,565,872	377	
				WHITEWATER TWP., 27N-9W, SECTION 36																
Active oil	WILEY	TRAVERSE	1962	MASON	1,663	5 L	39.9	ST. PETER SS.	5,890	18	0	0	9	380	2,013	422,985			1,113	102
				EDEN TWP., 17N-16W, SECTION 18 RIVERTON TWP., 17N-17W, SECTION 12																
Active oil	WINFIELD	DUNDEE-REED CITY	1936	MONTCALM	3,340	1 L	43.2	REED CITY	3,500	8	0	0	2	120	992	117,546			980	40
				WINFIELD TWP., 12N-9W, SECTIONS 20, 28, 29																
⊖	WINFIELD	REFER TO TABLE 3 DEVELOPED GAS STORAGE RESERVOIRS																		
Active oil	WINTERFIELD	TRAVERSE	1940	CLARE	3,105	1 L		SYLVANIA	5,273					260	5,999		61,636	265,215		1
Active oil		DUNDEE	1940		3,794	3 L	44.2							740	3,131					1,400
Active oil		RICHFIELD	1942		5,015	15 D				50	0	0	13	100	16,956	5,245,098			4,768	
				WINTERFIELD TWP., 20N-6W, SECTIONS 28 THROUGH 32, 35, 36 REDDING TWP., 19N-6W, SECTIONS 1, 5 GREENWOOD TWP., 19N-5W, SECTION 6									THE 13 WELLS INCLUDE 8 TRAVERSE, 4 DUNDEE & 1 TRAVERSE & RICHFIELD							
Active gas	WISE	MICHIGAN STRAY	1940	ISABELLA	1,250	5 S		SYLVANIA	5,205	7	0	0	5	1,280			0	1,705,139	DOMESTIC USE & LEASE FUEL	
Active oil		TRAVERSE	1953		3,090	31 L	43.0								461					
Active oil		DUNDEE	1938		3,700	11 L	45.2			79	0	0	24	1,640	6,455	3,959,059			2,414	1,628
Active oil		DETROIT RIVER SZ	1955		4,415	48 DL	42.6			2	0	0	1	80	768	59,719			746	30
				WISE TWP., 16N-3W, SECTIONS 8, 9, 16, 17, 20, 21, 28, 29, 32, 33									THE 24 WELLS INCLUDE 18 DUNDEE, 1 STRAY, 4 TRAVERSE AND DUNDEE AND 1 DUNDEE AND DETROIT RIVER							
Abandoned gas	WOLF LAKE	"BEREA"	1949	MUSKEGON	1,050	7 D		DETROIT RIVER	2,290	2	ABANDONED 1956			320				99,756		
Active oil		TRAVERSE	1968		1,741	23 L				3	0	0	2	60	0	4,614			77	
				EGELSTON TWP., 10N-15W, SECTIONS 7, 8, 18 MUSKEGON TWP., 10N-16W, SECTION 13																
Active gas	WOODSTOCK	TRAVERSE	1969	LENAWEE	1,465	2 L		TRAVERSE	1,467	2	0	0	1	80			SHUT-IN FOR MARKET			
				WOODSTOCK TWP., 5S-1E, SECTION 18																
Active oil	WOODVILLE	TRAVERSE	1943	NEWAYGO	2,820	5 L	43.5	DETROIT RIVER	3,534	10	0	0	10	350	5,123	561,665			1,605	50
				NORWICH TWP., 15N-11W, SECTIONS 20, 28, 29																
⊕	WOODVILLE (NORWICH)	REFER TO TABLE 3 DEVELOPED GAS STORAGE RESERVOIRS																		
Active oil	WRIGHT	"BEREA"	1954	OTTAWA	1,170	3 L		DETROIT RIVER	2,337	7	0	0	4	60	0	47,302	SHUT-IN — LACK OF STORAGE		788	
Active oil		TRAVERSE	1953	OTTAWA	1,920	1 L				7	0	0	2	70	0	18,158			259	
				WRIGHT TWP., 8N-13W, SECTIONS 28, 32, 33 TALLMADGE TWP., 7N-13W, SECTION 4																

POOL CLASSIFICATION: ● ACTIVE OIL FIELD OR POOL — ABANDONED OIL FIELD OR POOL — ACTIVE GAS FIELD OR POOL — ABANDONED GAS FIELD OR POOL — GAS-CONDENSATE FIELD OR POOL — ABANDONED GAS-CONDENSATE FIELD OR POOL — ⊕ GAS STORAGE RESERVOIR — ⊖ UNDEVELOPED GAS STORAGE RESERVOIR

FIELD NAME	PRODUCING FORMATION OR POOL	YEAR OF DISC.	COUNTY TOWNSHIP PRODUCING SECTIONS	PAY ZONE DEPTH IN FEET	PAY ZONE THICKNESS AND LITHOLOGY	PAY ZONE OIL GRAVITY A.P.I.	DEEPEST FORMATION OR POOL TESTED	DEPTH IN FEET	NUMBER OF WELLS TO END 1975	COMP. IN 1975	ABAND. IN 1975	ACTIVE AT END 1975	DRILLED ACRES	OIL PRODUCTION—BBLS. PRODUCED IN 1975	OIL PRODUCTION—BBLS. CUMULATIVE THROUGH 1975	GAS PRODUCTION—MCF PRODUCED IN 1975	GAS PRODUCTION—MCF CUMULATIVE THROUGH 1975	RECOVERY PER ACRE DRILLED (BBLS.)	TOTAL BARRELS BRINE PER DAY
WEST BRANCH	TRAVERSE	1933	OGEMAW	1,796	2 L		CAMBRO-ORDOVICIAN	11,012					PRODUCTION COMBINED WITH WEST BRANCH DUNDEE			SOME TRAVERSE OIL PRODUCED IN CONNECTION WITH WATER FLOOD PROJECT			
	DUNDEE	1933		2,650	20 L	36.8			281	0	0	159	2,770	131,861	9,350,001			3,375	1,921
	DETROIT RIVER SZ	1951		3,585	9 D	38.9						THE 159 WELLS INCLUDE 157 DUNDEE & 1 TRAVERSE & 1 TRAVERSE & DUNDEE							
	RICHFIELD	1952		4,127		33.0			63	0	0	60	2,520	67,927	3,107,453		[illegible]	1,233	4
												THE 60 WELLS INCLUDE 29 RICHFIELD, 25 SOUR ZONE, AND 6 RICHFIELD & SOUR ZONE							
			WEST BRANCH TWP., 22N-2E, SECTIONS 18, 19, 20, 21, 26, 27, 28, 29, 34, 35, 36 OGEMAW TWP., 22N-1E, SECTIONS 10, 13, 14, 23, 24 CHURCHILL TWP., 22N-3E, SECTION 31																
			HORTON TWP., 21N-2E, SECTIONS 1, 2 MILLS TWP., 21N-3E, SECTIONS 5, 6																
WHEATLAND	MICHIGAN STRAY	1947	MECOSTA	1,399	3 S		DETROIT RIVER	3,849	4	0	0	1	160				506,369	DOMESTIC USE	
	DUNDEE	1945		3,690	2 L	43.0			6	ABANDONED 1960			100		141,631			1,416	
			WHEATLAND TWP., 14N-7W, SECTIONS 7, 8, 9																
WHITE CLOUD	TRAVERSE	1963	NEWAYGO	2,537	1 L		TRAVERSE	2,540	1	ABANDONED 1964			40		1,295			32	
			WILCOX TWP., 14N-12W, SECTION 19																
WHITE OAK 32-2N-2E	SALINA-NIAGARAN REEF	1973	INGHAM	3,970	8 D		CATARACT	4,583	3	0	0	3	240	18,401	44,124	3,309	6,964	184	422
			WHITE OAK TWP., 2N-2E, SECTION 32																
WHITE RIVER	DUNDEE	1950	MUSKEGON	2,053	2 L	28.0	DUNDEE *	2,055	1	ABANDONED 1951			20		7,061			353	
			WHITE RIVER TWP., 12N-18W, SECTION 15																
WILEY	TRAVERSE	1962	MASON	1,663	5 L	39.9	ST. PETER SS.	5,890	18	0	0	4	380	829	425,479			1,120	100
			EDEN TWP., 17N-16W, SECTION 18 RIVERTON TWP., 17N-17W, SECTION 12																
WINFIELD	DUNDEE-REED CITY	1936	MONTCALM	3,340	1 L	43.2	REED CITY	3,500	8	0	0	2	120	565	118,542			988	30
			WINFIELD TWP., 12N-9W, SECTIONS 20, 28, 29																
WINFIELD	REFER TO TABLE 4 DEVELOPED GAS STORAGE RESERVOIRS																		
WINTERFIELD	TRAVERSE	1940	CLARE	3,105	1 L		SYLVANIA	5,273					260	4,872	293,566	0	256,586	1,129	
	DUNDEE	1940		3,794	3 L	44.2							740	13,769	[illegible],813,554			6,505	1,400
	RICHFIELD	1942		5,015	15 D				50	0	0	13	100	2,842	181,118			1,811	
			WINTERFIELD TWP., 20N-6W, SECTIONS 28 THROUGH 32, 35, 36 REDDING TWP., 19N-6W, SECTIONS 1, 5 GREENWOOD TWP., 19N-5W, SECTION 6									THE 13 WELLS INCLUDE 5 TRAVERSE, 4 DUNDEE & 1 TRAVERSE & RICHFIELD							
WISE	MICHIGAN STRAY	1940	ISABELLA	1,250	5 S		SYLVANIA	5,205	7	0	0	5	1,280			0	[illegible]	DOMESTIC USE & LEASE FUEL	
	TRAVERSE	1953		3,090	31 L	43.0								2,421	49,029				
	DUNDEE	1938		3,700	11 L	45.2			79	0	0	23	1,640	12,430	3,935,595			2,430	1,629
	DETROIT RIVER SZ	1955		4,415	48 DL	42.6			2	0	0	1	80	1,292	63,571			795	35
			WISE TWP., 16N-3W, SECTIONS 8, 9, 16, 17, 20, 21, 28, 29, 32, 33									THE 23 WELLS INCLUDE 17 DUNDEE, 1 STRAY, 4 TRAVERSE AND DUNDEE AND 1 DUNDEE AND DETROIT RIVER							
WOLF LAKE	"BEREA"	1949	MUSKEGON	1,050	7 D		DETROIT RIVER	2,250	2	ABANDONED 1956			320				95,756		
	TRAVERSE	1968		1,741	23 L				3	0	0	1	60	0	4,614			77	
			EGELSTON TWP., 10N-15W, SECTIONS 7, 8, 18 MUSKEGON TWP., 10N-16W, SECTION 13																
WOODSTOCK	TRAVERSE	1969	LENAWEE	1,465	2 L		TRAVERSE	1,467	2	0	0	1	80			SHUT-IN FOR MARKET			
			WOODSTOCK TWP., 5S-1E, SECTION 18																
WOODVILLE	TRAVERSE	1943	NEWAYGO	2,820	5 L	43.5	DETROIT RIVER	3,534	10	0	0	10	350	4,172	572,187			1,635	45
			NORWICH TWP., 15N-13W, SECTIONS 20, 28, 29																
WOODVILLE (NORWICH)	REFER TO TABLE 4 DEVELOPED GAS STORAGE RESERVOIRS																		
WRIGHT	"BEREA"	1954	OTTAWA	1,170	3 L		DETROIT RIVER	2,337	7	0	0	4	60	111	47,195	SHUT-IN -- LACK OF STORAGE		788	7
	TRAVERSE	1953	OTTAWA	1,920	1 L				7	0	0	2	70	12	18,498			264	1
			WRIGHT TWP., 8N-13W, SECTIONS 28, 32, 33 TALLMADGE TWP., 7N-13W, SECTION 4																
WYOMING PARK	TRAVERSE	1939	KENT	1,870	6 L	39.0	DETROIT RIVER	2,255	21	ABANDONED 1970			300		157,873			526	
			WYOMING TWP., 6N-12W, SECTIONS 13, 14, 23																
YANKEE	NIAGARAN REEF	1963	ST. CLAIR	2,620	20 D		CLINTON	2,829	2	0	0	2	80				354,177		
			ST. CLAIR TWP., 5N-16E, SECTION 25																
ZEELAND	"BEREA"	1946	OTTAWA	945	9 D		NIAGARAN	3,388	7	ABANDONED 1975			280					DOMESTIC USE	
			ZEELAND TWP., 5N-14W, SECTIONS 2, 11, 12, 13, 14																
ZEELAND	TRAVERSE	1942	OTTAWA	1,514	3 L	41.9	NIAGARAN	3,052	21	ABANDONED 1967			400		310,085			775	
	SALINA	1958		2,792	5 D	20.5			1	ABANDONED 1962			10		1,606			161	
			ZEELAND TWP., 5N-14W, SECTIONS 25, 30, 31, 32, 36 HOLLAND TWP., 5N-15W, SECTIONS E½ 35, 36 (TRAVERSE; ZEELAND TWP., 5N-14W, SECTION 29 (SALINA)																
ZEELAND, SEC. 28	TRAVERSE	1954	OTTAWA	1,491	1 L		DETROIT RIVER	2,215	3	ABANDONED 1956			30		4,437			148	
			ZEELAND TWP., 5N-14W, SECTIONS 21, 28																
1975 TOTALS:													325,385	11,180,505	641,406,568	26,185,444	455,[illegible],341		108,226

CHANGES IN FIELD NAMES

HISTORICALLY, WITH FEW EXCEPTIONS, MICHIGAN OIL AND GAS FIELDS HAVE BEEN NAMED AFTER NEARBY GEOGRAPHIC ENTITIES SUCH AS TOWNS, VILLAGES, LAKES AND TOWNSHIP NAMES. DUE TO NUMEROUS NIAGARAN REEF DISCOVERIES WITHIN RELATIVELY SMALL AREAS AND A LACK OF SUITABLE, IDENTIFYING NAMES FOR THOSE IN NORTHERN MICHIGAN AND POSSIBLY THOSE IN SOUTHERN MICHIGAN IN FUTURE YEARS, THE NAMING SYSTEM HAS BEEN MODIFIED. STARTING IN 1971, MOST NEW NIAGARAN REEF FIELDS WERE NAMED ACCORDING TO TOWNSHIP NAME, FOLLOWED BY THE SECTION NUMBER FOR THE DISCOVERY WELL, AND THEN BY NUMERICAL TOWN AND RANGE. SEPARATE POOLS OR RESERVOIRS OCCURRING IN THE SAME FIELD ARE DESIGNATED POOL A, B, C AS NECESSARY.

LISTING OF A SECTION OR PART OF A SECTION DOES NOT NECESSARILY MEAN THE ENTIRE SECTION TO BE PRODUCTIVE OF OIL OR GAS IN ANY OR ALL POTENTIALLY PRODUCTIVE FORMATIONS. ONLY THOSE SECTIONS OR PARTS OF SECTIONS WHICH HAVE HAD AT LEAST ONE WELL COMPLETED AS AN OIL OR GAS WELL ARE LISTED.

1975 OIL AND CONDENSATE PRODUCTION FROM TABLE 2	13,234,595 BARRELS
1975 OIL PRODUCTION FROM TABLE 3 AND 4	11,184,930
TOTAL 1975 OIL PRODUCTION	24,419,525
CUMULATIVE OIL AND CONDENSATE PRODUCTION FROM TABLE 2	29,554,765
CUMULATIVE OIL PRODUCTION FROM TABLE 3 AND 4	641,530,192
TOTAL STATE CUMULATIVE OIL PRODUCTION THROUGH 1975	671,084,962*

*CUMULATIVE FIGURE INCLUDES 18,097 BARRELS OF OIL FROM MISCELLANEOUS OIL WELLS DRILLED FROM 1925 THROUGH 1975 AND SUBSEQUENTLY COMPLETED AS DRY HOLES

1975 GAS PRODUCTION FROM TABLE 2	76,184,089 MCF
1975 GAS PRODUCTION FROM TABLE 3 AND 4	26,493,978
TOTAL 1975 GAS PRODUCTION	102,678,067
CUMULATIVE GAS PRODUCTION FROM TABLE 2	144,896,825 MCF
CUMULATIVE GAS PRODUCTION FROM TABLE 3 AND 4	828,675,233
TOTAL CUMULATIVE GAS PRODUCTION THROUGH 1975	973,572,058

POOL CLASSIFICATION

- ● ACTIVE OIL FIELD OR POOL
- ● (struck) ABANDONED OIL FIELD OR POOL
- ☼ ACTIVE GAS FIELD OR POOL
- ☼ (struck) ABANDONED GAS FIELD OR POOL
- ✸ GAS-CONDENSATE FIELD OR POOL
- ✸ (struck) ABANDONED GAS-CONDENSATE FIELD OR POOL
- ⊕ GAS STORAGE RESERVOIR
- ⊖ UNDEVELOPED GAS STORAGE RESERVOIR

Pool Class.	Field Name	Producing Formation or Pool	Year of Disc.	County / Township / Producing Sections	Pay Zone: Depth in Feet	Pay Zone: Thickness and Lithology	Pay Zone: Oil Gravity A.P.I.	Deepest Formation or Pool Tested	Depth in Feet	No. of Wells: To End 1974	Comp In 1974	Aband. In 1974	Active at End 1974	Drilled Acres	Oil Production—Bbls.: Produced in 1974	Oil: Cumulative Through 1974	Gas Production—Mcf: Produced in 1974	Gas: Cumulative Through 1974	Recovery per Acre Drilled (Bbls.)	Total Barrels Brine per Day
●	VEVAY 17-2N-1W	NIAGARAN REEF	1972	INGHAM	4,162	12 D		NIAGARAN	4,300	3	1	0	3	240	23,697	29,577	34,139	34,139	123	
				VEVAY TWP., 2N-1W, SECTION 17																
● (abandoned)	VEVAY 19-2N-1W	TRAVERSE	1971	INGHAM	2,141	65 L	37	CINCINNATIAN	4,600	2	ABANDONED 1973			30	0	12,330			161	
☼	NIAGARAN POOL A	NIAGARAN REEF	1972		3,942	24 D				2	0	0	2	320	67,708	137,527	271,424	2,403,425	431	
●	NIAGARAN POOL B	NIAGARAN REEF								4	0	0	4	640	43,270	117,201	557,329	1,707,489	183	
●	NIAGARAN POOL C	NIAGARAN REEF								1	0	0	1	160	1,590	7,498	15,456	61,652	47	
	FIELD DECLARED TO HAVE 3 SEPARATE RESERVOIRS OR POOLS (ORDER NO. 2-1-73)			POOL (A) INCLUDES THE F. MILLER & A. IMLAY WELLS LOCATED IN THE SE¼ OF SECTION 24, T.2N., R.2W., & THE SW¼ OF SECTION 19, T.2N., R.1W					POOL (B) INCLUDES THE CARTER, LYON, DART, & KRANZ WELLS LOCATED IN THE N½ OF SECTION 19 & THE S½ OF SECTION 18, T.2N., R.1W.								POOL (C) INCLUDES THE LOVETTE WELL LOCATED IN THE SW¼ OF THE NE¼ OF SECTION 18, T.2N., R.1W.			
				VEVAY TWP., 2N-1W, SECTIONS 18, 19 AURELIUS TWP., 2N-2W, SECTION 24																
●	VEVAY 20-2N-1W	NIAGARAN REEF	1972	INGHAM	3,939	2 D		PRAIRIE DU CHIEN	5,985	1	0	0	1	80	6,720	14,744	28,871	112,359	184	73
				VEVAY TWP., 2N-1W, SECTION 20																
● (abandoned)	VICTORY, SEC. 10	TRAVERSE	1957	MASON	1,603	9 L	36.0	TRAVERSE	1,616	1	ABANDONED 1958			10		580			58	DOMESTIC USE
				VICTORY TWP., 19N-17W, SECTION 10										NONCOMMERCIAL GAS PRODUCTION IN BASE OF GLACIAL DRIFT						
●	VOGEL CENTER	DUNDEE	1966	MISSAUKEE	3,392	3 L		DUNDEE	3,395	2	0	0	2	30	1,470	42,394			530	150
				CLAM UNION TWP., 21N-6W, SECTION 32																
●	WALKER	"BEREA"	1940	KENT-OTTAWA	1,121	21 SL		ST. PETER SS.	5,222											
●		TRAVERSE	1938		1,872	8 L	36.0			752	0	4	349	5,560	118,112	6,860,442		3,678,731	1,367	96
													THE 349 WELLS INCLUDE 346 TRAVERSE AND 3 "BEREA"							
●		DETROIT RIVER	1957		2,132	12 D				1	0	0	1	10						1
☼		"BEREA", TRAVERSE & DETROIT RIVER								5	0	0	5	THE 5 WELLS INCLUDE 3 BEREA, 1 DETROIT RIVER & 1 TRAVERSE			7,446	1,309,385	DOMESTIC USE & LEASE FUEL	
				WALKER TWP., 7N-12W, SECTIONS 19, 20, 27, 28, 29, 30, 31, 32, 33, 34 WALKER TWP., 6N-12W, SECTIONS 3, 4, 5, 6 WYOMING TWP., 6N-12W, SECTIONS 2, 3, 4, 7, 8																
				TALLMADGE TWP., 7N-13W, SECTIONS 14, 15, 22 THROUGH 28, 33, 34, 35, 36 TALLMADGE TWP., 6N-13W, SECTIONS 1, 12 GEORGETOWN TWP., 6N-13W, SECTIONS 1, 2 GEORGETOWN TWP., 7N-13W, SECTION 35																
●	WAYLAND	TRAVERSE	1944	ALLEGAN	1,799	6 L	36.0	TRENT.-BLK. RIVER	4,400	54	0	0	2	530	965	264,374			500	1
●		SALINA	1960		3,132	12 D	28.0			31	0	0	28	1,240	30,893	1,313,363			1,059	
				WAYLAND TWP., 3N-11W, SECTIONS E½ 8, 9, 16, 17, 18, 20, 21																
●	WAYLAND, NORTH	TRAVERSE	1957	ALLEGAN	1,696	7 L		TRAVERSE	1,712	15	0	0	5	150	322	110,411			736	
				WAYLAND TWP., 3N-11W, SECTIONS 6, 7, NW¼ 8																
● (abandoned)	WEARE	TRAVERSE	1961	OCEANA	1,681	2 L		TRAVERSE	1,737	3	ABANDONED 1964			30		6,919			231	
				WEARE TWP., 16N-17W, SECTIONS 12, 13																
● (abandoned)	WEARE, SEC. 14	TRAVERSE	1952	OCEANA	1,674	1 L	41.4	DUNDEE	2,217	1	ABANDONED 1954			10		1,096			110	
				WEARE TWP., 16N-17W, SECTION 14																
●	WEST BRANCH	TRAVERSE	1933	OGEMAW	1,796	2 L		CAMBRO-ORDOVICIAN	11,012						PRODUCTION COMBINED WITH WEST BRANCH DUNDEE		SOME TRAVERSE OIL PRODUCED IN CONNECTION WITH WATER FLOOD PROJECT			
●		DUNDEE	1933		2,650	20 L	36.8			281	4	7	159	2,770	133,011	8,212,636			2,965	1,422
●		DETROIT RIVER SZ	1951		3,585	9 D	38.9						THE 159 WELLS INCLUDE 157 DUNDEE & 1 TRAVERSE & 1 TRAVERSE & DUNDEE							
OK ← ●		RICHFIELD	1952		4,127		33.0			63	0	1	60	2,520	65,513	4,065,030		61,430	1,605	4
													THE 60 WELLS INCLUDE 29 RICHFIELD, 25 SOUR ZONE, AND 6 RICHFIELD & SOUR ZONE							
				WEST BRANCH TWP., 22N-2E, SECTIONS 18, 19, 20, 21, 26, 27, 28, 29, 34, 35, 36 OGEMAW TWP., 22N-1E, SECTIONS 10, 13, 14, 23, 24 CHURCHILL TWP., 22N-3E, SECTION 31																
				HORTON TWP., 21N-2E, SECTIONS 1, 2 MILLS TWP., 21N-3E, SECTIONS 5, 6																
← ☼	WHEATLAND	MICHIGAN STRAY	1947	MECOSTA	1,399	3 S		DETROIT RIVER	3,849	4	0	0	1	160				506,369	DOMESTIC USE	
● (abandoned)		DUNDEE	1945		3,690	2 L	43.0			6	ABANDONED 1960			100		141,631			1,416	
				WHEATLAND TWP., 14N-7W, SECTIONS 7, 8, 9																
● (abandoned)	WHITE CLOUD	TRAVERSE	1963	NEWAYGO	2,537	1 L		TRAVERSE	2,540	1	ABANDONED 1964			40		1,295			32	
				WILCOX TWP., 14N-12W, SECTION 19																
●	WHITE OAK 32-2N-2E	SALINA-NIAGARAN REEF	1973	INGHAM	3,970	8 D		CATARACT	4,583	3	2	0	3	240	18,373	25,723	3,655	3,655	107	75
				WHITE OAK TWP., 2N-2E, SECTION 32																
● (abandoned)	WHITE RIVER	DUNDEE	1950	MUSKEGON	2,053	2 L	28.0	DUNDEE	2,055	1	ABANDONED 1951			20		7,061			353	
				WHITE RIVER TWP., 12N-18W, SECTION 15																
●	WILEY	TRAVERSE	1962	MASON	1,663	5 L	39.9	ST. PETER SS.	5,890	18	0	5	4	380	1,738	424,650			1,118	93
				EDEN TWP., 17N-16W, SECTION 18 RIVERTON TWP., 17N-17W, SECTION 12																
●	WINFIELD	DUNDEE-REED CITY	1936	MONTCALM	3,340	1 L	43.2	REED CITY	3,500	8	0	0	2	120	648	117,977			983	30
				WINFIELD TWP., 12N-9W, SECTIONS 20, 28, 29																
⊕	WINFIELD	REFER TO TABLE 3 DEVELOPED GAS STORAGE RESERVOIRS																		
●	WINTERFIELD	TRAVERSE	1940	CLARE	3,105	1 L		SYLVANIA	5,273					260	5,188		0	256,586		1
●		DUNDEE	1940		3,794	3 L	44.2							740	14,660					1,400
●		RICHFIELD	1942		5,015	15 D				50	0	0	13	100	2,707	5,267,055			4,788	
				WINTERFIELD TWP., 20N-6W, SECTIONS 28 THROUGH 32, 35, 36 REDDING TWP., 19N-6W, SECTIONS 1, 5 GREENWOOD TWP., 19N-5W, SECTION 6									THE 13 WELLS INCLUDE 8 TRAVERSE, 4 DUNDEE & 1 TRAVERSE & RICHFIELD							
☼	WISE	MICHIGAN STRAY	1940	ISABELLA	1,250	5 S		SYLVANIA	5,205	7	0	0	5	1,280			0	1,705,130	DOMESTIC USE & LEASE FUEL	
●		TRAVERSE	1953		3,090	31 L	43.0								699					
●		DUNDEE	1938		3,700	11 L	45.2			79	0	1	23	1,640	9,791	3,371,005			2,421	1,036
●		DETROIT RIVER SZ	1955		4,415	48 DL	42.6			2	0	0	1	80	1,166	61,047			763	28
				WISE TWP., 16N-3W, SECTIONS 8, 9, 16, 17, 20, 21, 28, 29, 32, 33									THE 23 WELLS INCLUDE 17 DUNDEE, 1 STRAY, 4 TRAVERSE AND DUNDEE AND 1 DUNDEE AND DETROIT RIVER							
☼ (abandoned)	WOLF LAKE	"BEREA"	1949	MUSKEGON	1,050	7 D		DETROIT RIVER	2,250	2	ABANDONED 1956			320				99,756		
●		TRAVERSE	1968		1,741	23 L				3	0	1	1	60	0	4,614			77	
				EGELSTON TWP., 10N-15W, SECTIONS 7, 8, 18 MUSKEGON TWP., 10N-16W, SECTION 13																
☼	WOODSTOCK	TRAVERSE	1969	LENAWEE	1,465	2 L		TRAVERSE	1,467	2	0	0	1	80			SHUT-IN FOR MARKET		.	
				WOODSTOCK TWP., 5S-1E, SECTION 18																

POOL CLASSIFICATION				OF ACTIVE OIL FIELD OR POOL / AOF ABANDONED OIL FIELD OR POOL				GF ACTIVE GAS FIELD OR POOL / AGF ABANDONED GAS FIELD OR POOL						G-C GAS-CONDENSATE FIELD OR POOL / AG-C ABANDONED GAS-CONDENSATE FIELD OR POOL				GS GAS STORAGE RESERVOIR		
	FIELD NAME	PRODUCING FORMATION OF POOL	YEAR OF DISC.	COUNTY TOWNSHIP PRODUCING SECTIONS	PAY ZONE DEPTH IN FEET	PAY ZONE THICKNESS AND LITHOLOGY	PAY ZONE OIL GRAVITY A.P.I.	DEEPEST FORMATION OR POOL TESTED	DEPTH IN FEET	NUMBER OF WELLS 1976 TO END	COMP IN	ABAND IN	ACTIVE AT END	DRILLED ACRES	OIL PRODUCTION - BBLS. PRODUCED IN 1976	CUMULATIVE THROUGH 1976	GAS PRODUCTION - MCF PRODUCED IN 1976	CUMULATIVE THROUGH 1976	RECOVERY PER ACRE DRILLED (BBLS)	TOTAL BARRELS BRINE PER DAY
OF	WILEY	TRAVERSE	1952	MASON	1,663	5 L	39.9	ST. PETER SS.	5,890	18	0	0	4	180	417	425,896			1,121	99
				EDEN TWP., 17N-16W, SECTION 15 RIVERTON TWP., 17N-17W, SECTION 12																
OF	WINFIELD	DUNDEE-REED CITY	1936	MONTCALM	3,340	1 L	43.2	REED CITY	3,500	8	0	2	2	120	357	118,899			991	45
				WINFIELD TWP., 12N-9W, SECTIONS 20, 28, 29																
GS	WINFIELD (STRAY)	REFER TO TABLE 4 - DEVELOPED GAS STORAGE RESERVOIRS																		
OF	WINTERFIELD	TRAVERSE	1940	CLARE	3,105	1 L		SYLVANIA	5,273					260	4,155	297,721	0	256,586	1,145	
OF		DUNDEE	1940		3,794	3 L	44.2							740	12,895	4,826,449			6,522	1,901
OF		RICHFIELD	1942		5,015	15 D				50	0	0	13	100	2,292	163,410			1,834	
				WINTERFIELD TWP., 20N-6W, SECTIONS 28 THROUGH 32, 35, 36 REDDING TWP., 19N-6W, SECTIONS 1, 5 GREENWOOD TWP., 19N-5W, SECTION 6						THE 13 WELLS INCLUDE 8 TRAVERSE, 4 DUNDEE & 1 TRAVERSE & RICHFIELD										
GF	WISE	MICHIGAN STRAY	1940	ISABELLA	1,250	5 S		SYLVANIA	5,205	[illegible]	0	0	5	1,280	0	0		1,705,130	DOMESTIC USE & LEASE FUEL	
OF		TRAVERSE	1953		3,090	31 L	43.0								1,391	50,420				
OF		DUNDEE	1938		3,700	11 L	45.2			79	0	0	23	1,640	10,928	3,946,523			2,437	964
OF		DETROIT RIVER SS	1955		4,415	46 DL	42.6			2	0	0	1	80	2,186	65,757			822	28
				WISE TWP., 16N-3W, SECTIONS 8, 9, 16, 17, 20, 21, 28, 29, 32, 33						THE 23 WELLS INCLUDE 17 DUNDEE, 1 STRAY, 4 TRAVERSE AND DUNDEE AND 1 DUNDEE AND DETROIT RIVER										
AGF	WOLF LAKE	"BEREA"	1949	MUSKEGON	1,050	7 S		DETROIT RIVER	2,250	2	ABANDONED 1956			320				99,756		
OF		TRAVERSE	1968		1,741	23 L				3	0	0	1	60		4,614			77	
				EGELSTON TWP., 10N-15W, SECTIONS 7, 8, 18 MUSKEGON TWP., 10N-16W, SECTION 13																
GF	WOODSTOCK	TRAVERSE	1969	LENAWEE	1,465	2 L		TRAVERSE	1,467	2	0	0	1	80			SHUT-IN FOR MARKET			
				WOODSTOCK TWP., 5S-1E, SECTION 18																
OF	WOODVILLE	TRAVERSE	1943	NEWAYGO	2,820	5 L	43.5	DETROIT RIVER	3,534	10	0	0	10	350	3,859	576,046			1,646	65
				NORWICH TWP., 15N-11W, SECTIONS 20, 28, 29																
GS	WOODVILLE (NORWICH)	REFER TO TABLE 4 DEVELOPED GAS STORAGE RESERVOIRS																		
OF	WRIGHT	"BEREA	1954	OTTAWA	1,170	3 L		DETROIT RIVER	2,337	7	0	0	4	60	0	47,195	SHUT-IN -- LACK OF STORAGE		787	
OF		TRAVERSE	1953	OTTAWA	1,920	1 L				7	0	0	2	70	0	18,498			264	
				WRIGHT TWP., 8N-13W, SECTIONS 28, 32, 33 TALLMADGE TWP., 7N-13W, SECTION 4																
AOF	WYOMING PARK	TRAVERSE	1939	KENT	1,870	6 L	39.0	DETROIT RIVER	2,255	21	ABANDONED 1970			300		157,873			526	
				WYOMING TWP., 6N-12W, SECTIONS 13, 14, 23																
GF	YANKEE	NIAGARAN REEF	1963	ST. CLAIR	2,620	20 D		CLINTON	2,829	2	0	0	2	80				354,177		
				ST. CLAIR TWP., 5N-16E, SECTION 25																
AGF	ZEELAND	"BEREA	1946	OTTAWA	945	9 S		NIAGARAN	3,388	7	ABANDONED 1975			280					DOMESTIC USE	
				ZEELAND TWP., 5N-14W, SECTIONS 2, 11, 12, 13, 14																
AOF	ZEELAND	TRAVERSE	1942	OTTAWA	1,514	3 L	41.9	NIAGARAN	3,052	21	ABANDONED 1967			400	·	310,085			775	
AOF		SALINA	1958		2,792	5 D	20.5			1	ABANDONED 1962			10		1,606			161	
				ZEELAND TWP., 5N-14W, SECTIONS 25, 30, 31, 32, 36 HOLLAND TWP., 5N-15W, SECTIONS E½ 35, 36 (TRAVERSE) ZEELAND TWP., 5N-14W, SECTION 29 (SALINA)																
AOF	ZEELAND, SEC. 28	TRAVERSE	1954	OTTAWA	1,491	1 L		DETROIT RIVER	2,215	3	ABANDONED 1956			30		4,437			148	
				ZEELAND TWP., 5N-14W, SECTIONS 21, 28																
								1976 TOTALS:						332,030	11,334,579	652,559,212	25,644,364	496,441,374		108,703

LISTING OF A SECTION OR PART OF A SECTION DOES NOT NECESSARILY MEAN THE ENTIRE SECTION TO BE PRODUCTIVE OF OIL OR GAS IN ANY OR ALL POTENTIALLY PRODUCTIVE FORMATIONS. ONLY THOSE SECTIONS OR PARTS OF SECTIONS WHICH HAVE HAD AT LEAST ONE WELL COMPLETED AS AN OIL OR GAS WELL ARE LISTED.

CHANGES IN FIELD NAMES

HISTORICALLY, WITH FEW EXCEPTIONS, MICHIGAN OIL AND GAS FIELDS HAVE BEEN NAMED AFTER NEARBY GEOGRAPHIC ENTITIES SUCH AS TOWNS, VILLAGES, LAKES AND TOWNSHIP NAMES. DUE TO NUMEROUS NIAGARAN REEF DISCOVERIES WITHIN RELATIVELY SMALL AREAS AND A LACK OF SUITABLE IDENTIFYING NAMES FOR THOSE IN NORTHERN MICHIGAN AND POSSIBLY THOSE IN SOUTHERN MICHIGAN IN FUTURE YEARS, THE NAMING SYSTEM HAS BEEN MODIFIED. STARTING IN 1971, MOST NEW NIAGARAN REEF FIELDS WERE NAMED ACCORDING TO TOWNSHIP NAME, FOLLOWED BY THE SECTION NUMBER FOR THE DISCOVERY WELL, AND THEN BY NUMERICAL TOWN AND RANGE. SEPARATE POOLS OR RESERVOIRS OCCURRING IN THE SAME FIELD ARE DESIGNATED POOL A, B, C AS NECESSARY.

1976 OIL AND CONDENSATE PRODUCTION FROM TABLE 2	19,084,477 BARRELS
1976 OIL PRODUCTION FROM TABLE 3 AND 4	11,336,986
TOTAL 1976 OIL PRODUCTION	30,421,363
CUMULATIVE OIL AND CONDENSATE PRODUCTION FROM TABLE 2 . .	48,741,245
CUMULATIVE OIL PRODUCTION FROM TABLE 3 AND 4	652,685,143
TOTAL STATE CUMULATIVE OIL PRODUCTION THROUGH 1976 . . .	701,426,388*

*CUMULATIVE FIGURE INCLUDES 11,779 BARRELS OF OIL FROM MISCELLANEOUS OIL WELLS DRILLED FROM 1925 THROUGH 1976 AND SUBSEQUENTLY COMPLETED AS DRY HOLES

1976 GAS PRODUCTION FROM TABLE 2	94,506,351 MCF
1976 GAS PRODUCTION FROM TABLE 3 AND 4	25,743,754
TOTAL 1976 GAS PRODUCTION.	120,250,105
CUMULATIVE GAS PRODUCTION FROM TABLE 2	239,466,726 MCF
CUMULATIVE GAS PRODUCTION FROM TABLE 3 AND 4	854,355,841
TOTAL CUMULATIVE GAS PRODUCTION THROUGH 1976	1,093,822,567

POOL CLASSIFICATION: OF ACTIVE OIL FIELD OR POOL; AOF ABANDONED OIL FIELD OR POOL; GF ACTIVE GAS FIELD OR POOL; AGF ABANDONED GAS FIELD OR POOL; G-C GAS-CONDENSATE FIELD OR POOL; AG-C ABANDONED GAS-CONDENSATE FIELD OR POOL; GS GAS STORAGE RESERVOIR

Pool Class.	Field Name	Producing Formation or Pool	Year of Disc.	County / Township / Producing Sections	Pay Zone: Depth in Feet	Pay Zone: Thickness and Lithology	Pay Zone: Oil Gravity A.P.I.	Deepest Formation or Pool Tested	Depth in Feet	No. of Wells: To End	Comp in 1977	Aband in 1977	Active at End	Drilled Acres	Oil Production (BBLS): Produced in 1977	Oil: Cumulative Through 1977	Gas Production (MCF): Produced in 1977	Gas: Cumulative Through 1977	Recovery per Acre Drilled (BBLS)	Total Barrels Brine per Day
OF	WALKER	"BEREA"	1940	KENT-OTTAWA	1,121	21 SL		ST. PETER SS.	5,222					220	430	46,511			222	
OF		TRAVERSE	1938		1,272	5 L	36.0			784	0	1	341	5,560	110,173	17,152,4[illegible]		[illegible]	3,0[illegible]	283
				THE 341 WELLS INCLUDE 338 TRAVERSE AND 3 "BEREA																
OF		DETROIT RIVER	1957		2,132	12 D				1	0	0	1	10	PRODUCTION COMBINED WITH TRAVERSE					1
GF		"BEREA", TRAVERSE & DETROIT RIVER								14	0	0	5		THE 5 WELLS INCLUDE 3 BEREA, 1 DETROIT RIVER, & 1 TRAVERSE		753	1,322,032	DOMESTIC USE & LEASE FUEL	
				WALKER TWP., 7N-12W, SECTIONS 19, 20, 27, 28, 29, 30, 31, 32, 33, 34 WALKER TWP., 6N-12W, SECTIONS 3, 4, 5, 6; WYOMING TWP., 6N-12W, SECTIONS 2, 3, 4, 7, 8; TALLMADGE TWP., 7N-13W, SECTIONS 14, 15, 22, THROUGH 28, 33, 34, 35, 36 TALLMADGE TWP., 6N-13W, SECTIONS 1, 12; GEORGETOWN TWP., 6N-13W, SECTIONS 1, 2 GEORGETOWN TWP., 7N-13W, SECTION 35																
GF	WASHINGTON, SEC.10	SALINA-NIAGARAN REEF	1974	MACOMB	3,304	179 D		NIAGARAN	3,635	11	6	0	11	480			29,217	29,217		
GF	WASHINGTON, SEC.10 POOL A	NIAGARAN REEF	1976	MACOMB	3,352	234 D		SALINA-NIAGARAN	3,722	5	1	0	5	240			2,983	2,983		
				WASHINGTON TWP., 4N-12E, SECTION 10																
GF	WASHINGTON, SEC.11	NIAGARAN REEF	1965	MACOMB	3,290	180 D		CLINTON	3,686	1	0	0	1	40			16,105	5,291,205		
				WASHINGTON TWP., 4N-12E, SECTION 11																
OF	WASHINGTON, SEC.28	SALINA A-1 CARBONATE	1975	MACOMB	3,357	18 D		NIAGARAN	3,546	9	4	0	9	320	3,228	9,735	23,587	62,991	30	5
				WASHINGTON TWP., 4N-1E, SECTIONS 22, 28																
OF	WAYLAND	TRAVERSE	1944	ALLEGAN	1,799	6 L	36.0	TRENTON-BLK. RIVER	4,400	54	0	0	2	530	700	266,925			504	2
OF		SALINA	1960		3,132	12 D	28.0			34	0	0	31	1,360	55,701	1,475,253			1,085	5
				WAYLAND TWP., 3N-11W, SECTIONS E½ 8, 9, 16, 17, 18, 20, 21																
OF	WAYLAND, NORTH	TRAVERSE	1957	ALLEGAN	1,696	7 L		TRAVERSE	1,712	15	0	0	5	150	1,050	113,300			755	33
				WAYLAND TWP., 3N-11W, SECTIONS 6, 7, NW¼ 8																
AOF	WEARE	TRAVERSE	1961	OCEANA	1,681	2 L		TRAVERSE	1,737	3	ABANDONED 1964			30		6,319			231	
				WEARE TWP., 16N-17W, SECTIONS 12, 13																
AOF	WEARE, SEC. 14	TRAVERSE	1952	OCEANA	1,674	1 L	41.4	DUNDEE	2,217	1	ABANDONED 1954			10		1,096			110	
				WEARE TWP., 16N-17W, SECTION 14																
OF	WEST BRANCH	TRAVERSE	1933	OGEMAW	1,796	2 L		CAMBRO-ORDOVICIAN	11,012						PRODUCTION COMBINED WITH WEST BRANCH DUNDEE		SOME TRAVERSE OIL PRODUCED IN CONNECTION WITH WATER FLOOD PROJECT			
OF		DUNDEE	1933		2,650	20 L	36.8			299	6	0	172	2,890	245,795	5,771,875			2,[illegible]	2,120
OF		DETROIT RIVER SZ	1951		3,585	9 D	38.9							THE 172 WELLS INCLUDE 170 DUNDEE AND 1 TRAVERSE AND 1 TRAVERSE & DUNDEE						
OF		RICHFIELD	1952		4,127		33.0			65	9	0	60	2,520	67,804	3,232,572	2,550	33,580	1,283	4
														THE 60 WELLS INCLUDE 33 RICHFIELD, 25 SOUR ZONE, AND 2 RICHFIELD & SOUR ZONE						
				WEST BRANCH TWP., 22N-2E, SECTIONS 18, 19, 20, 21, 26, 27, 28, 29, 34, 35, 36 OGEMAW TWP., 22N-1E, SECTIONS [illegible]; CHURCHILL TWP., 22N-3E, SECTION 31																
				HORTON TWP., 21N-2E, SECTIONS 1, 2 MILLS TWP., 21N-3E, SECTIONS 5, 6																
GF	WHEATLAND	MICHIGAN STRAY	1947	MECOSTA	1,399	3 S		DETROIT RIVER	3,849	4	0	0	[illegible]	160				525,355	DOMESTIC USE	
AOF		DUNDEE	1945		3,690	2 L	43.0			6	ABANDONED 1960			100		141,6[illegible]			1,416	
				WHEATLAND TWP., 14N-7W, SECTIONS 7, 8, 9																
AOF	WHITE CLOUD	TRAVERSE	1963	NEWAYGO	2,537	1 L		TRAVERSE	2,540	1	ABANDONED 1964			40		1,295			32	
				WILCOX TWP., 14N-12W, SECTION 19																
OF	WHITE OAK 32-2N-2E	SALINA-NIAGARAN REEF	1973	INGHAM	3,970	8 D		CATARACT	4,583	5	1	0	5	400	23,605	93,0[illegible]	4,025	14,048	233	407
				WHITE OAK TWP., 2N-2E, SECTIONS 29, 31, 32 WELLS IN SECTION 29 ARE PROBABLY IN A SEPARATE RESERVOIR																
AOF	WHITE RIVER	DUNDEE	1950	MUSKEGON	2,053	2 L	28.0	DUNDEE	2,055	1	ABANDONED 1951			20		7,061			353	
				WHITE RIVER TWP., 12N-18W, SECTION 15																
OF	WILEY	TRAVERSE	1962	MASON	1,663	5 L	39.9	ST. PETER SS.	5,890	18	0	0	4	380	212	426,138			1,121	64
				EDEN TWP., 17N-16W, SECTION 18 RIVERTON TWP., 17N-17W, SECTION 12																
OF	WINFIELD	DUNDEE-REED CITY	1936	MONTCALM	3,340	1 L	43.2	REED CITY	3,500	3	0	0	2	120	346	119,2[illegible]			994	31
				WINFIELD TWP., 12N-9W, SECTIONS 20, 28, 29																
GS	WINFIELD (STRAY)	REFER TO TABLE 4 DEVELOPED GAS STORAGE RESERVOIRS																		
OF	WINTERFIELD	TRAVERSE	1940	CLARE	3,105	1 L		SYLVANIA	5,273					260	4,394	304,115	[illegible]	256,566	1,170	4
OF		DUNDEE	1940		3,794	3 L	44.2							740	15,974	4,842,303			6,5[illegible]	1,945
OF		RICHFIELD	1942		5,015	15 D				53	3	0	16	100	5,753	185,163			1,852	
				WINTERFIELD TWP., 20N-6W, SECTIONS 28 THROUGH 32, 35, 36 REDDING TWP., 19N-6W, SECTIONS 1, 5; GREENWOOD TWP., 19N-5W, SECTION 6											THE 16 WELLS INCLUDE 8 TRAVERSE, 4 DUNDEE, 2 RICHFIELD & 1 TRAVERSE & RICHFIELD					
GF	WISE	MICHIGAN STRAY	1940	ISABELLA	1,250	5 S		SYLVANIA	5,205	[illegible]	0	0	6	1,280				1,705,130	DOMESTIC USE & LEASE FUEL	
OF		TRAVERSE	1953		3,092	31 L	43.0								1,545	51,592				
OF		DUNDEE	1939		3,700	11 L	45.2			79	0	0	21	1,640	14,387	3,961,4[illegible]			2,4[illegible]7	988
OF		DETROIT RIVER SZ	1955		4,415	48 DL	42.6			2	0	0	[illegible]	80	1,695	67,4[illegible]			843	28
				WISE TWP., 16N-3W, SECTIONS 8, 9, 16, 17, 20, 21, 28, 29, 32, 33											THE 21 WELLS INCLUDE 17 DUNDEE, 4 TRAVERSE AND DUNDEE, DUNDEE AND DETROIT RIVER					
AGF	WOLF LAKE	"BEREA"	1949	MUSKEGON	1,050	7 D		DETROIT RIVER	2,250	2	ABANDONED 1956			320				99,756		
OF		TRAVERSE	1966		1,741	23 L				4	1	0	2	60		4,614			77	
				EGELSTON TWP., 10N-15W, SECTIONS 7, 8, 18 MUSKEGON TWP., 10N-16W, SECTION 13																
GF	WOODSTOCK	TRAVERSE	1969	LENAWEE	1,465	2 L		TRAVERSE	1,467	2	0	0	1	80			SHUT-IN FOR MARKET			
				WOODSTOCK TWP., 5S-1E, SECTION 8																
OF	WOODVILLE	TRAVERSE	1943	NEWAYGO	2,820	5 L	43.5	DETROIT RIVER	3,534	10	0	0	10	350	3,349	579,393			1,655	108
				NORWICH TWP., 15N-11W, SECTIONS 20, 28, 29																
GS	WOODVILLE (NORWICH)	REFER TO TABLE 4 DEVELOPED GAS STORAGE RESERVOIRS																		
OF	WRIGHT	"BEREA"	1954	OTTAWA	1,170	3 L		DETROIT RIVER	2,337	7	0	0	4	60		47,195	SHUT-IN — LACK OF STORAGE		786	10
OF		TRAVERSE	1953	OTTAWA	1,920	1 L				7	0	0	2	70		18,498			264	11
				WRIGHT TWP., 8N-13W, SECTIONS 28, 32, 33 TALLMADGE TWP., 7N-13W, SECTION 4																
AOF	WYOMING PARK	TRAVERSE	1939	KENT	1,875	6 L	39.0	DETROIT RIVER	2,255	21	ABANDONED 1970			300		157,673			526	
				WYOMING TWP., 6N-12W, SECTIONS 13, 14, 23																
GF	YANKEE	NIAGARAN REEF	1963	ST. CLAIR	2,620	20 D		CLINTON	2,829	2	[illegible]	0	[illegible]	80			1,812	353,985		
				ST. CLAIR TWP., 5N-16E, SECTION 25																
AGF	ZEELAND	"BEREA"	1946	OTTAWA	949	9 D		NIAGARAN	3,383	7	ABANDONED 1975			280					DOMESTIC USE	
				ZEELAND TWP., 5N-14W, SECTIONS 2, 11, 12, 13, 14																

POOL CLASSIFICATION																				
OF ACTIVE OIL FIELD OR POOL; AOF ABANDONED OIL FIELD OR POOL				GF ACTIVE GAS FIELD OR POOL; AGF ABANDONED GAS FIELD OR POOL				G-C GAS-CONDENSATE FIELD OR POOL; AG-C ABANDONED GAS-CONDENSATE FIELD OR POOL						GS GAS STORAGE RESERVOIR						
	FIELD NAME	PRODUCING FORMATION OR POOL	YEAR OF DISC.	COUNTY TOWNSHIP PRODUCING SECTIONS	PAY ZONE: DEPTH IN FEET	PAY ZONE: THICKNESS AND LITHOLOGY	PAY ZONE: OIL GRAVITY A.P.I.	DEEPEST FORMATION OR POOL TESTED	DEPTH IN FEET	NUMBER OF WELLS 1978: TO END	COMP IN	ABAND IN	ACTIVE AT END	DRILLED ACRES	OIL PRODUCTION - BBLS: PRODUCED IN 1978	OIL PRODUCTION - BBLS: CUMULATIVE THROUGH 1978	GAS PRODUCTION - Mcf: PRODUCED IN 1978	GAS PRODUCTION - Mcf: CUMULATIVE THROUGH 1978	RECOVERY PER ACRE DRILLED (BBLS)	TOTAL BARRELS BRINE PER DAY
AOF	VEVAY 20-2N-1W	NIAGARAN REEF	1972	INGHAM	3,939	2 D		PRAIRIE DU CHIEN	5,985	1	ABANDONED 1976			80		17,013		126,542	213	
				VEVAY TWP., 2N-1W, SECTION 20																
AOF	VICTORY, SEC. 10	TRAVERSE	1957	MASON	1,603	9 L	36.0	TRAVERSE	1,616	1	ABANDONED 1956			10		560			58	
				VICTORY TWP., 19N-17W, SECTION 10											NONCOMMERCIAL GAS PRODUCTION IN BASE OF GLACIAL DRIFT					
OF	VOGEL CENTER	DUNDEE	1966	MISSAUKEE	3,892	3 L		DUNDEE	3,895	2	0	0	1	80	313	47,437			593	140
				CLAM UNION TWP., 21N-6W, SECTION 32																
GF	WALES 16-6N-15E	SALINA-NIAGARAN REEF	1976	ST. CLAIR	3,264	195.5 D		SALINA-NIAGARAN	3,650	2	0	0	2	80						
				WALES TWP., 6N-15E, SECTION 16																
OF	WALKER	"BEREA"	1942	KENT-OTTAWA	1,121	21 SL		ST. PETER SS.	5,222					220	496	49,007			223	
OF		TRAVERSE	1938		1,872	8 L	36.0			382	0	2	335	8,560	98,761	17,251,162		3,658,751	2,015	227
															THE 339 WELLS INCLUDE 336 TRAVERSE AND 3 "BEREA"					
OF		DETROIT RIVER	1957		2,132	12 D				1	0	0	1	10	PRODUCTION COMBINED WITH TRAVERSE					1
GF		"BEREA", TRAVERSE, & DETROIT RIVER								14	0	0	5	THE 5 WELLS INCLUDE 3 BEREA, 1 DETROIT RIVER, & 1 TRAVERSE			0	1,348,473	DOMESTIC USE & LEASE FUEL	
				WALKER TWP., 7N-12W, SECTIONS 19, 20, 27, 28, 29, 30, 31, 32, 33, 34 WALKER TWP., 6N-12W, SECTIONS 3, 4, 5, 6 WYOMING TWP., 6N-12W, SECTION 2, 3, 4, 7, 8																
				TALLMADGE TWP., 7N-13W, SECTIONS 14, 15, 22, THROUGH 28, 33, 34, 35, 36 TALLMADGE TWP., 6N-13W, SECTIONS 1, 12 GEORGETOWN TWP., 6N-13W, SECTIONS 1, 2 GEORGETOWN TWP., 7N-13W, SECTION 35																
GF	WASHINGTON, SEC. 10	SALINA-NIAGARAN REEF	1974	MACOMB	3,304	179 D		NIAGARAN	3,635	11	6	0	11	480			462,799	492,600		
GF	WASHINGTON, SEC. 10 [illegible]	NIAGARAN REEF	1976	MACOMB	3,352	234 D		SALINA-NIAGARAN	3,722	5	1	0	5	240			123,287	126,330		
				WASHINGTON TWP., 4N-12E, SECTION 10																
GF	WASHINGTON, SEC. 11	NIAGARAN REEF	1965	MACOMB	3,290	180 D		CLINTON	3,686	1	0	0	1	40			24,750	5,421,779		
				WASHINGTON TWP., 4N-12E, SECTION 11																
OF	WASHINGTON, SEC. 28	SALINA A-1 CARBONATE	1975	MACOMB	3,357	18 D		NIAGARAN	3,546	9	0	0	5	320	1,400	11,139	54,761	117,752	35	
				WASHINGTON TWP., 4N-1E, SECTIONS 22, 28																
OF	WAYLAND	TRAVERSE	1944	ALLEGAN	1,799	6 L	36.0	TRENTON-BLK. RIVER	4,400	54	0	0	2	530	295	267,224			504	1
OF		SALINA	1960		3,132	12 D	28.0			34	2	0	33	1,360	57,885	1,533,138			1,127	12
				WAYLAND TWP., 3N-11W, SECTIONS E½ 8, 9, 16, 17, 18, 20, 21																
OF	WAYLAND, NORTH	TRAVERSE	1957	ALLEGAN	1,696	7 L		TRAVERSE	1,712	15	0	0	5	150	986	114,186			761	47
				WAYLAND TWP., 3N-11W, SECTIONS 6, 7, NW¼ 8																
AOF	WEARE	TRAVERSE	1961	OCEANA	1,681	2 L		TRAVERSE	1,737	3	ABANDONED 1964			30		6,919			231	
				WEARE TWP., 16N-17W, SECTIONS 12, 13																
AOF	WEARE, SEC. 14	TRAVERSE	1952	OCEANA	1,674	1 L	41.4	DUNDEE	2,217	1	ABANDONED 1954			10		1,096			110	
				WEARE TWP., 16N-17W, SECTION 14																
OF	WEST BRANCH	TRAVERSE	1933	OGEMAW	1,796	2 L		CAMBRO-ORDOVICIAN	11,012						PRODUCTION COMBINED WITH WEST BRANCH DUNDEE		SOME TRAVERSE OIL PRODUCED IN CONNECTION WITH WATER FLOOD PROJECT			
OF		DUNDEE	1933		2,050	20 L	36.8			313	14	0	184	2,970	277,405	10,049,464			3,384	2,812
OF		DETROIT RIVER SZ	1951		3,585	9 D	38.9						THE 186 WELLS INCLUDE 184 DUNDEE AND 1 TRAVERSE AND 1 TRAVERSE & DUNDEE							
OF		RICHFIELD	1952		4,127		33.0			63	0	0	60	2,520	47,841	3,280,413	4,325	68,022	1,302	2
													THE 60 WELLS INCLUDE 29 RICHFIELD, 25 SOUR ZONE, AND 6 RICHFIELD & SOUR ZONE							
				WEST BRANCH TWP., 22N-2E, SECTIONS 16, 19, 20, 21, 26, 27, 28, 29, 34,35, 36 OGEMAW TWP., 22N-1E, SECTIONS 10, 13, 14, 23, 24 CHURCHILL TWP., 22N-3E, SECTION 31																
				HORTON TWP., 21N-2E, SECTIONS 1, 2 MILLS TWP., 21N-3E, SECTIONS 5, 6																
GF	WHEATLAND	MICHIGAN STRAY	1947	MECOSTA	1,399	3 S		DETROIT RIVER	3,849	4	0	0	1	160				516,496	DOMESTIC USE	
AOF		DUNDEE	1945		3,690	2 L	43.0			6	ABANDONED 1960			100		141,631			1,416	
				WHEATLAND TWP., 14N-7W, SECTIONS 7, 8, 9																
AOF	WHITE CLOUD	TRAVERSE	1963	NEWAYGO	2,537	1 L		TRAVERSE	2,540	1	ABANDONED 1964			40		1,295			32	
				WILCOX TWP., 14N-12W, SECTION 19																
OF	WHITE OAK 29-2N-2E	SALINA-NIAGARAN REEF	1974	INGHAM	4,066	19 D		NIAGARAN	4,583	2	0	0	2	160	10,946	48,917			306	30
				WHITE OAK TWP., 2N-2E, SECTION 29																
OF	WHITE OAK 32-2N-2E	SALINA-NIAGARAN REEF	1973	INGHAM	3,970	8 D		CATARACT	4,583	2	0	0	2	160	8,131	63,208	1,841	15,889	395	407
OF	WHITE OAK 32-2N-2E POOL A	NIAGARAN REEF	1977	INGHAM	4,046	6 D			4,278	1	0	0	1	80	3,332	10,770			135	
				WHITE OAK TWP., 2N-2E, SECTIONS 31, 32				WHITE OAK 29-2N-2E, WHITE OAK 32-2N-2E AND WHITE OAK 32-2N-2E POOL A MADE SEPARATE FIELDS IN 1978 DUE TO ABROGATION OF PREVIOUS SPACING ORDER												
AOF	WHITE RIVER	DUNDEE	1950	MUSKEGON	2,053	2 L	28.0	DUNDEE	2,055	1	ABANDONED 1951			20		7,061			353	
				WHITE RIVER TWP., 12N-18W, SECTION 15																
OF	WILEY	TRAVERSE	1962	MASON	1,663	5 L	39.9	ST. PETER SS.	5,890	18	0	0	4	380	0	426,108			1,121	154
				EDEN TWP., 17N-16W, SECTION 18 RIVERTON TWP., 17N-17W, SECTION 12																
OF	WINFIELD	DUNDEE-REED CITY	1936	MONTCALM	3,340	1 L	43.2	REED CITY	3,500	8	1	0	1	120	167	119,412			995	0
				WINFIELD TWP., 12N-9W, SECTIONS 20, 28, 29																
GS	WINFIELD (STRAY)	REFER TO TABLE 4 DEVELOPED GAS STORAGE RESERVOIRS																		
OF	WINTERFIELD	TRAVERSE	1940	CLARE	3,105	1 L		SYLVANIA	5,273					260	7,332	311,447		261,718	1,198	10
OF		DUNDEE	1940		3,794	3 L	44.2							740	12,442	4,854,765			6,560	1,600
OF		RICHFIELD	1942		5,015	15 D				63	10	0	26	500	20,032	209,195			418	58
				WINTERFIELD TWP., 20N-6W, SECTIONS 28 THROUGH 32, 35, 36 REDDING TWP., 19N-6W, SECTIONS 1, 5 GREENWOOD TWP., 19N-5W, SECTION 6										THE 26 WELLS INCLUDE 9 TRAVERSE, 4 DUNDEE, 12 RICHFIELD & 1 TRAVERSE & RICHFIELD						
GF	WISE	MICHIGAN STRAY	1940	ISABELLA	1,250	5 S		SYLVANIA	5,205	7	0	0	5	1,250				1,739,233	DOMESTIC USE & LEASE FUEL	
OF		TRAVERSE	1953		3,090	31 L	43.0								1,131	53,096				
OF		DUNDEE	1938		3,700	11 L	45.2			79	0	0	*21	1,640	12,923	3,974,333			2,456	1,329
OF		DETROIT RIVER SZ	1955		4,415	48 DL	42.6			2	0	0	**1	80	2,100	69,542			869	20
				WISE TWP., 16N-3W, SECTIONS 8, 9, 16, 17, 20, 21, 28, 29, 32, 33										*THE 21 WELLS INCLUDE 17 DUNDEE, 4 TRAVERSE AND DUNDEE **DUNDEE AND DETROIT RIVER						
AGF	WOLF LAKE	"BEREA"	1949	MUSKEGON	1,050	7 D		DETROIT RIVER	2,250	2	ABANDONED 1956			320				101,751		
OF		TRAVERSE	1968		1,741	23 L				4	1	0	2	60	287	4,901			82	15
				EGELSTON TWP., 10N-15W, SECTIONS 7, 8, 18 MUSKEGON TWP., 10N-16W, SECTION 13																
GF	WOODSTOCK	TRAVERSE	1969	LENAWEE	1,465	2 L		TRAVERSE	1,467	2	0	0	1	80			SHUT-IN FOR MARKET			
				WOODSTOCK TWP., 5S-1E, SECTION 8																
OF	WOODVILLE	TRAVERSE	1943	NEWAYGO	2,320	5 L	43.5	DETROIT RIVER	3,534	10	0	1	9	350	2,619	582,014			1,663	130
				NORWICH TWP., 15N-11W, SECTIONS 20, 26, 29																

POOL CLASSIFICATION			OF ACTIVE OIL FIELD OR POOL AOF ABANDONED OIL FIELD OR POOL				GF ACTIVE GAS FIELD OR POOL AGF ABANDONED GAS FIELD OR POOL					G-C GAS-CONDENSATE FIELD OR POOL AG-C ABANDONED GAS-CONDENSATE FIELD OR POOL					GS GAS STORAGE RESERVOIR			
	FIELD NAME	PRODUCING FORMATION OR POOL	YEAR OF DISC.	COUNTY TOWNSHIP PRODUCING SECTIONS	PAY ZONE DEPTH IN FEET	PAY ZONE THICKNESS AND LITHOLOGY	PAY ZONE OIL GRAVITY A.P.I.	DEEPEST FORMATION OR POOL TESTED	DEPTH IN FEET	NUMBER OF WELLS TO END 1979	COMP IN 1979	ABAND IN 1979	ACTIVE AT END 1979	DRILLED ACRES	OIL PRODUCTION - BBLS. PRODUCED IN 1979	OIL CUMULATIVE THROUGH 1979	GAS PRODUCTION - Mcf PRODUCED IN 1979	GAS CUMULATIVE THROUGH 1979	RECOVERY PER ACRE DRILLED (BBLS)	TOTAL BARRELS BRINE PER DAY
AOF	WEARE	TRAVERSE	1961	OCEANA	1,681	2 L		TRAVERSE	1,737	3	ABANDONED 1964			30		6,919			231	
				WEARE TWP., 16N-17W, SECTIONS 12, 13																
AOF	WEARE, SEC. 14	TRAVERSE	1952	OCEANA	1,674	1 L	41.4	DUNDEE	2,217	1	ABANDONED 1954			10		1,096			110	
				WEARE TWP., 16N-17W, SECTION 14																
OF	WEST BRANCH	TRAVERSE	1933	OGEMAW	1,796	2 L		CAMBRO-ORDOVICIAN	11,012						PRODUCTION COMBINED WITH WEST BRANCH DUNDEE		SOME TRAVERSE OIL PRODUCED IN CONNECTION WITH WATER FLOOD PROJECT			
OF		DUNDEE	1933		2,650	20 L	36.8			320	7	0	188	3,040	332,479	10,381,363			3,415	2,300
OF		DETROIT RIVER SZ	1951		3,585	9 D	38.9						THE 188 WELLS INCLUDE 186 DUNDEE AND 1 TRAVERSE AND 1 TRAVERSE & DUNDEE							
OF		RICHFIELD	1952		4,127		33.0			63	0	0	60	2,520	58,673	3,339,086	2,367	70,965	1,325	2
													THE 60 WELLS INCLUDE 29 RICHFIELD, 25 SOUR ZONE, AND 6 RICHFIELD & SOUR ZONE							
				WEST BRANCH TWP., 22N-2E, SECTIONS 18, 19, 20, 21, 26, 27, 28, 29, 34, 35, 36 OGEMAW TWP., 22N-1E, SECTIONS 10, 13, 14, 23, 24 CHURCHILL TWP., 22N-3E, SECTION 31																
				HORTON TWP., 21N-2E, SECTIONS 1, 2 MILLS TWP., 21N-3E, SECTIONS 5, 6																
GF	WHEATLAND	MICHIGAN STRAY	1947	MECOSTA	1,399	3 S		DETROIT RIVER	3,849	4	0	0	1	160				516,496	DOMESTIC USE	
AOF		DUNDEE	1945		3,690	2 L	43.0			6	ABANDONED 1960			100		161,631			1,616	
				WHEATLAND TWP., 14N-7W, SECTIONS 7, 8, 9																
AOF	WHITE CLOUD	TRAVERSE	1963	NEWAYGO	2,537	1 L		TRAVERSE	2,540	1	ABANDONED 1964			40		1,295			32	
				WILCOX TWP., 14N-12W, SECTION 19																
OF	WHITE OAK 29-2N-2E	SALINA-NIAGARAN REEF	1974	INGHAM	4,066	19 D		NIAGARAN	4,583	2	0	0	2	160	5,884	54,301			343	112
				WHITE OAK TWP., 2N-2E, SECTION 29																
OF	WHITE OAK 32-2N-2E	SALINA-NIAGARAN REEF	1973	INGHAM	3,970	8 D		CATARACT	4,583	2	0	0	2	160	2,364	66,072	1,487	17,376	413	174
OF	WHITE OAK 32-2N-2E POOL A	NIAGARAN REEF	1977	INGHAM	4,046	6 D			4,278	1	0	0	1	80	1,502	12,272			153	
				WHITE OAK TWP., 2N-2E, SECTIONS 31, 32				WHITE OAK 29-2N-2E, WHITE OAK 32-2N-2E AND WHITE OAK 32-2N-2E POOL A MADE SEPARATE FIELDS IN 1978 DUE TO ABROGATION OF PREVIOUS SPACING ORDER												
AOF	WHITE RIVER	DUNDEE	1950	MUSKEGON	2,053	2 L	28.0	DUNDEE	2,055	1	ABANDONED 1951			20		7,061			353	
				WHITE RIVER TWP., 12N-18W, SECTION 15																
OF	WILEY	TRAVERSE	1962	MASON	1,663	5 L	39.9	ST. PETER SS.	5,890	18	0	0	4	380	226	426,334			1,122	
				EDEN TWP., 17N-16W, SECTION 18 RIVERTON TWP., 17N-17W, SECTION 12																
OF	WINFIELD	DUNDEE-REED CITY	1936	MONTCALM	3,340	1 L	43.2	REED CITY	3,500	5	0	0	1	120		119,412			395	
				WINFIELD TWP., 12N-9W, SECTIONS 20, 28, 29																
GS	WINFIELD (STRAY)	REFER TO TABLE 4 DEVELOPED GAS STORAGE RESERVOIRS																		
OF	WINTERFIELD	TRAVERSE	1940	CLARE	3,105	1 L		SYLVANIA	5,273					200	5,963	317,410	372,472	634,190	1,587	81
OF		DUNDEE	1940		3,794	3 L	44.2							740	11,925	4,866,690			[illegible],577	1,375
OF		RICHFIELD	1942		5,015	15 D				74	11	2	34	940	180,370	390,065			415	196
				WINTERFIELD TWP., 20N-6W, SECTIONS 28 THROUGH 32, 35, 36 REDDING TWP., 19N-6W, SECTIONS 1, 5 GREENWOOD TWP., 19N-5W, SECTION 6									THE 34 WELLS INCLUDE 7 TRAVERSE, 4 DUNDEE, 22 RICHFIELD & 1 TRAVERSE & RICHFIELD							
GF	WISE	MICHIGAN STRAY	1940	ISABELLA	1,250	5 S		SYLVANIA	5,205	7	0	0	5	1,260				1,739,233	DOMESTIC USE & LEASE FUEL	
OF		TRAVERSE	1953		3,090	31 L	43.0								1,159	54,255				
OF		DUNDEE	1938		3,700	11 L	45.2			79	0	0	*21	1,640	16,231	3,390,564			2,466	1,169
OF		DETROIT RIVER SZ	1955		4,415	48 DL	42.6			2	0	0	**1	80	1,932	71,474			393	30
				WISE TWP., 16N-3W, SECTIONS 8, 9, 16, 17, 20, 21, 28, 29, 32, 33									*THE 21 WELLS INCLUDE 17 DUNDEE, 4 TRAVERSE AND DUNDEE **DUNDEE AND DETROIT RIVER							
AGF	WOLF LAKE	"BEREA"	1949	MUSKEGON	1,050	7 D		DETROIT RIVER	2,250	2	ABANDONED 1956			320				101,751		
OF		TRAVERSE	1968		1,741	23 L				4	0	0	2	60	629	5,530			32	14
				EGELSTON TWP., 10N-15W, SECTIONS 7, 8, 18 MUSKEGON TWP., 10N-16W, SECTION 13																
GF	WOODSTOCK	TRAVERSE	1969	LENAWEE	1,465	2 L		TRAVERSE	1,467	2	0	0	1	80			SHUT-IN FOR MARKET			
				WOODSTOCK TWP., 5S-1E, SECTION 8																
OF	WOODVILLE	TRAVERSE	1943	NEWAYGO	2,820	5 L	43.5	DETROIT RIVER	3,534	10	0	0	9	350	5,166	587,180			1,673	205
				NORWICH TWP., 15N-11W, SECTIONS 20, 28, 29																
GS	WOODVILLE (NORWICH)	REFER TO TABLE 4 DEVELOPED GAS STORAGE RESERVOIRS																		
OF	WRIGHT	"BEREA"	1954	OTTAWA	1,170	3 L		DETROIT RIVER	2,337	7	0	0	1	60	829	49,174	SHUT-IN -- LACK OF STORAGE		320	5
OF		TRAVERSE	1953		1,920	1 L				7	0	0	2	70	53	18,624			266	
				WRIGHT TWP., 8N-13W, SECTIONS 28, 32, 33 TALLMADGE TWP., 7N-13W, SECTION 4																
AOF	WYOMING PARK	TRAVERSE	1939	KENT	1,870	6 L	39.0	DETROIT RIVER	2,255	21	ABANDONED 1970			300		157,373			526	
				WYOMING TWP., 6N-12W, SECTIONS 13, 14, 23																
GF	YANKEE	NIAGARAN REEF	1963	ST. CLAIR	2,620	20 D		CLINTON	2,829	2	0	0	2	80				363,109		
				ST. CLAIR TWP., 5N-16E, SECTION 25																
AGF	ZEELAND	"BEREA"	1946	OTTAWA	945	9 D		NIAGARAN	3,388	7	ABANDONED 1975			280					DOMESTIC USE	
				ZEELAND TWP., 5N-14W, SECTIONS 2, 11, 12, 13, 14																
AOF	ZEELAND	TRAVERSE	1942	OTTAWA	1,514	3 L	41.9	NIAGARAN	3,052	21	ABANDONED 1967			400		310,385			775	
OF		SALINA	1958		2,792	5 D	20.5			2	0	0	2	10	3,735	13,515			1,352	10
	SALINA ABANDONED 1962 - REACTIVATED 1976 ZEELAND TWP., 5N-14W, SECTIONS 25, 30, 31, 32, 36 HOLLAND TWP., 5N-15W, SECTIONS E½ 35, 36 (TRAVERSE) ZEELAND TWP., 5N-14W, SECTION 29 (SALINA)																			
AOF	ZEELAND, SEC. 28	TRAVERSE	1954	OTTAWA	1,491	1 L		DETROIT RIVER	2,215	3	ABANDONED 1956			30		4,437			148	
				ZEELAND TWP., 5N-14W, SECTIONS 21, 28																
								1979 TOTALS						331,870	[illegible]	682,[illegible]	21,313,315	569,502,994		142,085

1979 OIL AND CONDENSATE PRODUCTION FROM TABLE 2 . . . . 25,330,757 BARRELS
1979 OIL PRODUCTION FROM TABLE 3 AND 4 9,415,915

TOTAL 1979 OIL PRODUCTION 34,746,672

CUMULATIVE OIL AND CONDENSATE PRODUCTION FROM TABLE 2 121,239,340
CUMULATIVE OIL PRODUCTION FROM TABLE 3 AND 4 682,547,635

TOTAL STATE CUMULATIVE OIL PRODUCTION THROUGH 1979 803,786,975

*CUMULATIVE FIGURE INCLUDES 11,086 BARRELS OF OIL FROM MISCELLANEOUS OIL WELLS DRILLED FROM 1925 THROUGH 1979 AND SUBSEQUENTLY COMPLETED AS DRY HOLES

1979 GAS PRODUCTION FROM TABLE 2 . . . . 135,924,526 MCF
1979 GAS PRODUCTION FROM TABLE 3 AND 4 21,369,193

TOTAL 1979 GAS PRODUCTION 157,293,719

CUMULATIVE GAS PRODUCTION FROM TABLE 2 . . . . 617,478,540 MCF
CUMULATIVE GAS PRODUCTION FROM TABLE 3 AND 4 937,000,322

TOTAL CUMULATIVE GAS PRODUCTION THROUGH 1979 1,554,478,362

POOL CLASS	FIELD OR POOL NAME	PRODUCING FORMATION	YEAR OF DISC	COUNTY, TOWNSHIP - T, R, SEC for Discovery Well	MAP REF NO	DEPTH IN FEET	PAY ZONE THICK-NESS & LITHO	PAY ZONE API OIL GRAV	DEEPEST FORMATION TESTED FORMATION OR POOL NAME	DEEPEST FORMATION TESTED DEPTH IN FEET	NUMBER OF WELLS TO END 1980	NUMBER OF WELLS COMP IN 1980	NUMBER OF WELLS ABND IN 1980	NUMBER OF WELLS ACTIV @ END 1980	ACRES DRILLED	OIL IN BBLS PRODUCED IN 1980	OIL IN BBLS CUMULATIVE THROUGH 1980	GAS IN MCF PRODUCED IN 1980	GAS IN MCF CUMULATIVE THROUGH 1980	RECOVERY PER ACRE DRILLED IN BBLS	TOTAL BARRELS OF BRINE PER DAY
OF	VEVAY 16-2N-1W (MASON)	NIAGARAN	1970	INGHAM, VEVAY-2N,1W,16	3779	4,165	39 D	49.4	NIAGARAN	4,555	2	0	0	2	120	13,013	215,986	191,052	1,120,395	1,799	7
OF	VEVAY 17-2N-1W	NIAGARAN	1972	INGHAM, VEVAY-2N,1W,17	3779	4,162	12 D	--	NIAGARAN	4,300	3	0	0	3	240	28,877	254,283	73,477	644,502	1,059	9
AOF	VEVAY 19-2N-1W	TRAVERSE	1971	INGHAM, VEVAY-2N,1W,19	3779	2,141	65 L	37	CINCINNATIAN	4,600	2		1972		80	0	12,930	0	0	162	0
GF	VEVAY 19-2N-1W P/A	NIAGARAN	1971	INGHAM, VEVAY-2N,1W,19	3779	3,942	24 D	46.8	CINCINNATIAN		2	0	0	1	320	2,491	207,430	19,361	2,793,731	648	47
OF	VEVAY 19-2N-1W P/B	NIAGARAN	1972	INGHAM, VEVAY-2N,1W,18	3779	4,030	50 D	42	CINCINNATIAN		4	0	0	4	640	26,768	348,769	692,843	5,207,333	544	0
OF	VEVAY 19-2N-1W P/C	NIAGARAN	1972	INGHAM, VEVAY-2N,1W,18	3779	4,142	50 D	--	CINCINNATIAN		1	0	0	1	160	14,009	75,734	137,983	658,000	473	0
AOF	VEVAY 20-2N-1W	NIAGARAN	1972	INGHAM, VEVAY-2N,1W,20	3779	3,939	2 D	--	PRAIRIE DU CHIEN	5,905	1		1976		80	0	17,013	0	126,542	213	0
G-C	VICTORY 05-19N-17W	NIAGARAN	1974	MASON, VICTORY-19N,17W,5	3801	4,199	200 D	69.0	NIAGARAN	4,779	1	0	0	1	80	25	2,083	4,358	149,391	26	0
G-C	VICTORY 07-19N-17W	NIAGARAN	1973	MASON, VICTORY-19N,17W,7	3801	4,092	369 D	61.2	NIAGARAN	4,730	3	0	0	3	240	15,693	89,741	306,545	1,517,338	373	79
OF	VICTORY 10-19N-17W	NIAGARAN	1973	MASON, VICTORY-19N,17W,10	3801	4,344	22 D	50.0	NIAGARAN	4,650	2	0	0	2	160	15,338	146,017	80,553	465,567	912	100
G-C	VICTORY 18-19N-17W P/A	NIAGARAN	1974	MASON, VICTORY-19N,17W,18	3801	4,467	5 D	73.3	NIAGARAN	4,555	2	0	0	2	160	729	11,748	52,778	901,020	73	0
OF	VICTORY 19-19N-17W	NIAGARAN	1972	MASON, VICTORY-19N,17W,19	3801	4,387	14 D	--	NIAGARAN	4,537	2	0	0	2	160	17,797	299,969	88,260	1,097,600	1,874	91
G-C	VICTORY 19-19N-17W P/A	NIAGARAN	1974	MASON, VICTORY-19N,17W,19	3801	4,358	16 D	69.2	NIAGARAN	4,516	2	0	0	2	160	1,474	47,900	629,168	5,870,556	299	0
AOF	VICTORY, SEC. 10	TRAVERSE	1957	MASON, VICTORY-19N,17W,10	3801	1,603	9 L	36.0	TRAVERSE	1,616	1		1958		10	0	500	0	0	56	0
OF	VOGEL CENTER	DUNDEE	1966	MISSAUKEE, CLAM UNION-21N,6W,32	3077	3,892	3 L	--	DUNDEE	3,895	2	0	0	1	80	789	49,480	0	0	618	220
GF	WALES 16-6N-15E	SALINA-NIAGARAN	1976	ST. CLAIR, WALES-6N,15E,16	3774	3,264	196 D	--	SALINA-NIAGARAN	3,650	3	0	0	3	120	28,427	28,559	212,750	457,750	237	0
OF	WALKER	BEREA	1940	KENT, WALKER-7N,12W,4	3730	1,121	21 SL	--	ST. PETER SS.	5,222	WELL COUNT	COMB.	WITH	TRAVERSE	220	347	49,951	0	0	227	0
OF	WALKER	TRAVERSE	1938	KENT, WALKER-7N,12W,32	3730	1,872	8 L	36.0	ST. PETER SS.		783	0	0	340	8,560	96,230	17,432,117	0	3,658,751	2,036	231
OF	WALKER	DETROIT RIVER	1957	KENT, WYOMING-6N,12W,2	3730	2,132	12 D	--	ST. PETER SS.		1	0	0	1	10	SEE	WALKER	TRAVERSE			2
GF	WALKER	BEREA, TRAV. & D.R.	1939	KENT, WALKER-6N,12W,4	3730				ST. PETER SS.		14	0	0	5					1,348,473	DOMESTIC	& LEASE
GF	WASHINGTON, SEC. 10	SALINA-NIAGARAN	1974	MACOMB, WASHINGTON-4N,12E,10	3813	3,304	179 D	--	NIAGARAN	3,635	15	3	0	15	760	9,977	9,977	2,656,650	3,963,002	13	0
GF	WASHINGTON, SEC. 10 P/A	NIAGARAN	1976	MACOMB, WASHINGTON-4N,12E,10	3813	3,352	234 D	--	SALINA-NIAGARAN	3,722	5	0	0	5	200	3,854	3,854	1,020,824	1,626,769	19	0
GF	WASHINGTON, SEC. 11	NIAGARAN	1965	MACOMB, WASHINGTON-4N,12E,11	3813	3,290	180 D	--	NIAGARAN	3,686	1	0	0	1	40	446	446	88,554	5,542,659	11	0
OF	WASHINGTON, SEC. 28	A-1 CARBONATE	1975	MACOMB, WASHINGTON-4N,12E,28	3813	3,357	18 D	--	NIAGARAN	3,546	9	0	0	9	400	3,116	14,926	1,064,320	1,559,016	37	0
OF	WAYLAND	TRAVERSE	1944	ALLEGAN, WAYLAND-3N,11W,8	3650	1,799	6 L	36.0	TRENTON-BLK. RIVER	4,400	54	0	0	2	530	582	268,537	0	0	513	1
OF	WAYLAND	SALINA	1960	ALLEGAN, WAYLAND-3N,11W,17	3650A	3,132	12 D	28.0	TRENTON-BLK. RIVER		40	0	0	36	1,680	62,793	1,675,569	0	0	997	5
OF	WAYLAND, NORTH	TRAVERSE	1957	ALLEGAN, WAYLAND-3N,11W,6	3650	1,696	7 L	--	TRAVERSE	1,712	15	0	0	5	150	3,261	118,341	0	0	788	92
AOF	WEARE	TRAVERSE	1961	OCEANA, WEARE-16N,17W,12	3934	1,681	2 L	--	TRAVERSE	1,737	3		1964		30	0	6,919	0	0	231	0
AOF	WEARE, SEC. 14	TRAVERSE	1952	OCEANA, WEARE-16N,17W,14	3934	1,674	1 L	41.4	DUNDEE	2,217	1		1954		10	0	1,096	0	0	110	0
OF	WEST BRANCH	TRAVERSE	1933	OGEMAW, WEST BRANCH-22N,2E,27	3687	1,796	2 L	--	CAMBRO-ORDOVICIAN	11,012						SEE	WEST BRANCH	DUNDEE			
OF	WEST BRANCH	DUNDEE	1933	OGEMAW, WEST BRANCH-22N,2E,27	3687	2,650	20 L	36.8	CAMBRO-ORDOVICIAN		324	4	0	192	3,170	286,504	10,668,467	0	0	3,365	3,474
OF	WEST BRANCH	DETROIT RIVER SZ	1951	OGEMAW, MILLS-21N,3E,6	3687A	3,585	9 D	38.9	CAMBRO-ORDOVICIAN							SEE	WEST BRANCH	RICHFIELD			
OF	WEST BRANCH	RICHFIELD	1952	OGEMAW, OGEMAW-22N,1E,10	3687	4,127	8 D	33.0	CAMBRO-ORDOVICIAN		65	2	0	62	2,600	60,984	3,400,070	4,364	75,329	1,308	10
G-C	WEXFORD 01-24N-12W	NIAGARAN	1977	WEXFORD, WEXFORD-24N,12W,1	3812	6,231	91 D	63.4	NIAGARAN	6,612	1	0	0	1	60	1,453	5,994	140,298	346,056	74	1
G-C	WEXFORD 01-24N-12W P/A	NIAGARAN	1978	WEXFORD, WEXFORD-24N,12W,1	3812	6,167	100 D	63	NIAGARAN	6,640	1	0	0	1	80	2,013	10,103	165,831	345,582	126	1
G-C	WEXFORD 02-24N-12W	NIAGARAN	1977	WEXFORD, WEXFORD-24N,12W,2	3812	6,156	49 D	--	NIAGARAN	6,267	1	0	0	1	80	111	44,542	139,899	1,045,825	556	0
G-C	WEXFORD 03-24N-12W	NIAGARAN	1977	WEXFORD, WEXFORD-24N,12W,3	3812	6,077	76 D	65.2	NIAGARAN	6,324	1	0	0	1	80	1,261	46,721	270,143	1,928,241	584	0
G-C	WEXFORD 04-24N-12W	NIAGARAN	1978	WEXFORD, WEXFORD-24N,12W,4	3812	6,095	45 D	64.8	NIAGARAN	6,316	1	0	0	1	160	16,397	88,323	670,697	1,603,030	552	0
OF	WEXFORD 05-24N-12W	NIAGARAN	1974	WEXFORD, WEXFORD-24N,12W,5	3812	5,820	127 D	--	NIAGARAN	6,119	6	1	0	6	360	180,896	583,879	169,972	495,882	1,621	2
OF	WEXFORD 05-24N-12W P/A	NIAGARAN	1976	WEXFORD, WEXFORD-24N,12W,5	3812	5,785	229 D	48.3	NIAGARAN	6,192	1	0	0	1	80	38,024	135,372	166,638	584,657	1,692	0
OF	WEXFORD 06-24N-12W	NIAGARAN	1975	WEXFORD, WEXFORD-24N,12W,6	3812	5,775	153 D	41.1	NIAGARAN	6,061	4	1	0	4	320	359,976	989,417	159,780	413,856	3,091	5
AG-C	WEXFORD 09-24N-12W	NIAGARAN	1973	WEXFORD, WEXFORD-24N,12W,9	3812	6,232	4 D	69.8	NIAGARAN	6,265	1		1978		80	0	0	0	0	0	0
G-C	WEXFORD 09-24N-12W P/A	NIAGARAN	1973	WEXFORD, WEXFORD-24N,12W,9	3812	6,041	101 D	69.8	NIAGARAN	6,414	1	0	0	1	80	19,622	152,436	200,906	821,264	1,905	1
OF	WEXFORD 09-24N-12W P/B	NIAGARAN	1974	WEXFORD, WEXFORD-24N,12W,9	3812	6,081	71 D	42.4	NIAGARAN	6,324	3	0	0	3	240	66,842	460,376	59,763	438,945	1,918	4
G-C	WEXFORD 10-24N-12W	NIAGARAN	1972	WEXFORD, WEXFORD-24N,12W,10	3812	6,124	107 D	68.9	NIAGARAN	6,352	1	0	0	1	160	0	86,025	113,351	3,231,284	537	1
G-C	WEXFORD 18-24N-12W	NIAGARAN	1973	WEXFORD, WEXFORD-24N,12W,18	3812	5,842	96 D	--	NIAGARAN	6,130	3	0	0	3	360	1,011	64,856	587,519	5,381,951	180	0
OF	WEXFORD 18-24N-12W P/A	NIAGARAN	1975	WEXFORD, WEXFORD-24N,12W,18	3812	5,885	54 D	42.1	NIAGARAN	6,165	3	0	0	3	240	29,157	513,911	108,237	880,206	2,141	0
G-C	WEXFORD 20-24N-12W	NIAGARAN	1979	WEXFORD, WEXFORD-24N,12W,20	3812	6,082	20 L	--	NIAGARAN	6,240	1	0	0	1	80	0	0	0	0	0	0
OF	WHEATLAND	MICHIGAN STRAY	1947	MECOSTA, WHEATLAND-14N,7W,9	3673	1,399	3 S	--	DETROIT RIVER	3,849	4	0	0	1	160	0	0	0	516,496	0	DOMESTIC
AOF	WHEATLAND	DUNDEE	1945	MECOSTA, WHEATLAND-14N,7W,7	3673	3,690	2 L	43.0	DETROIT RIVER		6		1960		100	0	141,631	0	0	1,416	0
AOF	WHITE CLOUD	TRAVERSE	1963	NEWAYGO, WILCOX-14N,12W,19	3581	2,537	1 L	--	TRAVERSE	2,540	1		1964		40	0	1,295	0	0	32	0
OF	WHITE OAK 15-2N-2E	NIAGARAN	1980	INGHAM, WHITE OAK-2N,2E,15	3825	4,357	4 D	33	NIAGARAN	4,480	1	1	0	1	80	1,856	1,856	0	0	23	0
OF	WHITE OAK 29-2N-2E	SALINA-NIAGARAN	1974	INGHAM, WHITE OAK-2N,2E,29	3825	4,066	19 D	--	NIAGARAN	4,583	2	0	1	1	160	5,728	60,529	0	0	378	174
OF	WHITE OAK 30-2N-2E	NIAGARAN	1980	INGHAM, WHITE OAK-2N,2E,30	3825	4,231	25 D	36.4	NIAGARAN	4,276	1	1	0	1	80	11,386	11,386	0	0	142	0
OF	WHITE OAK 32-2N-2E	SALINA-NIAGARAN	1973	INGHAM, WHITE OAK-2N,2E,32	3825	3,970	8 D	--	CATARACT	4,583	2	0	0	2	160	4,879	70,951	922	18,298	443	69
OF	WHITE OAK 32-2N-2E P/A	NIAGARAN	1977	INGHAM, WHITE OAK-2N,2E,32	3825	4,046	6 D	--	CATARACT	4,278	1	0	0	1	80	1,250	13,522	0	0	169	0
AOF	WHITE RIVER	DUNDEE	1950	MUSKEGON, WHITE RIVER-12N,16W,15	3557	2,053	1 L	28.0	DUNDEE	2,055	1		1951		20	0	7,061	0	0	353	0
OF	WHITEWATER 20-27N-9W	NIAGARAN	1978	G. TRAVERSE, WHITEWATER-27N,9W,20	3789	6,095	15 D	45.7	NIAGARAN	6,360	1	0	0	1	80	38,967	61,515	158,531	223,921	768	25
OF	WHITEWATER 20-27N-9W P/A	NIAGARAN	1979	G. TRAVERSE, WHITEWATER-27N,9W,20	3789	6,149	24 D	45	NIAGARAN	6,361	1	0	0	1	80	106,895	187,789	122,730	207,433	2,347	50
OF	WHITEWATER 20-27N-9W P/B	NIAGARAN	1979	G. TRAVERSE, WHITEWATER-27N,9W,20	3789	5,962	17 D	48.3	NIAGARAN	6,455	1	0	0	1	80	1,775	4,491	24,958	69,885	56	150
G-C	WHITEWATER 22-27N-9W	NIAGARAN	1973	G. TRAVERSE, WHITEWATER-27N,9W,22	3789	6,172	62 D	--	NIAGARAN	6,516	3	0	0	3	200	37,727	294,564	2,937,300	13,562,613	1,472	0
OF	WHITEWATER 28-27N-9W	NIAGARAN	1975	G. TRAVERSE, WHITEWATER-27N,9W,28	3789	6,096	22 D	43.8	NIAGARAN	6,310	1	0	0	1	80	47,129	242,756	166,459	688,665	3,034	230
OF	WHITEWATER 32-27N-9W	NIAGARAN	1972	G. TRAVERSE, WHITEWATER-27N,9W,32	3789	6,100	10 D	44.3	NIAGARAN	6,200	2	0	0	2	160	75,125	952,027	202,867	1,508,058	5,950	125
OF	WHITEWATER 34-27N-9W	NIAGARAN	1972	G. TRAVERSE, WHITEWATER-27N,9W,34	3789	6,292	16 D	44.9	NIAGARAN	6,500	1	0	0	1	80	2,979	78,078	0	3,552	975	90
OF	WHITEWATER 35-27N-9W	NIAGARAN	1972	G. TRAVERSE, WHITEWATER-27N,9W,35	3789	6,270	60 D	39	NIAGARAN	6,740	1	0	0	1	80	5,896	152,785	0	7,020	1,909	80
OF	WHITEWATER 35-27N-9W P/A	NIAGARAN	1980	G. TRAVERSE, WHITEWATER-27N,9W,35	3789	6,412	28 D	51.1	NIAGARAN	6,743	1	1	0	1	80	775	775	0	0	10	0
G-C	WHITEWATER 36-27N-9W	NIAGARAN	1971	G. TRAVERSE, WHITEWATER-27N,9W,36	3789	6,560	40 D	66	NIAGARAN	6,750	1	0	0	1	40	71	64,229	155,337	6,124,851	1,605	0
G-C	WHITEWATER 36-27N-9W P/A	NIAGARAN	1976	G. TRAVERSE, WHITEWATER-27N,9W,36	3789	6,300	334 D	61.9	NIAGARAN	6,757	1	0	0	1	80	445	30,198	549,754	5,751,727	378	0
OF	WILEY	TRAVERSE	1962	MASON, EDEN-17N,16W,18	3628	1,663	5 L	39.9	ST. PETER SS.	5,890	18	0	0	4	380	93	426,427	0	0	1,122	10
OF	WILLIAMS	BEREA	1980	BAY, WILLIAMS-14N,3E,8	3935	2,403	5 S	43	DUNDEE	3,718	2	2	0	2	80	2,925	2,925	0	0	37	0
OF	WINFIELD	DUNDEE-REED CITY	1936	MONTCALM, WINFIELD-12N,9W,20	3718	3,340	1 L	43.2	REED CITY	3,500	8	0	0	1	120	0	119,412	0	0	995	0
OF	WINTERFIELD	TRAVERSE	1940	CLARE, WINTERFIELD-20N,6W,29	3569	3,105	1 L	--	SYLVANIA	5,273					200	9,134	326,544	590,189	1,224,379	1,633	8
OF	WINTERFIELD	DUNDEE	1940	CLARE, WINTERFIELD-20N,6W,35	3569	3,794	3 L	44.2	SYLVANIA						740	11,968	4,878,658	0	0	6,593	1,200
OF	WINTERFIELD	RICHFIELD	1942	CLARE, WINTERFIELD-20N,6W,30	3569	5,015	15 D	--	SYLVANIA		80	8	0	42	1,260	154,876	544,961	0	0	433	136
OF	WISE	MICHIGAN STRAY	1940	ISABELLA, WISE-16N,5W,17	3542	1,250	5 S	--	SYLVANIA	5,205	7	0	0	5	1,260	0	0	0	1,739,233	0	DOM/LEASE

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TABLE 23 MICHIGAN OIL AND GAS FIELDS

POOL CLASS	FIELD OR POOL NAME	PRODUCING FORMATION	YEAR OF DISC.	COUNTY, TOWNSHIP - T, R, SEC. for DISCOVERY WELL only	MAP REF. NO.	DEPTH IN FEET	PAY ZONE THICK-NESS & LITHO	PAY ZONE API OIL GRAV	DEEPEST FORMATION TESTED FORMATION OR POOL NAME	DEEPEST FORMATION TESTED DEPTH IN FEET	NUMBER OF WELLS TO END 1981	NUMBER OF WELLS COMP. IN 1981	NUMBER OF WELLS ABND. IN 1981	NUMBER OF WELLS ACTIVE END OF 1981	ACRES DRILLED	OIL IN BBLS. PRODUCED IN 1981	OIL IN BBLS. CUMM. THROUGH 1981	GAS IN MCF PRODUCED IN 1981	GAS IN MCF CUMM THROUGH 1981	RECOVERY PER ACRE DRILLED IN BBLS	TOTAL BARRELS OF BRINE PER DAY
G-C	WEXFORD 02-24N-12W	NIAGARAN	1977	WEXFORD, WEXFORD-24N, 12W, 2	3812	6,156	49 D	--	NIAGARAN	6,267	1	0	0	1	80	53	44,595	91,232	1,137,057	557	0
G-C	WEXFORD 03-24N-12W	NIAGARAN	1977	WEXFORD, WEXFORD-24N, 12W, 3	3812	6,077	76 D	65.2	NIAGARAN	6,324	1	0	0	1	80	807	47,528	58,283	1,986,524	594	0
G-C	WEXFORD 04-24N-12W	NIAGARAN	1978	WEXFORD, WEXFORD-24N, 12W, 4	3812	6,095	45 D	64.8	NIAGARAN	6,316	1	0	0	1	160	7,045	95,368	671,008	2,274,038	596	0
OF	WEXFORD 05-24N-12W	NIAGARAN	1974	WEXFORD, WEXFORD-24N, 12W, 5	3812	5,820	127 D	--	NIAGARAN	6,119	7	1	0	7	440	137,215	721,094	225,966	721,848	1,638	9
OF	WEXFORD 05-24N-12W P/A	NIAGARAN	1976	WEXFORD, WEXFORD-24N, 12W, 5	3812	5,785	229 D	48.3	NIAGARAN	6,192	1	0	0	1	80	26,027	161,399	152,803	737,460	2,017	0
OF	WEXFORD 06-24N-12W	NIAGARAN	1975	WEXFORD, WEXFORD-24N, 12W, 6	3812	5,775	153 D	41.1	NIAGARAN	6,061	4	0	0	4	320	335,854	1,325,271	236,030	649,886	4,141	13
AC-C	WEXFORD 09-24N-12W	NIAGARAN	1973	WEXFORD, WEXFORD-24N, 12W, 9	3812	6,232	4 D	69.8	NIAGARAN	6,265	1		1978		80	0	0	0	0	0	0
C-C	WEXFORD 09-24N-12W P/A	NIAGARAN	1973	WEXFORD, WEXFORD-24N, 12W, 9	3812	6,041	101 D	69.8	NIAGARAN	6,414	1	0	0	1	80	575	153,011	67,368	888,632	1,912	0
OF	WEXFORD 09-24N-12W P/B	NIAGARAN	1974	WEXFORD, WEXFORD-24N, 12W, 9	3812	6,081	71 D	42.4	NIAGARAN	6,324	3	0	0	3	240	70,064	530,440	59,143	498,088	2,210	14
C-C	WEXFORD 10-24N-12W	NIAGARAN	1972	WEXFORD, WEXFORD-24N, 12W, 10	3812	6,124	107 D	68.9	NIAGARAN	6,352	1	0	0	1	160	36	86,061	222,609	3,453,893	537	0
OF	WEXFORD 17-24N-12W	NIAGARAN	1981	WEXFORD, WEXFORD-24N, 12W, 17	3812	6,128	51 D	--	NIAGARAN	6,270	1	1	0	1	80	40	40	0	0	0	0
G-C	WEXFORD 18-24N-12W	NIAGARAN	1973	WEXFORD, WEXFORD-24N, 12W, 18	3812	5,842	96 D	--	NIAGARAN	6,130	3	0	0	3	360	970	65,826	842,205	6,224,156	182	1
OF	WEXFORD 18-24N-12W P/A	NIAGARAN	1975	WEXFORD, WEXFORD-24N, 12W, 18	3812	5,885	54 D	42.1	NIAGARAN	6,165	3	0	0	3	240	17,531	531,442	55,261	935,467	2,214	3
C-C	WEXFORD 20-24N-12W	NIAGARAN	1979	WEXFORD, WEXFORD-24N, 12W, 20	3812	6,082	20 L	--	NIAGARAN	6,240	2	1	0	2	160	48	48	0	0	0	0
AOF	WHEATLAND	DUNDEE	1945	MECOSTA, WHEATLAND-14N, 7W, 7	3673	3,690	2 L	43.0	DETROIT RIVER	3,849	4	0	0	1	160	0	0	0	516,496	0	DOMESTIC
OF	WHEATLAND	MICHIGAN STRAY	1947	MECOSTA, WHEATLAND-14N, 7W, 9	3673	1,399	3 S	--	DETROIT RIVER		6		1960		100	0	141,631	0	0	1,416	0
AOF	WHITE CLOUD	TRAVERSE	1963	NEWAYGO, WILCOX-14N, 12W, 19	3581	2,537	1 L	--	TRAVERSE	2,540	1		1964		40	0	1,295	0	0	32	0
OF	WHITE OAK 04-02N-02E	NIAGARAN	1981	INGHAM, WHITE OAK-02N, 02E, 04	3825	4,479	45 D	--	NIAGARAN	4,617	1	1	0	1	80	6,397	6,397	0	0	79	0
OF	WHITE OAK 11-02N-02E	SALINA-NIAGARAN	1981	INGHAM, WHITE OAK-02N, 02E, 11	3825	4,252	48 D	--	NIAGARAN	4,728	1	1	0	1	80	1,485	1,485	0	0	18	0
OF	WHITE OAK 15-02N-02E	NIAGARAN	1980	INGHAM, WHITE OAK-2N, 2E, 15	3825	4,357	4 D	33	NIAGARAN	4,480	1	0	0	1	80	9,484	11,340	0	0	141	0
OF	WHITE OAK 15-02N-02E P/A	NIAGARAN	1981	INGHAM, WHITE OAK-02N, 02E, 15	3825	4,197	21 D	--	NIAGARAN	4,469	1	1	0	1	160	0	0	0	0	0	0
OF	WHITE OAK 29-02N-02E	SALINA-NIAGARAN	1974	INGHAM, WHITE OAK-2N, 2E, 29	3825	4,066	19 D	--	NIAGARAN	4,583	2	0	0	1	160	6,004	66,533	0	0	415	13
OF	WHITE OAK 30-02N-02E	NIAGARAN	1980	INGHAM, WHITE OAK-2N, 2E, 30	3825	4,231	25 D	36.4	NIAGARAN	4,276	1	0	0	1	80	23,150	34,536	3,938	3,938	431	0
OF	WHITE OAK 32-02N-02E	SALINA-NIAGARAN	1973	INGHAM, WHITE OAK-2N, 2E, 32	3825	3,970	8 D	--	CATARACT	4,583	2	0	0	2	160	2,571	73,522	1,160	19,458	459	96
OF	WHITE OAK 32-02N-02E P/A	NIAGARAN	1977	INGHAM, WHITE OAK-2N, 2E, 32	3825	4,046	6 D	--	CATARACT	4,278	1	0	0	1	80	752	14,274	0	0	178	0
AOF	WHITE RIVER	DUNDEE	1950	MUSKEGON, WHITE RIVER-12N, 18W, 15	3557	2,053	2 L	28.0	DUNDEE	2,065	1		1951		20	0	7,061	0	0	353	0
OF	WHITEWATER 20-27N-09W	NIAGARAN	1978	GD. TRAVERSE, WHITEWATER-27N, 9W, 20	3789	6,095	15 D	45.7	NIAGARAN	6,360	1	0	0	1	80	40,465	101,980	174,816	398,737	1,274	35
OF	WHITEWATER 20-27N-09W P/A	NIAGARAN	1979	GD. TRAVERSE, WHITEWATER-27N, 9W, 20	3789	6,149	24 D	45	NIAGARAN	6,360	1	0	0	1	80	110,655	298,444	136,669	344,102	3,730	46
OF	WHITEWATER 20-27N-09W P/B	NIAGARAN	1979	GD. TRAVERSE, WHITEWATER-27N, 9W, 20	3789	5,962	17 D	48.3	NIAGARAN	6,455	1	0	0	1	80	1,141	5,632	6,123	76,008	70	0
C-C	WHITEWATER 22-27N-09W	NIAGARAN	1973	GD. TRAVERSE, WHITEWATER-27N, 9W, 22	3789	6,172	62 D	--	NIAGARAN	6,516	3	0	0	3	200	76,929	371,493	962,351	14,524,964	1,857	450
OF	WHITEWATER 28-27N-09W	NIAGARAN	1975	GD. TRAVERSE, WHITEWATER-27N, 9W, 28	3789	6,096	22 D	43.8	NIAGARAN	6,310	1	0	0	1	80	46,466	289,222	165,207	853,872	3,615	154
OF	WHITEWATER 32-27N-09W	NIAGARAN	1972	GD. TRAVERSE, WHITEWATER-27N, 9W, 32	3789	6,100	10 D	44.3	NIAGARAN	6,260	2	0	0	2	160	50,809	1,002,836	155,977	1,664,035	6,267	345
OF	WHITEWATER 34-27N-09W	NIAGARAN	1972	GD. TRAVERSE, WHITEWATER-27N, 9W, 34	3789	6,292	16 D	44.9	NIAGARAN	6,580	1	0	0	1	80	2,093	80,171	0	3,552	1,002	150
OF	WHITEWATER 35-27N-09W	NIAGARAN	1972	GD. TRAVERSE, WHITEWATER-27N, 9W, 35	3789	6,270	60 D	39	NIAGARAN	6,770	1	0	0	1	80	5,604	158,389	0	7,020	1,979	150
OF	WHITEWATER 35-27N-09W P/A	NIAGARAN	1980	GD. TRAVERSE, WHITEWATER-27N, 9W, 35	3789	6,412	28 D	51.1	NIAGARAN	6,743	1	0	0	1	80	15,504	16,279	67,355	67,355	203	0
G-C	WHITEWATER 36-27N-09W	NIAGARAN	1971	GD. TRAVERSE, WHITEWATER-27N, 9W, 36	3789	6,560	40 D	66	NIAGARAN	6,750	1	0	0	1	40	243	64,472	79,727	6,204,578	1,611	0
G-C	WHITEWATER 36-27N-09W P/A	NIAGARAN	1976	GD. TRAVERSE, WHITEWATER-27N, 9W, 36	3789	6,300	334 D	61.9	NIAGARAN	6,757	1	0	0	1	80	309	30,387	175,587	5,927,314	379	0
OF	WILEY	TRAVERSE	1962	MASON, EDEN-17N, 16W, 18	3628	1,663	5 L	39.9	ST. PETER SS.	5,890	18	0	0	4	380	0	426,427	0	0	1,122	0
OF	WILLIAMS	BEREA	1980	BAY, WILLIAMS-14N, 3E, 8	3935	2,403	5 S	43	DUNDEE	3,718	15	13	0	15	560	32,477	35,402	0	0	63	52
AOF	WINFIELD	DUNDEE-REED CITY	1936	MONTCALM, WINFIELD-12N, 9W, 20	3718	3,340	1 L	43.2	REED CITY	3,500	8		1980		120	0	119,412	0	0	995	0
OF	WINTERFIELD	TRAVERSE	1940	CLARE, WINTERFIELD-20N, 6W, 29	3569	3,105	1 L		SYLVANIA	5,273	SEE	RICH FOR	WELL	COUNT	200	~~11,466~~	~~338,010~~	644,577	1,868,956	~~1,690~~	~~10~~
OF	WINTERFIELD	DUNDEE	1940	CLARE, WINTERFIELD-20N, 6W, 35	3569	3,794	3 L	44.2	SYLVANIA		SEE	RICH FOR	WELL	COUNT	740	17,964	4,896,622	0	0	6,617	3,745
OF	WINTERFIELD	RICHFIELD	1942	CLARE, WINTERFIELD-20N, 6W, 30	3569	5,015	15 D		SYLVANIA		81	1	0	43	1,300	~~140,465~~	~~889,424~~	0	0	~~527~~	~~136~~
OF	WISE	MICHIGAN STRAY	1940	ISABELLA, WISE-16N, 3W, 17	3542	1,250	5 S	--	SYLVANIA	5,205	7	0	0	5	1,280	0	0	0	1,739,233	0	DOM/LEASE
OF	WISE	TRAVERSE	1953	ISABELLA, WISE-16N, 3W, 33	3542	3,090	31 L	43.0	SYLVANIA		SEE	DD FOR	WELL	COUNT	1,580	808	56,643	0	0	42	0
OF	WISE	DUNDEE	1938	ISABELLA, WISE-16N, 3W, 28	3542	3,700	11 L	45.2	SYLVANIA		79	0	0	22	1,640	17,375	4,023,248	0	0	2,453	1,683
OF	WISE	DETROIT RIVER	1955	ISABELLA, WISE-16N, 3W, 33	3542	4,415	48 DL	42.6	SYLVANIA		2	0	0	1	80	1,886	75,145	0	0	939	30
AOF	WOLF LAKE	BEREA	1949	MUSKEGON, EGELSTON-10N, 15W, 7	3557	1,050	7 D	--	DETROIT RIVER	2,250	2		1956		320	0	0	0	101,751	0	0
OF	WOLF LAKE	TRAVERSE	1968	MUSKEGON, EGELSTON-10N, 15W, 18	3557	1,741	23 L	--	DETROIT RIVER		4	0	0	2	60	0	5,530	0	0	92	14
OF	WOODSTOCK	TRAVERSE	1969	LENAWEE, WOODSTOCK-5S, 1E, 18	3698	1,465	2 L	--	TRAVERSE	1,467	2	0	0	1	80	0	0	SHUT-IN FOR MARKET	0	0	0
OF	WOODVILLE	TRAVERSE	1943	NEWAYGO, NORWICH-15N, 11W, 29	3676	2,820	5 L	43.5	DETROIT RIVER	3,534	10	0	0	9	350	5,373	598,037	0	0	1,708	205
OF	WRIGHT	BEREA	1954	OTTAWA, WRIGHT-8N, 13W, 32	3682	1,170	3 L	--	DETROIT RIVER	2,337	7	0	0	1	60	265	49,650	SHUT-IN LACK OF STORAGE		820	0
OF	WRIGHT	TRAVERSE	1953	OTTAWA, WRIGHT-8N, 13W, 33	3682	1,920	1 L	--	DETROIT RIVER		7	0	0	2	70	319	19,087	0	0	272	3
AOF	WYOMING PARK	TRAVERSE	1939	KENT, WYOMING-6N, 12W, 14	3731	1,870	6 L	39.0	DETROIT RIVER	2,255	21		1970		300	0	157,873	0	0	526	0
OF	YANKEE	NIAGARAN	[illegible]	ST. CLAIR, ST. CLAIR-5N, 16E, 25	3750	2,620	20 D	--	NIAGARAN	2,829	2	0	0	2	80	0	0	0	363,109	0	0
AOF	ZEELAND	"BEREA"	[illegible]	OTTAWA, ZEELAND-5N, 14W, 2	3583	945	9 D	--	NIAGARAN	3,388	7		1975		280	0	0	0	0	0	DOMESTIC
AOF	ZEELAND	TRAVERSE	[illegible]	OTTAWA, ZEELAND-5N, 14W, 30	3583	1,514	3 L	41.9	NIAGARAN	3,052	21		1967		400	0	310,085	0	0	775	0
OF	ZEELAND	SALINA	1955	OTTAWA, ZEELAND-5N, 14W, 29	3583	2,792	5 D	20.5	NIAGARAN		4	1	0	2	230	4,125	22,658	0	0	98	22
AOF	ZEELAND, SEC. 28	TRAVERSE	1954	OTTAWA, ZEELAND-5N, 14W, 28	3583	1,491	1 L	--	DETROIT RIVER	2,215	3		1956		30	0					

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TABLE 22 MICHIGAN OIL AND GAS FIELDS

POOL CLASS	FIELD OR POOL NAME	PRODUCING FORMATION	YEAR OF DISC.	COUNTY, TOWNSHIP - T, R, SEC. for DISCOVERY WELL only	MAP REF. NO.	DEPTH IN FEET	PAY ZONE THICK-NESS & LITHO	PAY ZONE API OIL GRAV	DEEPEST FORMATION FORMATION OR POOL NAME	TESTED DEPTH IN FEET	NUMBER OF WELLS TO END 1982	COMP. IN 1982	ABND. IN 1982	ACTIVE END OF 1982	ACRES DRILLED	OIL IN BBLS. PRODUCED IN 1982	OIL CUMM. THROUGH 1982	GAS IN MCF PRODUCED IN 1982	GAS CUMM. THROUGH 1982	RECOVERY PER ACRE DRILLED IN BBLS	TOTAL BARRELS OF BRINE PER DAY
G-C	WEXFORD 03-24N-12W	NIAGARAN	1977	WEXFORD, WEXFORD-24N,12W,3	3812	6,077	76 D	65.2	NIAGARAN	6,324	1	0	0	1	80	214	47,742	12,678	1,999,152	596	0
G-C	WEXFORD 04-24N-12W	NIAGARAN	1978	WEXFORD, WEXFORD-24N,12W,4	3812	6,095	45 D	64.8	NIAGARAN	6,316	1	0	0	1	160	1,112	96,480	265,784	2,539,822	603	0
OF	WEXFORD 05-24N-12W	NIAGARAN	1974	WEXFORD, WEXFORD-24N,12W,5	3812	5,820	127 D	--	NIAGARAN	6,119	7	0	0	7	440	111,992	833,086	424,625	1,146,473	1,893	7
OF	WEXFORD 05-24N-12W P/A	NIAGARAN	1976	WEXFORD, WEXFORD-24N,12W,5	3812	5,785	229 D	48.3	NIAGARAN	6,192	1	0	0	1	80	18,417	179,816	159,038	896,498	2,247	0
OF	WEXFORD 06-24N-12W	NIAGARAN	1975	WEXFORD, WEXFORD-24N,12W,6	3812	5,775	153 D	41.1	NIAGARAN	6,061	5	0	0	5	320	291,514	1,616,785	437,522	1,087,408	5,052	44
AG-C	WEXFORD 09-24N-12W	NIAGARAN	1973	WEXFORD, WEXFORD-24N,12W,9	3812	6,232	4 D	69.8	NIAGARAN	6,265	1		1978		80	0	0	0	0	0	0
G-C	WEXFORD 09-24N-12W P/A	NIAGARAN	1973	WEXFORD, WEXFORD-24N,12W,9	3812	6,041	101 D	69.8	NIAGARAN	6,414	1	0	0	1	80	293	153,304	36,330	924,962	1,916	0
OF	WEXFORD 09-24N-12W P/B	NIAGARAN	1974	WEXFORD, WEXFORD-24N,12W,9	3812	6,081	71 D	42.4	NIAGARAN	6,324	3	0	0	3	240	68,197	598,637	65,641	563,729	2,494	1
G-C	WEXFORD 10-24N-12W	NIAGARAN	1972	WEXFORD, WEXFORD-24N,12W,10	3812	6,124	107 D	68.9	NIAGARAN	6,352	1	0	0	1	160	87	86,148	111,512	3,565,405	538	0
OF	WEXFORD 17-24N-12W	NIAGARAN	1981	WEXFORD, WEXFORD-24N,12W,17	3812	6,128	51 D	--	NIAGARAN	6,270	1	0	0	1	80	0	40	0	0	0	0
G-C	WEXFORD 18-24N-12W	NIAGARAN	1973	WEXFORD, WEXFORD-24N,12W,18	3812	5,842	96 D	--	NIAGARAN	6,130	3	0	0	3	360	938	66,764	936,281	7,160,437	185	0
OF	WEXFORD 18-24N-12W P/A	NIAGARAN	1975	WEXFORD, WEXFORD-24N,12W,18	3812	5,885	54 D	42.1	NIAGARAN	6,165	3	0	0	3	240	14,041	545,483	40,634	976,101	2,272	1
G-C	WEXFORD 20-24N-12W	NIAGARAN	1979	WEXFORD, WEXFORD-24N,12W,20	3812	6,082	20 L	--	NIAGARAN	6,240	2	0	0	2	160	0	48	0	0	0	0
AOF	WHEATLAND	DUNDEE	1945	MECOSTA, WHEATLAND-14N,7W,7	3673	3,690	2 L	43.0	DETROIT RIVER		6		1960		100	0	141,631	0	0	1,416	0
OF	WHEATLAND	MICHIGAN STRAY	1947	MECOSTA, WHEATLAND-14N,7W,9	3673	1,399	3 S	--	DETROIT RIVER	3,849	4	0	0	1	160	0	0	0	516,496	0	DOMESTIC
AOF	WHITE CLOUD	TRAVERSE	1963	NEWAYGO, WILCOX-14N,12W,19	3581	2,537	1 L	--	TRAVERSE	2,540	1		1964		40	0	1,295	0	0	32	0
OF	WHITE OAK 04-02N-02E	NIAGARAN	1981	INGHAM, WHITE OAK-2N,2E,4	3825	4,479	45 D	--	NIAGARAN	4,617	1	0	0	1	80	23,888	30,285	0	0	378	0
OF	WHITE OAK 11-02N-02E	SALINA-NIAGARAN	1981	INGHAM, WHITE OAK-2N,2E,11	3825	4,252	48 D	--	NIAGARAN	4,728	1	0	0	1	80	90	1,575	0	0	19	0
OF	WHITE OAK 15-02N-02E	NIAGARAN	1980	INGHAM, WHITE OAK-2N,2E,15	3825	4,357	4 D	33	NIAGARAN	4,400	1	0	0	1	80	30,153	41,493	1,204	1,204	518	0
OF	WHITE OAK 15-02N-02E P/A	NIAGARAN	1981	INGHAM, WHITE OAK-2N,2E,15	3825	4,197	21 D	--	NIAGARAN	4,469	1	0	0	1	160	6,948	6,948	0	0	43	0
OF	WHITE OAK 17-02N-2E	AL CARBONATE-NIAGARAN	1982	INGHAM, WHITE OAK-02N,02E,18	3825	4,184	70 D	35.6	NIAGARAN	4,512	1	1	0	1	160	3,639	3,639	0	0	23	0
OF	WHITE OAK 29-02N-02E	SALINA-NIAGARAN	1974	INGHAM, WHITE OAK-2N,2E,29	3825	4,066	19 D	--	NIAGARAN	4,583	3	1	0	2	200	8,250	74,783	0	0	373	43
OF	WHITE OAK 30-02N-02E	NIAGARAN	1980	INGHAM, WHITE OAK-2N,2E,30	3825	4,231	25 D	36.4	NIAGARAN	4,276	1	0	0	1	80	47,011	81,547	13,240	17,178	1,019	45
OF	WHITE OAK 32-02N-02E	SALINA-NIAGARAN	1973	INGHAM, WHITE OAK-2N,2E,32	3825	3,970	8 D	--	CATARACT	4,583	2	0	0	1	160	839	74,361	483	19,941	464	69
OF	WHITE OAK 32-02N-02E P/A	NIAGARAN	1977	INGHAM, WHITE OAK-2N,2E,32	3825	4,046	6 D	--	CATARACT	4,278	1	0	0	1	80	0	14,274	0	0	178	0
AOF	WHITE RIVER	DUNDEE	1950	MUSKEGON, WHITE RIVER-12N,18W,15	3557	2,053	2 L	28.0	DUNDEE	2,055	1		1951		20	0	7,061	0	0	353	0
OF	WHITEWATER 20-27N-09W	NIAGARAN	1978	GD. TRAVERSE, WHITEWATER-27N,9W,20	3789	6,095	15 D	45.7	NIAGARAN	6,360	2	1	0	2	160	52,495	154,475	163,326	562,063	965	96
OF	WHITEWATER 20-27N-09W P/A	NIAGARAN	1979	GD. TRAVERSE, WHITEWATER-27N,9W,20	3789	6,149	24 D	45	NIAGARAN	6,360	2	1	0	2	160	158,564	457,008	243,741	587,843	2,856	539
OF	WHITEWATER 20-27N-09W P/B	NIAGARAN	1979	GD. TRAVERSE, WHITEWATER-27N,9W,20	3789	5,962	17 D	48.3	NIAGARAN	6,455	1	0	0	1	80	39	5,671	4	76,012	70	0
G-C	WHITEWATER 22-27N-09W	NIAGARAN	1973	GD. TRAVERSE, WHITEWATER-27N,9W,22	3789	6,172	62 D	--	NIAGARAN	6,516	3	0	0	3	200	36,734	408,227	110,996	14,635,960	2,041	273
OF	WHITEWATER 28-27N-09W	NIAGARAN	1975	GD. TRAVERSE, WHITEWATER-27N,9W,28	3789	6,096	22 D	43.8	NIAGARAN	6,310	2	1	0	2	160	70,449	359,671	226,655	1,080,527	2,247	436
OF	WHITEWATER 32-27N-09W	NIAGARAN	1972	GD. TRAVERSE, WHITEWATER-27N,9W,32	3789	6,100	10 D	44.3	NIAGARAN	6,260	2	0	0	2	160	35,698	1,038,534	147,042	1,811,077	6,490	464
OF	WHITEWATER 34-27N-09W	NIAGARAN	1972	GD. TRAVERSE, WHITEWATER-27N,9W,34	3789	6,292	16 D	44.9	NIAGARAN	6,580	1	0	0	1	80	1,404	81,575	0	3,552	1,019	0
OF	WHITEWATER 35-27N-09W	NIAGARAN	1972	GD. TRAVERSE, WHITEWATER-27N,9W,35	3789	6,270	60 D	39	NIAGARAN	6,770	1	0	0	1	80	5,982	164,371	0	7,020	2,054	200
OF	WHITEWATER 35-27N-09W P/A	NIAGARAN	1980	GD. TRAVERSE, WHITEWATER-27N,9W,35	3789	6,412	28 D	51.1	NIAGARAN	6,743	1	0	0	1	80	25,933	42,212	172,318	239,673	527	2
G-C	WHITEWATER 36-27N-09W	NIAGARAN	1971	GD. TRAVERSE, WHITEWATER-27N,9W,36	3789	6,560	40 D	66	NIAGARAN	6,750	1	0	0	1	40	469	64,941	66,784	6,271,362	1,623	0
G-C	WHITEWATER 36-27N-09W P/A	NIAGARAN	1976	GD. TRAVERSE, WHITEWATER-27N,9W,36	3789	6,300	334 D	61.9	NIAGARAN	6,757	1	0	0	1	80	0	30,387	44,231	5,971,545	379	0
OF	WILEY	TRAVERSE	1962	MASON, EDEN-17N,16W,18	3628	1,663	5 L	39.9	ST. PETER SS.	5,890	18	0	0	4	300	0	426,427	0	0	1,122	0
OF	WILLIAMS	BEREA	1980	BAY, WILLIAMS-14N,3E,8	3935	2,403	5 S	43	DUNDEE	3,718	43	27	0	42	1,640	123,932	171,108	0	0	104	531
AOF	WINFIELD	DUNDEE-REED CITY	1936	MONTCALM, WINFIELD-12N,9W,20	3718	3,340	1 L	43.2	REED CITY	3,500	8		1980		120	0	119,412	0	0	995	0
OF	WINTERFIELD	BLACK RIVER	1982	CLARE, WINTERFIELD-20N,06W,30	3569	10,276	80 D		PRAIRIE DU CHIEN	12,017	1	1	0	1	640	0	0	0	0	0	0
OF	WINTERFIELD	DUNDEE	1940	CLARE, WINTERFIELD-20N,6W,35	3569	3,794	3 L	44.2	SYLVANIA		SEE	RICHFORD	WELL	COUNT	740	27,417	4,896,622	0	0	6,617	3,225
OF	WINTERFIELD	RICHFIELD	1942	CLARE, WINTERFIELD-20N,6W,30	3569	5,015	15 D	--	SYLVANIA		81	0	0	43	1,300	144,578	829,752	0	0	698	121
OF	WINTERFIELD	TRAVERSE	1940	CLARE, WINTERFIELD-20N,6W,29	3569	3,105	1 L	--	SYLVANIA	5,273	SEE	RICHFORD	WELL	COUNT	200	9,312	338,010	501,058	1,868,956	1,690	4
OF	WISE	DETROIT RIVER	1955	ISABELLA, WISE-16N,3W,33	3542	4,415	48 DL	42.6	SYLVANIA		2	1	0	2	1,640	1,708	76,853	0	0	46	110
OF	WISE	DUNDEE	1938	ISABELLA, WISE-16N,3W,28	3542	3,700	11 L	45.2	SYLVANIA		79	1	0	26*	1,320	11,973	4,035,221	0	0	3,056	1,867
OF	WISE	MICHIGAN STRAY	1940	ISABELLA, WISE-16N,3W,17	3542	1,250	5 S	--	SYLVANIA	5,205	7	0	0	5	1,280	0	0	0	1,739,233	0	DOM/LEASE
OF	WISE	TRAVERSE	1953	ISABELLA, WISE-16N,3W,33	3542	3,090	31 L	43.0	SYLVANIA	SEE	DUNDEE	FOR	WELL	COUNT 1,500	502	56,643	0	0	42	142	
AOF	WOLF LAKE	BEREA	1949	MUSKEGON, EGELSTON-10N,15W,7	3557	1,050	7 D	--	DETROIT RIVER	2,250	2		1956		320	0	0	0	101,751	0	0
OF	WOLF LAKE	TRAVERSE	1968	MUSKEGON, EGELSTON-10N,15W,18	3557	1,741	23 L	--	DETROIT RIVER		4	0	0	2	60	96	5,626	0	0	93	14
OF	WOODSTOCK	TRAVERSE	1969	LENAWEE, WOODSTOCK-5S,1E,18	3698	1,465	2 L	--	TRAVERSE	1,467	2	0	0	1	80	0	0	SHUT-IN FOR MARKET	0	0	0
OF	WOODVILLE	TRAVERSE	1943	NEWAYGO, NORWICH-15N,11W,29	3676	2,020	5 L	43.5	DETROIT RIVER	3,534	10	0	0	9	350	3,982	602,019	0	0	1,720	210
OF	WRIGHT	"BEREA"	1954	OTTAWA, WRIGHT-8N,13W,32	3682	1,170	3 L	--	DETROIT RIVER	2,337	7	0	0	1	60	141	49,915	SHUT-IN LACK OF STORAGE		820	2
OF	WRIGHT	TRAVERSE	1953	OTTAWA, WRIGHT-8N,13W,33	3682	1,920	1 L	--	DETROIT RIVER		7	0	0	2	70	422	19,509	0	0	278	3
AOF	WYOMING PARK	TRAVERSE	1939	KENT, WYOMING-6N,12W,14	3731	1,870	6 L	39.0	DETROIT RIVER	2,255	21		1970		300	0	157,873	0	0	526	0
OF	YANKEE	NIAGARAN	1963	ST. CLAIR, ST. CLAIR-5N,16E,25	3750	2,620	20 D	--	NIAGARAN	2,829	2	0	0	2	80	0	0	57,067	420,176	0	0
AOF	ZEELAND	"BEREA"	1946	OTTAWA, ZEELAND-5N,14W,2	3583	945	9 D	--	NIAGARAN	3,388	7		1975		280	0	0	0	0	0	DOMESTIC
OF	ZEELAND	SALINA	1958	OTTAWA, ZEELAND-5N,14W,29	3583	2,792	5 D	20.5	NIAGARAN		5	1	0	3	300	5,596	28,254	0	0	94	45
AOF	ZEELAND	TRAVERSE	1942	OTTAWA, ZEELAND-5N,14W,30	3583	1,514	3 L	41.9	NIAGARAN	3,052	21		1967		400	0	310,085	0	0	775	0
AOF	ZEELAND, SEC. 28	TRAVERSE	1954	OTTAWA, ZEELAND-5N,14W,28	3583	1,491	1 L	--	DETROIT RIVER	2,215	3		1956		30	0	4,437	0	0	0	0

1983

1983 TABLE 10. MICHIGAN OIL AND GAS FIELDS

FIELD NAME -- LOCATION -- TYPE OF FIELD -- DISCOVERY DATE (ABANDONMENT DATE)
PRODUCING FORMATION @ DEPTH --- PAY THICK / LITH / API GRAV --- DEEPEST FORMATION @ DEPTH
WELL COMPLETION STATISTICS FOR 1983

OIL PRODUCED	O CUM END 1983	GAS PRODUCED	G CUM END 1983	ACREAGE	BBLS/ACRE	BRINE/DAY

WHITEWATER 34-27N-09W -- GD. TRAVERSE, WHITEWATER-27N,09W,34 -- OF -- Discovered 1972
NIAGARAN @ 6,292 --- 16 / D / 45 --- NIAGARAN @ 6,580
1 Total, 0 Completed, 0 Abandoned, 1 Active

0	81,575	0	3,552	80	1,020	0

WHITEWATER 35-27N-09W -- GD. TRAVERSE, WHITEWATER-27N,09W,35 -- OF -- Discovered 1972
NIAGARAN @ 6,270 --- 60 / D / 39 --- NIAGARAN @ 6,770
1 Total, 0 Completed, 0 Abandoned, 1 Active

3,878	168,249	0	7,020	80	2,103	0

WHITEWATER 35-27N-09W, P/A -- GD. TRAVERSE, WHITEWATER-27N,09W,35 -- OF -- Discovered 1980
NIAGARAN @ 6,412 --- 28 / D / 51 --- NIAGARAN @ 6,743
1 Total, 0 Completed, 0 Abandoned, 1 Active

44,931	87,143	361,914	601,587	80	1,089	150

WHITEWATER 36-27N-09W -- GD. TRAVERSE, WHITEWATER-27N,09W,36 -- GC -- Discovered 1971
NIAGARAN @ 6,560 --- 40 / D / 66 --- NIAGARAN @ 6,750
1 Total, 0 Completed, 0 Abandoned, 1 Active

1,082	66,023	48,386	6,319,748	40	1,651	0

WHITEWATER 36-27N-09W, P/A -- GD. TRAVERSE, WHITEWATER-27N,09W,36 -- GC -- Discovered 1976
NIAGARAN @ 6,300 --- 334 / D / 62 --- NIAGARAN @ 6,757
1 Total, 0 Completed, 0 Abandoned, 1 Active

264	30,651	41,611	6,013,156	80	383	0

WILEY -- MASON, EDEN-17N,16W,18 -- OF -- Discovered 1962
TRAVERSE @ 1,663 --- 5 / L / 40 --- SAINT PETER @ 5,890
18 Total, 0 Completed, 0 Abandoned, 4 Active

0	426,427	0	0	380	1,122	0

WILLIAMS -- BAY, WILLIAMS-14N,03E,08 -- OF -- Discovered 1980
BEREA @ 2,403 --- 5 / S / 43 --- DUNDEE @ 3,718
51 Total, 9 Completed, 1 Abandoned, 50 Active

188,447	332,413	0	0	2,000	166	113

WINFIELD -- MONTCALM, WINFIELD-12N,09W,20 -- AOF -- Discovered 1936, Abandoned 1980.
DUNDEE-REED CITY @ 3,340 --- 1 / L / 43 --- REED CITY @ 3,500
8 Total, 0 Completed, 0 Abandoned, 0 Active

0	119,412	0	0	120	995	0

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,29 -- OF -- Discovered 1940
TRAVERSE @ 3,105 --- 1 / L / -- --- SYLVANIA @ 5,273
-- Total, -- Completed, -- Abandoned, -- Active

8,031	355,353	252,387	2,622,401	0	0	5

WELL COUNT COMBINED W/WINTERFIELD DETROIT R-RICHFIELD POOL

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,35 -- OF -- Discovered 1940
DUNDEE @ 3,794 --- 3 / L / 44 --- SYLVANIA @ 5,273
-- Total, -- Completed, -- Abandoned, -- Active

55,388	4,979,427	0	0	0	0	480

WELL COUNT COMBINED W/WINTERFIELD DETROIT R-RICHFIELD POOL

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,30 -- OF -- Discovered 1942
DETROIT R-RICHFIELD @ 5,015 --- 15 / D / -- --- SYLVANIA @ 5,273
84 Total, 2 Completed, 0 Abandoned, 44 Active

54,280	884,032	0	0	1,380	641	66

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,30 -- GF -- Discovered 1982
BLACK RIVER @ 10,276 --- 80 / D / -- --- PRAIRIE DU CHIEN @ 12,017
1 Total, 0 Completed, 0 Abandoned, 1 Active

0	0	0	0	640	0	0

WISE -- ISABELLA, WISE-16N,03W,17 -- GF -- Discovered 1940
MICHIGAN STRAY @ 1,250 --- 5 / S / -- --- SYLVANIA @ 5,205
10 Total, 0 Completed, 0 Abandoned, 6 Active

0	0	0	1,739,233	1,440	0	0

DOMESTIC USE

1984

1984 TABLE 10. MICHIGAN OIL AND GAS FIELDS

FIELD NAME -- LOCATION -- TYPE OF FIELD -- DISCOVERY DATE (ABANDONMENT DATE)
PRODUCING FORMATION @ DEPTH --- PAY THICK / LITH / API GRAV --- DEEPEST FORMATION @ DEPTH
WELL COMPLETION STATISTICS FOR 1984

OIL PRODUCED	O CUM END 1984	GAS PRODUCED	G CUM END 1984	ACREAGE	BBLS/ACRE	BRINE/DAY

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,30 -- GF -- Discovered 1982
BLACK RIVER @ 10,276 --- 80 / D / -- --- PRAIRIE DU CHIEN @ 12,017
1 Total, 0 Completed, 0 Abandoned, 1 Active

0	0	0	0	640	0	0

WISE -- ISABELLA, WISE-16N,03W,17 -- GF -- Discovered 1940
MICHIGAN STRAY @ 1,250 --- 5 / S / -- --- SYLVANIA @ 5,205
10 Total, 0 Completed, 0 Abandoned, 6 Active

0	0	0	1,739,233	1,440	0	1

DOMESTIC USE

WISE -- ISABELLA, WISE-16N,03W,33 -- OF -- Discovered 1953
TRAVERSE @ 3,090 --- 31 / L / 43 --- SYLVANIA @ 5,205
-- Total, -- Completed, -- Abandoned, -- Active

1,538	59,695	0	0	1,580	38	320

WELL COUNT COMBINED W/WISE DUNDEE POOL

WISE -- ISABELLA, WISE-16N,03W,28 -- OF -- Discovered 1938
DUNDEE @ 3,700 --- 11 / L / 45 --- SYLVANIA @ 5,205
82 Total, 1 Completed, 0 Abandoned, 28 Active

17,194	4,087,240	0	0	1,620	2,523	3,910

WISE -- ISABELLA, WISE-16N,03W,33 -- OF -- Discovered 1955
DETROIT RIVER SZ @ 4,415 --- 48 / DL / 43 --- SYLVANIA @ 5,205
5 Total, 2 Completed, 0 Abandoned, 4 Active

51,164	132,826	0	0	200	664	190

SOME WELLS COUNTED TWICE DUE TO DUAL COMPLETION

WISE -- ISABELLA, WISE-16N,03W,33 -- OF -- Discovered 1983
DETROIT R-RICHFIELD @ 4,727 --- 0 / / -- --- DETROIT R-RICHFIELD @ 4,823
6 Total, 3 Completed, 0 Abandoned, 6 Active

2,713	3,592	0	0	240	15	0

SOME WELLS COUNTED TWICE DUE TO DUAL COMPLETION

WOLF LAKE -- MUSKEGON, EGELSTON-10N,15W,07 -- AGF -- Discovered 1949, Abandoned 1956.
BEREA @ 1,050 --- 7 / D / -- --- DETROIT RIVER @ 2,250
2 Total, 0 Completed, 0 Abandoned, 0 Active

0	0	0	101,751	320	0	0

WOLF LAKE -- MUSKEGON, EGELSTON-10N,15W,18 -- OF -- Discovered 1968
TRAVERSE @ 1,741 --- 23 / L / -- --- DETROIT RIVER @ 2,250
4 Total, 0 Completed, 0 Abandoned, 2 Active

90	5,716	0	0	60	95	0

WOODSTOCK -- LENAWEE, WOODSTOCK-05S,01E,18 -- GF -- Discovered 1969
TRAVERSE @ 1,465 --- 2 / L / -- --- TRAVERSE @ 1,467
2 Total, 0 Completed, 0 Abandoned, 1 Active

0	0	0	0	80	0	0

SHUT-IN, NO MARKET

WOODVILLE -- NEWAYGO, NORWICH-15N,11W,29 -- OF -- Discovered 1943
TRAVERSE @ 2,820 --- 5 / L / 44 --- DETROIT RIVER @ 3,534
10 Total, 0 Completed, 0 Abandoned, 9 Active

6,086	615,017	0	0	350	1,757	475

WRIGHT -- OTTAWA, WRIGHT-08N,13W,32 -- OF -- Discovered 1954
BEREA @ 1,170 --- 3 / L / -- --- DETROIT RIVER @ 2,337
7 Total, 0 Completed, 0 Abandoned, 1 Active

195	50,270	0	0	60	838	2

SHUT-IN, LACK OF STORAGE

WRIGHT -- OTTAWA, WRIGHT-08N,13W,33 -- OF -- Discovered 1953
TRAVERSE @ 1,920 --- 1 / L / -- --- DETROIT RIVER @ 2,337
7 Total, 0 Completed, 0 Abandoned, 2 Active

293	19,867	0	0	70	284	3

1984

1984 TABLE 10. MICHIGAN OIL AND GAS FIELDS

FIELD NAME -- LOCATION -- TYPE OF FIELD -- DISCOVERY DATE (ABANDONMENT DATE)
PRODUCING FORMATION @ DEPTH --- PAY THICK / LITH / API GRAV --- DEEPEST FORMATION @ DEPTH
WELL COMPLETION STATISTICS FOR 1984

OIL PRODUCED	O CUM END 1984	GAS PRODUCED	G CUM END 1984	ACREAGE	BBLS/ACRE	BRINE/DAY

WHITEWATER 32-27N-09W -- GD. TRAVERSE, WHITEWATER-27N,09W,32 -- OF -- Discovered 1972
NIAGARAN @ 6,100 --- 10 / D / 44 --- NIAGARAN @ 6,260
2 Total, 0 Completed, 0 Abandoned, 2 Active

20,195	1,085,112	72,562	1,995,491	160	6,782	301

WHITEWATER 34-27N-09W -- GD. TRAVERSE, WHITEWATER-27N,09W,34 -- AOF -- Disc. 1972, Aban. 1984.
NIAGARAN @ 6,292 --- 16 / D / 45 --- NIAGARAN @ 6,580
1 Total, 0 Completed, 1 Abandoned, 0 Active

0	81,575	0	3,552	80	1,020	0

WHITEWATER 35-27N-09W -- GD. TRAVERSE, WHITEWATER-27N,09W,35 -- AOF -- Discovered 1972
NIAGARAN @ 6,270 --- 60 / D / 39 --- NIAGARAN @ 6,770
1 Total, 0 Completed, 0 Abandoned, 1 Active

0	168,249	0	7,020	80	2,103	0

CONVERTED TO BRINE DISPOSAL IN 1984

WHITEWATER 35-27N-09W, P/A -- GD. TRAVERSE, WHITEWATER-27N,09W,35 -- OF -- Discovered 1980
NIAGARAN @ 6,412 --- 28 / D / 51 --- NIAGARAN @ 6,743
1 Total, 0 Completed, 0 Abandoned, 1 Active

16,427	103,570	140,887	742,474	80	1,295	175

WHITEWATER 36-27N-09W -- GD. TRAVERSE, WHITEWATER-27N,09W,36 -- GC -- Discovered 1971
NIAGARAN @ 6,560 --- 40 / D / 66 --- NIAGARAN @ 6,750
1 Total, 0 Completed, 0 Abandoned, 1 Active

84	66,107	3,355	6,323,103	40	1,653	0

WHITEWATER 36-27N-09W, P/A -- GD. TRAVERSE, WHITEWATER-27N,09W,36 -- GC -- Discovered 1976
NIAGARAN @ 6,300 --- 334 / D / 62 --- NIAGARAN @ 6,757
1 Total, 0 Completed, 0 Abandoned, 1 Active

238	30,889	48,117	6,061,273	80	386	0

WILEY -- MASON, EDEN-17N,16W,18 -- OF -- Discovered 1962
TRAVERSE @ 1,663 --- 5 / L / 40 --- SAINT PETER @ 5,890
18 Total, 0 Completed, 0 Abandoned, 4 Active

0	426,427	0	0	380	1,122	0

WILLIAMS -- BAY, WILLIAMS-14N,03E,08 -- OF -- Discovered 1980
BEREA @ 2,403 --- 5 / S / 43 --- DUNDEE @ 3,718
61 Total, 10 Completed, 0 Abandoned, 64 Active

253,805	586,218	0	0	2,520	233	827

INCLUDES 1984 PRODUCTION FROM 1985 COMPLETIONS

WINFIELD -- MONTCALM, WINFIELD-12N,09W,20 -- AOF -- Discovered 1936, Abandoned 1980.
DUNDEE-REED CITY @ 3,340 --- 1 / L / 43 --- REED CITY @ 3,500
8 Total, 0 Completed, 0 Abandoned, 0 Active

0	119,412	0	0	120	995	0

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,29 -- OF -- Discovered 1940
TRAVERSE @ 3,105 --- 1 / L / -- --- SYLVANIA @ 5,273
-- Total, -- Completed, -- Abandoned, -- Active

6,594	361,947	291,077	2,913,478	0		10

WELL COUNT COMBINED W/WINTERFIELD DETROIT R-RICHFIELD POOL

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,35 -- OF -- Discovered 1940
DUNDEE @ 3,794 --- 3 / L / 44 --- SYLVANIA @ 5,273
-- Total, -- Completed, -- Abandoned, -- Active

44,838	5,024,265	0	0	0		2,098

WELL COUNT COMBINED W/WINTERFIELD DETROIT R-RICHFIELD POOL

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,30 -- OF -- Discovered 1942
DETROIT R-RICHFIELD @ 5,015 --- 15 / D / -- --- SYLVANIA @ 5,273
88 Total, 4 Completed, 0 Abandoned, 48 Active

80,443	964,475	0	0	2,740	352	76

1985

TABLE 10. 1985 MICHIGAN OIL AND GAS FIELDS

FIELD NAME -- LOCATION -- TYPE OF FIELD -- DISCOVERY DATE (ABANDONMENT DATE)
PRODUCING FORMATION @ DEPTH --- PAY THICK / LITH / API GRAV --- DEEPEST FORMATION @ DEPTH
WELL COMPLETION STATISTICS FOR 1985
OIL PRODUCED | O CUM END 1985 | GAS PRODUCED | G CUM END 1985 | ACREAGE | BBLS/ACRE | BRINE/DAY

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,35 -- OF -- Discovered 1940
DUNDEE @ 3,794 --- 3 / L / 44 --- SYLVANIA @ 5,273
-- Total, 0 Completed, 0 Abandoned, -- Active
67,891 | 5,092,156 | 0 | 0 | 0 | | 2,044
WELL COUNT COMBINED W/WINTERFIELD DETROIT R-RICHFIELD POOL

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,30 -- OF -- Discovered 1942
DETROIT R-RICHFIELD @ 5,015 --- 15 / D / -- --- SYLVANIA @ 5,273
91 Total, 4 Completed, 0 Abandoned, 54 Active
82,100 | 1,046,575 | 0 | 0 | 2,740 | 382 | 144

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,30 -- GF -- Discovered 1982
BLACK RIVER @ 10,276 --- 80 / D / -- --- PRAIRIE DU CHIEN @ 12,017
1 Total, 0 Completed, 0 Abandoned, 1 Active
0 | 0 | 0 | 0 | 640 | 0 | 0

WISE -- ISABELLA, WISE-16N,03W,17 -- GF -- Discovered 1940
MICHIGAN STRAY @ 1,250 --- 5 / S / -- --- SYLVANIA @ 5,205
10 Total, 0 Completed, 0 Abandoned, 6 Active
188 | 188 | 0 | 1,739,233 | 1,440 | 0 | 1
GAS PRODUCTION IS FOR DOMESTIC USE

WISE -- ISABELLA, WISE-16N,03W,33 -- OF -- Discovered 1953
TRAVERSE @ 3,090 --- 31 / L / 43 --- SYLVANIA @ 5,205
-- Total, 0 Completed, 0 Abandoned, -- Active
0 | 59,695 | 0 | 0 | 1,580 | 38 | 303
WELL COUNT COMBINED W/WISE DUNDEE POOL 1985 PRODUCTION NOT AVAILABLE

WISE -- ISABELLA, WISE-16N,03W,28 -- OF -- Discovered 1938
DUNDEE @ 3,700 --- 11 / L / 45 --- SYLVANIA @ 5,205
82 Total, 0 Completed, 0 Abandoned, 28 Active
0 | 4,087,240 | 0 | 0 | 1,620 | 2,523 | 3,768
1985 PRODUCTION NOT AVAILABLE

WISE -- ISABELLA, WISE-16N,03W,33 -- OF -- Discovered 1955
DETROIT RIVER SZ @ 4,415 --- 48 / DL / 43 --- SYLVANIA @ 5,205
5 Total, 0 Completed, 0 Abandoned, 4 Active
0 | 132,826 | 0 | 0 | 200 | 664 | 136
SOME WELLS COUNTED TWICE DUE TO DUAL COMPLETION 1985 PRODUCTION NOT AVAILABLE

WISE -- ISABELLA, WISE-16N,03W,33 -- OF -- Discovered 1983
DETROIT R-RICHFIELD @ 4,727 --- 0 / / -- --- DETROIT R-RICHFIELD @ 4,823
6 Total, 3 Completed, 0 Abandoned, 6 Active
0 | 3,592 | 0 | 0 | 240 | 15 | 36
SOME WELLS COUNTED TWICE DUE TO DUAL COMPLETION 1985 PRODUCTION NOT AVAILABLE

WOLF LAKE -- MUSKEGON, EGELSTON-10N,15W,07 -- AGF -- Discovered 1949, Abandoned 1956.
BEREA @ 1,050 --- 7 / D / -- --- DETROIT RIVER @ 2,250
2 Total, 0 Completed, 0 Abandoned, 0 Active
0 | 0 | 0 | 101,751 | 320 | 0 | 0

WOLF LAKE -- MUSKEGON, EGELSTON-10N,15W,18 -- OF -- Discovered 1968
TRAVERSE @ 1,741 --- 23 / L / -- --- DETROIT RIVER @ 2,250
4 Total, 0 Completed, 0 Abandoned, 2 Active
0 | 5,716 | 0 | 0 | 60 | 95 | 0

WOODSTOCK -- LENAWEE, WOODSTOCK-05S,01E,18 -- GF -- Discovered 1969
TRAVERSE @ 1,465 --- 2 / L / -- --- TRAVERSE @ 1,467
2 Total, 0 Completed, 0 Abandoned, 1 Active
0 | 0 | 0 | 0 | 80 | 0 | 0
SHUT-IN, NO MARKET

WOODVILLE -- NEWAYGO, NORWICH-15N,11W,29 -- OF -- Discovered 1943
TRAVERSE @ 2,820 --- 5 / L / 44 --- DETROIT RIVER @ 3,534
10 Total, 0 Completed, 0 Abandoned, 9 Active
4,846 | 619,863 | 0 | 0 | 350 | 1,771 | 218

TABLE 10. 1986 MICHIGAN OIL AND GAS FIELDS

FIELD NAME -- LOCATION -- TYPE OF FIELD -- DISCOVERY DATE (ABANDONMENT DATE)
PRODUCING FORMATION @ DEPTH --- PAY THICK / LITH / API GRAV --- DEEPEST FORMATION @ DEPTH
WELL COMPLETION STATISTICS FOR 1986
OIL PRODUCED | O CUM END 1986 | GAS PRODUCED | G CUM END 1986 | ACREAGE | BBLS/ACRE | BRINE/DAY

WHITEWATER 34-27N-09W -- GD. TRAVERSE, WHITEWATER-27N,09W,34 -- AOF -- Discovered 1972, Abandoned 1984.
NIAGARAN @ 6,292 --- 16 / D / 45 --- NIAGARAN @ 6,580
1 Total, 0 Completed, 0 Abandoned, 0 Active
0 | 81,575 | 0 | 3,552 | 80 | 1,020 | 0

WHITEWATER 35-27N-09W -- GD. TRAVERSE, WHITEWATER-27N,09W,35 -- AOF -- Discovered 1972, Abandoned 1984.
NIAGARAN @ 6,270 --- 60 / D / 39 --- NIAGARAN @ 6,770
1 Total, 0 Completed, 0 Abandoned, 0 Active
0 | 168,249 | 0 | 7,020 | 80 | 2,103 | 0
CONVERTED TO BRINE DISPOSAL IN 1984

WHITEWATER 35-27N-09W, P/A -- GD. TRAVERSE, WHITEWATER-27N,09W,35 -- OF -- Discovered 1980
NIAGARAN @ 6,412 --- 28 / D / 51 --- NIAGARAN @ 6,743
1 Total, 0 Completed, 0 Abandoned, 1 Active
21,151 | 143,703 | 171,233 | 1,069,245 | 80 | 1,796 | 180

WHITEWATER 36-27N-09W -- GD. TRAVERSE, WHITEWATER-27N,09W,36 -- AGC -- Discovered 1971, Abandoned 1985.
NIAGARAN @ 6,560 --- 40 / D / 66 --- NIAGARAN @ 6,750
1 Total, 0 Completed, 0 Abandoned, 0 Active
0 | 66,107 | 0 | 6,323,103 | 40 | 1,653 | 0

WHITEWATER 36-27N-09W, P/A -- GD. TRAVERSE, WHITEWATER-27N,09W,36 -- GC -- Discovered 1976
NIAGARAN @ 6,300 --- 334 / D / 62 --- NIAGARAN @ 6,757
1 Total, 0 Completed, 0 Abandoned, 1 Active
286 | 31,362 | 58,628 | 6,156,908 | 80 | 392 | 0

WILEY -- MASON, EDEN-17N,16W,18 -- OF -- Discovered 1962
TRAVERSE @ 1,663 --- 5 / L / 40 --- SAINT PETER @ 5,890
18 Total, 0 Completed, 2 Abandoned, 1 Active
0 | 426,600 | 0 | 0 | 380 | 1,123 | 0

WILLIAMS -- BAY, WILLIAMS-14N,03E,08 -- OF -- Discovered 1980
BEREA @ 2,403 --- 5 / S / 43 --- DUNDEE @ 3,718
85 Total, 3 Completed, 1 Abandoned, 80 Active
486,238 | 1,664,405 | 0 | 0 | 3,360 | 495 | 1,037

WILLIAMS -- BAY, WILLIAMS-14N,03E,04 -- OF -- Discovered 1986
DUNDEE @ 3,528 --- 110 / / -- --- DUNDEE @ 3,825
2 Total, 2 Completed, 0 Abandoned, 2 Active
6,152 | 6,648 | 0 | 0 | 80 | 83 | 40

WINFIELD -- MONTCALM, WINFIELD-12N,09W,20 -- AOF -- Discovered 1936, Abandoned 1980.
DUNDEE-REED CITY @ 3,340 --- 1 / L / 43 --- REED CITY @ 3,500
8 Total, 0 Completed, 0 Abandoned, 0 Active
0 | 119,412 | 0 | 0 | 120 | 995 | 0

1986

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,29 -- OF -- Discovered 1940
TRAVERSE @ 3,105 --- 1 / L / -- --- SYLVANIA @ 5,273
-- Total, 0 Completed, 0 Abandoned, -- Active
5,608 | 375,449 | 455,463 | 3,730,716 | 0 | 375,449 | 36
WELL COUNT COMBINED W/WINTERFIELD DETROIT R-RICHFIELD POOL

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,35 -- OF -- Discovered 1940
DUNDEE @ 3,794 --- 3 / L / 44 --- SYLVANIA @ 5,273
-- Total, 0 Completed, 0 Abandoned, -- Active
67,293 | 5,159,449 | 0 | 0 | 0 | 5,159,449 | 094
WELL COUNT COMBINED W/WINTERFIELD DETROIT R-RICHFIELD POOL

WINTERFIELD -- CLARE, WINTERFIELD-20N,06W,30 -- OF -- Discovered 1942
DETROIT R-RICHFIELD @ 5,015 --- 15 / D / -- --- SYLVANIA @ 5,273
92 Total, 1 Completed, 0 Abandoned, 54 Active
67,293 | 1,113,868 | 0 | 0 | 2,740 | 407 | 73
1,113,868

APPENDIX D

SUBSEA ELEVATIONS OF SELECTED FORMATION TOPS

UTM X(m)	UTM Y(m)	Elevation of Datum(ft)	Coldwater Shale(ft)	Traverse Lime(ft)	Bell Shale(ft)	Dundee Limestone(ft)	Richfield Member(ft)	Detroit River(ft)	Total Depth(ft)	Completion Date
662899	4881644	1095	-463	-2049		-2715			-2731	05/12/42
663281	4880853	1096	-494	-2073	-2664	-2724			-2737	02/12/45
662924	4880845	1097	-492	-2073		-2709			-2717	07/13/42
662912	4881247	1099	-454	-2064		-2703			-2708	06/08/42
662517	4880940	1094	-531	-2076	-2656	-2702			-2736	09/11/42
662505	4881342	1095	-475	-2037	-2620	-2702			-2702	05/28/42
662495	4881674	1107	-475	-2061	-2648	-2705		-3005	-4088	07/27/78
662137	4881364	1093	-562	-2062	-2664	-2704			-2707	08/14/42
662093	4881827	1091	-474	-2057	-2657	-2695			-2706	01/20/42
662146	4881683	1107	-475	-2061	-2648	-2705	-3874	-3005	-4088	05/19/86
657378	4881597	1077	-483	-2001	-2623	-2679	-3807	-2948	-4077	05/20/84
655596	4881499	1078	-492	-1995	-2597	-2667			-2730	03/26/41
659745	4879563	1082	-564			-2789			-2844	01/26/40
657686	4887189	1125	-473			-2773			-2783	11/03/39
653495	4885883	1165	-421	-2031	-2622	-2680	-3807	-2947	-10395	09/09/89
654526	4884997	1148	-442	-1994	-2588	-2645	-3770	-2917	-4019	11/17/78
653918	4885750	1166	-421	-2000	-2604	-2660	-3775	-2927	-10397	02/14/83
655308	4885300	1151	-449	-2007	-2618	-2676	-3786	-2952	-4031	06/10/81
654911	4885461	1131	-414	-2016	-2621	-2681	-3799	-2953	-4003	08/08/83
655730	4885083	1116	-459	-2021	-2635	-2692	-3813	-2968	-4034	06/26/81
654926	4885039	1145	-448	-1997	-2601	-2658	-3775	-2933	-4030	06/23/80
657137	4884671	1105	-465	-2047	-2670	-2713			-2807	01/25/39
657146	4883582	1094	-436	-2026	-2586	-2681			-2689	04/29/41
656342	4883944	1113	-472	-1997	-2577	-2654			-2666	09/11/42
655380	4883873	1116	-469	-1984	-2576	-2659			-2667	07/15/43
654952	4883872	1123	-397	-1980	-2575	-2631	-3750	-2903	-4011	08/13/78
655143	4883882	1129	-456	-1971	-2581	-2630			-2692	08/20/41
654757	4883461	1118	-487	-1937	-2558	-2630			-2687	07/29/41
655148	4883481	1125	-405	-1975	-2580	-2626			-2685	07/30/41
655148	4883481	1111	-449	-1974	-2561	-2635			-2672	03/27/41
654944	4884274	1135	-439	-1999	-2590	-2645	-3756	-2913	-3984	01/15/79
655939	4883924	1084	-391	-1990	-2581	-2648			-2659	01/10/42

WINTERFIELD FIELD

SUBSEA ELEVATIONS OF SELECTED FORMATION TOPS

UTM X(m)	UTM Y(m)	Elevation of Datum(ft)	Coldwater Shale(ft)	Traverse Lime(ft)	Bell Shale(ft)	Dundee Limestone(ft)	Richfield Member(ft)	Detroit River(ft)	Total Depth(ft)	Completion Date
655345	4883892	1109	-396	-1964	-2553	-2629			-2638	08/13/41
655740	4884332	1122	-404	-1996	-2604	-2660	-3778	-2931	-4030	07/23/78
655537	4884706	1128		-2007		-2677			-2698	04/29/42
655546	4883904	1115	-455	-1947	-2574	-2639			-2646	09/24/41
655748	4883914	1099	-466	-1992	-2629	-2648			-2654	11/05/41
655217	4883555	1118	-416	-1978	-2582	-2899	-3769	-2977	-4030	11/05/79
655290	4884693	1149	-444	-2001	-2608	-2668	-3770	-2932	-4032	10/27/78
655737	4884686	1129	-456	-2012	-2621	-2676	-3787		-4041	10/27/78
654927	4883828	1135	-430	-1973	-2569	-2626	-3751	-2897	-4005	06/01/79
655349	4883491	1100	-460	-1976		-2624			-2635	07/02/41
654847	4884185	1149	-432	-1985	-2580	-2637		-2907	-2933	04/17/80
654947	4883468	1137	-400	-1979	-2583	-2640	-3756	-2894	-4003	08/19/85
655542	4884306	1126	-419	-2009	-2586	-2649			-2654	11/21/41
655743	4884316	1107	-408	-1999	-2583	-2656			-2658	01/24/42
655551	4883503	1106	-370			-2651			-2666	11/15/40
655752	4883513	1090	-415	-1975	-2595	-2638			-2641	01/18/42
655941	4883523	1075	-505	-1975	-2586	-2647			-2652	03/25/42
654757	4883491	1125	-421	-1976	-2580	-2627			-3948	07/24/46
654557	4883453	1124	-406	-1954	-2561	-2627	-3748	-2891	-3976	09/04/42
654483	4883914	1145	-502	-1985	-2583	-2639	-3745	-2897	-3978	03/22/78
653727	4883799	1152	-368	-1964	-2553	-2609	-3857	-2888	-4061	07/11/69
654536	4884257	1144	-498	-1985	-2587	-2643	-3886		-4006	06/10/78
653748	4883449	1146	-389	-1967	-2554	-2614			-2689	03/07/69
654487	4884655	1144	-434	-1984	-2578	-2636	-3761		-4015	11/13/78
654120	4884665	1152	-436	-1979	-2562	-2619	-3760	-2889	-4024	11/15/78
654477	4883853	1127	-428	-1988	-2628	-2638			-3954	07/04/43
654126	4884276	1156	-407	-1971	-2563	-2621	-3755	-2865	-3997	02/14/79
654142	4883845	1140	-450	-1956	-2545	-2610			-2678	02/08/42
654138	4883838	1144	-403	-1968	-2562	-2618	-3749		-4009	06/29/79
653730	4884206	1160	-404	-1968	-2553	-2609	-3753	-2876	-4012	02/14/79
653325	4884196	1156	-416	-1978	-2567	-2622	-3759	-2891	-4008	02/14/79
654148	4883428	1142	-405	-1974	-2567	-2625	-3745	-2891	-3995	06/27/80

WINTERFIELD FIELD

SUBSEA ELEVATIONS OF SELECTED FORMATION TOPS

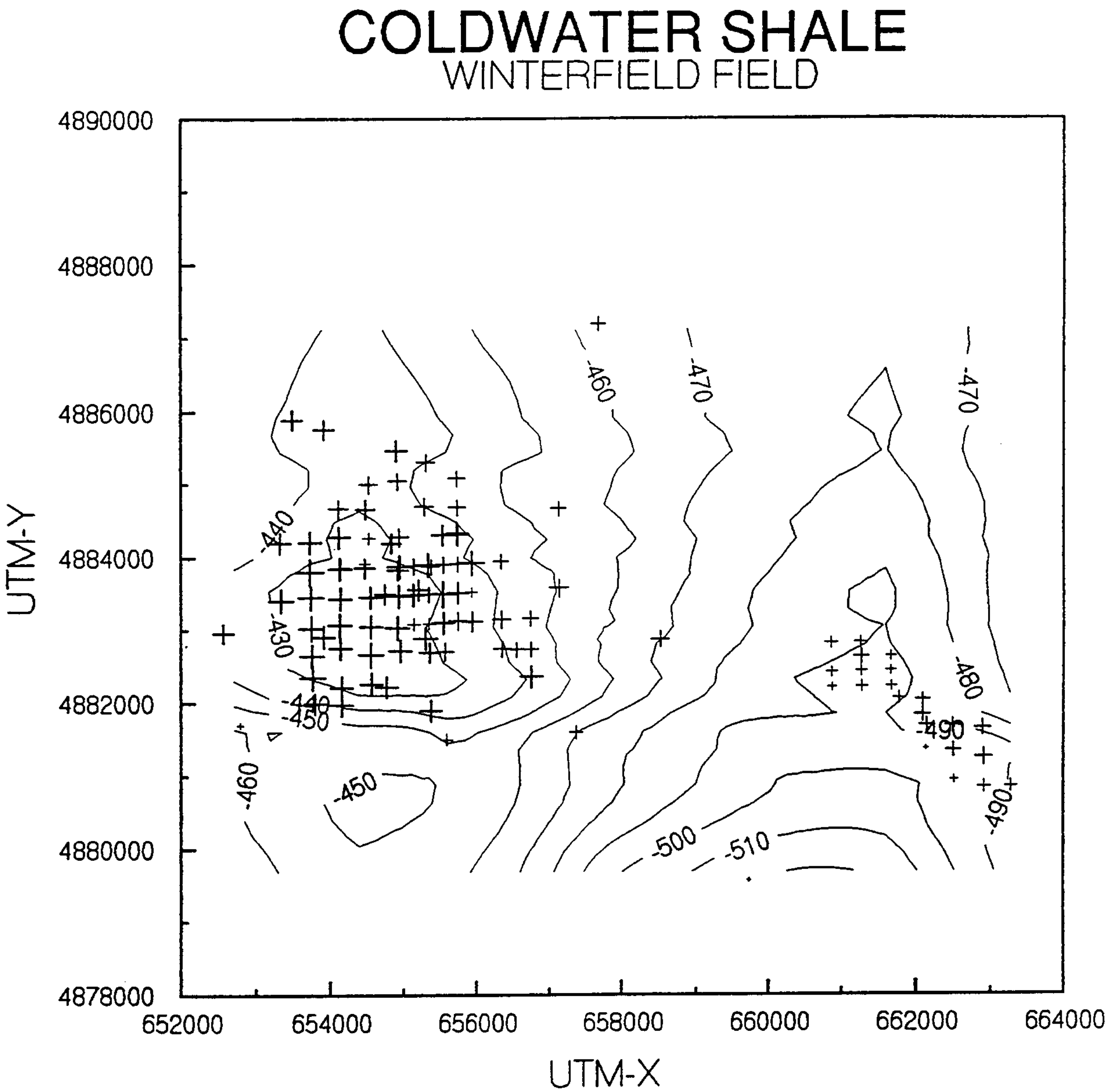
UTM X(m)	UTM Y(m)	Elevation of Datum(ft)	Coldwater Shale(ft)	Traverse Lime(ft)	Bell Shale(ft)	Dundee Limestone(ft)	Richfield Member(ft)	Detroit River(ft)	Total Depth(ft)	Completion Date
653339	4883400	1137	-395	-1970	-2567	-2624	-3757	-2883	-4018	07/13/80
654564	4883051	1119	-401	-1970	-2558	-2615	-3731	-2888	-3996	05/12/79
653753	4883029	1129	-383	-1971	-2556	-2614	-3866		-3928	07/28/69
654569	4882661	1136	-389	-1960	-2546	-2614	-3717	-2870	-4005	12/21/79
653770	4882343	1120	-435	-1966	-2545	-2613			-2699	06/27/54
653770	4882343	1132	-384	-1980	-2568	-2625	-3758	-2883	-4013	11/12/85
654142	4883074	1137	-395	-1952	-2546	-2612	-3714	-2881	-3995	09/06/79
654578	4882260	1117	-403	-1977	-2569	-2625	-3740	-2889	-4013	06/24/83
653803	4881986	1120	-412	-1980	-2562	-2620	-3746	-2872	-10420	01/06/89
654148	4882746	1132	-402	-1957	-2550	-2608	-3730	-2874	-3996	01/04/80
654167	4881970	1115	-405	-1984	-2598	-2665	-3775		-4008	08/15/85
653762	4882643	1140	-398	-1959	-2545	-2602	-3736	-2865	-4000	06/03/80
654164	4882213	1125	-402	-1968	-2569	-2632			-2707	05/31/85
653920	4882904	1159	-403						-10555	12/29/89
655356	4883089	1096	-504	-1972	-2554	-2632			-2681	01/15/41
654967	4883069	1122				-2624			-2689	07/18/41
655385	4881892	1081	-414	-1966	-2527	-2642			-4042	07/30/43
655947	4883121	1081	-424	-1973	-2529	-2644			-2705	05/18/42
655558	4883101	1109	-408	-1975	-2569	-2630			-2672	05/13/41
655155	4883079	1107	-493	-2003	-2558	-2628			-2665	05/16/41
655366	4882692	1082	-428	-1968	-2558	-2623			-2676	07/17/41
655755	4883131	1101	-438	-1975	-2569	-2629	-3767	-2892	-4059	04/04/79
655312	4882889	1096	-397	-1960	-2556	-2616	-3760	-2884	-4007	11/07/79
654970	4882718	1107	-401	-1963	-2560	-2616	-3743	-2923	-4002	07/26/79
654930	4883035	1132	-400	-1978	-2568	-2626	-3755		-4018	08/30/79
654783	4882219	1116	-408	-1972	-2562	-2620			-2620	07/18/85
655567	4882702	1085	-445	-1975	-2565	-2623			-2682	04/15/42
656761	4882358	1071	-409	-2007	-2609	-2680		-2927	-3036	04/08/42
656350	4883142	1085	-445	-1996	-2590	-2663	-3775	-2945	-4005	01/15/43
656760	4882733	1084	-471	-2014	-2618	-2676			-2768	05/08/84
656557	4882731	1095	-467		-2608	-2663	-3805		-4096	08/01/83
656753	4883162	1092	-461	-2002	-2608	-2666			-2783	04/07/84

WINTERFIELD FIELD

SUBSEA ELEVATIONS OF SELECTED FORMATION TOPS

UTM X(m)	UTM Y(m)	Elevation of Datum(ft)	Coldwater Shale(ft)	Traverse Lime(ft)	Bell Shale(ft)	Dundee Limestone(ft)	Richfield Member(ft)	Detroit River(ft)	Total Depth(ft)	Completion Date
656361	4882740	1094	-456	-1936	-2590	-2647			-2750	04/26/84
658530	4882864	1083	-453	-2019	-2625	-2683	-3821	-2953	-4073	06/27/85
660882	4882204	1070	-527			-2725			-2745	06/15/41
660877	4882409	1080	-507	-2038	-2655	-2721			-2826	07/01/41
660868	4882811	1071	-499	-2042	-2659	-2723			-2729	09/03/41
661671	4882632	1072	-518	-2061	-2633	-2720			-2724	04/01/41
661275	4882622	1081	-479			-2703			-2710	02/13/41
661681	4882221	1069	-516	-2051	-2621	-2694			-2697	08/04/41
661285	4882212	1066	-504	-2060	-2643	-2711			-2722	06/23/41
661676	4882431	1071	-514	-2043	-2647	-2706			-2711	07/02/41
661280	4882421	1074	-501	-2053	-2641	-2690			-2693	05/01/41
661271	4882823	1085	-495	-2058	-2639	-2710			-2711	04/07/41
662089	4882028	1074	-486	-2058	-2651	-2706			-2712	09/06/41
661786	4882052	1069	-491	-2056	-2627	-2699			-2700	11/19/41
652577	4882959	1146	-426	-1969	-2561	-2620	-3749	-2877	-10604	07/14/89
652803	4881697	1030	-540	-2070	-2678	-2736	-3858	-2992	-10554	02/09/90

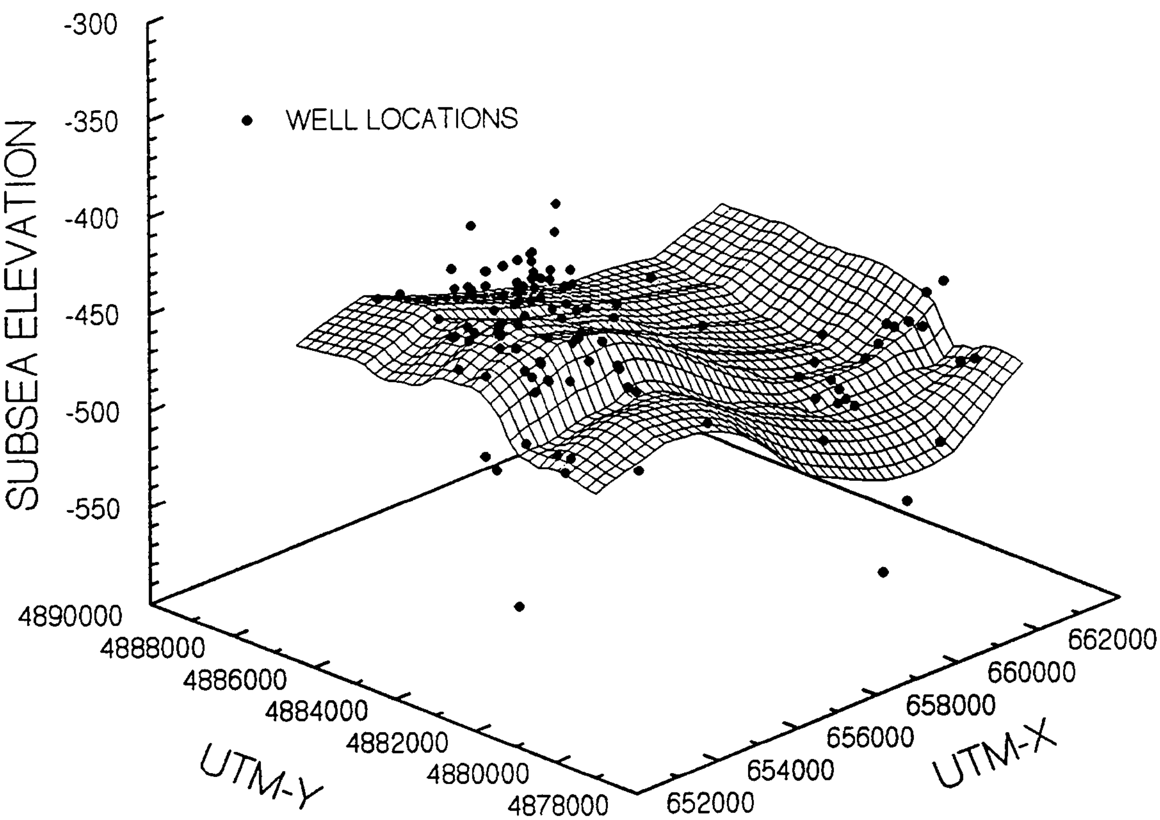
WINTERFIELD FIELD



Coldwater Shale structure contour map with well locations.
Size of + indicates relative depth (smaller are deeper).

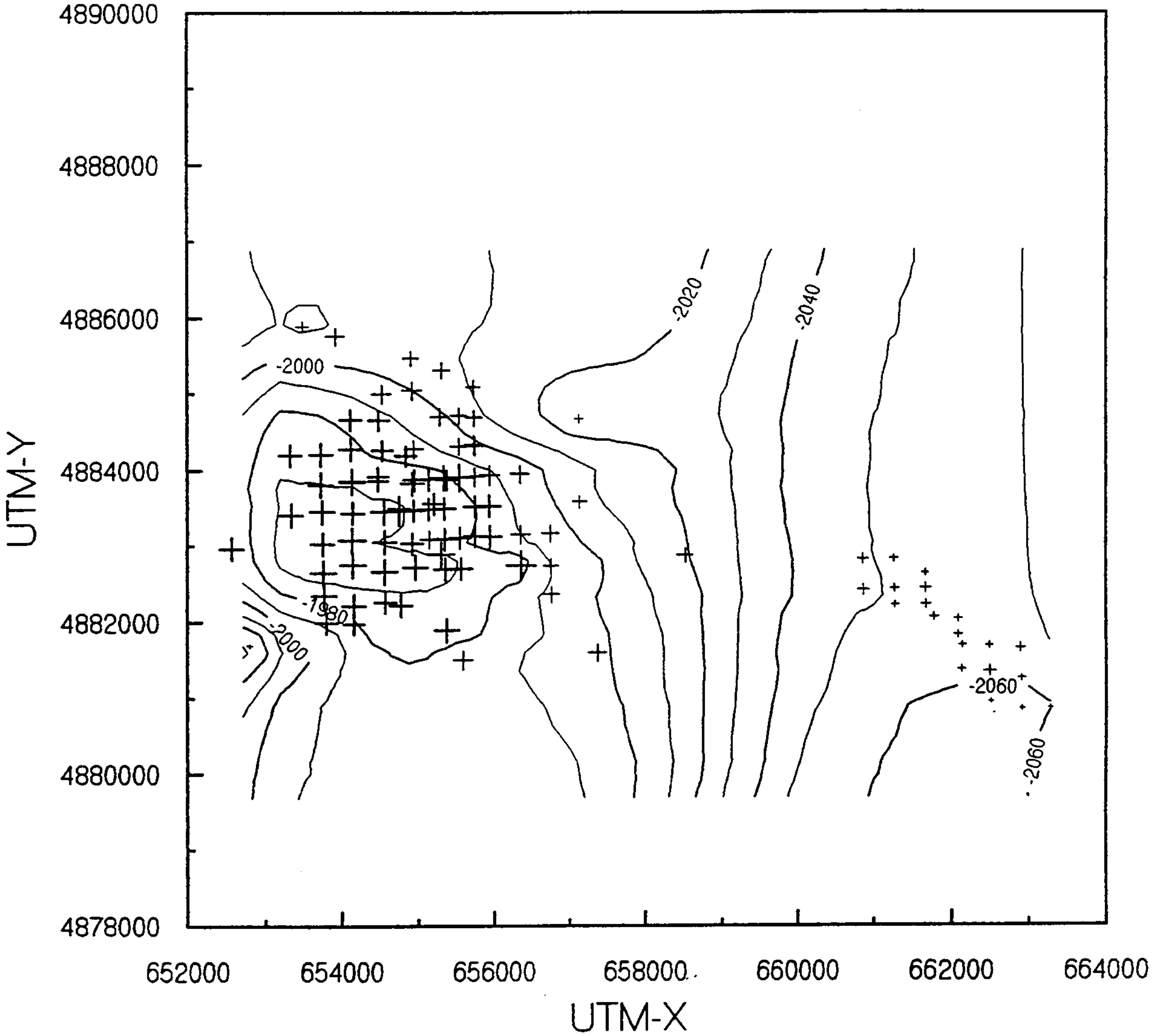
Contour Interval = 10'

COLDWATER SHALE
WINTERFIELD FIELD



Coldwater Shale surface map with well locations.

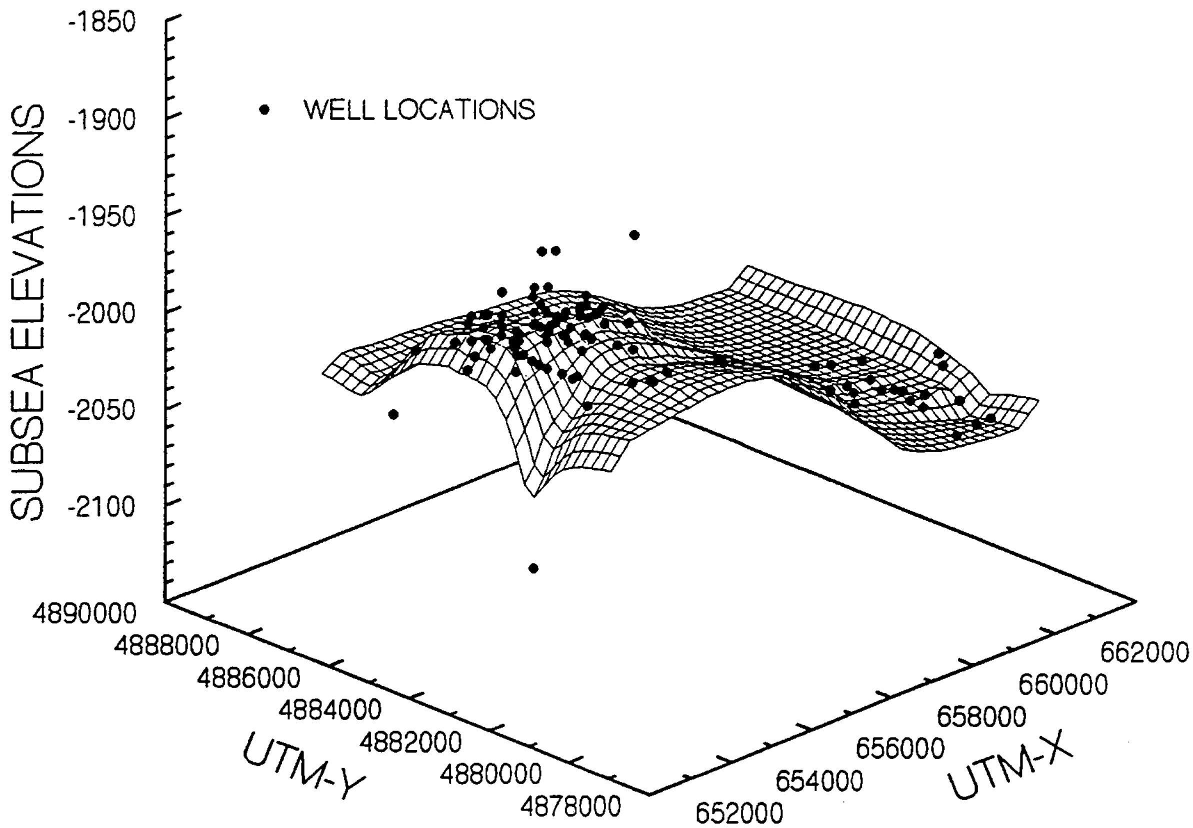
TRAVERSE LIMESTONE
WINTERFIELD FIELD



Traverse Limestone surface contour map with well locations.

Contour Interval = 10'

TRAVERSE LIMESTONE
WINTERFIELD FIELD



Traverse Limestone surface map with well locations

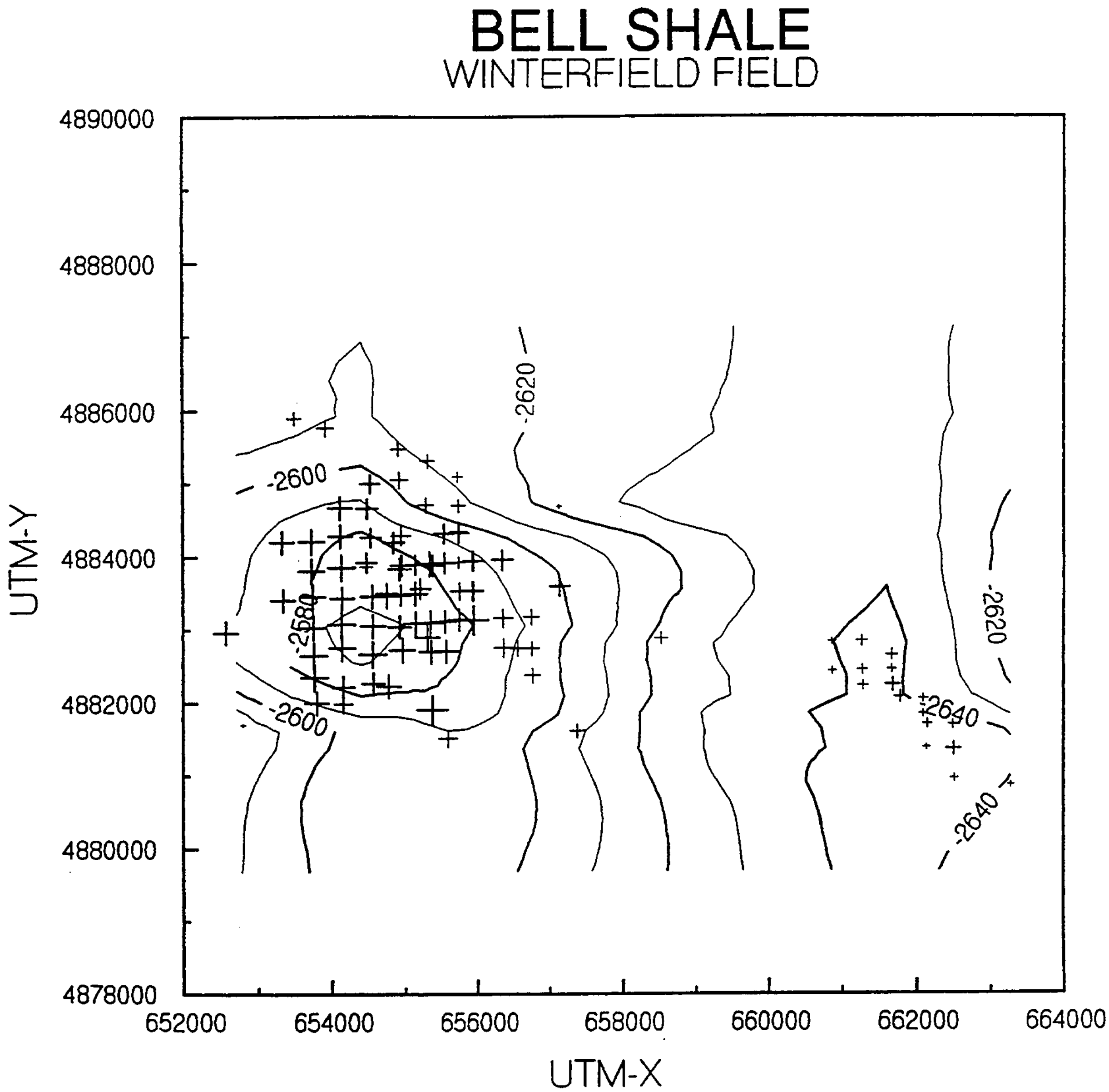
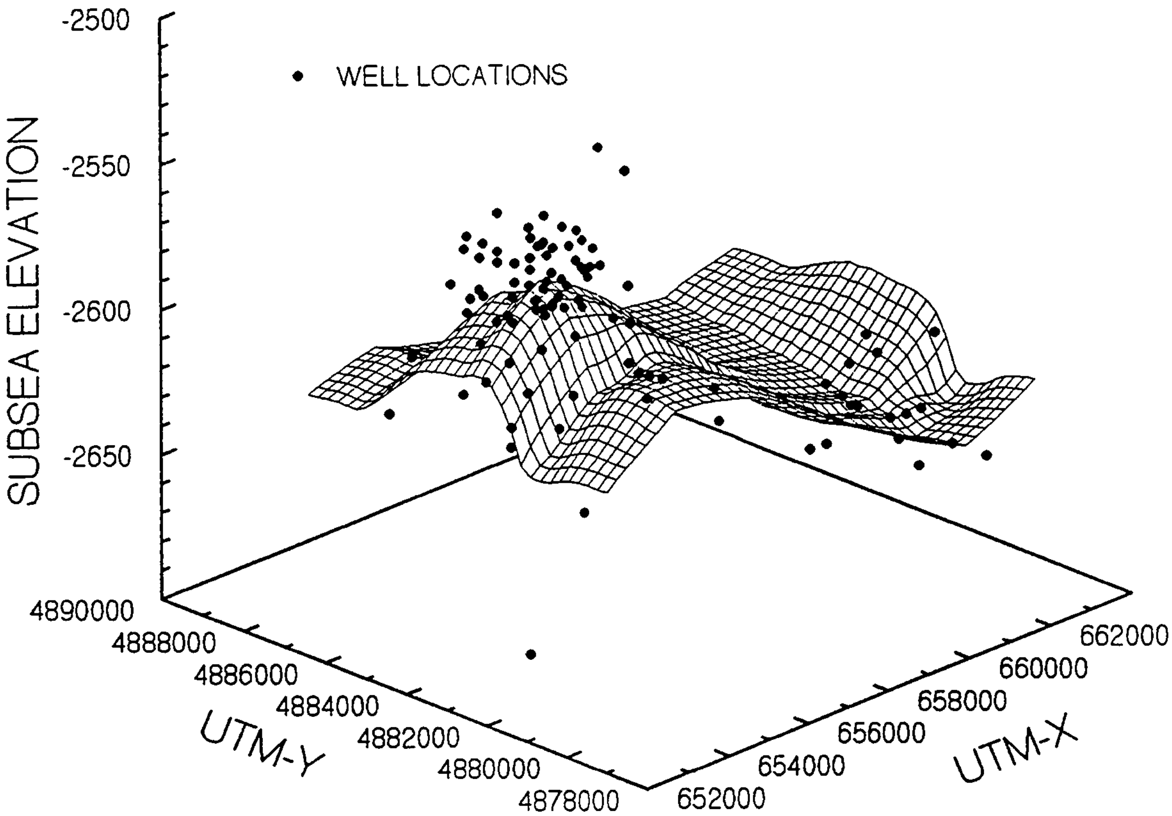


Figure 15(a) Bell Shale surface contour map with well locations.

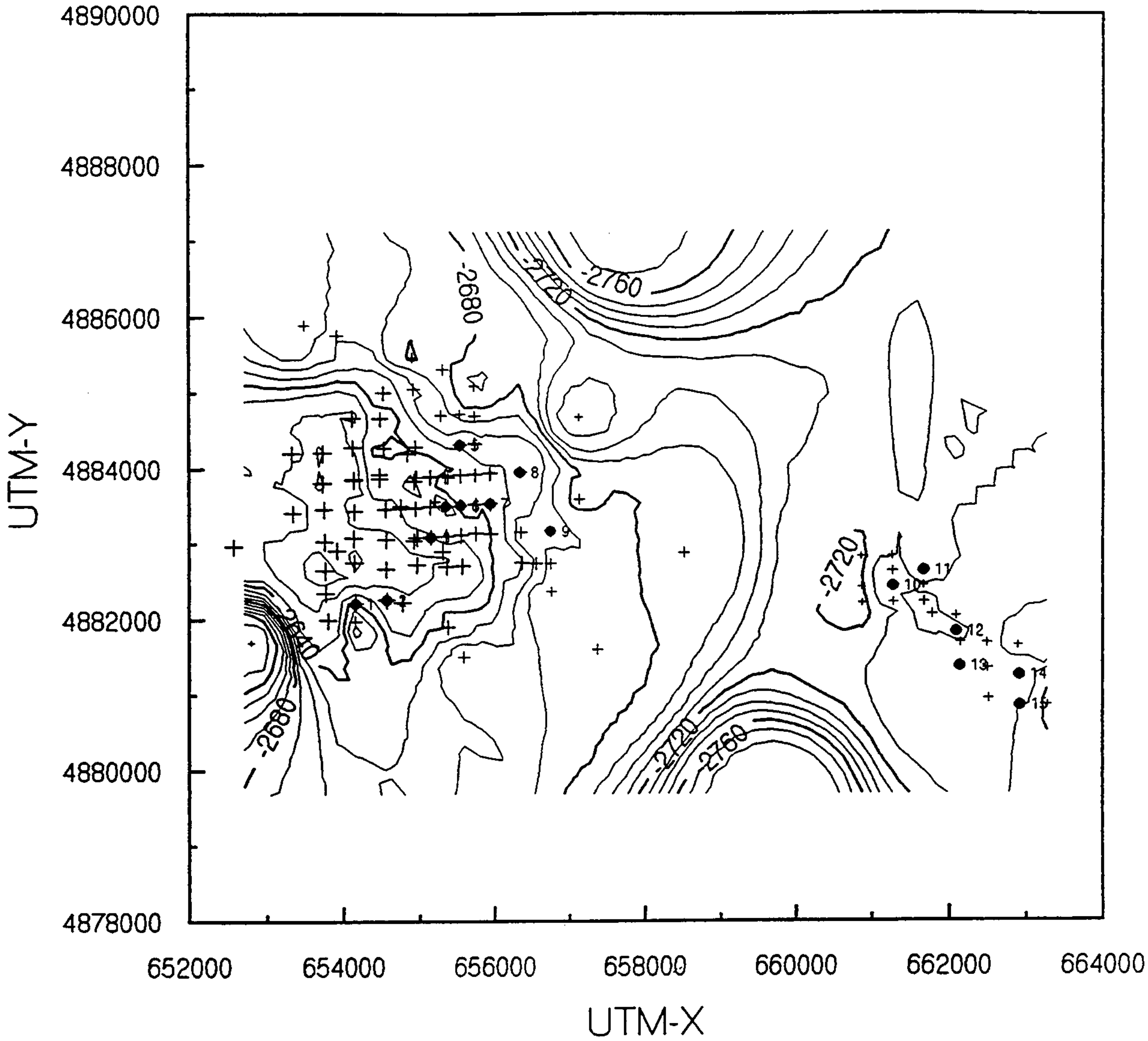
Contour Interval = 10'

BELL SHALE
WINTERFIELD FIELD



Bell Shale surface map with well locations.

DUNDEE FORMATION
WINTERFIELD FIELD

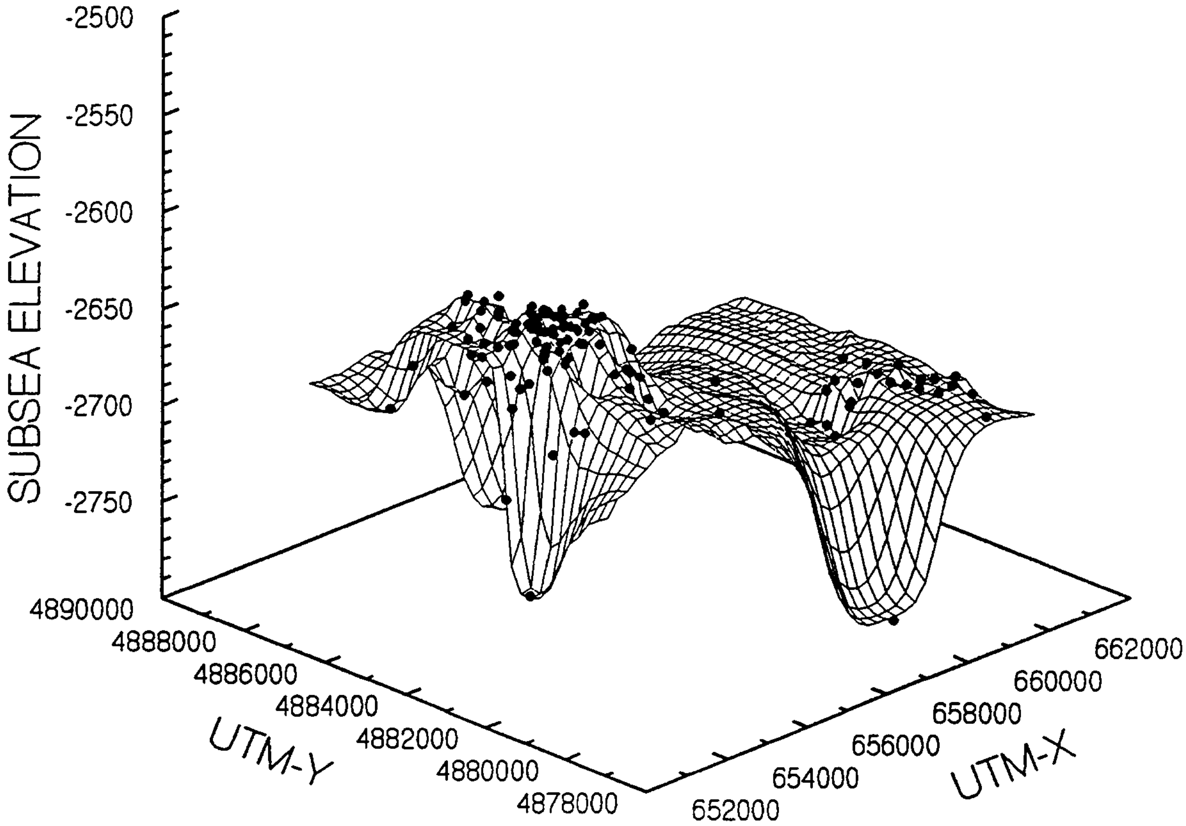


Dundee Structure Contour Map.

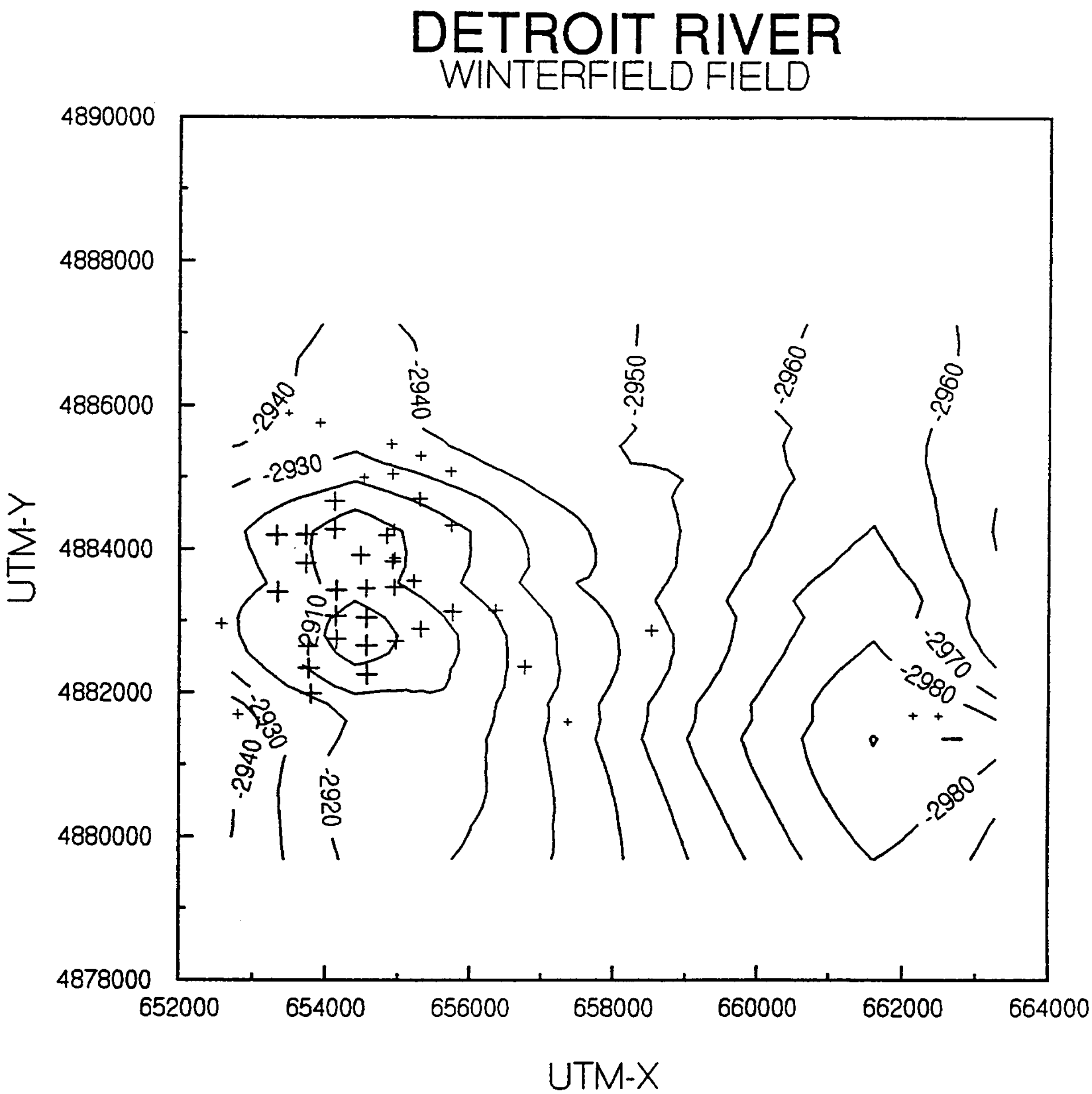
+'s are well locations, black dots with numbers are lease locations.

Contour Interval = 10'

DUNDEE FORMATION
WINTERFIELD FIELD



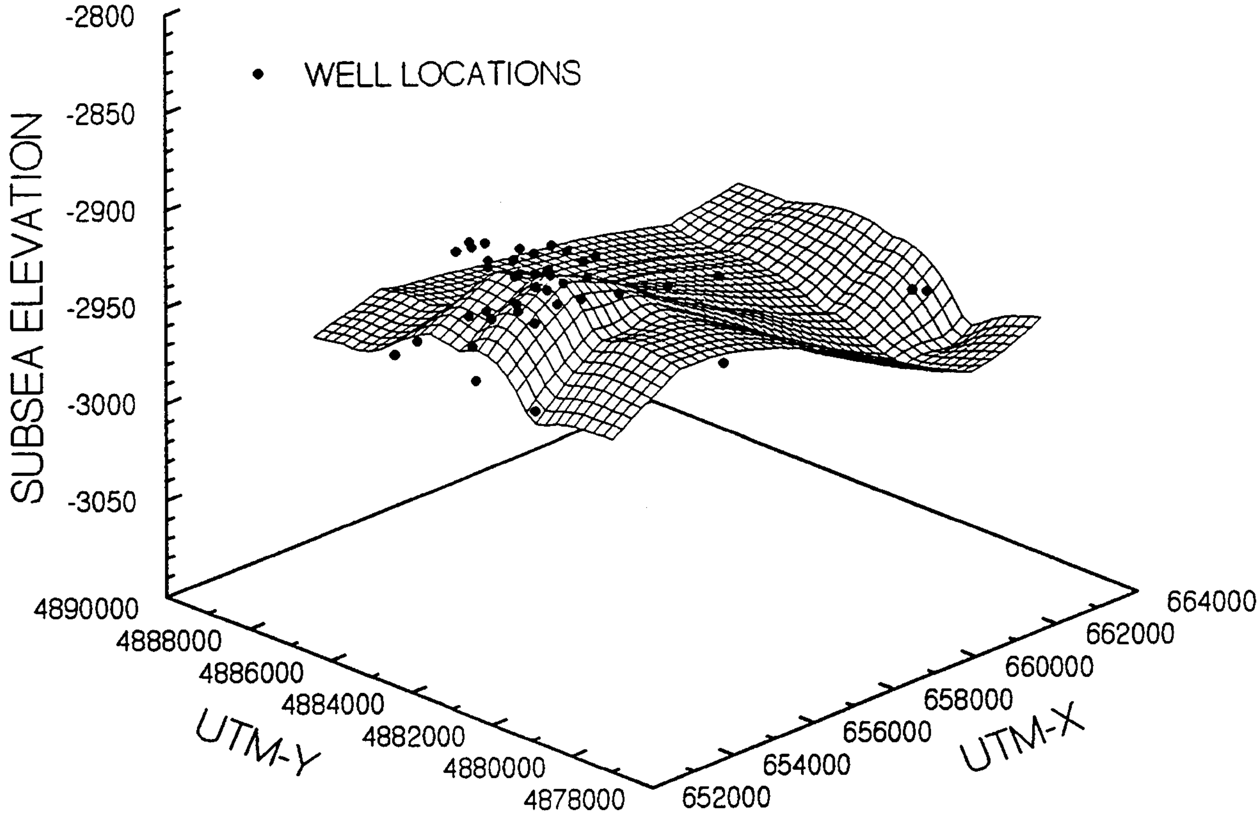
Dundee surface map with well locations.



Detroit River surface contour map with well locations.

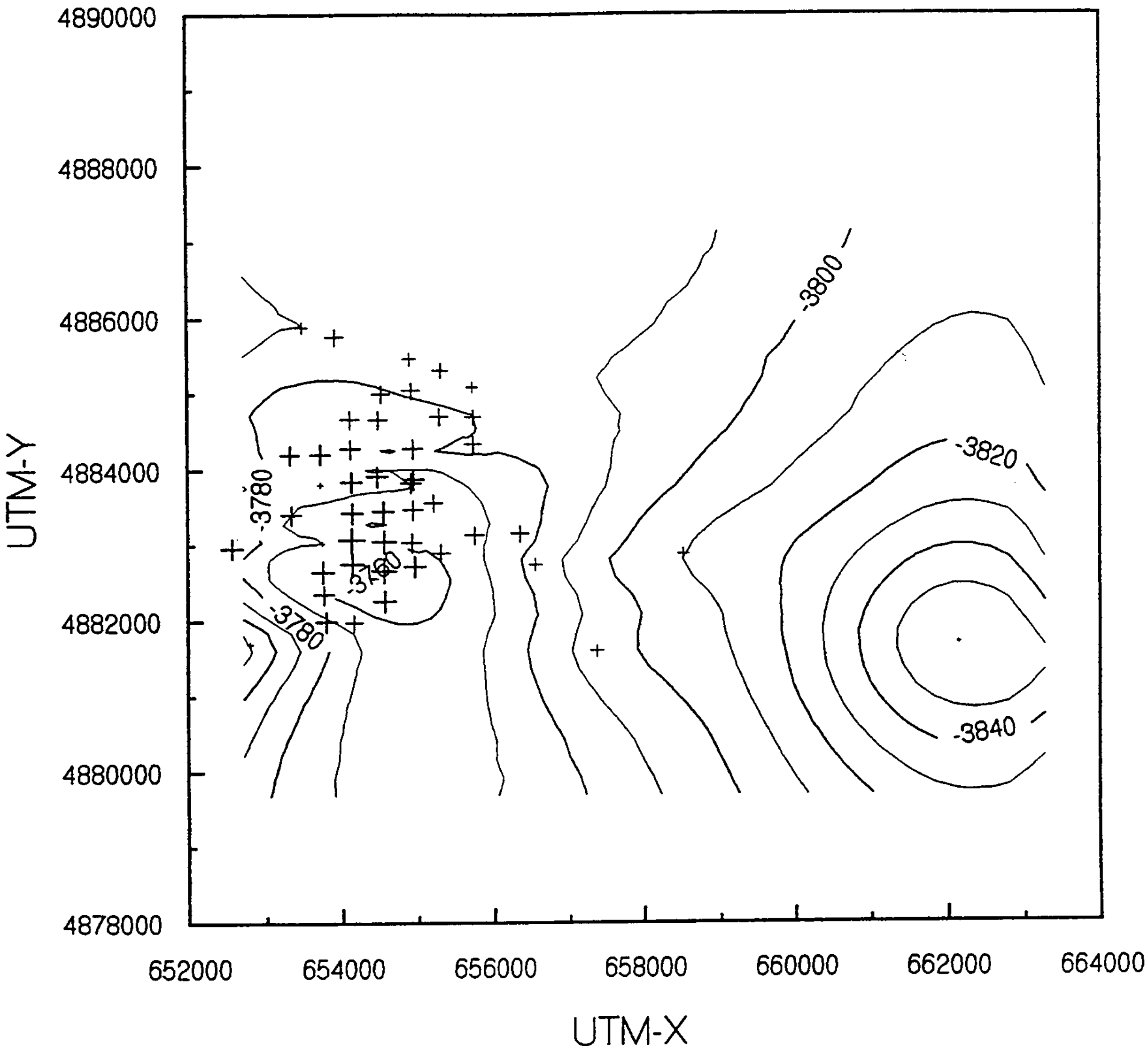
Contour Interval = 10'

DETROIT RIVER
WINTERFIELD FIELD



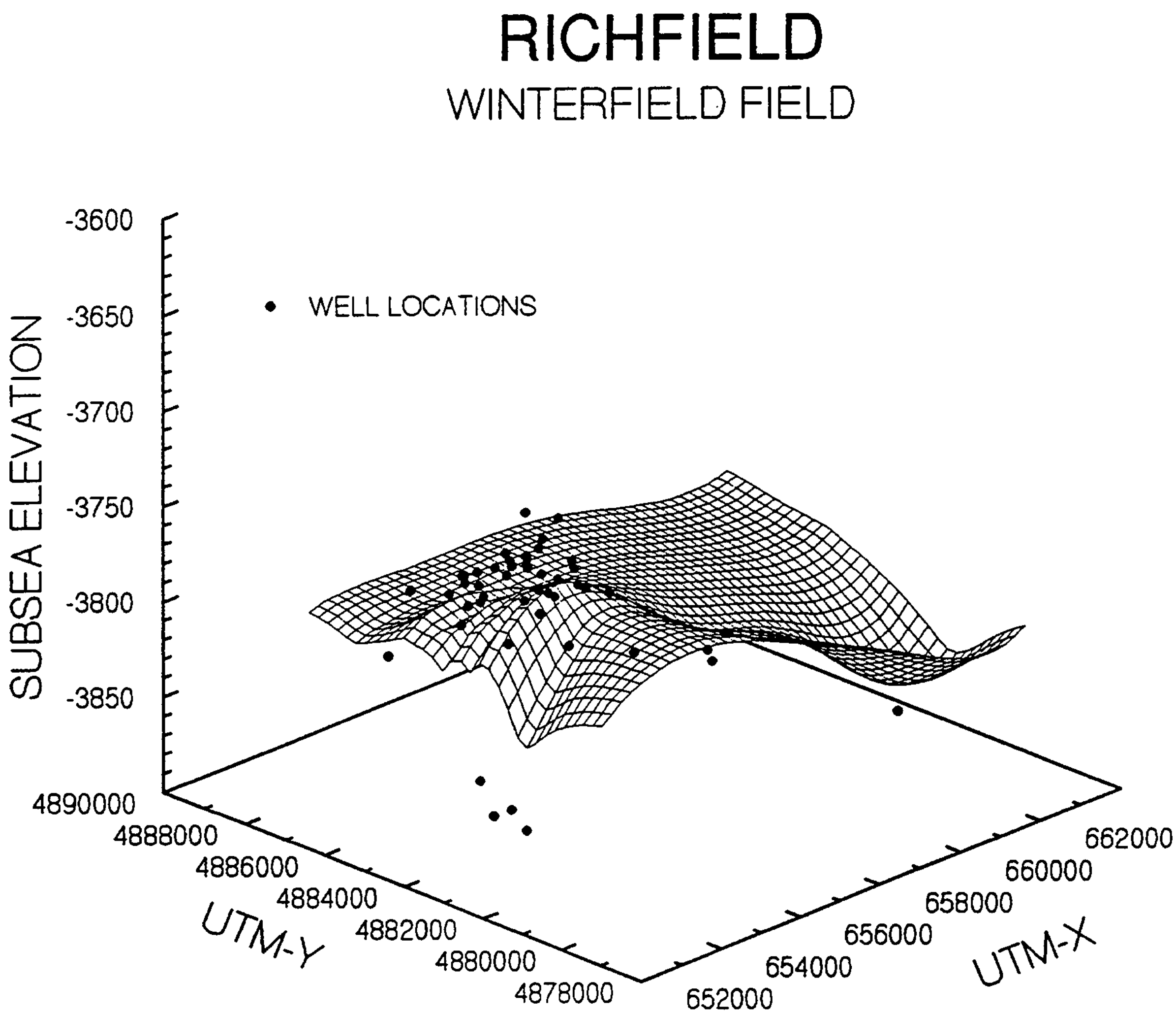
Detroit River surface map with well locations.

RICHFIELD
WINTERFIELD FIELD



Richfield surface contour map with well locations.

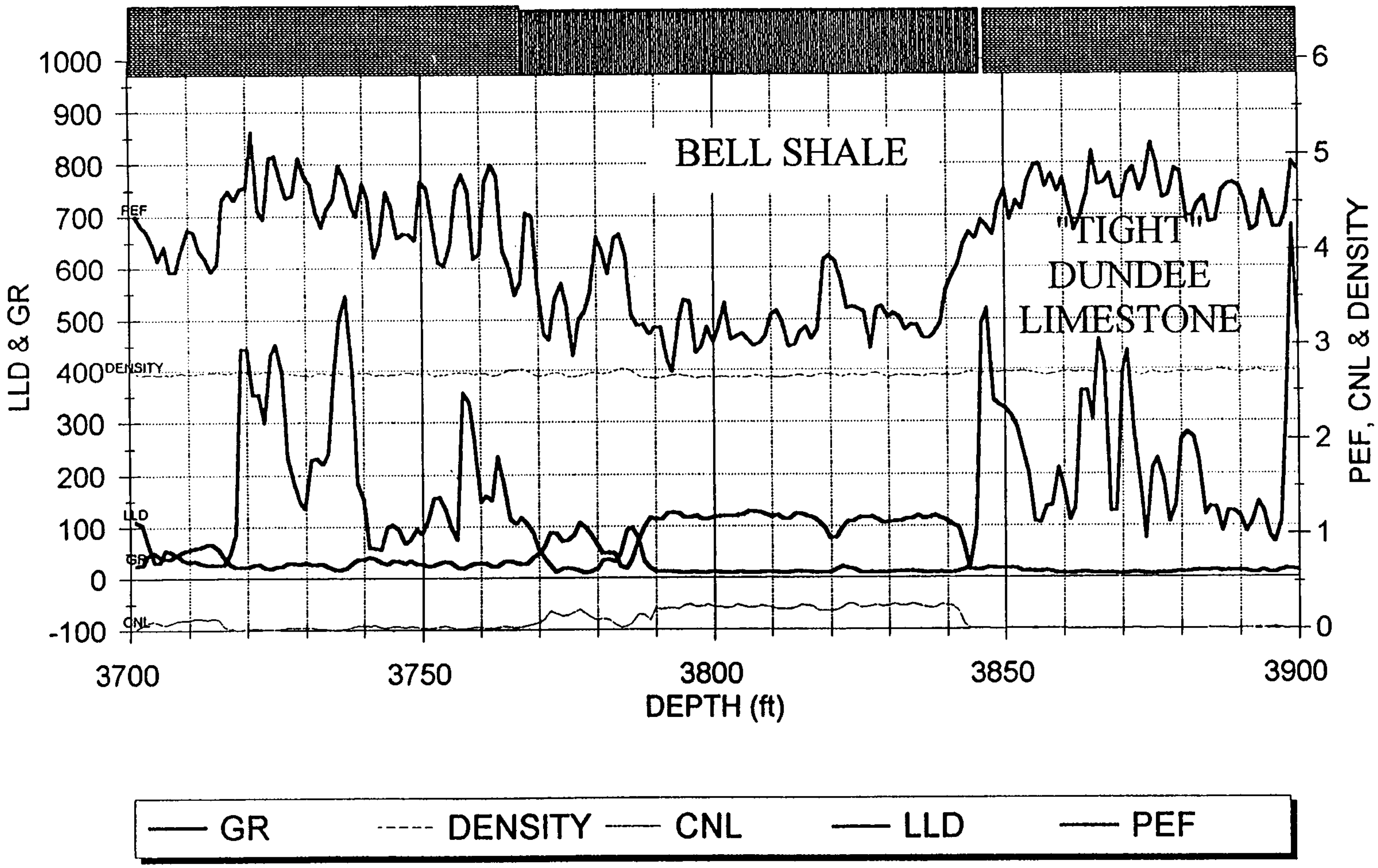
Contour Interval = 10'



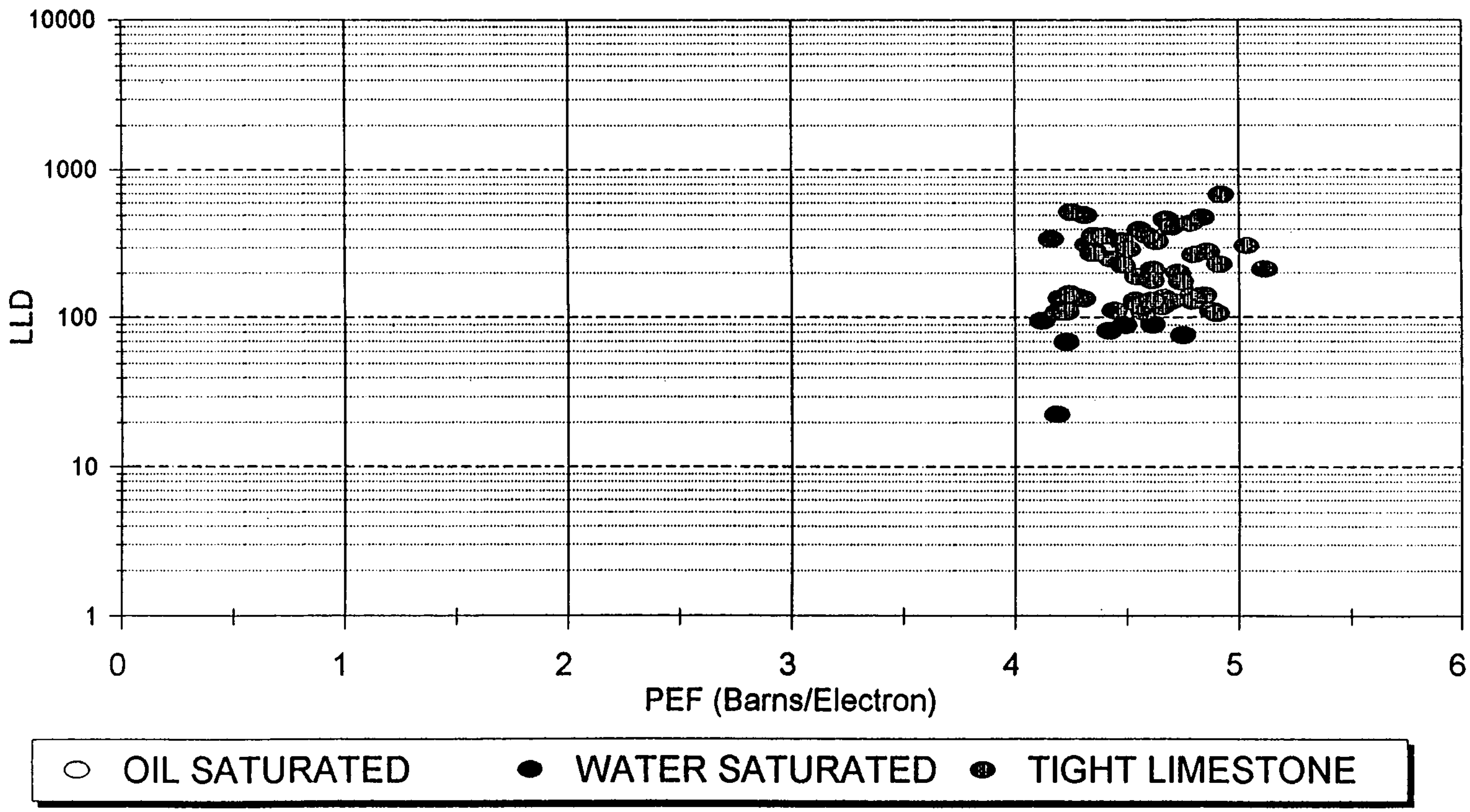
Richfield surface map with well locations.

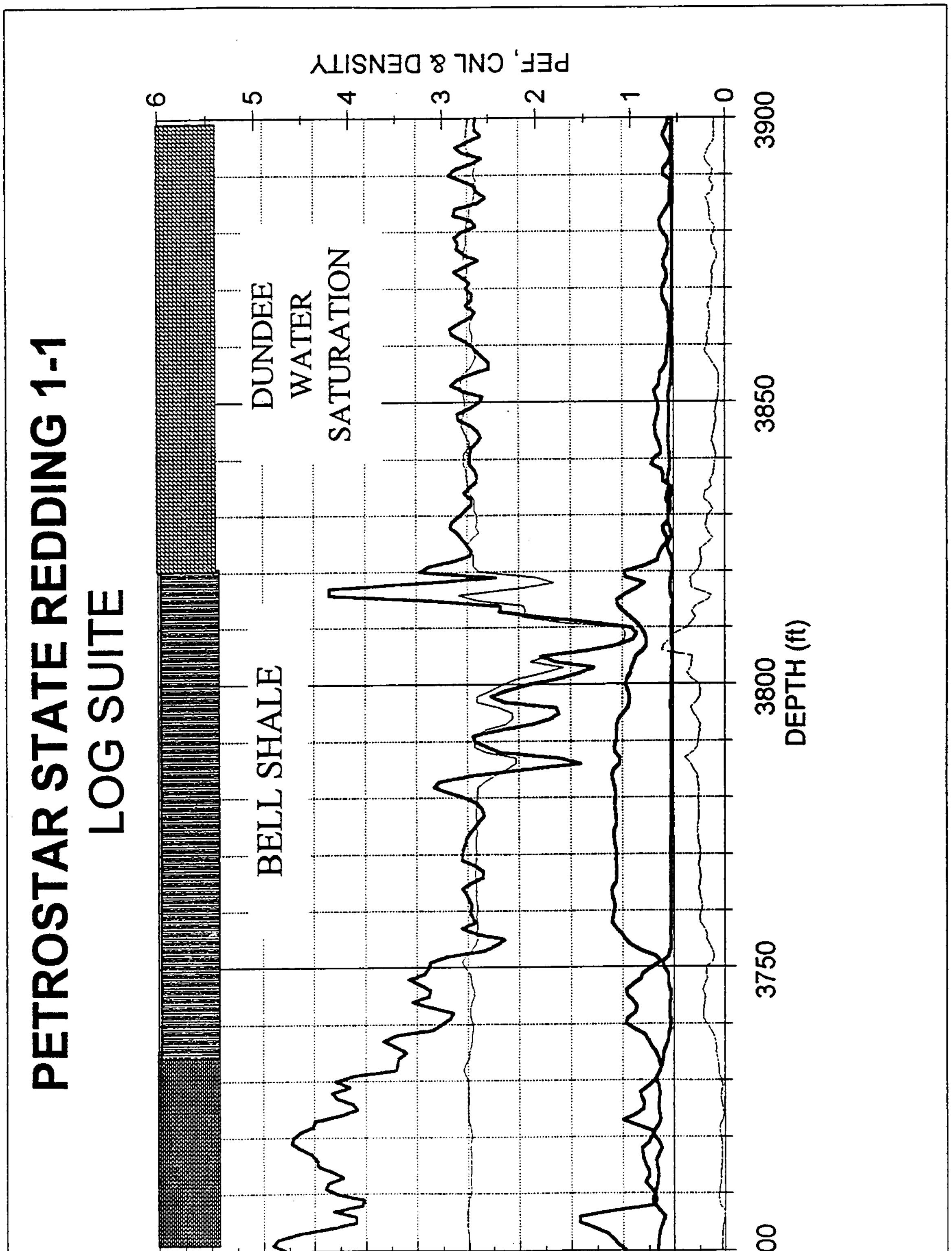
APPENDIX E

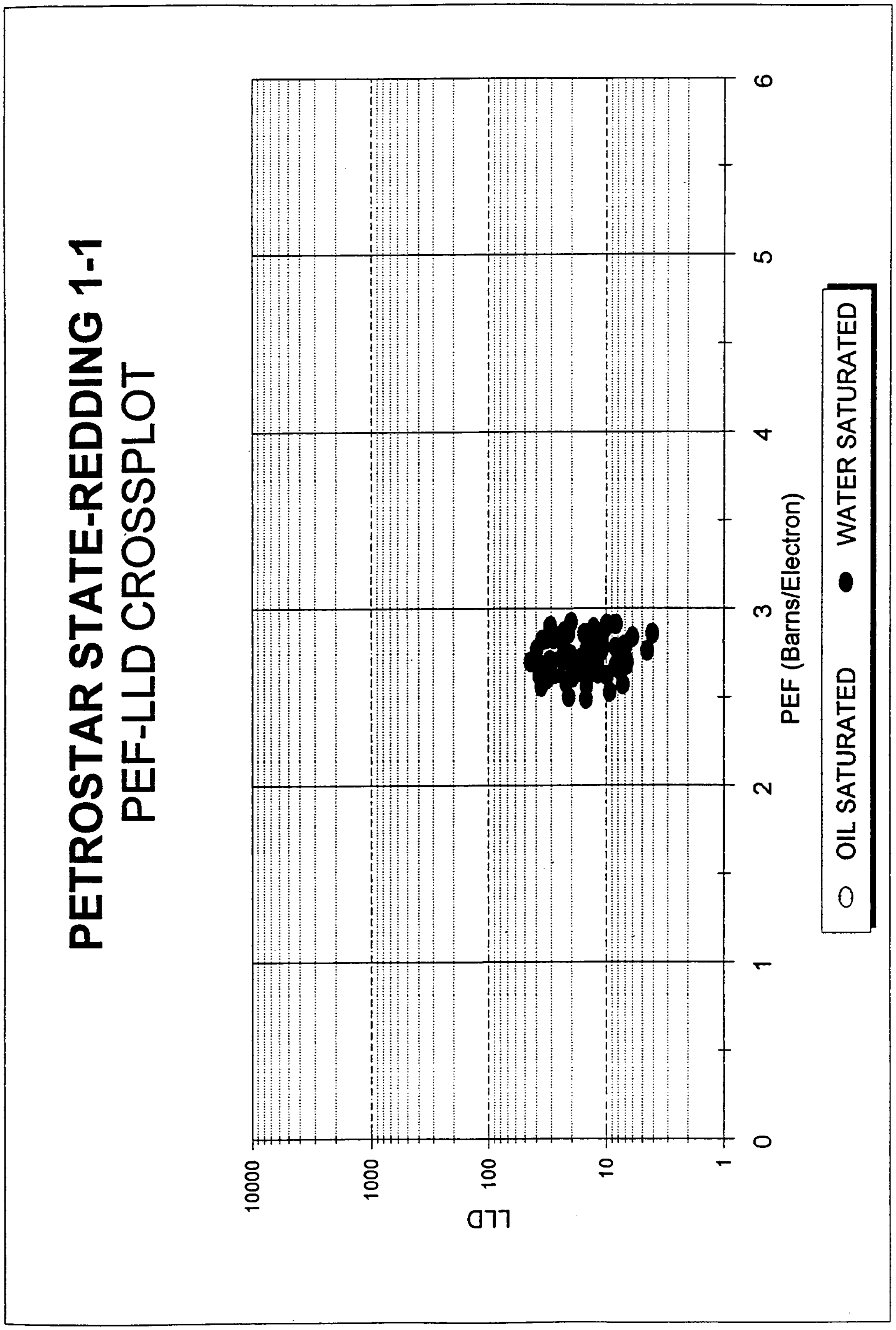
PETROSTAR STATE WINTERFIELD 1-19
LOG SUITE

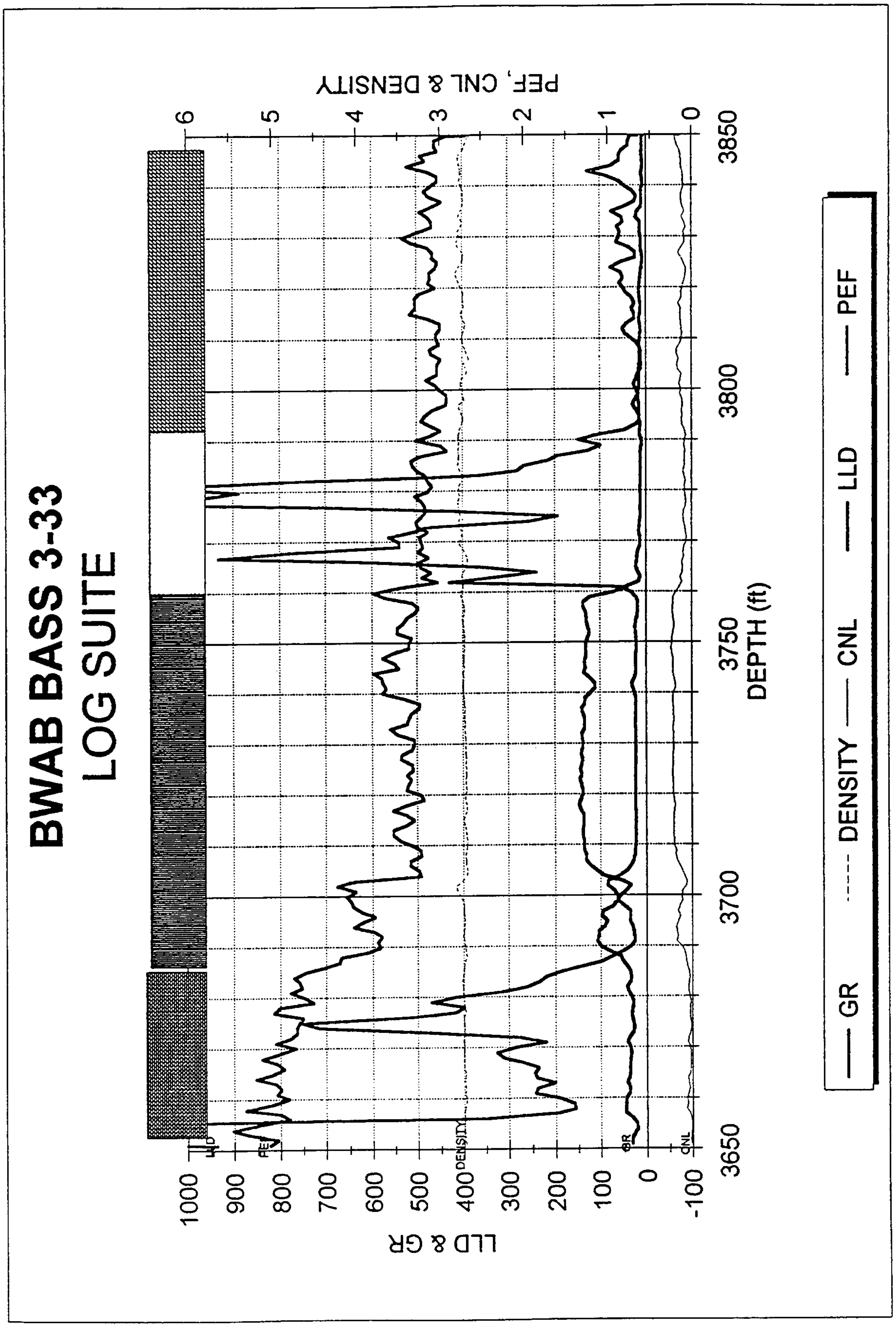


PETROSTAR STATE WINTERFIELD 1-19
PEF-LLD CROSSPLOT



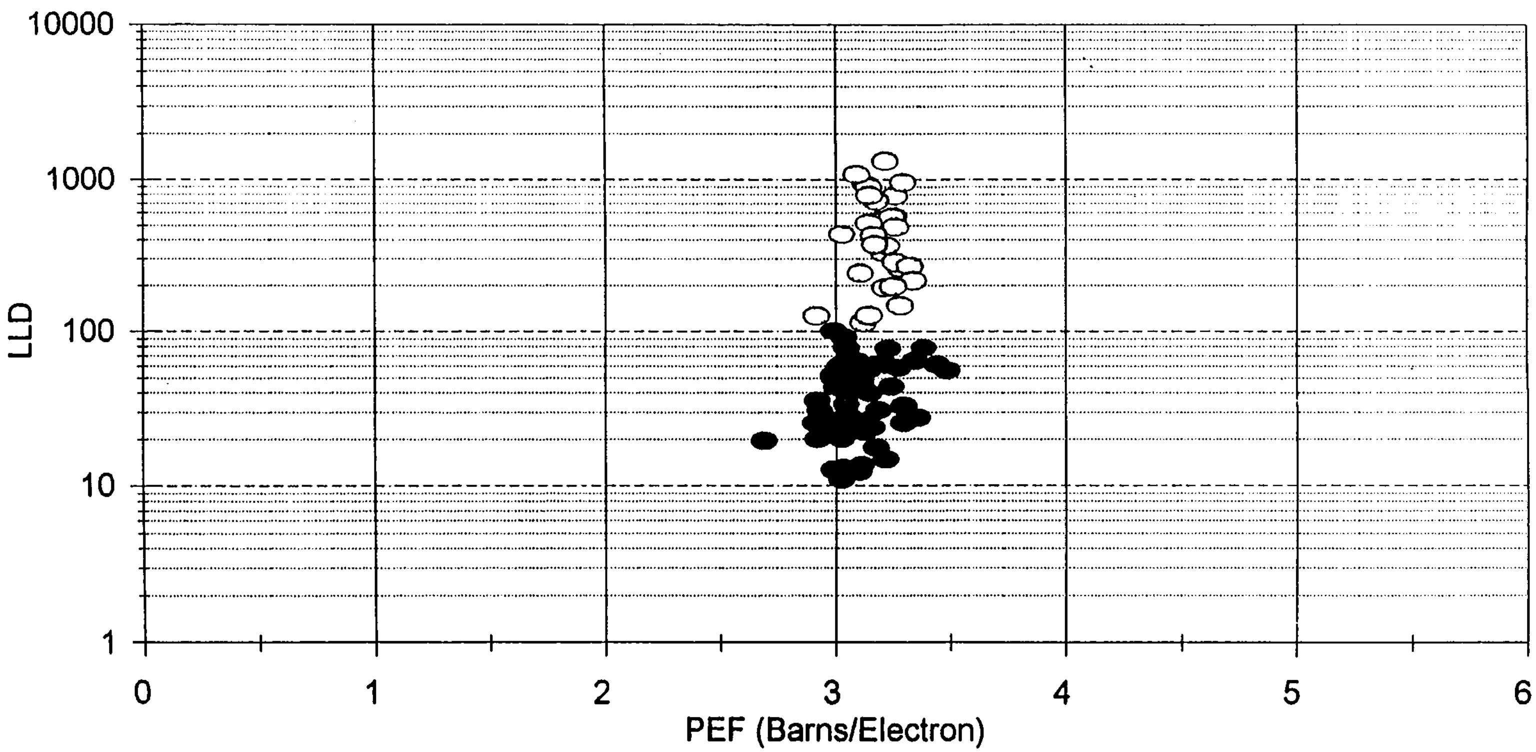

PETROSTAR STATE REDDING 1-1
LOG SUITE
BELL SHALE
DUNDEE
WATER
SATURATION
LLD & GR
PEF, CNL & DENSITY
DEPTH (ft)
3700
3750
3800
3850
3900
1000
900
800
700
600
500
400
300
200
100
0
-100
6
5
4
3
2
1
0


PETROSTAR STATE-REDDING 1-1
PEF-LLD CROSSPLOT
LLD
10000
1000
100
10
1
0
1
2
3
4
5
6
PEF (Barns/Electron)
OIL SATURATED
WATER SATURATED



BWAB BASS 3-33
LOG SUITE
LLD & GR
PEF, CNL & DENSITY
DEPTH (ft)
3650
3700
3750
3800
3850
1000
900
800
700
600
500
400
300
200
100
0
-100
6
5
4
3
2
1
0
LLD
PEF
DENSITY
GR
CNL
GR
DENSITY
CNL
LLD
PEF

BWAB BASS 3-33
PEF-LLD CROSSPLOT



MICHIGAN OILFIELD RESEARCH CONSORTIUM (MOFRC)

Newsletter 1
April, 1995

The Michigan Oilfield Research Consortium (MOFRC) was organized to facilitate the transfer of information and technology between research-oriented and application-oriented groups. Current members of MOFRC include two universities, Michigan Technological University (MTU) and Western Michigan University (WMU); one research center, the Institute of Materials Processing (IMP) at MTU; and two industry partners, Terra Energy Ltd. and Savoy Oil and Gas.

MOFRC was formed to meet the needs of the Michigan oil industry by acting as a research and development organization. To date, the industry members of MOFRC are independent oil companies that benefit greatly from the access to research facilities and personnel that membership provides.

A United States Department of Energy (DOE) award to some current members greatly aids MOFRC in achieving its goals of combining research and application in shallow-shelf carbonate settings. Part of the DOE award is intended to support technology transfer between interested groups (both academia and industry). This newsletter is the first step in that process and is intended to inform interested parties about the existence of MOFRC and planned MOFRC-sponsored activities. We encourage your participation in MOFRC. The DOE's positive response to our first request for funding is very encouraging and we plan to submit more proposals to funding agencies in the future. MOFRC should provide a mechanism that will help revitalize the oil and gas industry in Michigan by facilitating the application of new technologies to existing and poorly understood fields. If you are interested in joining MOFRC, please notify one of the people listed at the end of the newsletter.

OPERATIONAL STRUCTURE

MOFRC's operations reflect its goal of providing research services for industry. Potential projects will be submitted to the membership at MOFRC meetings. Potential sources for funding will be identified, and teaming and cost-sharing arrangements will be made. Proposals will be assembled and submitted by teams composed of both research-oriented members and industry partners. This mechanism ensures that research projects are directly applicable to industry problems.

The research-oriented members of MOFRC are committed to sharing information and technology. Non-proprietary research findings and technological developments will be distributed throughout the MOFRC membership and to the scientific community in general. MOFRC, through the Institute of Materials Processing, can also conduct privately funded, proprietary research for industry.

BACKGROUND

The initial MOFRC project is sponsored by the U.S. Department of Energy under their "Class II Oil Program: Near Term Activities", which focuses on shallow shelf carbonate reservoirs. MTU, WMU, and Terra Energy Ltd. have teamed up to conduct a project entitled "Recovery of Bypassed Oil in the Dundee Formation Using Horizontal Drains".

The goal of this project is to demonstrate that oil production from selected fields in the Dundee Formation (Devonian) of Michigan can be substantially increased, perhaps restored to near-original production levels in some fields in Michigan, by using horizontal drain wells. The main technical goal of this project is to provide small-to-medium size oil-field operators with an example in the form of a detailed case history from the Crystal Field (Montcalm County, Michigan) in which a horizontal well will be used to recover bypassed oil. The techniques and methodologies will be demonstrated as a field trial in Crystal Field. Approximately 30 other Dundee Fields have also been selected for characterization only.

Reservoir characterization will involve assembling, visualizing, and manipulating standard reservoir data, including well logs and sample measurements. The project will also integrate data available for gas and oil fields with predictive models for reservoir alteration, and will link these data and models with modern computer hardware and software to provide 2D and 3D visualizations of the reservoir and its attributes. Data sets from laboratory measurements of cuttings and core will be used to develop algorithms correlating the log responses with geologic and engineering measurements.

This project started in April, 1994. It is a two phase project, with each phase lasting 18 months. Drilling will commence as soon as environmental issues are resolved. Reservoir characterization is underway.

TECHNOLOGY TRANSFER MECHANISMS

Two primary target audiences will profit from rapid disbursement of information resulting from MOFRC projects. The first group constitutes the members of MOFRC itself. The second group is composed of geoscientists and engineers who are concerned with production from the Michigan basin and/or other reservoirs similar to those being studied (i.e., shallow marine shelf carbonate reservoirs, pinnacle reefs, etc.). The following methods will be used to ensure all interested parties have access to the information.

Meetings: MOFRC will sponsor semiannual meetings for at least the next two years (the length of the DOE project). The first meeting will be held after the drilling in the Crystal Field is complete. All members and other interested parties are encouraged to participate in this, and subsequent, meetings.

Reports: MOFRC will produce written project reports that will be supplied to all members. These reports will contain information about the status of all MOFRC projects. Preliminary results of research projects and descriptions of technological developments will form the core of these reports. Electronic distribution via the Ethernet is a possibility. Please let us know if you are interested in this option.

Professional Meetings and Publications: The format provided by meetings and publications of professional societies (including but not restricted to the American Association of Petroleum Geologists, the Society of Petroleum Engineers, and the Michigan Basin Geological Society) are ideal for distribution of non-proprietary information related to this project. Developments from MOFRC-affiliated projects will be presented to the geoscience and engineering communities at-large through these types of regional and national organizations.

Workshops: Some of the technical work done as part of this project involves the use of equipment, software, and facilities not available to independent oil companies. MOFRC will provide access to university-owned computational facilities and analytical equipment. For example, the Subsurface Studies Laboratory (SSL) at Michigan Technological University (MTU) is equipped with state-of-the-art computational hardware and software developed for the petroleum industry. Training workshops will be held at MTU. After the initial training, members may visit MTU to use the SSL computational facilities or access the facility over an Ethernet network. This networking allows the SSL facilities to serve all members.

Workshops will be held at MTU and Western Michigan University (WMU) on an annual basis to demonstrate the reservoir characterization methodology developed for the current project. Because MOFRC is composed of an interdisciplinary group of scientists, diverse datasets and unconventional methods are commonly employed during reservoir characterization. For example, the apparent link between sequence and parasequence boundaries and diagenetic anomalies in the Crystal Field will be examined through the combined efforts of sequence stratigraphers and geochemists.

Personnel Transfer: An effective way to transfer information is through the transfer of personnel. Research-oriented members of MOFRC
are encouraged to perform research while in residence at an industry partner's facility. This mechanism for technology transfer facilitates rapid communication of information throughout the membership. MOFRC plans to demonstrate the benefits of personnel transfer during completion of the current DOE project. At the conclusion of the project, this aspect of technology transfer will be evaluated by members, and the results of the evaluation will be made available to all interested parties. This type of interface between research-oriented and application-oriented groups may serve as a model program for other independent companies.

MARKETING OF TECHNOLOGY

Each entity in MOFRC will be the sole owner of new technologies developed within that entity. Each entity will license products according to its own procedures. Because the university members of MOFRC have less experience in marketing, that aspect of technology transfer will be the responsibility of the industry partners. Royalties and license fees will be transferred to MOFRC members through its representative, Michigan Technological University.

For more information about MOFRC, contact:

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Let us know if you are interested in receiving information electronically. If you have colleagues or know of other people who would benefit or be interested in being involved with MOFRC, let us know and we will include them on our mailing list. If you received this mailing directly, you are on our list, and will continue to get MOFRC mailings. If this report was routed to you indirectly, let us know and we will add you to our list.

The next mailing will be to invite everyone to the first MOFRC meeting. The specific meeting location and date will be given at that time. If you are interested in making a presentation, we will be asking for speakers.

Your comments, questions, and input are always appreciated.

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Shreveport, LA 71151

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Cronus Development
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