CASE 7070: TESORO PETROLEUM CORPORATION FOR A PILOT CAUSTIC FLOOD PROJECT, McKINLEY COUNTY, NEW MEXICO

CASE NO.

7070

APPLICATION,
TRANSCRIPTS,
SMALL EXHIBITS,

ETC.

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO

12 November 1980

EXAMINER HEARING

IN THE MATTER OF:

Application of Tesoro Petroleum Corporation for a pilot caustic flood project, McKinley County, New Mexico.

CASE 7070

BEFORE: Richard L. Stamets

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division:

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I N D E X

E X H I B I T S

MR. STAMETS: Call next Case 7070.

MR. PADILLA: Application of Tesoro Petroleum Corporation for a pilot caustic flood project, McKinley County, New Mexico.

MR. KELLAHIN: I'm Tom Kellahin of Santa Fe, New Mexico, appearing on behalf of the applicant, and I have one witness to be sworn.

(Witness sworn.)

TRAVIS CROW

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. Would you please state your name and occupation?

A. My name is Travis Crow, Reservoir Engineer for Tesoro Petroleum Corporation.

Q. Mr. Crow, have you previously testified before the Division as a reservoir engineer?

A. No, I have not.

Q. Would you explain for the Examiner when

and where you obtained your degree?

A. I received a Bachelor of Science degree in petroleum engineering from Louisiana State University, January of 1960.

Q. Subsequent to graduation where have you been employed, either as a petroleum engineer or as an engineer specializing in reservoir engineering?

A. I worked as a pipeline engineer for Texas Eastern Transmission Corporation from 1962 to 1965.

I worked as a production engineer and reservoir engineer for Mobil Oil Corporation from 1965 through 1969.

I worked as a reservoir engineer for CORE Laboratories from 1969 through 1976, and have since been employed as a reservoir engineer for Tesoro.

Q. Pursuant to your employment as a reservoir engineer for Tesoro, have you made a study of the possibility of implementation of a pilot caustic flood project in the Hospah Field in McKinley County, New Mexico?

A. Yes, I have.

Q. And pursuant to that study have you prepared certain exhibits?

A. Yes, I have.

MR. KELLAHIN: We tender Mr. Crow as an

expert reservoir engineer.

MR. STAMETS: The witness is considered qualified.

Q. Mr. Crow, we have presented to the Examiner a written summary outlining the -- in a general way, the proposed caustic flood pilot project, and then in your package of exhibits and testimony is a list of the exhibits followed, then, by Exhibit Number One. I'd like to direct your attention to Exhibit Number One and before we go into detail about how you propose to set up your pilot project, I'd like for you to give us a general description of why you have elected a caustic flood project for the Seven Lakes Sand formation of the Hospah formation.

And give us a general overall picture of the different types of pilot projects you've studied and why you have selected this particular one.

A. Yes. In the summary that precedes the exhibits I state that the objectives of this project is to establish the presence of a mobile oil phase in the Seven Lakes Sand; it is to evaluate the reservoir fluid properties and the effect of caustic solutions on those properties; to evaluate the displacement process in core samples, and the effect of caustic solutions on displacement; to evaluate the feasibility of treating produced water; to confirm laboratory

findings by pilot flooding; to evaluate the economic feasibility of a caustic flood process in the Seven Lakes Sand; and to expand the caustic flood process over the field area, if warranted by findings.

And considering the Seven Lakes Sand for oil recovery, we found that there was no evidence to substantially support the idea that there is a mobile oil phase present. We recognize the possibility that there is a mobile oil phase present and that this was not determined in our core studies due to the fact that any mobile oil may have been flushed by the drilling fluids.

So the only data we have indicates a residual oil saturation. We feel like we should direct our efforts toward recovering a residual oil saturation rather than a mobile oil saturation because of the likelihood that no mobile oil is present. We considered other types of tertiary projects. For example, we considered a mycellar (sic) polymer flood, but determined that the economics of such a flood would not make that type of project feasible.

We considered a thermal project, but we felt that the low saturation of oil that we expect to find in this sand would preclude that sort of operation.

For this reason we decided that the caustic flood might offer us the opportunity to recover resi-

dual oil and still retain a rather low cost for the project.

Q Would you describe generally the geology of the Seven Lakes Sand in the Upper Hospah formation in the area of the pilot?

A Yes, may I refer to Exhibit Nine?

Exhibit Nine is a structure map showing the top of the Seven Lakes Sand. The project area is located in Section 1 of Township 17 North, Range 9 West. It's located in the northwest quarter -- correction, in the northeast quarter of the southwest quarter of Section 1. The reservoir that we are testing is structurally controlled and is located in a horst on the northern plunge of an anticline, which generally makes up the Hospah Field area.

This is a fine grained sandstone with slight calcium cementation; porosity of 28-1/2 percent; permeability of about 270 millidarcies, average.

Q Would you identify for us the lines of fault that cross through this area?

A Yes. Diagonally, running from northeast to southwest across Section 1 is a fault which is downthrown to the southeast.

Running across the northwest corner of the section is a tentative fault downthrown to the northwest. This is the horst structure that I described earlier.

To the southeast of the project area is a graben. We feel that the fault separation between the graben and the horst is sufficient to prevent fluid migration.

Q Would you explain to us why you have chosen this particular location at which to install a pilot project?

A. Yes. We do have some indication that there is oil present within this fault block. The particular location within the fault block was selected to provide us a maximum of area without interference with other wells which are producing in the field; that is, we tried to stay away from productive wellbores.

We also felt that by placing the pattern near the fault, this would provide us a certain amount of control over fluid migration.

Q Would you direct your attention to Exhibit Number One? Would you identify the pattern to be used for the pilot project, including identifying for us the location of those particular wells?

A. Yes. Exhibit One illustrates a 1/16th of Section One, being the northeast quarter of the southwest quarter of Section 1, Township 17 North, Range 9 West.

In the northwest corner of that 1/16th section we've illustrated a 1-acre normal 5-spot flood pattern,

consisting of one injection -- or correction, of one production well, located 330 feet from the line of that 1/16th section, both from a north line and from the west line.

In addition there are 4 injection wells located at the corners of the flood pattern. The northwestern-most well is located 225.6 feet from the corner of that 1/16th section.

Q Do you have an estimate at this time, Mr. Crow, of the anticipated life of the pilot project?

A Yes. We anticipate that the pilot would take a total of 17 to 18 months.

Q Do you have any particular order to the drilling of the five wells identified in the pilot project?

A Yes. In the brief discussion preceding the exhibits we indicate that a general procedure will be to drill, core, and complete a production well; install test equipment and test that particular well; to drill, core, and complete the four injection wells; and to core those wells, as well.

Q What is the depth of the Seven Lakes Sand in this area?

A The depth varies. We expect at this particular location that we should see the sand at about 300 feet.

Q And what is the gross thickness of this sand?

A If I can refer to Exhibit -- what is the exhibit of the type log? Exhibit Four?

Exhibit Four is a type log taken from Well No. 55, which offsets the pattern approximately a quarter of a mile to the northeast. It shows that we expect the sand to have a gross thickness of about 40 feet and a net thickness of about 30 feet.

Q Would you describe for us the general procedures of implementing the pilot project after the wells have been drilled?

A Yes. Again referring to the description provided with the exhibits, following the drilling of the wells we would test each of the production and injection wells to determine their productivity and injectivity.

We would recover any produced fluids for laboratory studies, as well as cores for laboratory studies.

We would install surface facilities required to lift, treat, and store produced fluids, including pumping unit, flow lines, free-water knockout, and other oil-water dehydration or demulsification equipment as needed.

We would install caustic -brine injection facilities; supply water treating and softening facilities,

as necessary, and injection pumps and lines.

Once the installation is complete, we would begin the injection of a softened water pre-flush into the four injection wells. The pre-flush would consist of approximately 13,000 barrels of 1.0 percent by weight of sodium chloride. This would be injected into the four wells at a total rate of about 172 barrels per day with an injection pressure of about 60 psig.

Q What's the purpose of the pre-flush, Mr. Crow?

A In the caustic flood process it is necessary to remove any divilin ions (sic) which might be present in the reservoir. These are generally calcium or magnesium ions. The softened water would have these particular ions removed and would tend to flush out any naturally occurring ions from the reservoir. This is -- this is due to the fact that these divilin (sic) ions would be detrimental to the operation of the flood.

Q Are you familiar with the policy of the Oil Conservation Division limiting injection pressures?

A Yes, I am.

Q And do you anticipate that you'll be able to comply with the policy of limiting injection pressures to no greater than 0.2 psi per foot?

A. AT this time we anticipate no problems with that.

Q. All right. After the pre-flush process is completed, describe for us generally the volumes of caustics to be injected into the formation.

A. In terms of total volumes we expect to inject 9100 pounds of caustic material into the formation during the caustic slug phase. This would be, again, as one tenth of one percent of the total solution.

Following the caustic slug we would inject a caustic brine solution into the four injection wells. This solution would consist of one tenth of one percent by weight of sodium hydroxide and one percent by weight of sodium chloride, and would consist of approximately 51,000 barrels of solution over a period of ten months, and during this phase of injection we would expect to inject 17,850 pounds of caustic material.

In addition to the caustic material, we would inject during the pre-flush and during the caustic brine slug a total of 224,000 pounds of sodium chloride.

Q. Your Exhibit Number One shows that the pilot project is a 1-acre pattern?

A. That's correct.

Q. Do you have any estimates at this time

as to the number of total acres that may be affected by the pilot project?

A. We have designed our injection volumes assuming that we might flood a total of two acres.

Of course, if breakthrough occurred more rapidly than we -- than the design, the affected area would be less.

Q. Can you identify for us the procedures that could be implemented to monitor the pilot project to assure that the project remains confined to a given area?

A. Yes, we have two procedures in mind. One would be that at the time of drilling the production and injection wells we would test the wells for productivity of fresh water. If there is no productivity, or if the productivity is low, we would expect this to be an indication that this is a static aquifer rather than a dynamic aquifer.

During the conduct of the pilot we would, in addition, monitor certain offset wells from the pilot area; observe the casing pressure in order to see if any changes indicate that the injected fluids may be reaching these particular wells. At the time that we observe any evidence of fluid migration we would take corrective action with that particular well.

Q. Are you aware of any indication now that the aquifer encountered in the Seven Lakes Sand is in

movement?

A. We have no indication that it is moving in this area. In fact, our records indicate that when Well 55 was drilled a test was attempted and no production was made; however, in other parts of the formation in other areas there could be aquifer dynamics.

Q. If you'll turn to Exhibit Number Two, which is the large plat, I'd like to ask you some questions about that.

MR. STAMETS: Could I ask one question on Exhibit One before we move on?

You're talking about monitoring offset producers. Which wells on Exhibit One would be monitored?

A. Okay, I may have indicated producers, but in fact on the exhibit there are two producers which we can use, Well No. 13 and Well No. 39. In addition there are two injection wells, Well No. 60 and Well No. 94.

MR. STAMETS: And those will be monitored as well?

A. Yes.

MR. STAMETS: Thank you.

Q. While we're looking at Exhibit Number One, you've shown some actual footage locations on the plat. Have those locations been surveyed in?

A. Some locations have been surveyed in this general area, but there may be some slight variations from the plat due to terrain problems.

Q. When do you anticipate having the actual surveyed footages available for the Division?

A. That information has been requested today. I do not have a time; should be within the near future.

MR. KELLAHIN: If the Examiner please, I assume the order will contain the approval of the wells at particular footage location.

MR. STAMETS: How about approximate footage location?

MR. KELLAHIN: Fine. I point to the problem because they're being surveyed now and they may vary slightly from those indicated on the exhibit and we would not want to get locked into an order that didn't have some flexibility, or at least hold the order until we could survey the locations in and give you those numbers.

MR. STAMETS: Okay. Tesoro owns all the offest acreage, don't they?

MR. KELLAHIN: Yes.

MR. STAMETS: Okay, either do that or say within 100 feet.

Q. Will that do it?

A. Yep.

Q. Okay. Would you turn to Exhibit Number Two? Would you identify generally what information is contained on Exhibit Two?

A. Yes. Exhibit Two is a location map showing the general field area of Hospah Field. It indicates units outlined as the Upper Hospah Sand Unit, which Tesoro operates; the South Hospah Sand Unit, which Tenneco operates; the Lone Pine Dakota "D" Unit, which Tenneco operates; and I'm not sure, but this unit may be shut-in at this time.

Q. What's the purpose of the circles?

A. Two circles are shown. One is a one-half mile radius from the pattern area; the other is a two-mile radius from the pattern area. These circles are required exhibits for our testimony.

Q. Would you locate for us the area for which Tenneco received an order to institute a fireflood project in Section 12?

A. Yes. I don't have the exact location, but it is located in Section 12 within the South Hospah Sand Unit.

Q. Now while we're looking at this exhibit, Mr. Crow, have you been able to identify any water wells that produce from the Seven Lakes Sand formation?

A. Yes, I have. Mr. Steve Hudson of Tenneco supplied us with information to indicate that they have a fresh water well operating within the South Hospah Sand Unit area. It's located in Section 12, 17 North, 9 West, 2445 feet from the north line, 2920 feet from the east line.

It's completed at a depth of 550 to 600 feet; has a total depth of 674 feet; is producing 2-1/2 gallons a minute on submersible pump.

And this is used for local consumption.

Q. Are you aware of any other fresh water wells in the area that produce from the Seven Lakes formation?

A. I have no information on other wells in that sand.

Q. What is the principal aquifer in the area from which domestic water supplies are obtained?

A. Our water supply is the Morrison formation, which is at a depth of about 3100 feet.

Q. Is the Morrison formation also the source of the water to be used in the caustic plant?

A. Yes, it is.

MR. KELLAHIN: If the Examiner please, we have checked the records of the State Engineer. They do not indicate permits or the existence of any water wells producing in any formation in this area, including the Tenneco

well or the Tesoro well, just no records of it at all.

Q. Now with regards to the Tenneco water well to the south, Mr. Crow, what if any risk is posed to that well by the implementation and approval of the proposed pilot project?

A. In my opinion there is no risk through contamination of that particular well for two reasons.

One reason is that we have identified at least two faults separating the pilot area with the water well which is located approximately one mile south of the pilot project.

In addition, the pilot is of such size that it seems highly unlikely that the total amount of fluid we'll be injecting will ever reach that area. We're talking about flooding at the most a two-acre area and this well is located approximately a mile away.

Q. Would you refer to Exhibit Number Three and tell us what that exhibit is?

A. Exhibit Three is a tabulation of wells that are located within a one-half mile radius of the pattern area. Also indicated on the Exhibit Two a circle which is labeled one-half mile radius.

The tabulation shows the operators, well names, locations, size of casing, depth to which casing was

set; volume of cement used to set casing; tops of cement where known; total depth; producing interval and status in producing formations in the wells.

Q Now with regards to the tabulation of the existing wells within the half mile radius, in your opinion is there any risk that the fluids from the pilot project will migrate outside of the pilot area and use any of these wellbores or wells to have fluids migrate out of the zone of injection?

A. I think the likelihood that that would occur would be very low. Again, the wells most in danger from contamination or this flood would be monitored. They are, in fact, the wells that we will be checking.

Q These are all wells operated by Tesoro?

A. That's correct.

Q And you would be monitoring these wells?

A. That's correct.

Q And if --

A. Let me clarify that. I'm not stating that we'll monitor every well shown on the tabulation, but rather the wells previously indicated.

Q I understand. In your opinion is the monitoring of those four wells adequate to insure that the

fluids will remain confined to the area and will not migrate out through any of these other wells beyond the area of the monitoring?

A. I think that by monitoring these four wells plus the other factors considered, particularly the size of the flood, the fact that we have a -- we will establish a pressure sink in the center of the pattern area, will afford us sufficient security with regard to fluid migration.

Q. In fact one of the purposes of the pilot, is it not, Mr. Crow, to demonstrate what remedial action, if any, will be required in order to protect other zones in these offset wells?

A. That's correct.

Q. Now you've talked to us about Exhibit Number Four. Would you turn to Exhibit Number Five? Would you identify that and tell us what it is?

A. Exhibit Five is a wellbore schematic showing an injection well as we propose to complete it in the pilot flood. It indicates that we would set 7-inch casing to a depth of approximately 291 feet. It would be cemented to the surface. Inside that 7-inch string of casing we would run a 4-1/2 inch casing string, which would be cemented to approximately 30 feet up into the 7-inch casing.

That in a case that perforations were

to be made over an interval of 291 to 321 feet, which would be Seven Lakes Sand, and that tubing would be set with a packer at a depth of 276 feet above the injection interval.

Q. Would you refer to Exhibit Number Six and identify that?

A. Exhibit Six is a wellbore schematic of a production well. Generally the well completion is the same as an injection well, the only difference being that tubing would be run to the mid-point of the perforations at a depth of 315 feet.

Q. Okay. Now in compliance with Commission requirements for an application of this nature, have you submitted an application that shows wellbore schematics of all plugged and abandoned wells within a half mile radius of the pilot?

A. Yes, Exhibit Seven includes wellbore schematics of all plugged and abandoned wells within that radius.

Q. Let's turn to Exhibit Number Eight. Would you identify Exhibit Eight for us?

A. Exhibit Eight is a laboratory analysis report provided by CORE Laboratories. It reports on a compositional analysis of a water sample taken from our water supply well.

Q Where is your water supply well?

A I'm sorry, I don't have the location. I would ask Mr. Parks about that.

Q Say again?

MR. PARKS: 53-Y.

MR. KELLAHIN: 53-Y is your water well?

MR. PARKS: (Inaudible)

MR. KELLAHIN: Here it is.

Q The water sample was taken from your water supply well, which is 53-Y, is it?

A Yes, and it's located in Section 36 in the southeast quarter of -- correction, in the southwest quarter of the southeast quarter.

The producing interval from that well is the Morrison formation at a depth of 3100 to 3200 feet. It indicates that total dissolved samples from the sample were 774 milligrams per liter.

Q This is the water analysis of the water to be used for the pilot?

A That's correct.

Q Do you have any indication of the quality of the water that now exists in the Seven Lakes Sand?

A We have no data on that.

Q Okay. Except for the fact that Tenneco

does operate a drinking water well in --

A. Yes, we recognize that this is a fresh water sand.

Q. In your opinion, Mr. Crow, will approval of this application be in the best interests of conservation, the prevention of waste, and the protection of correlative rights?

A. In my opinion, yes, sir.

Q. In your opinion is the installation of a pilot project of this nature necessary in order to determine the feasibility of enhanced recovery of hydrocarbons from the Seven Lakes formation?

A. Yes, it is.

Q. Were Exhibits One through Nine compiled by you or prepared under your direction and supervision?

A. Exhibit Nine, which is the structure map of the sand was not prepared under my direction or supervision but by our geological staff.

Exhibit Three, which is a tabulation of wells within one-half mile radius was partially completed by myself and partially by our Denver production office.

Q. Have you reviewed the tabulation of Three to determine in your own mind that it's accurate and correct to the best of your knowledge?

A. Yes, sir.

Q And with regards to Exhibit Number Nine, have you studied the geology indicated on that plat and is it true and correct to the best of your knowledge?

A. Yes, it is.

MR. KELLAHIN: We move the introduction of Exhibits One through Nine.

MR. STAMETS: These exhibits will be admitted.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Crow, will you determine during the course of this project or at the end of it, the effect of the caustic solution on the formation, formation fluids, and also the nature of the residues left in the reservoir?

A. Yes, we will. Part of the project will be to run numerous laboratory studies on core samples which should provide that information.

We expect that the residue that would be left from the caustic material would consist of calcite and magnesium sulfate. These are innocuous materials which are handled in California in the Wilmington Field by using them as landfill, so we feel there would be no problem with

the residue material.

Q. Okay, and then you indicated you will be testing the wells upon completion, gathering information on fluids in the reservoir.

A. That's correct.

Q. I believe you indicated you also would attempt to make determination of whether you've got fluid in motion --

A. That's correct.

Q. Would Tesoro be willing to submit a final report which outlines the results of -- of these tests for this particular information?

A. Yes, we would.

Q. Is there any shallower ground water in the area of the pilot project?

A. I'm not aware of any.

Q. Now, just briefly looking at, I think, what you've identified as Exhibits Three and Four, the well summary. I guess it's not Three and Four. It would be Exhibit Three and Seven. It would appear as though if we were talking about a typical waterflood covering all of the territory in side the half a mile circle, that there would be a lot of wells which were not adequately cemented or plugged, but since this is going to be a small, one-acre pilot project, you

would not expect these fluids to reach any such wells, is that correct?

A. No. That is one reason for using the pilot approach. We would be able to better evaluate the effect of the pilot on these wells and make a decision at the proper time as to whether the full scale operation would be feasible.

MR. STAMETS: Any other questions of the witness?

MR. CHAVEZ: I have just one.

CROSS EXAMINATION

BY MR. CHAVEZ:

Q. What is the displacement along that fault to the south of the proposed project?

A. From the structure map, Exhibit Nine, it appears the displacement would be about fifty feet -- I'm sorry, about 90 feet.

Q. And so far it's been shown that that fault seals at the Hospah. Is there any indication at all that you've seen so far that the seal is not -- it may not seal up at shallower depths?

A. I don't have any data that would state either way, really.

Q. What is the monitoring system you'll use to monitor the Wells Nos. 44 and 39 that you said you would monitor for --

A. Yes, we would observe casing pressure, casing annulus pressure.

Q. It would be by gauge, I guess --

A. Yes.

Q. -- instead of examining?

A. That's correct.

Q. What effect will, say, if your pre-flush is -- isn't totally effective, what will the presence of these divalent (sic) ions that you're talking about have on your caustic flood? What would be the chemical reaction?

A. Right, it would tend to render the caustic ineffective. The -- the process depends upon a particular interfacial tension of about a thousandth of a dyn per centimeter square -- or per centimeter.

It's sensitive to the concentration of caustic material. If you go below or above that significantly you can nullify the effect. The divalent (sic) ions can alter the concentration and therefor be detrimental to the actual formation of the emulsion which is required in this process.

Q. Do you expect any type of precipitants

to, say, flood off the formation in those areas?

A. That is possible. The precipitants might be calcite or magnesium sulfate, which is essentially limestone.

MR. STAMETS: Any other questions for the witness? He may be excused.

Anything further in this case?

Identify yourself, please, for the record.

MR. STROBL: My name is Glenn Strobl with Tenneco Oil Company.

As mentioned, we do produce fresh water from a geologically correlatable sand in our South Hospah Field. We do not feel that this pilot will be a threat to our water well and therefor are not opposed to it.

We trust that if this or any future chemical flood is approved, that our water well will be safe.

MR. STAMETS: Anything further in this case?

The case will be taken under advisement.

(Hearing concluded.)

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

_____

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. _____, heard by me on _____ 19____.

_____, Examiner
Oil Conservation Division

PROPOSAL FOR A CAUSTIC FLOOD PILOT
HOSPAH FIELD

Tesoro Petroleum Corporation proposes to install and operate a caustic flood pilot in the Hospah field, Mc Kinley County, New Mexico. The purpose of the pilot is to evaluate the feasibility of the caustic flood process in the shallow Seven Lakes sand. The objectives are:

1. To establish the presence of a mobile oil phase in the Seven Lakes sand.
2. To evaluate reservoir fluid properties and the effect of caustic solutions on those properties.
3. To evaluate the displacement process in core samples and the effect of caustic solutions on displacement.
4. To evaluate the feasibility of treating produced water.
5. To confirm laboratory findings by pilot flooding.
6. To evaluate the economic feasibility of a caustic flood process in the Seven Lakes sand.
7. To expand the caustic flood process over the field area if warranted by findings.

The Hospah field currently produces from the upper Hospah sand of Upper Cretaceous age. Tesoro operates the field as the Hospah Sand Unit waterflood.

The shallow, Upper Cretaceous, Seven Lakes sand has not been successfully tested at Hospah but has produced in the area in the Seven Lakes field which is located about 15 miles west-northwest of Hospah. Available core data establish only that a residual oil saturation is present. The trapping mechanism is a horst located on the northern plunge of an anticline. The sand has an average porosity of 0.285 and an average permeability of 270 md as determined by core analysis. By analogy with the Seven Lakes field, the oil is expected to be gas free and to have a gravity of 30.5° API.

Cores of the Seven Lakes sand in the pilot area had an average oil saturation of 21.1 percent. It is expected that this saturation has been affected by the flushing of the drilling fluids used and that the in-place oil saturation is somewhat higher. If the actual saturation is as much as 30 percent, the initial oil in place would be 650.3 STB/acre-ft. A caustic flood might be expected to produce 25 percent of this residual oil or 162.6 STB/acre-ft. This represents a potential of 766,000 STB of oil from a fully developed project.

The following procedure describes the installation and operation of a mini-pilot flood project to test and evaluate the caustic-flood process for the Seven Lakes sand. The sand occurs at a depth of about 300 feet. The pattern is a one-acre normal five-spot consisting of one production well and four injection wells.

The general procedure is:

1. Drill, core, and complete a production well in Sec. 1-T17N-R9W at the location described (see Exhibit 1). Core the interval of interest (30 ft) and preserve and freeze the core for laboratory analyses.

2. Install test equipment and test producing well to establish productivity and nature of produced fluids. Sample any produced fluid for laboratory analyses.

3. Drill, core, and complete four injection wells at locations 147.6 ft from the production well at the locations described (see Exhibit 1). Core the intervals of interest (30 ft each) and preserve and freeze the cores for laboratory analyses.

4. Conduct pressure falloff tests of injection wells to determine injectivity of each. Stimulate wells as needed to remove any wellbore damage. Run a production log over the sand interval to define the initial injection profile.

5. Install surface facilities required to lift, treat, and store the produced fluids including pumping unit, flowlines, free-water knockout, and other oil-water dehydration or demulsification equipment as needed.

6. Install caustic-brine injection facilities; supply water treating and softening facilities as necessary; and injection pumps and lines.

7. Inject a softened water pre-flush into the four injection wells. Chemical tracers will be injected during this phase to investigate flood pattern development and time of breakthrough of the pre-flush slug. The pre-flush will consist of approximately 13,000 bbl of 1.0 percent by weight of sodium chloride (NaCl). The estimated injection rate into four wells is 172 BPD with an injection pressure of 60 psig. The estimated pre-flush injection period is 2.5 months.

8. Inject caustic slug into the four injection wells. Chemical tracers will be injected with the slug to observe breakthrough patterns and times. Periodic injection profiles and production profiles will be taken to monitor changes in vertical efficiency. The slug will consist of approximately 26,000 bbl of 0.1 percent by weight of sodium hydroxide (NaOH). The estimated caustic slug injection period is five months.

9. Inject caustic-brine solution into the four injection wells. The solution will consist of 0.1 percent by weight of NaOH and 1.0 percent by weight of NaCl. Approximately 51,000 bbl of the solution will be injected over a period of ten months.

10. Injection wells will be acidized as needed to maintain injection rates.

11. During the pilot test period, laboratory studies will be conducted to investigate the entrapment and entrainment mechanisms of caustic flooding. Tests will also be made to determine the methods to be used in dehydrating the produced emulsion and in treating the produced water for reinjection.

A one-acre pattern has been selected for the pilot to minimize the time required to evaluate the process and to limit the field area affected by the injected fluids. If one-half of the injected fluid is lost outside the pattern area, only two acres of the field would be swept. This represents an average radial distance of 295 ft from the production well. The nearest existing wellbore is Hospah Sand Unit No. 13, which is located 482.5 ft from the proposed production well. The casing annuli of those wells offsetting the pattern will be monitored for pressure changes or other

evidence of influence by the injected fluids. If such evidence is noted, Tesoro will take necessary action to prevent wellbore communication with other sands. This would include squeezing the affected annulus with cement from the Seven Lakes interval to the surface.

The source of the injection water supply is the Morrison formation at a depth of 3,100 to 3,200 ft. This sand is currently supplying fresh water for injection into the upper Hospah sand. A typical water analysis is shown by Exhibit 8. The Seven Lakes sand is believed to contain fresh water but no analysis is available.

LIST OF EXHIBITS

PROPOSAL FOR A CAUSTIC FLOOD PILOT

HOSPAH FIELD

1. Location Plat, Proposed Caustic Flood Pilot

2. Proposed Location, Caustic Flood Pilot

3. Tabular Summary of All Wells Within a One-Half Mile Radius of Proposed Injection Wells

4. Type Log (Well No. 55)

5. Wellbore Schematic, Caustic Flood Injection Well

6. Wellbore Schematic, Caustic Flood Production Well

7. Wellbore Schematics of All Plugged and Abandoned Wells Within a One-Half Mile Radius of Proposed Injection Wells

8. Water Analysis, Water Supply Well

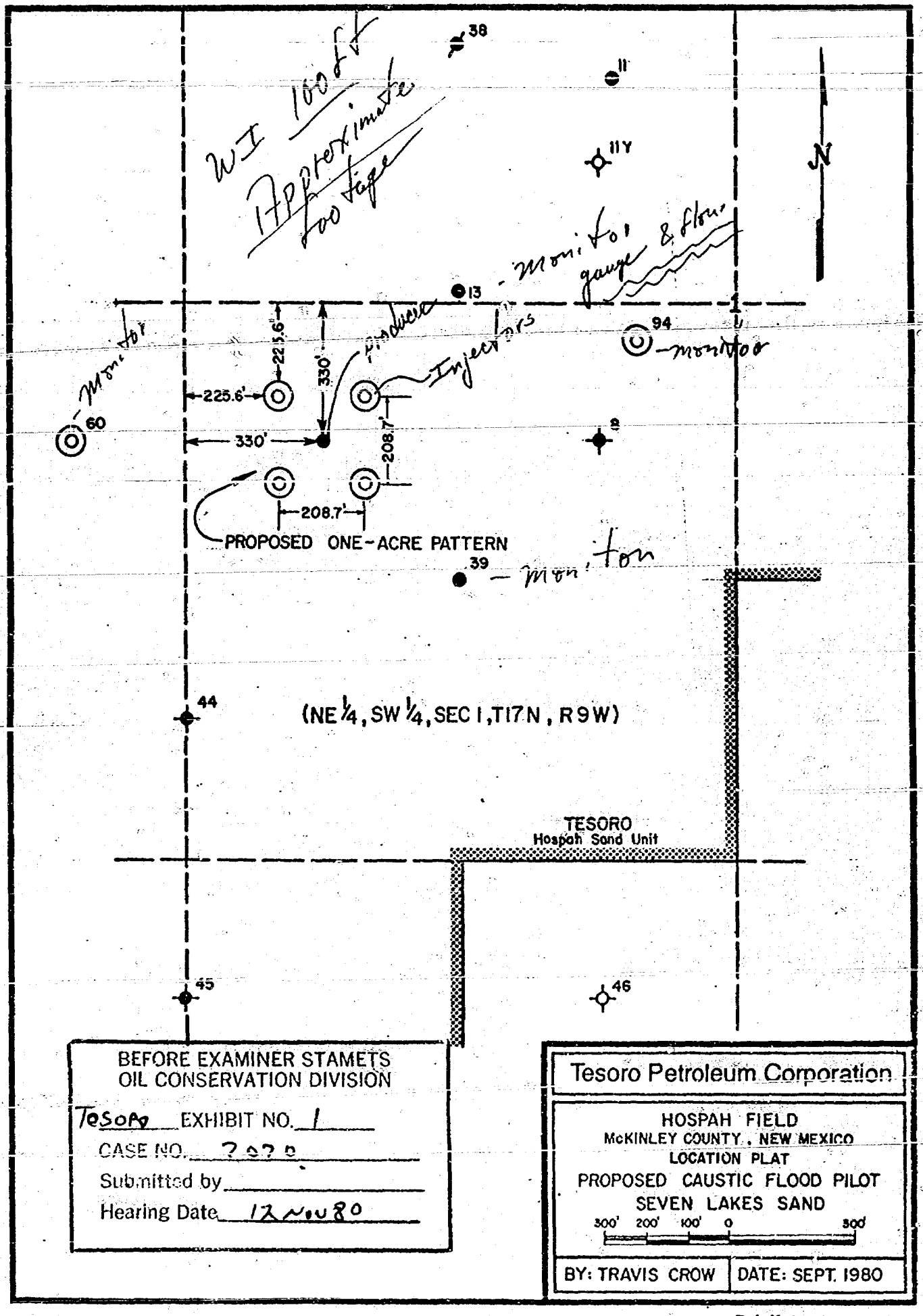


Exhibit 1
Page 1 of 2

LOCATION PLAT

Production well 330 ft from the west line and 330 ft from the north line of the NE 1/4 of the SW 1/4 of Sec. 1-T17N-R9W.

Injection well 225.6 ft from the west line and 225.6 ft from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Sec. 1-T17N-R9W.

Injection well 434.3 ft from the west line and 225.6 ft from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Sec. 1-T17N-R9W.

Injection well 434.3 ft from the west line and 434.3 ft from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Sec. 1-T17N-R9W.

Injection well 225.6 ft from the west line and 434.3 ft from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Sec. 1-T17N-R9W.

SUMMARY OF ALL WELLS WITHIN A ONE-HALF MILE RADIUS OF PROPOSED INJECTION WELLS
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Pet. Prod. Co.	#24	SE-NE Sec 2-17N-9W	--	--	--	--	--	P & A	--
Tenneco	Hotchkiss #1	NE-SE Sec 2-17N-9W	--	--	--	--	--	P & A	--
Tesoro	HSU #2	SE-NW Sec 1-17N-9W	8 5/8"	1528'	75 sx	1340'	1576'	1528'-76'	U. Hospah
Tesoro	HSU #4	NE-NW Sec 1-17N-9W	7"	1611'	70 sx	1400'	1611'	P & A	--
Tesoro	HSU #4Y	NE-NW Sec 1-17N-9W	8 5/8" 5 1/2"	74' 1556'	60 sx 150 sx	surface 620'	1581'	1556'-81'	U. Hospah
Tesoro	HSU #5	NE-NW Sec 1-17N-9W	14" 6 5/8"	80' 1604'	16 sx 75 sx	50' 1300'	1604'	1552'-65'	U. Hospah
Tesoro	HSU #6	NE-NW Sec 1-17N-9W	11" 7"	20' 1538'	155 sx 70 sx	surface 1230'	1582'	1538'-82'	U. Hospah
Tesoro	HSU #8	NE-SW Sec 1-17N-9W	12 1/2" 7"	22' 1533'	10 sx 50 sx	surface 1300'	1578'	P & A	--
Tesoro	HSU #9	NW-SE Sec 1-17N-9W	10" 7"	17' 1535'	10 sx 40 sx	surface 1350'	1570'	1535'-70'	U. Hospah
Tesoro	HSU #11	SE-NW Sec 1-17N-9W	12" 7"	22' 1522'	12 sx 50 sx	surface 1280'	1550'	P & A	--
Tesoro	HSU #11Y	SE-NW Sec 1-17N-9W	8 5/8" 5 1/2"	73' 1538'	60 sx 150 sx	surface 590'	1563'	1538'-63'	U. Hospah
Tesoro	HSU #12	NW-NE Sec 1-17N-9W	10" 7"	21' 1535'	12 sx 45 sx	surface 1320'	1580'	1535'-80'	U. Hospah
Tesoro	HSU #13	SE-NW Sec 1-17N-9W	10" 7"	22' 1530'	15 sx 50 sx	surface 1300'	1561'	1530'-61'	U. Hospah

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
Tesoro EXHIBIT NO. 3
CASE NO. 2070
Submitted by
Hearing Date 12 Aug 80

SUMMARY OF ALL WELLS WITHIN A ONE-HALF MILE RADIUS OF PROPOSED INJECTION WELLS
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

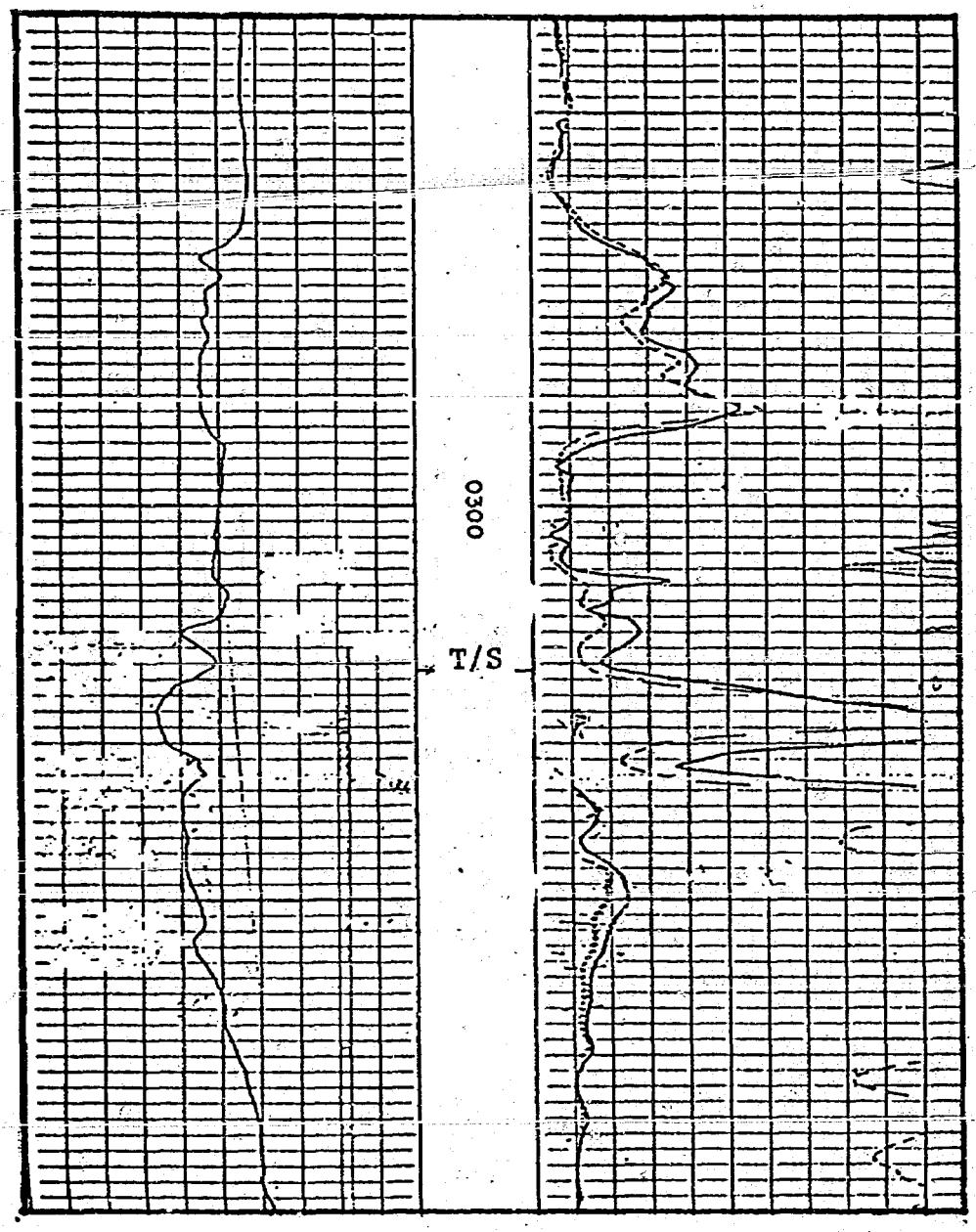
Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	HSU #21	SE-NW Sec 1-17N-9W	7"	1547'	40 sx	1360'	1591'	1547'-85'	U. Hospah
Tesoro	HSU #22	NE-NW Sec 1-17N-9W	7"	1553'	41 sx	1360'	1595'	1553'-95'	U. Hospah
Tesoro	HSU #23	NW-NE Sec 1-17N-9W	5 3/8"	1528'	75 sx	1200'	1570'	1528'-70'	U. Hospah
Tesoro	HSU #24A	SW-NE Sec 1-17N-9W	5 3/8"	1512'	75 sx	1190'	1552'	1512'-52'	U. Hospah
Tesoro	HSU #38	SE-NW Sec 1-17N-9W	5 1/2"	1557'	50 sx	1250'	1565'	1557'-65'	U. Hospah
Tesoro	HSU #39	NE-SW Sec 1-17N-9W	--	-	--	--	1557'	--	--
Tesoro	HSU #44	NE-SW Sec 1-17N-9W	5 1/2"	1554'	75 sx	--	1572'	P & A	--
Tesoro	HSU #45	SE-SW Sec 1-17N-9W	5 1/2"	1634'	85 sx	--	1818'	P & A	--
Tesoro	HSU #51	NW-NE Sec 1-17N-9W	7"	1532'	50 sx	1340'	1576'	1532'-76'	U. Hospah
Tesoro	HSU #52	SW-NE Sec 1-17N-9W	7"	1514'	50 sx	1330'	1526'	1514'-26'	U. Hospah
Tesoro	HSU #55	SW-NE Sec 1-17N-9W	4 1/2"	447'	50 sx	surface	450'	310'-48'	Temp. abnd. in Seven Lakes sand
Tesoro	HSU #56	SW-NE Sec 1-17N-9W	8 5/8" 5 1/2"	302' 1694'	200 sx 140 sx	surface 268'	2730'	1514'-42'	U. Hospah
Tesoro	HSU #60	NW-SW Sec 1-17N-9W	7" 4 1/2"	84' 1640'	35 sx 50 sx	surface 1350'	1640'	1559'-90' 1600'-01'	U. Hospah (Inj.)
Tesoro	HSU #61	SW-NW Sec 1-17N-9W	7" 4 1/2"	64' 1700'	35 sx 50 sx	surface 1220'	1715'	1632'-56'	U. Hospah (Inj.)

SUMMARY OF ALL WELLS WITHIN A ONE-HALF MILE RADIUS OF PROPOSED INJECTION WELLS
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	HSU #67	SE-NE Sec 1-17N-9W	7"	83'	35 sx	surface	1636'	1546'-64'	U. Hospah (Inj.)
			4 1/2"	1634'	55 sx	1150'			
Tesoro	HSU #84	SE-NW Sec 1-17N-9W	8 5/8"	70'	50 sx	surface	1574'	1536'-74'	U. Hospah (Inj.)
			4 1/2"	1536'	120 sx	879'			
Tesoro	HSU #85	SW-NE Sec 1-17N-9W	8 5/8"	104'	100 sx	surface	1551'	1535'-51'	U. Hospah
			5 1/2"	1535'	150 sx	450'			
Tesoro	HSU #87	NW-NE Sec 1-17N-9W	8 5/8"	53'	35 sx	--	1590'	1535'-55'	U. Hospah (Inj.)
			5 1/2"	1590'	120 sx	--			
Tesoro	HSU #93	NE-NW Sec 1-17N-9W	8 5/8"	23'	30 sx	surface	1605'	1540'-60'	U. Hospah (Inj.)
			5 1/2"	1632'	125 sx	1100'			
Tesoro	HSU #94	NE-SW Sec 1-17N-9W	8 5/8"	40'	30 sx	surface	1575'	1515'-30'	U. Hospah (Inj.)
			5 1/2"	--	125 sx	1100'			
Tesoro	SF Hurst #1	NW-NE Sec 1-17N-9W	13 3/8"	207'	150 sx	surface	7852'	P & A	--
			9 5/8"	3317'	325 sx	2400'			
Tesoro	SFRR "A" 46	SE-SW Sec 1-17N-9W	--	--	--	--	--	P & A	--
Tesoro	SFRR "A" 73	SW-SE Sec 1-17N-9W	8 5/8"	63'	40 sx	surface	1665'	open hole comp.	L. Hospah
			4 1/2"	1639'	75 sx	1300'			
Tesoro	SFRR "A" 79	SW-SE Sec 1-17N-9W	8 5/8"	67'	50 sx	surface	1624'	open hole comp.	U. Hospah
			5 1/2"	1589'	50 sx	1300'		1589'-1624'	
Tesoro	SFRR "A" 81	SW-SE Sec 1-17N-9W	8 5/8"	62'	50 sx	surface	1655'	open hole comp.	L. Hospah
			5 1/2"	1644'	100 sx	700'		1644'-55'	

SUMMARY OF ALL WELLS WITHIN A ONE-HALF MILE RADIUS OF PROPOSED INJECTION WELLS
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	SFRR "A" 84	SW-SE Sec 1-17N-9W	9 5/8"	95'	100 sx	surface	1656'	open hole comp.	L. Hospah (Inj.)
			7"	1639'	100 sx	---			
Tesoro	SFRR "A" 89	SW-SE Sec 1-17N-9W	8 5/8"	104'	100 sx	surface	1769'	Open hole comp.	L. Hospah
			5 1/2"	1769'	100 sx	500'		1648-54'	
Tesoro	SFRR "A" 57	NW-SE Sec 1-17N-9W	8 5/8"	135'	110 sx	---	2800'	P & A	—
			5 1/2"	1698'	140 sx	---			



BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION

Tesoro EXHIBIT NO. 4

CASE NO. 7070

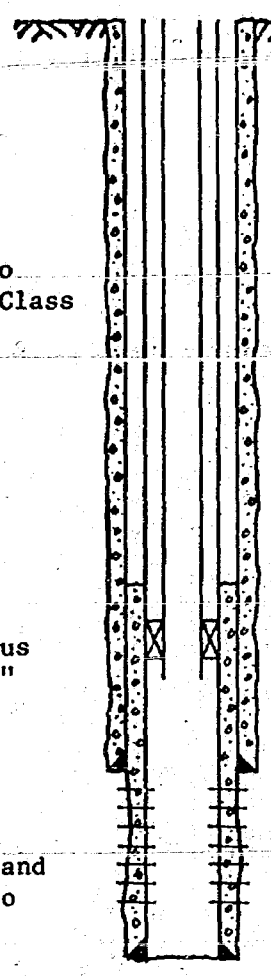
Submitted by

Hearing Date 12Nov80

TYPE LOG

(Well No. 55)
SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 4

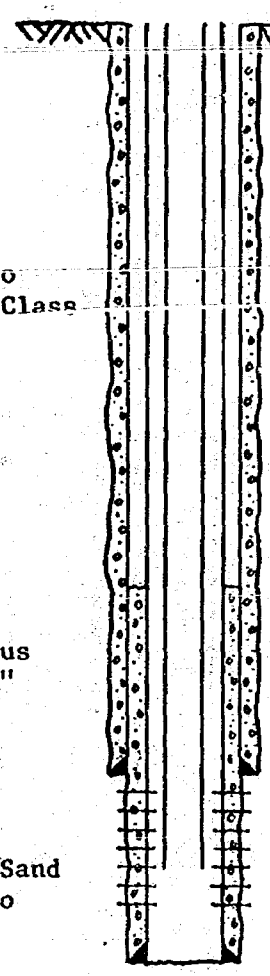


TESORO PETROLEUM CORPORATION
WELLBORE SCHEMATIC
CAUSTIC FLOOD INJECTION WELL

SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
Tesoro EXHIBIT NO. 5
CASE NO. 7070
Submitted by
Hearing Date 12 Nov 80

Exhibit 5



Cement 7-in. annulus to surface with 50 sacks Class "A" neat.

Cement 4-1/2-in. annulus with 10 sacks Class "A" neat.

Perforate Seven Lakes Sand at approximately 291 to 321 ft.

Top of cement: 261 ft

7-in. casing: 291 ft

2-in. tbg: 315 ft

4-1/2-in. casing: 336 ft

TESORO PETROLEUM CORPORATION
WELLBORE SCHEMATIC
CAUSTIC FLOOD PRODUCTION WELL

SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
Tesoro EXHIBIT NO. 6
CASE NO. 7070
Submitted by
Hearing Date 12Nov80

Exhibit 6

Exhibit 7

Well bore Schematics of All Plugged and Abandoned Wells

Within a One-Half Mile Radius of Proposed Injection Wells

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION

Tesoro EXHIBIT NO. 7

CASE NO. 7070

Submitted by

Hearing Date 12 NOV 80

Well: Hospah Sand Unit #8
Field: Hospah
Location: NE 1/4 SW Sec. 1 - T 17N - R 9W
County: McKinley State: N. M.
Zero Elevation: ____ Ft. (____ AGL) GL.
TD: 1578 Ft. PBTD: ____ Ft.

Wellhead: ____

Tubing String: ____

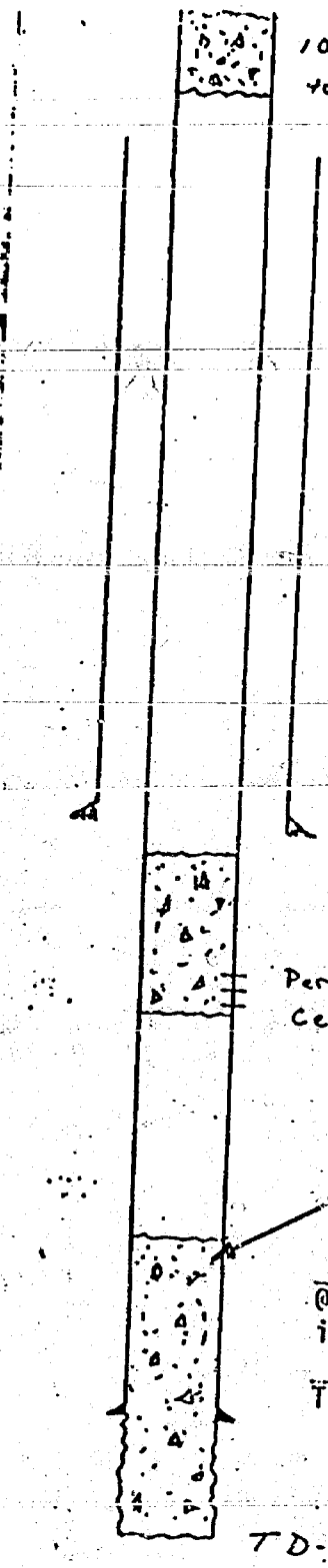
Centralizers: ____

12¼ "OD ____ LB ____ GR. ____ THRD.
@ 22' FT. W/ 10 SX (____ FT3) cmt.
in 15 " hole (CMT. CLASS-ADDITIVES: ____)
T.O.C. @ surface BY: ____

7 "OD 20 LB ____ GR ____ THRD.
@ 1533 FT. W/ 50 SX (____ FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES: ____)
T.O.C. @ 1300' BY: ____

UPDATED BY: KJK DATE: 1/21/80.

✓



10' cement plug @ top of 7" csg.

Well: Hospah Sand Unit # 21
Field: Hospah
Location: SE 1/4 NW Sec. 1 T. 17N R. 9W
County: McKinley State: N.M.
Zero Elevation: ft. (AGL) GL:
TD: 1550 ft. PBTD: ft.

Wellhead:

Tubing String:

Centralizers:

12 "OD LB GR THRD.
@ 22 FT. w/ 12 SX (FT3) cmt.
in 15 " hole (CMT. CLASS-ADDITIVES:)
T.O.C. @ surface BY:

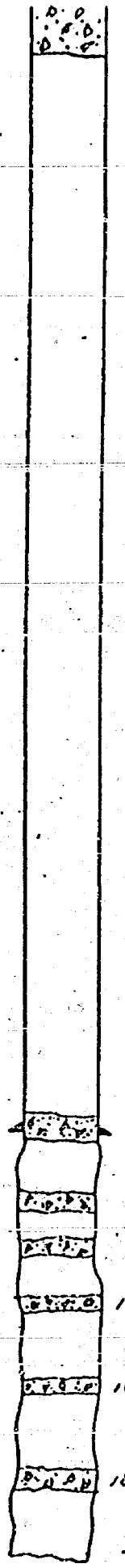
Perforated @ 430'. Squeezed w/ 80 sx cement
Cement Top inside 7" csg. is 277'

25 sk cement plug: 1550' - 1416'

7 "OD LB GR THRD.
@ 1522 FT. w/ 50 SX (FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES:)
T.O.C. @ 1280' BY:

TD: 1550'

UPDATED BY: KJK DATE: 1/21/80



top of csg.

Field: Hospah
Location: NW / NE Sec. 1 - T 17 N - R 9 W
County: McKinley State: N. M.
Zero Elevation: _____ ft. (_____ AGL) GL: _____
TD: 7852 ft. PBTD: _____ ft.

Wellhead: _____

Tubing String: _____

Centralizers: _____

13 3/8" OD _____ LB _____ GR. _____ THRD.
@ 207 FT. W/ 150 SX (_____ FT³) cmt.
in 17½" hole (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ surface BY: _____

9 5/8" OD _____ LB _____ GR _____ THRD.
@ 3317 FT. W/ 325 SX (_____ FT³) cmt.
in 12 1/4" HOLE (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ 2400' BY: _____

10 sk cement plug: 3314' - 3280'

10 sk cement plug: 3750' - 3720'

10 sk cement plug: 4800' - 4770'

10 sk cement plug: 5100' - 5070'

10 sk cement plug: 5500' - 4970'

10 sk cement plug: 7050' - 7020'

TD - 7852'

UPDATED BY: K. T. K. DATE: 1/21/80

✓

Well: Hospah Sand Unit #4
Field: Hospah
Location: NE / NW Sec. 1 - T 17N - R 9W
County: McKinley State: N.M.
Zero Elevation: _____ (_____ AGL.) GL.: _____
TD: 1611 FT. PBTD: _____ FT.

Wellhead: _____

Tubing String: _____

Centralizers: _____

← No Surface Casing

_____ "OD ____ LB _____ GR. _____ THRD.
@ _____ FT. w/ _____ SX (_____ FT3) cmt.
in _____ " hole (CMT. CLASS-ADDITIVES:
_____)
T.O.C. @ _____ BY: _____

10' cement plug @ top of csg.

Perforated @ 499'. Squeezed w/ 80 sx cement. Cement Top inside csg. @ 277'

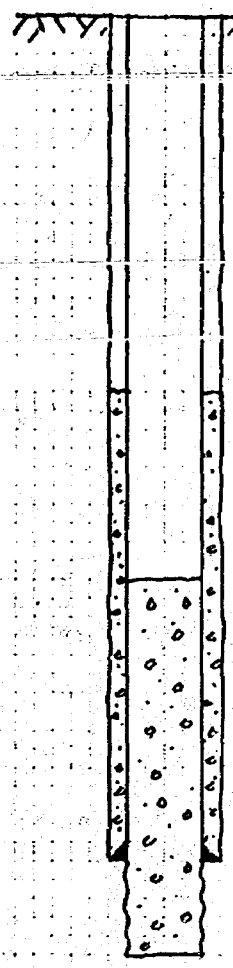
25 sk. cement plug: 1610' - 1481'

7 "OD ____ LB ____ GR ____ THRD.
@ 1611 FT. w/ 70 SX (_____ FT3) cmt.
in 8 3/8 " HOLE (CMT. CLASS-ADDITIVES:
_____)
T.O.C. @ 1400' BY: _____

TD - 1611'

UPDATED BY: K.J.K DATE: 1/21/83

✓



GROUND LEVEL

CSG CEMENTED W/75 SX
TOP OF CEMENT UNKNOWN

P & A 7/46 W/ 25 SX CMT
TOP OF CMT @ 1,354 FT

5-½-IN. CSG @ 1,554 FT

TD 1,572 FT

Wellbore Schematic
Plugged and Abandoned Well
Well No. 44
Hospah Field
Mc Kinley County, New Mexico

GROUND LEVEL

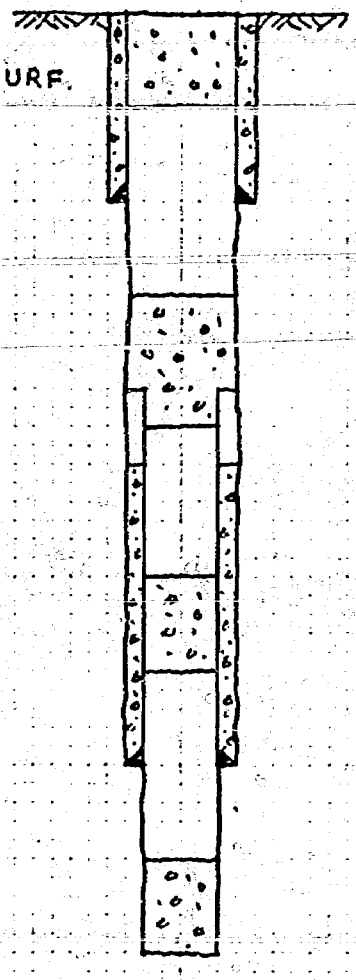
CSG CEMENTED W/ 85 SX
TOP OF CEMENT UNKNOWN

P&A 11/30/45 W/ 50 SX CMT
TOP OF CMT @ 1,214 FT

5-½-IN. CSG @ 1,634 FT

TD 1,818 FT

Wellbore Schematic
Plugged and Abandoned Well
Well No. 45
Hospah Field
Mc Kinley County, New Mexico



10,5 SX CMT @ SURF.

CSG CEMENTED W/110 SX

8-5/8-IN. CSG @ 123 FT

SPOTTED 30 SX CEMENT
883-745 FT

CSG SHOT OFF AT 825 FT

CSG CEMENTED W 140 SX
TOP OF CEMENT UNKNOWN

SPOTTED 15 SX CEMENT
1,644-1,513 FT

5-1/2-IN. CSG @ 1,698 FT

PBTD 1,750 FT
PB W/ 125 SX CEMENT

TD 2,800 FT

Wellbore Schematic
Plugged and Abandoned Well
Well No. 57
Hospah Field
Mc Kinley County, New Mexico

CORE LABORATORIES, INC.
Petroleum Reserve Engineering
DALLAS, TEXAS

WATER ANALYSIS

File IWTL-7117

Company Tesoro Petroleum Corporation Well Name Water supply well Sample No. 1

Formation Morrison Depth 3100' - 3200' Sampled From Hospah sand unit 53

Location ____ Field ____ County ____ State ____

Date Sampled ____ Date Analyzed 3-11-71 Analyst RAL

Total Dissolved Solids 774 mg/L calculated

Specific Gravity 0.9993 @ 60° F. / 0.9965 @ 74 °F.

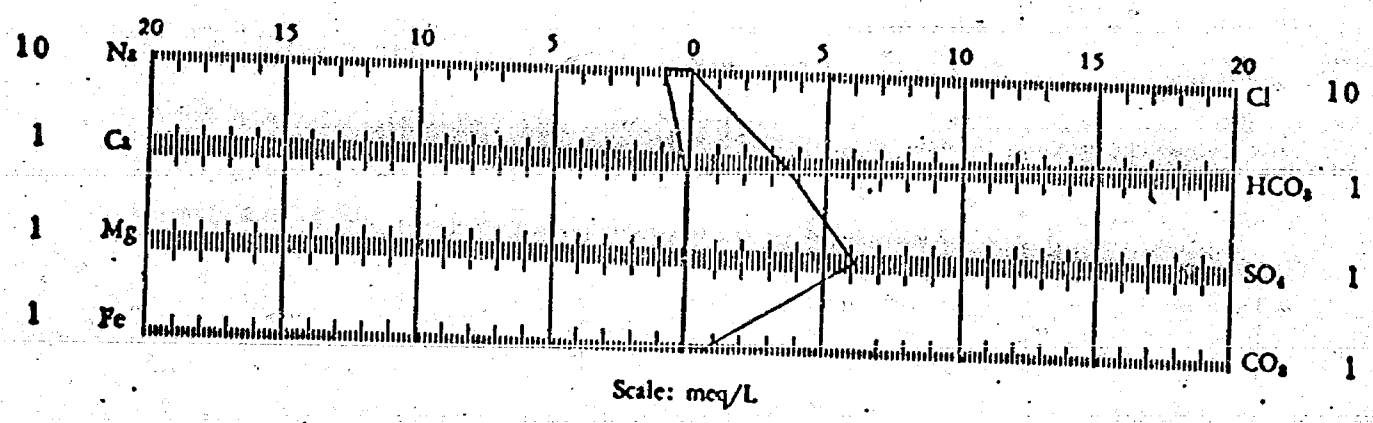
Resistivity 9.097 ohm-meters @ 74 °F. measured

pH 9.05 @ 76 °F.

Hydrogen Sulfide absent

Constituents	meq/L	mg/L
Sodium	10.19	234 ✓
Calcium	0.24	4.8 ✓
Magnesium	0.03	0.4 ✓
Iron	0.01	0.33 ✓
Barium	0.0	0.0 ✓ (Grav.)

Constituents	meq/L	mg/L
Chloride	0.27	9.7 ✓
Bicarbonate	3.51	214 ✓
Sulfate	6.12	294 ✓ (Grav.)
Carbonate	0.57	17 ✓
Hydroxide	0.0	0.0 ✓

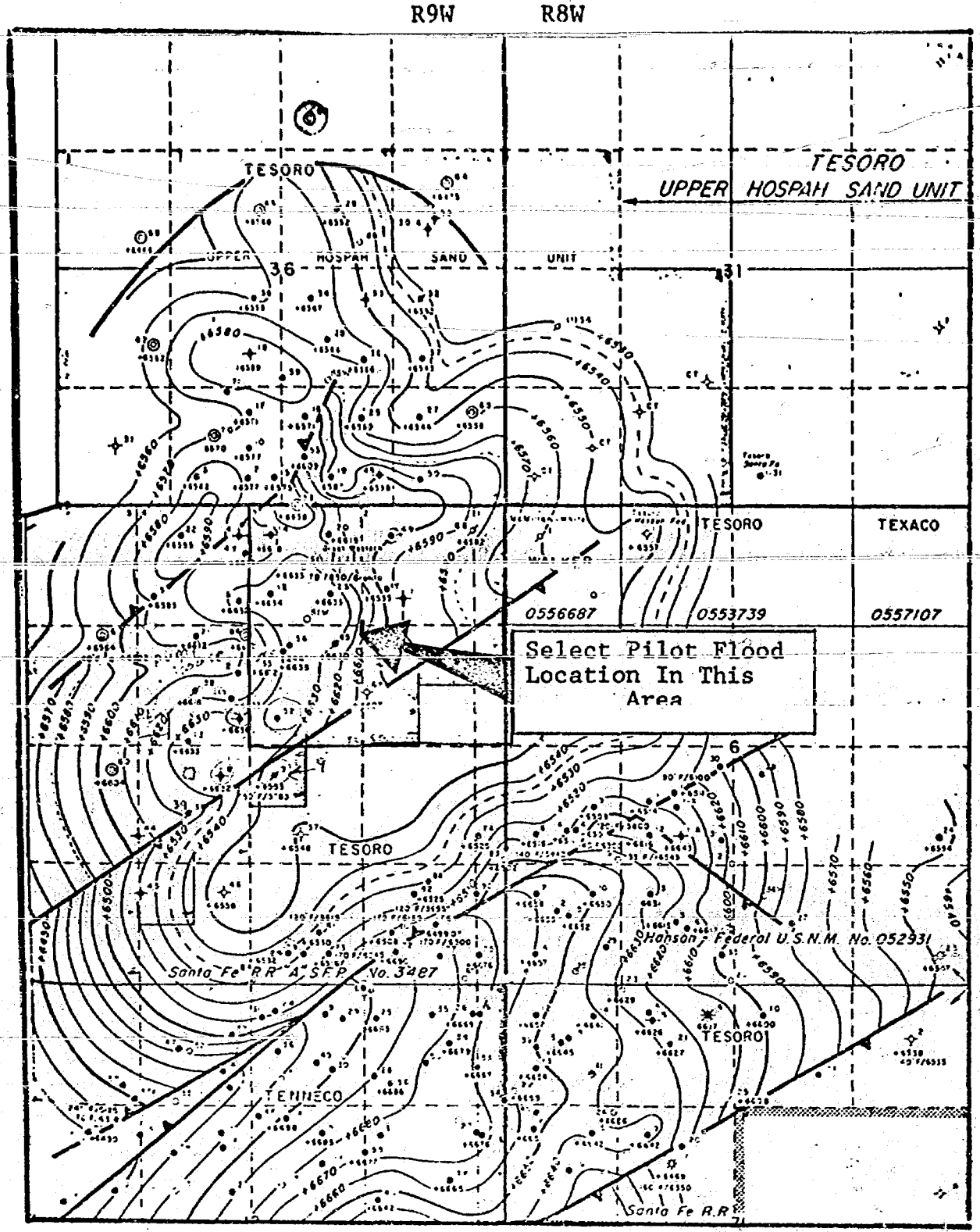


Scale: meq/L

* All analyses except iron determination performed on a filtered sample.

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
Tesoro EXHIBIT NO. 8
CASE NO. 7070
Submitted by ____
Hearing Date 12 Nov 80

Exhibit 8



Wells used to evaluate core data

----- Possible oil-water contact

Tesoro Petroleum Corporation

HOSPAH AREA

McKinley County, New Mexico

STRUCTURE MAP

TOP SEVEN LAKE SAND

SCALE 500 0 1000 2000 FEET

BY: VIC KING | C.I.= 10 | DATE: JANUARY, 1980

Figure 1

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION

Tesoro EXHIBIT NO. 9

CASE NO. 7070

Submitted by

Hearing Date 12 Nov 80

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO

12 November 1980

EXAMINER HEARING

IN THE MATTER OF:

Application of Tesoro Petroleum Corporation for a pilot caustic flood project, McKinley County, New Mexico.

CASE 7070

BEFORE: Richard L. Stamets

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division: Ernest L. Padilla, Esq.
Legal Counsel to the Division
State Land Office Bldg.
Santa Fe, New Mexico 87501

For the Applicant: W. Thomas Kellahin, Esq.
KELLAHIN & KELLAHIN
500 Don Gaspar
Santa Fe, New Mexico 87501

I N D E X

E X H I B I T S

MR. STAMETS: Call next Case 7070.

MR. PADILLA: Application of Tesoro Petroleum Corporation for a pilot caustic flood project, McKinley County, New Mexico.

MR. KELLAHIN: I'm Tom Kellahin of Santa Fe, New Mexico, appearing on behalf of the applicant, and I have one witness to be sworn.

(Witness sworn.)

TRAVIS CROW

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. Would you please state your name and occupation?

A. My name is Travis Crow, Reservoir Engineer for Tesoro Petroleum Corporation.

Q. Mr. Crow, have you previously testified before the Division as a reservoir engineer?

A. No, I have not.

Q. Would you explain for the Examiner when

and where you obtained your degree?

A. I received a Bachelor of Science degree in petroleum engineering from Louisiana State University, January of 1960.

Q. Subsequent to graduation where have you been employed, either as a petroleum engineer or as an engineer specializing in reservoir engineering?

A. I worked as a pipeline engineer for Texas Eastern Transmission Corporation from 1962 to 1965.

I worked as a production engineer and reservoir engineer for Mobil Oil Corporation from 1965 through 1969.

I worked as a reservoir engineer for CORE Laboratories from 1969 through 1976, and have since been employed as a reservoir engineer for Tesoro.

Q. Pursuant to your employment as a reservoir engineer for Tesoro, have you made a study of the possibility of implementation of a pilot caustic flood project in the Hospah Field in McKinley County, New Mexico?

A. Yes, I have.

Q. And pursuant to that study have you prepared certain exhibits?

A. Yes, I have.

MR. KELLAHIN: We tender Mr. Crow as an

expert reservoir engineer.

MR. STAMETS: The witness is considered qualified.

Q. Mr. Crow, we have presented to the Examiner a written summary outlining the -- in a general way, the proposed caustic flood pilot project, and then in your package of exhibits and testimony is a list of the exhibits followed, then, by Exhibit Number One. I'd like to direct your attention to Exhibit Number One and before we go into detail about how you propose to set up your pilot project, I'd like for you to give us a general description of why you have elected a caustic flood project for the Seven Lakes Sand formation of the Hospah formation.

And give us a general overall picture of the different types of pilot projects you've studied and why you have selected this particular one.

A. Yes. In the summary that precedes the exhibits I state that the objectives of this project is to establish the presence of a mobile oil phase in the Seven Lakes Sand; it is to evaluate the reservoir fluid properties and the effect of caustic solutions on those properties; to evaluate the displacement process in core samples, and the effect of caustic solutions on displacement; to evaluate the feasibility of treating produced water; to confirm laboratory

findings by pilot flooding; to evaluate the economic feasibility of a caustic flood process in the Seven Lakes Sand; and to expand the caustic flood process over the field area, if warranted by findings.

And considering the Seven Lakes Sand for oil recovery, we found that there was no evidence to substantially support the idea that there is a mobile oil phase present. We recognize the possibility that there is a mobile oil phase present and that thiswas not determined in our core studies due to the fact that any mobile oil may have been flushed by the drilling fluids.

So the only data we have indicates a residual oil saturation. We feel like we should direct our efforts toward recovering a residual oil saturation rather than a mobile oil saturation because of the likelihood that no mobile oil is present. We considered other types of tertiary projects. For example, we considered a mycellar (sic) polymer flood, but determined that the economics of such a flood would not make that type of project feasible.

We considered a thermal project, but we felt that the low saturation of oil that we expect to find in this sand would preclude that sort of operation.

For this reason we decided that the caustic flood might offer us the opportunity to recover resi-

dual oil and still retain a rather low cost for the project.

Q. Would you describe generally the geology of the Seven Lakes Sand in the Upper Hospah formation in the area of the pilot?

A. Yes, may I refer to Exhibit Nine?

Exhibit Nine is a structure map showing the top of the Seven Lakes Sand. The project area is located in Section 1 of Township 17 North, Range 9 West. It's located in the northwest quarter -- correction, in the northeast quarter of the southwest quarter of Section 1. The reservoir that we are testing is structurally controlled and is located in a horst on the northern plunge of an anticline, which generally makes up the Hospah Field area.

This is a fine grained sandstone with slight calcium cementation; porosity of 28-1/2 percent; permeability of about 270 millidarcies, average.

Q. Would you identify for us the lines of fault that cross through this area?

A. Yes. Diagonally, running from northeast to southwest across Section 1 is a fault which is downthrown to the southeast.

Running across the northwest corner of the section is a tentative fault downthrown to the northwest. This is the horst structure that I described earlier.

To the southeast of the project area is a graben. We feel that the fault separation between the graben and the horst is sufficient to prevent fluid migration.

Q. Would you explain to us why you have chosen this particular location at which to install a pilot project?

A. Yes. We do have some indication that there is oil present within this fault block. The particular location within the fault block was selected to provide us a maximum of area without interference with other wells which are producing in the field; that is, we tried to stay away from productive wellbores.

We also felt that by placing the pattern near the fault, this would provide us a certain amount of control over fluid migration.

Q. Would you direct your attention to Exhibit Number One? Would you identify the pattern to be used for the pilot project, including identifying for us the location of those particular wells?

A. Yes. Exhibit One illustrates a 1/16th of Section One, being the northeast quarter of the southwest quarter of Section 1, Township 17 North, Range 9 West.

In the northwest corner of that 1/16th section we've illustrated a 1-acre normal 5-spot flood pattern,

consisting of one injection -- or correction, of one production well, located 330 feet from the line of that 1/16th section, both from a north line and from the west line.

In addition there are 4 injection wells located at the corners of the flood pattern. The northwestern-most well is located 225.6 feet from the corner of that 1/16th section.

Q. Do you have an estimate at this time, Mr. Crow, of the anticipated life of the pilot project?

A. Yes. We anticipate that the pilot would take a total of 17 to 18 months.

Q. Do you have any particular order to the drilling of the five wells identified in the pilot project?

A. Yes. In the brief discussion preceding the exhibits we indicate that a general procedure will be to drill, core, and complete a production well; install test equipment and test that particular well; to drill, core, and complete the four injection wells; and to core those wells, as well.

Q. What is the depth of the Seven Lakes Sand in this area?

A. The depth varies. We expect at this particular location that we should see the sand at about 300 feet.

Q. And what is the gross thickness of this sand?

A. If I can refer to Exhibit -- what is the exhibit of the type log? Exhibit Four?

Exhibit Four is a type log taken from Well No. 55, which offsets the pattern approximately a quarter of a mile to the northeast. It shows that we expect the sand to have a gross thickness of about 40 feet and a net thickness of about 30 feet.

Q. Would you describe for us the general procedures of implementing the pilot project after the wells have been drilled?

A. Yes. Again referring to the description provided with the exhibits, following the drilling of the wells we would test each of the production and injection wells to determine their productivity and injectivity.

We would recover any produced fluids for laboratory studies, as well as cores for laboratory studies.

We would install surface facilities required to lift, treat, and store produced fluids, including pumping unit, flow lines, free-water knockout, and other oil-water dehydration or demulsification equipment as needed.

We would install caustic -brine injection facilities; supply water treating and softening facilities,

as necessary, and injection pumps and lines.

Once the installation is complete, we would begin the injection of a softened water pre-flush into the four injection wells. The pre-flush would consist of approximately 13,000 barrels of 1.0 percent by weight of sodium chloride. This would be injected into the four wells at a total rate of about 172 barrels per day with an injection pressure of about 60 psig.

Q. What's the purpose of the pre-flush, Mr. Crow?

A. In the caustic flood process it is necessary to remove any divilin ions (sic) which might be present in the reservoir. These are generally calcium or magnesium ions. The softened water would have these particular ions removed and would tend to flush out any naturally occurring ions from the reservoir. This is -- this is due to the fact that these divilin (sic) ions would be detrimental to the operation of the flood.

Q. Are you familiar with the policy of the Oil Conservation Division limiting injection pressures?

A. Yes, I am.

Q. And do you anticipate that you'll be able to comply with the policy of limiting injection pressures to no greater than 0.2 psi per foot?

A. AT this time we anticipate no problems with that.

Q. All right. After the pre-flush process is completed, describe for us generally the volumes of caustics to be injected into the formation.

A. In terms of total volumes we expect to inject 9100 pounds of caustic material into the formation during the caustic slug phase. This would be, again, as one tenth of one percent of the total solution.

Following the caustic slug we would inject a caustic brine solution into the four injection wells. This solution would consist of one tenth of one percent by weight of sodium hydroxide and one percent by weight of sodium chloride, and would consist of approximately 51,000 barrels of solution over a period of ten months, and during this phase of injection we would expect to inject 17,850 pounds of caustic material.

In addition to the caustic material, we would inject during the pre-flush and during the caustic brine slug a total of 224,000 pounds of sodium chloride.

Q. Your Exhibit Number One shows that the pilot project is a 1-acre pattern?

A. That's correct.

Q. Do you have any estimates at this time

as to the number of total acres that may be affected by the pilot project?

A. We have designed our injection volumes assuming that we might flood a total of two acres.

Of course, if breakthrough occurred more rapidly than we -- than the design, the affected area would be less.

Q. Can you identify for us the procedures that could be implemented to monitor the pilot project to assure that the project remains confined to a given area?

A. Yes, we have two procedures in mind. One would be that at the time of drilling the production and injection wells we would test the wells for productivity of fresh water. If there is no productivity, or if the productivity is low, we would expect this to be an indication that this is a static aquifer rather than a dynamic aquifer.

During the conduct of the pilot we would, in addition, monitor certain offset wells from the pilot area; observe the casing pressure in order to see if any changes indicate that the injected fluids may be reaching these particular wells. At the time that we observe any evidence of fluid migration we would take corrective action with that particular well.

Q. Are you aware of any indication now that the aquifer encountered in the Seven Lakes Sand is in

movement?

A. We have no indication that it is moving in this area. In fact, our records indicate that when Well 55 was drilled a test was attempted and no production was made; however, in other parts of the formation in other areas there could be aquifer dynamics.

Q. If you'll turn to Exhibit Number Two, which is the large plat, I'd like to ask you some questions about that.

MR. STAMETS: Could I ask one question on Exhibit One before we move on?

You're talking about monitoring offset producers. Which wells on Exhibit One would be monitored?

A. Okay, I may have indicated producers, but in fact on the exhibit there are two producers which we can use, Well No. 13 and Well No. 39. In addition there are two injection wells, Well No. 60 and Well No. 94.

MR. STAMETS: And those will be monitored as well?

A. Yes.

MR. STAMETS: Thank you.

Q. While we're looking at Exhibit Number One, you've shown some actual footage locations on the plat. Have those locations been surveyed in?

A. Some locations have been surveyed in this general area, but there may be some slight variations from the plat due to terrain problems.

Q. When do you anticipate having the actual surveyed footages available for the Division?

A. That information has been requested today. I do not have a time; should be within the near future.

MR. KELLAHIN: If the Examiner please, I assume the order will contain the approval of the wells at particular footage location.

MR. STAMETS: How about approximate footage location?

MR. KELLAHIN: Fine. I point to the problem because they're being surveyed now and they may vary slightly from those indicated on the exhibit and we would not want to get locked into an order that didn't have some flexibility, or at least hold the order until we could survey the locations in and give you those numbers.

MR. STAMETS: Okay. Tesoro owns all the offest acreage, don't they?

MR. KELLAHIN: Yes.

MR. STAMETS: Okay, either do that or say within 100 feet.

Q. Will that do it?

A. Yep.

Q. Okay. Would you turn to Exhibit Number Two? Would you identify generally what information is contained on Exhibit Two?

A. Yes. Exhibit Two is a location map showing the general field area of Hospah Field. It indicates units outlined as the Upper Hospah Sand Unit, which Tesoro operates; the South Hospah Sand Unit, which Tenneco operates; the Lone Pine Dakota "D" Unit, which Tenneco operates; and I'm not sure, but this unit may be shut-in at this time.

Q. What's the purpose of the circles?

A. Two circles are shown. One is a one-half mile radius from the pattern area; the other is a two-mile radius from the pattern area. These circles are required exhibits for our testimony.

Q. Would you locate for us the area for which Tenneco received an order to institute a fireflood project in Section 12?

A. Yes. I don't have the exact location, but it is located in Section 12 within the South Hospah Sand Unit.

Q. Now while we're looking at this exhibit, Mr. Crow, have you been able to identify any water wells that produce from the Seven Lakes Sand formation?

A. Yes, I have. Mr. Steve Hudson of Tenneco supplied us with information to indicate that they have a fresh water well operating within the South Hospah Sand Unit area. It's located in Section 12, 17 North, 9 West, 2445 feet from the north line, 2920 feet from the east line.

It's completed at a depth of 550 to 600 feet; has a total depth of 674 feet; is producing 2-1/2 gallons a minute on submersible pump.

And this is used for local consumption.

Q. Are you aware of any other fresh water wells in the area that produce from the Seven Lakes formation?

A. I have no information on other wells in that sand.

Q. What is the principal aquifer in the area from which domestic water supplies are obtained?

A. Our water supply is the Morrison formation, which is at a depth of about 3100 feet.

Q. Is the Morrison formation also the source of the water to be used in the caustic plant?

A. Yes, it is.

MR. KELLAHIN: If the Examiner please, we have checked the records of the State Engineer. They do not indicate permits or the existence of any water wells producing in any formation in this area, including the Tenneco

well or the Tesoro well, just no records of it at all.

Q. Now with regards to the Tenneco water well to the south, Mr. Crow, what if any risk is posed to that well by the implementation and approval of the proposed pilot project?

A. In my opinion there is no risk through contamination of that particular well for two reasons.

One reason is that we have identified at least two faults separating the pilot area with the water well which is located approximately one mile south of the pilot project.

In addition, the pilot is of such size that it seems highly unlikely that the total amount of fluid we'll be injecting will ever reach that area. We're talking about flooding at the most a two-acre area and this well is located approximately a mile away.

Q. Would you refer to Exhibit Number Three and tell us what that exhibit is?

A. Exhibit Three is a tabulation of wells that are located within a one-half mile radius of the pattern area. Also indicated on the Exhibit Two a circle which is labeled one-half mile radius.

The tabulation shows the operators, well names, locations, size of casing, depth to which casing was

set; volume of cement used to set casing; tops of cement where known; total depth; producing interval and status in producing formations in the wells.

Q. Now with regards to the tabulation of the existing wells within the half mile radius, in your opinion is there any risk that the fluids from the pilot project will migrate outside of the pilot area and use any of these well-bores or wells to have fluids migrate out of the zone of injection?

A. I think the likelihood that that would occur would be very low. Again, the wells most in danger from contamination of this flood would be monitored. They are, in fact, the wells that we will be checking.

Q. These are all wells operated by Tesoro?

A. That's correct.

Q. And you would be monitoring these wells?

A. That's correct.

Q. And if --

A. Let me clarify that. I'm not stating that we'll monitor every well shown on the tabulation, but rather the wells previously indicated.

Q. I understand. In your opinion is the monitoring of those four wells adequate to insure that the

fluids will remain confined to the area and will not migrate out through any of these other wells beyond the area of the monitoring?

A. I think that by monitoring these four wells plus the other factors considered, particularly the size of the flood, the fact that we have a -- we will establish a pressure sink in the center of the pattern area, will afford us sufficient security with regard to fluid migration.

Q. In fact one of the purposes of the pilot, is it not, Mr. Crow, to demonstrate what remedial action, if any, will be required in order to protect other zones in these offset wells?

A. That's correct.

Q. Now you've talked to us about Exhibit Number Four. Would you turn to Exhibit Number Five? Would you identify that and tell us what it is?

A. Exhibit Five is a wellbore schematic showing an injection well as we propose to complete it in the pilot flood. It indicates that we would set 7-inch casing to a depth of approximately 291 feet. It would be cemented to the surface. Inside that 7-inch string of casing we would run a 4-1/2 inch casing string, which would be cemented to approximately 30 feet up into the 7-inch casing.

That in a case that perforations were

to be made over an interval of 291 to 321 feet, which would be Seven Lakes Sand, and that tubing would be set with a packer at a depth of 276 feet above the injection interval.

Q. Would you refer to Exhibit Number Six and identify that?

A. Exhibit Six is a wellbore schematic of a production well. Generally the well completion is the same as an injection well, the only difference being that tubing would be run to the mid-point of the perforations at a depth of 315 feet.

Q. Okay. Now in compliance with Commission requirements for an application of this nature, have you submitted an application that shows wellbore schematics of all plugged and abandoned wells within a half mile radius of the pilot?

A. Yes, Exhibit Seven includes wellbore schematics of all plugged and abandoned wells within that radius.

Q. Let's turn to Exhibit Number Eight. Would you identify Exhibit Eight for us?

A. Exhibit Eight is a laboratory analysis report provided by CORE Laboratories. It reports on a compositional analysis of a water sample taken from our water supply well.

Q. Where is your water supply well?

A. I'm sorry, I don't have the location. I would ask Mr. Parks about that.

Q. Say again?

MR. PARKS: 53-Y.

MR. KELLAHIN: 53-Y is your water well?

MR. PARKS: (Inaudible)

MR. KELLAHIN: Here it is.

Q. The water sample was taken from your water supply well, which is 53-Y, is it?

A. Yes, and it's located in Section 36 in the southeast quarter of -- correction, in the southwest quarter of the southeast quarter.

The producing interval from that well is the Morrison formation at a depth of 3100 to 3200 feet. It indicates that total dissolved samples from the sample were 774 milligrams per liter.

Q. This is the water analysis of the water to be used for the pilot?

A. That's correct.

Q. Do you have any indication of the quality of the water that now exists in the Seven Lakes Sand?

A. We have no data on that.

Q. Okay. Except for the fact that Tenneco

does operate a drinking water well in --

A. Yes, we recognize that this is a fresh water sand.

Q. In your opinion, Mr. Crow, will approval of this application be in the best interests of conservation, the prevention of waste, and the protection of correlative rights?

A. In my opinion, yes, sir.

Q. In your opinion is the installation of a pilot project of this nature necessary in order to determine the feasibility of enhanced recovery of hydrocarbons from the Seven Lakes formation?

A. Yes, it is.

Q. Were Exhibits One through Nine compiled by you or prepared under your direction and supervision?

A. Exhibit Nine, which is the structure map of the sand was not prepared under my direction or supervision but by our geological staff.

Exhibit Three, which is a tabulation of wells within one-half mile radius was partially completed by myself and partially by our Denver production office.

Q. Have you reviewed the tabulation of Three to determine in your own mind that it's accurate and correct to the best of your knowledge?

A. Yes, sir.

Q. And with regards to Exhibit Number Nine, have you studied the geology indicated on that plat and is it true and correct to the best of your knowledge?

A. Yes, it is.

MR. KELLAHIN: We move the introduction of Exhibits One through Nine.

MR. STAMETS: These exhibits will be admitted.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Crow, will you determine during the course of this project or at the end of it, the effect of the caustic solution on the formation, formation fluids, and also the nature of the residues left in the reservoir?

A. Yes, we will. Part of the project will be to run numerous laboratory studies on core samples which should provide that information.

We expect that the residue that would be left from the caustic material would consist of calcite and magnesium sulfate. These are innocuous materials which are handled in California in the Wilmington Field by using them as landfill, so we feel there would be no problem with

the residue material.

Q. Okay, and then you indicated you will be testing the wells upon completion, gathering information on fluids in the reservoir.

A. That's correct.

Q. I believe you indicated you also would attempt to make determination of whether you've got fluid in motion --

A. That's correct.

Q. Would Tesoro be willing to submit a final report which outlines the results of -- of these tests for this particular information?

A. Yes, we would.

Q. Is there any shallower ground water in the area of the pilot project?

A. I'm not aware of any.

Q. Now, just briefly looking at, I think, what you've identified as Exhibits Three and Four, the well summary. I guess it's not Three and Four. It would be Exhibit Three and Seven. It would appear as though if we were talking about a typical waterflood covering all of the territory inside the half a mile circle, that there would be a lot of wells which were not adequately cemented or plugged, but since this is going to be a small, one-acre pilot project, you

would not expect these fluids to reach any such wells, is that correct?

A. No. That is one reason for using the pilot approach. We would be able to better evaluate the effect of the pilot on these wells and make a decision at the proper time as to whether the full scale operation would be feasible.

MR. STAMETS: Any other questions of the witness?

MR. CHAVEZ: I have just one.

CROSS EXAMINATION

BY MR. CHAVEZ:

Q. What is the displacement along that fault to the south of the proposed project?

A. From the structure map, Exhibit Nine, it appears the displacement would be about fifty feet -- I'm sorry, about 90 feet.

Q. And so far it's been shown that that fault seals at the Hospah. Is there any indication at all that you've seen so far that the seal is not -- it may not seal up at shallower depths?

A. I don't have any data that would state either way, really.

Q. What is the monitoring system you'll use to monitor the Wells Nos. 44 and 39 that you said you would monitor for --

A. Yes, we would observe casing pressure, casing annulus pressure.

Q. It would be by gauge, I guess --

A. Yes.

Q. -- instead of examining?

A. That's correct.

Q. What effect will, say, if your pre-flush is -- isn't totally effective, what will the presence of these divalent (sic) ions that you're talking about have on your caustic flood? What would be the chemical reaction?

A. Right, it would tend to render the caustic ineffective. The -- the process depends upon a particular interfacial tension of about a thousandth of a dyn per centimeter square -- or per centimeter.

It's sensitive to the concentration of caustic material. If you go below or above that significantly you can nullify the effect. The divalent (sic) ions can alter the concentration and therefor be detrimental to the actual formation of the emulsion which is required in this process.

Q. Do you expect any type of precipitants

to, say, flood off the formation in those areas?

A. That is possible. The precipitants might be calcite or magnesium sulfate, which is essentially limestone.

MR. STAMETS: Any other questions for the witness? He may be excused.

Anything further in this case?

Identify yourself, please, for the record.

MR. STROBL: My name is Glenn Strobl with Tenneco Oil Company.

As mentioned, we do produce fresh water from a geologically correlatable sand in our South Hospah Field. We do not feel that this pilot will be a threat to our water well and therefor are not opposed to it.

We trust that if this or any future chemical flood is approved, that our water well will be safe.

MR. STAMETS: Anything further in this case?

The case will be taken under advisement.

(Hearing concluded.)

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd C.S.R.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 7070 heard by me on 11-12 1980.

Richard L. Stamets, Examiner
Oil Conservation Division

STATE OF NEW MEXICO
DEPARTMENT OF ENERGY AND MINERALS
OIL CONSERVATION DIVISION

IN THE MATTER OF THE APPLICATION OF TESORO PETROLEUM CORPORATION FOR APPROVAL OF A PILOT PROJECT, INCLUDING WELL-SPACING EXCEPTIONS FOR INJECTION AND PRODUCING WELLS, SEVEN LAKES SAND OF THE UPPER HOSPAH FORMATIONS, HOSPAH FIELD, MCKINLEY COUNTY, NEW MEXICO.

Case 7070

A P P L I C A T I O N

COMES NOW TESORO PETROLEUM CORPORATION, by and through its attorneys, KELLAHIN & KELLAHIN, and applies to the Oil Conservation Division of the State of New Mexico for approval of a pilot caustic flood project for the Upper Hospah formations of the Hospah Field, McKinley County, New Mexico and in support thereof would show:

1. Applicant is the operator in the Upper Hospah formation of the Hospah Field, McKinley County, New Mexico, including Section 1, T17N, R9W, NMPM.

2. Applicant seeks to initiate a pilot caustic flood project in the Seven Lakes Sand of the Upper Hospah formation at a location in the NE/4SW/4 Section 1, T17N, R9W, NMPM hereinafter set forth.

3. The Hospah field is now in its later stages of secondary recovery by waterflood and applicant proposes to determine by the proposed pilot project the feasibility of a tertiary recovery project by the use of a caustic flood process. Attached as Exhibit "1" is a plat showing all wells in the area.

4. Applicant proposes to drill four injection wells and one producing well within a one acre area to a depth sufficient to penetrate the Seven Lakes Sand of the Upper Hospah Field at the following locations:

(a) Production well 330 feet from the west line and 330 feet from the north line of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(b) Injection well 225.6 feet from the west line and 225.6 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(c) Injection well 434.3 feet from the west line and 225.6 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(d) Injection well 434.3 feet from the west line and 434.3 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(e) Injection well 225.6 feet from the west line and 434.3 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

5. In accordance with Rule 701 of the Rules of the New Mexico Oil Conservation Division, the following Exhibits are attached and incorporated herein by reference:

(a) Exhibit 2: Plat showing the location of the project and all other wells within a two mile radius.

(b) Exhibit 3: A tabular summary of all wells within a one-half mile radius;

(c) Exhibit 4: A type Log (Well No. 55)

(d) Exhibit 5: A Wellbore Schematic of the proposed injection wells;

(e) Exhibit 6: a Wellbore Schematic of the proposed producing well;

(f) Exhibit 7: Wellbore Schematics of all plugged and abandoned wells within a one-half mile radius;

6. The injection of the caustic fluid will consist of 0.1 percent by weight of sodium hydroxide in solution with water and will be injected at pressures below that required to fracture the confining strata.

7. The proposed pilot project has a potential life of two years from commencement.

8. The proposed pilot will be limited to the Seven Lakes Sand of the Upper Hospah Field at an approximate depth of 300-500 feet.

9. The potable water utilized in the area as well as the source water for this pilot project is in the Morrison formation at a depth of 3,100 to 3,200 feet. A typical water analysis is attached as Exhibit 8.

10. The proposed pilot project as outlined in Exhibit 9, attached hereto, will not present a risk of contamination of fresh-water sources in the area, will not impair the correlative rights of others, will be in the best interests of conservation, will determine the feasibility of a caustic flood of this formation, and will not cause waste.

WHEREFORE, Applicant seeks approval for this application for a pilot caustic flood project in the Sevel Lakes Sand of the Upper Hospah Field, McKinley County, New Mexico including but not limited to authority to:

(a) to approve the drilling and spacing of the

proposed injection wells and producing well at the proposed location;

(b) to approve the proposed pilot project;

(c) grant such additional authority and approval as may be required to implement the proposed pilot project.

KELLAHIN KELLAHIN

By: W. Thomas Kellahin

W. Thomas Kellahin
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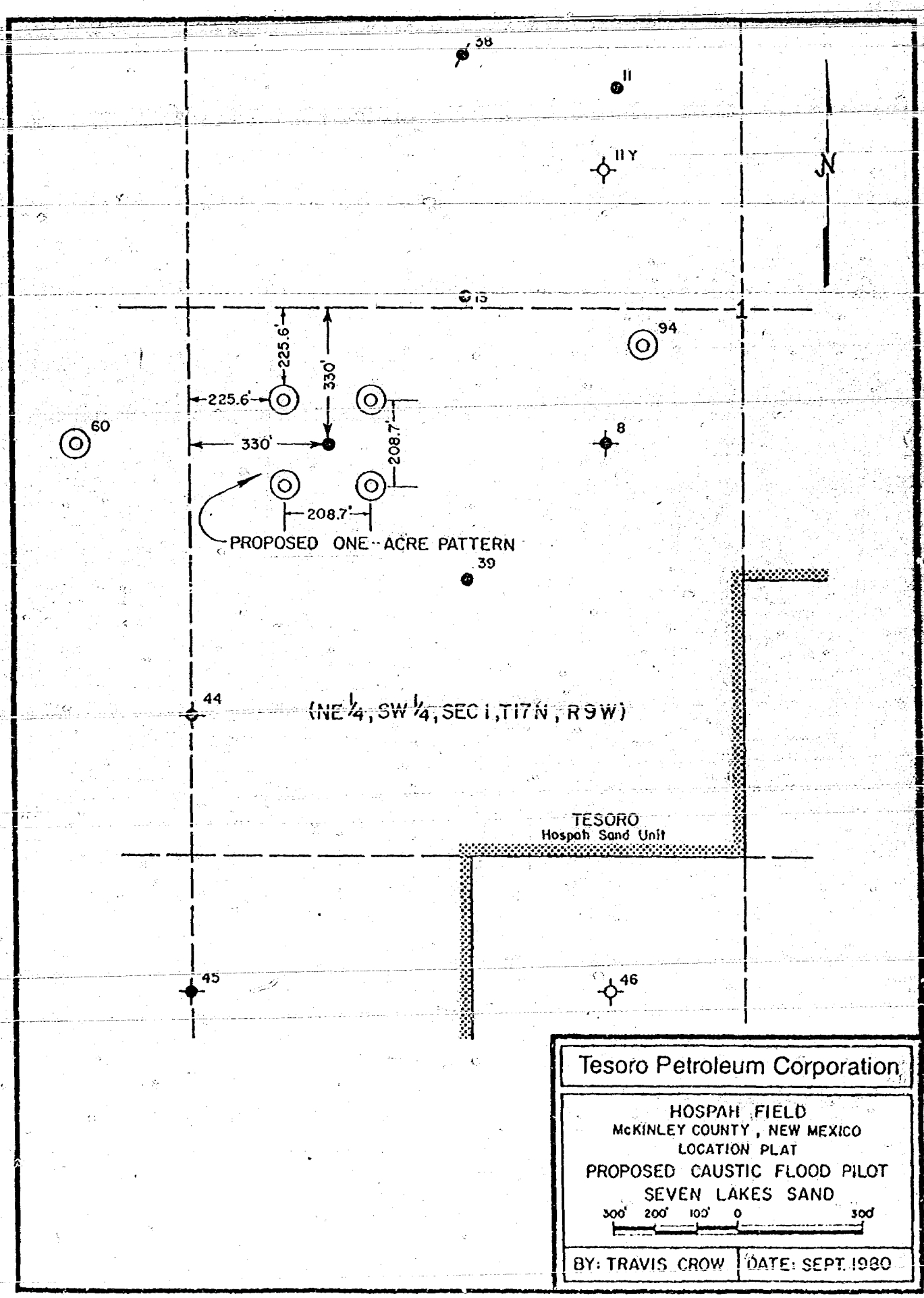
Santa Fe, New Mexico 87501
(505) 982-4285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PROPOSED ONE-ACRE PATTERN
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(NE¼, SW¼, SEC 1, T17N, R9W)
TESORO
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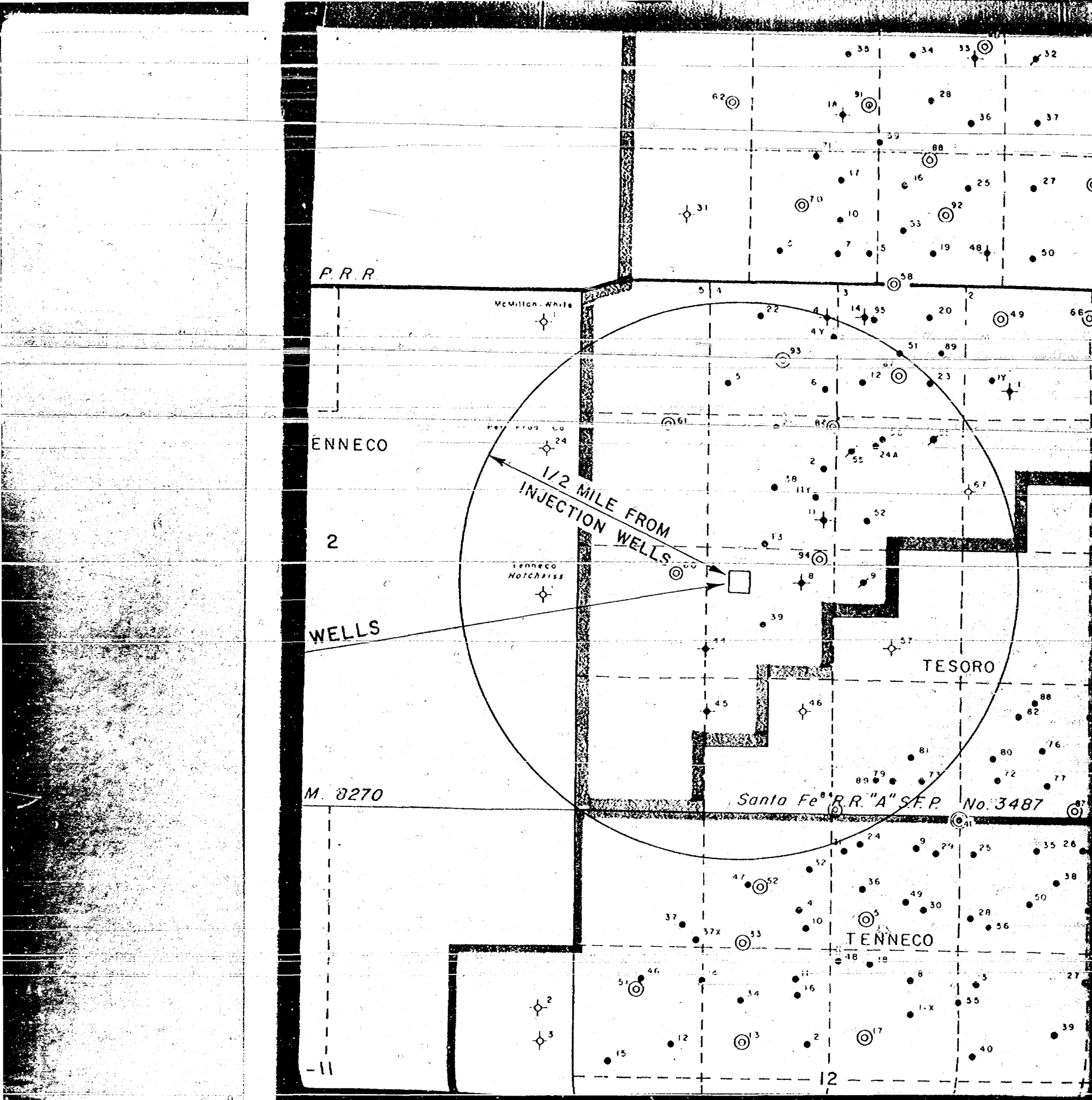
Tesoro Petroleum Corporation
HOSPAH FIELD
McKINLEY COUNTY, NEW MEXICO
LOCATION PLAT
PROPOSED CAUSTIC FLOOD PILOT
SEVEN LAKES SAND
300' 200' 100' 0 300'
BY: TRAVIS CROW
DATE: SEPT. 1980

Exhibit 1


P.R.R
McMillan-White
ENNECO
1/2 MILE FROM INJECTION WELLS
2
WELLS
Tenneco Hotchkiss
TESORO
M. 8270
Santa Fe R.R. "A" S.F.P. No. 3487
TENNECO
11
12

Wells Within 1/2 Mile of Proposed Injection Wells

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	HSU #8	NE-SW Sec 1-17N-9W	12 1/2" 7"	22' 1533'	10 sx 50 sx	surface 1300'	1578'	P & A	--
Tesoro	HSU #9	NW-SE Sec 1-17N-9W	10" 7"	17' 1535'	10 sx 40 sx	surface 1350'	1570'	1535'-70'	U. Hospah
Tesoro	HSU #13	SE-NW Sec 1-17N-9W	10" 7"	22' 1530'	15 sx 50 sx	surface 1300'	1561'	1530'-61'	U. Hosp.
Tesoro	HSU #11	SE-NW Sec 1-17N-9W	12" 7"	22' 1522'	12 sx 50 sx	surface 1280'	1550'	P & A	--
Tesoro	HSU #11-Y	SE-NW Sec 1-17N-9W	8 5/8" 5 1/2"	73' 1538'	60 sx 150 sx	surface 590'	1563'	1538'-63'	U. Hospah
Tesoro	HSU #38	SE-NW Sec 1-17N-9W	5 1/2"	1557'	50 sx	1250'	1565'	1557'-65'	U. Hospah
Tesoro	HSU #2	SE-NW Sec 1-17N-9W	8 5/8"	1528'	75 sx	1340'	1576'	1528'-76'	U. Hospah
Tesoro	HSU #21	SE-NW Sec 1-17N-9W	7"	1547'	40 sx	1360'	1591'	1547'-85'	U. Hospah
Tesoro	HSU #84	SE-NW Sec 1-17N-9W	8 5/8" 4 1/2"	70' 1536'	50 sx 120 sx	surface 879'	1574'	1536'-74'	U. Hospah (Injectic
Tesoro	HSU #61	SW-NW Sec 1-17N-9W	7" 4 1/2"	64' 1700'	35 sx 50 sx	surface 1220'	1715'	1632'-56'	U. Hospah (Injection
Tesoro	HSU #56	SW-NE Sec 1-17N-9W	8 5/8" 5 1/2"	302' 1694'	200 sx 140 sx	surface 268'	2730'	1514-42'	U. Hospah
Tesoro	HSU #24-A	SW-NE Sec 1-17N-9W	5 3/8"	1512'	75 sx	1190'	1552'	1512'-52'	U. Hospah
Tesoro	HSU #52	SW-NE Sec 1-17N-9W	7"	1514'	50 sx	1330'	1526'	1514'-26'	U. Hospah

Tabular Summary of All Wells
Within a One-Half Mile Radius
of Proposed Injection Wells

Exhibit 3

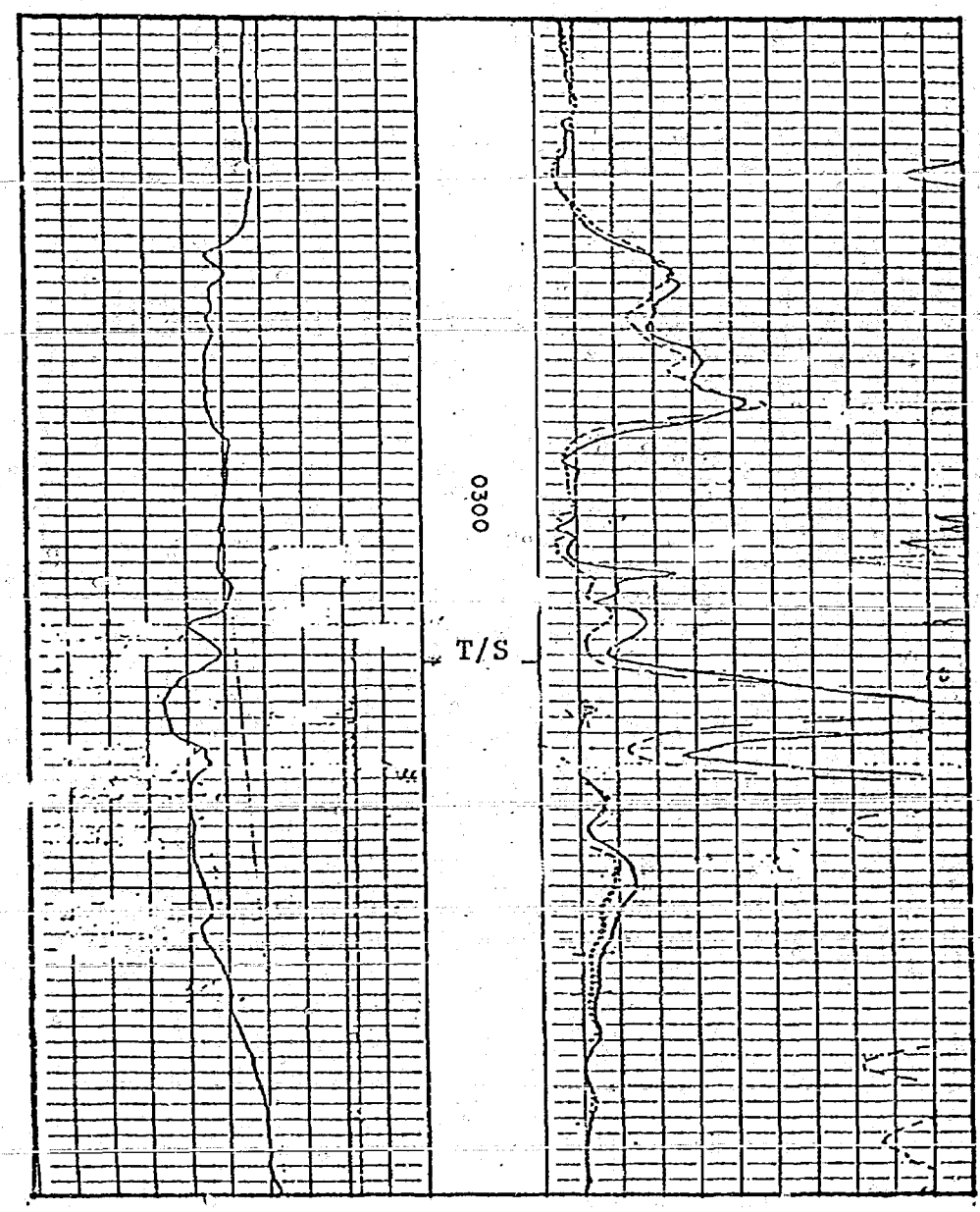
Wells Within 1/2 Mile of Proposed Injection Wells

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producin Formatio
Tesoro	HSU #85	SW-NE Sec 1-17N-9W	8 5/8" 5 1/2"	104' 1535'	100 sx 150 sx	surface 450'	1551'	1535'-51'	U. Hospa
Tesoro	HSU #67	SE-NE Sec 1-17N-9W	7" 4 1/2"	83' 1634'	35 sx 55 sx	surface 1150'	1636'	1546'-64'	U. Hospa (Injection
Tesoro	HSU #23	NW-NE Sec 1-17N-9W	5 3/8"	1528'	75 sx	1200'	1570'	1528'-70'	U. Hospah
Tesoro	SF Hurst #1	NW-NE Sec 1-17N-9W	13 3/8" 9 5/8"	207' 3317'	150 sx 325 sx	surface 2400'	7852'	P & A	--
Tesoro	HSU #51	NW-NE Sec 1-17N-9W	7"	1532'	50 sx	1340'	1576'	1532'-76'	U. Hospah
Tesoro	HSU #12	NW-NE Sec 1-17N-9W	10" 7"	21' 1535'	12 sx 45 sx	surface 1320'	1580'	1535'-80'	U. Hospah
Tesoro	HSU #4	NE-NW Sec 1-17N-9W	7"	1611'	70 sx	1400'	1611'	P & A	--
Tesoro	HSU #4Y	NE-NW Sec 1-17N-9W	8 5/8" 5 1/2"	74' 1556'	60 sx 150 sx	surface 620'	1581'	1556'-81'	U. Hospah
Tesoro	HSU #6	NE-NW Sec 1-17N-9W	1" 7"	20' 1538'	155 sx 70 sx	surface 1230'	1582'	1538'-82'	U. Hospah
Tesoro	HSU #22	NE-NW Sec 1-17N-9W	7"	1553'	41 sx	1360'	1595'	1553'-95'	U. Hosp.
Tesoro	HSU #5	NE-NW Sec 1-17N-9W	14" 5 5/8"	80' 1604'	16 sx 75 sx	50' 1300'	1604'	1552'-65'	U. Hospah

Tabular Summary of All Wells
Within a One-Half Mile Radius
of Proposed Injection Wells

Well Name	Location	Casing Size	Setting Depth	Cement Volume	Cement Top	Tbl Depth	Producing Interval	Producing Formation	
HSU 93	NE-NW-Sec 1-17N-9W	8 5/8"	28'	30 sx	surface	1605'	1540-1560'	U. Hospah (Inj.)	
		5 1/2"	1632'	125 sx	1100'				
HSU 87	NW-NE-Sec 1-17N-9W	8 5/8"	53'	35 sx		1590'	1535-1555'	U. Hospah (Inj.)	
		5 1/2"	1590'	120 sx					
Coleman #1	SE-NE-Sec 2-17N-9W	—	—	—	—	—	—	P & A	
HSU 53	SW-NE-Sec 1-17N-9W	4 1/2"	447'	50 sx	surface	450'	310-348'	Temp. abnd in Seven Lakes sd.	dry hole TA
Hobbs #1	NE-SE-Sec 2-17N-9W	—	—	—	—	—	—	P & A	
HSU 61	SE-NE-Sec 1-17N-9W	7"	82.8'	35 sx	circ.	1636'	1552-1560'	U. Hospah (Inj.)	
		4 1/2"	1634'	55 sx	1350'		1563-1570'		
HSU 60	NW-SW-Sec 1-17N-9W	7"	84'	35 sx	circ.	1640'	1559-1590'	U. Hospah (Inj.)	
		4 1/2"	1640'	50 sx	1350'		1600-1601'		
HSU 44	NE-SW-Sec 1-17N-9W	5 1/2"	1554'	75 sx		1572'		P & A	
HSU 59	NE-SW-Sec 1-17N-9W	—	—	—	—	1557'	—	—	
HSU 94	NE-SW-Sec 1-17N-9W	8 5/8"	40'	30 sx	surface	1575'	1515-1530'	U. Hospah (Inj.)	
		5 1/2"		125 sx	1100'				
SFRR "A" 57	NW-SE-Sec 1-17N-9W	8 5/8"	135'	110 sx		2800'	1625-1634'	P & A	
		5 1/2"	1698'	140 sx					P&A 6/7?
HSU 45	SE-SW-Sec 1-17N-9W	5 1/2"	1634'	35 sx		1818'		P & A	
SFRR "A" 96	SE-SW-Sec 1-17N-9W	—	—	—	—	—	—	P & A	
SFRR "A" 73	SW-SE-Sec 1-17N-9W	8 5/8"	63'	10 sx	circ	1665'	open hole comp.	L. Hospah	
		4 1/2"	1639'	75 sx	1300'				
SFRR "A" 79	SW-SE-Sec 1-17N-9W	8 5/8"	67'	50 sx	circ.	1624'	open hole comp.	U. Hospah	
		5 1/2"	1589'	150 sx	1300'		1589-1624'		

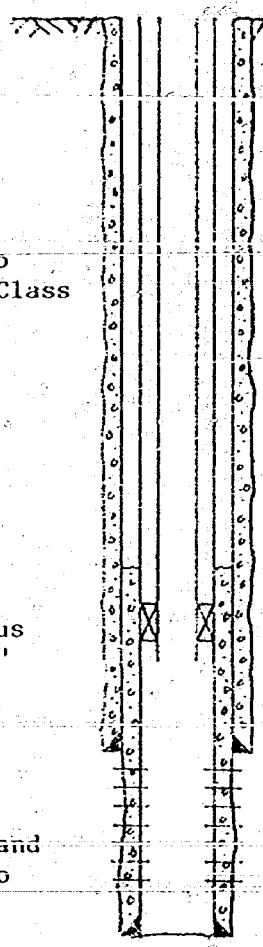
Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	SFRU "A" 81	SW-SE-Sec1-17N-9W	8 5/8"	62'	50 sk	circ	1655'	open hole comp.	L. Hospah
			5 1/2"	1643.5'	100 sk	700		1613.5' - 1655'	
Tesoro	SFRU "A" 84	SW-SE-Sec1-17N-9W	9 5/8"	95'	100 sk	circ	1656'	open hole comp.	L. Hospah (Inj)
			7"	1639'	100 sk	—			
Tesoro	SFRU "A" 85	SW-SE-Sec1-17N-9W	8 5/8"	104'	100 sk	surface	1769'	open hole comp.	L. Hospah
			5 1/2"	1769'	100 sk	500		1698' - 1654'	



TYPE LOG

(Well No. 55)
SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 4



C ent 7-in. annulus to surface with 50 sacks Class "A" neat.

Cement 4-1/2-in. annulus with 10 sacks Class "A" neat.

Perforate Seven Lakes Sand at approximately 291 to 321 ft.

Top of cement: 261 ft

2-in. tbg w/pkr: 276 ft

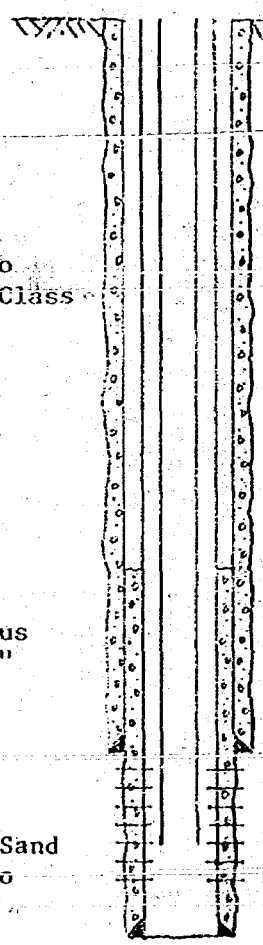
7-in. casing: 291 ft

4-1/2-in. casing: 336 ft

TESORO PETROLEUM CORPORATION
WELLBORE SCHEMATIC
CAUSTIC FLOOD INJECTION WELL

SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 5



Cement 7-in. annulus to surface with 50 sacks Class "A" neat.

Cement 4-1/2-in. annulus with 10 sacks Class "A" neat.

Perforate Seven Lakes Sand at approximately 291 to 321 ft.

Top of cement: 261 ft

7-in. casing: 291 ft

2-in. tbg: 315 ft

4-1/2-in. casing: 336 ft

TESORO PETROLEUM CORPORATION
WELLBORE SCHEMATIC
CAUSTIC FLOOD PRODUCTION WELL

SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

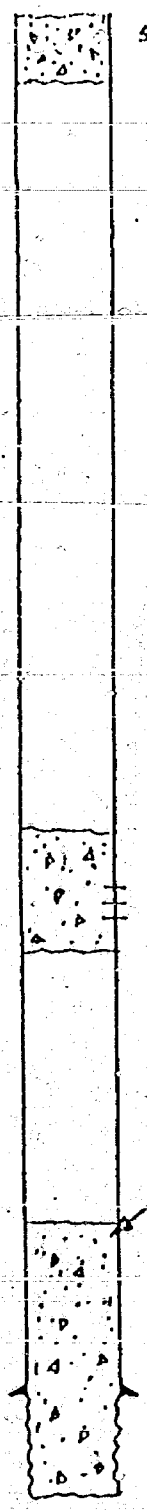
Exhibit 6

Exhibit 7

Well bore Schematics of All Plugged and Abandoned Wells

Within a One-Half Mile Radius of Proposed Injection Wells

Well Hospah Sand Unit # 8
Field: Hospah
Location: NE/SW Sec. 1-17N-9W
County: McKinley State: N.M.
Zero Elevation: ____ Ft. (____ AGL) GL.: ____
TD: 1578 Ft. PBTD: ____ Ft.



5 sk cement plug in top of 7" csg.

Wellhead: ____

Tubing String: ____

Centralizers: ____

12¼ "OD ____ LB ____ GR. ____ THRD.
@ 22' FT. W/ 10 SX (____ FT3) cmt.
in 15 " hole (CMT. CLASS-ADDITIVES: ____)
T.O.C. @ surface BY: ____

Perforated @ 570'. Squeezed w/ 130 sx cement.
Cement Top inside 7" csg. is 300'

30 sk. cement Plug: 1578'-1450'

7 "OD 20 LB ____ GR ____ THRD.
@ 1533 FT. W/ 50 SX (____ FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES: ____)
T.O.C. @ 1300' BY: ____

TD: 1578'

UPDATED BY: KJK DATE: 12/20.

Well: Hospah Sand Unit # 11
Field: Hospah
Location: SE 1/4 NW Sec 1 T 17N R 9W
County: McKinley State: N.M.
Zero Elevation: Ft. (AGL) Gl.:
TD: 1550 Ft. PBTD:

Wellhead:

Tubing String:

Centralizers:

12 "OD LB GR THRD.
@ 22 FT. w/ 12 SX (FT3) cmt.
in 15 " hole (CMT. CLASS-ADDITIVES:)
T.O.C. @ surface BY:

7 "OD LB GR THRD.
@ 1522 FT. w/ 50 SX (FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES:)
T.O.C. @ 1280' BY:

UPDATED BY: KTK DATE: 1/21/80

top of csg.

Field: Hospah
Location: NW 1/NE Sec. 1 - T 17N - R 9W
County: McKinley State: N. M.
Zero Elevation: _____ Ft. (_____ AGL) GL: _____
TD: 2852 Ft. PBTD: _____ Ft.

Wellhead: _____

Tubing String: _____

Centralizers: _____

13 3/8" OD LB GR THRD.
@ 207 FT. W/ 150 SX (_____ FT³) cmt.
in 17½" hole (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ surface BY: _____

9 5/8" OD LB GR THRD.
@ 3317 FT. W/ 325 SX (_____ FT³) cmt.
in 12¼" HOLE (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ 2400' BY: _____

10 sk cement plug: 3314'-3280'

10 sk cement plug: 3750'-3720'

10 sk cement plug: 4800'-4770'

10 sk cement plug: 5100'-5070'

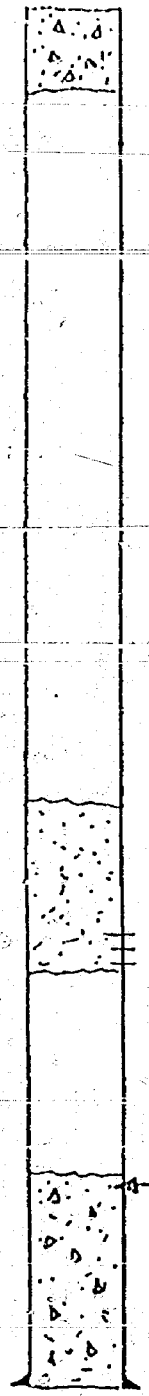
10 sk cement plug: 5500'-4970'

10 sk cement plug: 7050'-7020'

TD. 7852'

UPDATED BY: K.T.K. DATE: 1/21/80

Well: Hospah Sand Unit #42
Field: Hospah
Location: NE 1/4 NW Sec. 1 T 17N R 9W
County: McKinley State: N.M.
Zero Elevation: Ft. (AGL) GL:
TD: 1611 Ft. PBTD: Ft.



10' cement plug @ top of csg.

Wellhead:

Tubing String:

Centralizers:

← No Surface Casing

" OD LB GR THRD.
@ FT. w/ SX (FT³) cmt.
in " hole (CMT. CLASS-ADDITIVES:
)
T.O.C. @ BY:

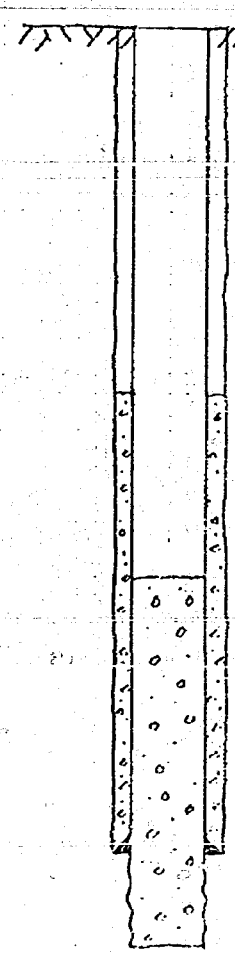
Perforated @ 499'. Squeezed w/ 80 sx cement.
Cement Top inside csg. @ 277'

← 25 sk. cement plug: 1610'-1481'

7 " OD LB GR THRD.
@ 1611 FT. w/ 70 SX (FT³) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES:
)
T.O.C. @ 1400' BY:

TD - 1611'

UPDATED BY: K.J.K DATE: 1/21/87



GROUND LEVEL

CSG CEMENTED W/75 SX
TOP OF CEMENT UNKNOWN

P & A 7/46 W/ 25 SX CMT
TOP OF CMT @ 1,354 FT

5-½-IN. CSG @ 1,554 FT

TD 1,572 FT

Wellbore Schematic
Well No. 44
Plugged and Abandoned Well

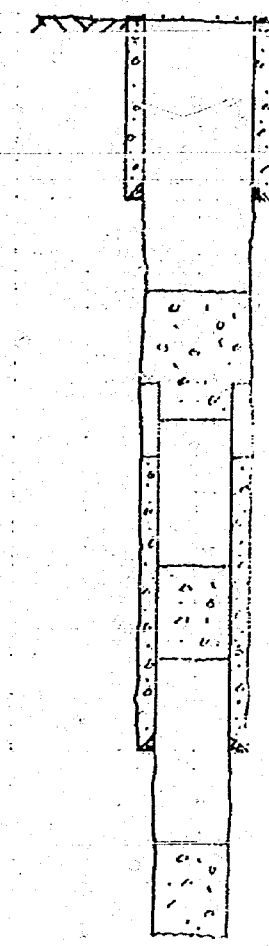
CSG CEMENTED W/ 85 SX
TOP OF CEMENT UNKNOWN

P&A 11/30/45 W/ 50 SX CMT
TOP OF CMT @ 1,214 FT

5-1/2-IN. CSG @ 1,634 FT

TD 1,818 FT

Wellbore Schematic
Well No. 45
Plugged and Abandoned Well



CSG CEMENTED W/110 SX

8-5/8-IN. CSG @ 123 FT

SPOTTED 30 SX CEMENT
883-745 FT

CSG SHOT OFF AT 825 FT

CSG CEMENTED W 140 SX
TOP OF CEMENT UNKNOWN

SPOTTED 15 SX CEMENT
1,644-1,513 FT.

5-1/2-IN. CSG @ 1,698 FT

PBTD 1,750 FT
PB W/ 125 SX CEMENT

TD 2,800 FT

Wellbore Schematic
Well No. 57
Plugged and Abandoned Well

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

WATER ANALYSIS

File IWTL-7117

Company Tesoro Petroleum Corporation Well Name Water supply well Sample No. 1

Formation Morrison Depth 3100' - 3200' Sampled From unit 534 Hospah sand

Location ____ Field ____ County ____ State ____

Date Sampled ____ Date Analyzed 3-11-71 Analyst RAL

Total Dissolved Solids 774 mg/L calculated

Specific Gravity 0.9993 @ 60° F. / 0.9965 @ 74 °F.

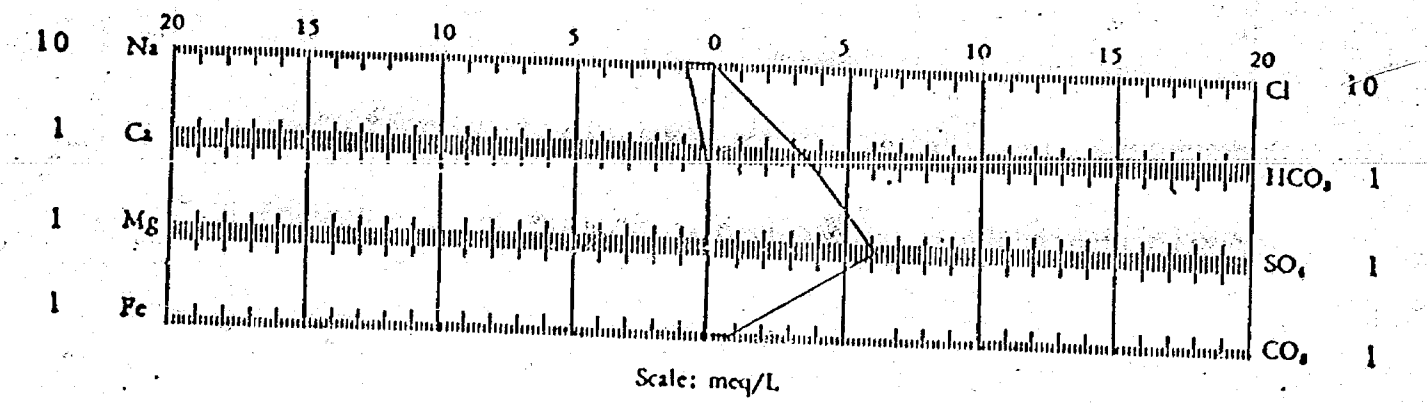
Resistivity 9.097 ohm-meters @ 74 °F. measured

Hydrogen Sulfide absent

pH 9.05 @ 76 °F.

* Constituents	meq/L	mg/L
Sodium	10.19	234
Calcium	0.24	4.8
Magnesium	0.03	0.4
Iron	0.01	0.33
Barium	0.0	0.0 (Grav.)

Constituents	meq/L	mg/L
Chloride	0.27	9.7
Bicarbonate	3.51	214
Sulfate	6.12	294 (Grav.)
Carbonate	0.57	17
Hydroxide	0.0	0.0



Scale: meq/L

* All analyses except iron determination performed on a filtered sample.

Exhibit 8

PROPOSAL FOR A CAUSTIC FLOOD PILOT
HOSPAH FIELD

Tesoro Petroleum Corporation proposes to install and operate a caustic flood pilot in the Hospah field, Mc Kinley County, New Mexico. The purpose of the pilot is to evaluate the feasibility of the caustic flood process in the shallow Seven Lakes sand. The objectives are:

1. To establish the presence of a mobile oil phase in the Seven Lakes sand.
2. To evaluate reservoir fluid properties and the effect of caustic solutions on those properties.
3. To evaluate the displacement process in core samples and the effect of caustic solutions on displacement.
4. To evaluate the feasibility of treating produced water.
5. To confirm laboratory findings by pilot flooding.
6. To evaluate the economic feasibility of a caustic flood process in the Seven Lakes sand.
7. To expand the caustic flood process over the field area if warranted by findings.

The Hospah field currently produces from the upper Hospah sand of Upper Cretaceous age. Tesoro operates the field as the Hospah Sand Unit waterflood.

The shallow, Upper Cretaceous, Seven Lakes sand has not been successfully tested at Hospah but has produced in the area in the Seven Lakes field which is located about 15 miles west-northwest of Hospah. Available core data establish only that a residual oil saturation is present. The trapping mechanism is a horst located on the northern plunge of an anticline. The sand has an average porosity of 0.285 and an average permeability of 270 md as determined by core analysis. By analogy with the Seven Lakes field, the oil is expected to be gas free and to have a gravity of 30.5° API.

Cores of the Seven Lakes sand in the pilot area had an average oil saturation of 21.1 percent. It is expected that this saturation has been affected by the flushing of the drilling fluids used and that the in-place oil saturation is somewhat higher. If the actual saturation is as much as 30 percent, the initial oil in place would be 650.3 STB/acre-ft. A caustic flood might be expected to produce 25 percent of this residual oil or 162.6 STB/acre-ft. This represents a potential of 766,000 STB of oil from a fully developed project.

The following procedure describes the installation and operation of a mini-pilot flood project to test and evaluate the caustic-flood process for the Seven Lakes sand. The sand occurs at a depth of about 300 feet. The pattern is a one-acre normal five-spot consisting of one production well and four injection wells.

The general procedure is:

1. Drill, core, and complete a production well in Sec. 1-T17N-R9W at the location described (see Exhibit 1). Core the interval of interest (30 ft) and preserve and freeze the core for laboratory analyses.

2. Install test equipment and test producing well to establish productivity and nature of produced fluids. Sample any produced fluid for laboratory analyses.

3. Drill, core, and complete four injection wells at locations 147.6 ft from the production well at the locations described (see Exhibit 1). Core the intervals of interest (30 ft each) and preserve and freeze the cores for laboratory analyses.

4. Conduct pressure falloff tests of injection wells to determine injectivity of each. Stimulate wells as needed to remove any wellbore damage. Run a production log over the sand interval to define the initial injection profile.

5. Install surface facilities required to lift, treat, and store the produced fluids including pumping unit, flowlines, free-water knockout, and other oil-water dehydration or demulsification equipment as needed.

6. Install caustic-brine injection facilities; supply water treating and softening facilities as necessary; and injection pumps and lines.

7. Inject a softened water pre-flush into the four injection wells. Chemical tracers will be injected during this phase to investigate flood pattern development and time of breakthrough of the pre-flush slug. The pre-flush will consist of approximately 13,000 bbl of 1.0 percent by weight of sodium chloride (NaCl). The estimated injection rate into four wells is 172 BPD with an injection pressure of 60 psig. The estimated pre-flush injection period is 2.5 months.

8. Inject caustic slug into the four injection wells. Chemical tracers will be injected with the slug to observe breakthrough patterns and times. Periodic injection profiles and production profiles will be taken to monitor changes in vertical efficiency. The slug will consist of approximately 26,000 bbl of 0.1 percent by weight of sodium hydroxide (NaOH). The estimated caustic slug injection period is five months.

9. Inject caustic-brine solution into the four injection wells. The solution will consist of 0.1 percent by weight of NaOH and 1.0 percent by weight of NaCl. Approximately 51,000 bbl of the solution will be injected over a period of ten months.

10. Injection wells will be acidized as needed to maintain injection rates.

11. During the pilot test period, laboratory studies will be conducted to investigate the entrapment and entrainment mechanisms of caustic flooding. Tests will also be made to determine the methods to be used in dehydrating the produced emulsion and in treating the produced water for reinjection.

A one-acre pattern has been selected for the pilot to minimize the time required to evaluate the process and to limit the field area affected by the injected fluids. If one-half of the injected fluid is lost outside the pattern area, only two acres of the field would be swept. This represents an average radial distance of 295 ft from the production well. The nearest existing wellbore is Hospah Sand Unit No. 13, which is located 482.5 ft from the proposed production well. The casing annuli of those wells offsetting the pattern will be monitored for pressure changes or other

evidence of influence by the injected fluids. If such evidence is noted, Tesoro will take necessary action to prevent wellbore communication with other sands. This would include squeezing the affected annulus with cement from the Seven Lakes interval to the surface.

The source of the injection water supply is the Morrison formation at a depth of 3,100 to 3,200 ft. This sand is currently supplying fresh water for injection into the upper Hospah sand. A typical water analysis is shown by Exhibit 8. The Seven Lakes sand is believed to contain fresh water but no analysis is available.

STATE OF NEW MEXICO

DEPARTMENT OF ENERGY AND MINERALS

OIL CONSERVATION DIVISION

RECEIVED
OCT 02 1980
OIL CONSERVATION DIVISION
SANTA FE

IN THE MATTER OF THE APPLICATION OF TESORO PETROLEUM CORPORATION FOR APPROVAL OF A PILOT PROJECT, INCLUDING WELL-SPACING EXCEPTIONS FOR INJECTION AND PRODUCING WELLS, SEVEN LAKES SAND OF THE UPPER HOSPAH FORMATIONS, HOSPAH FIELD, MCKINLEY COUNTY, NEW MEXICO.

Case 7020

A P P L I C A T I O N

COMES NOW TESORO PETROLEUM CORPORATION, by and through its attorneys, KELLAHIN & KELLAHIN, and applies to the Oil Conservation Division of the State of New Mexico for approval of a pilot caustic flood project for the Upper Hospah formations of the Hospah Field, McKinley County, New Mexico and in support thereof would show:

1. Applicant is the operator in the Upper Hospah formation of the Hospah Field, McKinley County, New Mexico, including Section 1, T17N, R9W, NMPM.

2. Applicant seeks to initiate a pilot caustic flood project in the Seven Lakes Sand of the Upper Hospah formation at a location in the NE/4SW/4 Section 1, T17N, R9W, NMPM hereinafter set forth.

3. The Hospah field is now in its later stages of secondary recovery by waterflood and applicant proposes to determine by the proposed pilot project the feasibility of a tertiary recovery project by the use of a caustic flood process. Attached as Exhibit "1" is a plat showing all wells in the area.

4. Applicant proposes to drill four injection wells and one producing well within a one acre area to a depth sufficient to penetrate the Seven Lakes Sand of the Upper Hospah Field at the following locations:

(a) Production well 330 feet from the west line and 330 feet from the north line of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(b) Injection well 225.6 feet from the west line and 225.6 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(c) Injection well 434.3 feet from the west line and 225.6 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(d) Injection well 434.3 feet from the west line and 434.3 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(e) Injection well 225.6 feet from the west line and 434.3 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

5. In accordance with Rule 701 of the Rules of the New Mexico Oil Conservation Division, the following Exhibits are attached and incorporated herein by reference:

(a) Exhibit 2: Plat showing the location of the project and all other wells within a two mile radius.

(b) Exhibit 3: A tabular summary of all wells within a one-half mile radius;

(c) Exhibit 4: A type Log (Well No. 55)

(d) Exhibit 5: A Wellbore Schematic of the proposed injection wells;

(e) Exhibit 6: a Wellbore Schematic of the proposed producing well;

(f) Exhibit 7: Wellbore Schematics of all plugged and abandoned wells within a one-half mile radius;

6. The injection of the caustic fluid will consist of 0.1 percent by weight of sodium hydroxide in solution with water and will be injected at pressures below that required to fracture the confining strata.

7. The proposed pilot project has a potential life of two years from commencement.

8. The proposed pilot will be limited to the Seven Lakes Sand of the Upper Hospah Field at an approximate depth of 300-500 feet.

9. The potable water utilized in the area as well as the source water for this pilot project is in the Morrison formation at a depth of 3,100 to 3,200 feet. A typical water analysis is attached as Exhibit 8.

10. The proposed pilot project as outlined in Exhibit 9, attached hereto, will not present a risk of contamination of fresh-water sources in the area, will not impair the correlative rights of others, will be in the best interests of conservation, will determine the feasibility of a caustic flood of this formation, and will not cause waste.

WHEREFORE, Applicant seeks approval for this application for a pilot caustic flood project in the Sevel Lakes Sand of the Upper Hospah Field, McKinley County, New Mexico including but not limited to authority to:

(a) to approve the drilling and spacing of the

proposed injection wells and producing well at the proposed location;

(b) to approve the proposed pilot project;

(c) grant such additional authority and approval as may be required to implement the proposed pilot project.

KELLAHIN KELLAHIN

By: W. Thomas Kellahin

W. Thomas Kellahin
P.O. Box 1769
Santa Fe, New Mexico 87501
(505) 982-4285

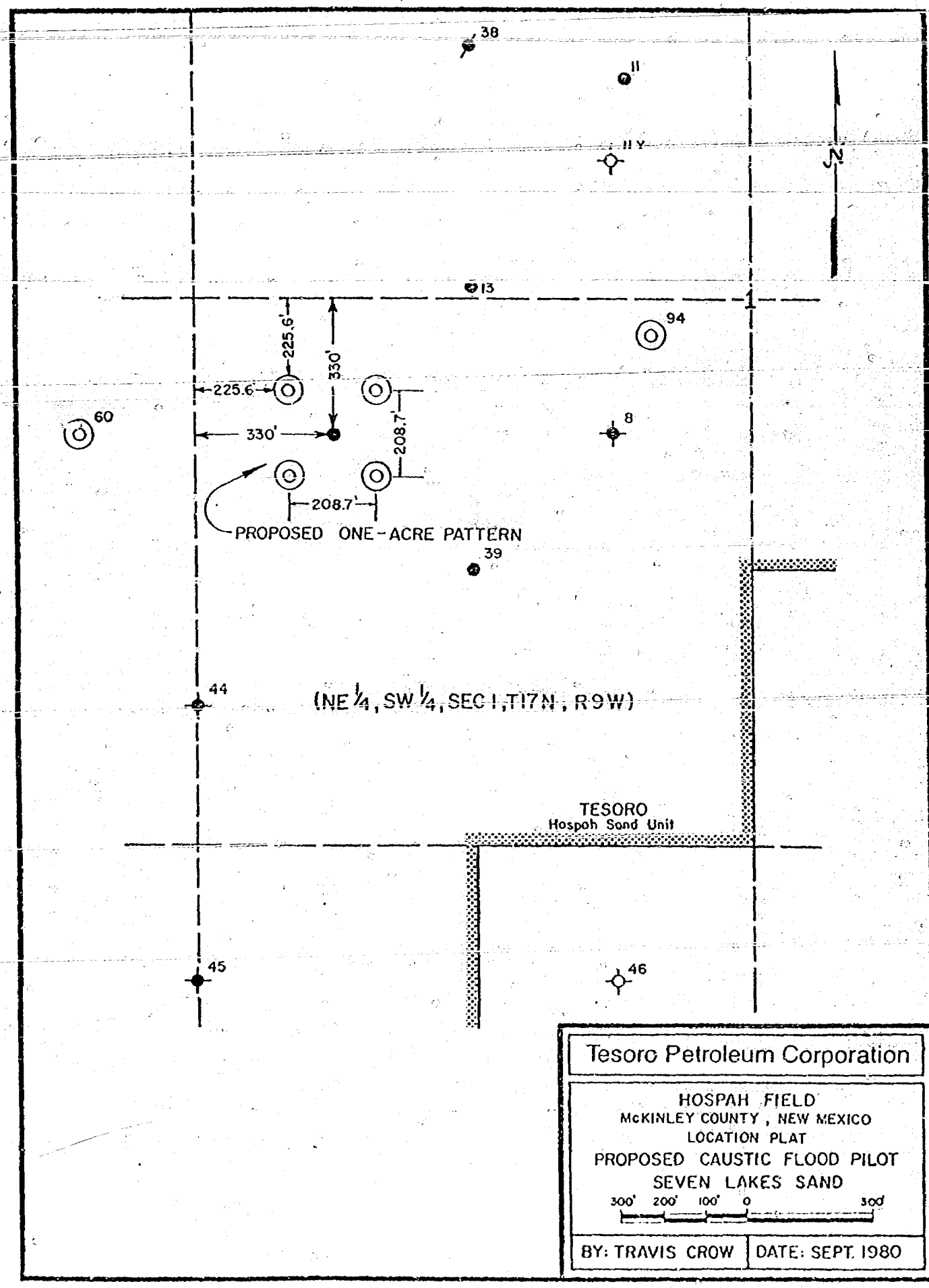

38
11
11 Y
13
94
225.6'
330'
225.6
208.7'
60
8
208.7'
PROPOSED ONE-ACRE PATTERN
39
44
(NE¼, SW¼, SEC 1, T17N, R9W)
TESORO
Hospah Sand Unit
45
46
Tesoro Petroleum Corporation
HOSPAH FIELD
McKINLEY COUNTY, NEW MEXICO
LOCATION PLAT
PROPOSED CAUSTIC FLOOD PILOT
SEVEN LAKES SAND
300' 200' 100' 0 300'
BY: TRAVIS CROW
DATE: SEPT. 1980

Exhibit 1


P R R
McMillan-White
Pet Prod Co
ENNECO
2
WELLS
1/2 MILE FROM
INJECTION WELLS
TESORO
M. 8270
Santa Fe R.R. "A" S.F.P. No. 3487
TENNECO
-11
12

Exhibit 3

Wells Within 1/2 Mile of Proposed Injection Wells

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	HSU #8	NE-SW Sec 1-17N-9W	12 1/2" 7"	22' 1533'	10 sx 50 sx	surface 1300'	1578'	P & A	--
Tesoro	HSU #9	NW-SE Sec 1-17N-9W	10" 7"	17' 1535'	10 sx 40 sx	surface 1350'	1570'	1535'-70'	U. Hospah
Tesoro	HSU #13	SE-NW Sec 1-17N-9W	10" 7"	22' 1530'	15 sx 50 sx	surface 1300'	1561'	1530'-61'	U. Hosp
Tesoro	HSU #11	SE-NW Sec 1-17N-9W	12" 7"	22' 1522'	12 sx 50 sx	surface 1280'	1550'	P & A	--
Tesoro	HSU #11-Y	SE-NW Sec 1-17N-9W	8 5/8" 5 1/2"	73' 1538'	60 sx 150 sx	surface 590'	1563'	1538'-63'	U. Hospah
Tesoro	HSU #38	SE-NW Sec 1-17N-9W	5 1/2"	1557'	50 sx	1250'	1565'	1557'-65'	U. Hospah
Tesoro	HSU #2	SE-NW Sec 1-17N-9W	8 5/8"	1528'	75 sx	1340'	1576'	1528'-76'	U. Hospah
Tesoro	HSU #21	SE-NW Sec 1-17N-9W	7"	1547'	40 sx	1360'	1591'	1547'-85'	U. Hospah
Tesoro	HSU #84	SE-NW Sec 1-17N-9W	8 5/8" 4 1/2"	70' 1536'	50 sx 120 sx	surface 879'	1574'	1536'-74'	U. Hospah (Injectic
Tesoro	HSU #61	SW-NW Sec 1-17N-9W	7" 4 1/2"	64' 1700'	35 sx 50 sx	surface 1220'	1715'	1632'-56'	U. Hospah (Injection
Tesoro	HSU #56	SW-NE Sec 1-17N-9W	8 5/8" 5 1/2"	302' 1694'	200 sx 140 sx	surface 268'	2730'	1514-42'	U. Hospah
Tesoro	HSU #24-A	SW-NE Sec 1-17N-9W	5 3/8"	1512'	75 sx	1190'	1552'	1512'-52'	U. Hospah
Tesoro	HSU #52	SW-NE Sec 1-17N-9W	7"	1514'	50 sx	1330'	1526'	1514'-26'	U. Hospah

Tabular Summary of All Wells
Within a One-Half Mile Radius
of Proposed Injection Wells

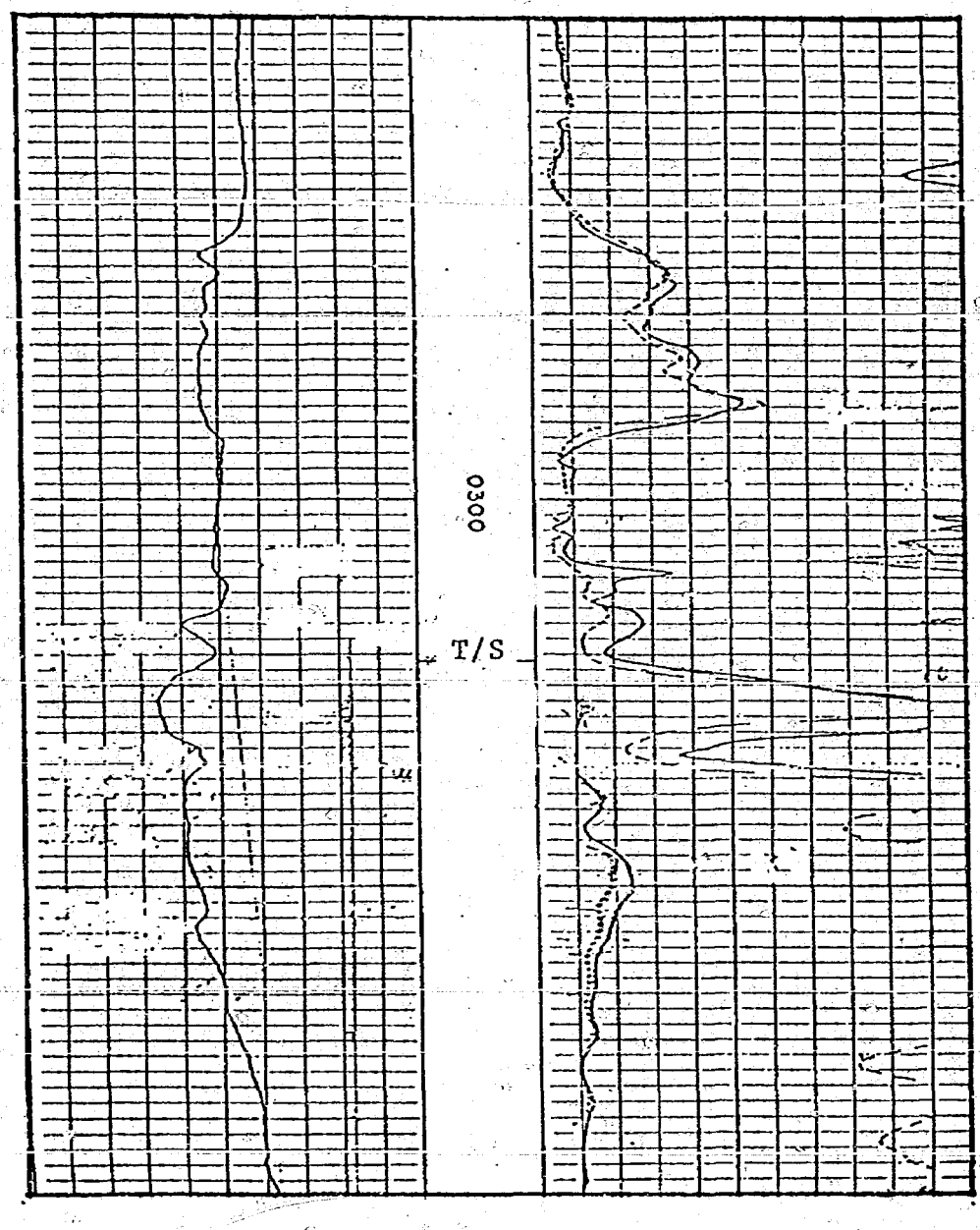
Wells Within 1/2 Mile of Proposed Injection Wells

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producin Formatio
Tesoro	HSU #85	SW-NE Sec 1-17N-9W	8 5/8" 5 1/2"	104' 1535'	100 sx 150 sx	surface 450'	1551'	1535'-51'	U. Hospa
Tesoro	HSU #67	SE-NE Sec 1-17N-9W	7" 4 1/2"	83' 1634'	35 sx 55 sx	surface 1150'	1636'	1546'-64'	U. Hospa (Injection
Tesoro	HSU #23	NW-NE Sec 1-17N-9W	5 3/8"	1523'	75 sx	1200'	1570'	1528'-70'	U. Hospah
Tesoro	SF Hurst #1	NW-NE Sec 1-17N-9W	13 3/8" 9 5/8"	207' 3317'	150 sx 325 sx	surface 2400'	7852'	P & A	--
Tesoro	HSU #51	NW-NE Sec 1-17N-9W	7"	1532'	50 sx	1340'	1576'	1532'-76'	U. Hospah
Tesoro	HSU #12	NW-NE Sec 1-17N-9W	10" 7"	21' 1535'	12 sx 45 sx	surface 1320'	1580'	1535'-80'	U. Hospah
Tesoro	HSU #4	NE-NW Sec 1-17N-9W	7"	1611'	70 sx	1400'	1611'	P & A	--
Tesoro	HSU #4Y	NE-NW Sec 1-17N-9W	8 5/8" 5 1/2"	74' 1556'	60 sx 150 sx	surface 620'	1581'	1556'-81'	U. Hospah
Tesoro	HSU #6	NE-NW Sec 1-17N-9W	11" 7"	20' 1538'	55 sx 70 sx	surface 1230'	1582'	1538'-82'	U. Hospah
Tesoro	HSU #22	NE-NW Sec 1-17N-9W	7"	1553'	41 sx	1360'	1595'	1553'-95'	U. Hosp.
Tesoro	HSU #5	NE-NW Sec 1-17N-9W	14" 6 5/8"	80' 1604'	16 sx 75 sx	50' 1300'	1604'	1552'-65'	U. Hospah

Tabular Summary of All Wells
Within a One-Half Mile Radius
of Proposed Injection Wells

operator	Well Name	Location	Casing String	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation		
Texaco	HSU 93	NE-NW-Sec.1-17N-9W	8 5/8"	28'	30 sx	surface	1605'	1540-1560'	U. Hospah (Inj)		
			5 1/2"	1632'	125 sx est	1100'					
Texaco	HSU 87	NW-NE-Sec1-17N-9W	8 5/8"	53'	35 sx		1590'	1535-1555'	U. Hospah (Inj)		
			5 1/2"	1530'	120 sx						
Tex. Prod. Co.	"A"	SE-NE-Sec 2-17N-9W	—	—	—	—	—	—	P & A		
Texaco	HSU 55	SW-NE-Sec 1-17N-9W	4 1/2"	447'	50 sx	surface	450'	310-348'	Temp. abnd in Seven Lakes sd.	Dry Hole	TA
Texaco	Hubbard #1	NE-SE-Sec 2-17N-9W	—	—	—	—	—	—	P & A		
Texaco	HSU 67	SE-NE-Sec 1-17N-9W	7"	32.8'	35 sx est	circ.	1636'	1552-1560'	U. Hospah (Inj)		
			4 1/2"	1634'	55 sx	1350'		1563-1570'			
Texaco	HSU 60	NW-SW-Sec1-17N-9W	7"	84'	35 sx est	circ.	1640'	1559-1590'	U. Hospah (Inj)		
			4 1/2"	1640'	50 sx	1350'		1600-1601'			
Texaco	HSU 44	NE-SW-Sec 1-17N-9W	5 1/2"	1554'	75 sx		1572'		P & A		
Texaco	HSU 89	NE-SW-Sec 1-17N-9W	—	—	—	—	1557'	—	—		
Texaco	HSU 94	NE-SW-Sec 1-17N-9W	8 5/8"	40'	30 sx	surface	1575'	1515-1530'	U. Hospah (Inj)		
			5 1/2"		125 sx	1100'					
Texaco	SFRR "A" 57	NW-SE-Sec 1-17N-9W	8 5/8"	135'	110 sx		2800'	1625-1634'	P & A		
			5 1/2"	1698'	140 sx					P & A 6/70	
Texaco	HSU 45	SE-SW-Sec 1-17N-9W	5 1/2"	1634'	85 sx		1818'		P & A		
Texaco	SFRR "A" 46	SE-SW-Sec 1-17N-9W	—	—	—	—	—	—	P & A		
Texaco	SFRR "A" 73	SW-SE-Sec 1-17N-9W	8 5/8"	63'	40 sx	circ	1665'	open hole comp.	L. Hospah		
			4 1/2"	1629'	75 sx est	1300'					
Texaco	SFRR "A" 70	SW-SE-Sec 1-17N-9W	8 5/8"	107'	50 sx	circ.	1624'	open hole comp.	U. Hospah		
			5 1/2"	1589'	50 sx	1300'		1589-1624'			

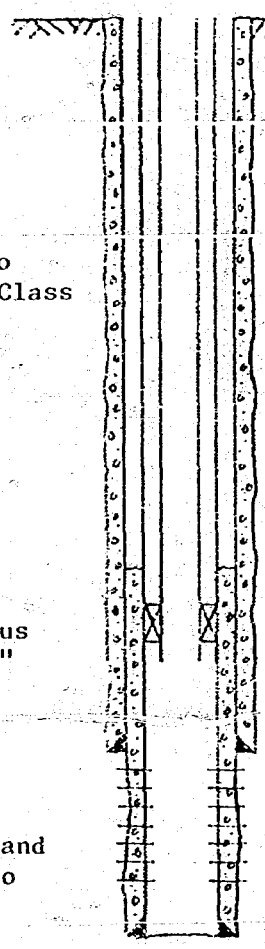
operator	Well Name		Location	Casing Strings	Setting Depth	Cement Volume		Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	SFRR "A"	81	SW-SE-Sec1-17N-9W	8 5/8"	62'	50 sx	cir	circ	1655	open hole comp.	L. Hospah
				5 1/2"	1643.5'	100 sx		700		1643.5 - 1655'	
Tesoro	SFRR "A"	34	SW-SE-Sec1-17N-9W	9 5/8"	95'	100 sx	cir	circ	1656	open hole comp.	L. Hospah (Inj)
				7"	1639'	100 sx		—			
Tesoro	SFRR "A"	89	SW-SE-Sec1-17N-9W	8 5/8"	104'	100 sx	cir	surface	1769	open hole comp.	L. Hospah
				5 1/2"	1769'	100 sx		500		1648 - 1654'	



TYPE LOG

(Well No. 55)
SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

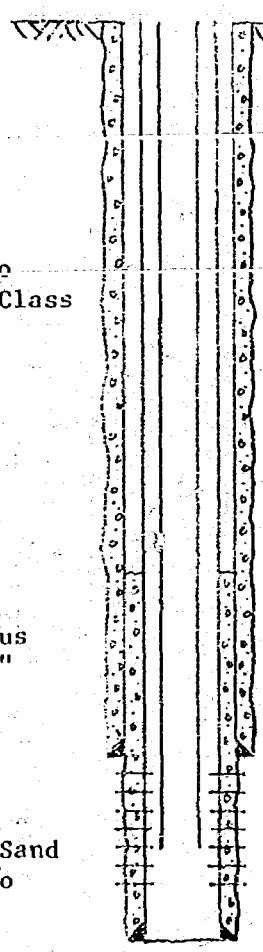
Exhibit 4



TESORO PETROLEUM CORPORATION
WELLBORE SCHEMATIC
CAUSTIC FLOOD INJECTION WELL

SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 5



Cement 7-in. annulus to surface with 50 sacks Class "A" neat.

Cement 4-1/2-in. annulus with 10 sacks Class "A" neat.

Perforate Seven Lakes Sand at approximately 291 to 321 ft.

Top of cement: 261 ft

7-in. casing: 291 ft

2-in. tbg: 315 ft

4-1/2-in. casing: 336 ft

TESORO PETROLEUM CORPORATION
WELLBORE SCHEMATIC
CAUSTIC FLOOD PRODUCTION WELL

SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 6

Exhibit 7

Well bore Schematics of All Plugged and Abandoned Wells

Within a One-Half Mile Radius of Proposed Injection Wells

Well Hospah Sand Unit # 8
Field: Hospah
Location: NE / SW Sec. 1 - T 17N - R 9W
County: McKinley State: N. M.
Zero Elevation: _____ FT. (_____ AGL) G.L.: _____
TD: 1578 FT. PBTD: _____ FT.

5 sk cement plug in top of 7" csg.

Wellhead: _____

Tubing String: _____

Centralizers: _____

12¼ "OD _____ LB _____ GR. _____ THRD.
@ 22' FT. W/ 10 SX (_____ FT³) cmt.
in 15 " hole (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ surface BY: _____

Perforated @ 570'. Squeezed w/ 130 sx cement.
Cement Top inside 7" csg. is 300'

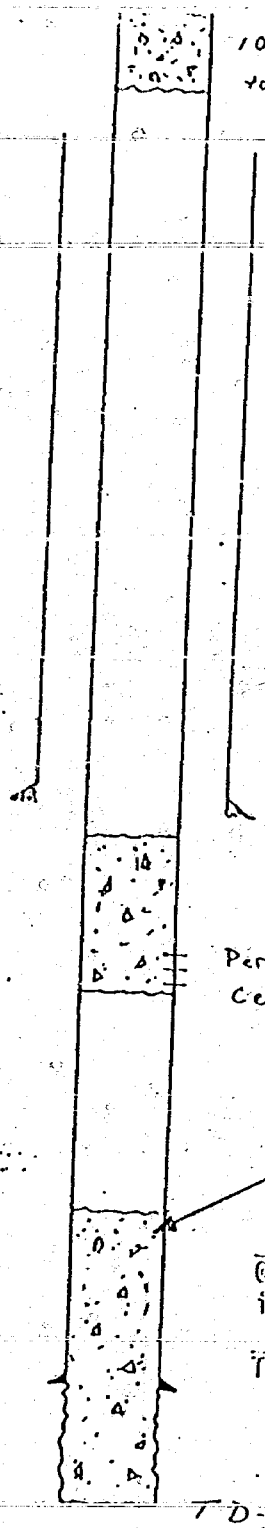
30 sk. cement Plug: 1578' - 1450'

7 "OD 20 LB _____ GR _____ THRD.
@ 1533 FT. W/ 50 SX (_____ FT³) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ 1300' BY: _____

TD - 1578'

UPDATED BY: K.J.K DATE: 1/21/80.

Well: Hospah Sand Unit # 11
Field: Hospah
Location: SE 1/4 NW Sec. 1 T. 17N R. 9W
County: McKinley State: N.M.
Zero Elevation: _____ ft. (_____ AGL) GL: _____
TD: 1550 ft. PBTD: _____ ft.



10' cement plug @ top of 7" csg.

Wellhead: _____

Tubing String: _____

Centralizers: _____

12 "OD _____ LB _____ GR _____ THRD.
@ 22 FT. w/ 12 SX (_____ FT3) cmt.
in 15 " hole (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ surface BY: _____

Perforated @ 430'. Squeezed w/ 80 sx cement
Cement top inside 7" csg. is 277'

25 sk cement plug: 1550'-1416'

7 "OD _____ LB _____ GR _____ THRD.
@ 1522 FT. w/ 50 SX (_____ FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ 1280' BY: _____

TD: 1550'

UPDATED BY: KJK DATE: 1/21/80

Field: Hospah

Location: NW NE Sec. 1 - T 17N - R 9W

County: McKinley State: N. M.

Zero Elevation: _____ Ft. (_____ AGL) GL: _____

TD: 2852 Ft. PBTD: _____ Ft.

Wellhead: _____

Tubing String: _____

Centralizers: _____

13 3/8" OD ____ LB ____ GR. ____ THRD.
@ 207 FT. W/ 150 SX (_____ FT³) cmt.
in 17½" hole (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ surface BY: _____

9 5/8" OD ____ LB ____ GR ____ THRD.
@ 3317 FT. W/ 325 SX (_____ FT³) cmt.
in 12¼" HOLE (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ 2400' BY: _____

UPDATED BY: K.T.K. DATE: 1/21/80

Well: Hospah Sand Unit #4
Field: Hospah
Location: NE 1/4 NW Sec. 1 -T 17N -R 9W
County: McKinley State: N.M.
Zero Elevation: _____ FT. (_____ AGL) GL: _____
TD: 1611 FT. PBTD: _____ FT.

10' cement plug @ top of csg.

Wellhead: _____

Tubing String: _____

Centralizers: _____

← No Surface Casing
_____ "OD LB GR THRD.
@ _____ FT. W/ SX (_____ FT3) cmt.
in _____ " hole (CMT. CLASS-ADDITIVES:
_____)
T.O.C. @ _____ BY: _____

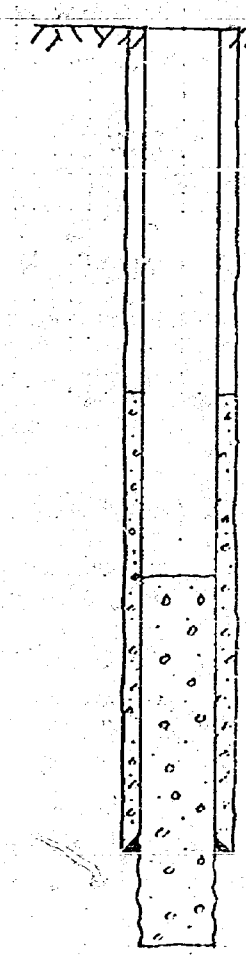
Perforated @ 499' Squeezed w/ 80 sx cement.
Cement Top inside csg. @ 277'

← 25 sk. cement plug: 1610' - 1481'

7 "OD LB GR THRD.
@ 1611 FT. W/ 70 SX (_____ FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES:
_____)
T.O.C. @ 1400' BY: _____

TD - 1611'

UPDATED BY: K.J.K DATE: 1/21/91



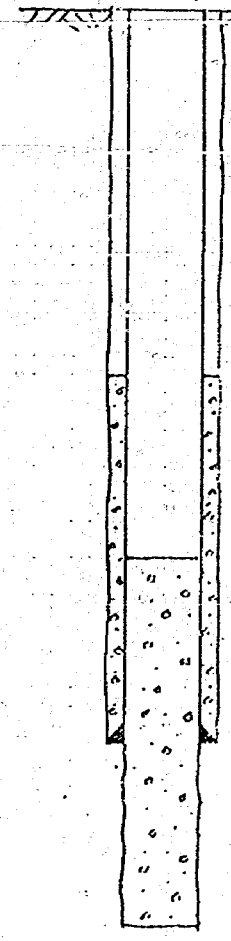
CSG CEMENTED W/75 SX
TOP OF CEMENT UNKNOWN

P & A 7/46 W/ 25 SX CMT
TOP OF CMT @ 1,231 FT

5-½-IN. CSG @ 1,554 FT

TD 1,572 FT

Wellbore Schematic
Well No. 44
Plugged and Abandoned Well



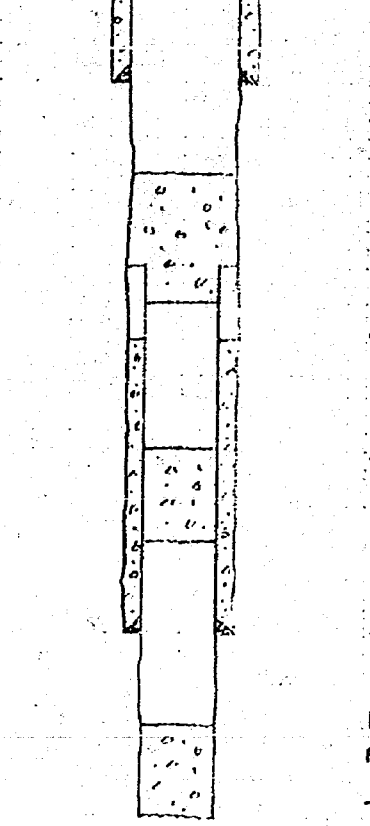
CSG CEMENTED W/ 65 SX
TOP OF CEMENT UNKNOWN

P&A 11/30/45 W/ 50 SX CMT
TOP OF CMT @ 1,214 FT

5-1/2-IN. CSG @ 1,634 FT

TD 1,818 FT

Wellbore Schematic
Well No. 45
Plugged and Abandoned Well



CSG CEMENTED W/110 SX

8-5/8-IN. CSG @ 123 FT

SPOTTED 30 SX CEMENT
883-745 FT

CSG SHOT OFF AT 825 FT

CSG CEMENTED W 140 SX
TOP OF CEMENT UNKNOWN

SPOTTED 15 SX CEMENT
1,644-1,513 FT

5-1/2-IN. CSG @ 1,698 FT

PBTD 1,750 FT
PB W/ 125 SX CEMENT

TD 2,800 FT

Wellbore Schematic
Well No. 57
Plugged and Abandoned Well

CORE LABORATORIES, INC.
Petroleum Reserve Engineering
DALLAS, TEXAS
WATER ANALYSIS

File IWTL-7117

Company Tesoro Petroleum Corporation Well Name Water supply well Sample No. 1

Formation Morrison Depth 3100' - 3200' Sampled From Hospah sand unit 53X

Location ____ Field ____ County ____ State ____

Date Sampled ____ Date Analyzed 3-11-71 Analyst RAL

Total Dissolved Solids 774 mg/L calculated

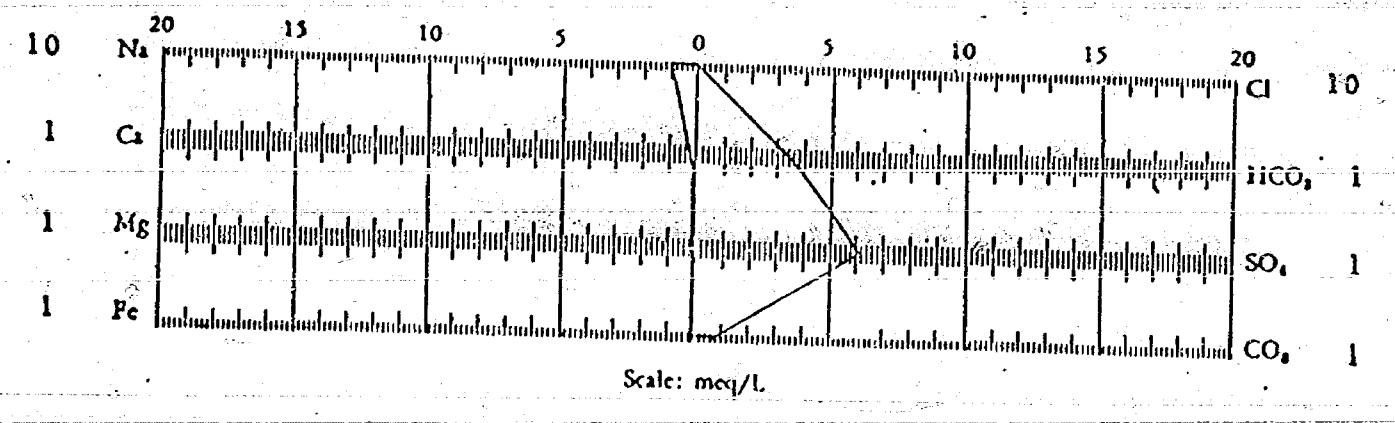
Specific Gravity 0.9993 @ 60° F. / 0.9965 @ 74 °F.

Resistivity 9.097 ohm-meters @ 74 °F. measured

pH 9.05 @ 76 °F.

Hydrogen Sulfide absent

* Constituents	meq/L	mg/L		Constituents	meq/L	mg/L	
Sodium	10.19	234		Chloride	0.27	9.7	
Calcium	0.24	4.8		Bicarbonate	3.51	214	
Magnesium	0.03	0.4		Sulfate	6.12	294	(Grav.)
Iron	0.01	0.33		Carbonate	0.57	17	
Barium	0.0	0.0	(Grav.)	Hydroxide	0.0	0.0	



Scale: meq/L

* All analyses except iron determination performed on a filtered sample.

Exhibit 8

PROPOSAL FOR A CAUSTIC FLOOD PILOT
HOSPAH FIELD

Tesoro Petroleum Corporation proposes to install and operate a caustic flood pilot in the Hospah field, Mc Kinley County, New Mexico. The purpose of the pilot is to evaluate the feasibility of the caustic flood process in the shallow Seven Lakes sand. The objectives are:

1. To establish the presence of a mobile oil phase in the Seven Lakes sand.
2. To evaluate reservoir fluid properties and the effect of caustic solutions on those properties.
3. To evaluate the displacement process in core samples and the effect of caustic solutions on displacement.
4. To evaluate the feasibility of treating produced water.
5. To confirm laboratory findings by pilot flooding.
6. To evaluate the economic feasibility of a caustic flood process in the Seven Lakes sand.
7. To expand the caustic flood process over the field area if warranted by findings.

The Hospah field currently produces from the upper Hospah sand of Upper Cretaceous age. Tesoro operates the field as the Hospah Sand Unit waterflood.

The shallow, Upper Cretaceous, Seven Lakes sand has not been successfully tested at Hospah but has produced in the area in the Seven Lakes field which is located about 15 miles west-northwest of Hospah. Available core data establish only that a residual oil saturation is present. The trapping mechanism is a horst located on the northern plunge of an anticline. The sand has an average porosity of 0.285 and an average permeability of 270 md as determined by core analysis. By analogy with the Seven Lakes field, the oil is expected to be gas free and to have a gravity of 30.5° API.

Cores of the Seven Lakes sand in the pilot area had an average oil saturation of 21.1 percent. It is expected that this saturation has been affected by the flushing of the drilling fluids used and that the in-place oil saturation is somewhat higher. If the actual saturation is as much as 30 percent, the initial oil in place would be 650.3 STB/acre-ft. A caustic flood might be expected to produce 25 percent of this residual oil or 162.6 STB/acre-ft. This represents a potential of 766,000 STB of oil from a fully developed project.

The following procedure describes the installation and operation of a mini-pilot flood project to test and evaluate the caustic-flood process for the Seven Lakes sand. The sand occurs at a depth of about 300 feet. The pattern is a one-acre normal five-spot consisting of one production well and four injection wells.

EXHIBIT 9

The general procedure is:

1. Drill, core, and complete a production well in Sec. 1-T17N-R9W at the location described (see Exhibit 1). Core the interval of interest (30 ft) and preserve and freeze the core for laboratory analyses.

2. Install test equipment and test producing well to establish productivity and nature of produced fluids. Sample any produced fluid for laboratory analyses.

3. Drill, core, and complete four injection wells at locations 147.6 ft from the production well at the locations described (see Exhibit 1). Core the intervals of interest (30 ft each) and preserve and freeze the cores for laboratory analyses.

4. Conduct pressure falloff tests of injection wells to determine injectivity of each. Stimulate wells as needed to remove any wellbore damage. Run a production log over the sand interval to define the initial injection profile.

5. Install surface facilities required to lift, treat, and store the produced fluids including pumping unit, flowlines, free-water knockout, and other oil-water dehydration or demulsification equipment as needed.

6. Install caustic-brine injection facilities; supply water treating and softening facilities as necessary; and injection pumps and lines.

7. Inject a softened water pre-flush into the four injection wells. Chemical tracers will be injected during this phase to investigate flood pattern development and time of breakthrough of the pre-flush slug. The pre-flush will consist of approximately 13,000 bbl of 1.0 percent by weight of sodium chloride (NaCl). The estimated injection rate into four wells is 172 BPD with an injection pressure of 60 psig. The estimated pre-flush injection period is 2.5 months.

8. Inject caustic slug into the four injection wells. Chemical tracers will be injected with the slug to observe breakthrough patterns and times. Periodic injection profiles and production profiles will be taken to monitor changes in vertical efficiency. The slug will consist of approximately 26,000 bbl of 0.1 percent by weight of sodium hydroxide (NaOH). The estimated caustic slug injection period is five months.

9. Inject caustic-brine solution into the four injection wells. The solution will consist of 0.1 percent by weight of NaOH and 1.0 percent by weight of NaCl. Approximately 51,000 bbl of the solution will be injected over a period of ten months.

10. Injection wells will be acidized as needed to maintain injection rates.

11. During the pilot test period, laboratory studies will be conducted to investigate the entrapment and entrainment mechanisms of caustic flooding. Tests will also be made to determine the methods to be used in dehydrating the produced emulsion and in treating the produced water for reinjection.

A one-acre pattern has been selected for the pilot to minimize the time required to evaluate the process and to limit the field area affected by the injected fluids. If one-half of the injected fluid is lost outside the pattern area, only two acres of the field would be swept. This represents an average radial distance of 295 ft from the production well. The nearest existing wellbore is Hospah Sand Unit No. 13, which is located 482.5 ft from the proposed production well. The casing annuli of those wells offsetting the pattern will be monitored for pressure changes or other

evidence of influence by the injected fluids. If such evidence is noted, Tesoro will take necessary action to prevent wellbore communication with other sands. This would include squeezing the affected annulus with cement from the Seven Lakes interval to the surface.

The source of the injection water supply is the Morrison formation at a depth of 3,100 to 3,200 ft. This sand is currently supplying fresh water for injection into the upper Hospah sand. A typical water analysis is shown by Exhibit 8. The Seven Lakes sand is believed to contain fresh water but no analysis is available.

PROPOSAL FOR A CAUSTIC FLOOD PILOT
HOSPAH FIELD

Tesoro Petroleum Corporation proposes to install and operate a caustic flood pilot in the Hospah field, Mc Kinley County, New Mexico. The purpose of the pilot is to evaluate the feasibility of the caustic flood process in the shallow Seven Lakes sand. The objectives are:

1. To establish the presence of a mobile oil phase in the Seven Lakes sand.
2. To evaluate reservoir fluid properties and the effect of caustic solutions on those properties.
3. To evaluate the displacement process in core samples and the effect of caustic solutions on displacement.
4. To evaluate the feasibility of treating produced water.
5. To confirm laboratory findings by pilot flooding.
6. To evaluate the economic feasibility of a caustic flood process in the Seven Lakes sand.
7. To expand the caustic flood process over the field area if warranted by findings.

The Hospah field currently produces from the upper Hospah sand of Upper Cretaceous age. Tesoro operates the field as the Hospah Sand Unit waterflood.

The shallow, Upper Cretaceous, Seven Lakes sand has not been successfully tested at Hospah but has produced in the area in the Seven Lakes field which is located about 15 miles west-northwest of Hospah. Available core data establish only that a residual oil saturation is present. The trapping mechanism is a horst located on the northern plunge of an anticline. The sand has an average porosity of 0.285 and an average permeability of 270 md as determined by core analysis. By analogy with the Seven Lakes field, the oil is expected to be gas free and to have a gravity of 30.5° API.

Cores of the Seven Lakes sand in the pilot area had an average oil saturation of 21.1 percent. It is expected that this saturation has been affected by the flushing of the drilling fluids used and that the in-place oil saturation is somewhat higher. If the actual saturation is as much as 30 percent, the initial oil in place would be 650.3 STB/acre-ft. A caustic flood might be expected to produce 25 percent of this residual oil or 162.6 STB/acre-ft. This represents a potential of 766,000 STB of oil from a fully developed project.

The following procedure describes the installation and operation of a mini-pilot flood project to test and evaluate the caustic-flood process for the Seven Lakes sand. The sand occurs at a depth of about 300 feet. The pattern is a one-acre normal five-spot consisting of one production well and four injection wells.

The general procedure is:

1. Drill, core, and complete a production well in Sec. 1-T17N-R9W at the location described (see Exhibit 1). Core the interval of interest (30 ft) and preserve and freeze the core for laboratory analyses.

2. Install test equipment and test producing well to establish productivity and nature of produced fluids. Sample any produced fluid for laboratory analyses.

3. Drill, core, and complete four injection wells at locations 147.6 ft from the production well at the locations described (see Exhibit 1). Core the intervals of interest (30 ft each) and preserve and freeze the cores for laboratory analyses.

4. Conduct pressure falloff tests of injection wells to determine injectivity of each. Stimulate wells as needed to remove any wellbore damage. Run a production log over the sand interval to define the initial injection profile.

5. Install surface facilities required to lift, treat, and store the produced fluids including pumping unit, flowlines, free-water knockout, and other oil-water dehydration or demulsification equipment as needed.

6. Install caustic-brine injection facilities; supply water treating and softening facilities as necessary; and injection pumps and lines.

7. Inject a softened water pre-flush into the four injection wells. Chemical tracers will be injected during this phase to investigate flood pattern development and time of breakthrough of the pre-flush slug. The pre-flush will consist of approximately 13,000 bbl of 1.0 percent by weight of sodium chloride (NaCl). The estimated injection rate into four wells is 172 BPD with an injection pressure of 60 psig. The estimated pre-flush injection period is 2.5 months.

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11. During the pilot test period, laboratory studies will be conducted to investigate the entrapment and entrainment mechanisms of caustic flooding. Tests will also be made to determine the methods to be used in dehydrating the produced emulsion and in treating the produced water for reinjection.

A one-acre pattern has been selected for the pilot to minimize the time required to evaluate the process and to limit the field area affected by the injected fluids. If one-half of the injected fluid is lost outside the pattern area, only two acres of the field would be swept. This represents an average radial distance of 295 ft from the production well. The nearest existing wellbore is Hospah Sand Unit No. 13, which is located 482.5 ft from the proposed production well. The casing annuli of those wells offsetting the pattern will be monitored for pressure changes or other

evidence of influence by the injected fluids. If such evidence is noted, Tesoro will take necessary action to prevent wellbore communication with other sands. This would include squeezing the affected annulus with cement from the Seven Lakes interval to the surface.

The source of the injection water supply is the Morrison formation at a depth of 3,100 to 3,200 ft. This sand is currently supplying fresh water for injection into the upper Hospah sand. A typical water analysis is shown by Exhibit 8. The Seven Lakes sand is believed to contain fresh water but no analysis is available.

LIST OF EXHIBITS

PROPOSAL FOR A CAUSTIC FLOOD PILOT

HOSPAH FIELD

1. Location Plat, Proposed Caustic Flood Pilot

2. Proposed Location, Caustic Flood Pilot

3. Tabular Summary of All Wells Within a One-Half Mile Radius of Proposed Injection Wells

4. Type Log (Well No. 55)

5. Wellbore Schematic, Caustic Flood Injection Well

6. Wellbore Schematic, Caustic Flood Production Well

7. Wellbore Schematics of All Plugged and Abandoned Wells Within a One-Half Mile Radius of Proposed Injection Wells

8. Water Analysis, Water Supply Well

9. Geology.

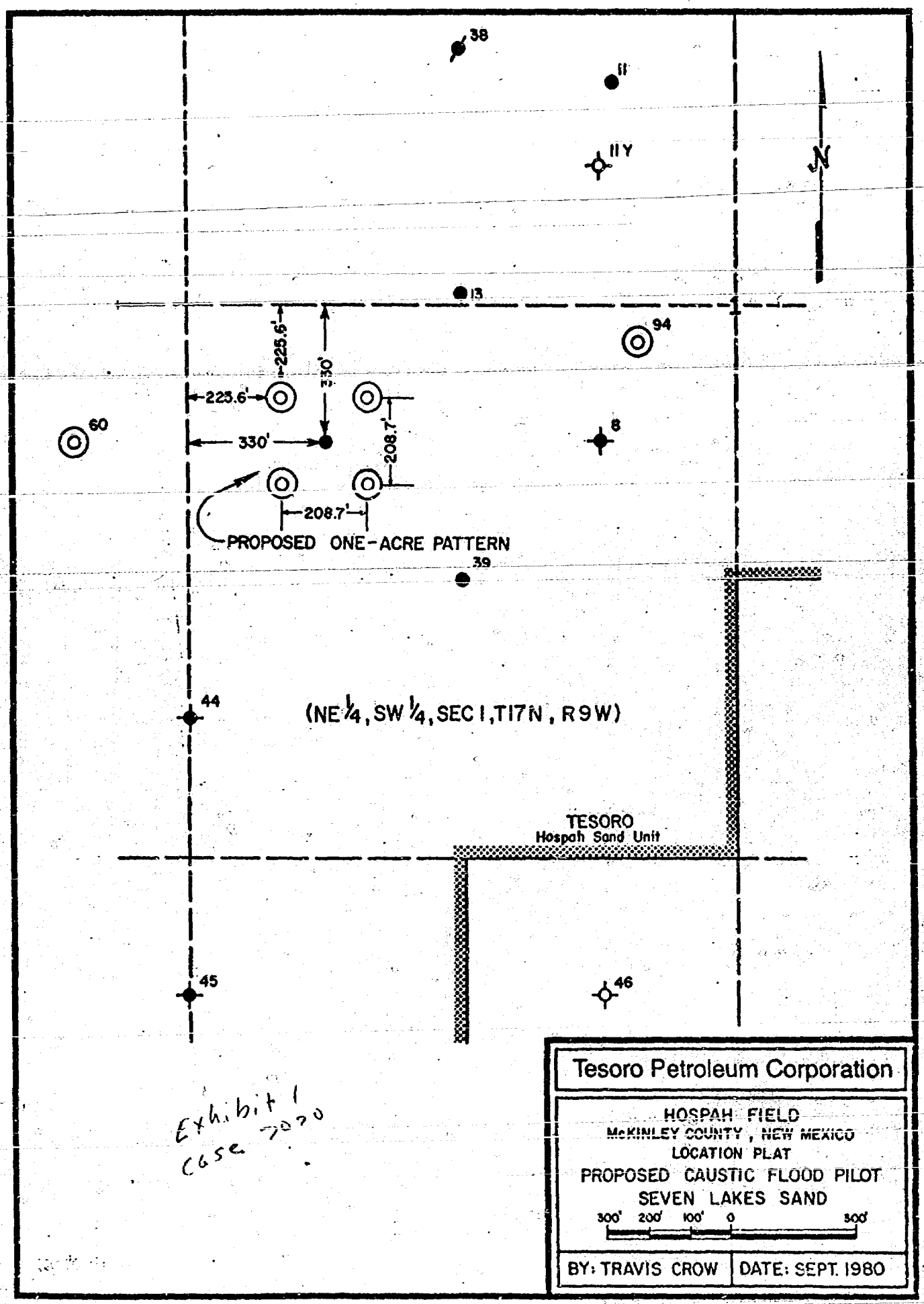


Exhibit 1
case 7020

LOCATION PLAT

Production well 330 ft from the west line and 330 ft from the north line of the NE 1/4 of the SW 1/4 of Sec. 1-T17N-R9W.

Injection well 225.6 ft from the west line and 225.6 ft from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Sec. 1-T17N-R9W.

Injection well 434.3 ft from the west line and 225.6 ft from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Sec. 1-T17N-R9W.

Injection well 434.3 ft from the west line and 434.3 ft from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Sec. 1-T17N-R9W.

Injection well 225.6 ft from the west line and 434.3 ft from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Sec. 1-T17N-R9W.

SUMMARY OF ALL WELLS WITHIN A ONE-HALF MILE RADIUS OF PROPOSED INJECTION WELLS
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Pet. Prod. Co.	#24	SE-NE Sec 2-17N-9W	--	--	--	--	--	P & A	---
Tenneco	Hotchkiss #1	NE-SE Sec 2-17N-9W	--	--	--	--	--	P & A	---
Tesoro	HSU #2	SE-NW Sec 1-17N-9W	8 5/8"	1528'	75 sx	1340'	1576'	1528'-76'	U. Hospah
Tesoro	HSU #4	NE-NW Sec 1-17N-9W	7"	1611'	70 sx	1400'	1611'	P & A	---
Tesoro	HSU #4Y	NE-NW Sec 1-17N-9W	8 5/8" 5 1/2"	74' 1556'	60 sx 150 sx	surface 620'	1581'	1556'-81'	U. Hospah
Tesoro	HSU #5	NE-NW Sec 1-17N-9W	14" 6 5/8"	80' 1604'	16 sx 75 sx	50' 1300'	1604'	1552'-65'	U. Hospah
Tesoro	HSU #6	NE-NW Sec 1-17N-9W	11" 7"	20' 1538'	155 sx 70 sx	surface 1230'	1582'	1538'-82'	U. Hospah
Tesoro	HSU #8	NE-SW Sec 1-17N-9W	12 1/2" 7"	22' 1533'	10 sx 50 sx	surface 1300'	1578'	P & A	--
Tesoro	HSU #9	NW-SE Sec 1-17N-9W	10" 7"	17' 1535'	10 sx 40 sx	surface 1350'	1570'	1535'-70'	U. Hospah
Tesoro	HSU #11	SE-NW Sec 1-17N-9W	12" 7"	22' 1522'	12 sx 50 sx	surface 1280'	1550'	P & A	--
Tesoro	HSU #11Y	SE-NW Sec 1-17N-9W	8 5/8" 5 1/2"	73' 1538'	60 sx 150 sx	surface 590'	1563'	1538'-63'	U. Hospah
Tesoro	HSU #12	NW-NE Sec 1-17N-9W	10" 7"	21' 1535'	12 sx 45 sx	surface 1320'	1580'	1535'-80'	U. Hospah
Tesoro	HSU #13	SE-NW Sec 1-17N-9W	10" 7"	22' 1530'	15 sx 50 sx	surface 1300'	1561'	1530'-61'	U. Hospah

Exhibit 3, Page 1 of 4

SUMMARY OF ALL WELLS WITHIN A ONE-HALF MILE RADIUS OF PROPOSED INJECTION WELLS
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

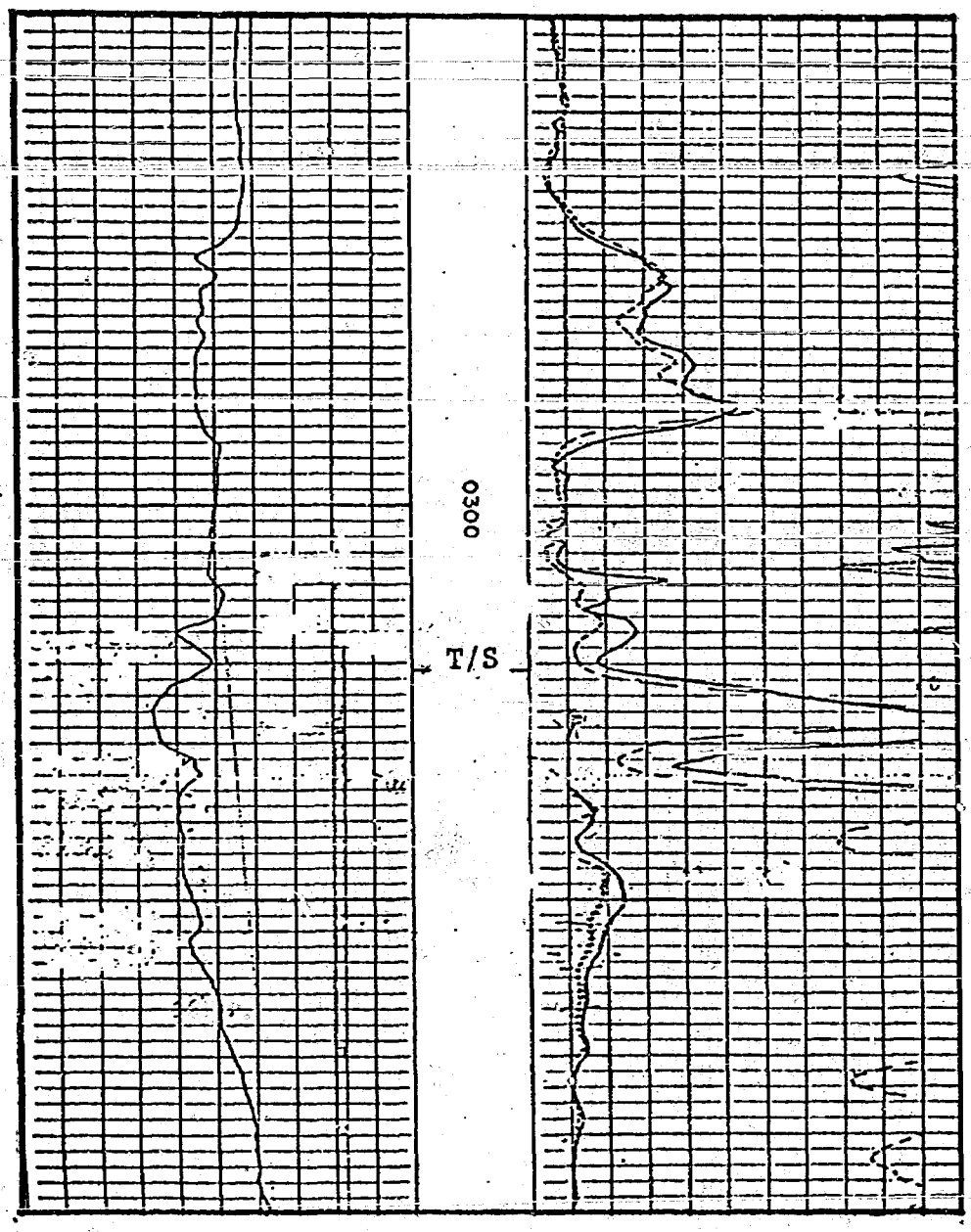
Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	HSU #21	SE-NW Sec 1-17N-9W	7"	1547'	40 sx	1360'	1591'	1547'-85'	U. Hospah
Tesoro	HSU #22	NE-NW Sec 1-17N-9W	7"	1553'	41 sx	1360'	1595'	1553'-95'	U. Hospah
Tesoro	HSU #23	NW-NE Sec 1-17N-9W	5 3/8"	1528'	75 sx	1200'	1570'	1528'-70'	U. Hospah
Tesoro	HSU #24A	SW-NE Sec 1-17N-9W	5 3/8"	1512'	75 sx	1190'	1552'	1512'-52'	U. Hospah
Tesoro	HSU #38	SE-NW Sec 1-17N-9W	5 1/2"	1557'	50 sx	1250'	1565'	1557'-65'	U. Hospah
Tesoro	HSU #39	NE-SW Sec 1-17N-9W	--	--	--	--	1557'	--	--
Tesoro	HSU #44	NE-SW Sec 1-17N-9W	5 1/2"	1554'	75 sx	--	1572'	P & A	--
Tesoro	HSU #45	SE-SW Sec 1-17N-9W	5 1/2"	1634'	85 sx	--	1818'	P & A	--
Tesoro	HSU #51	NW-NE Sec 1-17N-9W	7"	1532'	50 sx	1340'	1576'	1532'-76'	U. Hospah
Tesoro	HSU #52	SW-NE Sec 1-17N-9W	7"	1514'	50 sx	1330'	1526'	1514'-26'	U. Hospah
Tesoro	HSU #55	SW-NE Sec 1-17N-9W	4 1/2"	447'	50 sx	surface	450'	310'-48'	Temp. abnd. in Seven Lakes sand
Tesoro	HSU #56	SW-NE Sec 1-17N-9W	8 5/8" 5 1/2"	302' 1594'	200 sx 140 sx	surface 268'	2730'	1514'-42'	U. Hospah
Tesoro	HSU #60	NW-SW Sec 1-17N-9W	7" 4 1/2"	84' 1540'	35 sx 50 sx	surface 1350'	1640'	1559'-90' 1600'-01'	U. Hospah (Inj.)
Tesoro	HSU #61	SW-NW Sec 1-17N-9W	7" 4 1/2"	64' 1700'	35 sx 50 sx	surface 1220'	1715'	1632'-56'	U. Hospah (Inj.)

SUMMARY OF ALL WELLS WITHIN A ONE-HALF MILE RADIUS OF PROPOSED INJECTION WELLS
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	HSU #67	SE-NE Sec 1-17N-9W	7"	83'	35 sx	surface	1636'	1546'-64'	U. Hospah (Inj.)
			4 1/2"	1634'	55 sx	1150'			
Tesoro	HSU #84	SE-NW Sec 1-17N-9W	8 5/8"	70'	50 sx	surface	1574'	1536'-74'	U. Hospah (Inj.)
			4 1/2"	1536'	120 sx	879'			
Tesoro	HSU #85	SW-NE Sec 1-17N-9W	8 5/8"	104'	100 sx	surface	1551'	1535'-51'	U. Hospah
			5 1/2"	1535'	150 sx	450'			
Tesoro	HSU #87	NW-NE Sec 1-17N-9W	8 5/8"	53'	35 sx	--	1590'	1535'-55'	U. Hospah (Inj.)
			5 1/2"	1590'	120 sx	--			
Tesoro	HSU #93	NE-NW Sec 1-17N-9W	8 5/8"	23'	30 sx	surface	1605'	1540'-60'	U. Hospah (Inj.)
			5 1/2"	1632'	125 sx	1100'			
Tesoro	HSU #94	NE-SW Sec 1-17N-9W	8 5/8"	40'	30 sx	surface	1575'	1515'-30'	U. Hospah (Inj.)
			5 1/2"	--	125 sx	1100'			
Tesoro	SF Hurst #1	NW-NE Sec 1-17N-9W	13 3/8"	207'	150 sx	surface	7852'	P & A	--
			9 5/8"	3317'	325 sx	2400'			
Tesoro	SFRR "A" 46	SE-SW Sec 1-17N-9W	--	--	--	--	--	P & A	--
Tesoro	SFRR "A" 73	SW-SE Sec 1-17N-9W	8 5/8"	63'	40 sx	surface	1665'	open hole comp.	L. Hospah
			4 1/2"	1639'	75 sx	1300'			
Tesoro	SFRR "A" 79	SW-SE Sec 1-17N-9W	8 5/8"	67'	50 sx	surface	1624'	open hole comp.	U. Hospah
			5 1/2"	1589'	50 sx	1300'		1589'-1624'	
Tesoro	SFRR "A" 81	SW-SE Sec 1-17N-9W	8 5/8"	62'	50 sx	surface	1655'	open hole comp.	L. Hospah
			5 1/2"	1644'	100 sx	700'		1644'-55'	

SUMMARY OF ALL WELLS WITHIN A ONE-HALF MILE RADIUS OF PROPOSED INJECTION WELLS
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	SFRR "A" 84	SW-SE Sec 1-17N-9W	9 5/8"	95'	100 sx	surface	1656'	open hole comp.	L. Hospah (Inj.)
			7"	1639'	100 sx	--			
Tesoro	SFRR "A" 89	SW-SE Sec 1-17N-9W	8 5/8"	104'	100 sx	surface	1769'	Open hole comp.	L. Hospah
			5 1/2"	1769'	100 sx	500'		1643-54'	
Tesoro	SFRR "A" 57	NW-SE Sec 1-17N-9W	8 5/8"	135'	110 sx	--	2800'	P & A	—
			5 1/2"	1698'	140 sx	--			

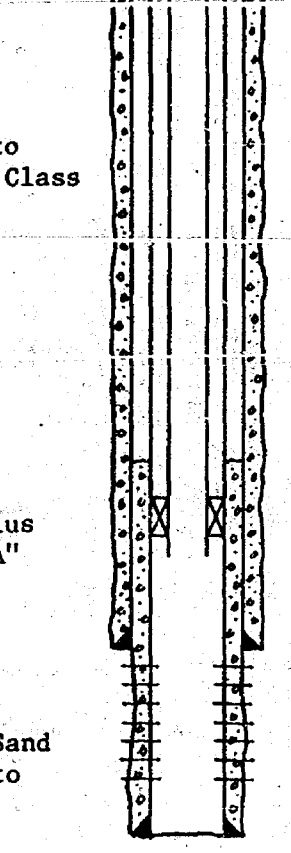


TYPE LOG

(Well No. 55)
SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 4

Exhibit 4
Case 7070



Cement 7-in. annulus to surface with 50 sacks Class "A" neat.

Cement 4-1/2-in. annulus with 10 sacks Class "A" neat.

Perforate Seven Lakes Sand at approximately 291 to 321 ft.

Top of cement: 261 ft

2-in. tbg w/pkr: 276 ft

7-in. casing: 291 ft

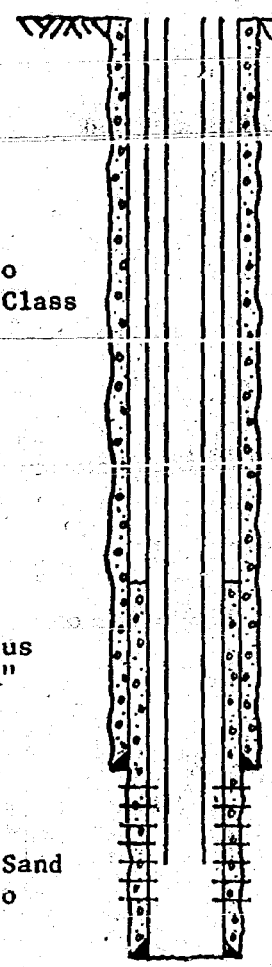
4-1/2-in. casing: 336 ft

TESORO PETROLEUM CORPORATION
WELLBORE SCHEMATIC
CAUSTIC FLOOD INJECTION WELL

SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 5

Exhibit 5
Case 1070



Cement 7-in. annulus to surface with 50 sacks Class "A" neat.

Cement 4-1/2-in. annulus with 10 sacks Class "A" neat.

Perforate Seven Lakes Sand at approximately 291 to 321 ft.

Top of cement: 261 ft

7-in. casing: 291 ft

2-in. tbg: 315 ft

4-1/2-in. casing: 336 ft

TESORO PETROLEUM CORPORATION
WELLBORE SCHEMATIC
CAUSTIC FLOOD PRODUCTION WELL

SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 6

Exhibit 6
Case 7075

Exhibit 7

Well bore Schematics of All Plugged and Abandoned Wells

Within a One-Half Mile Radius of Proposed Injection Wells

Exhibit 7
Case 7070

Well: Hospah Sand Unit #8
Field: Hospah
Location: NE 1/4 SW Sec. 1 -T 17N -R 9W
County: McKinley State: N. M.
Zero Elevation: _____ Ft. (_____ AGL) GL: _____
TD: 1578' Ft. PBTD: _____ Ft.

Wellhead: _____

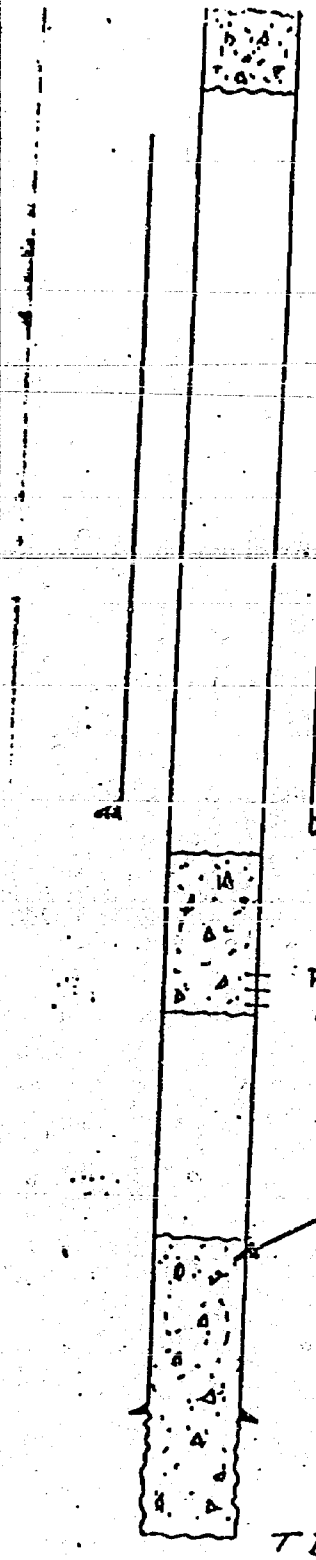
Tubing String: _____

Centralizers: _____

12 1/4 "OD _____ LB _____ GR. _____ THRD.
@ 22' FT. W/ 10 SX (_____ FT3) cmt.
in 15 " hole (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ surface BY: _____

7 "OD 20 LB _____ GR _____ THRD.
@ 1533 FT. W/ 50 SX (_____ FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ 1300' BY: _____

UPDATED BY: KJK DATE: 1/21/80



10' cement plug @ top of 7" csg.

Well: Hospah Sand Unit # 11
Field: Hospah
Location: SE / NW Sec 1 - T 17N - R 9W
County: McKinley State: N.M.
Zero Elevation: _____ ft. (_____ AGL) GL.: _____
TD: 1550 ft. PBTD: _____ ft.

Wellhead: _____

Tubing String: _____

Centralizers: _____

12 "OD ____ LB ____ GR. ____ THRD.
@ 22 FT. w/ 12 SX (_____ FT3) cmt.
in 15 " hole (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ surface BY: _____

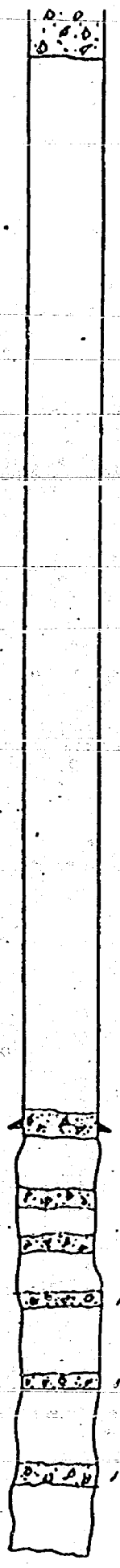
Perforated @ 430'. Squeezed w/ 80 sx cement
Cement Top inside 7" csg. is 277'

25 sk cement plug: 1550' - 1416'

7 "OD ____ LB ____ GR ____ THRD.
@ 1522 FT. w/ 50 SX (_____ FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ 1280' BY: _____

TD: 1550'

UPDATED BY: KJK DATE: 1/21/80



top of csg.

Field: Hospah
Location: NW / NE Sec. 1 - T 17 N - R 9 W
County: McKinley State: N. M.
Zero Elevation: _____ ft. (_____ AGL) GL:
TD: 7852 ft. PBTD: _____ ft. G.

Wellhead: _____

Tubing String: _____

Centralizers: _____

13 3/8" OD LB GR THRD.
@ 207 FT. W/ 150 SX (_____ FT³) cmt.
in 17 1/2" hole (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ surface BY: _____

9 5/8" OD LB GR THRD.
@ 3317 FT. W/ 325 SX (_____ FT³) cmt.
in 12 1/4" HOLE (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ 2400' BY: _____

10 sk cement plug : 3314' - 3280'

10 sk cement plug : 3750' - 3720'

10 sk cement plug : 4800' - 4770'

10 sk cement plug : 5100' - 5070'

10 sk cement plug : 5500' - 4970'

10 sk cement plug : 7050' - 7020'

TD - 7852'

UPDATED BY: K.J.K. DATE: 1/21/80

✓

1/11/11

Well: Hospah Sand Unit #4
Field: Hospah
Location: NE / NW Sec. 1 - T 17N - R 9W
County: McKinley State: N.M.
Zero Elevation: _____ ft. (_____ AGL) GL.: _____
TD: 1611 ft. PBTD: _____ ft.

10' cement plug @ top of csg.

Wellhead: _____

Tubing String: _____

Centralizers: _____

← No surface Casing
_____ "OD ____ LB ____ GR. ____ THRD.
@ _____ FT. w/ _____ SX (_____ FT3) cmt.
in _____ " hole (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ _____ BY: _____

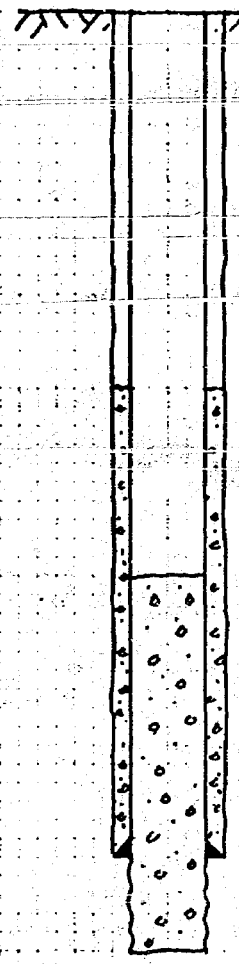
Perforated @ 499' Squeezed w/ 80 sx cement.
Cement Top inside csg. @ 277'

25 sk. cement plug: 1610' - 1481'

7 "OD ____ LB ____ GR ____ THRD.
@ 1611 FT. w/ 70 SX (_____ FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ 1400' BY: _____

TD - 1611'

UPDATED BY: K.J.K DATE: 1/21/11



GROUND LEVEL

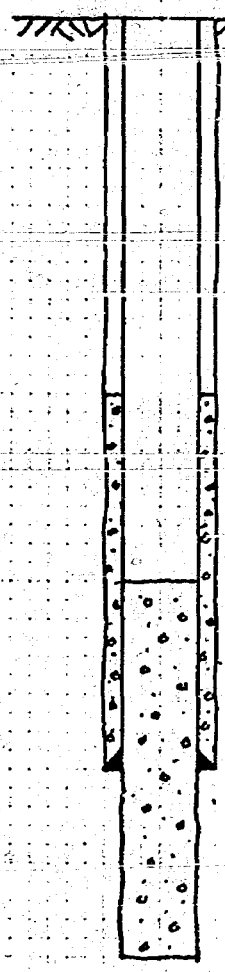
CSG CEMENTED W/75 SX
TOP OF CEMENT UNKNOWN

P & A 7/46 W/25 SX CMT
TOP OF CMT @ 1,354 FT

5-½-IN. CSG @ 1,554 FT

TD 1,572 FT

Wellbore Schematic
Plugged and Abandoned Well
Well No. 44
Hospah Field
Mc Kinley County, New Mexico



GROUND LEVEL

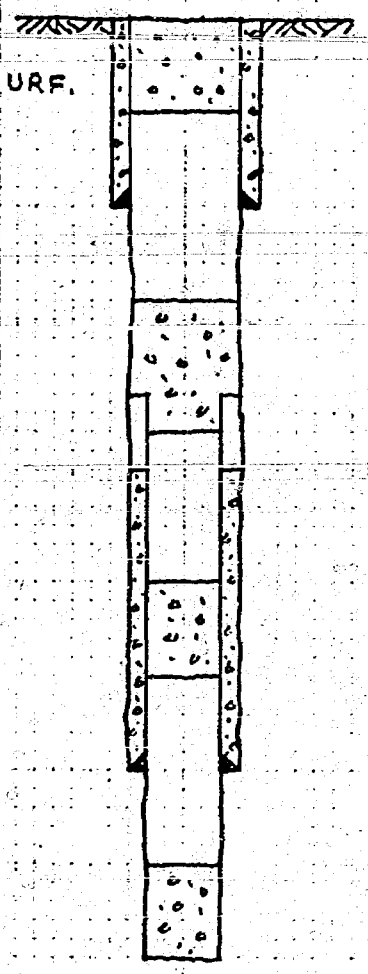
CSG CEMENTED W/ 85 SX
TOP OF CEMENT UNKNOWN

P&A 11/30/45 W/ 50 SX CMT
TOP OF CMT @ 1,214 FT

5-½-IN. CSG @ 1,634 FT

TD 1,818 FT

Wellbore Schematic
Plugged and Abandoned Well
Well No. 45
Hospah Field
Mc Kinley County, New Mexico



10.5 SX CMT @ SURF.

CSG CEMENTED W/110 SX

8-5/8-IN. CSG @ 123 FT

SPOTTED 30 SX CEMENT
695-745 FT

CSG SHOT OFF AT 825 FT

CSG CEMENTED W/140 SX
TOP OF CEMENT UNKNOWN

SPOTTED 15 SX CEMENT
1,644-1,513 FT

5-½-IN. CSG @ 1,698 FT

PBTD 1,750 FT
PB W/125 SX CEMENT

TD 2,800 FT

Wellbore Schematic
Plugged and Abandoned Well
Well No. 57
Hospah Field
Mc Kinley County, New Mexico

CORE LABORATORIES, INC.
Petroleum Reserve Engineering
DALLAS, TEXAS
WATER ANALYSIS

File IWTL-7117

Company Tesoro Petroleum Corporation Well Name Water supply well Sample No. 1

Formation Morrison Depth 3100 - 3200 Sampled From unit 534 Hospah sand

Location _____ Field _____ County _____ State _____

Date Sampled _____ Date Analyzed 3-11-71 Analyst RAL

Total Dissolved Solids 774 mg/L calculated

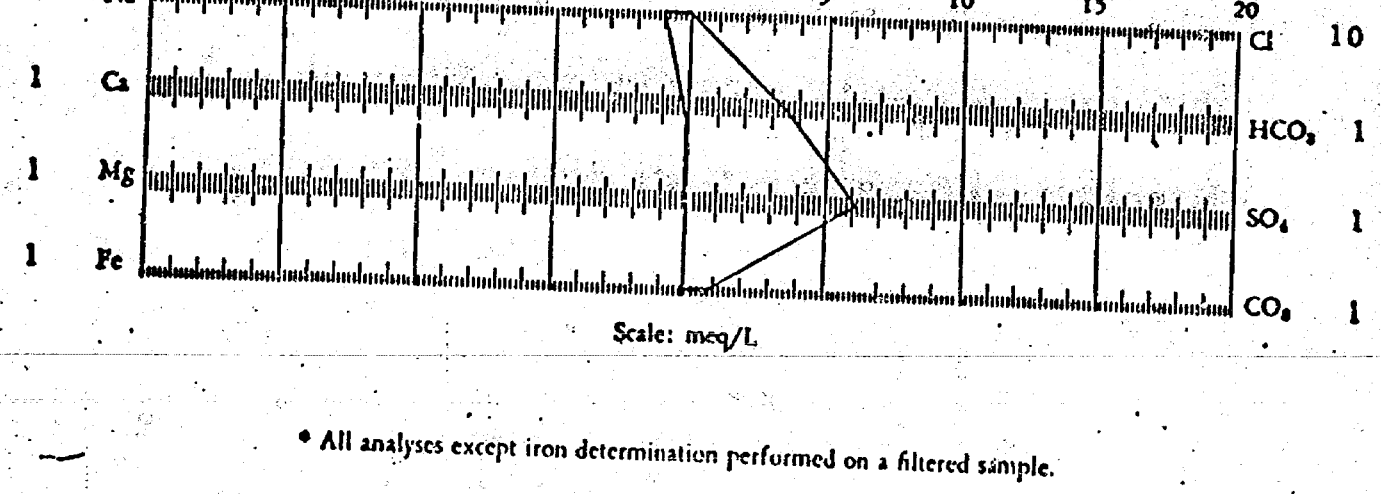
Specific Gravity 0.9993 @ 60° F. 0.9965 @ 74 °F.

Resistivity 9.097 ohm-meters @ 74 °F. measured

pH 9.05 @ 76 °F.

Hydrogen Sulfide absent

Constituents*	meq/L	mg/L	Constituents	meq/L	mg/L
Sodium	10.19	234	Chloride	0.27	9.7
Calcium	0.24	4.8	Bicarbonate	3.51	214
Magnesium	0.03	0.4	Sulfate	6.12	294
Iron	0.01	0.33	Carbonate	0.57	17
Barium	0.0	0.0 (Grav.)	Hydroxide	0.0	0.0



Scale: meq/L

* All analyses except iron determination performed on a filtered sample.

Exhibit 8

Exhibit 8
Case 7070

TESORO

RECEIVED
DEC 12 1980
OIL CONSERVATION DIVISION
SANTA FE

Tesoro Petroleum Corporation

December 9, 1980

Mr. Richard Stamets
Technical Support Chief
State of New Mexico
P. O. Box 2088
Santa Fe, NM 87501

RE: Hospah Field

Dear Dick:

Attached are the new plats which reflect the actual staked locations in the Seven Lakes Caustic Pilot project. The locations are essentially within 200 feet of those submitted during the hearing of November 12, 1980. These locations were positioned to miss power lines and other surface facilities.

If you have any questions concerning these locations, please let me know.

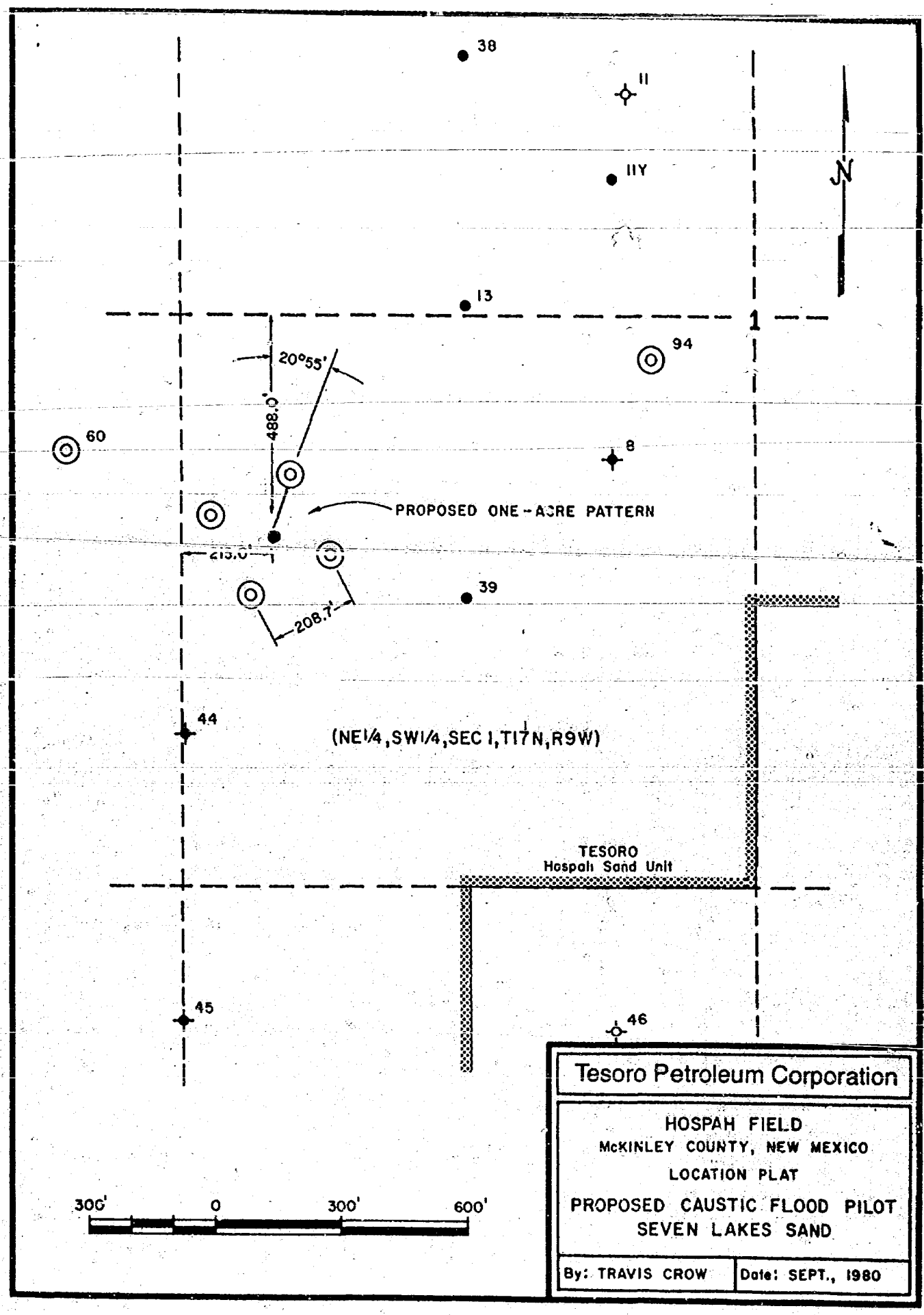
Sincerely,

W. F. Parks
District Operations Manager

WFP/gh

Enclosures

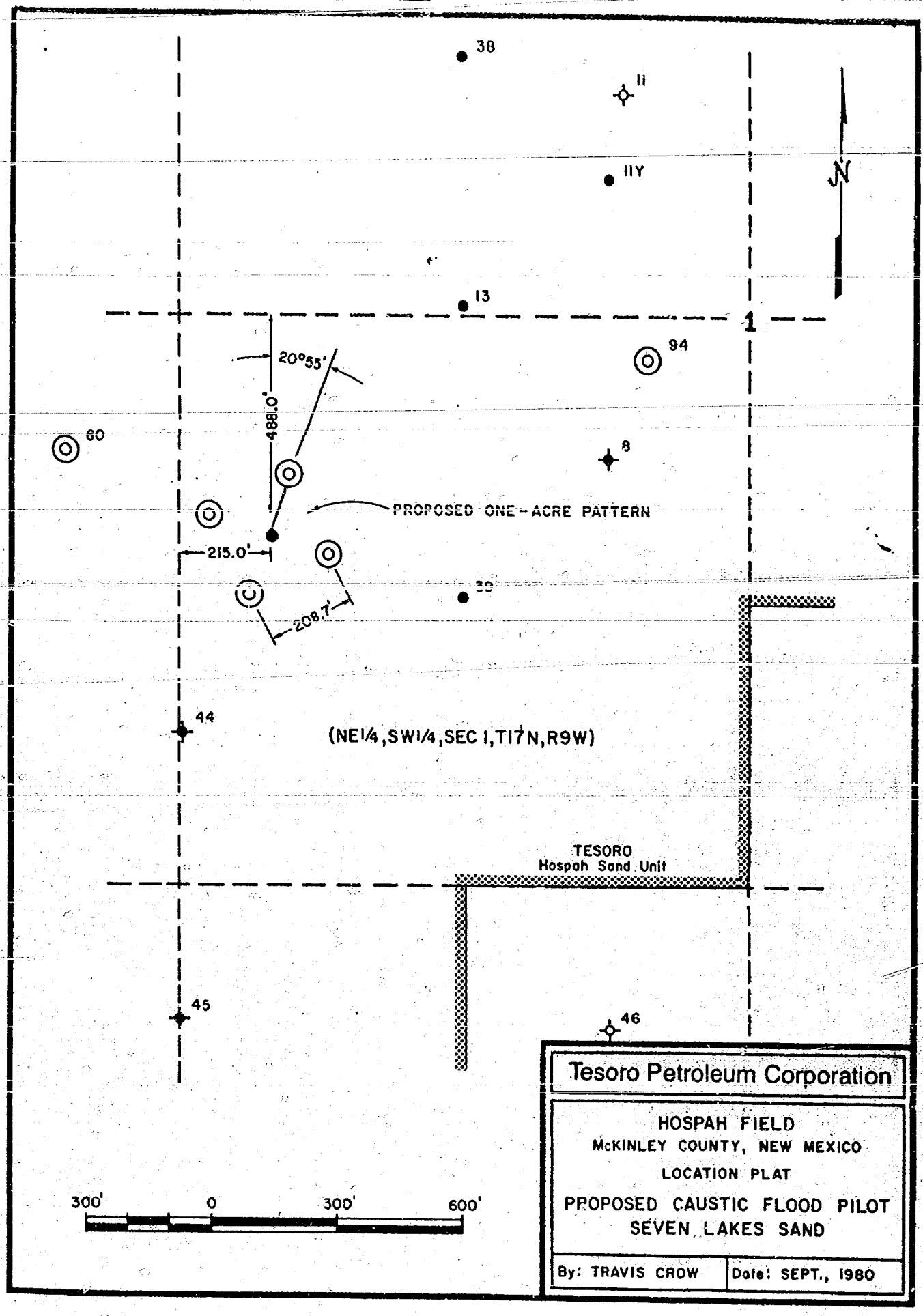
Joan call → 303 825 2000



Tesoro Petroleum Corporation

HOSPAH FIELD
McKINLEY COUNTY, NEW MEXICO
LOCATION PLAT
PROPOSED CAUSTIC FLOOD PILOT
SEVEN LAKES SAND

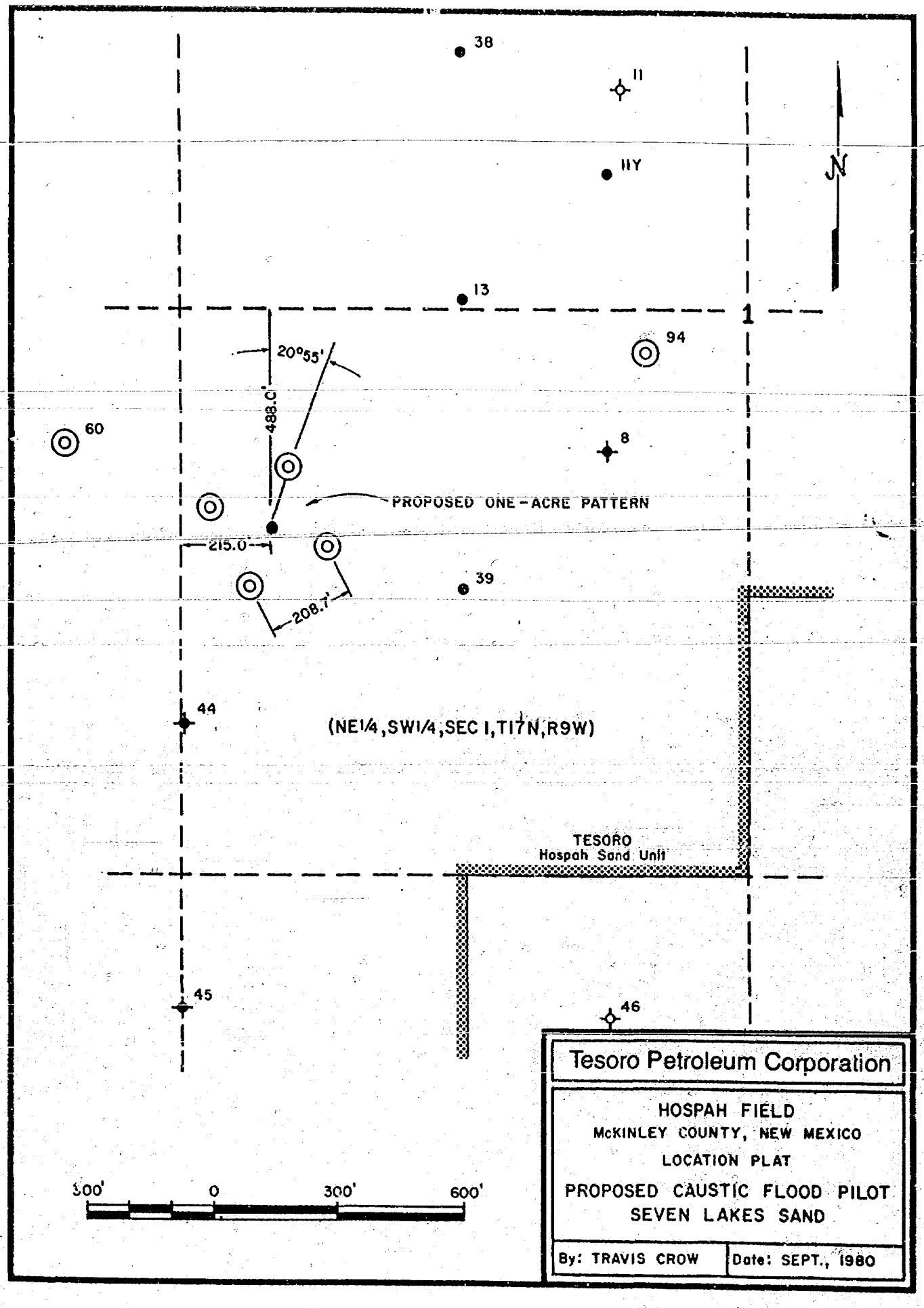
By: TRAVIS CROW | Date: SEPT., 1980

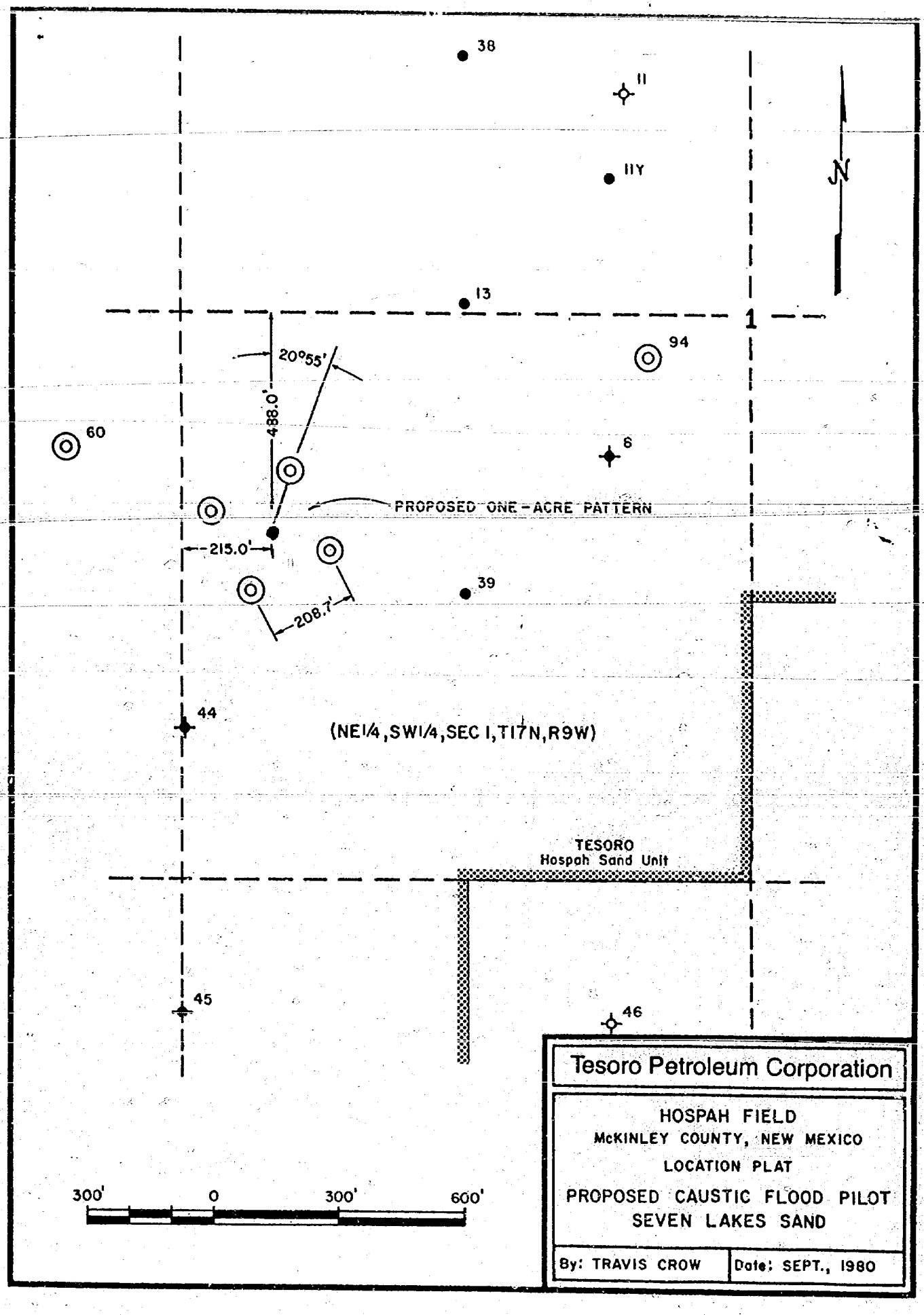


Tesoro Petroleum Corporation

HOSPAH FIELD
McKINLEY COUNTY, NEW MEXICO
LOCATION PLAT
PROPOSED CAUSTIC FLOOD PILOT
SEVEN LAKES SAND

By: TRAVIS CROW | Date: SEPT., 1980

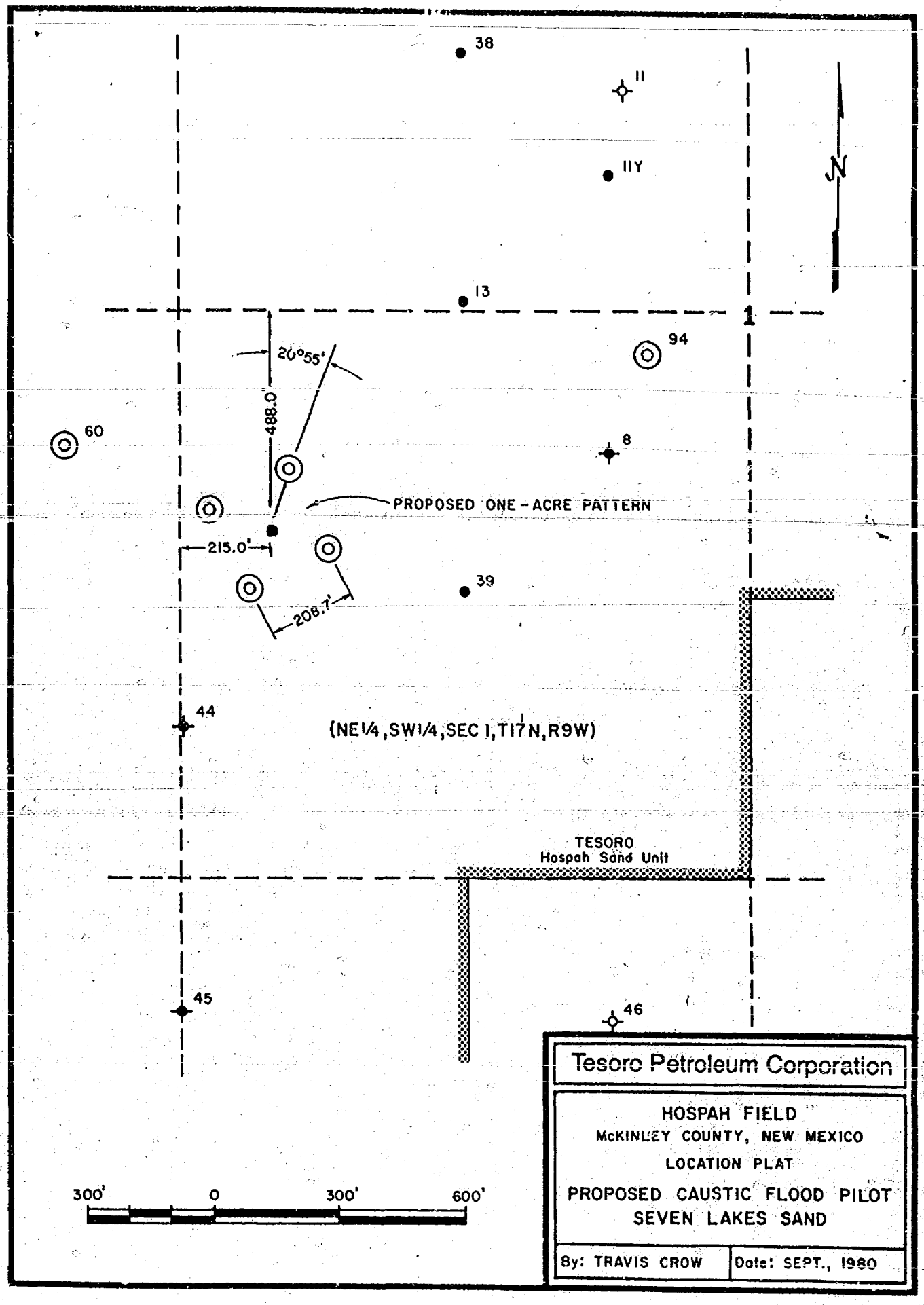

38
11
11Y
13
94
60
8
20°55'
488.0'
PROPOSED ONE-ACRE PATTERN
215.0'
208.7'
39
44
(NE1/4, SW1/4, SEC 1, T17N, R9W)
TESORO
Hospah Sand Unit
45
46
N
1
500'
0
300'
600'
Tesoro Petroleum Corporation
HOSPAH FIELD
McKINLEY COUNTY, NEW MEXICO
LOCATION PLAT
PROPOSED CAUSTIC FLOOD PILOT
SEVEN LAKES SAND
By: TRAVIS CROW
Date: SEPT., 1980



Tesoro Petroleum Corporation

HOSPAH FIELD
McKINLEY COUNTY, NEW MEXICO
LOCATION PLAT
PROPOSED CAUSTIC FLOOD PILOT
SEVEN LAKES SAND

By: TRAVIS CROW | Date: SEPT., 1980


38
11
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20°55'
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PROPOSED ONE-ACRE PATTERN
215.0'
208.7'
39
44
(NE1/4, SW1/4, SEC 1, T17N, R9W)
TESORO
Hospah Sand Unit
45
46
300'
0
300'
600'
Tesoro Petroleum Corporation
HOSPAH FIELD
McKINLEY COUNTY, NEW MEXICO
LOCATION PLAT
PROPOSED CAUSTIC FLOOD PILOT
SEVEN LAKES SAND
By: TRAVIS CROW
Date: SEPT., 1980

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

January 16, 1981

Re: CASE NO. 7070
ORDER NO. R-6557

Mr. Thomas Kellahin
Kellahin & Kellahin
Attorneys at Law
Post Office Box 1769
Santa Fe, New Mexico

Applicant:

~~Texaco Petroleum Corporation~~

Dear Sir:

Enclosed herewith are two copies of the above-referenced Division order recently entered in the subject case.

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

Copy of order also sent to:

Hobbs OCD ___x___
Artesia OCD ___x___
Aztec OCD ___x___

Other _____

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
29 October 1980

EXAMINER HEARING

IN THE MATTER OF:

Application of Tesoro Petroleum Corporation for a pilot caustic flood project, McKinley County, New Mexico.

CASE 7070

BEFORE: Daniel S. Nutter

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division: W. Perry Pearce, Esq.
Legal Counsel to the Division
State Land Office Bldg.
Santa Fe, New Mexico 87501

For the Applicant: W. Thomas Kellahin, Esq.
KELLAHIN & KELLAHIN
500 Don Gaspar
Santa Fe, New Mexico 87501

MR. NUTTER: We'll call Case Number 7070.

MR. PEARCE: Application of Tesoro Petroleum Corporation fora pilot caustic flood project, McKinley County, New Mexico.

MR. KELLAHIN: If the Examiner please, we'd request that that case be continued and set over to the Examiner Hearing on November 12th, 1980.

MR. NUTTER: Case Number 7070 will be continued to the Examiner Hearing scheduled to be held at this same place at 9:00 o'clock a. m. November 12th, 1980.

(Hearing concluded.)

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd C.S.R.

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 7072 heard by me on 10/29 1980.

Examiner
Oil Conservation Division

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
29 October 1980

EXAMINER HEARING

IN THE MATTER OF:

Application of Tesoro Petroleum Corporation for a pilot caustic flood project, McKinley County, New Mexico.

CASE 7070

BEFORE: Daniel S. Nutter

TRANSCRIPT OF HEARING

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Legal Counsel to the Division
State Land Office Bldg.
Santa Fe, New Mexico 87501

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KELLAHIN & KELLAHIN
500 Don Gaspar
Santa Fe, New Mexico 87501

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(Hearing concluded.)

C E R T I F I C A T E

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SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 7070 heard by me on 10/29 1980.

Examiner
Oil Conservation Division

Dockets Nos. 37-80 and 38-80 are tentatively set for November 25 and December 10, 1980. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: EXAMINER HEARING - WEDNESDAY - NOVEMBER 12, 1980

9 A.M. - OIL CONSERVATION DIVISION CONFERENCE ROOM,
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

The following cases will be heard before Richard L. Stamets, Examiner, or Daniel S. Nutter, Alternate Examiner:

ALLOWABLE: (1) Consideration of the allowable production of gas for December, 1980, from fifteen prorated pools in Lea, Eddy, and Chaves Counties, New Mexico.

(2) Consideration of the allowable production of gas for December, 1980, from four prorated pools in San Juan, Rio Arriba, and Sandoval Counties, New Mexico.

CASE 7076: Application of Vista Resources, Inc. for an unorthodox gas well location, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its John H. Dashko Federal Well No. 1 to be drilled 2510 feet from the South line and 790 feet from the East line of Section 11, Township 24 North, Range 7 West, Basin-Dakota Pool, the E/2 of said Section 11 to be dedicated to the well.

CASE 7077: Application of Threshold Development Company for a dual completion, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the dual completion of its Conoco "10" State Com Well No. 1 located in Unit I of Section 10, Township 19 South, Range 29 East, Turkey Track Field, to produce oil from the Wolfcamp formation and gas from the Atoka formation through parallel strings of tubing.

CASE 7046: (Continued from October 15, 1980, Examiner Hearing)

Application of Cotton Petroleum Corporation for downhole commingling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Chacra and Pictured Cliffs production in the wellbores of wells in the South Blanco-Pictured Cliffs Pool located in Sections 1, 2, 3, 4, 9, 10, 11, 13, 23, and 24, Township 24 North, Range 4 West.

CASE 7078: Application of Conoco Inc. for a dual completion, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the dual completion of its Warren Unit Well No. 82 located in Unit C of Section 33, Township 20 South, Range 38 East, to produce oil from the Blinebry Oil and Gas or Warren-Tubb Pools and the D-K Abo Pool.

CASE 7079: Application of HNG Oil Company for the amendment of Order No. R-5727, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the amendment of Order No. R-5727 to include the entire Pennsylvanian formation under the compulsory pooling order rather than only the Morrow formation as previously ordered.

CASE 7080: Application of Franks Petroleum, Inc. for an unorthodox gas well location, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a well to be drilled 660 feet from the North and East lines of Section 9, Township 21 South, Range 32 East, Hat Mesa-Morrow Gas Pool, the E/2 of said Section 9 to be dedicated to the well.

CASE 7081: Application of Belco Petroleum Corporation for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Pennsylvanian formation underlying the E/2 of Section 19, Township 23 South, Range 28 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision, designation of applicant as operator of the well, and a charge for risk involved in drilling said well.

CASE 7070: (Continued from October 29, 1980, Examiner Hearing)

Application of Tesoro Petroleum Corporation for a pilot caustic flood project, McKinley County, New Mexico. Applicant, in the above-styled cause, seeks authority to institute a one-acre pilot caustic flood project in the Hospah Field by the injection of caustic fluid into the Seven Lakes Sand of the Upper Hospah Field at an approximate depth of 300-500 feet through four injection wells in Unit K of Section 1, Township 17 North, Range 9 West.

CASE 7082: Application of Maralo, Inc. and Dalport Oil Corporation for a waterflood project, Lea County, New Mexico. Applicants, in the above-styled cause, seek authority to institute a joint waterflood project on Dalport's Winters Lease offsetting Maralo's Jalmat Yates Unit waterflood project by the injection of water into the Yates-Seven Rivers-Queen formations through a well to be jointly drilled at an unorthodox location 1260 feet from the South line and 1250 feet from the West line of Section 7, Township 25 South, Range 36 East, Jalmat Pool.

CASE 7065: Application of El Paso Natural Gas Company for twelve non-standard proration units, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the establishment of eight non-standard proration units for Pictured Cliffs wells to be drilled in the W/2 of partial Sections 6, 7, 18, 19, 30 and 31 of Township 30 North, Range 4 West, and four non-standard proration units for Pictured Cliffs wells in partial Sections 7, 8, and 9 of Township 28 North, Range 4 West.

CASE 7066: Application of Conoco Inc. for a dual completion, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the dual completion of its Britt "B" Well No. 27 located in Unit G of Section 15, Township 20 South, Range 37 East, to produce oil from the Weir-Drinkard or an undesignated Blinebry pool and an undesignated Abo pool.

CASE 7067: Application of Conoco Inc. for a dual completion, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the dual completion of its Dagger Draw Com. Well No. 4 located in Unit J of Section 25, Township 19 South, Range 24 East, to produce oil from the North Dagger Draw-Upper Penn Pool and gas from an undesignated Morrow pool.

CASE 7068: Application of Conoco Inc. for a dual completion and an unorthodox well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the dual completion of its Penny Federal Com. Well No. 2 at an unorthodox location 1650 feet from the North line and 1980 feet from the East line of Section 23, Township 20 South, Range 24 East, to produce oil from the South Dagger Draw-Upper Penn Pool and gas from an undesignated Morrow pool.

CASE 7069: Application of Anadarko Production Company for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a Morrow test well to be drilled 660 feet from the South and East lines of Section 4, Township 19 South, Range 25 East, the S/2 of said Section 4 to be dedicated to the well.

CASE 7070: Application of Tesoro Petroleum Corporation for a pilot caustic flood project, McKinley County, New Mexico. Applicant, in the above-styled cause, seeks authority to institute a one-acre pilot caustic flood project in the Hospah Field by the injection of caustic fluid into the Seven Lakes Sand of the Upper Hospah Field at an approximate depth of 300-500 feet through four injection wells in Unit K of Section 1, Township 17 North, Range 9 West.

CASE 7071: Application of Jake L. Hamon for an unorthodox well location and simultaneous dedication, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the simultaneous dedication of a 640-acre proration unit comprising all of Section 17, Township 20 South, Range 36 East, North Osudo-Morrow Pool, to its Amerada Federal Well No. 2 located in Unit F and its Amerada Federal Well No. 3, to be drilled at an unorthodox location 1650 feet from the South line and 660 feet from the East line of said Section 17.

CASE 6668: (Reopened and Readvertised)

In the matter of Case 6668 being reopened pursuant to the provisions of Order No. R-6139 which order promulgated temporary special rules and regulations for the South Culebra Bluff-Bone Spring Pool in Eddy County, New Mexico, including a provision for 80-acre spacing units. Operators in said pool may appear and show cause why the pool should not be developed on 40-acre spacing units.

CASE 7005: (Continued from September 17, 1980, Examiner Hearing)

Application of Sol West III for an NGPA determination, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks a new onshore reservoir determination in the Morrow formation for his Turkey Track-Morrow Sand Well No. 1 in Unit I of Section 26, Township 18 South, Range 28 East.

CASE 7072: Application of Enserch Exploration, Inc. for pool creation and special pool rules, Roosevelt County, New Mexico. Applicant, in the above-styled cause, seeks the creation of a new Pennsylvanian oil pool for its Enserch Amoco State Well No. 1 located in Unit L of Section 16, Township 4 South, Range 33 East, and the promulgation of special pool rules therefor, including a provision for 80-acre spacing.

CASE 7073: Application of Enserch Exploration, Inc. for pool creation, temporary special pool rules, and assignment of a discovery allowable, Chaves County, New Mexico. Applicant, in the above-styled cause, seeks the creation of a new Fusselman oil pool for its J. G. O'Brien Well No. 1 located 1980 feet from the North line and 660 feet from the West line of Section 31, Township 7 South, Range 29 East, with special rules therefor, including provisions for 80-acre spacing, a limiting gas-oil ratio of 3000 to one and special well location requirements providing for the drilling of wells within 150 feet of the center of a quarter-quarter section. Applicant further seeks approval of a 74.24-acre proration and spacing unit and a discovery allowable for said J. G. O'Brien Well No. 1.

KELLAHIN and KELLAHIN
Attorneys at Law

Jason Kellahin
W. Thomas Kellahin

Karen Aubrey

500 Don Gaspar Avenue
Post Office Box 1769
Santa Fe, New Mexico 87501

Telephone 982-4285
Area Code 505

October 2, 1980

Mr. Joe Ramey
Oil Conservation Division
P.O. Box 2088
Santa Fe, New Mexico 87501

Case 7070

Re: Tesoro Petroleum Corporation
Seven Lakes Sand
Upper Hospah
Pilot Caustic Flood

Dear Joe:

Please set the enclosed application for an examiner hearing on October 29, 1980.

Very truly yours,

W. Thomas Kellahin

Encl.
cc: Mr. Bill Parks
Mr. Travis Crow

WTK:jm

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

CASE NO. 7070
Order No. R-6557

APPLICATION OF TESORO PETROLEUM CORPORATION FOR A PILOT CAUSTIC FLOOD PROJECT, McKINLEY COUNTY, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on November 12, 1980, at Santa Fe, New Mexico, before Examiner Richard L. Stamets.

NOW, on this 14th day of January, 1981, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Division has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Tesoro Petroleum Corporation, seeks authority to institute a one-acre pilot caustic flood project on its Hospah Sand Unit, Hospah Field, by the injection of caustic fluid into the Seven Lakes Sand of the Upper Hospah Field at an approximate depth of 300-500 feet through four injection wells in Unit K of Section 1, Township 17 North, Range 9 West, NMPM, McKinley County, New Mexico.

(3) That the Seven Lakes Sand within the project area appears to be incapable of being produced by normal primary recovery methods.

(4) That the proposed caustic fluid flood project is needed to develop data which may result in the recovery of otherwise unrecoverable oil, thereby preventing waste.

(5) That the operator should take all steps necessary to ensure that the injected fluid enters only the proposed injection interval and is not permitted to escape to other formations or onto the surface from injection, production, or plugged and abandoned wells.

(6) That the operator should test all pilot project wells upon completion, gathering fluids for analysis.

(7) That the operator should monitor nearby deeper wells for signs of fluid movement in the Seven Lakes Sand interval.

(8) That the operator should determine the effect of the caustic solution on the formation and formation fluids and determine the nature and chemical makeup of the residue in the area swept.

(9) That the operator should submit a report to the Director of the Division within six months following completion of the pilot project which report shall contain data derived and resulting from the requirements of Findings (6), (7), and (8) above.

(10) That the injection wells or injection pressurization system should be so equipped as to limit injection pressure at the wellhead to no more than 60 psi, but the Division Director should have authority to increase said pressure limitation, should circumstances warrant.

(11) That the subject application should be approved and the project should be governed by the provisions of Rules 701, 702, and 703 of the Division Rules and Regulations.

IT IS THEREFORE ORDERED:

(1) That the applicant, Tesoro Petroleum Corporation, is hereby authorized to institute a one-acre pilot caustic flood project in the Hospah Field by the injection of caustic fluid into the Seven Lakes Sand of the Upper Hospah Field at an approximate depth of 300-500 feet through four injection wells in Unit K of Section 1, Township 17 North, Range 9 West, NMPM, McKinley County, New Mexico.

(2) That said wells may be located anywhere within Unit K but not closer than 10 feet to any quarter-quarter section line.

(3) That injection into each of said wells shall be through internally coated tubing, set in a packer which shall be located

as near as practicable to the uppermost perforation; that the casing-tubing annulus of each injection well shall be loaded with an inert fluid and equipped with an approved pressure gauge or attention-attracting leak detection device.

(4) That the operator shall immediately notify the supervisor of the Division's Aztec district office of the failure of the tubing or packer in any of said injection wells, the leakage of water or oil from or around any producing well, or the leakage of water or oil from any plugged and abandoned well within the project area and shall take such timely steps as may be necessary or required to correct such failure or leakage.

(5) That the operator shall test all pilot project wells upon completion gathering fluids for analysis.

(6) That the operator shall monitor nearby deeper wells for signs of fluid movement.

(7) That the operator shall determine the effect of the caustic solution on the formation and formation fluids and determine the nature and chemical makeup of the residue in the area swept.

(8) That the operator shall submit a report to the Director of the Division within six months following completion of the pilot project which report shall contain data derived and resulting from the requirements of Orders (5), (6), and (7) above.

(9) That the injection wells herein authorized and/or the injection pressurization system shall be so equipped as to limit injection pressure at the wellhead to no more than 60 psi, provided however, the Division Director may authorize a higher surface injection pressure upon satisfactory showing that such pressure will not result in fracturing of the confining strata.

(10) That the subject caustic flood project is hereby designated the Tesoro Hospah Seven Lakes Project and shall be governed by the provisions of Rules 701, 702, and 703 of the Division Rules and Regulations.

(11) That monthly progress reports of the caustic flood project herein authorized shall be submitted to the Division in accordance with Rules 704 and 1120 of the Division Rules and Regulations.

(12) That jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

JOE D. RAMEY
Director

S E A L

fd/

ROUGH

dr/

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
DIVISION FOR THE PURPOSE OF
CONSIDERING:

CASE NO. 7070

Order No. R-6557

APPLICATION OF TESORO PETROLEUM
CORPORATION FOR A PILOT CAUSTIC FLOOD
PROJECT, McKINLEY COUNTY, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on ~~October 29~~ November 12, 19 80, at Santa Fe, New Mexico, before Examiner ~~Daniel S. Nutter~~ R RS.

NOW, on this _____ day of _____, 19 80, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Division has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Tesoro Petroleum Corporation, seeks authority to institute a one-acre pilot caustic flood project on its Hospah Sand Unit ~~Lease~~, Hospah Field, by the injection of caustic fluid into the Seven Lakes Sand of the Upper Hospah Field at an approximate depth of 300-500 feet through four injection wells in Unit K of Section 1, Township 17 North,

Range 9 West, NMPM, McKinley County, New Mexico.

(3) That the ~~wells in~~ Seven Lakes Sand within the project area ~~are in an advanced state of depletion and should properly be classified as "stripper" wells.~~ appears to be incapable of being produced by normal primary recovery methods.

(4) That the proposed caustic fluid flood project ~~should~~ is needed to develop data which may result in the recovery of otherwise unrecoverable oil, thereby preventing waste.

(5) That the operator should take all steps necessary to ensure that the injected fluid enters only the proposed injection interval and is not permitted to escape to other formations.or onto the surface from injection, production, or plugged and abandoned wells.

(6) That the operator should test all pilot project wells upon completion, gathering fluids for analysis.

(7) That the operator should monitor nearby deeper wells for signs of fluid movement in the Seven Lakes Sand interval.

(8) That the operator should determine the effect of the caustic solution on the formation and formation fluids and determine the nature and chemical makeup of the residue in the area swept.

(9) That the operator should submit a report to the Director of the Division within six months following completion of the pilot project which report shall contain data derived and resulting from the requirements of Findings (6), (7), and (8) above.

(10) That the injection wells or injection pressurization system should be so equipped as to limit injection pressure at the wellhead to no more than 60 psi, but the Division Director should have authority to increase said pressure limitation, should circumstances warrant.

(11) That the subject application should be approved and the project should be governed by the provisions of Rules 701, 702, and 703 of the Division Rules and Regulations.

IT IS THEREFORE ORDERED:

(1) That the applicant, Tesoro Petroleum Corporation, is hereby authorized to institute a one-acre pilot caustic flood project in the Hospah Field by the injection of caustic fluid into the Seven Lakes Sand of the Upper Hospah Field at an approximate depth of 300-500 feet through four injection wells in Unit K of Section 1, Township 17 North, Range 9 West, NMPM, McKinley County, New Mexico.

(2)

(3) That injection into each of said wells shall be through

(2) That said wells may be located anywhere within ~~the~~ Unit K but not closer than 10 feet to any quarter ~~quarter~~ quarter section line.

internally coated tubing, set in a packer which shall be located as near as practicable to the uppermost perforation; that the casing-tubing annulus of each injection well shall be loaded with an inert fluid and equipped with an approved pressure gauge or attention-attracting leak detection device.

(4) That the operator shall immediately notify the supervisor of the Division's Aztec district office of the failure of the tubing or packer in any of said injection wells, the leakage of water or oil from or around any producing well, or the leakage of water or oil from any plugged and abandoned well within the project area and shall take such timely steps as may be necessary or required to correct such failure or leakage.

(5) That the operator ~~should~~ shall test all pilot project wells upon completion gathering fluids for analysis.

(6) That the operator ~~shall~~ monitor nearby deeper ~~and~~ wells for signs of fluid movement.

(7) That the operator ~~shall~~ shall determine the effect of the caustic on the formation and formation fluids and determine the nature ~~and partial analysis~~ and chemical make up of the residue in the area swept.

(8) That the operator ~~shall~~ shall submit a report to the Director of the Division within ~~6~~ six months following completion of the pilot project which report shall contain data derived ~~from~~ and ~~the~~ resulting from the requirements of ~~Findings (6), (7),~~ Orders (5), (6) and (7) above.

(9) That the injection wells herein authorized and/or the injection pressurization system shall be so equipped as to limit injection pressure at the wellhead to no more than 60 psi, provided however, the Division Director may authorize a higher surface injection pressure upon satisfactory showing that such pressure will not result in fracturing of the confining strata.

(10) That the subject ~~waterflood~~ Caustic flood project is hereby designated the Tesoro Hospah Seven Lakes ~~Waterflood~~ Project and shall be governed by the provisions of Rules 701, 702, and 703 of the Division Rules and Regulations.

(11) That monthly progress reports of the ~~waterflood~~ caustic flood project herein authorized shall be submitted to the Division in accordance with Rules 704 and 1120 of the Division Rules and Regulations.

(12) That jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year herein-above designated.

STATE OF NEW MEXICO
DEPARTMENT OF ENERGY AND MINERALS
OIL CONSERVATION DIVISION

IN THE MATTER OF THE APPLICATION OF TESORO PETROLEUM CORPORATION FOR APPROVAL OF A PILOT PROJECT, INCLUDING WELL-SPACING EXCEPTIONS FOR INJECTION AND PRODUCING WELLS, SEVEN LAKES SAND OF THE UPPER HOSPAH FORMATIONS, HOSPAH FIELD, MCKINLEY COUNTY, NEW MEXICO.

Case 7070

A P P L I C A T I O N

COMES NOW TESORO PETROLEUM CORPORATION, by and through its attorneys, KELLAHIN & KELLAHIN, and applies to the Oil Conservation Division of the State of New Mexico for approval of a pilot caustic flood project for the Upper Hospah formations of the Hospah Field, McKinley County, New Mexico and in support thereof would show:

1. Applicant is the operator in the Upper Hospah formation of the Hospah Field, McKinley County, New Mexico, including Section 1, T17N, R9W, NMPM.

2. Applicant seeks to initiate a pilot caustic flood project in the Seven Lakes Sand of the Upper Hospah formation at a location in the NE/4SW/4 Section 1, T17N, R9W, NMPM hereinafter set forth.

3. The Hospah field is now in its later stages of secondary recovery by waterflood and applicant proposes to determine by the proposed pilot project the feasibility of a tertiary recovery project by the use of a caustic flood process. Attached as Exhibit "1" is a plat showing all wells in the area.

4. Applicant proposes to drill four injection wells and one producing well within a one acre area to a depth sufficient to penetrate the Seven Lakes Sand of the Upper Hospah Field at the following locations:

(a) Production well 330 feet from the west line and 330 feet from the north line of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(b) Injection well 225.6 feet from the west line and 225.6 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(c) Injection well 434.3 feet from the west line and 225.6 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(d) Injection well 434.3 feet from the west line and 434.3 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

(e) Injection well 225.6 feet from the west line and 434.3 feet from the north line of the NW 1/4 of the NE 1/4 of the SW 1/4 of Section 1, T17N, R9W.

5. In accordance with Rule 701 of the Rules of the New Mexico Oil Conservation Division, the following Exhibits are attached and incorporated herein by reference:

(a) Exhibit 2: Plat showing the location of the project and all other wells within a two mile radius.

(b) Exhibit 3: A tabular summary of all wells within a one-half mile radius;

(c) Exhibit 4: A type Log (Well No. 55)

(d) Exhibit 5: A Wellbore Schematic of the proposed injection wells;

(e) Exhibit 6: a Wellbore Schematic of the proposed producing well;

(f) Exhibit 7: Wellbore Schematics of all plugged and abandoned wells within a one-half mile radius;

6. The injection of the caustic fluid will consist of 0.1 percent by weight of sodium hydroxide in solution with water and will be injected at pressures below that required to fracture the confining strata.

7. The proposed pilot project has a potential life of two years from commencement.

8. The proposed pilot will be limited to the Seven Lakes Sand of the Upper Hospah Field at an approximate depth of 300-500 feet.

9. The potable water utilized in the area as well as the source water for this pilot project is in the Morrison formation at a depth of 3,100 to 3,200 feet. A typical water analysis is attached as Exhibit 8.

10. The proposed pilot project as outlined in Exhibit 9, attached hereto, will not present a risk of contamination of fresh-water sources in the area, will not impair the correlative rights of others, will be in the best interests of conservation, will determine the feasibility of a caustic flood of this formation, and will not cause waste.

WHEREFORE, Applicant seeks approval for this application for a pilot caustic flood project in the Sevel Lakes Sand of the Upper Hospah Field, McKinley County, New Mexico including but not limited to authority to:

(a) to approve the drilling and spacing of the

proposed injection wells and producing well at the proposed location;

(b) to approve the proposed pilot project;

(c) grant such additional authority and approval as may be required to implement the proposed pilot project.

KELLAHIN KELLAHIN

By: W. Thomas Kellahin

W. Thomas Kellahin
P.O. Box 1769
Santa Fe, New Mexico 87501
(505) 982-4285

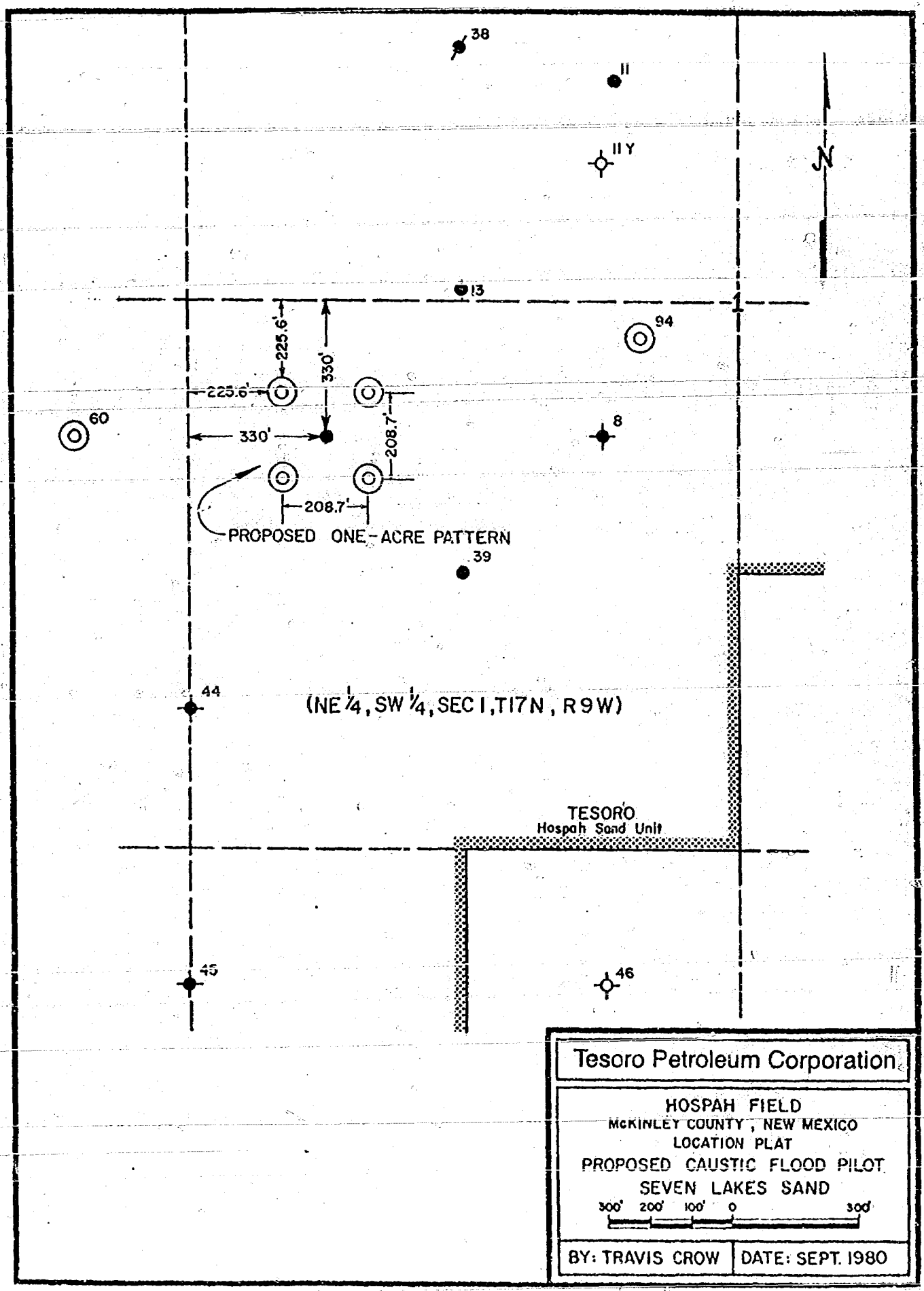

38
11
11Y
N
13
94
225.6'
330'
225.6'
330'
208.7'
60
8
208.7'
PROPOSED ONE-ACRE PATTERN
39
44
(NE¼, SW¼, SEC 1, T17N, R9W)
TESORO
Hospah Sand Unit
45
46
Tesoro Petroleum Corporation
HOSPAH FIELD
McKINLEY COUNTY, NEW MEXICO
LOCATION PLAT
PROPOSED CAUSTIC FLOOD PILOT
SEVEN LAKES SAND
300' 200' 100' 0 300'
BY: TRAVIS CROW
DATE: SEPT. 1980

Exhibit 1

Wells Within 1/2 Mile of Proposed Injection Wells

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	HSU #8	NE-SW Sec 1-17N-9W	12 1/2" 7"	22' 1533'	10 sx 50 sx	surface 1300'	1578'	P & A	--
Tesoro	HSU #9	NW-SE Sec 1-17N-9W	10" 7"	17' 1535'	10 sx 40 sx	surface 1350'	1570'	1535'-70'	U. Hospah
Tesoro	HSU #13	SE-NW Sec 1-17N-9W	10" 7"	22' 1530'	15 sx 50 sx	surface 1300'	1561'	1530'-61'	U. Hosp
Tesoro	HSU #11	SE-NW Sec 1-17N-9W	12" 7"	22' 1522'	12 sx 50 sx	surface 1280'	1550'	P & A	--
Tesoro	HSU #11-Y	SE-NW Sec 1-17N-9W	8 5/8" 5 1/2"	73' 1538'	60 sx 150 sx	surface 590'	1563'	1538'-63'	U. Hospah
Tesoro	HSU #38	SE-NW Sec 1-17N-9W	5 1/2"	1557'	50 sx	1250'	1565'	1557'-65'	U. Hospah
Tesoro	HSU #2	SE-NW Sec 1-17N-9W	8 5/8"	1528'	75 sx	1340'	1576'	1528'-76'	U. Hospah
Tesoro	HSU #21	SE-NW Sec 1-17N-9W	7"	1547'	40 sx	1360'	1591'	1547'-85'	U. Hospah
Tesoro	HSU #84	SE-NW Sec 1-17N-9W	8 5/8" 4 1/2"	70' 1536'	50 sx 120 sx	surface 879'	1574'	1536'-74'	U. Hospah (Injectic
Tesoro	HSU #61	SW-NW Sec 1-17N-9W	7' 4 1/2"	64' 1700'	35 sx 50 sx	surface 1220'	1715'	1632'-56'	U. Hospah (Injection
Tesoro	HSU #56	SW-NE Sec 1-17N-9W	8 5/8" 5 1/2"	302' 1694'	200 sx 140 sx	surface 268'	2730'	1514-42'	U. Hospah
Tesoro	HSU #24-A	SW-NE Sec 1-17N-9W	5 3/8"	1512'	75 sx	1190'	1552'	1512'-52'	U. Hospah
Tesoro	HSU #52	SW-NE Sec 1-17N-9W	7"	1514'	50 sx	1330'	1526'	1514'-26'	U. Hospah

Tabular Summary of All Wells Within a One-Half Mile Radius of Proposed Injection Wells

Exhibit 3

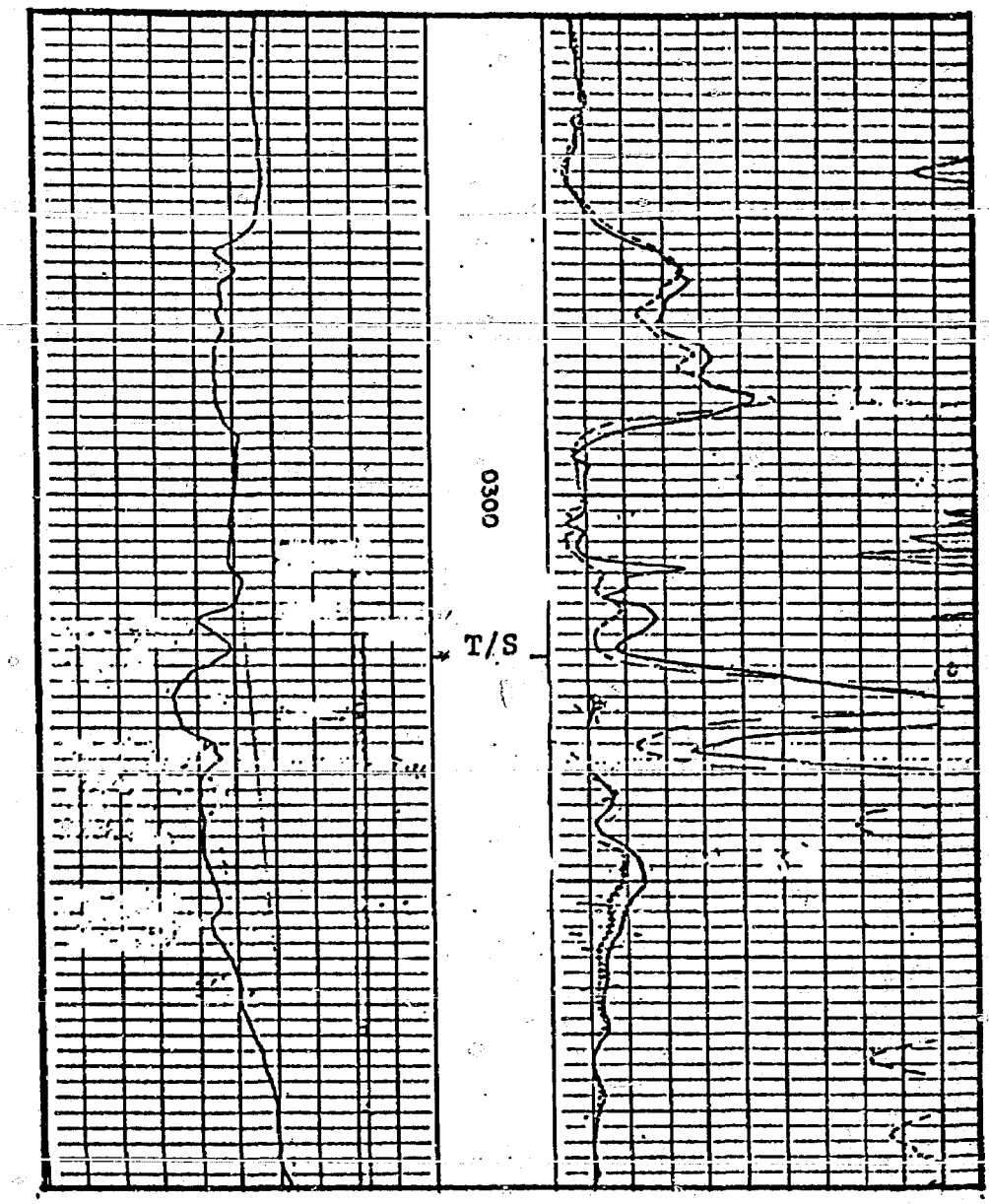
Wells Within 1/2 Mile of Proposed Injection Wells

Operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	HSU #85	SW-NE Sec 1-17N-9W	8 5/8" 5 1/2"	104' 1535'	100 sx 150 sx	surface 450'	1551'	1535'-51'	U. Hospah
Tesoro	HSU #67	SE-NE Sec 1-17N-9W	7" 4 1/2"	83' 1634'	35 sx 55 sx	surface 1150'	1636'	1546'-64'	U. Hospah (Injection
Tesoro	HSU #23	NW-NE Sec 1-17N-9W	5 3/8"	1528'	75 sx	1200'	1570'	1528'-70'	U. Hospah
Tesoro	SF Hurst #1	NW-NE Sec 1-17N-9W	13 3/8" 9 5/8"	207' 3317'	150 sx 325 sx	surface 2400'	7852'	P & A	--
Tesoro	HSU #51	NW-NE Sec 1-17N-9W	7"	1532'	50 sx	1340'	1576'	1532'-76'	U. Hospah
Tesoro	HSU #12	NW-NE Sec 1-17N-9W	10" 7"	21' 1535'	12 sx 45 sx	surface 1320'	1580'	1535'-80'	U. Hospah
Tesoro	HSU #4	NE-NW Sec 1-17N-9W	7"	1611'	70 sx	1400'	1611'	P & A	--
Tesoro	HSU #4Y	NE-NW Sec 1-17N-9W	13 5/8" 5 1/2"	74' 1556'	60 sx 150 sx	surface 620'	1581'	1556'-81'	U. Hospah
Tesoro	HSU #6	NE-NW Sec 1-17N-9W	11" 7"	20' 1538'	155 sx 70 sx	surface 1230'	1582'	1538'-82'	U. Hospah
Tesoro	HSU #22	NE-NW Sec 1-17N-9W	7"	1553'	41 sx	1360'	1595'	1553'-95'	U. Hosp.
Tesoro	HSU #5	NE-NW Sec 1-17N-9W	14" 6 5/8"	80' 1604'	16 sx 75 sx	50' 1300'	1604'	1552'-65'	U. Hospah

Tabular Summary of All Wells
Within a One-Half Mile Radius
of Proposed Injection Wells

operator	well Name	Location	Casing String	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation	
Tesoro	HSU 93	NE-NW-Sec 1-17N-9W	8 5/8"	23'	30 sx	surface	1605'	1540-1560'	U. Hospah (Inj)	
			5 1/2"	1632'	165 sx	1100				
Tesoro	HSU 87	NW-NE-Sec 1-17N-9W	8 5/8"	53'	35 sx		1590'	1535-1555'	U. Hospah (Inj)	
			5 1/2"	1590'	160 sx					
Ind. Prod. Co.	#4	SE-NE-Sec 2-17N-9W	—	—	—	—	—	—	P & A	
Tesoro	HSU 55	SW-NE-Sec 1-17N-9W	4 1/2"	447'	50 sx	surface	450'	310-348'	Temp. abnd in Seven Lakes Sd.	P & A
Tenneco	Hotchkiss #1	NE-SE-Sec 2-17N-9W	—	—	—	—	—	—	P & A	
Tesoro	HSU 67	SE-NE-Sec 1-17N-9W	7"	82.8'	25 sx	est circ.	1636'	1552-1560'	U. Hospah (Inj.)	
			4 1/2"	1634'	55 sx	1350		1563-1570'		
Tesoro	HSU 60	NW-SW-Sec 1-17N-9W	7"	84'	25 sx	est circ.	1640'	1559-1590'	U. Hospah (Inj)	
			4 1/2"	1640'	50 sx	1350		1600-1601'		
Tesoro	HSU 44	NE-SW-Sec 1-17N-9W	5 1/2"	1554'	75 sx		1572'		P & A	
Tesoro	HSU 39	NE-SW-Sec 1-17N-9W	—	—	—	—	1557'	—	—	
Tesoro	HSU 94	NE-SW-Sec 1-17N-9W	8 5/8"	40'	30 sx	surface	1575'	1515-1530'	U. Hospah (Inj)	
			5 1/2"		125 sx	1100'				
Tesoro	SFRR "A" 57	NW-SE-Sec 1-17N-9W	8 5/8"	135'	110 sx		2800'	1625-1634'	P & A	P & A 6/70
			5 1/2"	1698'	140 sx					
Tesoro	HSU 45	SE-SW-Sec 1-17N-9W	5 1/2"	1634'	85 sx		1818		P & A	
Tesoro	SFRR "A" 46	SE-SW-Sec 1-17N-9W	—	—	—	—	—	—	P & A	
Tesoro	SFRR "A" 73	SW-SE-Sec 1-17N-9W	8 5/8"	63'	40 sx	est circ.	1665'	open hole comp.	L. Hospah	
			4 1/2"	1639'	75 sx	1300				
Tesoro	SFRR "A" 79	SW-SE-Sec 1-17N-9W	8 5/8"	67'	50 sx	est. circ.	1624'	open hole comp.	U. Hospah	
			5 1/2"	1589'	50 sx	1300		1589-1624'		

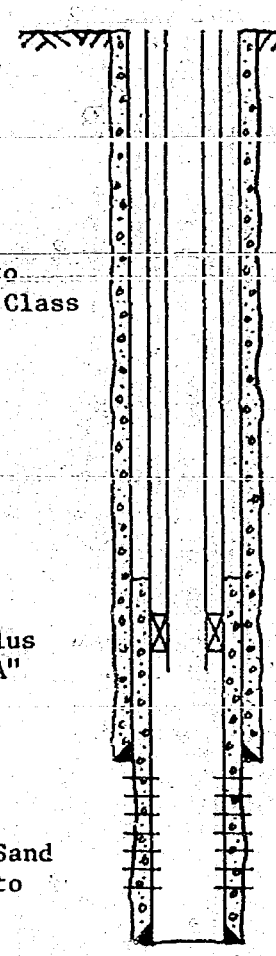
operator	Well Name	Location	Casing Strings	Setting Depth	Cement Volume	Cement Top	Total Depth	Producing Interval	Producing Formation
Tesoro	SFRR "A" 8-1	SW-SE-Sec1-17N-9W	8 5/8"	62'	5C sk	circ	1655'	open hole comp.	L. Hospah
			5 1/2"	1643.5'	100 sk	700'		1643.5-1655'	
Tesoro	SFRR "A" 8-9	SW-SE-Sec1-17N-9W	9 5/8"	95'	100 sk	circ	1656'	open hole comp.	L. Hospah (Inj)
			7"	1639'	100 sk	—			
Tesoro	SFRR "A" 8-7	SW-SE-Sec1-17N-9W	8 5/8"	104'	100 sk	surface	1769'	open hole comp.	L. Hospah
			5 1/2"	1769'	100 sk	500'		1648-1654'	



TYPE LOG

(Well No. 55)
SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 4



Cement 7-in. annulus to surface with 50 sacks Class "A" neat.

Cement 4-1/2-in. annulus with 10 sacks Class "A" neat.

Perforate Seven Lakes Sand at approximately 291 to 321 ft.

Top of cement: 261 ft

2-in. tbg w/pkr: 276 ft

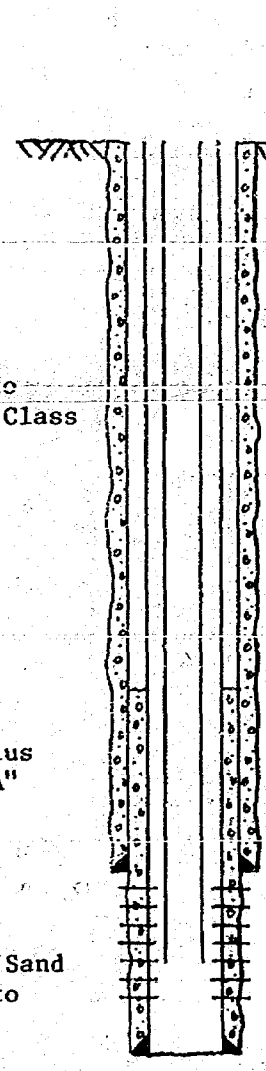
7-in. casing: 291 ft

4-1/2-in. casing: 336 ft

TESORO PETROLEUM CORPORATION
WELLBORE SCHEMATIC
CAUSTIC FLOOD INJECTION WELL

SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 5



Cement 7-in. annulus to surface with 50 sacks Class "A" neat.

Cement 4-1/2-in. annulus with 10 sacks Class "A" neat.

Perforate Seven Lakes Sand at approximately 291 to 321 ft.

Top of cement: 261 ft

7-in. casing: 291 ft

2-in. tbg: 315 ft

4-1/2-in. casing: 336 ft

TESORO PETROLEUM CORPORATION
WELLBORE SCHEMATIC
CAUSTIC FLOOD PRODUCTION WELL

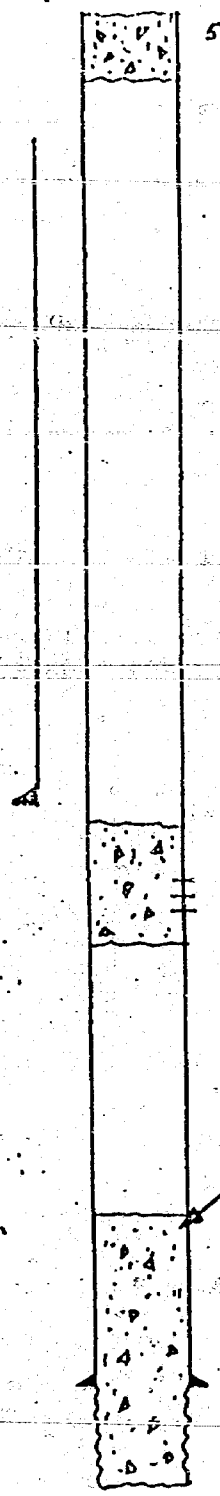
SEVEN LAKES SAND
HOSPAH FIELD
MC KINLEY COUNTY, NEW MEXICO

Exhibit 6

Exhibit 7

Well bore Schematics of All Plugged and Abandoned Wells

Within a One-Half Mile Radius of Proposed Injection Wells



Well Hospah Sand Unit # 8
Field: Hospah
Location: NE 1/4 SW Sec. 1 -T17N -R9W
County: McKinley State: N.M.
Zero Elevation: ____ Ft. (____ AGL) GL.: ____
TD: 1570 Ft. PBTD: ____ Ft.

Wellhead: ____

Tubing String: ____

Centralizers: ____

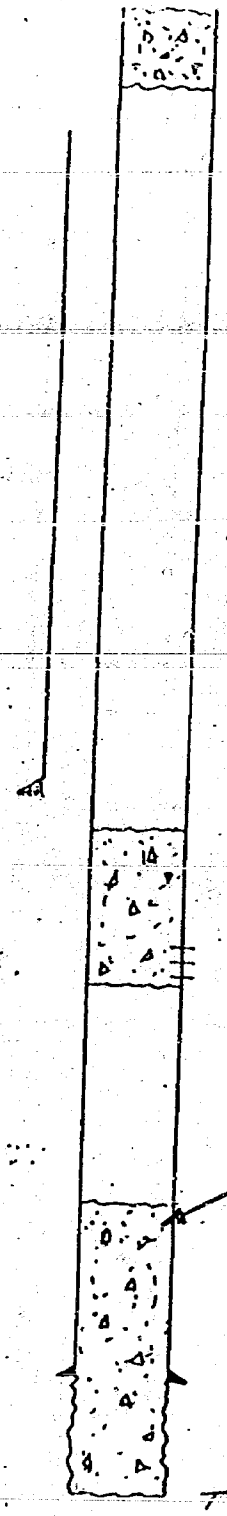
12¼ "OD ____ LB ____ GR. ____ THRD.
@ 22' FT. W/ 10 SX (____ FT3) cmt.
in 15 " hole (CMT. CLASS-ADDITIVES: ____)
T.O.C. @ surface BY: ____

Perforated @ 570'. Squeezed w/ 130 sx cement.
Cement Top inside 7" csg. is 300'

7 "OD 20 LB ____ GR ____ THRD.
@ 1533 FT. W/ 50 SX (____ FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES: ____)
T.O.C. @ 1300' BY: ____

UPDATED BY: KJK DATE: 1/21/80

✓



10' cement plug @ top of 7" csg.

Well: Hospah Sand Unit # 11
Field: Hospah
Location: SE / NW Sec 1 - T 17N - R 9W
County: McKinley State: N.M.
Zero Elevation: ft. (AGL) GL:
TD: 1550 ft. PBTD: ft.

Wellhead:

Tubing String:

Centralizers:

12 "OD LB GR THRD.
@ 22 FT. W/ 12 SX (FT3) cmt.
in 15 " hole (CMT. CLASS-ADDITIVES:
T.O.C. @ surface BY:)

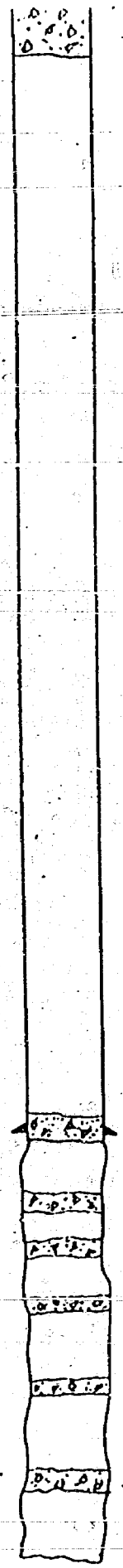
Perforated @ 430'. Squeezed w/ 80 sx cement
Cement Top inside 7" csg. is 277'

25 sk cement plug: 1550'-1416'

7 "OD LB GR THRD.
@ 1522 FT. W/ 50 SX (FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES:
T.O.C. @ 1280' BY:)

TD: 1550'

UPDATED BY: KJK DATE: 1/21/80



Field: Hospah

Location: NW / NE Sec 1 - T 17N - R 9W

County: McKinley State: N. M.

Zero Elevation: _____ Ft. (_____ AGL) GL: _____

TD: 7852 Ft. PBTD: _____ Ft.

Wellhead: _____

Tubing String: _____

Centralizers: _____

13 3/8" OD ____ LB ____ GR ____ THRD.
@ 207 FT. w/ 150 SX (_____ FT³) cmt.
in 17 1/2" hole (CMT. CLASS-ADDITIVES: _____)

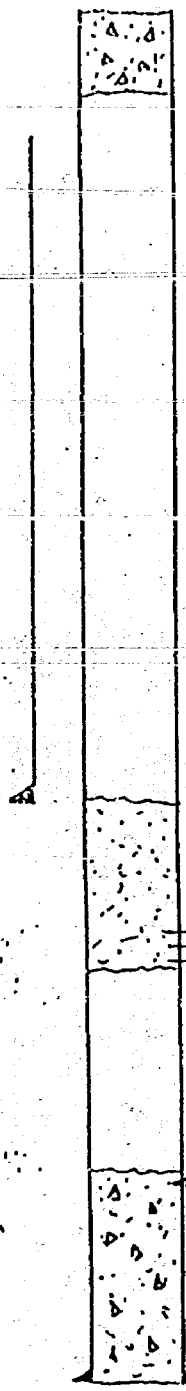
T.O.C. @ surface BY: _____

9 5/8" OD ____ LB ____ GR ____ THRD.
@ 3317 FT. w/ 325 SX (_____ FT³) cmt.
in 12 1/4" HOLE (CMT. CLASS-ADDITIVES: _____)

T.O.C. @ 2400' BY: _____

UPDATED BY: K.J.K. DATE: 1/21/80

✓



10' cement plug @ top of csg.

Well: Hospah Sand Unit #4
Field: Hospah
Location: NE / NW Sec 1 T 17N - R 8W
County: McKinley State: N.M.
Zero Elevation: _____ ft. (_____ AGL) GL.: _____
TD: 1611 ft. PBTD: _____ ft.

Wellhead: _____

Tubing String: _____

Centralizers: _____

← No Surface Casing

_____ "OD _____ LB _____ GR. _____ THRD.
@ _____ FT. w/ _____ SX (_____ FT3) cmt.
in _____ " hole (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ _____ BY: _____

Perforated @ 499' Squeezed w/ 80 sx cement.
Cement Top inside csg. @ 277'

← 25 sk. cement plug: 1610' - 1481'

7 "OD _____ LB _____ GR _____ THRD.
@ 1611 FT. w/ 70 SX (_____ FT3) cmt.
in 9 7/8 " HOLE (CMT. CLASS-ADDITIVES: _____)
T.O.C. @ 1400' BY: _____

TD - 1611'

UPDATED BY: K.J.K DATE: 1/21/8?

✓

GROUND LEVEL

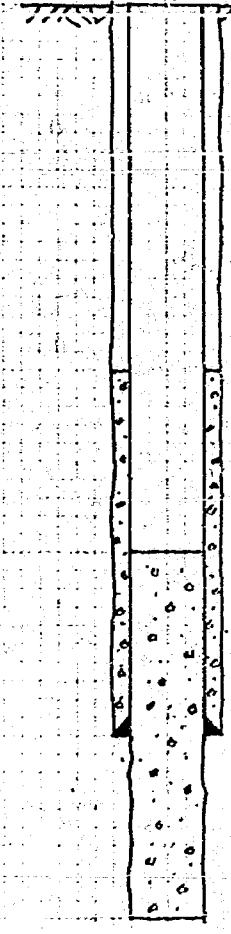
CSG CEMENTED W/75 SX
TOP OF CEMENT UNKNOWN

P & A 7/46 W/ 25 SX CMT
TOP OF CMT @ 1,354 FT

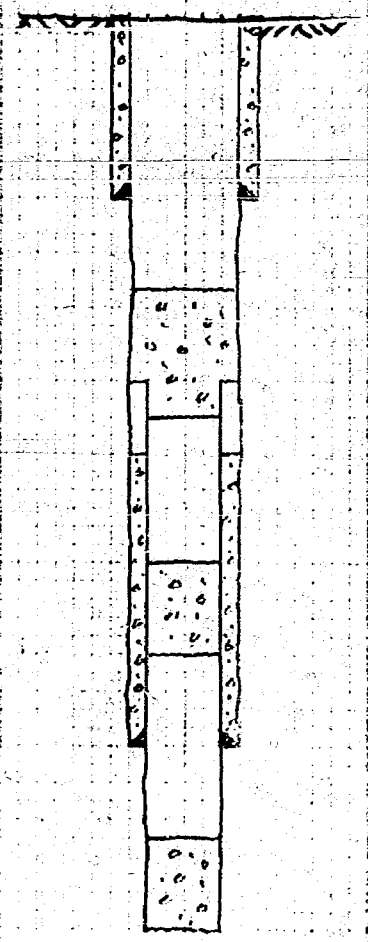
5-½ IN. CSG @ 1,554 FT

TD 1,572 FT

Wellbore Schematic
Well No. 44
Plugged and Abandoned Well



Wellbore Schematic
Well No. 45
Plugged and Abandoned Well



CSG CEMENTED W/110 SX

8-5/8-IN. CSG @ 123 FT.

SPOTTED 30 SX CEMENT
883-745 FT

CSG SHOT OFF AT 825 FT

CSG CEMENTED W 140 SX
TOP OF CEMENT UNKNOWN

SPOTTED 15 SX CEMENT
1,644-1,513 FT

5-1/2-IN. CSG @ 1,698 FT

PBTD 1,750 FT
PB W/ 125 SX CEMENT

TD 2,800 FT

Wellbore Schematic
Well No. 57
Plugged and Abandoned Well

CORE LABORATORIES, INC.
Petroleum Reserve Engineering
DALLAS, TEXAS

WATER ANALYSIS

File IWTL-7117

Company Tesoro Petroleum Corporation Well Name Water supply well Sample No. 1

Formation Morrison Depth 3100' - 3200' Sampled From Hosgah sand unit 53

Location _____ Field _____ County _____ State _____

Date Sampled _____ Date Analyzed 3-11-71 Analyst RAL

Total Dissolved Solids 774 mg/L calculated

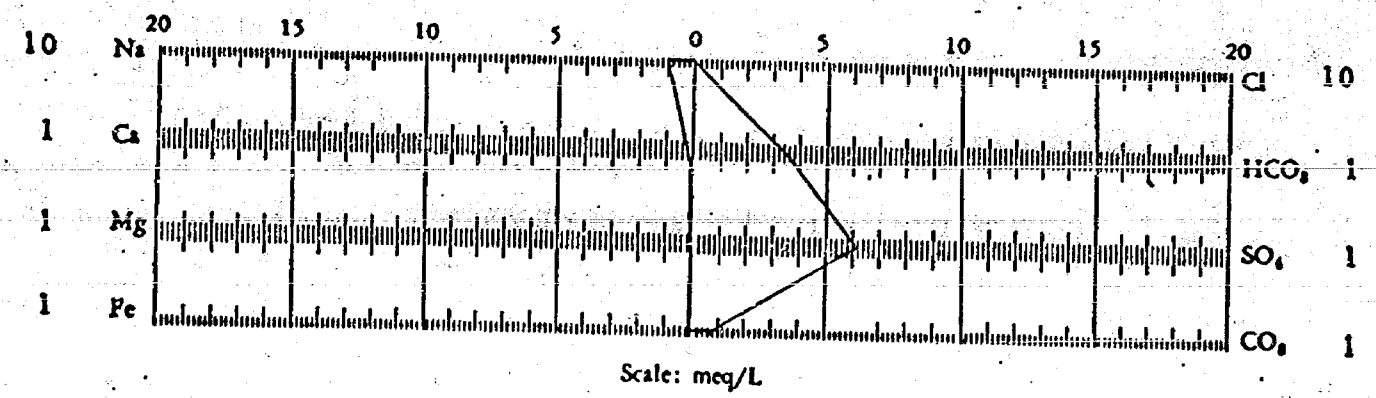
Specific Gravity 0.9993 @ 60° F. / 0.9965 @ 74 °F.

Resistivity 9.097 ohm-meters @ 74 °F. measured

Hydrogen Sulfide absent

pH 9.05 @ 76 °F.

* Constituents	meq/L	mg/L		Constituents	meq/L	mg/L	
Sodium	10.19	234		Chloride	0.27	9.7	
Calcium	0.24	4.8		Bicarbonate	3.51	214	
Magnesium	0.03	0.4		Sulfate	6.12	294	(Grav.)
Iron	0.01	0.33		Carbonate	0.57	17	
Barium	0.0	0.0	(Grav.)	Hydroxide	0.0	0.0	



Scale: meq/L

* All analyses except iron determination performed on a filtered sample.

Exhibit 8

PROPOSAL FOR A CAUSTIC FLOOD PILOT
HOSPAH FIELD

Tesoro Petroleum Corporation proposes to install and operate a caustic flood pilot in the Hospah field, Mc Kinley County, New Mexico. The purpose of the pilot is to evaluate the feasibility of the caustic flood process in the shallow Seven Lakes sand. The objectives are:

1. To establish the presence of a mobile oil phase in the Seven Lakes sand.
2. To evaluate reservoir fluid properties and the effect of caustic solutions on those properties.
3. To evaluate the displacement process in core samples and the effect of caustic solutions on displacement.
4. To evaluate the feasibility of treating produced water.
5. To confirm laboratory findings by pilot flooding.
6. To evaluate the economic feasibility of a caustic flood process in the Seven Lakes sand.
7. To expand the caustic flood process over the field area if warranted by findings.

The Hospah field currently produces from the upper Hospah sand of Upper Cretaceous age. Tesoro operates the field as the Hospah Sand Unit waterflood. The shallow, Upper Cretaceous, Seven Lakes sand has not been successfully tested at Hospah but has produced in the area in the Seven Lakes field which is located about 15 miles west-northwest of Hospah. Available core data establish only that a residual oil saturation is present. The trapping mechanism is a horst located on the northern plunge of an anticline. The sand has an average porosity of 0.285 and an average permeability of 270 md as determined by core analysis. By analogy with the Seven Lakes field, the oil is expected to be gas free and to have a gravity of 30.5° API.

Cores of the Seven Lakes sand in the pilot area had an average oil saturation of 21.1 percent. It is expected that this saturation has been affected by the flushing of the drilling fluids used and that the in-place oil saturation is somewhat higher. If the actual saturation is as much as 30 percent, the initial oil in place would be 650.3 STB/acre-ft. A caustic flood might be expected to produce 25 percent of this residual oil or 162.6 STB/acre-ft. This represents a potential of 766,000 STB of oil from a fully developed project.

The following procedure describes the installation and operation of a mini-pilot flood project to test and evaluate the caustic-flood process for the Seven Lakes sand. The sand occurs at a depth of about 300 feet. The pattern is a one-acre normal five-spot consisting of one production well and four injection wells.

EXHIBIT 9

The general procedure is:

1. Drill, core, and complete a production well in Sec. 1-T17N-R9W at the location described (see Exhibit 1). Core the interval of interest (30 ft) and preserve and freeze the core for laboratory analyses.

2. Install test equipment and test producing well to establish productivity and nature of produced fluids. Sample any produced fluid for laboratory analyses.

3. Drill, core, and complete four injection wells at locations 147.6 ft from the production well at the locations described (see Exhibit 1). Core the intervals of interest (30 ft each) and preserve and freeze the cores for laboratory analyses.

4. Conduct pressure falloff tests of injection wells to determine injectivity of each. Stimulate wells as needed to remove any wellbore damage. Run a production log over the sand interval to define the initial injection profile.

5. Install surface facilities required to lift, treat, and store the produced fluids including pumping unit, flowlines, free-water knockout, and other oil-water dehydration or demulsification equipment as needed.

6. Install caustic-brine injection facilities; supply water treating and softening facilities as necessary; and injection pumps and lines.

7. Inject a softened water pre-flush into the four injection wells. Chemical tracers will be injected during this phase to investigate flood pattern development and time of breakthrough of the pre-flush slug. The pre-flush will consist of approximately 13,000 bbl of 1.0 percent by weight of sodium chloride (NaCl). The estimated injection rate into four wells is 172 BPD with an injection pressure of 60 psig. The estimated pre-flush injection period is 2.5 months.

8. Inject caustic slug into the four injection wells. Chemical tracers will be injected with the slug to observe breakthrough patterns and times. Periodic injection profiles and production profiles will be taken to monitor changes in vertical efficiency. The slug will consist of approximately 26,000 bbl of 0.1 percent by weight of sodium hydroxide (NaOH). The estimated caustic slug injection period is five months.

9. Inject caustic-brine solution into the four injection wells. The solution will consist of 0.1 percent by weight of NaOH and 1.0 percent by weight of NaCl. Approximately 51,000 bbl of the solution will be injected over a period of ten months.

10. Injection wells will be acidized as needed to maintain injection rates.

11. During the pilot test period, laboratory studies will be conducted to investigate the entrapment and entrainment mechanisms of caustic flooding. Tests will also be made to determine the methods to be used in dehydrating the produced emulsion and in treating the produced water for reinjection.

A one-acre pattern has been selected for the pilot to minimize the time required to evaluate the process and to limit the field area affected by the injected fluids. If one-half of the injected fluid is lost outside the pattern area, only two acres of the field would be swept. This represents an average radial distance of 295 ft from the production well. The nearest existing wellbore is Hospah Sand Unit No. 13, which is located 482.5 ft from the proposed production well. The casing annuli of those wells offsetting the pattern will be monitored for pressure changes or other

evidence of influence by the injected fluids. If such evidence is noted, Tesoro will take necessary action to prevent wellbore communication with other sands. This would include squeezing the affected annulus with cement from the Seven Lakes interval to the surface.

The source of the injection water supply is the Morrison formation at a depth of 3,100 to 3,200 ft. This sand is currently supplying fresh water for injection into the upper Hospah sand. A typical water analysis is shown by Exhibit 8. The Seven Lakes sand is believed to contain fresh water but no analysis is available.