Huntington Beach Energy Series

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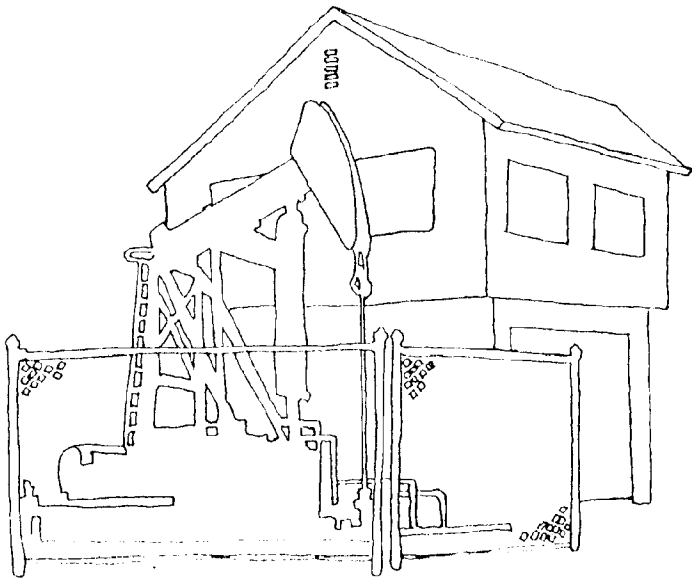
Report #1

Preserving Surface Access to Underground Oil Reserves in Developed Areas



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City of Huntington Beach
Department of Development Services
Planning Division

February, 1981

CITY OF HUNTINGTON BEACH

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HUNTINGTON BEACH ENERGY SERIES

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REPORT #1

PRESERVING SURFACE ACCESS TO UNDERGROUND OIL RESERVES IN DEVELOPED AREAS

CITY OF HUNTINGTON BEACH
DEPARTMENT OF DEVELOPMENT SERVICES
JAMES W. PALIN, DIRECTOR

FEBRUARY, 1981

Table of Contents

		PAGE
FORWARD		1
DEFINITIONS		2
1.0	INTRODUCTION	4
2.0	COASTAL ZONE MANAGEMENT AND ACCESS TO OIL RESERVES	7
3.0	UNITIZATION, WATERFLOODS, AND THE ACCESS PROBLEM	9
3.1	Primary, Secondary and Enhanced Oil Recovery Technology	10
3.2	Difficulties in Achieving Unit Operations	11
3.3	Voluntary Unitization: Difficulties in Assigning Costs and Benefits	12
3.4	Compulsory Unitization	14
3.5	Advantage of Unitization	15
4.0	ROLES FOR CITY GOVERNMENTS IN PROTECTING ACCESS TO UNDERGROUND OIL POOLS	17
5.0	TOWNLOT/DOWNTOWN ANALYSIS	19
5.1	Brief History	19
5.2	Remaining, Recoverable Oil	22
5.3	The Possibility of a Unitization and Enhanced Recovery Project	27
5.4	Surface Area Requirements	30
6.0	POLICY OPTIONS FOR THE CITY	36
6.1	Existing Land Use Regulations	37
6.2	Strategies to Help Preserve Existing Drill Sites	37
6.3	Strategies to Help Preserve Other Oil Operation Sites	39
6.4	Permitting New Wells in the Townlot Area	39
6.5	New Oil Sites	40
6.6	Other Possible Actions	42
7.0	CONCLUSION	43
8.0	NOTES	44
APPENDICES		45
Appendix A:	Questionnaire and Cover Letter	45
Appendix B:	Bibliography	48

Foreword

This is the first in a series of discussion papers on energy-related issues prepared by the Planning Division of the City of Huntington Beach. Huntington Beach is a center for many energy-related activities including onshore and offshore oil production, an electricity-generating power plant, and increasingly, solar and conservation technologies. The purpose of these reports is to help the City to accommodate the continued production of so vital a resource as energy while at the same time mitigating as much as possible any adverse impacts on the community that such activities might incur. Other reports in this series include the following:

#2 Fiscal Impacts of Oil Operations in Huntington Beach
#3 Oil Spill Contingency Planning in Huntington Beach
#4 Enhanced Oil Recovery Technology
#5 Solar and Conservation Policies at the Local Level

This publication was prepared with financial assistance from the U.S. Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, under the provisions of the Federal Coastal Zone Management Act of 1972, as amended, and from the California Coastal Commission under the provisions of the Coastal Act of 1976.

Definitions

This report necessarily discusses some technical aspects of the oil industry. Consequently, some terms are used which may not be familiar to the reader. The following definitions section was prepared to help clarify the meaning of some of these terms. To ease reference, all words defined in this section are italicized the first time they appear in the report's text.

Consolidation: The practice of concentrating oil facilities into relatively small, intensively-used surface areas.

Economies of scale: Lower average costs or greater average profits resulting from a larger business entity rather than a smaller one undertaking a particular function.

Enhanced recovery technology: In its broadest sense, any method which is used to recover more oil from a petroleum reservoir than would be obtained by primary methods; sometimes used to mean tertiary recovery only.

Free-rider problem: Situation in which one party gains from the efforts of another party, without contributing to those efforts.

Injectors: Wells through which pressurized water, steam or other fluids are driven or "injected" into an oil reservoir.

Joint organization: A cooperative group formed by several oil operators working a common reservoir for the purpose of investigating the feasibility of forming a unit.

Participation formula: An agreement among oil operators who have formed a unit regarding the proportion of expenses and profits of the unit each operator will be allocated.

Primary production: Oil driven up through wells by natural pressure in the formation or by pumping units, without injecting water or other fluids to help force the oil to the surface.

Producers: Wells used to pump out oil from a reservoir.

Recycling: In this context, refers to the redevelopment of the surface area of an oil field for uses such as housing or commerce.

Secondary production: Oil extracted after primary production usually by injecting gas or water into the reservoir.

Technical committee: A committee established by a joint organization of oil operators prior to the formation of a unit which is responsible for investigating variables such as the geology of the oil reservoir, characteristics of the oil and the best potential recovery techniques.

Tertiary methods: Oil recovery methods applied after secondary production which usually involve the injection of chemicals with water into the reservoir to help push out more oil than water alone can. In some cases, these methods are applied after primary production.

Unit: The entity formed by several different oil companies which work a common oil pool in order to share equipment and mineral interests to produce the reservoir as a single party. When the interests in a pool are fragmented, units are essential for the use of most enhanced oil recovery methods which can only be applied on a coordinated, pool-wide basis.

Unitization: The process of forming a unit.

Waterflood: A secondary recovery program through which pressurized water is injected into a reservoir in order to push more oil from the pores in the rock.

Water injection: Another term for "waterflood."

Well-bore: The hole drilled from the surface into the underground oil pool for the purpose of injecting materials into the pool and/or extracting materials out of it.

Zones: The underground rock strata which contain oil.

1.0 Introduction

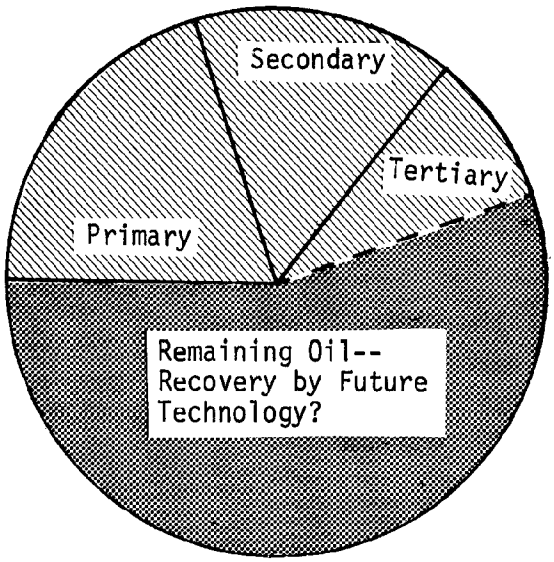
The City of Huntington Beach overlies an old and very productive oil field which, since its discovery in 1920, has produced almost a billion barrels of oil. Although the field passed its productive peak decades ago, it still produced enough oil during 1979 to rank seventh among all California oil fields in annual output. Over 1,000 wells are still active in the field and approximately 472 acres of the City are used for oil operations.

For several years, however, the amount of land devoted to oil extraction in Huntington Beach has declined. The reasons for this are clear. In those parts of the oil field where *water injection* or other ***enhanced recovery technologies*** have not been applied, production levels have dropped significantly. At the same time, the value of the surface area for new uses -- especially for housing here in coastal, suburban Southern California -- has risen dramatically. Building on the oil field surface has become more profitable than continued oil extraction at very low production rates. Thus, many parts of the field are ***recycling*** to new uses, especially to housing.

In most cases, however, the recoverable oil in the underground reservoir has not been exhausted when the surface area is developed. For example, ***primary production,*** simply pumping as much oil as possible without injecting water or other substances to help force it out, typically extracts only 15 to 20 percent of the oil in place. Consequently, when an oil field in which only primary production techniques have been utilized recycles to new uses, the great majority of the oil usually remains in the ground.

Existing and well-known ***secondary production*** techniques, such as water injection, can recover an additional 10 to 30 percent of the oil. In addition, several new technologies, ***tertiary methods,*** are being developed and tested to extract the oil remaining after secondary production.

Figure 1.1



Percentage of Oil in the Ground Which is Usually Recovered by Different Extraction Methods.

Source: Petroleum Engineer, January, 1976

Several of these methods are being tried in parts of the Huntington Beach field.

Secondary and most tertiary techniques cannot be applied on an individual well basis. Fluids, such as water or water treated with chemicals, are forced through several wells *(injectors)*, sweeping the residual oil out of the pore spaces and then to several other wells *(producers)* which pump the oil to the surface. The injectors and producers are typically arranged in patterns so that the injected fluids can efficiently sweep through an oil pool. Thus, entire oil pools must be treated as a whole or a unit and these methods must be applied in a coordinated way.

When the entire pool is owned by a single company, use of these methods is relatively easy. In fact, the major operators in Huntington Beach -- Aminoil, USA and Chevron, USA -- have been *waterflooding* their parts of the field for over two decades, and both companies are testing tertiary methods as well.

When the interests in an oil pool are highly fragmented, however, the numerous parties must act as a *unit* before these advanced technologies can be applied. The operators encounter several difficulties in forming a coordinated "unit," and often cannot act together to apply these more efficient production methods.

These difficulties are discussed later in this report. However, if these problems are overcome, *unitization* can be achieved and enhanced recovery methods applied to provide large amounts of oil.

Oil may not be recovered (even if unitization becomes economically feasible) if there are no surface areas from which extraction can be accomplished. It is precisely those areas where secondary methods are not currently used that production has declined so much that abandonment of the field for redevelopment is more profitable than continued oil extraction. Thus, the parts of the field which are most likely to be developed for residential or commercial uses and to lose future access from the surface are also the ones where secondary methods have not been tried and where their application could potentially produce large amounts of oil in the future.

Domestic oil supplies are an increasingly scarce and valuable resource. Their value derives not only from their economic worth but from other, less-tangible, benefits related to the decreased reliance on foreign oil sources. These benefits reach beyond the local community and have a regional and even a national importance. The greater-than-local importance of domestic oil would argue that the preservation of significant oil production opportunities should be the concern of the State or the federal government, and not primarily of the City.

Local governments, however, traditionally have control over land use. It is the City which must control surface activities if land for future oil extraction needs to be protected. The local government also shares the responsibility of protecting the interests of the present and future community surrounding oil operations.

Consequently, another reason for City involvement in this issue is to ensure that any adverse impacts on nearby uses from future oil operations are reduced to reasonable levels. One other consideration that the City must weigh in assessing the access issue is that oil production generates substantial tax revenues to the local government. Protecting access and the option to apply future extraction technologies may be crucial for the continuation of a very valuable revenue source in the community. The purpose of this report is to discuss the protection of access to oil resources as an important consideration for local land use policies. It discusses the numerous variables on which access preservation can be based, suggests a range of protection strategies, and analyzes specific areas in Huntington Beach where they could be applied.

2.0 Coastal Zone Management and Access to Oil Reserves

The California Coastal Act of 1976 calls for the protection of the natural resources of California's coastal zone. Among the goals of the Act is to:

"Assure orderly, balanced utilization and conservation of coastal zone resources taking into account the social and economic needs of the people of the state."[1]

Certainly the most significant natural resources in and near the Huntington Beach coastal zone include the long-productive deposits of oil. In accordance with the intent of the Coastal Act, the City is concerned with the orderly utilization of these deposits. The City's Local Coastal Plan (LCP) policies are intended to accommodate the legitimate needs of the oil industry while also protecting other important coastal resources such as the recreational and visual amenities of the shoreline.

Among the considerations relevant to the long-term utilization of these coastal resources is the need to protect surface access to the oil reserves. The area of the City where the most significant deposits still in primary production are found, and where future access is most jeopardized, is the Townlot/Downtown area, which is partially in the coastal zone. (See Figure 2.1). The City recognized this issue in the Land Use Plan of its LCP, which includes policies to amend the municipal code, if necessary, to help ensure that such surface access is reserved, if it is essential to the future development of significant oil resources. This report is intended to help the City analyze these issues, as a step toward refining its policies and ordinances aimed at ensuring the efficient, long-term use of these important coastal resources.

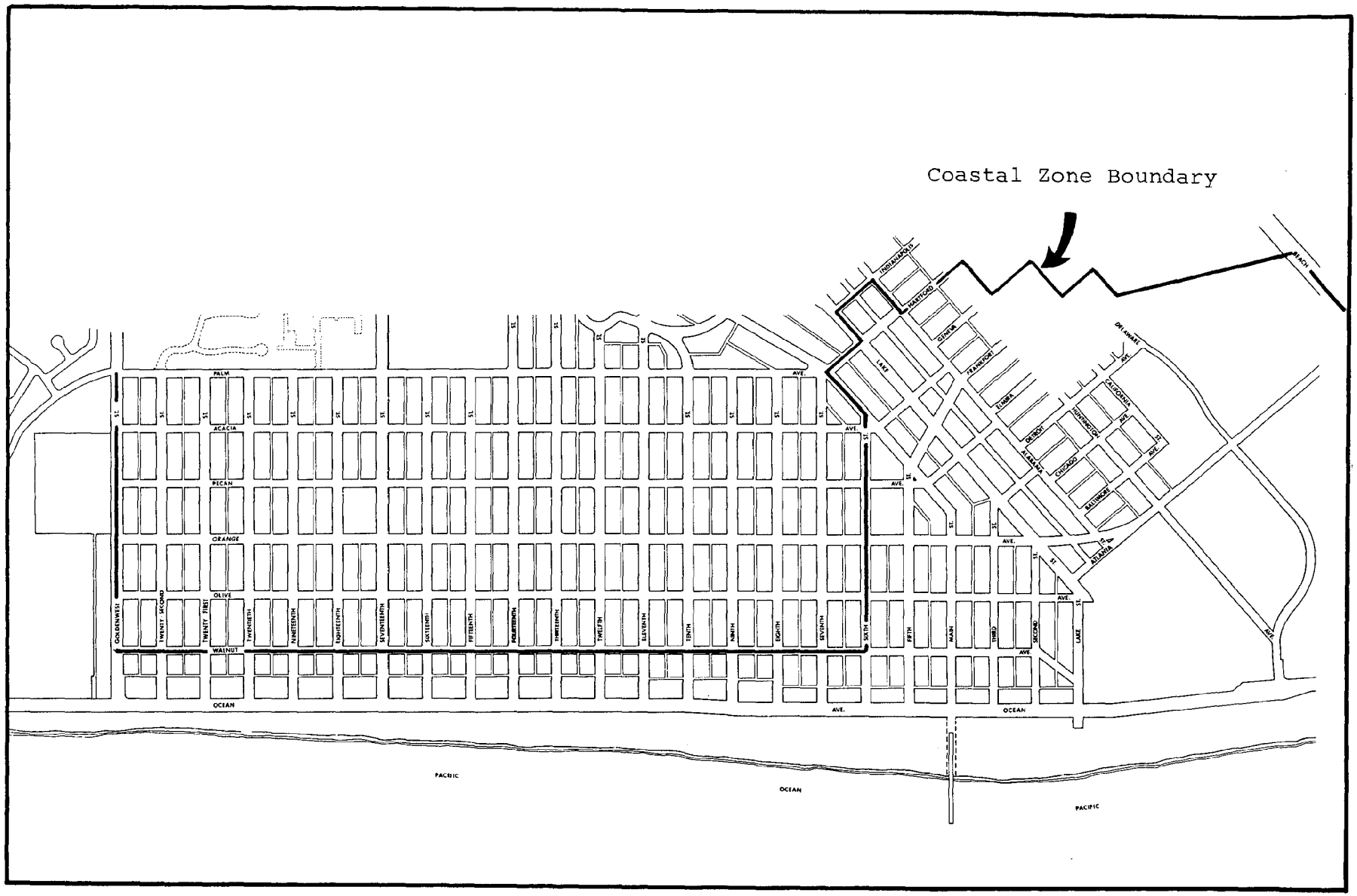


Figure 2.1 Townlot/Downtown, Huntington Beach.

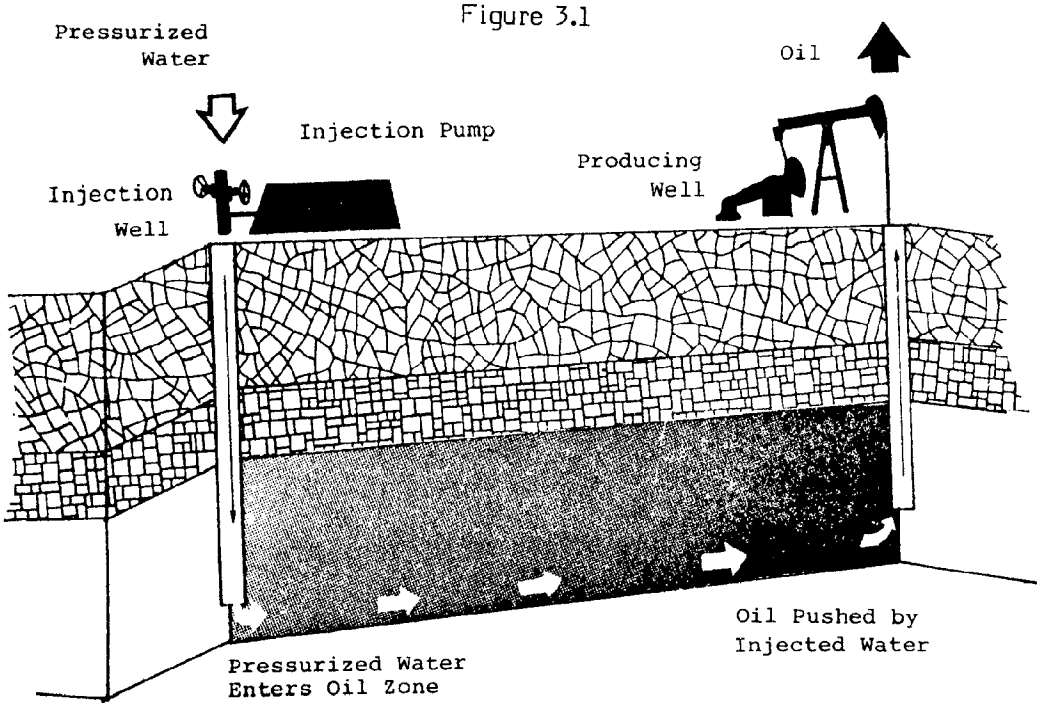
Source: Huntington Beach Planning Division.

huntington beach planning division

3.0 Unitization, Enhanced Recovery and the Access Problem

Providing future access to underdeveloped oil reserves is usually a concern only where many operators work a common reservoir and they have not been able to unitize and apply secondary or tertiary production technologies. Consequently, a discussion of how unitization is related to these methods and why unitization is sometimes difficult

Figure 3.1



Side View of a Waterflood Section.

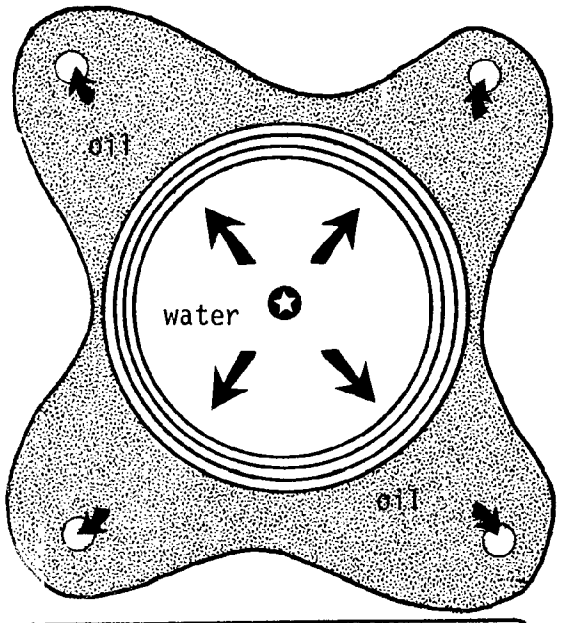
Source: Chevron, USA.

to achieve is very important to an analysis of the access issue.

3.1 Primary, Secondary and "Enhanced" Oil Recovery Technology

The simplest and most common method of extracting oil is to drill a well into the oil-laden rock (usually sandstone in this area) and pump as much of the oil as possible. However, oil is a sticky, thick substance which does not flow very easily through the pores between the grains of sand in the rock. Often, more than 80 percent of the original oil in place remains in the reservoir after this "primary" technique is accomplished.

Figure 3.2



Top View of Waterflood.

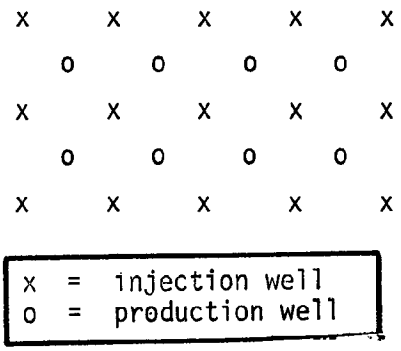
Source: Huntington Beach Planning Division.

Much more of the oil can often be recovered if pressurized water is injected into the oil pool. The water helps to move the oil through the pores in the rock. In this technique, the pressurized water is forced into the reservoir through "injector" wells. The water moves out in all directions from these wells, sweeping oil in front of it. (See Figure 3.1.)

Other wells, called "producing," are arranged around the injectors to pump out the oil and water. (See Figure 3.2.)

To efficiently use the pressurized water, producing and injector wells are arranged in patterns which allow most of the oil pushed by the water to be pumped out. (See Figure 3.3.)

Figure 3.3



Example of Well Pattern in Waterflood Program.

Source: Oil Well Drilling Technology, McCray and Cole, 1973.

These patterns are not always reflected in the surface locations of the wells because wells can be drilled "directionally," that is, at an angle, and it is the location of the bottoms of the wells in the oil pool itself which is so important to the application of these techniques. An advantage of directional drilling is that a few, centralized surface parcels can sometimes accommodate many directionally-drilled wells through which much larger underground areas can be tapped. *

* The practice of concentrating facilities into small, intensively-used surface areas, is called *consolidation*.

Clearly, this method which is called "water injection" or "waterflood," cannot be applied through a single well. Rather, many wells are involved which must be worked in a coordinated way; the location and depth of the wells, the timing of the injecting and producing phases, the pressure applied at different times and locations, and many other variables must be planned together to get the best use of the technique. The entire pool must be treated as a whole, or as a "unit" -- otherwise a significant part of the investment in drilling the well and injecting water under pressure may be lost because much of the oil may be pushed about but not collected.

When a single company works an entire oil pool, this type of production method is easily accomplished. When several operators are pumping from the same pool, they must agree to work together as a unit. This, however, is often very difficult. These difficulties will be discussed more fully in the next section.

Even after secondary recovery, more than 50 percent of the oil remains in the ground. New methods are being developed to recover some of this oil. Many of these involve injecting substances into the oil zones along with water; these substances help push out more oil than water can alone. Again, however, these techniques are most efficiently applied on a pool-wide basis.* These technologies are often called "tertiary production" when they follow an earlier water injection program. However, in a reservoir where water injection has not occured, these techniques might be applied simultaneously with or instead of a simple waterflood, to increase the efficiency of production.

3.2 Difficulties In Achieving Unit Operations

A large oil company which holds a substantial fraction of an oil pool will be the party most likely to try a unitization program. In fact, an important reason why unitization is not tried in many cases is that there is no large company with enough of an interest in the reservoir to warrant the costs and risks of trying to form a unit. Small oil companies usually do not have the technical or financial resources to instigate a unit.

However, even when a large corporation has an interest in the pool, it must overcome several barriers before unitization can be achieved.

First of all, there is a significant incentive for any individual operator not to participate in a unit while hoping that his more numerous neighbors instigate the project anyway. In this situation, the other operators in the field incur the cost of developing the secondary recovery program, while at the same time, if his wells are favorably located, the hold-out is able to recover some of the oil swept by the unit's injection pattern. The hold-out does not share in the costs of implementing the program, but he shares in the increased production. Often, so many operators refuse to join a unit for this reason, that the program cannot be undertaken. This predicament is often referred to as the *free-rider problem.*

Federal price controls on oil have often been cited as inhibiting unitization. The federal government has recently taken steps to deregulate the price of all domestic production, so price controls are no longer an important consideration in analyzing a unit's potential profits.

Some parties may not be interested in joining a unit because the oil operations are, in fact, owned by firms whose principal interest is in redeveloping the very valuable surface land at a time when it is most profitable. Such firms do not want to commit their surface holdings to a long-term unit agreement for oil production. This problem could be overcome if these operators are willing to join on the basis of mineral rights, but not surface area or equipment -- provided enough surface land still remains to produce the field economically.

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* However, not all such technologies are so applied. See Report 4 in this series, "Enhanced Oil Recovery," for a fuller discussion of these methods.

Another potential problem involves the liability of a unit for production decline among non-participants. If enough operators are willing to participate that a unit waterflood is undertaken, the operations could result in a non-participant's production declining (although often it increases as explained above).* The unit may then be liable for the loss in production. Court cases in Texas and Kansas have absolved units of such liability; however, some companies have cited the risk that the unit might be held liable as a reason for not participating.

Thus, for all these reasons, it is difficult to get all the parties that hold an interest in an oil pool to join a unit voluntarily. In light of this, and the fact that unitization and enhanced recovery is the most efficient method of extracting a very valuable resource, most states have established compulsory unitization laws. These require hold-outs to join a unit if a certain percentage of the total interest in a field is willing to participate. This percentage varies from 60 percent to 85 percent. (See Table 3.1.)

The compulsory unitization laws in California, however, are limited in their application and may not be relevant to Huntington Beach. Voluntary and compulsory unitization are the topics of the next sections.

3.3 Voluntary Unitization: Difficulties in Assigning Costs and Benefits

Despite the risks and costs of trying to put together a unit, sometimes the amount of oil that could be recovered and the suitability of the reservoir to secondary production--and hence the potential profits that could be realized from a unitization program--leads some of the parties holding an interest in the reservoir to pursue a voluntary unit agreement.

Usually, a major operator holding a substantial fraction of the interest in the reservoir contacts other ownership interests and invites them to a meeting to explain why a unit operation and a field-wide recovery project may be desirable. Often, many operators are not interested because they have no first-hand unitization experience, or they do not have the technical background to assess the potential value of the project. Many operators are simply suspicious of the true intentions of a major company, doubting that small firms will get fair treatment in the joint arrangement. Other reasons why individual operators might not express even a tentative interest in the project were discussed above.

In some cases, however, several of the parties are tentatively interested in a common operation and they begin to work on a unitization agreement. This is usually a very long, difficult and costly process. The first step is the initiation of a *joint organization*.

The joint organization usually establishes several committees to research information necessary for developing the unit. The most important of these is probably the *technical committee* whose task is to determine the geology of the reservoir and to recommend the best recovery technique to be applied. This committee analyzes such factors as the areal extent of the oil zones, their depth and thickness, faulting patterns, existing *well-bore* distribution, and surface areas available for new wells and equipment. The committee then evaluates possible recovery methods. Historically, most units were put together to apply simple water

*This could occur if the hold-out's well were so close to the unit's injectors that the oil in the zone near his well is swept away by the pressurized water. The result would be a large increase in the amount of water pumped from his well, but not in the amount of oil.

State	Percent of Working Interest Required For Compulsory Unit	State	Percent of Working Interest Required For Compulsory Unit	State	Percent of Working Interest Required For Compulsory Unit
Alabama	75	Louisiana	75	Ohio	65
Alaska	62.5	Maine	85	Oklahoma	63
Arizona	63	Michigan	75	Oregon	75
Arkansas	75	Missouri	75	South Dakota	75
California	75	Montana	80	Tennessee	50
Colorado	80	Nebraska	75	Utah	80
Florida	75	Nevada	62.5	West Virginia	75
Illinois	75	New Mexico	75	Wyoming	80
Kansas	75	New York	60		
Kentucky	75	North Dakota	80		

Table 3.1 Percent of Working Interest Required for Compulsory Unitization Statutes.

Source: EOR Potential in U.S., OTA, 1976

injection. However, future units may use enhanced recovery technology with the waterflood to recover more oil quicker, rather than waiting to apply such technologies after a simple injection project. The collection of data and the evaluation may take years, depending on the complexity of the geology and whether the field is well-known or not. The committee's recommendations must be brought before the full joint organization for approval.

A legal committee researches land and interest titles and royalty agreements and tries to determine if there are any legal restrictions or problems related to property rights which could jeopardize the unit project. This committee is also responsible for working with the Division of Oil and Gas, the State regulatory agency, to ensure that the proposed unit satisfies any statutory and administrative requirements related to multi-company oil operations.

A land committee identifies all the parties holding surface and mineral rights and informs them of the possible unit agreement.

An accounting committee records the expenses of the joint organization during this planning process. This committee will work with the technical committee in determining the most profitable technique to be applied (considering tax and depreciation regulations, etc.).

Probably the most difficult part of the voluntary unit agreement is to determine the *participation formula* -- the share of the costs each participant must pay and the amount each will later receive from the unit's profits. The input of the technical committee is very important in this determination. The value to the unit of certain mineral rights, for example, will depend on how much of the oil reservoir is included and where it is located in the oil-laden formation. The same is true for the valuation of existing wells -- the location, depth, age and condition of a well will affect how important it is to a unit.

Surface areas are likewise unequally valued -- some locations are more critical than others. Different operators will also contribute more wells, more mineral rights, more storage or processing equipment or more surface area than others. Pride in property ownership or in control over individual operations is another less tangible factor affecting the value an individual may place on his interests in the reservoir.

Clearly, assigning costs and benefits in a way that is considered fair by all parties is a very difficult process involving long-term negotiations. Usually, the greater the number of parties, the more difficult it is to reach an acceptable agreement

Once a participation formula is arrived at, unit agreements are drawn up for the operators and the royalty owners.

The time from initiation, through negotiations, to agreement can take up to four or more years. The length of time and concurrent expense of these negotiations, as well as the risk that the negotiations may reach an impasse and the project may be precluded, contribute to the reluctance of many operators to try to initiate or participate in such a program.

3.4 Compulsory Unitization

Many states, recognizing that unitization increases the efficiency of production as well as the total amount of oil ultimately recovered, have enacted compulsory unitization statutes. These laws require all interest-holding parties in an oil pool to join in a unit, if a certain majority percentage of the parties agree to unitize.

California actually has two compulsory unitization laws. The first requires unitization in order to waterflood and thus to repressurize an oil field if subsidence is injuring or imperiling buildings, harbors and other improvements or may be interferring with commerce, navigation or fishery, or where subsidence-induced inundation could

endanger life, health, safety, public peace, welfare or property.

This law is inapplicable to Huntington Beach at this time because there are presently no serious threats from subsidence in the City.

The second statute is sometimes referred to as the Townsite Law. If 75 percent of the working interest of an oil pool agree to a unit operation, this law enables the State to require the remaining interests to join the unit as well. The Townsite law, however, applies only to fields which were discovered before 1934 and which are at least 75 percent within an incorporated city. It is not clear that this law could be applied in Huntington Beach because large parts of this field extend offshore and into the Bolsa Chica which is unincorporated county land.

The rationale behind the law is "that the management, development and operation of lands as a unit for the production of oil and gas aids in preventing waste, increases the ultimate recovery of oil and gas, and facilitates increased concurrent use of surface lands for other beneficial purposes."[2]

Under the law, non-joiners may sell their interest in the pool at a fair-market value. This value is determined by an assessment of the "primary tract value" based on the projected future primary production if no secondary were undertaken, plus the "secondary tract value" based on estimates of secondary recovery. The members of the unit must purchase these interests if they are offered for sale. If the buyer and seller disagree on a fair selling price, an arbitration procedure has been established to determine a fair valuation.

3.5 Advantages of Unitization

It is clear that unitization is important for the application of waterflooding and other enhanced recovery techniques.

There are numerous related advantages that result from this.

First, by all measures, this is a more efficient production technique: the total volume of oil recovered increases; the time it takes to produce that oil is reduced; the amount of capital invested (equipment, well-bores) per volume of oil is reduced.

Second, consolidation of surface area usually accompanies unitization. By state law, a unit agreement can only be approved if it provides:

"To the full extent practical, for the organization and consolidation of surface facilities, including oil production, storage, treatment and transportation facilities, in such a manner as will eliminate wasteful and excessive use of land surface areas, freeing such areas for other productive use and development ..."[3]

For example, the many small tank systems associated with small groups of wells can be eliminated and a larger, centralized separation and treatment plant utilized. New wells and redrills can often be consolidated into walled and landscaped islands. Existing wells which are not important to the injection pattern may be plugged and abandoned.

A workshop on urban oil development held in the Southern California area recognized these kinds of advantages to unitization, concluding:

". . . unitization was a beneficial tool to be used in older fields for improving oil recovery, aesthetically improving oil field operations and eliminating deserted, idle or unneeded wells."[4]

The benefits of unitization extend to the fiscal status of the City as well. In another study, the Huntington Beach Planning Division has analyzed the fiscal impact of oil operations on the City. The findings indicate that consolidated facilities, employing waterflood and other enhanced

recovery technologies are significant net-revenue generators.* For example, Aminoil and Chevron, with highly consolidated operations, use about 60 percent of the wells in the City to produce about 85 percent of the oil and 85 percent of the oil-related revenues. The reasons for this are that costs tend to decrease as the facilities are consolidated and less acreage is used and that revenues increase as production increases.

The cost of police patroling, for example, is more sensitive to the number of oil sites than to the number of oil wells. Thus, in a unitization and consolidation project if the number of wells stay the same or even increase, but less sites are used, police costs attributable to oil can decline. For another example, the costs of the City for recordkeeping, inspection, taxation and billing all tend to decline when the City can deal with a large, single entity rather than scores of individual oil companies.

Revenues to the City are tied especially to the property tax on the mineral rights and to severance or "per barrel" tax on production. Interestingly, mineral rights assessment is tied to past productivity; thus, if productivity rises, mineral rights valuation rises, too. (Although there are important limits to how quickly valuation can rise as a result of Proposition 13.) Also, as productivity increases, revenues from the severance tax which is simply a production tax must increase, too.

Of course, there are some negative impacts. Use of a centralized treatment plant may require the laying of new pipelines in public right-of-way, causing temporary disruption of the street system. Increased waterflooding may increase demand on public sewerage and water disposal systems. Nonetheless, from a fiscal perspective, the revenues generated by unitization usually greatly outweigh the few costly effects.

The operations also tend to improve because the oil pool is now worked by a larger company or unit with a wider financial base than many of the individual operators. This tends to make financing of mitigations for adverse aesthetic and environmental impacts associated with oil production easier. The unit can typically provide better fencing and landscaping, sound-proofing and odor emission controls than individual operators. The higher production experienced with a unit and waterflood allows the larger companies or units to expend monies for better equipment and maintenance so that the newer operations are usually quieter, cleaner and less polluting than older facilities. Larger companies or units also experience *economies of scale* -- it is less expensive to landscape or soundproof a few intensively used islands than hundreds of individual well and tank sites; the one larger unit can deal with these problems more efficiently than dozens of individual operators.

In summary, unitization and consolidation of urban oil operations can be desirable for the following reasons:

- Oil production increases.
- Less land is used and unnecessary or inefficient tanks and wells are removed.
- The appearance of the operations improves; better mitigation of other adverse impacts is usually achieved.
- Costs to the City tend to decline but revenues tend to increase.

* See Report #2 in this series, "The Fiscal Impacts of Oil Operations in Huntington Beach," Huntington Beach Planning Division, March, 1981.

4.0 Roles for City Governments in Protecting Access to Oil Pools

The value of the increased domestic oil production that may be afforded by enhanced recovery technologies, as well as the advantages of unitization and consolidation discussed above, argue that protecting surface access to underground oil pools and encouraging the formation of unit operations to work those pools may be desirable policy objectives. This section discusses the kinds of roles which might be appropriate for local governments in promoting these objectives.

First of all, it should be noted that two of the principal problems which have inhibited unitization and the subsequent application of secondary and tertiary recovery methods are clearly outside the purview of the local jurisdiction.

Many oil companies have cited low oil prices, compounded by price controls, as an important reason why many potential units would not have been profitable in the past. De-regulation and the rapidly escalating price of oil should help to improve the profitability of potential units in the future. Another pricing problem is that the value of domestic oil to the society may not be fully reflected in its (even de-regulated) price because domestic production provides other, less tangible, benefits to the country related to the reduction of our reliance on foreign sources for oil. This situation might argue for federal incentives for increased domestic production.

All these considerations, however, are national in scope and lie within the jurisdiction of the federal government, not the municipality.

Another important problem related to unitization is the cost of forming a unit, especially the cost of getting enough operators to join. The existing State compulsory unitization laws are examples of ways to reduce these costs.

Note that the State regulates mineral rights and the unitization of oil pools; thus, the State, and not the City, is the appropriate jurisdiction for instigating policies and statutes aimed at reducing the costs currently associated with forming a unit.

In both of these cases, the appropriate role of the local government could be to adopt ordinances and policies which would not preclude future ameliorative actions by the federal or State governments.

Traditionally, control over land use has been the domain of the local government (although legally, States have pre-emptive control over land use.) The City should recognize the two problems noted above: inappropriate pricing and the sometimes excessive costs of forming a unit. The City should also understand that the appropriate solutions to these problems lie outside the City's purview. However, the City can help to implement any future corrective measures by the State or federal governments by not excessively restricting future oil operations from the surface of the field and by developing ordinances and policies aimed at keeping enough surface area open in the face of encroaching urbanization to accomodate future unitization and enhanced recovery programs.

The principal tools for achieving this are the City's General Plan and its zoning ordinances. Options for Huntington Beach regarding its land use policies are discussed in Section 6.0. Before reviewing policy options, however, it is important to discuss the particular situation in Huntington Beach where these issues are especially relevant. That is the topic of the next section.

5.0 Townlot/Downtown Analysis

As mentioned in Section 2.0, the "Townlot/Downtown" part of Huntington Beach appears to be the most likely candidate for a unitization and secondary recovery project. It is also an area where rapid redevelopment of oil parcels and vacant land is probable. Therefore, this area was analyzed specifically with regard to the importance of preserving access to remaining oil reserves.

The area studied is located between Pacific Coast Highway and Palm Avenue, from Goldenwest to Lake Street. Also, a relatively large oil lease near Lake Street and Atlanta Avenue was included. A large portion of this area lies within the coastal zone. (See Figure 2.1). Of the approximately 350 acres, only about 14 are still being used for oil production.

This part of the field has never been waterflooded, largely because ownership of the field is highly fragmented and unitization has not been achieved.

Over 35 oil companies operate only 98 active wells. Chevron has the largest single interest in this part of the field, but it accounts for less than 20 percent of the total interest. Aminoil, the other major oil company in the City, has virtually no holdings in this part of the oil field; (Aminoil does own some surface areas there from which wells have been directionally drilled to offshore pools).

Thus, unitization has been difficult not only because there are so many operators, but also because neither of the large companies which have the resources to instigate a unitization program has a particularly large stake in this part of the field.

5.1 A Brief History

Oil was first discovered in Huntington Beach in 1920, at a site near the present intersection of Goldenwest Street and Clay Avenue. During the next several years, oil was discovered throughout Huntington

Beach but the City prohibited oil drilling in the Townlot and Downtown areas. However, the continued success of oil operations north of 23rd Street (Goldenwest Street) in a barley field (which is now the "Seacliff" golf course and residential development) prompted the City to lift these restrictions in 1926 and to allow drilling between 23rd and 17th Streets. Two very important oil zones, the "Jones" and the "Main," were quickly discovered. The State Division of Oil and Gas noted that:

> "Intensive drilling activity followed these two discoveries, resulting in the fastest development and closest spacing experienced in California to that date. Some wells were drilled on 25-foot lots."[5]

Another important zone, the "Tar" or "Bolsa," was found later in 1926. In November of that year, the City opened the rest of the Townlot and Downtown to drilling, except for a "fire zone" between 5th and 3rd Streets which was excluded in order to protect the City's principal commercial district - - a short strip along Main Street. On December 24, 1926 production peaked at 63,400 barrels from 78 wells. Production dropped quickly from this early peak and then gradually declined until the late 1940's.[6]

During the early years of the field, development of the Tar zone was inhibited because the oil in these pools is very thick. The viscous ooze carried large amounts of sand in it which often clogged the wells and complicated later processing. The growth in automobile use after World War II spurred such a high demand for oil that even thick crude became profitable to extract and process. This prompted a second drilling campaign in the Townlot area as operators began to exploit the previously neglected Tar zones.

In 1954 oil pools were located farther south in the field, near the Downtown. Intensive drilling in this "southeast extension" of the Townlot resulted in another production peak in the mid-1950's.[7]

Since that time, production has declined to a relative trickle. In 1979-80, 138,983 barrels were recovered, an average of only 380 barrels per day for the entire area and only about four barrels per day per well.[8]

In other parts of the City, notably the leases north of Goldenwest, the two major companies, Chevron and Aminoil, run highly consolidated operations which tap very large underground areas. These companies began applying water injection in the late 1950's and now have extensive water and steam flood projects as well as several tertiary recovery pilot programs. These companies have employed these technologies to work these areas much more completely and efficiently than other areas in the field where fragmented ownership has precluded unitization. The Townlot is one of those areas which has not yet been waterflooded because the large number of operators there have not formed a unit.

In recent years, the increasing value of land near the coast for new uses (especially for housing) along with declining production have prompted many oil operators in the Townlot to abandon their wells and to redevelop their sites. Also, after the Local Coastal Plan is completed, development pressures on the many oil sites in the coastal zone will likely intensify. In light of these effects, it appears very possible that so many of the oil sites in the Townlot area will be redeveloped that there will not be enough active well holes nor enough available surface area for a future secondary recovery project.

This possibility raises several questions. First, how much oil could be recovered if an enhanced recovery program were undertaken? Second, even if there is a large amount of remaining oil, how likely is unitization and a future secondary recovery program? Third, should the City take steps to help preserve access to these oil reserves and, if so, what should those steps be? The remainder of this report tries to give tentative answers to each of these questions.

5.2 Remaining, Recoverable Oil

The most important variable for deciding whether the City should take steps to protect surface areas for future access to oil pools is the amount of oil that would be lost if the surface is completely developed. Using data from the State Division of Oil and Gas (DOG) and from the major oil companies in Huntington Beach, the City Planning Division estimated the remaining, recoverable oil in the Townlot area. The purpose of these studies is not to establish an exact numerical figure for the remaining oil, but to indicate whether there is enough oil to make an enhanced recovery program possible and, thus, if protecting surface areas and access for such a program is important.

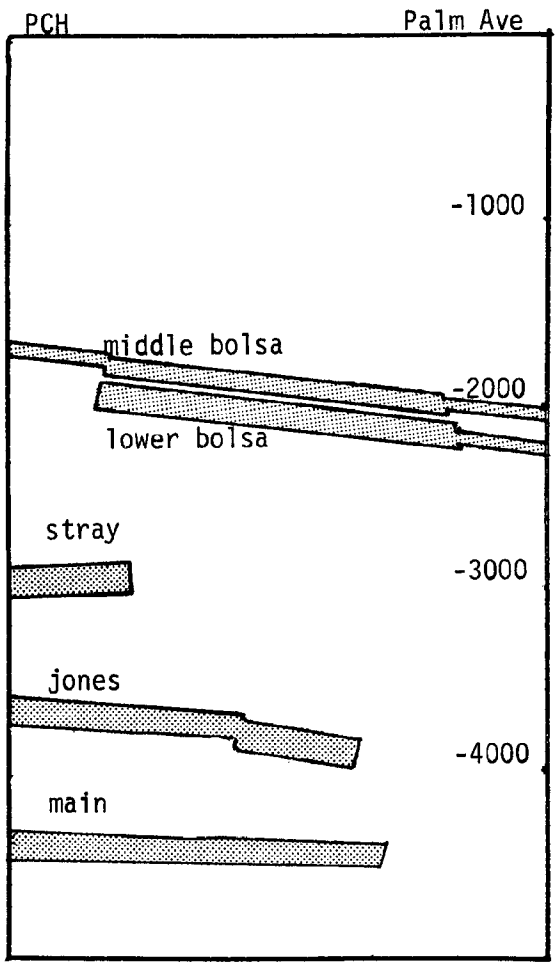
The first technique used to estimate the remaining reserves is the "volumetric method," which uses data about the physical parameters of the field to estimate the volume of the original oil in place (OOIP). Then, certain "recovery factors" -- estimates of the percentage of the oil that can be recovered by different extraction technologies -- are applied to the OOIP estimate. In this way, one can determine how much oil could be recovered by an enchanced recovery program.

This method requires much geologic information. First, one must know what oil zones underlie this part of the field.

Figure 5.1 illustrates a typical cross-section under the Townlot area, and Figures 5.2 and 5.3 show their areal extent. The important oil-bearing strata include the Middle Bolsa, Lower Bolsa, Stray or AC, Upper Jones and Main zones. However, because of the lack of reliable data, the Stray and Main zones were not included in the volumetric estimates. Thus, the results should be on the conservative side.

By multiplying the area of a zone in acres by its net thickness in feet, the total volume of the zone can be determined. The zones,

Figure 5.1



Example of Cross-Section Underlying Townlot.

Source: Division of Oil and Gas.

of course, are not liquid pools, but are rocks which contain oil in small pores between grains of solid material. Thus, the total volume in acre-feet must be multiplied by a "porosity factor" -- the percentage of the rock which is not solid, but is actually spaces or pores between the solid materials, and can hold the fluids. However, not all of that space is filled with oil. Water is also

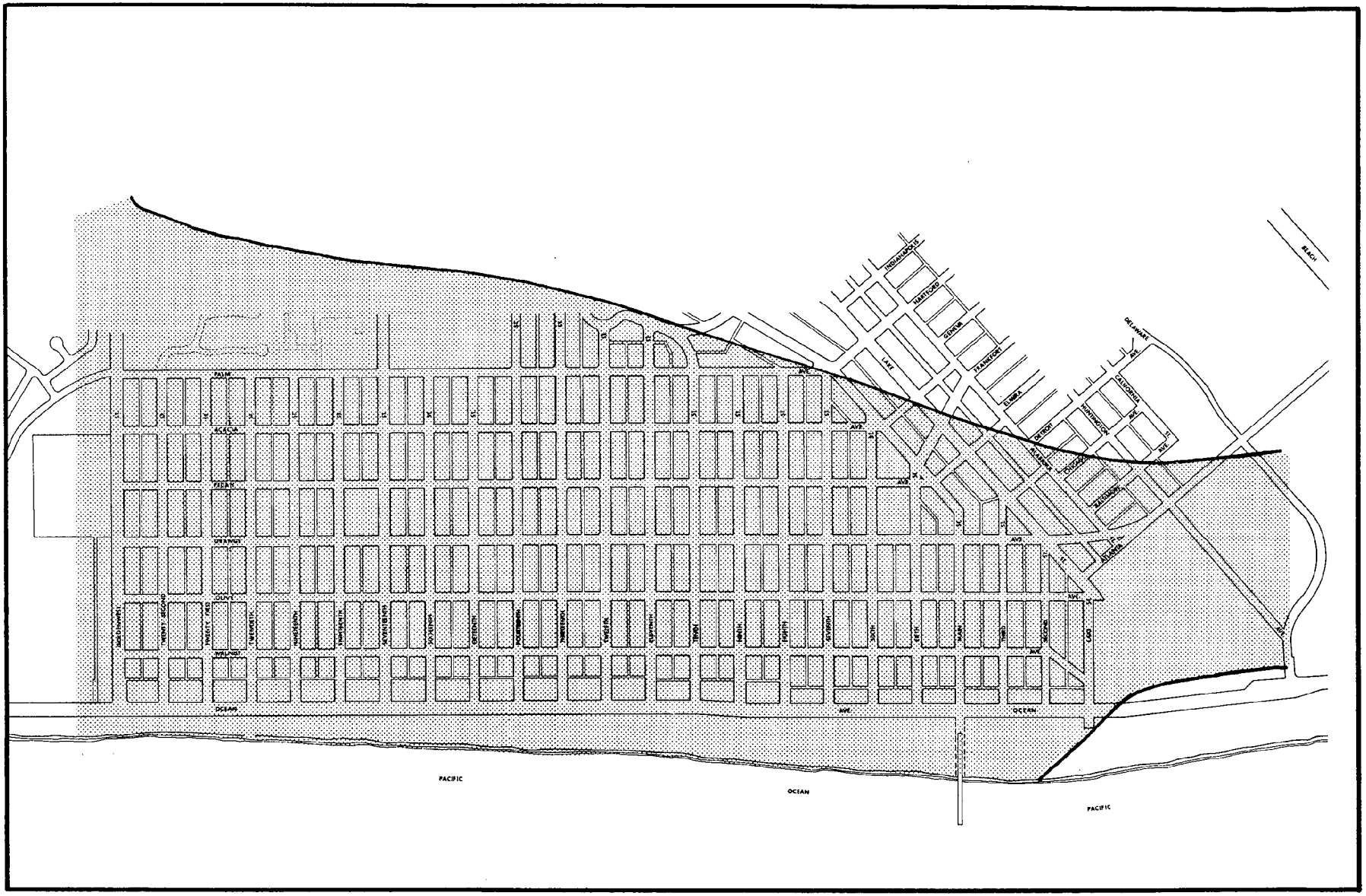


Figure 5.2 Areal Extent of Bolsa Zone.

Source: Division of Oil and Gas.

found in the pores between the solid materials. Thus, the total volume must be further reduced by a "water saturation" factor. By multiplying area by: 1) thickness, 2) porosity percentage, and 3) a water saturation factor, the number of "acre-feet" of oil is determined. There are 7,758 barrels of oil in an acre-foot and one can estimate barrels by using this factor. Finally, another variable called an "oil formation volume factor" must be considered. This simply adjusts for any difference between the volume of the oil underground and its volume at the surface.

Table 5.1 summarizes these variables and the formula used to determine OOIP.

Table 5.1

VOLUMETRIC METHOD

A	=	area in acres
P	=	porosity
H	=	net thickness in feet
Sw	=	water saturation
B	=	oil formation factor
7,758	=	bbls/acre-foot
OOIP	=	original oil in place

$$\frac{A \times h \times P \times (1-Sw) \times 7{,}758}{B} = OOIP$$

Formula for Volumetric Method.

Source: "Valuation of Oil Producing Properties", State Board of Equalization, 1972.

Reliable data for these variables were difficult to obtain. Net thicknesses of the zones in the Townlot area were unavailable, and were estimated from cross-sections and from discussions in several DOG reports. Areal extent was estimated from contour maps of the zones in DOG reports. The other variables were obtained from DOG and industry estimates. As mentioned above, the Stray and Main zones were excluded due to lack of data; thus the estimates are probably low.

Table 5.2 summarizes the data and calcuations for OOIP in the Townlot. The OOIP is estimated at 112.1 million barrels.

The next step is to determine how much of the OOIP can still be recovered by secondary and tertiary technologies. After discussing the performance of different extraction techniques in Huntington Beach and other nearby fields with engineers from the DOG, Aminoil and Chevron, the following recovery factors were established for the Townlot/Downtown area: primary, .30; secondary, .12; and tertiary, .07 of OOIP. Usually, the primary rate is lower and secondary rate higher; however, the engineers suggested that the very long term and unusually intensive production has probably accounted for a higher primary rate and thus a lower potential secondary one in the Townlot area.

These data and these recovery factors suggest that over 20 million barrels of oil may still be recovered in the Townlot area if secondary and tertiary technologies can be applied.

To help confirm the reasonableness of this estimate, the Planning Division calculated recoverable reserves using another method, the "decline curve technique." This method uses the past performance of the field for estimating future production.

The estimate would be most accurate if the annual production records of every well ever drilled in the Townlot/Downtown since 1926 were located, reviewed and totaled. This kind of research is very difficult and time-consuming. Instead, the Planning Division researched the production summaries for this part of the field found in several DOG Annual Summary of Operations and the recent production records of active wells. A reasonable decline curve was then interpolated between the few known data points. Cummulative production was then estimated from this decline curve. See Figure 5.4. The total production for the Townlot/Downtown is approximately 43 million barrels.

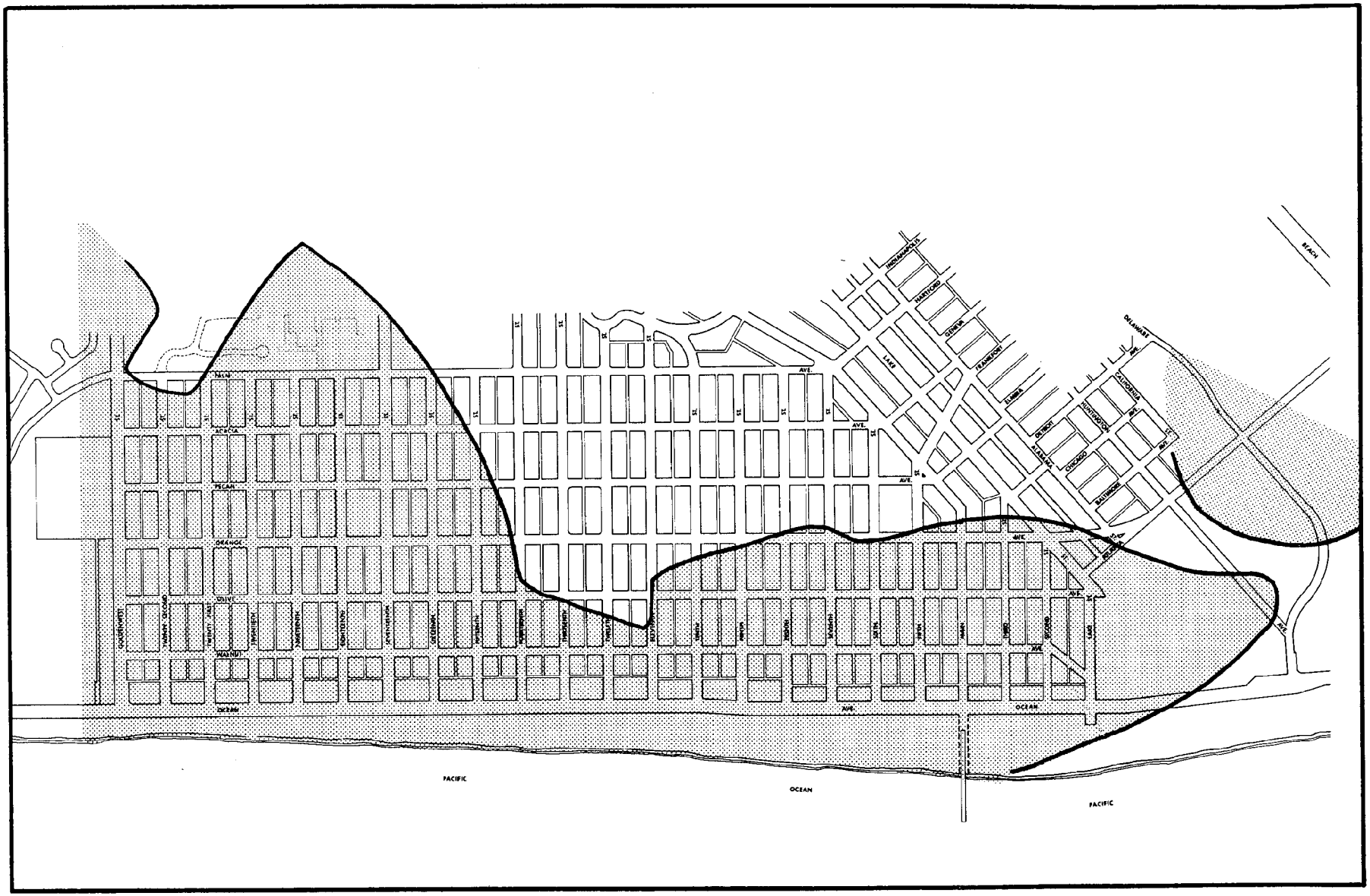


Figure 5.3 Areal Extent of Jones Zone.

Source: Division of Oil and Gas.

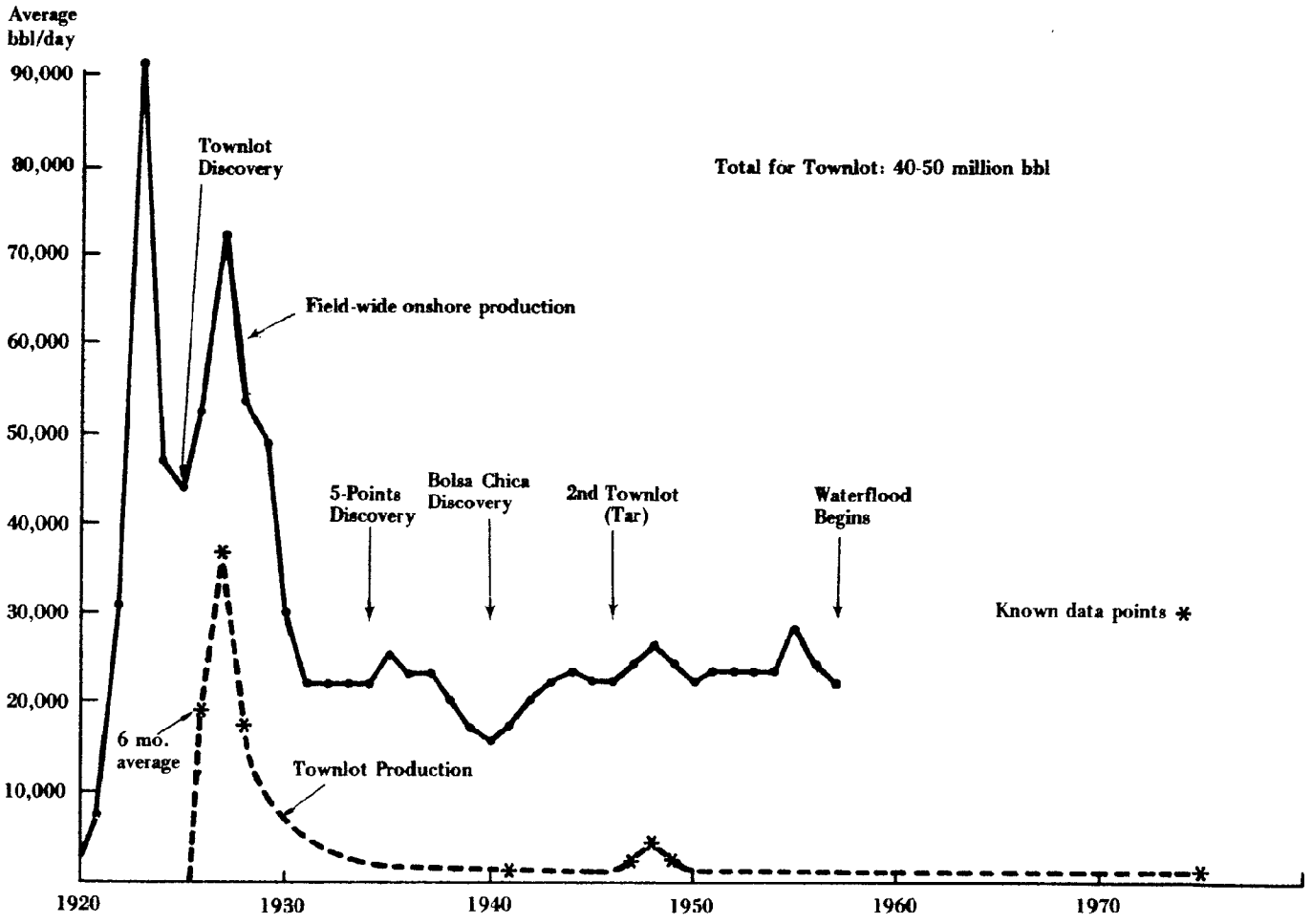


Figure 5.4 Decline Curve for Townlot/Downtown.

Source: Huntington Beach Planning Division and DOG.

Table 5.2

ZONE	A[1]	H[2]	P[3]	Sw[4]	B[5]
Middle Bolsa	350	80	.28	.30	1.07
Lower Bolsa	350	100	.28	.30	1.07
Upper Jones	150	100	.32	.35	1.07

1 DOG "Summary of Operations", 1958, contour maps
2 Estimated from various DOG reports
3 DOG and industry estimates
4 DOG estimates
5 DOG estimates

OOIP = A h P (1-Sw) 7,758 ÷ 1.07 =

Middle Bolsa	350 x 80 x .28 (1 - .30) (7,758) ÷ 1.07 =	39.8 million barrels
Lower Bolsa	350 x 100 x .28 (1 - .30) (7,758) ÷ 1.07 =	49.7 million barrels
Upper Jones	150 x 100 x .32 (1 - .35) (7,758) ÷ 1.07 =	22.6 million barrels
	TOTAL	112.1 million barrels

Recovery factors	Primary 30 percent	33.6 million
	Secondary 12 percent	13.5 million
	Tertiary 7 percent	7.8 million

Remaining recoverable oil = Secondary and Tertiary = 21.3 million barrels

Calculation of OOIP and Remaining Recoverable Oil Using Volumetric Method.

Source: Huntington Beach Planning Division.

The curve clearly indicates that production in this area using current extraction methods is approaching its limit. Thus, cumulative production should approximate all of primary production, which is (using the same recovery factor as in the volumetric method) .30 of OOIP. If 43 million barrels is .30 of OOIP, then OOIP must be 143 million barrels. Using the same recovery factors as the volumetric method for secondary (.12) and tertiary (.07) recovery, the staff estimates that about 17 million barrels could be extracted by secondary and an additional 10 million by tertiary. Remaining recoverable oil would be about 27 million barrels. See Table 5.3.

The decline curve method suggests somewhat larger reserves than the volumetric, which is not surprising because certain known producing zones were excluded from the volumetric study due to lack of data. Thus, the two methods give surprisingly similar estimates of recoverable reserves, indicating that perhaps 25 million barrels could still be extracted if unitization and the application of enhanced technologies were successful.

These calculations were reviewed by engineers at the DOG, Aminoil and Chevron. They concurred with City staff that the methods used were sound, but that the available data may not be completely accurate. Thus, the value of the analysis is not so much in the exact numbers as in providing an indication that considerable oil reserves probably remain beneath this part of the City.

5.3 The Possibility of a Unitization and Enhanced Recovery Project.

The analysis above suggests that there is probably enough oil remaining in the Townlot/Downtown area to make an enhanced recovery project profitable if unitization could be achieved. The next step, then, is to try to determine what the obstacles to unitization are and if they are likely to be overcome in the future.

Table 5.3

Primary Production	=	.30 OOIP = 43 million
OOIP = 43 million (1/.30)	=	143 million
Secondary Production	=	.12 OOIP = .12 (143 million) = 17 million bbl
Tertiary Production	=	.07 OOIP = .07 (143 million) = 10 million bbl

Total remaining, recoverable oil = 27 million bbls.

Calculations of Remaining Recoverable Oil Using Decline Curve Method.

Source: Huntington Beach Planning Division.

In order to do this, the City Planning Division sent a questionnaire to all the oil operators in the Townlot/Downtown area. The questionnaire and cover letter are included in Appendix A.

The results of the questionnaire are summarized in Table 5.4. Note that these results can be measured in two ways: the first is simply by the number of operators who gave different responses. A problem with this is that all companies are weighted equally, although a few own 10 or more wells while many have only one. The second method is to calculate the percentage of the total interest in the field held by the operators who gave a particular response. This is a somewhat more meaningful measure because the response of the relatively large operations will be more important to a unitization project than the very small companies. This method weighs each operator's response in proportion to the percentage of the field he owns. Interest in the field was considered to correspond to mineral rights valuations made for this area by the Orange County Assessor's office for property tax purposes.

Questionnaires were sent to the 36 operators in the Townlot/Downtown area; 21 responded. This response is indicative of one of the principal problems facing a unitization program: getting enough operators to consider even the possibility of forming a unit. However, most of the larger operators did fill out the questionnaire; the 21 respondents account for about 80 pecent of the total interest in the Townlot field.

The oil companies generally concur with the analysis in Section 5.2 that there may be significant oil reserves remaining in this area. Only three respondents felt that it was "very unlikely" that there is enough oil to make a waterflood economically profitable, and only one cited the lack of oil as a reason preventing a waterflood at this time. Thirteen of the respondents, accounting for about 62 percent of the working interest in the field, answered "very likely" or "perhaps" when asked if there was enough oil to make a waterflood profitable.

The operators were also asked to indicate the reasons why unitization has never been achieved here. Most felt that too many of the operators were unwilling to join a unit and that past price controls on oil rendered such an undertaking unprofitable. Several respondents felt that City zoning restrictions related to drilling new wells had contributed to the problem. Other reasons given included the difficulty in securing approval from land owners to encumber their property for many years. Another respondent suggested that the lack of reliable engineering data would hinder any unitization attempts.

The City staff also noted this lack of readily available data.

When asked if these difficulties could be overcome in the future and unitization made possible, the companies were equivocal. Seven operators, accounting for 21 percent of the interest in the field, answered "yes"; six operators, accounting for 41 percent of the field, said, "maybe"; and five companies, accounting for 12 percent of the interest in the field, responded "no."

Finally, when asked if the company would be interested in joining a voluntary unit, seven said "yes"; five, "maybe" and nine, "no." Yet those responding "yes" and "maybe" account for 61 percent of the total interest in the field, while those answering "no" account for 19 percent of the total interest. Interestingly, some operators who felt there was likely to be enough oil to make a unitization project profitable, and some who felt such a project might be feasible in the future, were also definitely not interested in joining a unit -- at least at this time.

The results of this survey indicate that a voluntary unitization project in the Townlot area is not imminent. Although a majority of the working interest in the field appears to be interested in such a project, a significant minority is opposed to it. In addition, many of the operators (who hold about 20 percent of the interest in the field) did not respond to the questionnaire at all.

1. Do you think there is enough recoverable oil in the Townlot/ Downtown part of the Huntington Beach Field so that a waterflood would be economically profitable (if unitization could be achieved?

	No. of Respondents	% Working Interest in Townlot Field
very likely	9	36%
perhaps	4	26%
very unlikely	3	5%
don't know	5	13%

2. If you think there is enough oil to make unitization and waterflooding in the Townlot area profitable, do you think other obstacles can be overcome so that such a project is possible in the future?

	No. of Respondents	% Working Interest in Townlot Field
yes	7	21%
maybe	6	41%
no	6	12%
don't know	3	6%

3. Which of the following reasons do you think have prevented a waterflood program from happening in the Townlot area?

	No. of Respondents
not enough oil	1
not enough operators willing to join	12
price controls on oil	11
zoning restrictions	6

other: answer included: lack of data, difficulty in getting approval of land owners to encumber surface properties.

4. Would your company be interested in joining a voluntary unit for the purpose of waterflooding?

	No. of Respondents	% Working Interest of Townlot Field
definitely interested	7	24%
maybe interested	5	37%
definitely not interested	9	19%

Table 5.4 Questionnaire Results.

Source: Huntington Beach Planning Division.

This lack of response underlines the difficulty in achieving unitization at this time. The companies are also equivocal on whether unitization can be achieved in the future. The principal reason holding up unitization, now that price decontrols are effected, will be the inability to get enough operators interested. The many reasons why operators may not join a unit have been discussed above.

A unitization project in the future is still possible, especially if either of the following "scenarios" develops. First, as the value of the land increases many of the operators will choose to sell their sites. The smaller companies with few wells and low productivity will tend to recycle their land first. Increasingly, the working interests in the field will be held by companies interested in continued oil production.

Second, in the face of domestic oil shortages, the State or federal government may enact a strict compulsory unitization law so that secondary and tertiary extraction technologies can be applied to domestic oil fields. These laws would require agreement among a smaller majority percentage of the operators before enacting compulsory unitization. For example, some States require as little as 60 percent of the interest of the field to agree to a unit before forcing the remainder to join. Currently, companies holding more than 60 percent of the Townlot working interest may be already, at least tentatively, interested in a unit project.

5.4 Surface Area Requirements

As the City considers the issue of helping to preserve surface areas for future oil operations in the Townlot, two key questions arise: 1) how much area is needed to accomodate a waterflood or enhanced recovery project? and 2) where must these sites be located? Much of the information used in answering these questions was supplied by the DOG and by Eastman Whipstock, Incorporated, a company involved in directional drilling projects.

Figure 5.5 illustrates the areas in and near the Townlot area where oil well drilling is currently allowed. These are limited to the leases operated by Chevron and Aminoil northwest of Goldenwest (sites #1 and #2), an island operated by Chevron at 17th Street and Palm Avenue (site #3), a relatively large area operated by Chevron near Lake Street and Atlantas Avenue (site #4) and a small island owned by Aminoil between 18th and 19th Streets along Pacific Coast Highway (site #5). This last site is intensively used for wells directionally drilled under the ocean and it is unclear whether this area would be available for wells tapping the Townlot area, at least in the near term. All of the other sites would very likely be able to accomodate wells and other facilities in a Townlot unitization and secondary recovery project. Figure 5.5 shows all the existing oil sites in the Townlot area. City ordinances currently allow existing wells and redrilling on most of these parcels, but prohibit new wells.

The surface area needed for an enhanced recovery project depends largely on the number of wells needed to produce the pool. As discussed in Section 3.0 above, injection and production wells are usually arranged in patterns to facilitate the efficient sweeping and subsequent collection of oil in the zone. Consequently, rough estimates of the number of wells needed in an enhanced recovery project can be made by calculating the spacing of wells in a pattern and dividing that factor into the total number of acres in the zone to be worked. For example, engineers at the Division of Oil and Gas estimated that the spacing for a waterflood project in the Jones zone would be approximately one well per 10 acres; and that only about 25 wells would be necessary for this kind of project there.

The characteristics of the zone will affect the kind of recovery method used, which could in turn affect the spacing and the number of wells needed. The Bolsa zone, for example, holds a very viscous oil; thus, steam, rather than water, would likely be

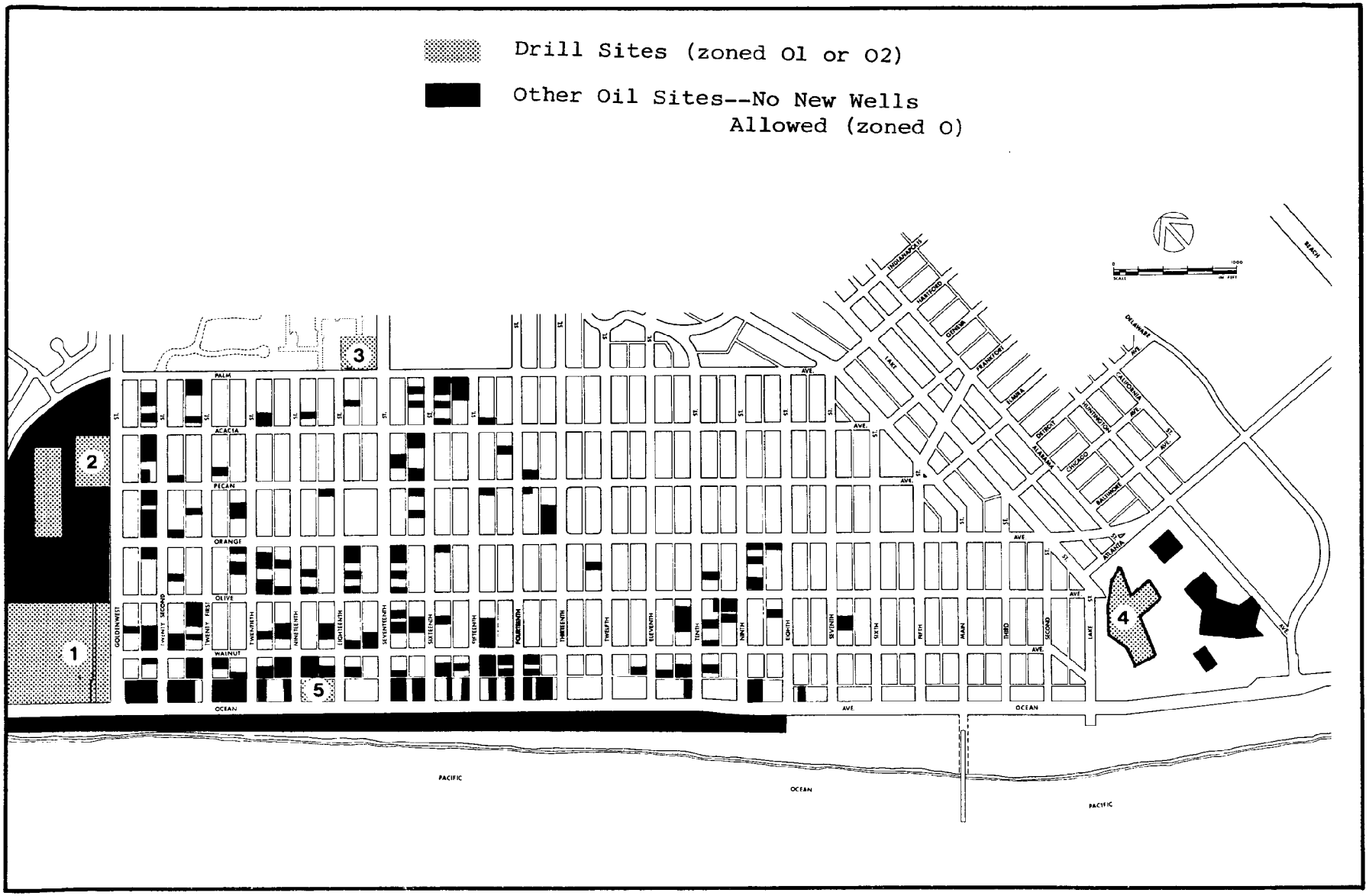


Figure 5.5 Drill Sites and Other Oil Operation Sites in Townlot/Downtown.

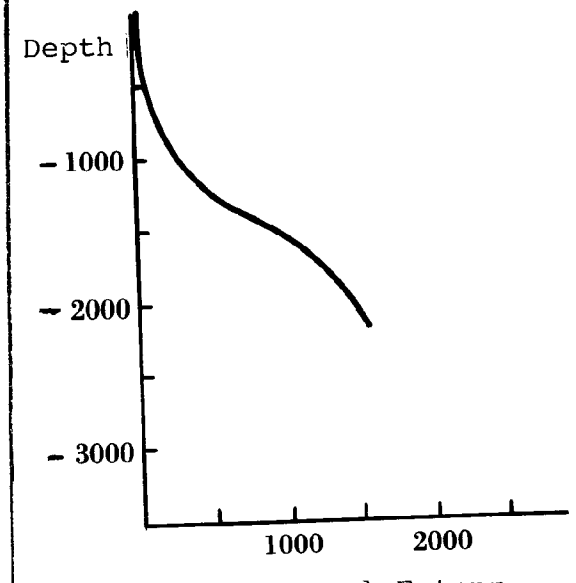
Source: Huntington Beach Planning Division.

huntington beach planning division

injected into the formation because the hot steam helps the thick oil to flow more freely. Because the oil must be kept warm for this technique to work, and because the steam and oil tends to cool as it moves through a formation, the spacing of the wells must usually be much closer in a steam program than in a waterflood. Engineers at the DOG estimated that one well per 5 acres or even one well per 2.5 acres might be needed to effect this kind of program. Thus, from 64 to as many as 128 wells might be needed in a steamflood of the Townlot Bolsa zones.

Considering the usual setbacks from public right-of-way and from nearby uses, the surface area needed for well drilling and maintenance, 25 wells or more could be easily accomodated on an oil operation site roughly the size of a square block in the Townlot area.

Figure 5.6



Directional Drilling Pattern for Wells Reaching the Bolsa Zone.

Source: Eastman Whipstock.

Thus, the surface area currently afforded by the drill sites (#1-5 in Figure 5.5) in and near the Townlot/Downtown could probably accomodate the wells needed in a secondary or tertiary recovery project, even in a closely spaced steamflood.

Another important consideration, though, is the location of these surface areas relative to the underground oil pools. As mentioned in Section 1.0, wells can be directionally drilled so that a few centralized surface areas can accomodate wells that produce a much larger subsurface area. The most important constraint on how far a well can extend from a surface site is the depth of the zone the well is tapping. The shallower zones are more difficult to reach because the angle of the well must be more acute. Eastman Whipstock calculated the distance that a well could be drilled in the Townlot area under usual economic and geologic conditions. Wells tapping the Bolsa zone could reach only about 1,500 feet from the surface bore hole; wells into the much deeper Jones zone could extend about 2,400 feet from the bore hole; (see Figures 5.6 and 5.7). Using these estimates, Figures 5.8 and 5.9 illustrate how much of the subsurface Townlot/Downtown field can be reached from the existing drill sites. If part of site #5 is considered available for this kind of project, then virtually all of the Jones zone can be reached from the presently available drilling sites. Likewise, a very substantial part of the Bolsa zone is also accessible from the existing sites, although a considerable area in the middle of the Townlot may be inaccessible.

Engineers from Chevron and Aminoil indicated that wells could be extended even farther than these estimated limits if necessary, although such wells would be more difficult to drill and more expensive.

A steam project adds a further factor into the analysis. As discussed above, steam tends to lose its heat after it moves away from its source (a boiler). The bottom of the steam injection well cannot be more than 1,000 - 1,500 feet from the boiler, otherwise the steam loses so much heat as it travels through the well that it is ineffective when it reaches the oil pool.

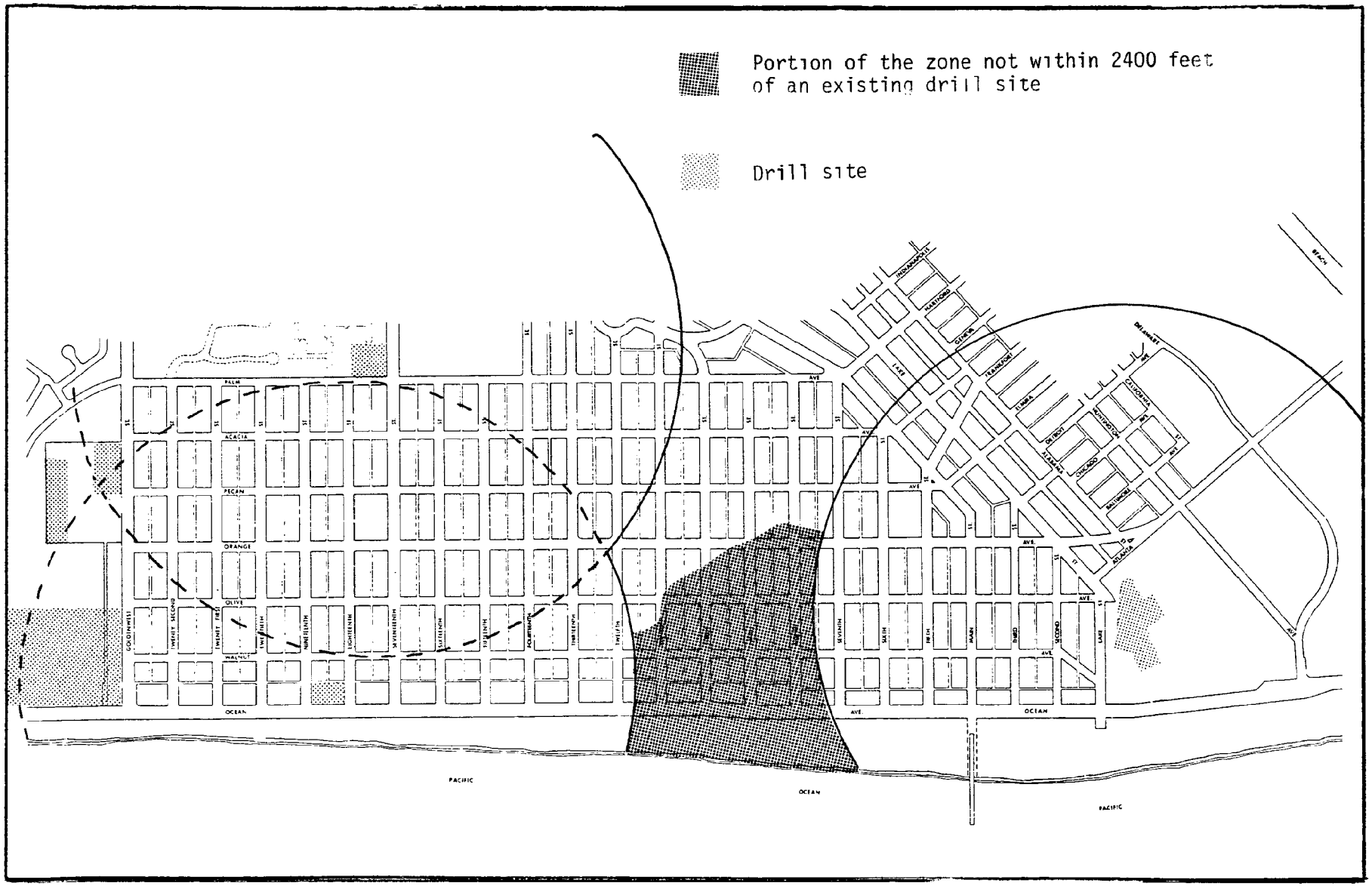


Figure 5.8 Approximate Coverage of Jones Zone from Exist

Source: Huntington Beach Planning Division and

huntington beach planning division

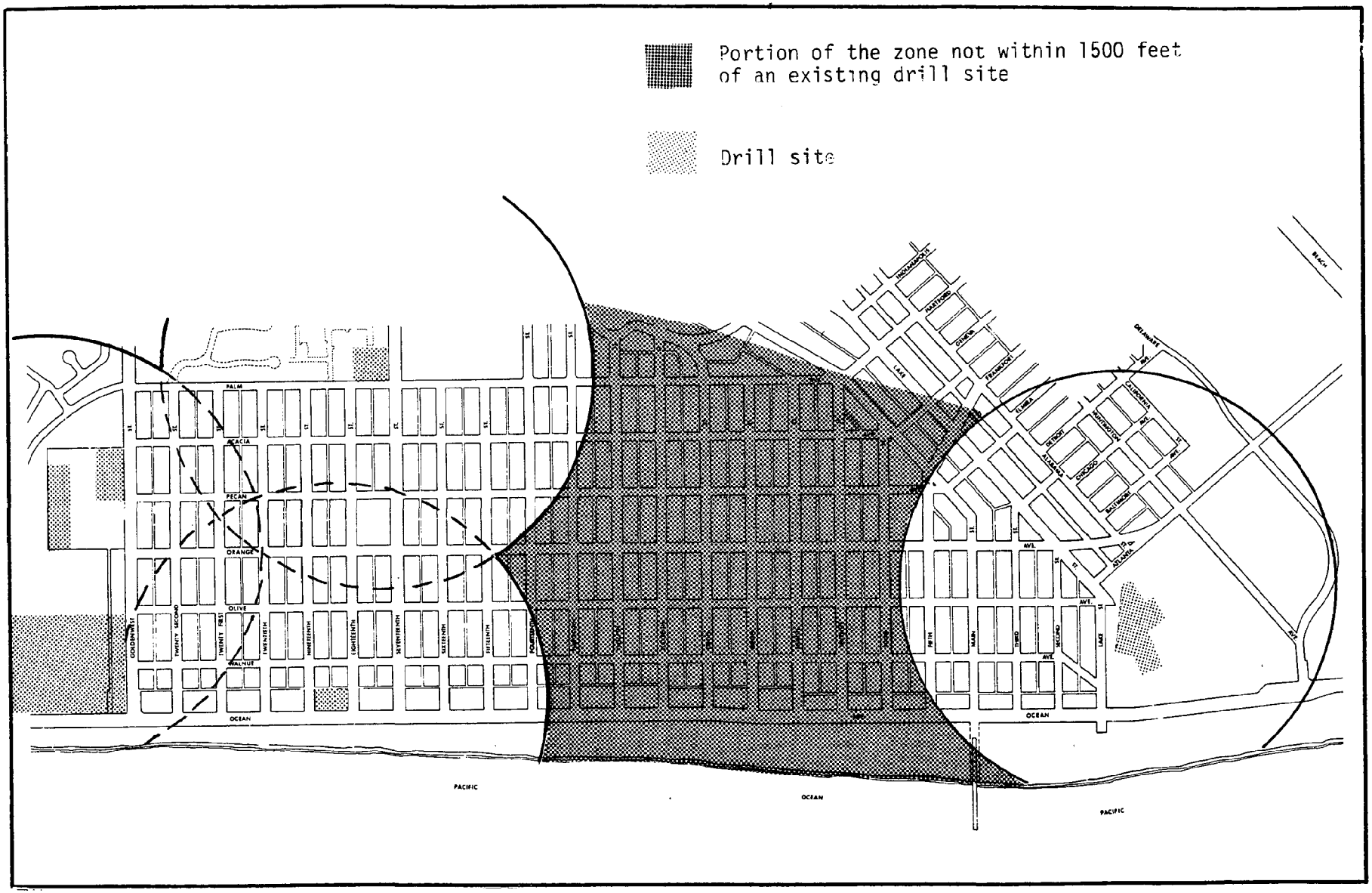
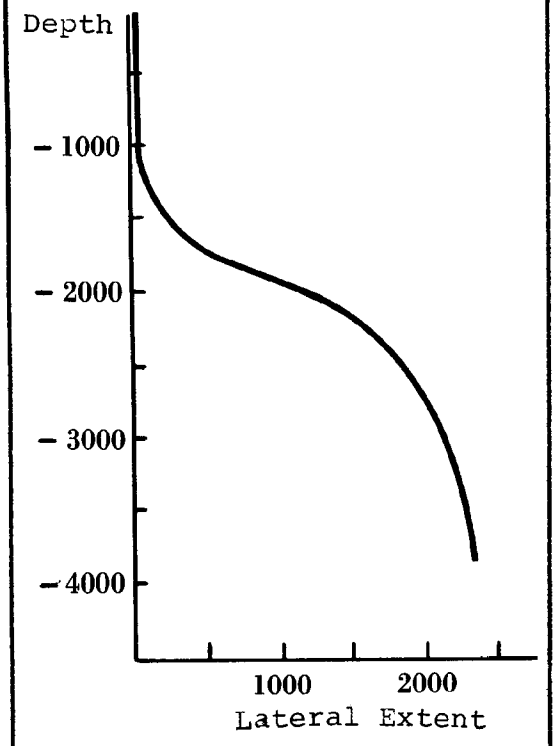


Figure 5.9 Approximate Coverage of Bolsa Zone from Existing Drill Sites.

Source: Huntington Beach Planning Division and DOG.

huntington beach planning division

Figure 5.7



Directional Drilling Pattern for Wells Reaching the Jones Zone.

Source: Eastman Whipstock.

This fact suggests that a secondary recovery program (steamflood), which utilized only the existing drill sites, might not be able to include a significant part of the Bolsa zone, (roughly between 6th and 13th Streets).

Another way of looking at the situation is that in order to undertake a comprehensive enhanced recovery program for the Townlot/Downtown, new wells or the redrilling of existing wells may be needed in the area roughly between 6th and 13th Streets. Furthermore, because of the problem of heat loss in a steam project, a steam generator (boiler) may also need to be located in this area. The current zoning laws affecting the existing oil sites in this area allow the boiler equipment and redrilling, but do not permit new wells.

In summary, a waterflood or other enhanced recovery project for the Jones zone, and presumably for the deeper Main zone, could probably be accomodated from the existing drilling sites in the Townlot/Downtown area. A comprehensive program for the shallower Bolsa zone would probably involve steaming, and might require some new wells, the redrilling of existing wells and the location of steam producing equipment outside the existing drill sites in an area between 6th and 13th Streets.

There are currently several oil operation sites in this area which could be utilized in such a project. The zoning on these sites allows the redrilling of wells and the installation of oil recovery equipment, but does not allow for the drilling of new wells.

6.0 Policy Options for the City

The discussion in Section 5.0 suggests that a considerable amount of oil can probably be recovered from the Townlot/Downtown area if unitization occured and enhanced recovery methods were applied. Although a majority of the oil operators there have indicated a tentative interest in such a project, unitization does not appear likely in the short-term.

Section 4.0 argued that the kinds of government policies which would directly encourage unitization and enhanced recovery do not lie within the jurisdiction of the local government. Still, there are important roles for a City government; namely, 1) helping to preserve enough surface area in the face of rapid urbanization for the facilities necessary for an enhanced recovery project if unitization is realized in the future, and 2) ensuring that any adverse impacts on nearby uses such as housing and coastal recreation are mitigated to acceptable levels.*

---

* Analysis by the City Planning staff indicates that potentially adverse impacts resulting from an enhanced recovery project can usually be mitigated; and, in fact, such projects tend to reduce undesirable effects and increase beneficial ones in areas like the Townlot/Downtown. A discussion of potential impacts and their mitigations is included in another report in this series, #4: "Enhanced Oil Recovery Technology".

This section discusses the policy options available to the City for preserving surface areas until a future unitization project is instigated or until it is apparent that such a project is so unlikely that restrictive land-use policies are unreasonable or unwise.

6.1 Existing Land-use Regulations Affecting Oil Operations in the Townlot/Downtown

Considering the long history of oil operations in Huntington Beach, as well as the benefits that oil production contributes to the community such as employment and revenues, the City's land-use regulations have traditionally accommodated oil activities.

The City currently uses three zoning districts, called "O," "O-1" and "O-2," to allow oil operations. More specifically, each of these is a zone suffix which is attached to a base zoning designation such as residential, commercial or industrial. Both the uses permitted in the base zone, as well as the oil-related activities permitted by the suffix zone, can be legally conducted on the site.

The "O" is the most restrictive of the oil suffixes. It permits wells and other oil-related equipment, including those which might be used in an enhanced recovery project. It allows the redrilling of existing wells, but does not allow any new wells to be drilled. The principal purpose of this suffix is to allow existing wells and the kinds of activities which could be reasonably expected in association with these wells. This is the designation on most of the oil operation sites remaining in the Townlot/Downtown area. They are shown in black in Figure 5.5.

The "O-1" designation allows all the uses permitted under the O suffix, but also allows new wells to be drilled. Drill sites 2 through 5 in Figure 5.5 are designated O-1.

The "O-2" suffix allows the same uses as O-1, but applies to oil operation sites greater than three acres. Drill site #1 in Figure 5.5 is designated O-2. For purposes of this discussion, there is no practical difference between O-1 and O-2. The important point is that both permit new wells, while the O suffix does not.

The discussion in Section 5.4 indicated that the five existing drill sites could probably accommodate an enhanced recovery program, except perhaps for a comprehensive steamflood in the Bolsa zone. The steamflood might require additional surface area outside the drill sites, somewhere between 13th and 6th Streets. There are several existing oil operation sites in this area which are zoned O; thus steam equipment and redrilling are permitted, but no new wells.

This indicates that current regulations would allow unitization and enhanced recovery. The relevant question, however, is how long will these sites be available for such a project?

Because the O, O-1 and O-2 districts are only suffixes, other uses are already permitted on these sites. At any time, the operator may abandon his oil operations, and new development can be constructed on the site. The loss of any of the remaining drill sites and the loss of the other oil operation sites, particularly in some parts of the Townlot, could potentially preclude a future enhanced recovery project.

Through its land use regulations the City can go beyond simply accomodating enhanced recovery projects now, and help to keep sites available for such use in the future. Strategies for achieving this are discussed in the following sections.

6.2 Strategies to Help Preserve Existing Drill Sites

Any enhanced recovery project will require a significant number of new wells.

The existing drill sites are large enough

to accommodate the anticipated number of wells and are distributed over the oil zones in such a way that most of the strata can be reached by directionally drilled wells. Thus, protection of these existing drill sites is probably highest priority for keeping open the option of a future enhanced recovery project. The following strategies might help to protect these sites:

Change O-1 to base designation rather than a suffix: If the existing base zone were removed, and the O-1 suffix were to become the base zone for the site, then a developer would need to come to the City for a zone change before new uses could be constructed on the drill site. Before the zone change would be permitted, the Planning Commission and City Council would have to approve the zone change and the new use. The City might require one or all of the following before allowing new uses on the drill site:

> An analysis by a petroleum engineer showing whether an enhanced recovery project in the Townlot area is impractical or not. If such a project is still possible, the analysis should indicate whether the drill site in question is necessary for such a project. The analysis should also indicate if only part of the surface area in the drill site is essential to such a project.
>
> Retention of part of the drill site surface as open space, available for future oil operations. This open surface area should be large enough to not only accommodate the equipment necessary for the enhanced recovery project, but also any buffers, walls, screens and sound-proofing barriers used to protect the nearby uses from any adverse impacts related to the future oil operations. These open spaces could be incorporated into the design of the new development and used for such things as recreation facilities or gardens, so long as there were a clear understanding that such areas might also be used for oil operations at a future date.
>
> Permit only new uses which do not cover the drill site (or parts of the drill site) extensively with permanent structures. These uses might include commercial recreation facilities such as "miniature golf," or other commercial establishments like garden supply outlets, or self-serve gas stations. Such uses would have to be reasonably feasible considering their location and appropriate considering other nearby uses.

The City might also establish regular review periods after which the owner or developer could request a re-evaluation of the site for an enhanced recovery project. If the City determined that an enhanced recovery project was no longer practical or that the site was no longer important for the success of such a project, the restrictions on the use of the surface could be removed.

Change General Plan designation on all drill sites to "Resource Production": Another important "tool" for regulating land uses besides zoning is the City's General Plan.

The General Plan indicates, in general terms, the kinds of uses which are appropriate in different parts of the City. For example, drill site #1 in Figure 5.5 is currently designated "resource production." This means that activities related to oil extraction are the most appropriate ones in this area during the "planning period" (which is usually 20 years). Before other uses would be permitted there, the developer would have to obtain a General Plan amendment from the City. Drill site #2 is designated "planned development" and drill sites #3-5 are in residential designations. If these sites were also changed to "resource production" then oil extraction would be the principal permitted use, and a General Plan amendment would be necessary before new uses would be allowed.

The advantage of requiring a General Plan amendment rather than a zone change is that the former usually entails a much more extensive review by the City's staff and policy-makers.

This might ensure that considerations like future recovery projects will be more completely analyzed before changes are permitted. The kinds of restrictions that might be placed on the site by the City before allowing new uses would be the same as in the zone change case discussed above. However, the mechanisms for the detailed review which would be required in that case are already established for General Plan amendments, but are not normally exercised currently for zone changes.

A disadvantage is that the General Plan currently does not usually differentiate land use categories on areas smaller than 20 acres. The intent of the General Plan is to indicate general uses for relatively large areas in the City, leaving more detailed restrictions on a site-by-site basis to zoning ordinances. A significant exception to this is the coastal zone, where land use designations have been applied to sites much smaller than 20 acres because of the special resources associated with the coast which require more detailed planning, even at the General Plan level. Drill sites #1, 2, 4, and 5 are in the coastal zone, so this kind of specificity in the land use designation would not be unprecedented.

Overlays and conditional-use permits: Another method by which the City could help protect surface areas for future oil operations would be through an "overlay" and a conditional-use permit. The City could indicate that the Townlot/Downtown area is a special resource production district by a general "overlay" designation. Before certain sites in the overlay district could be used for activities other than oil operations, the developer would be required to apply for and receive a conditional use permit -- that is, a permit allowing new uses, but only after a City review and analysis, and only if any conditions placed on the new uses by the City are accepted by the developer. These conditions could include the enhanced recovery analysis and reservation of open space which were discussed in the zone change option above.

A disadvantage to this approach is that it adds, (almost literally), a new layer of City land use restrictions, in addition to the existing General Plan and zoning ordinances. New review procedures would need to be developed in order to implement this approach. The advantage of the overlay is that it emphasizes the importance of protecting areas for enhanced recovery projects and it helps to focus the analysis of new uses on the enhanced recovery issue and not other peripheral ones.

6.3 Preserving Other Oil Operation Sites (Zoned O) in the Townlot/Downtown

The City may want to consider applying the strategies discussed above to the other oil operation sites in the Townlot/Downtown area which are currently zoned O. Some of these sites could be important to a comprehensive enhanced recovery project. Many of these sites, however, are very small and very close to other uses. The minimum surface area necessary to accommodate a drilling rig recommended by numerous oil companies and well drilling companies is approximately 100 by 200 feet.* Sites which are smaller than this minimum may not be appropriate for future re-drilling and, thus, might be excluded from consideration in a future enhanced recovery project.

6.4 Permitting New Wells in the Townlot

Besides protecting the existing drill sites and some of the larger O-zoned sites, the City might also consider allowing new wells in the Townlot, if the new wells were part of a unitization and consolidation program. New wells outside an existing drill site may be important to an enhanced recovery

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* Planning staff contacted the following companies: Chevron, Aminoil and California Production Services, as well as the DOG.

project if existing wells cannot be redrilled or if there are simply insufficient existing wells to complete the injection patterns. New wells should only be permitted if they meet the following criteria: 1) the site is larger than a minimum size; 2) mitigations of any potential adverse impacts are incorporated into the project; and 3) the new well is part of an overall unitization or consolidation program. Implementing strategies include developing a new zoning ordinance or utilizing an overlay district with a conditional-use permit requirement, similar to the strategies discussed in Section 6.2.

6.5 Other Possibilities for New Drill Sites

Besides the drill sites discussed above, there are other possiblities which should be discussed.

Bolsa Chica State Beach: Part of Bolsa Chica State Beach lies across Pacific Coast Highway along a large section of the Townlot/Downtown area. Several wells and related equipment are active in this area which is currently zoned O. Wells directionally drilled inland from this strip could cover a large part of the Townlot and could be very useful in a comprehensive enhanced recovery project. A serious problem with using this area for more intensive oil operations is the conflict between those activities and the area's use as a heavily-visited, public recreation facility. In light of the high priority in the Coastal Act given to public recreation along the shoreline, the City's LCP includes policies which encourage the "phase-out" of wells on Bolsa Chica Beach. New wells are not prohibited from locating on the beach, but can only be sited there if all the following condition are met:

1) The resources are not recoverable from any other onshore location or existing platform, 2) the site is improved to become compatible with recreation uses of the beach, 3) public health, safety and welfare are not jeopardized, 4) adverse environmental impacts are mitigated to the maximum extent feasible, 5) the net overall impact of oil production facilities on visual resources is improved, and 6) safe access to the beach is provided.

The aim of this policy is to protect and enhance the visual and recreational amenities afforded by the beach while permitting oil activities which must be located there. In view of this approach, reservation of Bolsa Chica Beach for future oil facilities appears inappropriate. However, if new facilities essential to the recovery of the oil deposits underneath the Townlot could not be sited any where else, then the City may still permit those facilities to be located on the beach if all of the conditions listed above are met. However, because this is a State beach, the California Department of Parks and Recreation would also have to give its permission before new wells could be drilled.

Offshore Locations: Another possible location for oil facilities needed in an enhanced recovery project is offshore.

In this case, preserving surface locations in the Townlot itself would not be important, although some onshore sites might be necessary to tap the more inland extremities of the oil pools. Wells and related equipment can be located on offshore platforms, man-made islands or piers extending from the shore. Because these wells would be reaching inland, they would be located as close as possible to the shore. Thus, a pier would be the most likely facility used if an offshore location were chosen.

The disadvantages of using a pier for oil facilities include the following: 1) risk of spills which could adversely affect the recreation beaches, 2) degradation of visual resources associated with the shoreline, 3) conflict between industrial and recreational uses of the shoreline and 4) conflicts between mobile, portable oil equipment and other traffic.

Advantages of using a pier include the following: 1) valuable surface areas onshore could be freed for other uses, and 2) the pier could be designed to accommodate public recreation facilities such as fishing areas and look-outs, and the private sector would probably be willing to finance the entire proposal. The pier would have to be designed to reduce any conflicts between the oil activities and the public recreation facilities.

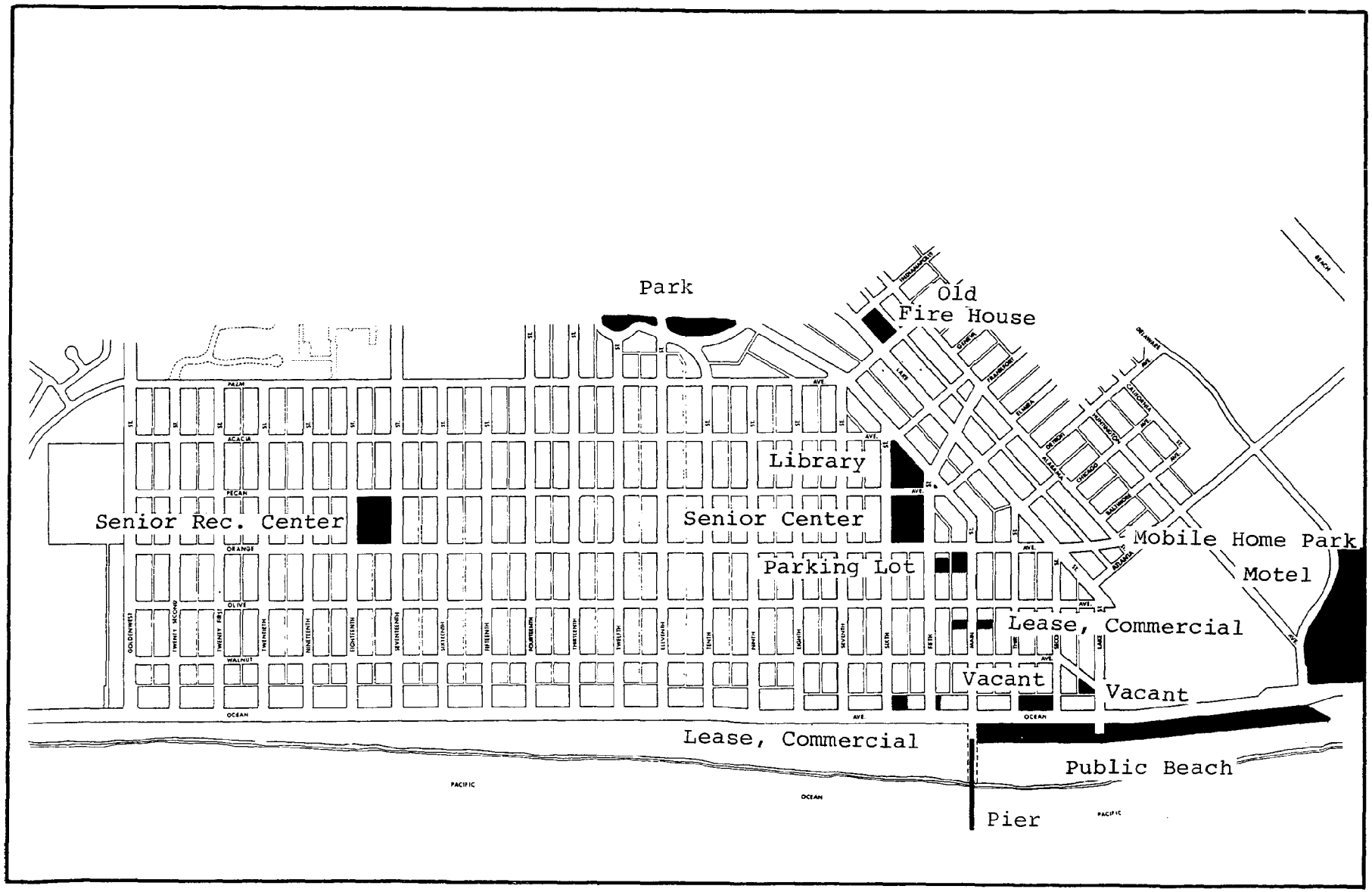

Figure 6.1 City-owned Properties in Townlot/Downtown.

Source: Huntington Beach Planning Division.

The City's planning and zoning jurisdiction does not extend beyond the mean high tide line. The State Land Commission regulates development in this area. Thus, the City can only discourage or encourage offshore development, but cannot regulate such development directly.

City-owned Property: Another option for preserving surface areas for future oil facilities is for the City to retain properties it owns itself and to restrict uses on the surface or parts of the surface. Figure 6.1 shows the City-owned properties in and near the Townlot/Downtown and indicates the uses currently located on each. The implementation approach would be to limit structures so that sections of these properties are preserved until such time that an enhanced recovery project is proposed. The City would then sell or lease the surface areas to the unit proposing the project. The City could still use these properties until that time for facilities like parks or parking lots which leave large parts of the surface free of permanent structures. The City would periodically review the properties reserved for potential enhanced recovery projects to determine if such projects are still possible and if particular properties would be important for the projects.

6.6 Other Possible Actions

There are other kinds of actions related to protecting surface areas which the City should consider. First, the City may want to hire a professional petroleum engineer to analyze the possibility of unitization and enhanced recovery in the Townlot/Downtown more completely before enacting zoning ordinances or other land use restrictions. Such a study may establish more exactly the likelihood of such a project, as well as its surface area requirements. This in turn could allow for the development of more precise regulations.

Secondly, an analysis of the remainder of the City may be helpful to locate other parts of the field where unitization and enhanced recovery projects are possible and where protection strategies similar to those discussed for the Townlot might be appropriate.

7.0 Conclusion

For the forseeable future, energy sources -- and especially oil -- will continue to be increasingly more expensive. New technologies will also continue to be developed to help increase energy supplies. In light of this situation, oil remaining in the ground after primary production which may be recovered by new technology is a very valuable natural resource.

This report shows that the Townlot/Downtown area of Huntington Beach may overlie such oil resources. It also discussed strategies for protecting surface areas necessary for access to those resources in the face of encroaching development, so that new technologies may someday be applied to recover the remaining oil. The City should consider evaluating other areas in the Huntington Beach oil field where conditions are similar to those in the Townlot; namely, where 1) significant quantities of oil may still exist in the ground because secondary and other enhanced recovery methods have not been applied, and where 2) new development is rapidly encroaching on the oil field, threatening to cover the surface to such an extent that the necessary extraction equipment can not be accomodated.

The City's principal role in this issue is to control land uses so that enough surface area is preserved until these technologies can be applied or until it is clear that application of those technologies is impractical. More direct actions which would encourage unitization and the use of enhanced recovery methods are more appropriately within the jurisdictions of State and federal governments. The City should monitor policy and legislative developments at these levels of government related to unitization and enhanced recovery, as well as to developments in the oil industry itself, to better determine if such programs are likely in Huntington Beach. By watching these developments, as well as by periodically evaluating the potential for new projects in Huntington Beach, the City can continue to promote policies which help to protect and carefully utilize its important oil resources.

NOTES

1. California Coastal Act of 1976.
2. California Public Resources Code, Division 3; Chapter 3.5.
3. Ibid.
4. Hill, F. L., Proceedings: Workshop on Urban Oil and Gas Development, 1978.
5. Hagenbush, G. C., and Allen D. R., "Huntington Beach Oil Field," Summary of Operations, Vol. 44, 1958.
6. Ibid.
7. Hunter, A. L., Bradford, W. C., and Allen, D. R., "Southeast Extension of the Townlot Area," Summary of Operations, Vol. 41, 1955.
8. Huntington Beach Planning Division, "Fiscal Impacts of Oil Operations in Huntington Beach," 1981.

APPENDIX A

Questionnaire and Cover Letter

COMPANY NAME: _____

DEFINITIONS:

Waterflood: A method for increasing oil production by injecting water into oil zones.

Unitization: An agreement among several oil operators to treat a shared oil pool as a "unit" and to produce the pool together in a coordinated way, as if they were a single company. Unitization is usually required before a waterflood project can be undertaken in all areas where many operators work the same reservoir.

1. Do you think there is enough recoverable oil in the Townlot-Downtown part of the Huntington Beach Field so that a waterflood would be economically profitable (if unitizations could be achieved).

   Very likely ___
   Perhaps ___
   Very unlikely ___
   Don't know ___

2. If you think there is enough oil to make unitization and waterflooding in the Townlot area profitable, do you think other obstacles can be overcome so that such a project is possible in the future?

   Yes ___
   Maybe ___
   No ___
   Don't know ___

3. Which of the following reasons do you think have prevented a waterflood program from happening in the Townlot area?

   Not enough oil ___
   Not enough operators willing to join ___
   Price controls on oil ___
   Zoning restrictions ___

   Other _____
   _____
   _____

4. Would your company be interested in joining a voluntary unit for the purpose of waterflooding?

   Definitely interested ___
   Maybe interested ___
   Definitely not interested ___

CITY OF HUNTINGTON BEACH

P.O. BOX 190 DEPARTMENT OF DEVELOPMENT SERVICES CALIFORNIA 92648

BUILDING DIVISION (714) 536-5241 PLANNING DIVISION (714) 536-5271

Dear Sir:

A problem facing oil producers in urban areas is the pressure for new development on the surface of oil fields. Houses and commercial structures are built near active oil operations; surface areas, from which new wells could be drilled and new technology could be tried, are covered over. This pressure for new development on oil fields is certainly evident in the City of Huntington Beach, and the City is concerned that potentially valuable oil reserves may be lost in the future if oil fields are completely covered by development.

The City Planning Division is studying this potential problem. As part of this study, we are trying to determine if a unitization and waterflood project is possible in the Townlot and Downtown parts of the City. (This is the area bounded by Pacific Coast Highway, Palm Avenue, Goldenwest Street and Lake Street.) Our records show that your company operates a well or wells in this part of the City, and we would very much appreciate your answering the questions on the enclosed sheet. You can just check off your answers on the sheet, put it in the enclosed envelope and drop it in a mailbox.

If you have other comments or ideas about the possibility of a waterflood program in the Townlot, or if you have any questions about the City's study, please feel free to write the Planning Division or simply call Mike Multari of our staff at 536-5279.

Thank you very much for your help.

Sincerely,

James W. Palin, Director
Department of Development Services

JWP/MM:cw

APPENDIX B

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CITY OF HUNTINGTON BEACH

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