This is to certify that the

thesis entitled

THE IMPACT OF MICHIGAN'S COASTAL ZONE
MANAGEMENT PROGRAMS ON PROPERTY VALUES

presented by

Michael A. Youngs

has been accepted towards fulfillment
of the requirements for

M.A. degree in Geography

Major professor

Date 12/10/99

THE IMPACT OF MICHIGAN'S COASTAL ZONE MANAGEMENT PROGRAMS ON PROPERTY VALUES

By

Michael A. Youngs

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Geography

1999

THE IMPACT OF MICHIGAN'S COASTAL ZONE MANAGEMENT PROGRAMS ON PROPERTY VALUES

By

Michael A. Youngs

As the demand for outdoor recreation continues to grow, more people are seeking out shore front property for permanent and secondary residences. As a result shore front property values have increased, and this trend is expected to continue. Meanwhile, state governments have become increasingly active in instituting land use legislation to protect sensitive coastal resources and homeowners from the hazards of shore erosion. This study examines developed and undeveloped Lake Michigan fronted lots in Ottawa County, Michigan. The Hedonic pricing method is presented as a model for predicting variations in lake fronted property value and as a means for assessing the impact of land use restrictions. Regression analysis is utilized to determine if variables defined by the hedonic model are significant in accounting for variations in shore front property values. In addition, regression analysis is used to determine if the presence of land use restrictions imposed by the Critical Dune Program, and the High Risk Erosion Program account for additional significant variation in property values. The results of the study indicate the hedonic model is a viable means of predicting variations in lake fronted parcels. Variables representing the hedonic model described 69% of the variation in the value of developed parcels and 64% of the variation of undeveloped parcels. In addition, the value of a front foot for developed parcels in critical dune areas was found to have nearly twice the value of a front foot in non-critical dune areas.

This Thesis is dedicated to the memory of my mother, Barbara.

ACKNOWLEDGEMENTS

Many individuals deserve thanks for their contribution to this research. Thanks to staff at the Ottawa County Land Description Office, Grand Haven Township, Park Township, Port Sheldon Township, the cities of Grand Haven, Ferrysburg, and Springport for allowing me to access their data. I would also like to express my gratitude to staff at the Great Lakes Shorelands section of the Michigan Department of Environmental Quality for providing me with an excellent internship experience and allowing me to use DEQ data for this study. Special thanks to Tom Bennett and Penny Holt for helping me shape an idea into a research question.

A special thanks must also be given to my committee members, Dr. Michael Chubb, Dr. Bruce Pigozzi, and Dr. Julie Winkler. Thank you for your time, patience and helpful suggestions. I would like to thank my Aunt and Uncle for helping me to get to Michigan State in the first place. I would also like to thank my good friend Arie Dejong for his encouragement and support. Finally, I would like to thank my loving wife, Betsy, who never let me believe that completing this project was impossible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I
INTRODUCTION

A battle is being waged between two conflicting interest groups in the United States. On one side are property owners who own water front property or land near other scenic areas. These landowners believe they are entitled to utilize or develop their land as they choose. On the other side are some environmental individuals and groups, and various environmental regulatory agencies that are concerned about protecting ecologically sensitive areas from human damage. In addition, the environmental regulatory agencies are concerned with protecting consumers from potential environmental hazards. The environmental regulatory groups often favor and seek to implement legislation that will limit the types of land uses that can take place in these environmentally sensitive areas.

A trend contributing to this conflict, is an increase of participation in some types of outdoor recreation, especially water related activities. More people have sought out coastal areas for retirement residences and second homes (Simmons, 1990). A recent survey indicated that properties located near water related amenities were identified as the preferred choice of prospective buyers in the burgeoning recreational housing market (Pompe and Rhinehart, 1995).

The response to consumer pressures to access water-related amenities has been the introduction of legislation at the federal and state levels which attempts to limit land uses in sensitive areas. Recent environmental legislation has had three origins. The first origin is an increased public interest in protecting natural areas from environmental degradation. The second origin is to ensure that all citizens will have access to such environmental amenities. A third origin is a perceived need to protect homeowners from the impact of natural disasters (Simmons, 1990). The cycles of hurricanes, floods, and in some cases, rising lake levels, has resulted in tremendous economic loss for consumers (Millemann, 1991). Furthermore, the expense of such natural disaster often impacts taxpayers in the form of relief programs or infrastructure repairs or replacements.

An example of the conflict between environmental regulation and property rights is being played out in Michigan's Great Lakes Coastal Zone. The state's Great Lakes shorelines are major generators of recreational expenditures, a well-known tourist attraction and a frequent choice for retirement residences or second home sites. The Great Lakes shore lands offer unique freshwater ecosystems, access to water related activities, and beautiful outdoor scenery. In addition, Michigan has 270 miles of sand dunes along Great Lakes shorelines. The importance of Michigan's sand dunes cannot be understated. Nowhere else in the world is such a vast collection of freshwater dunes found. Michigan's dune endowment truly represents a unique and irreplaceable resource (Wycoff, 1990).

Unfortunately, the Michigan coastal zone also offers potential loss for property owners from wind and water erosion as well as abnormal lake levels. Periods of high water levels in 1946-52 and 1985-87 have resulted in millions of dollars of property damage (Raphael and Kureth, 1988). Despite the potential for loss, Great Lakes property remains in great demand and the rate of development remains high (Campbell, 1986).

The continued high demand for access to aquatic amenities, coupled with public concern for potential environmental degradation and loss due to natural disasters, resulted in momentous legislation during the 1970's. The Michigan legislature passed the Shorelands Protection and Management Act of 1972, and the Sand Dunes Protection and Management

Act of 1976. Both acts created substantial land use guidelines for Michigan's Coastal Zones.

The new legislation was supported by the majority of Michigan's voters who gave their consent by way of referendum (MDNR, 1989). However, many Great Lakes property owners were concerned these statutes would impact them negatively. For example, one Lake Michigan property owner complained that the "DNR acts as if it owns my land" (Detroit Free Press, 1992). Many homeowners viewed the legislation as a threat to their property rights and economically detrimental.

The Michigan Department of Environmental Quality (formerly a part of the Michigan Department of Natural Resources) which is responsible for the implementation and enforcement of these programs often receives letters of concern from property owners. The most common fear of coastal zone property owners is that designation of their parcel as being in a high risk erosion area (Shorelands Protection and Management) or as a critical dune area (Sand Dunes Protection and Management) would result in a depreciation of value as a result of the imposed land use restrictions (MDEQ Correspondence). In 1990, for instance, the Forest Beach Development Company sued the Department of Natural Resources claiming that the Critical Dune Act amounts to "unconstitutional seizure of the development value of private property" (McKay, 1990). The Department of Environmental Quality argues that the restrictions will not affect property values because the demand for coastal property is so great. They justify the land use restrictions as a small cost for ensuring the preservation of a precious natural resource for future generations (Detroit Free Press, 1990).

This research will attempt to determine the economic impacts of Michigan's Coastal Zone Management programs on residential property owners. It is important because the possibility of such impacts resulting from land use restrictions often arise in policy debates. The economic impacts can be a major source of legal and or political challenges for the agencies that implement and enforce such restrictions. Thus, the affected state agencies should understand the possible ramifications of land value on any restrictions they impose. Meanwhile, it is the right of property owners to be made aware of any potential economic losses they might suffer from such legislation.

The *hedonic pricing method* is offered as a theoretical model to describe spatial and other factors accounting for variations in lake fronted recreational property values. In the hedonic approach, housing or land units are viewed as bundles of individual attributes each with an implicit price. These hedonic attributes can be classified into one of three categories: structural characteristics, neighborhood characteristics, and site quality characteristics (Pompe and Rhinehart, 1995). The sums of these implicit prices describe the total value of the housing commodity. This study will attempt to answer the question of whether or not the presence of legislative restrictions measured as locational quality attributes negatively impact property values as some land owners claim.

Regression analysis is utilized as a statistical tool to test variables fitting the hedonic model and to quantitatively assess the impact of the coastal zone management legislation on lake front property values. This thesis will begin with an introduction to the land use provisions of the coastal zone management programs. Second, a survey of the literature relating to land valuation and more specifically developing a "hedonic" model to predict recreational land values will be presented. Special emphasis will be given to studies using the hedonic model to assess the impact of land use restrictions. Next a presentation of initial hypotheses will be given, followed by a discussion of data sources and collection techniques. Finally, a series of regression analyses will be undertaken and the conclusions presented.

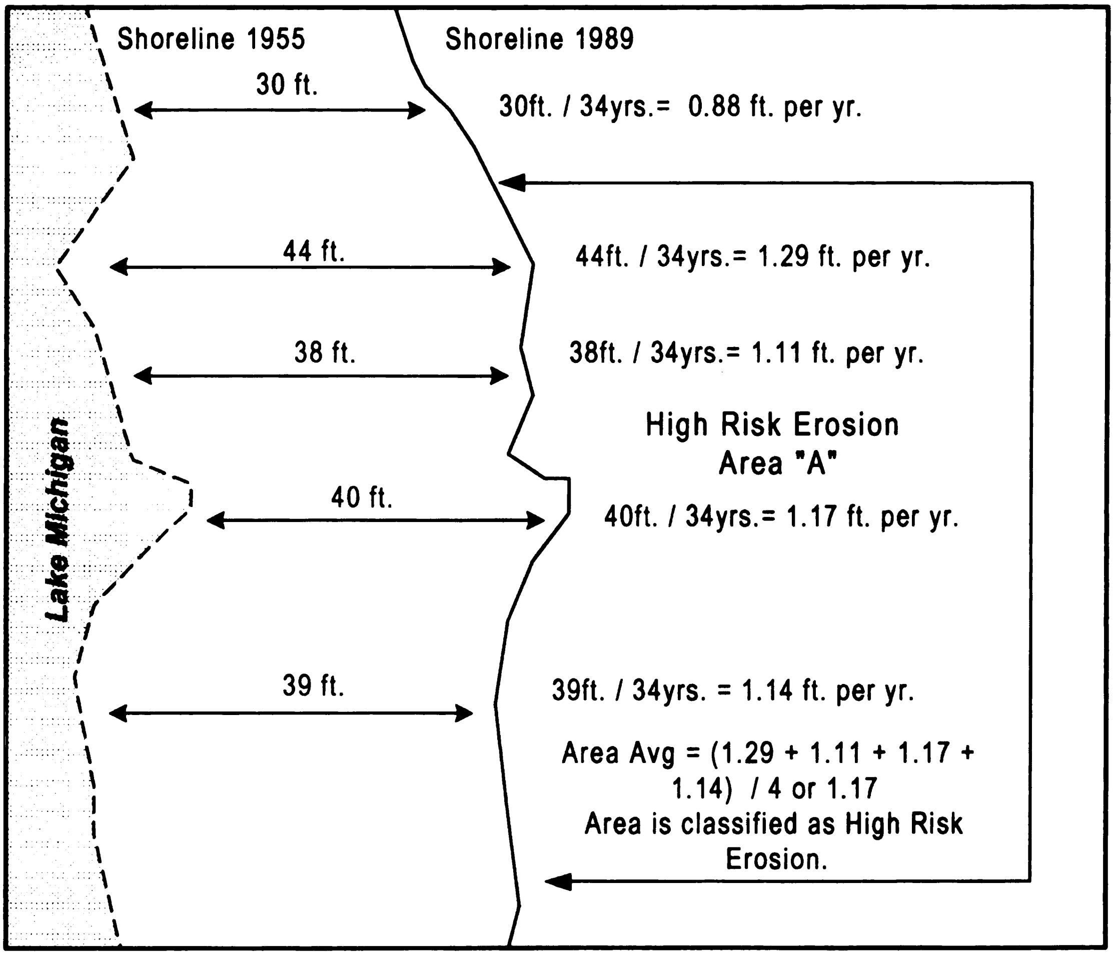
Chapter II
Michigan's Coastal Zone Management Programs

High Risk Erosion Area Program

This section will give a brief introduction to Michigan's coastal zone management programs. The Department of Environmental Quality's methodology for assigning high risk erosion areas and critical dune areas will be described. In addition the state's zoning regulations as they relate to residential property owners will be outlined. It should be noted that the original pieces of legislation became subsets of public act 451, The Natural Resources and Environmental Protection Act in 1994 (MDNR, 1994). However, since the two programs have different implications for property owners it is more convenient to treat them in subsequent discussions as unique pieces of legislation.

High risk erosion areas are defined in the Coastal Zone Protection and Management Program as "those shorelands of the Great lakes where recession of the zone of active erosion has been occurring at a long term average rate of one foot or more per year"(MDNR, 1994). The Department of Environmental Quality uses aerial photography to measure the rate of shoreline recession over a long period of time (greater than fifteen years.) A zoom transfer scope is used to match historic air photos with modern air photos showing the shoreline at different scales. A measurement is taken at various points along the shoreline to determine the distance in feet the shoreline has eroded from the historic photograph to the current photograph. The points of measurement, or transects, are selected based on features, such as a road intersection, which are clearly identifiable on both the historic and modern air photos. Transect measurements are normally made every 250 feet along the shoreline. The recession rate for a transect point is the average amount the shoreline has receded per year over the time period between the flying of the historic air photos and the modern air photos. If two or more transect points covering a distance along the shoreline greater than 500 feet have an annual rate of recession of greater than one foot per year, these points are classified as being a high risk erosion area. Similarly, a high-risk erosion area ends when two consecutive transect points have a recession rate of less than 1 foot per year (MDNR, 1994).

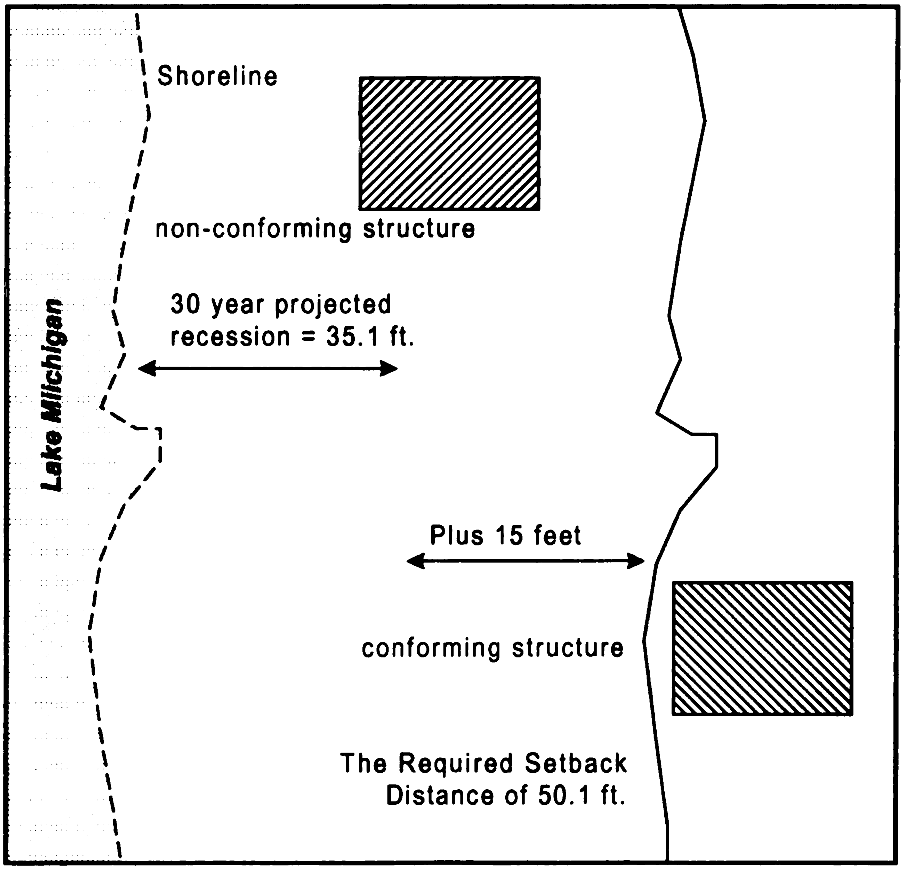
Figure 1
Determination of High Risk Erosion Areas



The Department of Environmental Quality undertakes a recession rate study of approximately three counties a year. As a result, each county unit is updated approximately every ten years to reflect changes in water levels and shore protection efforts. Thus, an area that is not currently classified as high risk could receive a future designation as a result of changing conditions. Likewise an area could lose it's high risk designation if new data indicated a drop in recession rates (MDNR, 1994).

Once a high risk erosion area has been designated all parcels in that area are subject to the zoning restrictions outlined in the Coastal Zone Management program. The major zoning prohibitions are as follows: A required setback distance is determined for each erosion hazard area. The required setback for a small structure is the thirty year projected recession distance plus fifteen feet. A home is considered a small structure if the size of the foundation is less than 3,000 square feet. The thirty year projected recession distance is the area average recession rate multiplied by thirty plus fifteen feet (MDNR, 1994).

Figure 2
High Risk Erosion Area Required Setback Distance



Research by the DNR and the DEQ has indicated shoreline areas with high bluffs (over 25 feet) and steep slopes are much more susceptible to rapid erosion (MDNR, 1994). As a result, a *slope factor* is also figured in to the required setback distance for areas with high bluffs and slopes greater than 25%. The slope factor is calculated by adding 1.0 to the percentage points of slope over 25% and then multiplying it by 0.5. This figure, which cannot exceed 2.0, is multiplied by the thirty year projected recession distance. Therefore, in high bluff areas the required setback distance can be as much as twice the distance of low bluff areas with the same area average (MDNR, 1994).

The impacts of high risk erosion area designation are felt by holders of developed and undeveloped parcels. The legislation says that no new permanent structure can be built on the lake-ward edge of the state designated minimum setback distance. If the lot is non-conforming, meaning that there is not sufficient space to place a permanent structure land-ward of the required setback distance, a structure can be built only if it is readily moveable. Building a readily moveable structure can increase construction costs and limits the housing options available to a property owner. For existing structures, an addition can be built only if it is built land-ward of the required setback distance. An addition to an existing non-conforming structure can only be made if the addition is a readily moveable structure. Furthermore, if a structure on a non-conforming lot deteriorates or becomes damaged, it may be restored to its condition before the deterioration or damage only if the repair cost does not exceed 60% of the replacement value. Finally, the slope or height of the dune or bluff on a parcel cannot be artificially altered to affect the setback requirements of that parcel (MDNR, 1994).

Currently over 300 miles of Great Lakes shoreline are designated as high risk for erosion in the state of Michigan. Over 7,500 individual parcels are impacted by setback restrictions. From the DEQ's perspective setback restrictions benefit the entire state by "reducing the need for public disaster assistance." The DEQ also believes that setbacks will economically benefit the owners of the 7,500 parcels in the long run (MDNR, 1994).

Critical Dune Program

Unlike the legislation creating high risk erosion areas, the primary goal of the Critical Dune Act was not consumer protection, but rather conservation of a natural resource. However, the citizen's committee which drafted the legislation recognized that the proposed restrictions would protect property owners from losses resulting from wind erosion as well. Following the passage of the Critical Dune Act (1976) the Department of Natural Resources was charged with the task of inventorying Michigan's dune areas, and identifying those dunes that were most sensitive to alteration and change. A thirteen year study culminated with the distribution of the <u>Atlas of Critical Dunes</u>, in 1989. The atlas defined the geographic limits of Michigan's Critical Dunes. Critical Dunes are 'those areas being dunes which exhibit the greatest natural relief compared to adjoining lands.' Areas identified as critical dunes in the atlas became subject to special zoning restrictions July 5, 1989. The restrictions for residential properties are outlined below.

After July 5, 1989 new construction is prohibited in critical dune areas on a slope that is greater than 25%. A new structure is also prohibited on a slope between 18-25% unless plans are developed by a professional engineer or architect. The plans must make provisions for disposal of waste without serious soil erosion and without sedimentation of any stream or other body of water. Other land uses are prohibited that involve a contour change or a vegetation removal that threaten to increase erosion or decrease stability. Any new construction must occur behind the crest of the first land-ward ridge of a critical dune that is not a fore dune. However, if construction occurs within 100 feet land-ward of the crest of the first ridge that is not a fore dune, the property owner must demonstrate that the use will not destabilize the critical dune area. The landowner must also demonstrate that contour changes or vegetation removal are limited to that essential to siting of the structure. Construction techniques must be utilized which mitigate the impact on the dune. Furthermore, the crest of the dune cannot be reduced in elevation, and access to the structure must be from the land-ward side of the dune (MDNR, 1989). Variances may be granted for properties that become non-conforming as a result of the implementation of the act, or become non-conforming as a result of natural shoreline erosion. However, these variances still require that a structure be built at the base of the dune on slopes less than 12% and that site impact mitigation issues discussed above are addressed (MDNR, 1989).

Although, the intended goals of the two land use restrictions are very different, the perceived impacts by property holders are quite similar. First and foremost landowners resent the lengthy permitting process which slows down the time it takes to develop their land. In 1992, one developer complained that it took six months to receive a permit from the DNR to construct a single-family home (Detroit Free Press, 1992). In addition, property owners who protest the designation of their land as high risk erosion, or critical dune, contend that any special designation by the state will negatively impact their ability to sell their property at some point in the future. Finally, landholders simply resent having limitations placed on how they develop their land. Setback restrictions and slope requirements limit where a new structure or addition can be placed or whether that use is permissible at all. Site mitigation issues such as waste disposal or the requirement of a readily moveable structure can raise the development cost substantially. One developer complained "due to the law his crews could not put any construction equipment on the lot. We had to do everything by hand . . . Some builders gave up on lakeshore building because of all the red tape" (Detroit Free Press, 1992).

Therefore, while the intent of the two aforementioned pieces of legislation are quite different, many landholders view them simply as unnecessary and costly state intervention. It is important to note that these two pieces of legislation do overlap. It is possible that a parcel is designated as high risk erosion and critical dune. Such a parcel could be subject to all the land use restrictions of both programs.

Chapter III
Land Value and the Hedonic Approach

Land value has long been an important research topic for economic geographers. Land is a unique commodity that can be conceptualized as a factor of production used to produce actual income or psychological satisfaction for owners as well as tenants. It is also a location in space that can produce amenities for owners, tenants, as well as visitors (Xu, Mittelhamer, Barkley, 1993). Much literature attempts to relate property values to different spatial and socioeconomic variables. However, the majority of research has examined property values in the urban setting and very little has been done with property values in extra-urban amenity areas, such as lakes, rivers or other natural resources. Even fewer studies attempt to assess the impact of land use restrictions or growth controls on the values of such properties. The following research will attempt to do both.

Some economic geographers have treated housing as a homogeneous commodity. For instance in William Alonso's famous work <u>Location and Landuse: Towards a General Theory of Land Rent</u> (1964), an ideal city located on a featureless, homogeneous plane is assumed. It is inhabited by identical one person, or n-person household - each household has the same income and taste preferences. Casetti (1970) and Thrall (1983) also assume an ideal city in their development of urban land rent models. These models are primarily concerned with understanding the spatial structure of land value. Important components of these models are distance from the central business district or in the case of agricultural land distance from the market.

Another approach is that a housing unit is really a combination of characteristics that satisfy various types of a household's demand. In recent years an attempt has been made to recognize and empirically describe the heterogeneity of the housing market. Some economists have chosen to explain commodities, including the housing market in 'hedonic' terms. In the hedonic approach commodities are viewed as a bundle of individual attributes each with an implicit price. The sum of these implicit prices describe the total value of the housing commodity.

Sherwin Rosen provided a theoretical framework for the statistical analysis of hedonic prices. In his 1974 article, Rosen depicted each household as having a maximum price it is willing to pay for alternative housing bundles. Each bundle is composed of varying levels of attributes. A household will decide to pay for more or less of an attribute depending upon its taste or preference. For example, one household may decide to pay more for additional floor space, while another household may value the attribute of a larger kitchen (Rosen, 1974).

Following up on Rosen's work, other scholars attempted to demonstrate that although housing bundles contain an enormous number of attributes, consumers view a housing market on a reduced set of composite attributes (Kain and Quigley 1970, King 1973, Freeman 1979). Thus, according to Freeman, the attributes describing a property's value can be assessed under three classifications: structural characteristics, locational characteristics, and site quality characteristics. A general model for land value using the hedonic approach can be stated as follows:

$$V_i = V(S_i, L_i, Q_i)$$

Where the price of a home, V_i, is a function of a vector of structural characteristics, a vector of locational characteristics, L_i, and a vector of site quality, Q_i.

Models such as Thrall's Consumption Theory of Land Rent (1983) are important in understanding the underlying spatial structure of land rent. The hedonic model however, is better suited for analyzing the structural components of land value. Furthermore, while the hedonic model is not necessarily concerned with describing how distance from some amenity affects land prices, it does recognize the importance of location as a substantial determinant of land value. Thus, traditional models seek to understand the difference of land value over space, where as the hedonic model can be used to understand the impact of space (location) on value.

An additional problem with most land value models is that they are designed to fit either an urban area or agricultural area. Recreational or dual-purpose properties can either be urban, rural or, in the case of this study both. The hedonic model, meanwhile, has been used in a variety of settings, urban, rural, agricultural, and recreational. For this study the hedonic method is appealing because of its extensibility to any study area.

To provide an empirical basis for testing Rosen's Hedonic theory researchers have often utilized regression analysis. By regressing independent variables measuring structural, locational, and site quality characteristics against land values researchers were able to assess the viability of Rosen's hedonic model. As mentioned previously the majority of the research using the hedonic approach has been conducted in an urban setting. A few scholars, however, have used the hedonic approach to examine property values near water related amenities or other recreational areas. In some instances the researchers have used the regression coefficients from an ordinary least squares analysis to determine the dollar amount a specific attribute contributes to land value. In other instances researchers have tested whether a variable has a significant relationship with value when other independent variables representing structural, neighborhood, and site quality variables are controlled.

Other researchers have simply tested whether the full spectrum of hedonic variables is significant using a multiple regression analysis.

Many studies of recreational properties have tried to assess the importance of a water related amenity on recreational property value. Studies by Conner, Gibbs, and Reynolds (1973), Brown and Pollakowski (1977), Milton, Gressel, and Mulky (1984), and Parsons and Wu (1991) all examined property value near a water related amenity. In each case the researchers determined that access to, distance from, and view of water were significant attributes in explaining recreational land values.

A unique study using the hedonic model for recreational property values was done by Pompe and Rhinehart (1993). They believed that beach width represented and important component of site quality in coastal South Carolina. The researchers contended that wider beaches provided aesthetic value as well as protection from high water and erosion. They hypothesized a direct relationship between the two variables. Therefore, they expected to see an increase in value as the independent variable beach width increased. The result of their least squares regression analysis indicated that indeed beach width had a significant and positive relationship with value. In addition, Pompe and Rhinehart also found that increasing the width of a beach by a foot, on average, added $558 to the value of a property in their study area.

Another unique variable was tested in a hedonic analysis done by Wertheim, Jivden, and Chatterjee (1992). They also examined recreational property in a coastal setting. In trying to create a set of variables which accurately predicted value for their study area they hypothesized that adjacent lots had a significant relationship with value. Specifically, they hypothesized that landowners would prefer to have vacant lots adjacent to their properties.

The rationale being that consumers would prefer to see "pristine" natural conditions as opposed to another home. To test this hypothesis they used regression analysis and introduced a dummy variable coded 1 if a lot had vacant land adjacent and 0 if the lot was without adjacent vacant land. Their study was also unique compared to others in that initially they tested the relationship between value and each independent variable using bivariate regression before moving on to a multiple regression analysis. They utilized bivariate regression to give an "indication of the relative importance of each variable." Seven of the nine variables they tested were significant in both the bivariate and multiple regression analysis. In addition, the dummy variable used to assess the importance of adjacent vacant land was significant as they hypothesized.

Several of the above studies include a variable to measure the distance of a home from the water's edge. They included the variable as a potential measure of the site quality component of the hedonic model. However, distance of a structure from the water's edge does not account for the effect of topography on the accessibility of a site to water. Thus, while the linear distance between a home and the water's edge may be small, the actual ease of accessibility may be difficult because of the topography. Previous studies, to my knowledge, have ignored this important component of the site quality of water-fronted property. An indication of topography is important in the context of this study given the way in which the regulations are enforced. High bluffs can increase the mandatory setback requirements of a parcel. High slope percentages can impact setback requirements or determine whether development can occur in that location at all.

Landuse Restrictions Literature and Methodology

Many Lake Michigan property owners have indicated that they perceive designation as erosion high risk or a critical dune site as a negative factor impacting their land value. Research indicates "that environmental features can increase land and house values if they are viewed as attractive or desirable, or they can reduce values if they are viewed as nuisances or undesirable" (Nelson, Generaux, Generaux, 1992). For instance Li and Brown (1980), found that residential property values were lower near large sources of ambient noise. Havilecek (1985) reported that property values near landfills were significantly lower than comparable property values in other areas. Kohlhase (1991) found that presence of a toxic waste site had a significant negative impact on land values. A great deal of literature exists which tries to relate property value to some negative externality, i.e. crime, nuclear power plants, airports etc. However, very little research examines the impact of land use restrictions, a potential negative externality, on property values. A few relevant studies are outlined and discussed below.

An early study of land use restrictions using a hedonic model was completed by Frech and Lafferty (1976). Their study analyzed the impacts of restrictions enacted by the California Coastal Commission on vacant lands in Ventura County, California. They found in a period of five years, the rate of growth in actual sales prices for vacant lands to be 15% **lower** for parcels under the commission's control than for comparable unregulated parcels elsewhere. In a follow up study in 1984, Frech and Lafferty analyzed the impacts of the coastal commission on developed parcels. In this context the researchers reported that actual sales prices for developed parcels **increased** between 8-13% in value when compared to lots not regulated by the commission. Thus, it is important to note that impacts of legislation may be significantly different depending on whether the parcel is developed or undeveloped.

Holway and Burby, in a 1990 Study, attempted to assess the impacts of the National Flood Insurance Program (NFIP) on undeveloped parcels. They contended that to truly assess the "development costs" of the regulation an analysis of undeveloped parcels was critical. A main test variable was the mandated height of new construction, a key component of the legislation. Their regression analysis showed a significant relationship between vacant lot value and the mandated height of new structures. Holway and Burby therefore concluded that the National Flood Insurance Program was having a significant negative impact on undeveloped property values. They attributed the negative impact on the additional cost involved in developing parcels covered in the legislation.

Other studies, which have examined the NFIP, have concluded that its regulations have no impact on property value. Two studies, one by Damianos and Shabman (1976), and Muckleston (1983) examined only the impacts of the legislation on developed parcels. In both studies, there was no clear statistical evidence that the legislation had any impact on value. Therefore, in the analyses of the NFIP, like the Frech and Lafferty studies (1976 & 1984), the effects of land use restrictions had differing results between developed and undeveloped parcels.

Patrick Beaton (1985 & 1991) has completed two studies assessing the impact of land use restrictions on recreational property values. The first study in 1985 assessed the impact of Chesapeake Bay Conservation Zone in Maryland. In a study of only developed parcels, Beaton found that the variable measuring designation as a conservation zone had a significant positive relationship with land value. He also concluded that distance from the water was a major determinant of the degree to which the conservation zone impacted value. He demonstrated that lots closest to the water benefited most from the designation.

A later study by Beaton in 1991 examining the impacts of land use restrictions in the New Jersey Pinelands was much more comprehensive. He collected two separate data sets, one set of sales values and attributes for developed parcels and one set of sales values and attributes for undeveloped parcels. Beaton's study area was also unique in that the legislation had varying degrees of restrictions. The restrictions where less or more stringent depending upon location in the Pinelands area. Beaton used dummy variables in his multiple regression analysis to measure the impact of differing levels of restriction on value. In short, Beaton found that developed parcels in the most restrictive areas had a significant and positive relationship with value and benefit the most from the Pinelands restrictions. Meanwhile, undeveloped parcels in the most restrictive Pinelands zone had a significant negative relationship with value and suffered the most from Pinelands preservation.

Similar to Beaton's analyses described above, the following study uses the hedonic model to explain variation in recreational property values. The presence of legislative restriction on a parcel is considered to be a component of a property's site quality that may or may not have a positive impact on land value. Previous research suggests that it is imperative that any assessment of the impact of land use legislation on property values should examine the impacts on both developed and undeveloped parcels. Therefore, following the research design proposed by Beaton, the impacts of the Michigan coastal zone statutes are assessed for both developed and undeveloped parcels. Prior research has shown a definite negative impact on the value of undeveloped land. However, studies of developed parcels have been inconclusive. Beaton, Frech, and Lafferty found positive relationships between value and land use restrictions for developed parcels. Damianos, Shabaman, and Muckleston found no relationship between land use restrictions and property values.

Table 1
Independent Variables and Expected Relationship With the Dependent Variable VALUE

Structural Variables	
SQFTHOUS- The size of a home measured in square feet.	+
AGE- The number of years since a home was Built.	-
LOTSIZE- Size of lot measured in square feet.	+
DEPTH- Distance in feet from the land-ward edge of the parcel to the water.	+
FRONTAGE- Distance in feet along the lake front.	+
Locational Variables	
DISTLAH-Manhattan distance measured in feet from the driveway of a parcel to the nearest limited access highway.	-
ADJVAC- A dummy variable coded 1 if there is adjacent vacant property and 0 if there is not.	+
Site Quality Variables	
BEACHWID- Width of beach measured in feet	+
BLUFFHEI- Height of a bluff above Lake Michigan measured in feet.	-
SETBACKB- Distance in feet from bluff to lakeward edge of home	+
SETBACKW- Distance in feet from the shoreline to the lake-ward edge of a home. For undeveloped parcels distance from the shore to the bluff line.	+
Legislative Variables for Developed Parcels	
CRITICAL – A dummy variable coded 1 if the parcel is designated as part of a critical dune are and 0 if it is not.	+
SETBKSD – A dummy variable coded 1 if the parcel has setback requirements for the high risk erosion area program, and 0 if it does not.	+
Legislative Variables for Undeveloped Parcels	
CRITICAL – A dummy variable coded 1 if the parcel is designated as part of a critical dune are and 0 if it is not.	-
SETBKSD – A dummy variable coded 1 if the parcel has setback requirements for the high risk erosion area program, and 0 if it does not.	-

Model Overview

In the previous section I outlined the hedonic model for describing variations in land value. I also summarized the relevant studies assessing the impact of land use restrictions on property values. In this section I will formally introduce the hypothesis to be tested in subsequent statistical analysis. The hedonic model is based on the assumption that property is composed of bundles of attributes, the sum of which describe the value of a property. These attributes can be categorized into three distinct types: structural characteristics, locational characteristics, and site quality characteristics. The following hypotheses are derived from the hedonic model $V_i = V(S_i, L_i, Q_i)$ introduced in the previous section. The value of a parcel, Vi is the sum of structural characteristics S_i, locational characteristics, L_i, and site quality characteristics, Q_i. Two hedonic models are proposed; one for improved parcels and another for unimproved parcels. A description of all independent variables introduced in the model and their expected relationship with land value is presented in table 1 above. The hedonic model for developed Lake Michigan fronted parcels can be stated as follows:

$$Vi = V((S_i\, sqfthouse + age + lotsize + depth + frontage) + (L_i\, distlah + adjvac) + (Q_i\, beachwid + bluffhei + setbackh + setbackw + critical + setbksd)$$

Since no structural attributes relating to a home exist for undeveloped parcels the hedonic model for undeveloped Lake Michigan fronted parcels is described as:

$$Vi = V((S_i\, lotsize + depth + frontage) + (L_i\, distlah + adjvac) + (Q_i\, beachwid + bluffhei + setbackw + critical + setbksd)$$

All variables and their hypothesized relationship with land value will be described in the next sections.

Structural Hypothesis

The first structural variable introduced is the square footage of a home. It can easily be assumed that consumers will value additional square footage. Therefore, it is hypothesized that:

H1: The square footage of a house will have a positive significant relationship with value.

The second structural variable to be tested is the age of a home. It is assumed that property owners prefer to have a newer home than an older one unless it is a unique structure or has historic values. The following hypothesis will be tested in regards to age of a structure:

H2: Newer homes are more valuable. Age of a home will have a significant negative relationship with land value.

Another structural component of land value is the lot size of a parcel. Once again it can be easily assumed that landowners will value larger parcels over smaller ones. Lot sizes are also an important in the context of the Michigan coastal zone restrictions. A larger lot size can potentially indicate greater protection from erosion. Larger lots also may have more potential developable sites if restrictions are in place. It is therefore hypothesized that:

H3: Lot size will have a positive relationship with land value. Larger lots increase land value.

An additional important structural component of land value is the depth of a parcel. Consumers would probably choose frontage over depth. However, with the threat of an eroding shoreline, and the possibility of setback restrictions, depth is hypothesized to be an important component of land value. This study proposes:

H4: Depth is positively related to land value. Increases in lot depth will increase land value.

The final structural component of land value is frontage. This variable has the most obvious aesthetic appeal and requires little summary. This study hypothesizes that:

H5: Frontage has a positive relationship with land value. More frontage means more value.

Locational Hypothesis

In addition to structural variables this analysis will test variables measuring the locational component of the hedonic model. The first locational variable described is distance from a limited access highway. The majority of homes along the shoreline of southeastern Lake Michigan are secondary, recreational residences. Many landowners commute to these homes on the weekends from Chicago, Detroit, Grand Rapids and other cities. Some are dual-purpose residences from which from which owners may commute one or more days each week. Distance from a limited access highway is intended to provide a measure of a site's accessibility. It can be assumed that recreational property owners value ease of accessibility. Therefore, I hypothesize:

H6: Distance from a limited access highway has a negative relationship with land value. As distance from a limited access highway increases, value decreases.

The other locational variable describing land value to be tested is the presence of adjacent vacant land. This variable is borrowed from research cited earlier by Wertheim, Jividen, Chatterjee, and Capen (1992). It is plausible that consumers would value a pristine natural look of undeveloped lands as opposed to additional development. It is thus hypothesized that:

H7: Presence of adjacent vacant property is well regarded and has a positive relationship with land value.

Site Quality Hypothesis

The remaining variables to be tested relate to the site quality component of land value. The first measure of site quality, beach width, is borrowed from research done by Pompe and Rhinehart (1995). Beach width is an important measure of site quality. In the case of Lake Michigan, wider beaches indicate a greater degree of protection from erosion. Wider beaches also have a pure aesthetic appeal. Surveys have indicated that beach goers value a wider beach (Lindsay, Halsted, Tupper, and Vaske 1992). It is therefore hypothesized that:

H8: Beach width is a significant component of recreational land value. Wider beaches will have a positive relationship with land value.

A second site quality variable, bluff height, is intended to give a measure of topography of a site. The variable is also intended as a partial measure of the accessibility of a lot to the water's edge. As mentioned previously, earlier hedonic models developed to describe variation in water fronted recreation properties have strangely ignored the importance of topography as a measure of a site's quality. Moreover, bluff height is an important measure given the importance of slope and high bluffs in determining the degree of restriction in the coastal zone management programs. Thus, it is hypothesized that:

H9: Bluff Height has a negative relationship with land value in the Lake Michigan Coastal Zone, when bluff heights increase land value decreases.

Legislative Hypothesis

It was suggested earlier in the study that to truly assess the impacts of land use restrictions, developed and undeveloped parcels should be included in the data evaluation. For this analysis, variables will be tested on a data set of developed parcels and undeveloped parcels. Previous hypothesis are applicable to either data set. All subsequent hypothesis are specific to developed or undeveloped parcels. The obvious exceptions are age and square footage of a home. Since undeveloped parcels do not have housing units, these two measures do not apply.

The setback of a home from the bluff is an important measure of site quality for developed parcels. The setback of a home from the bluff is intended as a partial measure of the home's protection from active erosion. Homes further away from the bluff are obviously safer from the erosion hazard. Therefore, the following hypothesis will be tested:

H10: The distance of a home away from a bluff will have a positive relationship with value.

An additional site quality measure is setback distance from the water. This variable is present in both data sets, but has slightly different descriptions in each. For developed parcels the setback distance from the water is the distance of the home to the water's edge. This variable is intended to provide another partial measure of a home's vulnerability to erosion. Another potential interpretation of the intent of the variable is to assess the accessibility of a housing unit to the water amenity. It should be noted that at a certain distance the setback of a home may not be valued if it prevents occupants views of the lake. However, in the context of this study it is hypothesized:

H11: The distance of a site from the water's edge will have a positive relationship with land value.

For undeveloped parcels, the setback distance from the water is the distance from the water's edge to the bluff line on a lot. The intent of this measure is to predict the distance a new structure, if it were built, would be from the water's edge, the idea being to estimate the relative threat of erosion a new structure would face. Therefore, it is hypothesized that:

H12: The setback distance of an undeveloped parcel's bluff line has a positive relationship with land value.

The remaining hypotheses relate specifically to the presence of two pieces of legislation under scrutiny. As stated earlier, regulation has been shown to impact developed parcel's land value differently than land value for undeveloped parcels. Due to the costs associated with developing a vacant parcel, the presence of regulations is expected to negatively impact the land value of undeveloped parcels. This study hypothesizes:

H13: The presence of setback requirements mandated by the high risk erosion program will have a negative relationship with land value for undeveloped parcels.

Similarly this study hypothesizes:

H14: The designation of a parcel as critical dune will have a negative relationship with land value for undeveloped parcels.

Developed parcels are expected to have a positive relationship with land value. This contradicts the expectations of property owners discussed earlier. The expectation that land use restrictions will have a positive impact on developed parcel land values is a result of findings by Frech, Lafferty and Beaton discussed earlier. This outcome is plausible given the hypothesized impact of restrictions on undeveloped parcels. The substantial cost associated with developing restricted vacant lots makes already developed parcels in restricted areas more valuable. Existing structures on developed parcels built prior to the enactment of the legislation may have been built in a location, or used a technique which is no longer permissible. This creates a category of land that is essentially unique. As a result I hypothesize that:

> *H15: The presence of setback requirements by the high risk erosion area program will have a positive relationship with land values of developed parcels.*

Similarly I hypothesize that:

> *H16: The designation of a parcel as critical dune will have a positive relationship with land values of developed parcels.*

It should be noted that the legislative variables are binary. A variable can only have a value of 1 if restrictions are in place or zero if they are not. The viability of the above hypothesis will be tested using regression analysis in the next chapter.

Chapter IV
Analyses and Results

This study will employ regression analysis to test the relationship between the independent variables generated by the hedonic model and the dependent variable assessed lot value. This chapter will first describe the data sources and study area. Next the analyses for testing the hypothesis in the previous chapter will be described and results presented. Finally the limitations of the study will be discussed.

Study Area and Data Sources

The study area for this analysis is the shoreline of Ottawa County, Michigan. Ottawa County is located on the Eastern Shore of Lake Michigan approximately thirty miles west of the City of Grand Rapids (Figure 3). Interstate 96 intersects the northern section of the county connecting Grand Rapids with Muskegon. Interstate 196 intersects the southern portion of the county. The only major north/south highway is U.S. 31 which travels roughly parallel to the Lake Michigan shoreline. Ottawa County proved to be the ideal study area due to the abundance of critical dune areas, and the availability of current tax assessment records, as well as accurate and current cadastral maps. Ottawa County also has a high percentage of water-fronted parcels that currently are developed, as well as a suitable number of parcels that remain undeveloped.

The data necessary to conduct this analysis was gathered from a variety of sources. Cadastral maps containing parcel identification numbers and boundaries were obtained from the Ottawa County land description office. A systematic sampling scheme was utilized for developed parcels so that every fourth lake fronted lot was initially selected. Some of the sampled developed parcels had to be removed due to incomplete data or because measurements from photos or maps were difficult to obtain. The final developed parcel data set numbered 274.

The number of undeveloped parcels along the lakefront in Ottawa County is much smaller than developed parcels. Consequently, another sampling approach was required to gather a representative sample of undeveloped parcels in Ottawa. A systematic

Figure 3
Map of Ottawa County

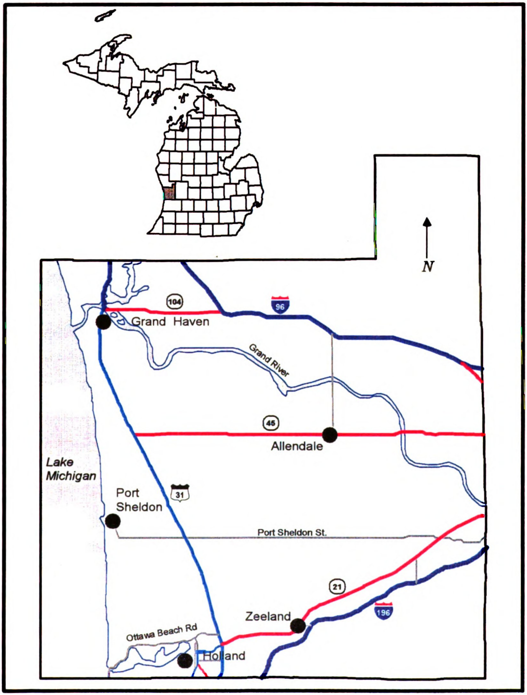


Figure 4:
Distribution of Sampled Developed Parcels Northern Ottawa County

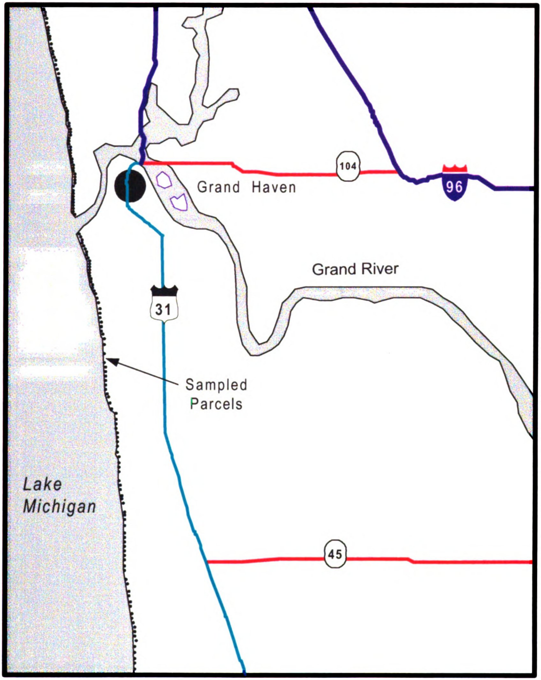


Figure 5:
Distribution of Sampled Developed Parcels Southern Ottawa County

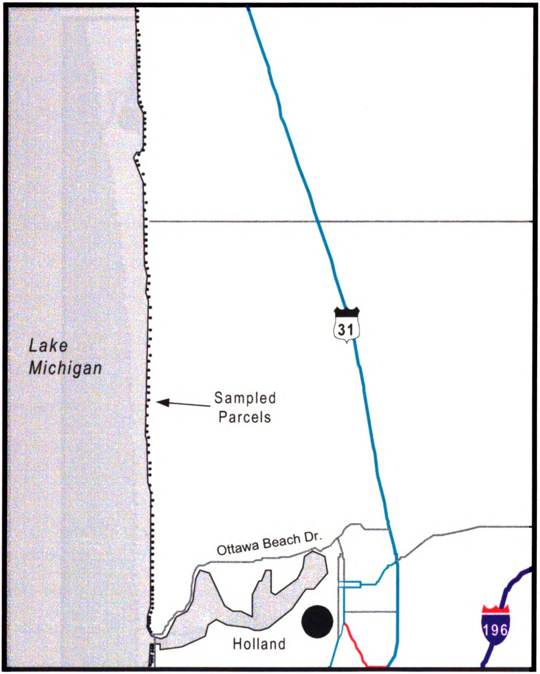
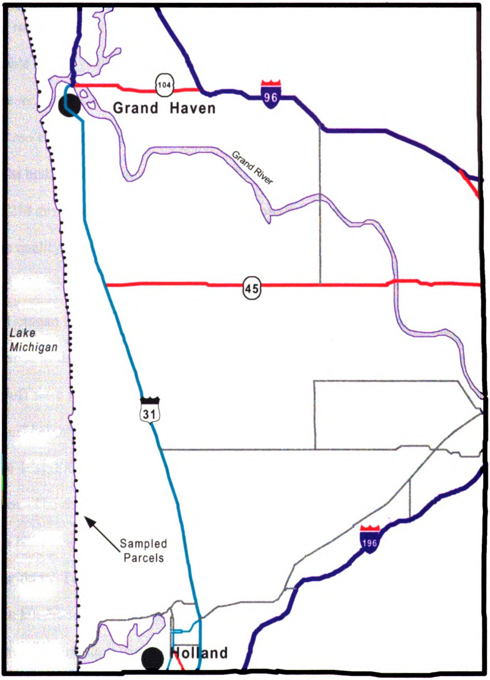


Figure 6
Distribution of Sampled Undeveloped Parcels



random sampling scheme was used. A minimum of two undeveloped parcels were selected for analysis from each quarter section of a township. In some cases only two undeveloped parcels occurred in a quarter section so both were selected. Some parcels had to be removed due to incomplete data. The final undeveloped parcel data set contained 76 observations.

The values for the dependent variable assessed parcel value were obtained from tax assessment records at the township and city assessment offices. Assessed property values were available for the 1995 tax year. It should be noted that these values are not actual sales data. However, assessment values are based on recent sales in the area (David, 1968). The assessment records also provided the square footage of the home as well as the year a structure was built. After some parcels were left out due to incomplete data, a final sample containing 274 developed parcels, and 76 undeveloped parcels remained.

Site quality variables were measured from color panchromatic air photos at a scale of 1:5,000 flown in April of 1989. These "natural" color photos were obtained from the Michigan Department of Environmental Quality. Measurements for beach width, distance of the home from the edge of the water, and the distance of the home from the bluff were taken from these photos based on the nominal scale of the imagery. Data for bluff height was compiled from the aerial photos and U.S.G.S. topographic maps at a scale of 1:24,000. The location of a given parcel's bluff line was located on the aerial photos. The corresponding location was then determined on the topographic map for which a bluff height estimate could be made by interpolating a point value between two contour lines. Topographic maps and the Michigan County Atlas were used to measure the Manhattan Distance in feet from a parcel to U.S. 31, the nearest limited access highway. Variable selection was guided by evidence from previous studies and data availability.

Regression Analysis

The methodology for this analysis will proceed in four phases. First, bivariate analyses will be presented regressing each independent variable for both data sets against value. Many earlier hedonic models of land value have simply presented the results of a multivariate regression analysis. Following the lead of Wertheim, Jividen, Chatterjee, and Capen (1992), this study presents the results of the bivariate regression analyses first. The results of the bivariate equations will give an initial indication of variables which strongly influence value as well as affording greater explanatory power in describing issues in subsequent analyses. After presenting the bivariate results, a multivariate regression model will be developed for both data sets to assess the impacts of multiple independent variables. The next step will be to utilize stepwise regression analyses to generate the best set of independent variables for both data sets. Finally, further regression equations will be tested to assess the impact of coastal zone legislation on property values.

Tables 2 and 3 present the descriptive statistics for both developed and undeveloped parcels. In both data sets the standard deviations for both LOTSIZE and VALUE are quite large indicating a wide degree of variance for both variables. The standard deviation for BLUFFHEI is quite small. The small value, 16.42, suggests that variance in relief is quite modest. However, since changes occur over such a small distance adjacent to the shore, a difference of only 16 feet could represent a significant obstacle in accessing Lake Michigan.

Table 2
Descriptive Statistics for Developed Parcels

Variable	Mean	Standard Deviation
VALUE	152412.639	130127.181
BLUFFHEI	619.755	16.425
BEACHWID	65.303	38.301
LOTSIZE	69358.876	197810.379
DEPTH	488.668	303.730
FRONTAGE	106.270	92.071
AGE	35.088	23.373
SQFTHOUS	1388.661	692.038
SETBACKB	57.109	76.886
SETBACKW	181.022	90.782
DISTLAH	23622.646	12681.677
CRITICAL	0.850	0.357
SETBKSD	0.726	0.447

Table 3
Descriptive Statistics for Undeveloped Parcels

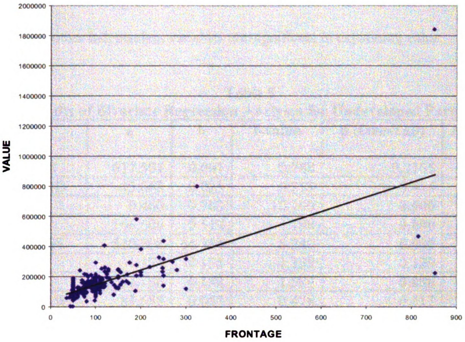
Variable	Mean	Standard Deviation
VALUE	81345.789	113989.233
BLUFFHEI	619.5	16.838
BEACHWID	86.447	63.128
LOTSIZE	72163.434	188988.314
DEPTH	489.355	353.84
FRONTAGE	118.053	148.692
DISTLAH	21732.895	12749.94
SETBACKW	136.355	75.641
CRITICAL	0.697	0.462
SETBKSD	0.737	0.434

Regression analysis was conducted using the statistical software package SYSTAT. The dependent variable assessed lot value was regressed against each independent variable for both data sets. The results of the bivariate analyses are presented in tables 4 and 5 below. For the purposes of this analysis, an independent variable is considered to be statistically significant if the coefficient value achieves the 95% confidence level for a one-tailed test, and the direction of the relationship, positive or negative, between the dependent and independent variables is as hypothesized in the preceding chapter. For developed parcels 9 of 13 variables had significant relationships with VALUE in the predicted direction. The adjusted squared mulitple R values are relatively small with the exception of the structural specific attributes of lot size, frontage and housing square footage. A bivariate plot showing the relationship between VALUE and FRONTAGE is shown in figure 6 below. There is an obvious positive relationship between the two variables. However, there is not a clear linear relationship, but probably a log-linear relationship. This relationship may introduce heteroscedasticity into the multiple regression analyses. Appendix A contains the bivariate plots for the other independent variables in the developed parcel data set. None of the site quality variables were significant, including the variables collected to account for the presence of restrictions.

Table 4
Results of Bivariate Regression Analyses for Developed Parcels

Variable	a	B	t-value	p (One-Tail)	Adj. R^2
BLUFHEI	-227.120	-0.029	-0.473	0.3185	0.001
BEACHWID	-54.046	-0.016	-0.262	0.3965	0.000
LOTSIZE	0.350	0.532	10.368	**0.0000**	0.281
DEPTH	115.103	0.269	4.600	**0.0000**	0.069
FRONTAGE	971.830	0.688	15.619	**0.0000**	0.471
AGE	-1651.884	-0.297	-5.124	**0.0000**	0.085
SQFTHOUS	127.017	0.675	15.109	**0.0000**	0.454
SETBACKB	318.129	0.188	3.156	**0.0010**	0.032
SETBACKW	278.376	0.194	3.265	**0.0005**	0.034
DISTLAH	-1.128	-0.110	-1.824	**0.0345**	0.008
ADJVAC	38513.788	0.106	1.754	**0.0405**	0.008
CRITICAL	-7256.047	-0.020	-0.329	0.3715	0.000
SETBKSD	-13455.045	-0.046	-0.763	0.2230	0.000

FIGURE 7
FRONTAGE Plotted Against VALUE



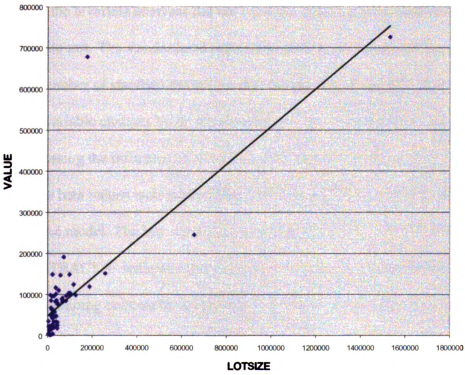
The results of the bivariate analyses for undeveloped parcels were less impressive. Only 4 of 10 independent variable had significant relationships with VALUE in the expected direction. Three structural variables lot size, depth, and frontage all had relatively large adjusted squared multiple R-values. A bivariate plot showing the relationship between VALUE and LOTSIZE is shown in figure 7 below. The plot demonstrates a clear positive relationship between the two independent variables. Unfortunately, the relationship is evidently not linear, and could introduce heteroscedasticity into subsequent regression analyses. Additional Bivariate plots for the remaining independent variables in the undeveloped parcel data set are shown in Appendix B.

It is interesting to note that the variable ADJVAC was significant with VALUE in both the developed and undeveloped data sets. These relationships confirm that the presence of adjacent vacant lands are an important measure of locational quality. Further tests using multivariate regression analysis will determine whether presence of these variables with other independent variables are significant in explaining value.

Table 5
Results of Bivariate Regression Analyses for Undeveloped Parcels

Variable	a	b	t-value	p (One-Tail)	Adj. R^2
BLUFFHEI	617.501	0.091	0.788	0.2165	0.008
BEACHWID	45.663	0.025	0.218	0.414	0.001
LOTSIZE	0.460	0.763	10.160	**0.000**	0.577
DEPTH	166.609	0.517	5.198	**0.000**	0.258
FRONTAGE	530.308	64.354	8.240	**0.000**	0.471
DISTLAH	-1.174	-0.131	-1.139	0.129	0.004
ADJVAC	41657.756	0.182	1.589	**0.058**	0.020
SETBACKW	83.585	0.055	0.478	0.317	0.003
CRITICAL	8489.877	0.034	0.296	0.384	0.000
SETBKSD	16009.929	0.062	0.537	0.296	0.000

FIGURE 8
LOTSIZE Plotted Against VALUE



A standard multivariate regression analysis was also conducted for both data sets using SYSTAT. The multiple regression equation for developed parcels can be stated as:

$Y\ VALUE = a + b_1\ BLUFFHEI + b_2\ BEACHWID + b_3\ LOTSIZE + b_4\ DEPTH + b_5\ FRONTAGE + b_6\ AGE + b_7\ SQFTHOUS + b_8\ SETBACKB + b_9\ SETBACKW + b_{10}\ DISTLAH + b_{11}\ ADJVAC + b_{12}\ CRITICAL + b_{13}\ SETBKSD$

For undeveloped parcels the equation can be stated as:

$Y\ VALUE = a + b_1\ BLUFFHEI + b_2\ BEACHWID + b_3\ LOTSIZE + b_4\ DEPTH + b_5\ FRONTAGE + b_6\ DISTLAH + b_7\ ADJVAC + b_8\ SETBACKW + b_9\ CRITICAL + b_{10}\ SETBKSD$

The results of the two standard multivariate analyses are presented in tables 6 and 7 below. For developed parcels the multivariate process produced 6 of 13 significant independent variables. Note that DEPTH, SEBACKW, and ADJVAC which were significant in the bivariate analyses did not meet the expected 95% confidence criteria for the multivariate test. The standardized regression coefficient values (or beta values) indicate the number of standard deviations that the dependent variable changes when an independent variable changes by on standard deviation. Thus, the beta values are a means of assessing the influence of an independent variable on the overall regression equation. The beta values indicate that SQFTHOUS and FRONTAGE have considerable influence in the model. The low tolerance values for LOTSIZE, FRONTAGE, and especially SETBACKW indicate some degree of co-linearity among the independent variables. Examining colinearity is important because extreme amounts may bias the interpretation of individual regression coeffiecients. The adjusted squared multiple R was a reasonable 0.652 indicating that the standard multivariate model accounts for 65%

of the variation in assessed values for improved lands.

Table 6
Results Multiple Regression Analysis of Developed Parcels

DEP VAR: VALUE	N: 274	MULTIPLE R: 0.818	SQUARED MULTIPLE R: 0.668			
ADJUSTED SQUARED MULTIPLE R: .652			STANDARD ERROR OF ESTIMATE: 76781.308			
VARIABLE	**COEFFICIENT**	**STD ERROR**	**STD COEF**	**TOLERANCE**	**T**	**P (1 Tail)**
CONSTANT	259549.521	220395.699	0	-	1.178	0.120
BLUFFHEI	-476.757	371.655	-0.06	0.58	-1.283	0.1005
BEACHWID	-89.484	203.7	-0.026	0.355	-0.439	0.3305
LOTSIZE	0.059	0.036	0.09	0.424	1.632	**0.052**
DEPTH	27.746	18.859	0.065	0.658	1.471	0.071
FRONTAGE	538.598	78.891	0.381	0.409	6.827	**0.000**
AGE	-532.414	220.328	-0.096	0.814	-2.416	**0.008**
SQFTHOUS	76.764	8.213	0.408	0.669	9.347	**0.000**
SETBACKB	-162.477	152.167	-0.096	0.158	-1.068	0.1435
SETBACKW	304.511	146.004	0.212	0.123	2.086	**0.019**
DISTLAH	-0.977	0.475	-0.095	0.595	-2.057	**0.0205**
CRITICAL	5682.678	16001.69	0.016	0.66	0.355	0.3615
ADJVAC	7773.289	13932.197	0.021	0.871	0.558	0.2885
STBACKSD	3611.371	12420.369	0.012	0.702	0.291	0.3855

ANALYSIS OF VARIANCE

SOURCE	**SUM-OF-SQUARES**	**DF**	**MEAN-SQUARE**	**F-RATIO**	**P**
REGRESSION	.308994E+13	13	.237687E+12	40.318	0.000
RESIDUAL	.153280E+13	260	.589537E+10		

The multiple regression analysis of undeveloped parcels produced only two significant variables, LOTSIZE and FRONTAGE. The lower tolerance values among the significant independent variables indicates some problems with co-linearity. The standardized regression coefficient values indicate, not surprisingly, that LOTSIZE and FRONTAGE are the most influential variables in the equation. The adjusted squared multiple R value indicates that 58% of the variation of unimproved assessed values are explained by this model. Clearly, the data for predicting the value of developed parcels is a better fit than the undeveloped parcel data set. Neither multivariate equations produced any significant site quality variables. Specifically, the dummy variables measuring the presence of the two statutes are not close to significance.

Table 7
Results of Multiple Regression Analysis for Undeveloped Parcels

DEP VAR: VALUE	N: 76	MULTIPLE R: 0.800		SQUARED MULTIPLE R: 0.640		
ADJUSTED SQUARED MULTIPLE R: .585			STANDARD ERROR OF ESTIMATE: 73456.582			
VARIABLE	**COEFFICIENT**	**STD ERROR**	**STD COEF**	**TOLERANCE**	**T**	**P (1 Tail)**
CONSTANT	74456.554	366834.96	0	.	0.203	0.42
BLUFFHEI	-43.972	603.273	-0.006	0.697	-0.073	0.471
BEACHWID	-139.48	300.079	-0.077	0.2	-0.465	0.322
LOTSIZE	0.271	0.082	0.449	0.303	3.32	**0.0005**
DEPTH	42.233	32.855	0.131	0.532	1.285	0.1015
FRONTAGE	244.674	95.235	0.319	0.359	2.569	**0.006**
DISTLAH	-0.57	0.798	-0.064	0.695	-0.715	0.2385
CRITICAL	-3583.073	24238.549	-0.015	0.573	-0.148	0.4415
ADJVAC	8644.389	19305.937	0.038	0.781	0.448	0.328
SETBACKW	-75.782	254.235	-0.05	0.195	-0.298	0.3835
SETBKSD	-1781.054	24466.955	-0.007	0.612	-0.073	0.471

ANALYSIS OF VARIANCE

SOURCE	**SUM-OF-SQUARES**	**DF**	**MEAN-SQUARE**	**F-RATIO**	**P**
REGRESSION	.623784E+12	10	.623784E+11	11.560	0.000
RESIDUAL	.350732E+12	65	.539587E+10		

Stepwise Regression Analyses

The next research process utilized stepwise multiple regression analyses to determine which independent variables representing the hedonic model best describe variation in value. Use of the stepwise process is somewhat controversial. Wilkinson, Blank, and Gruber (1996) caution against using the stepwise model claiming that it has been used in a "mindless fashion." A major problem with the stepwise process is that it never evaluates all possible combinations of independent variables. Therefore, there is no guarantee that the stepwise model will produce the highest adjusted squared multiple R value for a given set of independent variables. In addition, while several possible models may be possible, the stepwise process will output only one. Despite these limitations, Wilkinson, Blank, and Gruber acknowledge some benefits of using the stepwise process. In cases, such as this study, where there are a large number of independent variables and the researcher needs an objective means to "sort" through them, the stepwise process is preferable. An additional benefit of the stepwise process is that it provides the user the ability to specify acceptable significance levels (alpha level) as well as acceptable amounts of co-linearity (tolerance). Therefore, if the stepwise process is used with caution it is possible that the researcher can discover the best set of independent variables to account for variation in the dependent variable.

In the stepwise analyses conducted below all variables for both data sets were initially entered into the process. The minimum tolerance allowed for entry into the equation was .4. This is a lenient value accepting that some co-linearity will be present in the output. The significance level requirement for entry into the equation was .08 for a one-tailed test. The results of the stepwise process are summarized in table 8 and 9 below.

The stepwise process for developed parcels produced a slightly better model than the general multivariate output from the preceding section. The stepwise test produced 6 out of 13 variables with significant coefficient values as well as a high adjusted squared multiple R value of 0.655. In addition, the direction of the relationship for all six variables was in the hypothesized direction.

Table 8
Results of Stepwise Multiple Regression Analysis for Developed Parcels

DEP VAR: VALUE	N: 274	MULTIPLE R: 0.816		SQUARED MULTIPLE R: 0.666		
ADJUSTED SQUARED MULTIPLE R: .655		STANDARD ERROR OF ESTIMATE: 76422.620				
VARIABLE	**COEFFICIENT**	**STD ERROR**	**STD COEF**	**TOLERANCE**	**T**	**P(1-Tail)**
CONSTANT	163855.5	187167.4	0.0	-	0.875	0.191
BLUFFHEI	-288.406	310.681	-0.036	0.822	-0.928	0.177
LOTSIZE	0.061	0.036	0.093	0.431	1.714	**0.044**
DEPTH	24.218	18.284	0.057	0.694	1.324	0.093
FRONTAGE	535.935	78.155	0.379	0.413	6.857	**0.0**
AGE	-547.629	216.654	-0.098	0.834	-2.528	**0.006**
SQFTHOUS	76.173	8.092	0.405	0.682	9.413	**0.0**
SETBACKW	172.826	54.346	0.121	0.879	3.18	**0.001**
DISTLAH	-1.054	0.428	-0.103	0.726	-2.462	**0.007**
ADJVAC	8936.53	13624.03	0.025	0.902	0.656	0.256

ANALYSIS OF VARIANCE					
SOURCE	**SUM-OF-SQUARES**	**DF**	**MEAN-SQUARE**	**F-RATIO**	**P**
REGRESSION	.308086E+13	9	.342318E+12	58.612	0.000
RESIDUAL	.154187E+13	264	.584042E+10		

The model generated from the stepwise process for undeveloped parcels was not as meaningful. The same tolerance and significance levels specified for the developed parcels stepwise process were utilized for the analysis of undeveloped parcels. The undeveloped stepwise model produced only one significant independent variable with a relationship in the expected direction. Surprisingly, FRONTAGE, which had been significant in the multivariate equation, dropped out of the stepwise model. The dummy variables measuring the presence of restrictions were insignificant in both the developed and the undeveloped parcels data sets. Analysis of the restriction variables impact on other independent variables will be conducted in the next section.

Table 9
Results of Stepwise Multiple Regression Analysis for Undeveloped Parcels

DEP VAR: VALUE	N: 76	MULTIPLE R: 0.777	SQUARED MULTIPLE R: 0.603			
ADJUSTED SQUARED MULTIPLE R: .569			STANDARD ERROR OF ESTIMATE: 74877.457			
VARIABLE	**COEFFICIENT**	**STD ERROR**	**STD COEF**	**TOLERANCE**	**T**	**P(1-Tail)**
CONSTANT	58712.993	27671.606	0	-	2.122	0.0185
LOTSIZE	0.407	0.062	0.674	0.544	6.557	0.0
FRONTAGE	42.646	33.423	0.132	0.534	1.276	0.103
DISTLAH	-0.742	0.775	-0.083	0.766	-0.958	0.1705
CRITICAL	-10652.92	21515.592	-0.043	0.755	-0.495	0.311
ADJVAC	17281.341	18847.378	0.075	0.852	0.917	0.181
SETBACKW	-82.871	132.695	-0.055	0.742	-0.625	0.267

ANALYSIS OF VARIANCE					
SOURCE	**SUM-OF-SQUARES**	**DF**	**MEAN-SQUARE**	**F-RATIO**	**P**
REGRESSION	.587658E+12	6	.979430E+11	17.469	0.000
RESIDUAL	.386858E+12	69	.560663E+10		

Assessing Slope Dummy Variables

Another approach to determine the impact of the legislation on land value is to test whether the presence of a restriction impacts the relationship between VALUE and other independent variables. Given the zoning restrictions outlined by the two pieces of legislation it is likely that the relationship between VALUE and LOTSIZE, FRONTAGE, and DEPTH will be influenced depending upon the presence or absence of restrictions. For example a bigger lot should be more valuable in restricted areas than in areas without restrictions. Larger lots have more potential locations to build a new structure as well as more siting possibilities to relocate an existing structure or to build an addition. The possibility of these relationships can be tested for by using a multiplicative (slope) dummy variable (Neter and Wasserman 1974). In the model VALUE = a + b1(LOTSIZE) + b2 (CRITICAL * LOTSIZE), suggests that CRITICAL influences the effect of LOTSIZE on VALUE. It also implies that there can be different slope values for CRITICAL = 0 and CRITICAL = 1. When the dummy variable CRITICAL = 0, then the interaction term CRITICAL * LOTSIZE = 0, and therefore b2 is estimated to equal 0. However, when the dummy variable CRITICAL = 1, then the estimated regression coefficients on CRITICAL * LOTSIZE includes additional information only on the cases where CRITICAL = 1, or where restrictions are present. Thus, the multiplicative dummy variable will be used for estimation of a "slope effect" of the two dummy variables CRITICAL and SETBKSD on other independent variables.

Preliminary investigation of multiplicative dummies tested for the effects of CRITICAL and SETBKSD on FRONTAGE, DEPTH, and LOTSIZE. These independent variables are the most logical to test with CRITICAL and SETBKSD as slope dummy variables because of the implications of the bivariate analyses and the implications of the restrictions dictated by the coastal zone management programs. In the earlier bivariate regression analyses, FRONTAGE, DEPTH, and LOTSIZE were all highly significant and all had the three largest adjusted R^2 value for both data sets. These variables should reveal signs of an interactive effect with CRITICAL and SETBKSD given the zoning implications of the coastal zone programs. The degree to which the restrictions will effect a particular parcel are highly dependent upon the shape and configuration of that parcel. The results of the preliminary investigation showed a strong interactive effect between FRONTAGE * CRITICAL and FRONTAGE * SETBKSD. These multiplicative dummies will replace the intercept dummies CRITICAL and SETBKSD in further analyses. Therefore new hypothesis for testing the impacts of the legislation on developed parcels can be stated as follows:

H17: The presence of setback requirements mandated by the high risk erosion program on developed parcels will positively effect the relationship between FRONTAGE and VALUE .

*H17 will be accepted if b(SETBKSD * FRONTAGE) > b(FRONTAGE) .*

H18: The designation of a developed parcel as critical dune will positively effect the relationship between FRONTAGE and VALUE.

*H18 will be accepted if b(CRITICAL * FRONTAGE) > b(FRONTAGE).*

Similarly this study hypothesizes that:

H19: The presence of setback requirements mandated by the high risk erosion program on undeveloped parcels will negatively effect the relationship between FRONTAGE and VALUE.

*H19 will be accepted if b(Frontage) > b(SETBKSD * FRONTAGE) .*

H20: The designation of an undeveloped parcel as critical dune will negatively effect the relationship between FRONTAGE and VALUE.

*H20 will be accepted if b(Frontage) > b(CRITICAL * FRONTAGE).*

The results of the regression analyses using multiplicative dummies are displayed in tables 10 and 11 below. For the developed parcels data set the introduction of multiplicative dummies produced a set of variables highly significant in explaining value. The results of this regression demonstrate that water frontage has a higher degree of valuation in areas where parcels are designated as critical dune. The difference in standardized regression coefficient values demonstrates that frontage has nearly twice the degree of valuation in areas designated as critical dune. The regression results show the opposite impact for setbacks required by the high risk erosion area program. The presence of setback requirements actually makes frontage less valuable in those areas. The standardized regression coefficient for SETBKSD * CRITICAL is only .089 compared to .198 for FRONTAGE. Therefore, while hypothesis 17 can be accepted, hypothesis 18 must be rejected.

It should be noted that introduction of multiplicative dummies allowed substantial co-linearity into the equation. The co-linearity between FRONTAGE and the multiplicative dummies is expected. However, there seems to be a high degree of co-linearity between LOTSIZE and FRONTAGE as well. Despite the co-linearity problem the introduction of the multiplicative dummies to the set of variables output from the stepwise process produced a superior model. Nine of eleven variables have significant coefficient values in the expected direction. The adjusted squared multiple R value is an enhanced .698 indicating that 69% of the variation of value is accounted for the new model. However, the scattergram displayed in figure 8 shows that there are a several outlier cases, which may be causing undue leverage on the equation. A next step in this process would be to remove the outlier observations to see if a better fitting model is generated.

Figure 9
Developed Parcels Regression Scattergram Residual vs. Estimate

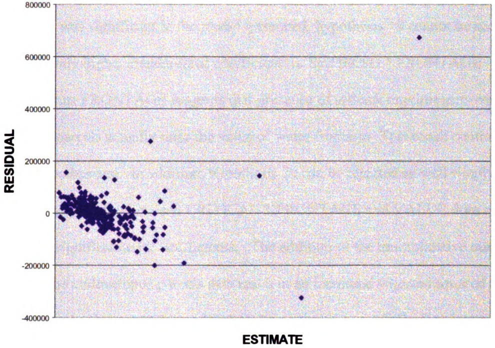


Table 10
Results of Multiplicative Dummy Regression Analysis for Developed Parcels

DEP VAR: VALUE	N: 274	MULTIPLE R: 0.841	SQUARED MULTIPLE R: 0.707			
ADJUSTED SQUARED MULTIPLE R: .698			STANDARD ERROR OF ESTIMATE: 71458.075			
VARIABLE	**COEFFICIENT**	**STD ERROR**	**STD COEF**	**TOLERANCE**	**T**	**P (1 Tail)**
CONSTANT	-22212.3	18983.55	0	-	-1.17	0.1215
LOTSIZE	-0.049	0.037	-0.074	0.353	-1.327	0.0093
FRONTAGE	278.743	81.28	0.197	0.334	3.429	0.0005
AGE	-613.645	201.95	-0.11	0.84	-3.039	0.0015
SQFTHOUS	73.73	7.575	0.392	0.681	9.733	0
SETBACKB	119.327	57.273	0.071	0.965	2.083	0.019
DISTLAH	0.042	0.384	0.004	0.79	0.109	0.4565
FRONTAGE *CRITICAL	588.599	97.631	0.39	0.264	6.029	0.0
FRONTAGE *STBACKSD	86.595	80.226	0.059	0.376	1.079	0.1405

ANALYSIS OF VARIANCE

SOURCE	**SUM-OF-SQUARES**	**DF**	**MEAN-SQUARE**	**F-RATIO**	**P**
REGRESSION	.326957E+13	8	.408697E+12	80.038	0.000
RESIDUAL	.135316E+13	265	.510626E+10		

The model generated from the multiplicative dummy equation for undeveloped parcels was not as meaningful. Although, the multiplicative variable SETBKSD * FRONTAGE was significant in the model generated, hypothesis 19 cannot be accepted. The significantly higher standardized coefficient for SETBKSD * FRONTAGE compared to just FRONTAGE suggests that presence of setback requirements on undeveloped parcels actually raise the value of water frontage. This result contradicts what was hypothesized. In addition, hypothesis 20 can be rejected as well simply because the relationship between CRITICAL * FRONTAGE and VALUE does not meet the specified significance for coefficients. The addition of the multiplicative dummy variables to the undeveloped parcels data result in an increased adjusted squared multiple R. Unfortunately, the results for undeveloped parcels are more difficult to interpret. A scattergram showing the regression residuals plotted against the regression estimate is shown in Figure 9. There are a few outlier cases that may be causing leverage problems however, the residuals appear to be homoscedastic.

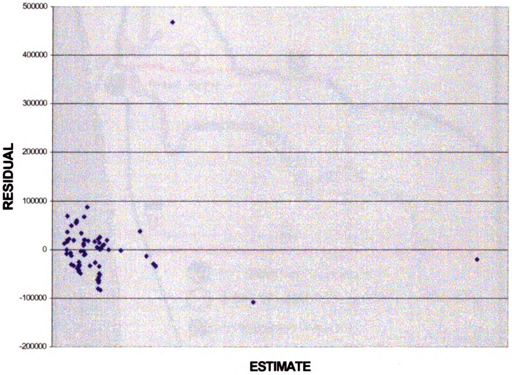
Table 11
Results of Multiplicative Dummy Regression Analysis for Undeveloped Parcels

DEP VAR: VALUE	N: 76	MULTIPLE R: 0.812		SQUARED MULTIPLE R: 0.659		
ADJUSTED SQUARED MULTIPLE R: .640		STANDARD ERROR OF ESTIMATE: 68436.322				
VARIABLE	**COEFFICIENT**	**STD ERROR**	**STD COEF**	**TOLERANCE**	**T**	**P(1-Tail)**
CONSTANT	13195.72	12151.43	0	.	1.086	0.1405
LOTSIZE	0.07	0.112	0.115	0.139	0.621	0.2685
FRONTAGE	231.315	96.544	0.302	0.303	2.396	**0.0095**
FRONTAGE *CRITICAL	-6.716	112.009	-0.008	0.249	-0.06	0.476
FRONTAGE *SETBKSD	446.193	151.9	0.477	0.183	2.937	**0.002**

ANALYSIS OF VARIANCE

SOURCE	**SUM-OF-SQUARES**	**DF**	**MEAN-SQUARE**	**F-RATIO**	**P**
REGRESSION	.641985E+12	4	.160496E+12	34.268	0.000
RESIDUAL	.332531E+12	71	.468353E+10		

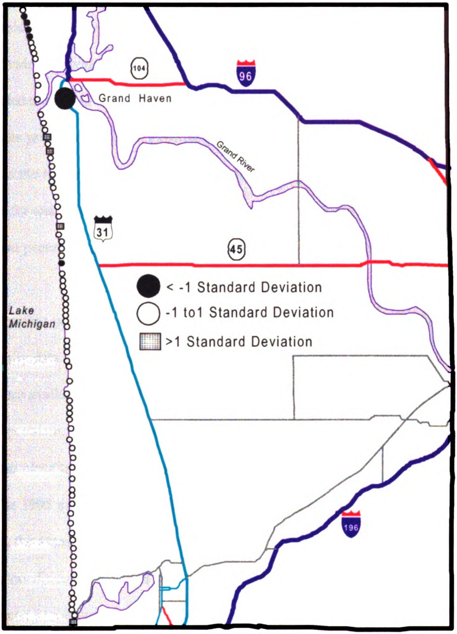
Figure 10
Undeveloped Parcels Regression Scattergram Residual vs. Estimate



Mapping of Residuals

Another investigation attempted in this study was the mapping of the residuals from the regression. Mapping of residuals can uncover spatial trends in the data not apparent in the raw statistical output. For instance, there may be spatial clusters of deviations from the regression, which require more in depth analysis. No clustering or obvious spatial pattern was detected from the map of developed parcels. However, the map of residuals for undeveloped parcels shown in figure 8 below did have a cluster of negative values along the northern portion of the shoreline. Some of the highest erosion rates in the county are found in this area. The cluster of negative values discovered on the map may be related to the severe erosion in the area.

Figure 10
Map of Residuals for Undeveloped Parcels



Assumptions and Limitations

A major assumption of this study involves the validity of the independent variable assessed lot value. The assessment process is intended to accurately reflect market value for property. Assessments are adjusted according to recent sale prices for homes in a given area. Some research has focused on errors in the assessment process. However, several studies justify and encourage using assessed values to approximate residential property value. David (1968) in a comparison of assessed values to actual sales price for lake fronted parcels in Wisconsin found assessed values did not significantly differ from actual sales price. In addition, Holway and Burby (1990) contend that use of assessment values has the further advantage of not constraining the number of parcels that can be collected for analysis in a given area. For the purpose of this study it is assumed that the assessment process accurately reflects the market value for lake front property in Ottawa County.

Another possibility for error is generated by temporal variations in data sources. Site amenity data were taken from the 1989 D.E.Q aerial photos. Assessed property values were available for the 1995 tax year. This six-year gap in data sources presents a potential problem. Storms could have eroded large beach areas. In addition, structures that appear close to the bluff line on the 1989 photos may have been moved back by 1995. The 1995 market values will reflect physical changes occurring since 1989. However, the assessment process, while representative of market forces, will reflect changing conditions at a slower rate. Assessment officials do not have the capacity to site inspect a property each year. Therefore, while a potential for error exists, it is safe to conclude that site conditions did not change drastically in a short span of time. Furthermore, any changes may not be yet reflected in the assessment records.

An additional limitation is the narrow time frame and study area of this analysis. The Coastal Zone Management programs affect 19 of 39 Michigan counties that border the Great Lakes. This study examines only one. Researchers (Schwartz and Zorn, 1986) suggest that growth control studies will benefit from the use of a series of time frames for analysis. Assessment records before 1990 were not easily available and prevented a time series analysis for this study. Since the land use restrictions for the Coastal Zone management programs have only been in effect since 1989, a substantial time frame for analysis does not exist. A final limitation is the use of dummy variables. While the use of dummy variables is useful, there is unavoidable introduction of co-linearity into the regression equation.

CHAPTER VI
Conclusions

In the hedonic model, land value is represented by varying levels of attributes describing the structural, locational, and site quality characteristics of a lot. This study developed a hedonic model for explaining lake fronted property value in Ottawa County, Michigan. Testable hypotheses were generated which assessed the relative importance of structural, locational, and site quality characteristics in predicting variations in land value for improved and unimproved lands. Additionally, variables measuring the impact of Michigan's coastal zone management programs were introduced and tested.

This study demonstrated, using regression analyses, that the hedonic model is a valid means of predicting variations in lake fronted property values. Multivariate regression analysis of developed parcels showed that variables describing structural, locational, and site quality attributes accounted for 69% of the variation in property value. In the case of undeveloped parcels locational and site quality factors accounted for 64% of the variation in property values. The presence of restrictions due to the Coastal Zone Management programs is clearly impacting property values as well.

The critical dune program is having a positive impact on land values for improved parcels. The multiple regression analyses presented in the previous chapter clearly showed that frontage has a higher degree of valuation in areas designated as critical dune. This conclusion is somewhat counterintuitive. As discussed in the introduction it is the assumption of many regulated landowners that designation will always have a negative impact on land value. However, the negative impacts of the legislation are simply not validated by previous research, or statistically in this analysis.

There are several ways the positive impacts might be explained. First and foremost are the increased development costs for unimproved lands. The presence of restrictions will make it more difficult to develop unimproved parcels. Therefore, existing improved lands in restricted areas become much more valuable. This explanation seems likely given that improved lands have structures built before the implementation of the regulations. These structures were more than likely built in locations or using techniques no longer permissible due to the legislation. In essence, the restrictions create unique pockets of development which cannot be replicated.

An additional explanation is the value of a slower rate of development. If new development is less likely to occur due to restrictions, more undeveloped land should remain in regulated areas. As suggested by previous studies, and by the significance of the variable ADJVAC in the bivariate analyses, consumers value adjacent vacant land. In an urban setting vacant land may not be valued. However, in a recreational context, vacant lands mean more trees, more wildlife, and more unspoiled views of the lake. Thus, a slower rate of development will have a positive effect for restricted improved lands.

Another explanation is the value of protection. Designation by the State of Michigan equates to protection of unique natural amenities. Land values should be higher in areas that the State of Michigan has identified as containing unique irreplaceable physical features. This could also explain why designation as critical dune positively effects developed land values but designation as high risk erosion does not. Designation as high risk has no positive connotations. Critical dune designation at least links a property to a treasured Michigan resource. The different implications of the legislation help explain why critical dune designation positively affects improved land value but high risk erosion designation does not.

The results of the analysis of undeveloped parcels is much more difficult to decipher. The hypothesis that presence of restrictions will have a significant negative relationship with value was not statistically validated in this analysis. The expectation that regulations will impact unimproved parcels negatively is intuitively appealing. The additional costs for permits, construction delays, and site mitigation issues should serve to drive the value of unimproved parcels down. In addition, there are no obvious positive effects that presence of the legislation could have on land value. While this analysis has been unsuccessful in demonstrating a negative relationship between land value and presence of restrictions on undeveloped parcels, the negative impacts of the legislation may exist. Beaton's study of the New Jersey Pinelands (1991) found that land values for undeveloped restricted lands fell immediately after the legislation was enacted, but rebounded slowly after several years. It is possible that a similar trend is occurring in Michigan. However, this analysis would be unable to detect that process.

Another explanation is the "ignorance is bliss theory." That is while owners of unimproved parcels may be aware that legislation impacts their parcel, they may not be aware of the full implications of the legislation as it relates to potential improvements. Moreover, buyers of unimproved lake fronted parcels may be unaware of the full implications of the restrictions as well. However, this belief may be somewhat flawed in that it assumes the only future use for undeveloped lands are residential. Some owners may have no intention of ever developing their lands for residential use.

The results of this study have important implications. First and foremost it presents policymakers with a statistically valid methodology to assess the impact of coastal zone restrictions in other parts of Michigan or elsewhere. More importantly, policymakers in Lansing have evidence which refutes the popular notion that regulation always results in lower property values. In the case of the Critical Dune program, this study determined that designation as Critical Dune raised the average value of a parcel by $337.47 per front foot for developed parcels. Therefore, a parcel with 100 feet of lake frontage which is designated as critical dune has $33,747 of additional value than the same lot which is not designated as critical dune. Meanwhile, property owners have evidence of economic harm caused by land use restrictions. In the case of the High Risk Erosion program the results indicate a negative impact for developed parcel holders. Lots designated as high risk are $148.13 less valuable per front foot than lots not designated. As a result lots with 100 feet of frontage have a difference of $14,813 depending on whether they are designated or non-designated.

Call For Future Research

To my knowledge no other studies exist which have attempted to assess the economic impacts of Michigan's coastal zone management programs. This study represents an initial probe into the question of whether coastal zone restrictions impact land values. Future studies should examine the effects of the legislation over time. By examining the mechanics of land value before and after the restrictions were implemented, a clearer picture may emerge as to the degree of economic impacts.

Future studies will also benefit by studying and comparing different areas. Ottawa County is a prime location for recreational lake frontage. Its proximity to Chicago, Detroit, Grand Rapids, Kalamazoo, Lansing, and South Bend ensures that its shores will always be highly sought after for secondary or dual-purpose residences.

Properties further to the north, which are less accessible, may feel the impact of the legislation differently. Other study areas which have a higher percentage of undeveloped lands compared to Ottawa County may have different impacts from the land use restrictions as well. In addition, comparing multiple study areas over time might show that sale and development of unrestricted unimproved lands has increased dramatically.

An attempt should also be made to assess the impacts of the two pieces of legislation independent of one another. There is a high degree of overlap of the two pieces of legislation in Ottawa County. The effects of the regulations on land value may vary in areas where one or the other statues predominates.

Finally, future studies will benefit from using geographic information systems as a tool to collect and manage data. This study presented several crude measures of locational and site quality attributes. The effort to collect this data could have been seriously reduced by using a geographic information system. Moreover, use of a GIS may have helped derive better variables for measuring site quality, such as percent slope. Thus, future studies should emphasize multiple time frames and multiple study areas for analysis. Attempts should be made to assess the two statutes independent of one another. GIS software should be utilized to automate data collection.

Although this study has provided only a limited examination of the problem of land use restrictions and land value it has shown that the Coastal Zone Management programs do impact land values. This is valuable information not only for property owners, but for the Michigan environmental regulatory agencies as well. These findings give the department of environmental quality statistical evidence to combat the notion that environmental regulation always results in losses of land value.

Bibliography

Alonso, William, "*Location and Land Use: Towards a General Theory of Land Rent,*" Cambridge: Harvard University Press, 1964.

"*Atlas of Critical Dunes,*" Michigan Department of Natural Resources, Land and Water Management Division, Lansing, MI, February 1993.

Beaton, W, Patrick, "*Living By the Shore: The Impact of Zoning on Housing Costs,*" The University of Maryland: College Park, MD. 1988.

Beaton, W. Patrick, "The Impact of Regional Land-Use Controls on Property Values: The Case of the New Jersey Pinelands," *Land Economics*, May 1991, Vol. 67, pp. 172-194.

Dr. Brater, Ernest F., "*Beach Erosion in Michigan: A Historical Review,*" Michigan Department of Natural Resources: Lansing, MI. Date Unknown.

Brown, G.M. and Pollakowski, H.O., "Economic Valuation of Shoreline," *Review of Economics and Statistics*, 1977, Vol. 59, pp. 272-278.

Campbell, Bob, "Flooding Forecast: More on the way, Lakes are still rising after a year of havoc," Sunday, December 14, 1986, *Detroit Free Press,* Section COM, pp. 1E.

Casetti, Emilio, "Equilibrium Land Values and Population Densities in an Urban Setting," *Economic Geography,*

"Critic Calls Dune Act Arbitrary," Thursday, August 13, 1992, *Detroit Free Press*, Section NWS, pp. 3B.

Damianos, Demitrios, Shabman Leonard, "*Land Prices in Flood Hazard Areas: Applying Methods of Land Value Analysis,*" Blacksburg, VA: Virginia Water Resources Research Center, 1976.

David, E.L., "The Use of Assessed Data to Approximate Sales Values of Recreational Property," *Land Economics*, 1968, Vol. 44, pp. 127-139.

Frech, H.E., & Lafferty, Ronald, "The Effect of the California Coastal Commission on Housing Prices," *Journal of Urban Economics*, 1984, Vol 16, pp. 105-123.

Freeman, A.M. "*Benefits of Environmental Improvements: Theory and Practice.* Baltimore," John Hopkins University Press. 1979.

Havlicek, Joseph, Jr. "Impacts of Solid Waste Disposal Sites on Property Values." In *Environmental Policy: Solid Waste,* Vol IV, eds. G.S. Tolley, J. Havlicek, JR., and R. Favian. Cambridge, MA: Ballinger, 1985.

Holway, James M., and Burby, Raymond J., "The effects of Floodplain Development Controls on Residential Land Values," *Land Economics,* Vol 66. August 1990. pp. 259 – 271.

Kain, J.K, and Quigley, J.M., "Measuring the Value of Housing Quality," *Journal of the American Statistical Association,* Vol. 65 June 1970, pp. 532-548.

Kiel, Katherine, McKay, Katherine, "Housing Prices During Siting Decision Stages: The case of an incinerator from rumor through operation," *Journal of Environmental Economics,"* 1995, vol. 28, pp. 241-255.

King, A.T., *"Property Taxes, Amenities, and Residential Land Values,"* Cambridge: Ballinger Publishing Co., 1973.

Kohlhase, Janet, "The Impact of Toxic Waste Sites on Housing Values," *Journal of Urban Economics,"* 1991, vol. 30, pp. 1-26.

Li, Mingche, and H. James Brown. "Micro-Neighboorhood Externalities and Hedonic Housing Prices, " *Land Economics* May, 1980, Vol 54, pp. 124-41.

Lindsay, B., Halstead, J., Tupper, M., & Vaske, C. "Willingness to Pay for Coastal Beach Protection," *Coastal Management,* 1992, Vol. 20, pp. 291-302.

McConnell, K.E., "Double Counting in the Hedonic Travel Cost Models," *Land Economics,* 1990, Vol. 66, pp. 121-127.

McKay, David, "Building on the Sand: Developer Sues Township, State over Dune Law," Monday, May 7, 1990, *Detroit Free Press*, Section NWS, pp. 1C

Michigan Department Of Environmental Quality, Personal Correspondence with Penny Holt, Land and Water Analyst, Great Lakes Shorelands Section, June 1999.

Michigan Department Of Natural Resources," *A Plan for Michigan's Shorelands,"* Lansing, MI. 1973.

Michigan Department Of Natural Resources, *"A Summary of Sand Dunes Statutes"* Lansing, MI. 1989.

Michigan Department Of Natural Resources, *"Summary of The Shorelands Protection and Management Program,"* Lansing, MI. 1994.

Millemann, Beth, "Time, Tide and Federal Insurers: How a Government Plan Has Helped Ruin America's Shores," *The Washington Post,* Sunday August 4, 1991.

Milton, W.J., Gressel, J., and Mulkey D. "Hedonic Amenity Evaluation and Functional Form Specification," *Land Economics,* 1984, Vol. 60, pp. 378-387.

Muckleston, Keith W., "The Impact of Floodplain Regulations on Residential Land Values in Oregon." *Water Resources Bulletin,* 1983, Vol. 19. pp. 1-7.

Nelson, Jon P. "Airport Noise, Location Rent, and the Market For Residential Amenities," *Journal of Environmental Economics and Management,* 1979, vol. 6, pp. 357-369.

Nelson, Arthur, Genereux, John, and Genereux, Michelle, "Price Effects of Landfills on House Values," *Land Economics,* Nov. 1992, Vol. 68 pp. 359-365.

Neter, John, and Wasserman, William. 1974. "*Applied Linear Statistical Models: Regression, Analysis of Variance, and Experimental Design,*" Homewood, IL: Richard D. Irwin, Inc.

Parsons, George R., Wu, Yangru, "The Opportunity Cost of Coastal Land-Use Controls: An Empirical Analysis," *Land Economics,* August 1991, Vol. 67(3), pp. 308-316.

Pompe, Jeffrey, and Rinehart, James, "Beach Quality and the Enhancement of Recreational Property Values," *Journal of Leisure Research*, 1995, Vol. 27, pp. 143-154.

Rapheal, C. Nicholas, and Kureth, Elwood J.C.., "*Bluff Line Recession and Economic Loss in Coastal Berrien County, Michigan,*" Ypsilanti, Michigan: Institute for Community and Regional Development, 1983.

Rosen, Sherwin, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition, " *Journal of Public Economy*, Jan. 1974, Vol. 82, No. 1.

Schwartz, S., Zorn, P., and Hansen, D., "Research Design Issues and Pitfalls in Growth Control Studies," *Land Economics*, 1986, Vol. 62, pp. 223-233.

Simmons, Malcolm M., "Coastal Development and the National Flood Insurance Program," *CRS Review,* November, 1990, pp. 6-9.

Smith, Kerry, and Kaoru, Yoshiaki, "The Hedonic Travel Cost Model: A View From the Trenches," *Land Economics*, 1987, Vol. 63 pp. 179-192.

Thrall, Grant, "The Consumption Theory of Land Rent," *Urban Geography,* 1983, Vol. 1, pp. 350-370.

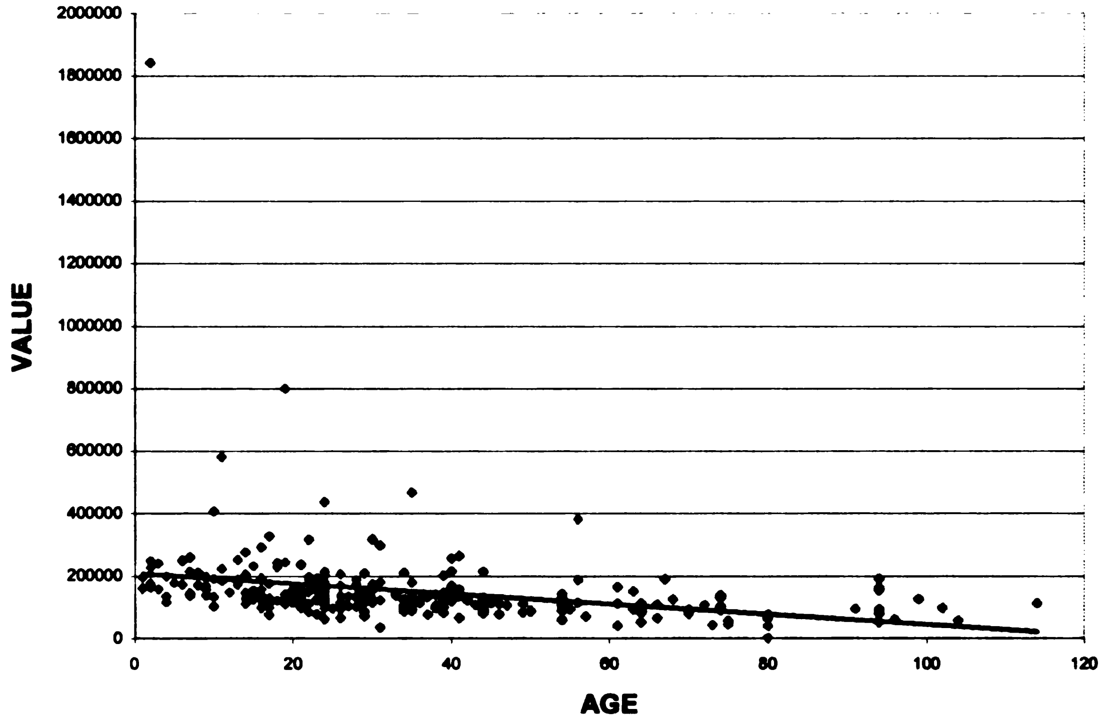
Wertheim, P., Jividen, J., Chatterjee, D. & Capen, M., "Characteristics That Affect the Market Value of Beach Lot Property," *The Real Estate Appraiser*, August, 1992, pp. 59-64.

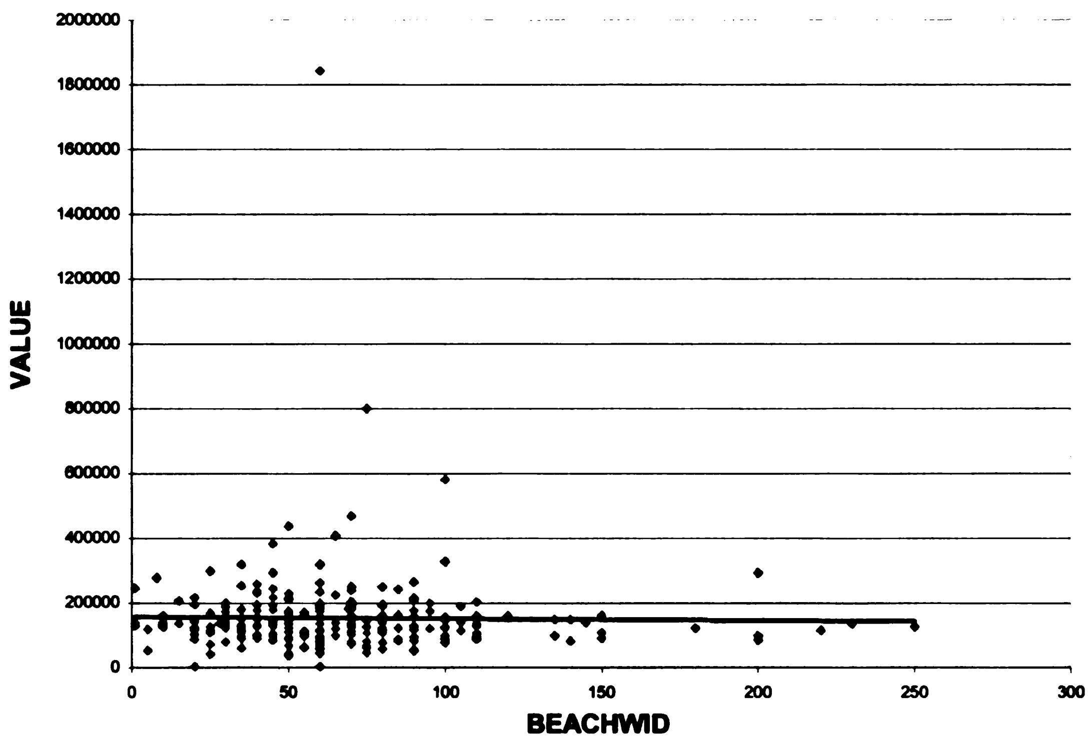
Wilkinson, Leland, Blank, Grant, and Gruber, Christian, "Desktop Data Analysis With Systat," Upper Saddle River, NJ: Prentice Hall, 1996.

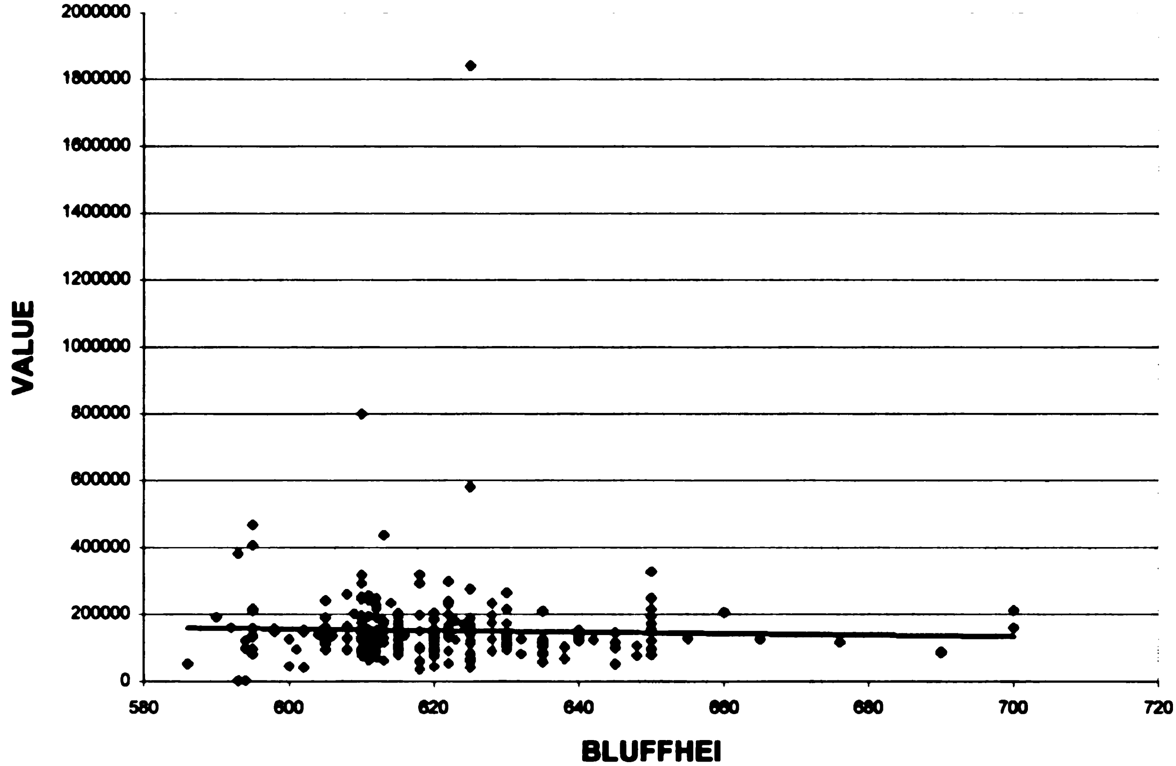
Wyckoff, Mark, "Local Zoning To Protect Michigan's Critical Sand Dune Areas," Lansing, MI: Planing and Zoning Center, inc. February, 1990.

Xu, Feng, Mittelhammer, Ron, Barkley, Paul, "Measuring the Contribution of Site Characteristics to the Value of Agricultural Land," *Land Economics,* Nov. 1993, Vol. 69, pp. 356-369.

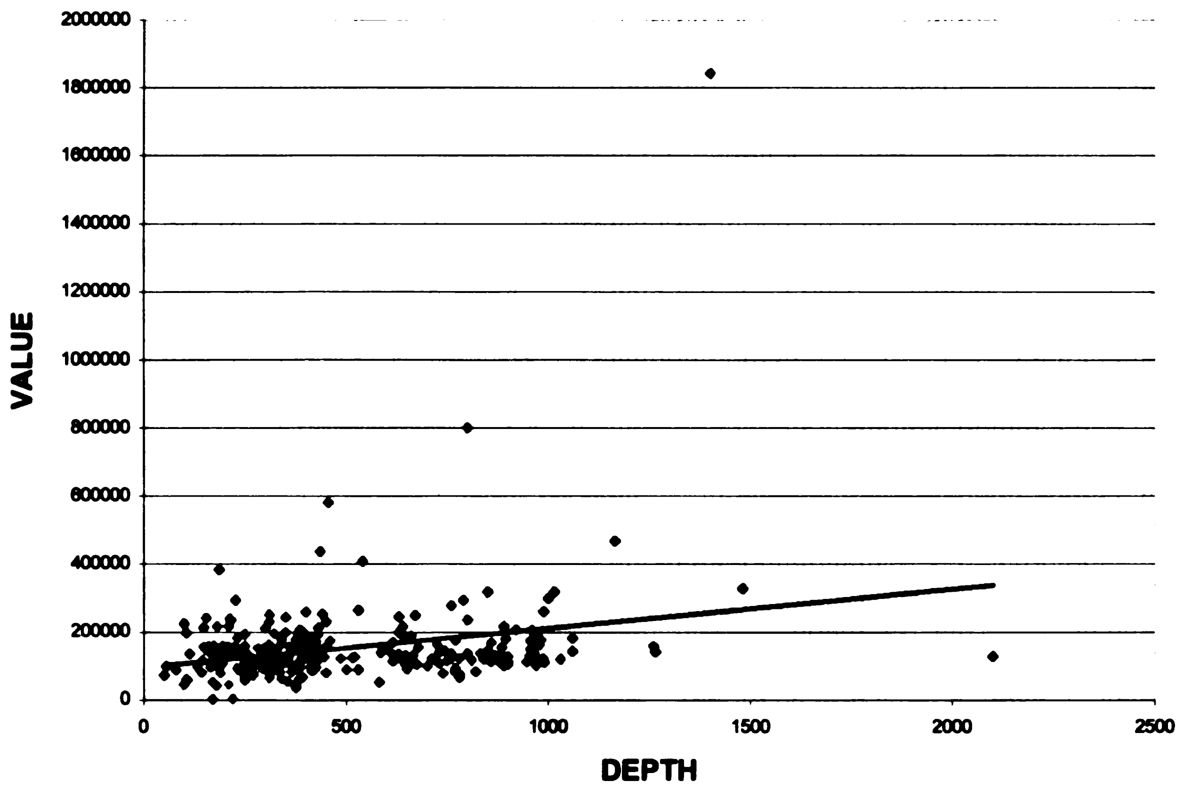
Appendix A:
Bivariate Plots For Developed Parcels



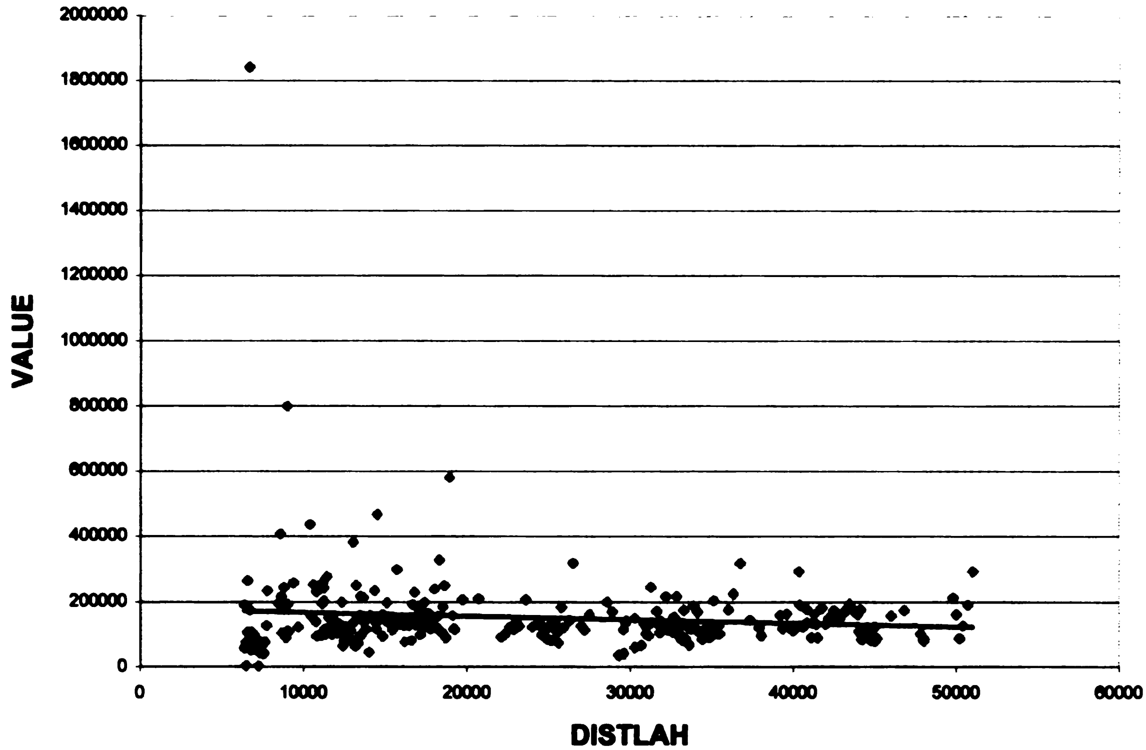


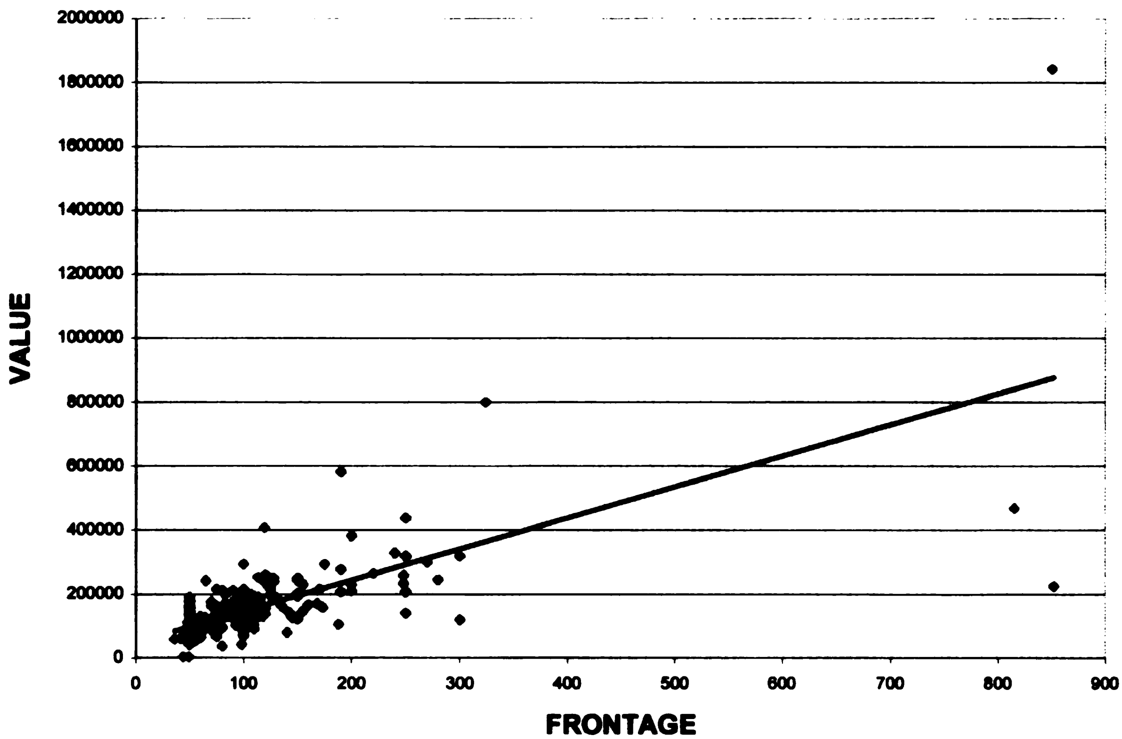


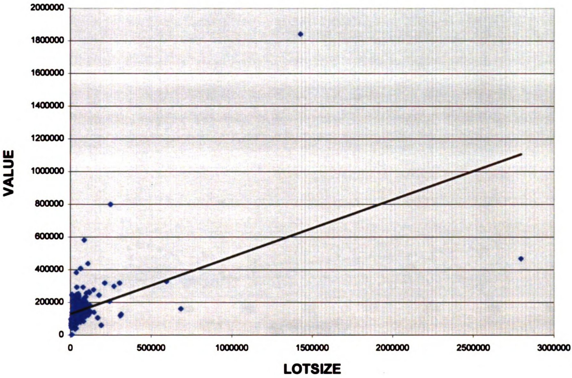
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
VALUE
580
600
620
640
660
680
700
720
BLUFFHEI



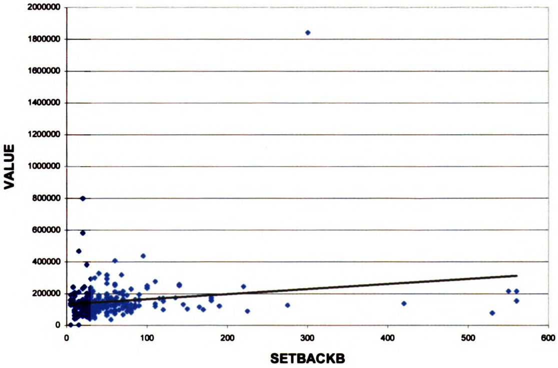
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
VALUE
0
500
1000
1500
2000
2500
DEPTH


2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
VALUE
0
10000
20000
30000
40000
50000
60000
DISTLAH

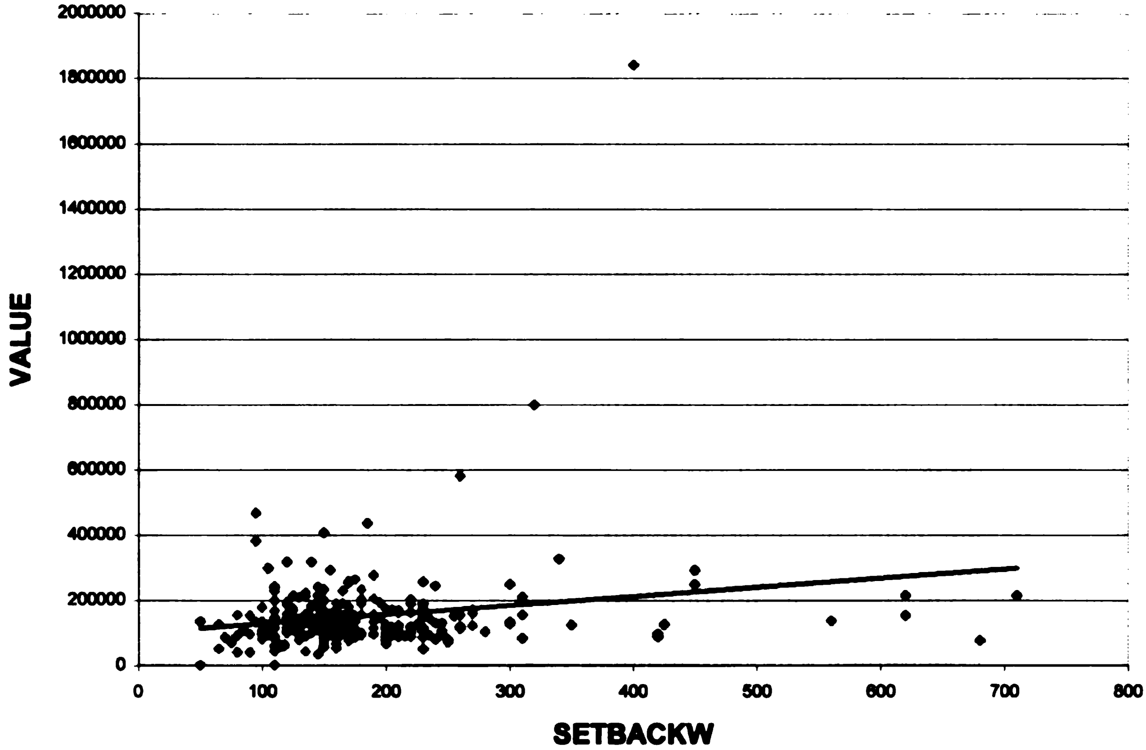

2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
VALUE
0
100
200
300
400
500
600
700
800
900
FRONTAGE

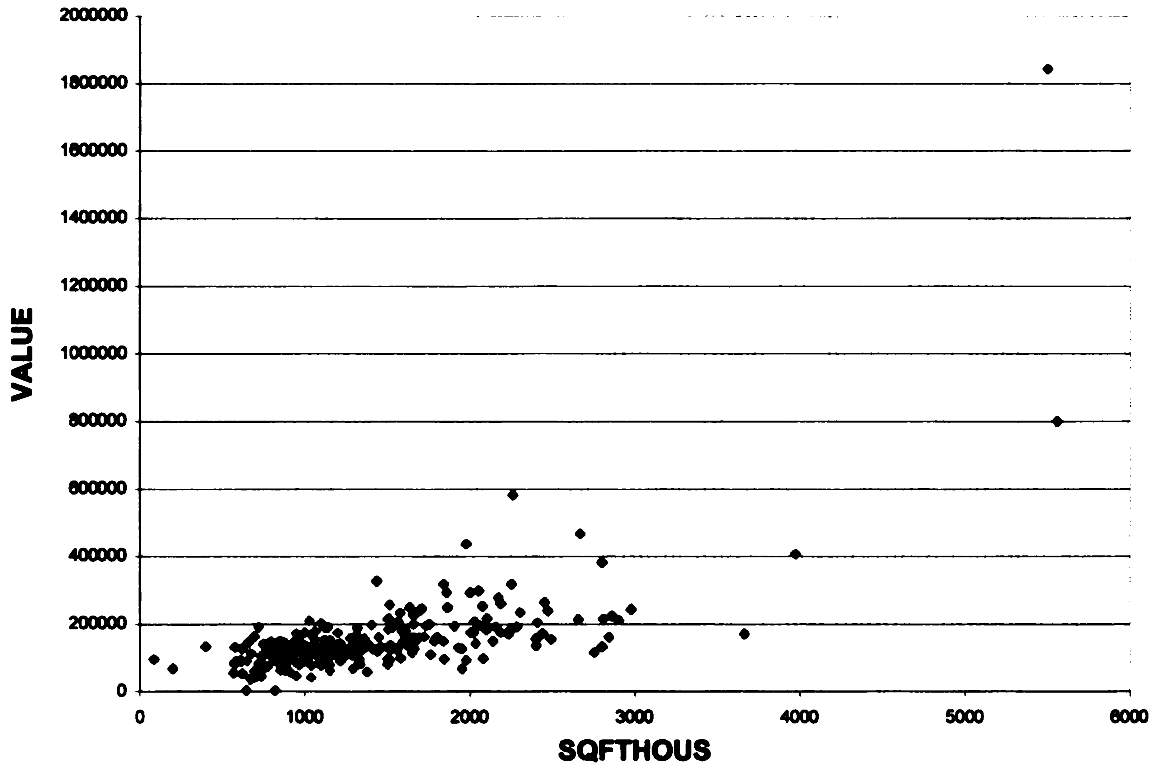


VALUE
LOTSIZE
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
0
500000
1000000
1500000
2000000
2500000
3000000

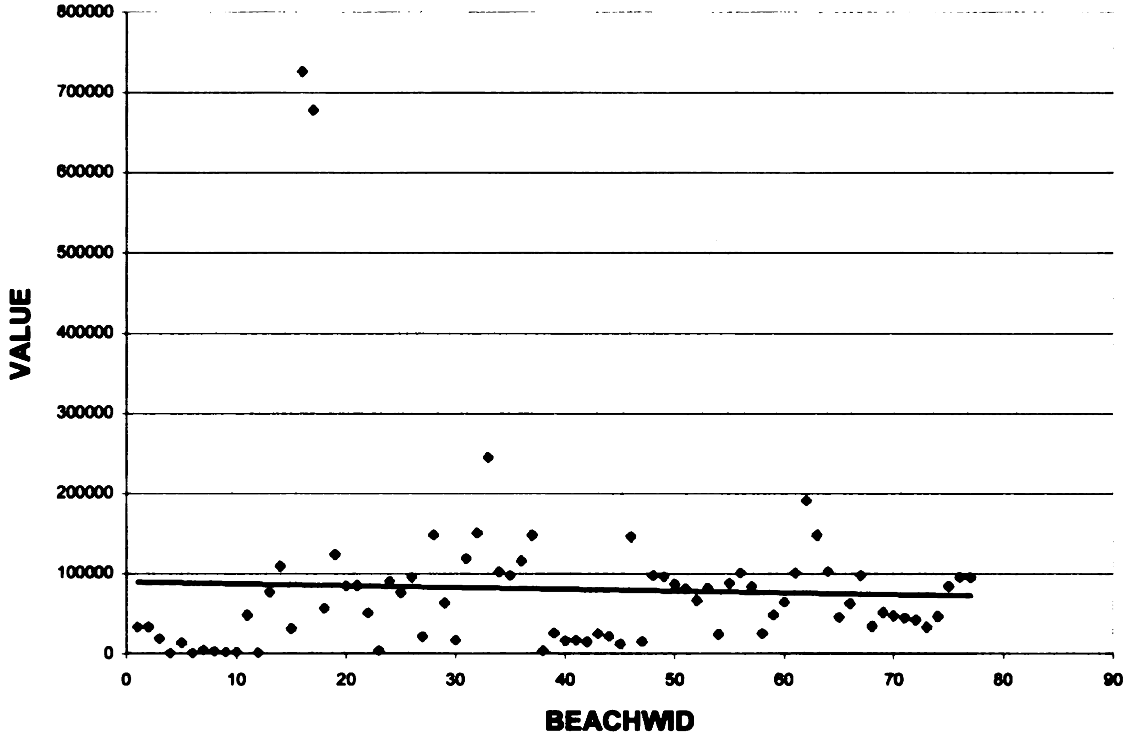


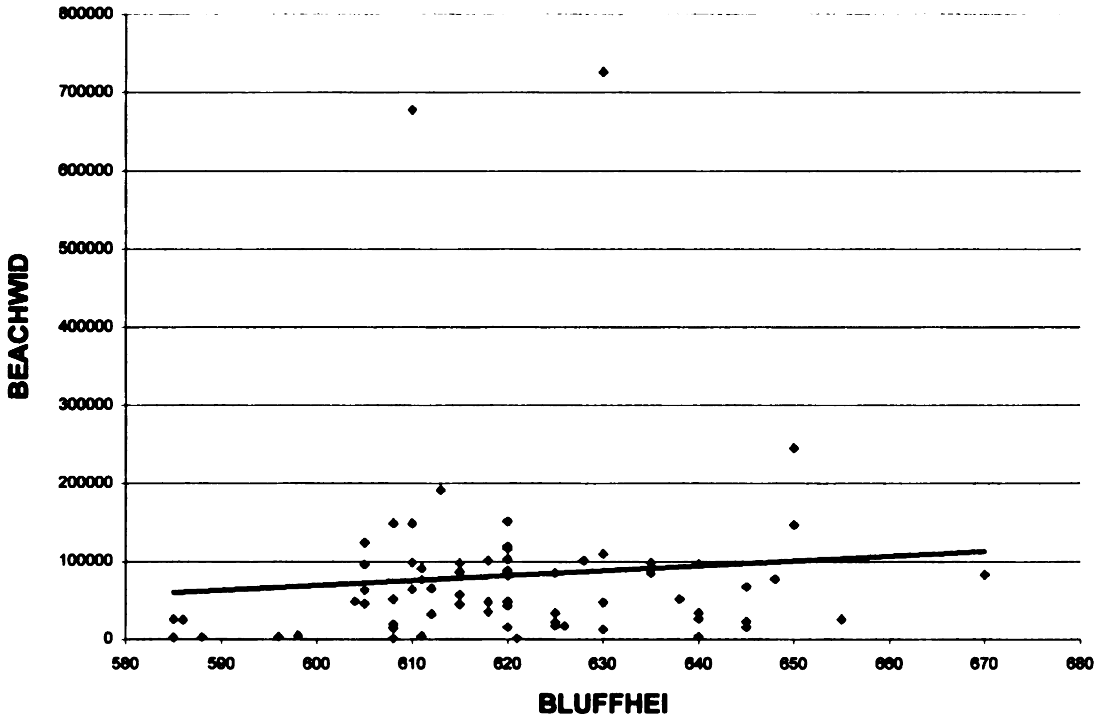
VALUE
SETBACKB
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
0
100
200
300
400
500
600

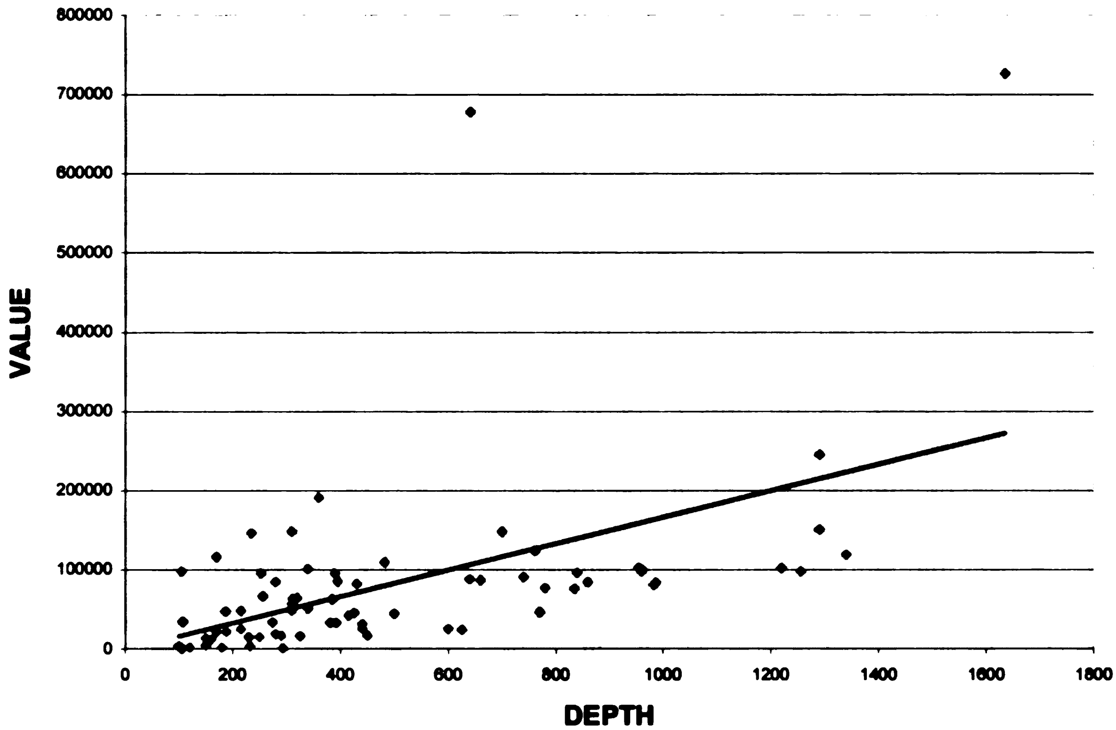

2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
VALUE
0
100
200
300
400
500
600
700
800
SETBACKW

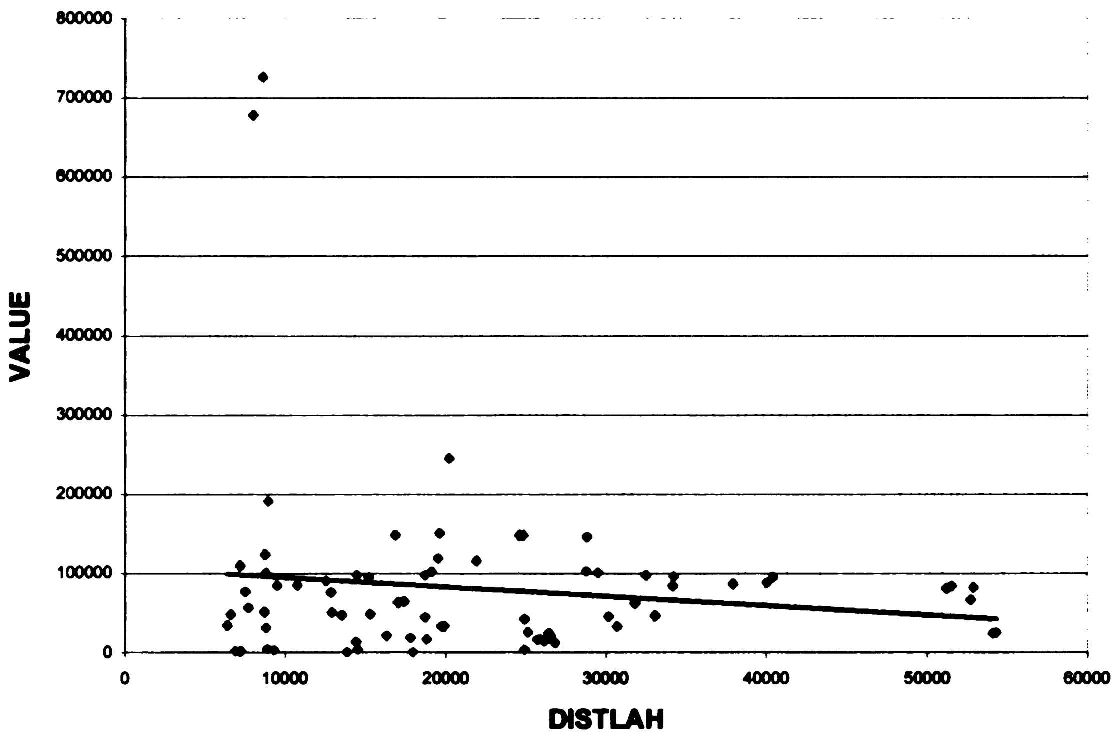

2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
VALUE
0
1000
2000
3000
4000
5000
6000
SQFTHOUS

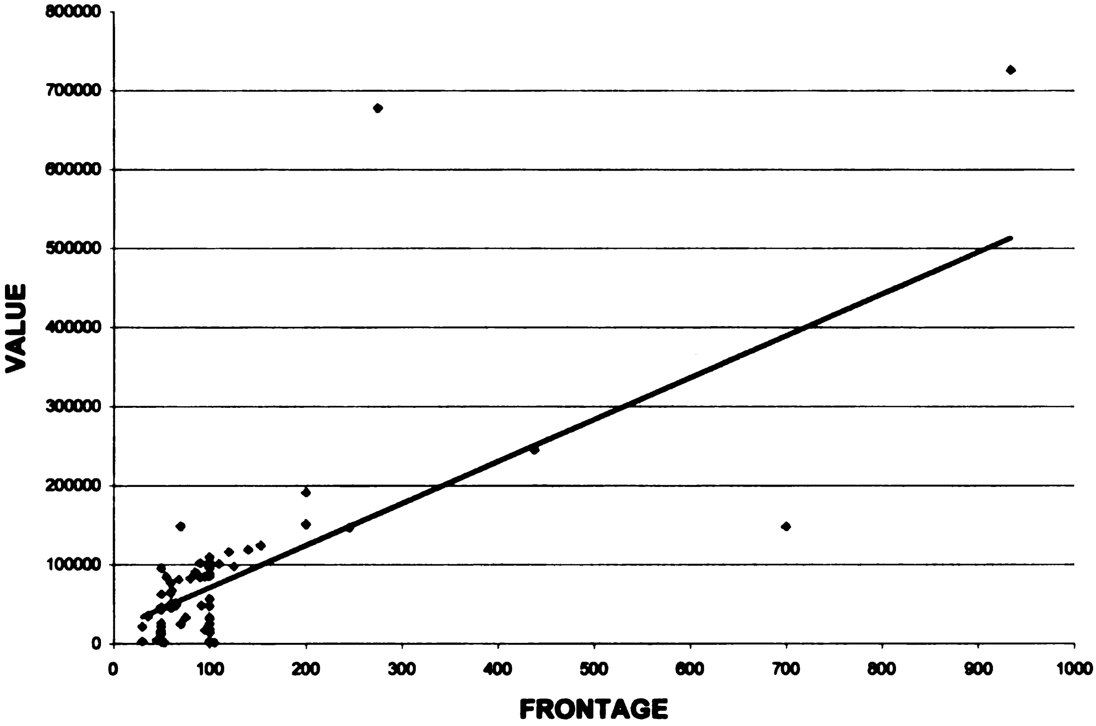
Appendix B:
Bivariate Plots For Undeveloped Parcels

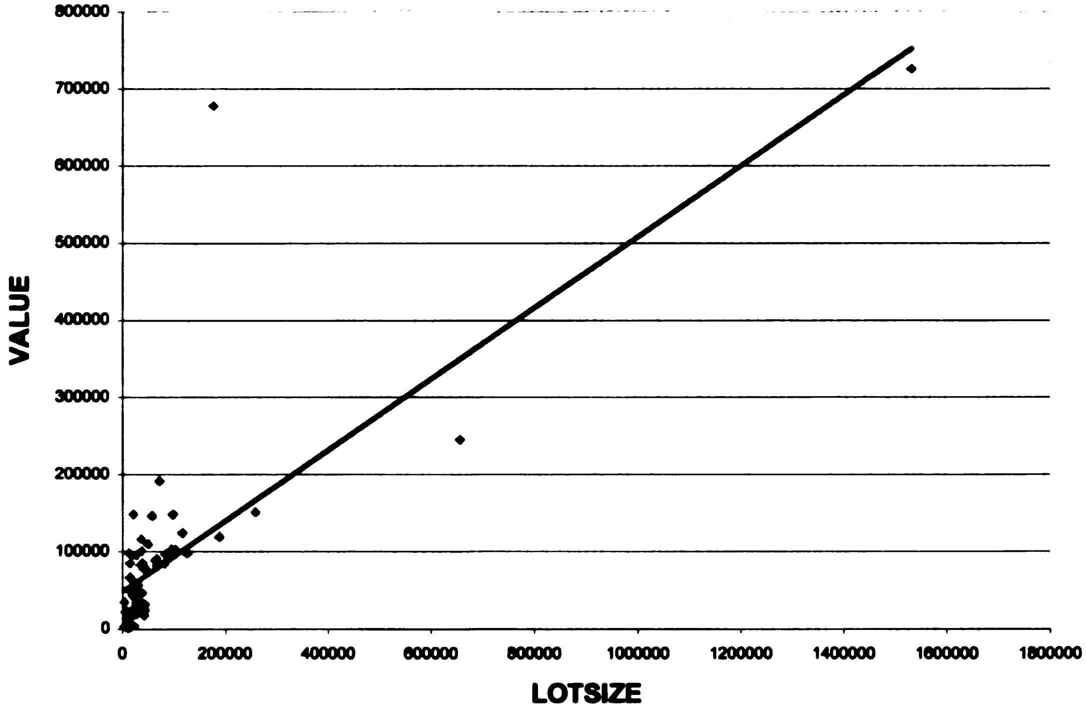


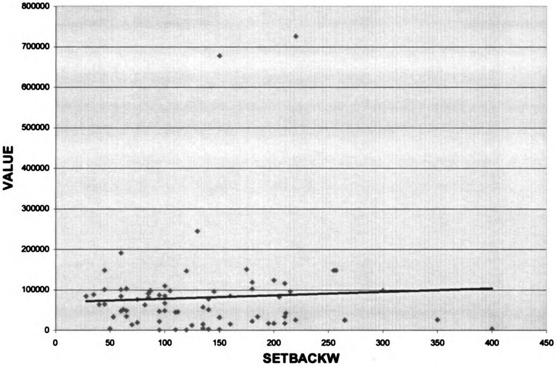



800000
700000
600000
500000
400000
300000
200000
100000
0
VALUE
0
200
400
600
800
1000
1200
1400
1600
1800
DEPTH


800000
700000
600000
500000
400000
300000
200000
100000
0
VALUE
0
10000
20000
30000
40000
50000
60000
DISTLAH


VALUE
FRONTAGE
0
100000
200000
300000
400000
500000
600000
700000
800000
100
200
300
400
500
600
700
800
900
1000


VALUE
LOTSIZE
0
100000
200000
300000
400000
500000
600000
700000
800000
200000
400000
600000
800000
1000000
1200000
1400000
1600000
1800000


800000
700000
600000
500000
400000
300000
200000
100000
0
VALUE
0
50
100
150
200
250
300
350
400
450
SETBACKW