Final General Reevaluation Report
and
Final Environmental Impact Statement

on

Hurricane Protection and Beach Erosion Control

WEST ONSLOW BEACH AND NEW RIVER INLET (TOPSAIL BEACH), NORTH CAROLINA

Appendix F

Beach Access and Parking Analysis and Requirements

Appendix F

Public Beach Access and Parking

1.0 INTRODUCTION

The Army Corps of Engineers has several requirements that must be met in order to fully cost share in a shore protection project (see ER 1105-2-100 and ER 1165-2-130). One of these requirements is that the beaches must be available for public use. As described in ER 1165-2-130 (Federal Participation in Shore Protection, paragraph 6.h.) public use implies reasonable access and parking. The Corps' Wilmington District, additionally, has developed more specific public access and parking requirements for participation in shore protection projects within the District's boundaries of North Carolina and Virginia.

The primary focus of the recreation study conducted by the University of North Carolina at Wilmington (UNCW) was to predict public access and parking demand. ER1165-2-130 stipulates that in order to qualify for Federal cost sharing of Hurricane and Storm Damage Reduction projects, the local community must, at a minimum, provide public access every one half mile and parking with a one quarter mile radius of those access points. Parking must satisfy the lesser of beach capacity or peak hour demand for that beach community. The peak demand hour had been previously identified as noon on the 4th of July holiday by USACE. The Wilmington District has further established a ten-space minimum for parking lots within one-quarter mile of each required public access point. Total beach visitation and the associated recreation benefit depend on day trip visitors having adequate available public parking. In areas where adequate parking is not provided, the recreation benefits for that portion of the project cannot be counted towards the justification of the project. As required by guidance, an analysis was conducted to determine the peak hour demand for Topsail Beach. The data was gathered by UNCW using a survey research methodology. The analysis of the data will be used to determine additional parking needed to meet the Corps' requirements for peak hour demand over the 50-year life of the project. See Appendix O, Recreation Analysis.

Another purpose of this study was to estimate peak and latent demand of the beaches under study. Latent demand is also known as potential demand, or the number of individuals who would come to the beach if conditions were more conducive to recreation. This demand is modeled from the stated preference of the respondent versus their revealed preference. The recommended methodology and data collected from survey instruments were used to develop a model to calculate the estimated number of trips taken to each beach in 2003 and the additional trips that the respondent would take if the width of the beach were increased. The model was also used to predict a decrease in trips with a decrease in beach width, or erosion of the beach. The results for this study will focus on with and without project conditions in each study area. An increase in

beach width would be expected to generate the latent demand resulting in a need for additional parking spaces for future re-nourishment cycles. LIMDEP software was used to develop econometric models to analyze the data. Models recommended by UNCW were used to compute the number of trips taken to each beach community and the latent demand for those beach communities if the beach width were increased. The number of trips taken to each beach community and the increase in those trips derived from the latent demand were used to develop parking requirements for each beach community. For the purpose of this analysis, parking requirements for a beach are defined as the number of parking spaces that would accommodate all visitors to that beach on a specified percentage (e.g., 70%, 90%, etc.) of peak summer weekend days.

The remainder of this report is organized as follows. Section 2 describes the present conditions – access points, parking, and topographic map of the area. Section 3 is devoted to the with project condition. Data and methods of analysis are presented in section 4. Section 5 discusses the empirical results. Finally section 6 presents summary and conclusion.

2.0 PRESENT CONDITIONS

2.1. Access

Topsail Beach has 22 public beach access points within the project limits. The access points generally consist of small parking areas and wooden walkways to the beach. Two of the public beach access points are vehicle cross-overs for beach maintenance and emergency access. The town has another 3 proposed public beach access points for a total of 25. Table F-1 lists the existing and proposed public access locations. The column titled “Name” contains the name of the nearest cross street or other landmark. At 3 of the accesses (O #8, O #5, and O#2) the wooden walkways ER 1165-2-130 states that, “… public use is construed to be effectively limited to within one-quarter mile from available points of public access to any particular shore.” Therefore the minimum distance between public access points is one half mile. Through most of the project length the public access sites surpass this definition. There are only 2 sections of shoreline within the project limits, both near the north end of town, that presently do not have access points within one-quarter mile. One is 950 feet long overlapping reaches 17 and 18 in the 1100 block of North Anderson Boulevard. The other area is 330 feet long in reach 22, near the 700 block of North Anderson Boulevard. However, the proposed access points would be located so that the ½ mile requirement would be met for those two areas.

2.2. Parking

There are a wide variety of public parking spaces throughout Topsail Beach. These are located at the access sites, on nearby street right-of-ways, at sound

side access points, and at 2 large parking lots. The parking space count administered in June 2003 by the Wilmington District and a representative from the Town of Topsail Beach is included in Table F-1. The combined total is presently 374 spaces. Presently, 140 of the 374 spaces are located on private property. For the sponsor to meet requirements for participating in the Federal project the sponsor will need to obtain a real estate interest that will ensure those spaces are made available for public parking for the life of the project. In addition, the town has indicated in a more recent count during the summer of 2004, there may be at least 300 additional parking spaces unaccounted for on the rights of way (ROW) along town streets. However, these spaces have not been included in the official count or the parking model analysis because USACE representatives have not verified these spaces. These ROW spaces are not currently marked with signage, and there has been some question that some roads in the town limits may be private. These additional spaces may be verified at the signing of the PCA.

The Wilmington District requires a minimum of 10 spaces for each access point regardless of demand. Criteria for minimum parking requirements was established for Wilmington District projects in North Carolina based on using an average lot size along the shoreline area and determining how many parking spaces could be provided in that lot size (example provided for 50' x 95' lot size which provided 8 spaces + 1 handicapped space or 10 spaces without a handicapped space. Where the spacing of the accesses is less than one half mile, having a total sum of 10 parking spaces within one quarter mile of any point in the project provides the 10-space minimum parking requirement. For the project length of 26,200 feet the minimum number of accesses and parking spaces are computed as follows:

$$26{,}200 \text{ feet} \times \frac{1 \text{ access}}{0.5 \text{ mile (2640 feet)}} = 9.9 \text{ accesses, approximately 10 accesses}$$

$$10 \text{ accesses} \times \frac{10 \text{ spaces}}{\text{access}} = 100 \text{ spaces.}$$

The present total number of public parking spaces, 374, more than surpasses the minimum required number of spaces, 100. The distribution of parking spaces is uneven with a large amount in the southern and central project reaches and few in the northern project reaches. A total of 15 additional parking spaces among the northern access points are needed to satisfy the 10-space minimum requirements. The results of the peak demand analysis study will determine whether that the 10-space minimum needs to be increased to meet the predicted demand. The required parking would be met once the proposed access points are constructed.

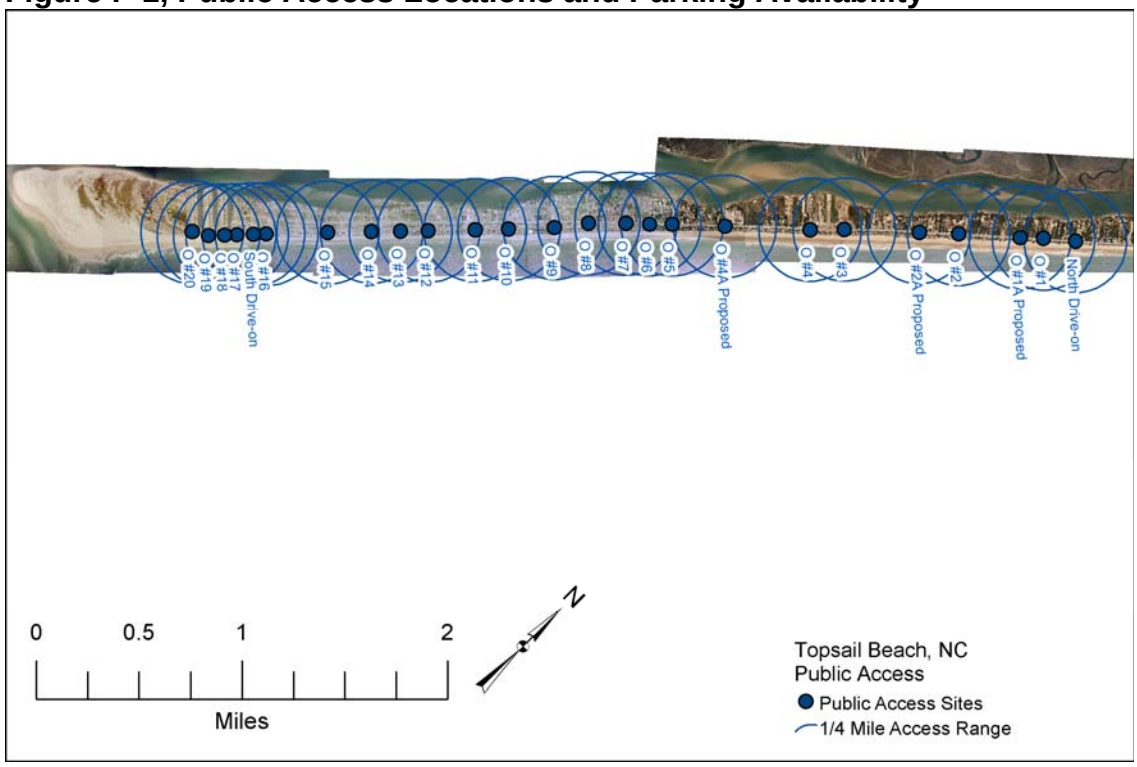
Table F-1, Public Access Locations and Parking Availability June 2003.

Access Points	Street	Existing	Future
Oceanside Access			
O #20	*Godwin*	15	
O #19	*McLeod*	24	
O #18	*Boryk*	24	
O #17	*Trout*	24	
South Drive-on	*Drum*	12	
O #16	*Florida*	8	
O #15	*Smith*	8	
O #14	*Darden*	5	
O #13	*Crocker*	5	TBD
O #12	*Scott*	6	TBD
O #11	*Hines*	8	TBD
O #10	*Crews*	5	6
O #9	*Davis*	6	
O #8	*Haywood*	5	
O #7	*Empie*	6	
O #6	*Rocky Mount*	5	
O #5	*Barwick*	3	
O #4A Proposed	*Monroe*		*6*
O #4	*Queens S*	0	TBD
O #3	*Queens N*	12	
O #2A Proposed	*Nixon*		
O #2	*Sidbury*	8	
O #1A Proposed	*Catherine*		*2*
O #1	*Catherine*	0	
Sound Side Access			
S #1		17	
S #2		4	
S #3		0	
S #4		4	
S #5		0	
S #6		16	
S #7		ROW	
S #8		ROW	
S #9		ROW	
Sea Turtle Hospital		4	
Assembly Bldg		100/Private	
Florida @ Sound Pier		40/Private	
Totals		**374**	**14**

2.3 Map

A map of the access locations is shown in Figure F-1. The access points are labeled with the Access Point designation (from Topsail Beach's March 17, 2005 survey). The one-quarter mile radius circles centered on each existing and proposed access site show the project areas serviced by the accesses.

Figure F-1, Public Access Locations and Parking Availability



3.0 WITH PROJECT CONDITION

The sponsor is in the process of obtaining the additional public access sites and public parking for the project area to meet the definition of a public use shoreline. There will be no placement of material on private-use shores.

The Town of Topsail Beach Core Land Use Plan 2005 addresses additional public access. One of the specific goals is "To increase and enhance public access opportunity to the ocean and sound waters of Topsail Beach." The following text is taken from a section contained in Public Access Goal & Policies in the Core Land Use Plan 2005.

> (2)(2)(A)(1)a. - It is the policy of Topsail Beach to continue to provide access to public trust waters through the acquisition, development, and redevelopment of beach and sound access areas, parks, and boat launching areas. This development and redevelopment activity shall be consistent with the need to protect the area's natural resources. Topsail

Beach will, in the future, seek financial assistance from State and federal sources to support the development, and/or expansion, of parks and recreational facilities in appropriately sited locations.

--The Town seeks to provide one neighborhood public access area every ½ mile along the beach. Parking spaces will be provided for the neighborhood public access ways within ¼ mile radius.

--The Town seeks to provide public or private local access every ½ mile to give neighborhood residents, pedestrians, and bicyclists access to the beach.

--The Town of Topsail Beach seeks to provide public access opportunities for all area residents and visitors including the handicapped.

All project reaches will be eligible for cost sharing of 65% Federal and 35% non-Federal sponsor once the above requirements have been met. These values are based on the sponsor's Core Land Use Plan 2005 and will be subject to change if more, less, or different access sites are decided upon prior to signing the Project Cooperation Agreement (PCA). Once all access and/or parking sites are obtained, and prior to signing the PCA, the Corps will obtain specific measurements using GIS and or survey data of these sites to make a final determination on project cost sharing. The sponsor will be responsible for ensuring that the access and parking requirements are met throughout the life of the project.

4.0 DATA AND METHODS

This section provides an overview of the data and method that was used for this study. The data on which the analysis is based comes the from telephone and onsite surveys conducted by the University of North Carolina at Wilmington. This data will be used to establish parking requirements for Topsail Beach and to project those needs over the life of a Federal project.

The telephone survey asked respondents about trips taken in a 120-mile radius of the North Carolina coast during a typical peak summer season. The data was used to construct an index of the number of recreational day trip (TRIPINDX) to a beach. $TRIPINDX_i$ is the estimated number of recreational day trips taken to beach i per year by 1,067 households in the telephone survey sample. PC Miler, a Poisson/negative-binomial cluster regression model, was used to generate TRIPINDX. Other data collected for this study include stay time, STAYTIME, which is the average length of time in hours that a visitor remained at the beach. The duration of stay is assumed to affect parking demand. If the duration of stay is usually long, more parking spaces should be provided.

The on-site survey collected parking space data for ten beaches on peak (weekend) days in July and August 2003. For this analysis the variable SPACES, which gives the existing number of parking spaces at each beach, is

used as a censoring variable by the Tobit regression procedure. Each beach i has a separate censoring limit, as specified by the $SPACES_i$ variable. Two holidays were included in the survey effort: the Fourth of July weekend and the Labor Day Weekend. To test for the effect of holiday on parking demand, a dummy variable, $HOLIDAY_{d,}$ was generated equal to 1 if the day is July 4 or 5, or August 30 or 31, days corresponding to the Fourth of July and Labor Day holidays.

To account for fixed effects in the model, beach-specific dummy variables, DB00, DB09, that shift the intercept were generated for nine beaches. The dummy for beach 10 is omitted to avoid a dummy variable trap. Observe that beach 08 is omitted from the whole analysis. Dummy variables capturing time of day effects were constructed as follows: if t = 9am-11am, DMORN = 1, DMORN = 0 otherwise; if t = 3pm-5pm, DAFTN = 1, DAFTN = 0 otherwise. Note that potential dummy variable DMID = 1 when t = 12noon-2pm is omitted to avoid the dummy variable trap. Under this specification, with all dummy variables set to zero, the regression predicts uncensored FILLEDSP (dependent variable) at midday on a non-holiday weekend day on beach 10 (Atlantic Beach). Setting one of the various dummy variables to the value "1" adjusts the regression predictions for an alternative time of day or an alternative beach destination. Table 1 summarizes key statistics for the survey data sample.

Table 1. Summary Statistics of Survey Data

Variable	Description	Mean	Std.Dev.	Minimum	Maximum
FILLEDSP	Filled Parking Spaces	2.5666	2.2871	0	9.09
STAYTIME	Stay Time at beach	4.339445	1.318575	0.1875	9.5
HOLIDAY	Holiday {Fourth of July and Labor Day}	0.532934	0.49929	0	1
TRIPINDX	Trip index	428.956	255.16	146	924
DMORN	Day time dummy variable	0.377246	0.48506	0	1
DAFTN	Afternoon time dummy variable	0.211078	0.408379	0	1
DB00	Caswell Beach	0.0329	0.178598	0	1
DB01	Oak Island Beach	0.0449	0.207262	0	1
DB02	Holden Beach	0.0404	0.197088	0	1
DB03	North Topsail Beach	0.0449	0.207262	0	1
DB04	Surf City Beach	0.0404	0.197088	0	1
DB05	Topsail Beach	0.0404	0.197088	0	1
DB06	Pine Knoll Shores Beach	0.0389	0.193554	0	1
DB08	Indian Beach	0.0404	0.197088	0	1
DB09	Emerald Isle Beach	0.0434	0.203938	0	1

Notes: Only aggregate statistics are reported in table. The descriptive statistics for the 10 individual beaches are not presented to economize on space.

4.1 Censored Regression Model

It is likely that some visitors may not use the beach because parking capacity is limited. Suppose that out of 500 potential beach visitors, 200 are unable to use the beach because they cannot find parking space. One strategy of dealing with this difficulty is to ignore or drop these observations from the sample. However, by eliminating this subset from the sample not only do we lose degrees of freedom and therefore precision, we also risk biased estimates of the effects of independent variables. That is, important factors correlated with the dependent variable may characterize this group of visitors that has been dropped. In situations such as these, a better strategy that allows use of the entire sample is to assume that the dependent variable FILLEDSP (number of parking spaces filled at a give beach) has a censored distribution; that is, the dependent variable cannot be observed above or below some threshold value, and therefore is reported as this threshold value.

The underlying model of censored regression assumes that the true value of the dependent variable is unobservable. The basic form of the censored regression model is given by the latent variable formulation:.

$$Y_i^* = X'_i\beta + \varepsilon_i \qquad (1)$$

Where y_i^* *is the latent variable,* X'_i *is a vector of exogenous variables and* ε_i *is a normal error term with zero mean and standard deviation* σ*.*

Define the censored random variable Y_i *as*

$y_i = o$ *if* $y_i^* \leq 0$

$y_i = y^*_i$ *if* $y_i^* \phi\ 0$

The dependent variable of the censored regression model is observed when $y_i^* \phi\ 0$. With the survey we can obtain the observable response (y_i) which represents the unobservable outcome of a particular range.

When the range of dependent variable is limited, censored regression methodology are used to analyze the data. Given the censored nature of the dependent variable, performing OLS on equation (1) will result in inconsistent coefficient estimates. To account for censored dependent variable and to obtain consistent estimates of the parameters, we estimate a censored regression within a maximum likelihood Tobit model.

The Tobit regression model (with upper and lower tail censoring) is specified as:

$$Ln(FILLEDSP_{idt}) = \beta_o + \beta_1 DMORN + \beta_2 DAFTN + \beta_3 DB00 + ...\beta_{11} DB09 + \beta_{12} STAYTIME_{id} + \beta_{13} HOLIDAY_d + \beta_{14} TRIPINDX_i + e_{idt} \quad (2)$$

If $\text{Ln}(FILLEDSP_{idt}) \leq 0$, then $\text{Ln}(FILLEDSP_{idt}) = 0$,
If $\text{Ln}(FILLEDSP_{idt}) \geq \text{ln}(SPACES_i)$, then $\text{In}((FILLEDSP_{idt}) = (SPACES_i)$,

where:

FILLEDSP, STAYTIME, SPACES, HOLIDAY, DMORN, DAFTN, DB00…DB9, and TRIPINDX are variables defined above, e_{idt} is a heteroskedastic error term. The error term is specified as $e_{idt} \sim N(0, \sigma^2.\exp(\alpha.TRIPIND_i))$, where σ (the standard deviation of the uncensored dependent variable in the absence of heteroskedasticity), α and $\beta_0 - \beta_{14}$ are the parameters to be estimated.

Parameters of the distribution of the latent dependent variable are estimated by maximum likelihood in LIMDEP (2002). The Tobit regression model estimates the probability distribution of FILLEDSP, including the number of FILLEDSP that would occur if the number of parking spaces were not constrained. The resulting probability distribution can be used to estimate parking requirements beyond current parking space capacity.

5. RESULTS AND DISCUSSIONS

Estimates of the beach parking demand model using the two-limit Tobit regression estimation procedure is shown in Table 3.

Table F-3 Tobit Regression Results - Dependent Variable: FIllEDSP,

Explanatory Variables	Coefficient	Std. Error.	t-ratio	P-value	Mean
Constant	4.557***	0.506	9.00	0	1
DMORN	-0.666	0.488	-1.36	0.1727	0.3772
DAFTN	-0.307	0.490	-0.63	0.5311	0.2111
DB00	-0.518	0.567	-0.92	0.3601	0.0329
DB01	0.699	0.512	1.37	0.1723	0.0449
DB02	-0.379	0.527	-0.719	0.4722	0.0404
DB03	0.166	0.595	0.279	0.7803	0.0449
DB04	-0.706	0.564	-1.252	0.2105	0.0404
DB05	-0.101	0.543	-0.186	0.8521	0.0404
DB06	-0.262	0.5577	-0.47	0.6383	0.0389
DB07	-0.946*	0.5378	-1.76	0.0785	0.0404
DB09	-1.271**	0.5544	-2.293	0.0218	0.0434
STAYTIME	0.008	0.0206	0.362	0.7175	4.339
HOLIDAY	0.364***	0.0536	6.78	0	0.5329
TRIPINDX	0.003***	0.00018	12.6	0	428.656
Sigma	0.451***	0.0161	28.023	0	----
Alpha	0.0007***	0.000067	10.992	0	----
Log-likelihood	-623.66				

Notes: ***,**, and * refer to significance at the 1%, 5%, and 10% levels, respectively. The chi-square and overall likelihood ratio statistics are 29.1 and 546.7, respectively. Number of observations =699. Dependent variable: FILLEDSP. D13 is the omitted time of day dummy variable.

As expected the coefficient on the beach specific index of recreation demand, TRIPINDX, is positive and strongly significant. The large t statistic, 12.6, allows us to reject the null hypothesis of no trip demand at the 1% level of significance. Thus, providing evidence that beach trip demand impacts the number of parking spaces. The heteroskedasticity parameter α is positive and strongly significant, indicating that larger values of TRIPINDX increase the variance of ln(FILLEDSP). There is evidence to indicate that HOLIDAY has a positive and significant effect on filled spaces. We also find evidence that STAYTIME has a positive but insignificant effect on filled spaces. Fixed effects dummy variables DB00…DB09 vary in sign, reflecting differences in the estimated value of filled parking spaces, ln(FILLEDSP), at midday across beaches. However, after controlling for other variables in the regression, only DB07 and DB09 are statistically significant at the 10% and 5% level, respectively. There is no evidence to indicate that this data suggests that time of day variables, DMORN

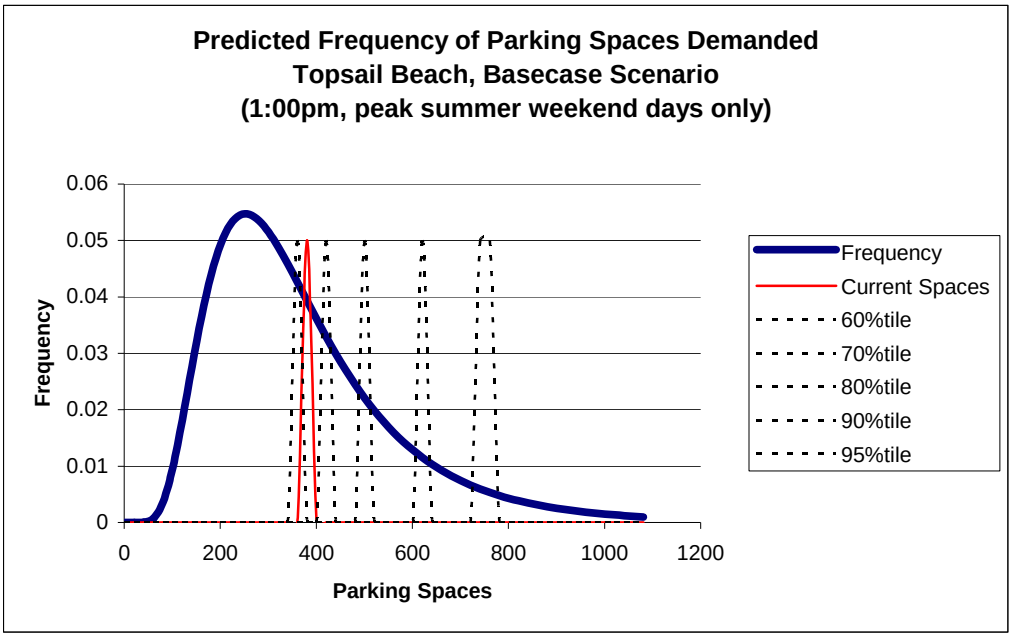
and DAFTN, significantly impact beach-parking demand. In all, the explanatory power of the regression is reasonably good given the individual cross section data. The likelihood ratio test indicates that the overall regression is significant at $p<0.01$.

As mentioned earlier, an important component of this analysis was to determine parking spaces that would be required to accommodate all peak (weekend holiday) day beach visitors. With the estimated Tobit coefficients, it is possible to calculate the number of spaces that would be required to accommodate all peak (weekend holiday) day beach visitors 60% of the time, 95% of the time, etc. For each beach, ln(FILLEDSP) follows a normal distribution, with a beach-specific mean value given by the Tobit regression equation (with variables replaced by their mean values), and a beach-specific standard deviation given by $(\sigma^2 \cdot \exp[\alpha \cdot TRIPINDX_i])^{0.5}$. The unconditional mean of $\ln(FILLEDSP_i)$, denoted $\bar{\mu}$, is given by: $\bar{\mu} = \beta_0 + \beta_1$ DMORN + β_2 DAFTN + β_3 DB00 + . . . + β_{11} DB09 + β_{12} $STAYTIME_{id}$ + β_{13} $HOLIDAY_d$ + β_{14} $TRIPINDX_i$,

where mean values are inserted for independent variables. The standard deviation of $\ln(FILLEDSP_i)$, denoted SD, is given by: $SD = (\sigma^2 \cdot \exp[\alpha \cdot TRIPINDX_i])^{0.5}$. The unconditional 90 percentile, for example, of $FILLEDSP_i$ is then given by: 90 percentile $FILLEDSP_i$ = EXP(NORMINV(0.90, $\bar{\mu}$, SD)), where NORMINV is the inverse normal cumulative distribution function.

For each beach, the frequency of FILLEDSP can be graphed against FILLEDSP to determine the number of spaces that would be necessary to accommodate all peak (weekend holiday) day beach visitors 60% of the time, 95% of the time, etc. The graph below (Figure F-2) shows the estimated frequency of (latent, uncensored) filled parking spaces at Topsail Beach on peak, summer weekend holidays in base year 2004.

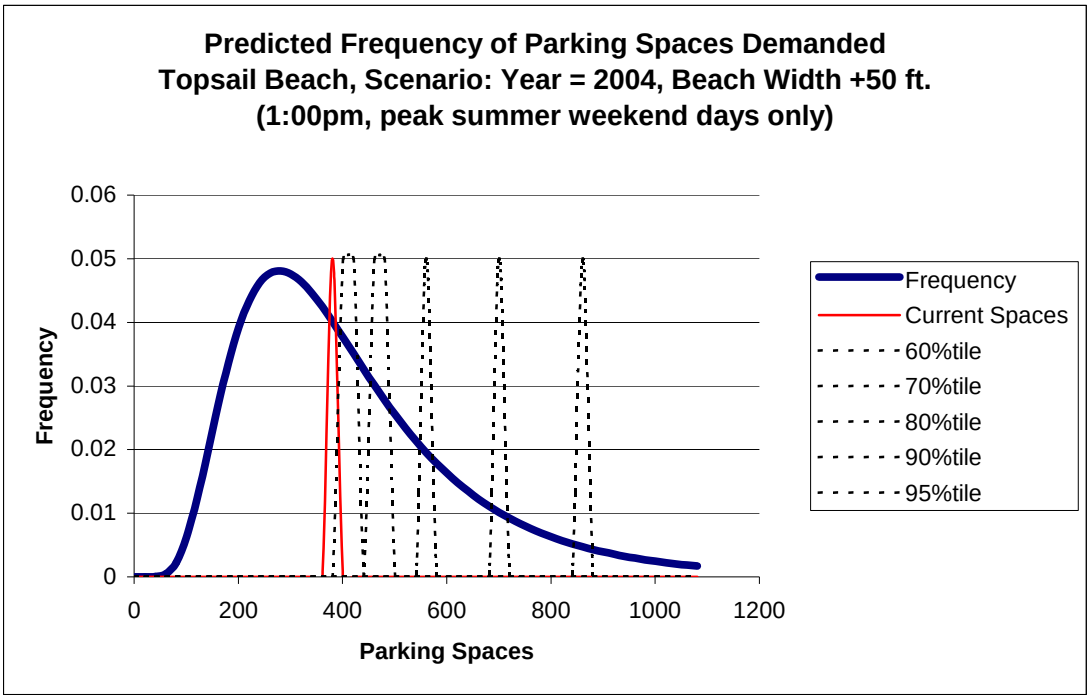
Figure F-2



The current, existing number of parking spaces at Topsail Beach is 374, indicated by the solid indicator spike, which is used solely to designate particular values of parking spaces. Sixty-three percent of the frequency distribution of FILLEDSP occurs to the left of 374 spaces, suggesting that the existing spaces (summer 2004) fully accommodate all Topsail Beach visitors on 63% of peak (summer holiday weekend) days. Observe that 37% of the frequency distribution of FILLEDSP lies to the right of 374 spaces, indicating that the existing spaces do not accommodate all Topsail Beach visitors 37% of peak days. Providing additional parking spaces would accommodate additional visitors. The remaining, dashed indicator spikes on the graph mark the numbers of parking spaces that would be required to accommodate all Topsail Beach visitors on 60%, 70%, etc., of peak days. Again, the spikes are used solely to designate particular values of parking spaces.

Furthermore, changes in beach conditions may shift the frequency distribution of FILLEDSP. The graph below (Figure F3) shows the predicted frequency of FILLEDSP at Topsail Beach with a 50 ft increase in beach width. The increase in beach width attracts additional beach visitation, which shifts the frequency distribution to the right. As the distribution shifts to the right, the current number of parking spaces accommodates all visitors less frequently. In this example, the current number of spaces (374) would accommodate all Topsail Beach visitors on only 53% of peak days with a 50 ft increase in beach width. The indicator spikes mark the number of parking spaces that would be required to accommodate parking demand on 60%, 70%, etc., of peak days.

Figure F-3



As state population increases, the number of visitors to Topsail Beach is expected to increase, assuming that the number of trips per household remains constant. Table F-4 shows the predicted frequency of FILLEDSP at Topsail Beach under + 50 ft beach width conditions from the base year 2004 through 2024, based on projected increases in the population of the telephone survey region. An increase in projected population in the telephone survey region increases the $TRIPINDX_i$ value for Topsail Beach, which in turn shifts the predicted frequency distribution of FILLEDSP for Topsail Beach to the right. As the curve shifts to the right, the current number of parking spaces accommodates all Topsail Beach visitors less frequently. By 2008, it is estimated that 763 parking spaces would be necessary to accommodate peak demand on ninety percent of peak days.

Table F4. Projected Topsail Beach Parking Space Requirements, 2004-2024 (+50 ft beach width conditions)

Year	Telephone Survey Region Population Index (2004 Base Year)	TRIPINDX	Mean FILLEDSP	60%tile FILLEDSP	70%tile FILLEDSP	80%tile FILLEDSP	90%tile FILLEDSP	95%tile FILLEDSP
2004	1.000	454.0	357.6	409.4	473.3	560.8	709.5	861.6
2005	1.015	460.9	363.2	416.1	481.1	570.3	722.0	877.2
2006	1.031	468.1	369.1	423.0	489.3	580.3	735.0	893.5
2007	1.047	475.4	375.3	430.2	497.9	590.8	748.8	910.8
2008	1.064	482.9	381.7	437.7	506.8	601.6	763.1	928.7
2009	1.080	490.5	388.4	445.5	516.0	612.9	777.9	947.2
2010	1.097	498.0	395.0	453.3	525.3	624.1	792.8	965.9
2011	1.112	504.9	401.2	460.6	533.9	634.7	806.6	983.2
2012	1.127	511.8	407.5	468.0	542.7	645.4	820.8	1001.0
2013	1.143	518.9	414.1	475.7	551.9	656.7	835.6	1019.6
2014	1.159	526.2	421.0	483.8	561.5	668.4	851.2	1039.2
2015	1.175	533.6	428.1	492.3	571.5	680.7	867.4	1059.5
2016	1.192	541.1	435.4	500.9	581.8	693.2	883.9	1080.4
2017	1.209	548.7	443.0	509.7	592.3	706.1	901.0	1101.9
2018	1.226	556.4	450.8	518.9	603.3	719.6	918.8	1124.4
2019	1.243	564.5	459.0	528.7	614.9	733.8	937.7	1148.1
2020	1.261	572.3	467.3	538.4	626.5	748.0	956.5	1171.9
2021	1.276	579.2	474.7	547.1	636.8	760.7	973.4	1193.2
2022	1.291	586.2	482.2	556.0	647.4	773.8	990.7	1215.1
2023	1.307	593.3	490.0	565.2	658.5	787.3	1008.8	1237.9
2024	1.323	600.7	498.3	575.0	670.1	801.6	1027.8	1262.0

6.0 SUMMARY AND CONCLUSION

This study analyzed the demand for beach parking in Topsail Beach using a Tobit regression estimation approach. The study employed data collected through telephone and onsite surveys conducted by the UNCW. Respondents were asked to provide information about distance traveled to a particular beach and duration of stay for each visit. Other information used includes fixed effects and time dummy variables. Fourth of July and Labor Day weekends were also used to test the effect of holidays on beach parking demand.

This study presents strong empirical evidence that a beach-specific index of recreation demand significantly impacts the number of parking spaces filled. There is evidence indicated in this data to suggest that holidays have a positive and significant impact on beach parking demand. On the other hand, there is no evidence to indicate that time of day variables, DMORN and DAFTN, significantly impact beach-parking demand.

An objective of this study was to establish parking needs for Topsail Beach and to project those needs over the life of a Federal project. Estimated coefficients obtained from Tobit regression were used to compute the required number of parking spaces that would accommodate all peak hour and weekend day beach visitors 60%, 70%, 90%, and 95% of the time. For Topsail beach the frequency of FILLEDSP was graphed against FILLEDSP to determine the number of spaces that would be necessary to accommodate all peak (weekend holiday) day beach visitors. The analysis shows that in 2004 the existing spaces, 374, at Topsail beach fully accommodate all visitors sixty-three percent of peak (summer holiday weekend) days. Therefore, providing additional parking spaces would accommodate all visitors a greater percentage of the peak days.

The analysis show that a 50 ft increase in beach width will attract additional visitation and will shift the frequency distribution of FILLEDSP to the right. Under that scenario the current number of parking spaces would accommodate all Topsail Beach visitors on only 53% of peak days. Furthermore, an increase in projected population in the telephone survey region increases the trip index value for Topsail Beach, which in turn shifts the predicted frequency distribution of FILLEDSP to the right. It is estimated that by 2008 763 parking spaces would be required to accommodate peak demand 90% of peak days. Similarly, by 2016 884 parking spaces would be required to accommodate peak demand 90% of peak days.