

BEACH LIGHTING MANAGEMENT PLAN
for
VOLUSIA COUNTY, FLORIDA

Prepared for:
U.S. Fish & Wildlife Service
Jacksonville, Florida

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TABLE OF CONTENTS

BACKGROUND	2
Goals and Objectives of the Volusia County Beach Lighting Management Plan	2
Effects of Artificial Lights on Sea Turtles	2
Nesting Adult Sea Turtles	3
Hatchling Sea Turtles	3
How Hatchling Sea Turtles Perceive Light	4
Effects of the Moon on Hatchling Orientation	5
Conservation Techniques To Minimize Hatchling Disorientations	6
Nest Relocation	6
Nest Caging	7
Light Management	8
Lighting Ordinances	8
Issue Identification	9
Crime and Public Safety	10
Insurance Liability	11
Interior Lighting of Buildings	11
Flashlights and Lanterns	12
Retrofit Costs	12
Daytona Beach and Daytona Beach Shores Exemption	13
Incidental Take Permit & the BLMP	14
Elements of the BLMP	14
CHARACTERIZATION OF EXISTING LIGHTING ENVIRONMENT	16
BLMP Zones & Jurisdictions	16
Upland Development Patterns	16
Lighting Characterization Survey	19
Summary of Lighting Characterization	27
SEA TURTLE NESTING & DISORIENTATIONS IN VOLUSIA COUNTY	29
Sea Turtle Monitoring	29
Nest Site Selection by Adult Sea Turtles	30
Evidence of Artificial Lights Disrupting Nesting Adult Sea Turtles	30
Documenting Hatchling Disorientation Events	32
Completing Disorientation Reports	32
Disorientation Reports from Volusia County	32
Determining the Number of Hatchlings Involved	34
Regional Evaluation of Disorientation Events	34
Ormond by the Sea - North (Zone I)	37
Ormond by the Sea - South (Zone II)	37
City of Ormond Beach (Zones III-IV)	39
City of Daytona Beach (Zones V-VIa)	39
City of Daytona Beach Shores (Zones VIIb-VIIIa)	40
Wilbur by the Sea (Zone VIIIb)	40

Town of Ponce Inlet (Zones VIIIc-IX)	40
City of New Smyrna Beach (Zones X-XIIa)	41
Bethune Beach (Zones XIIb-XIII)	43
Effects of Climate Conditions & the Moon on 1997 Disorientations	43
SUMMARY OF PROBLEMS RELATED TO LIGHT MANAGEMENT	46
EXISTING LIGHT MANAGEMENT ORDINANCES IN VOLUSIA COUNTY	51
Minimum Environmental Standards	51
Enforcement Ordinances in Effect	51
Volusia County	51
Ormond Beach	53
New Smyrna Beach	54
Enforcement Procedures for Existing Lights	54
Volusia County	54
Town of Ponce Inlet	56
City of Ormond Beach	56
City of New Smyrna Beach	57
Enforcement Procedures for Proposed Lights	57
Volusia County	57
Incorporated Areas	57
RECOMMENDED ENFORCEMENT PROCESS IMPROVEMENTS	59
Illumination vs. Visibility	59
Amendments to Existing Ordinances	59
Minimum Standards Ordinance	59
County Enforcement Ordinance	60
Further Assessment of Enforcement Processes	60
Training for and Performing Night Evaluations	60
Public Lighting	61
Case Tracking	61
Interagency Coordination	61
Daytona Beach & Daytona Beach Shores Exemption	61
Public Service Information	62
LIGHTING EVALUATIONS	63
PUBLIC AWARENESS PROGRAM	64
COMPLIANCE ASSISTANCE PROGRAM	65
Official Correspondence	65
Technical Assistance	66
LONG-TERM MONITORING	67
Light Maintenance Evaluations	67
Disorientation Reporting	67
IMPLEMENTATION STRATEGY	68
Year Two of the ITP	68
Year Three of the ITP	69
Year 4 & 5 of the ITP	70
PROGRAM EVALUATION	70

BACKGROUND

GOALS AND OBJECTIVES OF THE VOLUSIA COUNTY BEACH LIGHTING MANAGEMENT PLAN

Florida's beaches provide important nesting habitat for five species of sea turtles (Meylan et al., 1995): the loggerhead turtle (*Caretta caretta*) the green turtle (*Chelonia mydas*), the leatherback turtle (*Dermochelys coriacea*), the Kemp's ridley turtle (*Lepidochelys kempii*) and the hawksbill turtle (*Eretmochelys imbricata*). All of these species have been reported to nest in Volusia County.

All species of marine turtles occurring in waters of the United States are listed as endangered or threatened, and as such, are protected by law under the U.S. Endangered Species Act of 1973, as amended, and Florida statutes. Recovery plans for U.S. sea turtle populations place considerable emphasis on preserving, and where possible improving, the quality of Florida's beaches as nesting habitat (NMFS and USFWS, 1991a; NMFS and USFWS, 1991b; NMFS and USFWS, 1992).

Urbanization of coastal areas adjacent to sea turtle nesting beaches has led to a number of sea turtle habitat modifications. The introduction of artificial lighting has been perhaps the most intrusive of these. Outdoor lighting along Volusia County's beaches is used to illuminate roads, parking lots, signs, buildings, walkways, yards and commercial areas. The nighttime environment has been modified with bright lights to improve human visibility and provide a sense of security and safety.

Coastal management laws attempt to balance human needs along the beach are balanced with the needs of threatened and endangered species who depend on the same habitat. The ultimate goal of this document, the *Volusia County Beach Lighting Management Plan* or BLMP, is to establish, to the greatest extent practicable, nesting beaches throughout Volusia County which are both attractive to nesting females and safe for their emerging hatchlings. A "safe" nesting beach is defined as a site where the emerging hatchlings orient directly to the ocean, without any need for human intervention (EAI, 1997a). Critical to this effort will be an effective reduction in the extent and intensity of errant beachfront lighting.

The Volusia County BLMP was prepared by the Volusia County Environmental Management Service Center with input from Ecological Associates, Incorporated (EAI), the County's Protected Species Specialist. Information provided by two sea turtle conservation groups, the Volusia Turtle Patrol and the Volusia Sea Turtle Society, was also incorporated. The BLMP contains the tools, procedures, and strategies needed to implement a county-wide coastal light pollution abatement program. This manual provides general information about the effects of artificial lights on sea turtles and presents evidence of how often this occurs in Volusia County. As a step-by-step, "how-to" manual, the BLMP is also intended to serve as a blueprint for use by both the County and local governments to address coastal lighting problems.

EFFECTS OF ARTIFICIAL LIGHTS ON SEA TURTLES

Many animals rely on the natural cycle of celestial light for visual orientation and/or the timing of periodic behavior. Artificial light that interferes with these essential behavioral systems is termed "photopollution"

(Verheijen, 1985). Unlike chemical pollutants, errant artificial light is not toxic. Nevertheless, it can have profound effects on the survival of animals that rely on accurate light information to initiate or guide critical biological activities (Witherington, in press). Light cues figure prominently in the reproductive behavior of sea turtles. Errant lighting on or near nesting beaches introduces misinformation to turtles during vital phases of the reproductive process (Witherington and Martin, 1996; Lohman et al., 1997).

Nesting Adult Sea Turtles

Sea turtles in Volusia County and elsewhere nest almost exclusively at night. This adaptive behavior protects the female from would-be predators and from over heating. Scientific evidence shows that beachfront lights deter adult females from emerging out of the ocean to nest (Witherington & Martin, 1996). Many researchers have noted a relationship between the amount of lighted beach development and sea turtle nest densities (Mattison et al., 1993; Salmon et al., 1995). However, the actual number of turtles that are affected by lighting is unknown, since they generally do not leave any quantifiable evidence on the beach, such as false crawls. In addition to lights, other factors can affect nesting patterns, such as beach profile.

Another type of artificial light that may affect nesting adult turtles are flashlights and spotlights used by beach pedestrians and fishermen. Many people walk and fish on the beaches at night in Volusia County with these lights, which are highly disruptive to sea turtles. Scientific evidence suggests, however, that just the presence of humans near an emerging turtle, with or without flashlights, often causes the turtle to abandon the nesting attempt (Johnson et al., 1996). If a turtle successfully excavates a nest and is approached by curious onlookers with flashlights, the process of covering and camouflaging the nest may be unnaturally abbreviated. Another transient source of lights come from vehicle headlights, particularly in beachfront parking areas where people park and leave their headlights on.

Therefore, both fixed and transient sources of artificial lights can affect nesting adult turtles. The primary effect is the prevention of emergence from the ocean. Secondary effects include interruptions to normal nesting behavior as evidenced by abandoned digs, indirect return crawls to the ocean and, in extreme cases, disoriented crawls away from the ocean.

Hatchling Sea Turtles

Although nesting turtles prefer dark beaches, they still nest on lighted shores and place the survival of their hatchlings at risk. Artificial lighting often impairs the ability of hatchlings to properly orient and crawl to the ocean. Evidence has been collected since at least 1994 of sea turtle hatchlings being misdirected by artificial lighting on Volusia County beaches (FDEP, unpub. reports; VCEM, unpub. reports; EAI, 1997b).

Hatchling sea turtles exhibit a robust sea-finding behavior. A direct and timely migration from the nest to sea may be vital to their survivorship. Although the cues involved in sea finding are complex, hatchlings rely primarily on vision for proper orientation (Witherington and Martin, 1996; Lohman et al., 1997). A combination of light and shapes is thought to be responsible. The extent to which one or the other drives the process may be a function of the relative strength of each stimuli.

Hatchlings typically orient toward the brightest direction. There are two mechanisms that permit this type of orientation. The simplest is known as “phototropotaxis” (a turning and movement toward light). Hatchlings turn first in one direction and then in the other until the perceived light intensity is balanced between both eyes. When light balance is achieved, they will be facing the brightest direction. A more complex mechanism, “telotaxis” (fixation on and movement toward a target stimulus), allows instantaneous integration of light stimuli from many directions to establish the brightest direction.

On natural, undeveloped beaches the brightest direction is almost always away from elevated shapes (e.g., dunes, vegetation, etc.) and their silhouettes and toward the broad open horizon of the sea. On developed beaches, the brightest direction is often away from the ocean and toward lighted structures. Hatchlings unable to find the ocean, or delayed in reaching it, are likely to incur high mortality from dehydration and predators. Hatchlings lured into parking lots or toward street lights are often crushed by passing vehicles (McFarlane, 1963; Philibosian, 1976; Peters and Verhoeven, 1994; Witherington and Martin, 1996).

When artificial lighting is strongly attractive, hatchlings move in a highly directed but incorrect path away from the ocean. This behavioral anomaly is termed “misorientation”. Less attractive lighting may prevent hatchlings from orienting in a constant direction either toward or away from the sea. Hatchlings crawling erratically are said to be “disoriented”. Throughout the remainder of this manual, both types of misdirected crawling will be referred to as “disorientation”. This term is most frequently used by sea turtle conservationists in describing all events where hatchlings do not orient properly to the ocean.

HOW HATCHLING SEA TURTLES PERCEIVE LIGHT

To reduce the effects of artificial lighting on sea turtles, it is first essential to understand how sea turtles perceive light in their environment. First, and most importantly, strategies to resolve lighting problems must recognize that our common notions of brightness and color do not apply, because sea turtles and humans perceive light quite differently.

Both the color (wavelength) and relative brightness of light sources are important in the sea-finding capabilities of hatchling sea turtles (Witherington and Martin, 1996; Lohman, 1997). Green turtles are strongly attracted to light in the near-ultraviolet to yellow region of the visible spectrum (360 to 600 nm) but are relatively indifferent to light in the yellow-orange to red region (630 to 700 nm). Loggerhead turtles are also strongly attracted to short wavelength light, but unlike green turtles, have an aversion to bright light in the green-yellow to yellow spectrum (560 to 600 nm); loggerheads are only moderately attracted to longer wavelength light in the orange and red spectra. The relatively high sensitivity of turtles to short wavelengths is not surprising considering that they live in a medium, the ocean, that selectively filters out long wavelength colors.

The relative attractiveness of hatchlings to different colors is a function of brightness. Relatively low intensities of ultraviolet to green light (short wavelengths) are needed to elicit an orientation response in loggerhead hatchlings, whereas much higher intensities of long wavelength light would be required to elicit a similar response (Witherington and Martin, 1996). It is important to note that hatchlings can be attracted to even long wavelength red light at very high intensities.

Most light sources used by humans are composed of many different wavelengths. However, we are unable to distinguish among the different components; we see only a single color. Hatchlings, on the other hand, are sensitive to the full spectrum of wavelengths present in light (Witherington and Martin, 1996). This is an important consideration in determining whether a particular light source is likely to be attractive to turtles. For example, a source emitting monochromatic (single wavelength) yellow light might be unattractive or only weakly attractive to hatchlings. Yet, another source appearing yellow to humans, but containing both green and red spectral components, would be highly attractive to hatchlings because of its green content.

In addition to their spectral sensitivity, hatchling sea turtles collect and process light differently than humans (Witherington and Martin, 1996; Lohman, 1997). Hatchlings integrate light through a broad, relatively flat cone of acceptance. For loggerhead turtles, the cone of acceptance is about 180° wide and about 10° to 30° above the ground. This implies that light reaching the hatchling from all sources combined (illuminance) is more important in influencing orientation than the brightness of light emanating from a particular source (luminance). Furthermore, light near the horizon plays the greatest role in determining orientation direction. Thus, a combination of color, brightness, proximity to the beach, and broadcast characteristics are involved in determining the relative attractiveness of a light source to a hatchling.

EFFECTS OF THE MOON ON HATCHLING ORIENTATION

Questions frequently arise as to why a light source near the beach has any more influence over a hatchling's orientation than does a full moon. Although celestial light sources can be very bright, they are also very distant. Light from these sources is scattered by the atmosphere and reflected by the ocean and land. By the time it reaches the hatchlings, it is only moderately directed. On the other hand, artificial light sources, although not as bright, may be very close to the beach. Light reaching hatchlings from these sources is highly directed. From a hatchling's perspective, one direction (the one towards the artificial light source) may be much brighter than all others, and this typically will be the direction the hatchling chooses.

Although a bright moon does not interfere with hatchling orientation, it may diminish the extent of disruption caused by nearby artificial lights. By illuminating broad areas of the beach, moon light diminishes the directivity of nearby artificial light fields. Consequently, artificial lights typically are more disruptive to hatchling orientation on nights around a new moon than on nights around a full moon. Conversely, the effects of artificial lighting are accentuated during periods of overcast skies and heavy sea mist. These conditions tend to scatter light more and increase the effects of artificial beach illumination. Since natural astronomic and climatic conditions vary, so does the occurrence of disorientation events.

Based on the above information, it is apparent that most standard light meters would prove inadequate in determining whether or not a light source is likely to be disruptive to sea turtles. First, hatchlings show a preference for short wavelength light and respond to ultraviolet light that we cannot even see. Second, illuminance is "measured" by hatchlings through a broad, flat cone of acceptance which is dissimilar to

the acceptance cones utilized in most light meters. Third, the low intensity of light needed to elicit orientation behavior for certain wavelengths may be below the detectable limits of many light meters.

For these reasons, the best available illuminance meters are the hatchlings themselves. If hatchlings emerging from a nest are disoriented, there is almost assuredly a disruptive artificial light source nearby.

However, rather than waiting for a disorientation event to occur, a proactive posture should be adopted to identify and remedy potential problem lights before hatchlings are negatively impacted. Later sections of this manual present guidelines for determining if a light is likely to cause a problem for sea turtles and discuss alternative lighting options for resolving identified problems.

For a more thorough review and assessment of lighting impacts on sea turtles and other animals refer to Witherington and Martin (1996), Lohman et al. (1997), and Witherington (in press).

CONSERVATION TECHNIQUES TO MINIMIZE HATCHLING DISORIENTATIONS

Nest Relocation

Questions frequently arise as to why lights must be modified to protect sea turtles. Why can't nests simply be moved to darker areas of the beach? In fact, until recently, lighting impacts on many Florida nesting beaches were addressed through this type of program.

The regulatory agencies responsible for coordinating sea turtle recovery efforts in Florida (Florida Department of Environmental Protection; FDEP) and the United States (U.S. Fish and Wildlife Service; USFWS) do not consider nest relocation a substitute for light management. The current conservation philosophy is to minimize manipulations of sea turtle eggs and hatchlings and allow the sea turtle reproductive process to occur naturally. There are a variety of reasons why state and federal agencies responsible for sea turtle conservation and recovery programs discourage relocation as a substitute for light management:

1. Relocation of nests gives the false impression that lighting impacts to hatchlings have been averted. In reality, some turtle nests are missed by those responsible for protecting them (unpublished data, FDEP Index Nesting Beach Survey; B. Witherington, pers. comm.). Nesting surveys are typically conducted soon after daybreak. Observers interpret the tracks and other signs left on the beach by the turtle the previous night to determine which species came ashore and whether or not it nested. Even experienced professionals are unable to locate nests when wind, rain and/or high tides obscure these interpretive signs. Hatchlings from missed nests are at risk from light pollution.
2. Eggs are occasionally broken during the excavation and relocation process. Additionally, developing embryos are sensitive to movement and may be harmed by improper handling during nest relocation (Limpus et al., 1979). Data from several nesting beaches in Florida suggest that hatchling emergence success (the percentage of hatchlings emerging from the nest) is reduced for relocated nests when compared to nests left in place (Moody, in Press).

3. Because of the sensitivity of developing embryos to movement, FDEP requires that nest relocations be performed by 9:00 AM on the morning the nests are first encountered. Depending on the number and location of nests and the number of qualified monitoring personnel available, it may not always be possible to meet to this requirement.
4. Just as the cues used by hatchlings to orient to the sea are complex, assessments of what constitutes a safe hatching environment can be difficult. When nesting surveys are conducted during the early morning hours many lights have been turned off. Thus, without additional nighttime evaluations, it would be difficult to gauge how safe or risky a particular section of beach might be. Even if nighttime evaluations are performed, problem lights may be turned off or burned out at the time of evaluation, giving the appearance that there is limited risk to hatchlings. Furthermore, monitoring personnel with varied levels of experience may arrive at different conclusions regarding the relative safety of a given beach location. For these reasons, it is not surprising that FDEP has documented disorientation of hatchlings from nests intentionally left in place in what was considered a safe hatching environment.
5. Frequently during relocation programs, nests are moved to a centralized beach hatchery. This literally places all eggs in one basket. A major disruptive event impacting the hatchery (e.g., erosion, stormwater runoff, etc.) could have catastrophic consequences to a beach's annual reproductive output. Furthermore, hatcheries tend to concentrate hatchlings making them more susceptible to land and ocean predators.
6. Best available scientific data support the long-held belief that female sea turtles return to their natal beaches to lay their eggs (Bowen and Karl, 1997). Presumably critical cues are imprinted by hatchlings while in the nest and/or during their migration from the nest to offshore habitats. Manipulation of eggs and/or hatchlings to distant safe locations could potentially interfere with these imprinting mechanisms.
7. Even if problems for hatchlings could be satisfactorily resolved, lighting might still reduce the frequency of emergences onto the beach by nesting females. Light pollution diminishes the suitability of available nesting habitat and may force turtles to utilize less appropriate nesting sites.

Nest Caging

Another management technique that has been used in Volusia County to protect hatchlings from lighting impacts is caging. Cages are placed over the nests as they near hatching and are checked periodically during the night. Hatchlings confined by the cage are collected and released at a dark beach. Although this intervention technique avoids some of the pitfalls associated with nest relocation, it too has drawbacks:

1. After leaving the nest, hatchlings crawl frantically to reach the ocean. Upon entering the ocean, they swim continuously for about 24 hours to reach protective offshore habitats (Wyneken and Salmon, 1992). Survivorship may depend on the amount of available energy during this frenzied swimming

phase. When confined by cages, the incessant crawling of hatchlings attempting to reach the ocean may deplete valuable energy reserves prior to their release.

2. As for nest relocation, some nests are likely to be missed during morning surveys, and hatchlings from these nests are at risk from light pollution. Similarly, nest caging does not address the degradation of nesting habitat caused by artificial lighting. Incubation periods of nests cannot be accurately predicted and some nests hatch earlier than expected before the cage is put in place. Unrestrained hatchlings are then subject to disorient away from the ocean.
3. Caging is labor intensive because cages must be checked several times every night that the nest is caged. Hatchlings collected must be released on another darker beach, which similar to relocation, may interfere with normal imprinting mechanisms.

Light Management

Because of the potential conservation liabilities associated with nest relocation and caging, current conservation philosophy advocates light management as the best strategy for minimizing lighting impacts to sea turtles. The management of light pollution is occurring nationwide to reduce urban skyglow and the inefficient use of electricity. Good lighting provides adequate light for the intended task, but never over-lights. Poor outdoor lighting can be costly, glairy and wasteful, particularly if it “trespasses” beyond the target area where it is needed. Reducing light pollution has benefits to humans by conserving electricity, saving money and darkening the sky for celestial observations while still providing sufficient light for visibility, safety and security.

These same light management principles are feasible and economically practical in most coastal settings, including Volusia County. If properly implemented, light management can substantially reduce the need for sea turtle nest manipulation while maintaining the desired effects of nighttime lighting. Beachfront light management techniques include turning off unnecessary lights, minimizing outdoor lighting that trespasses onto the sandy beach, and minimizing lighting from indoor sources. Effective light management can be applied to private single and multi-family buildings, publicly operated lights such as street lights and public park and parking lot lights and to commercial properties.

Additional information about the human benefits of light management is available from:

the International Dark-Sky Association
3545 N. Stewart Avenue
Tucson, AZ 85716
E-mail: SaveOurSky@aol.com
WWW: <http://www.darksky.org>

LIGHTING ORDINANCES

Most coastal communities adjacent to important nesting beaches in Florida have implemented some type

of lighting ordinance, including Volusia County, to implement these techniques. High rates of compliance have been achieved through effective public awareness programs and dedicated enforcement. Unfortunately, few communities that have implemented beachfront lighting regulations have any good statistics on the effects these regulations had in reducing hatchling disorientations. Where nests were relocated because of lights, there is no background data. Even where nests were left *in situ* (in place), the lack of systematic surveys for disorientation events (e.g., equal survey effort, proper scientific assessment, consistent reporting, etc.) precludes valid comparisons of data collected before and after lighting modifications. Nevertheless, there is both experimental (see Lohmann et al., 1997 for summary) and anecdotal evidence (B. Witherington, FDEP; pers. comm.) to show that hatchling disorientations will be reduced on beaches where coastal lighting is properly managed.

Adopting a lighting ordinance is a significant step towards managing outdoor lights for sea turtles. However, the enforcement processes and the cooperation of beachfront property owners are the critical factors for improving the lighting environment. Volusia County and the municipalities of Ormond Beach and New Smyrna Beach have had lighting ordinances in place for more than five years (Appendix A). All three of these jurisdictions perform enforcement tasks to implement their ordinances, such as advising beachfront residences of ordinance requirements, performing nighttime lighting evaluations, fielding reports of problem lights and disorientations from the Volusia Turtle Patrol and the Volusia Sea Turtle Society, sending out notices to properties with problem lights, and even forwarding difficult cases to their respective Code Enforcement Boards for resolution. Volusia County even passed amendments to the lighting ordinance to clarify compliance requirements. However, disorientation events continue to occur in Volusia County in spite of these enforcement efforts.

The current state of affairs regarding sea turtles in Volusia County has received a great deal of attention recently, particularly the continuation of hatchling disorientation events. Critics blame enforcement officials, claiming that they are not doing enough to prevent disorientations. The officials, on the other hand, spend many hours every summer attempting to minimize the potential for these events and seem equally frustrated by the continuation of disorientations in spite of their efforts.

Enforcing a lighting ordinance is a complex process requiring dedicated resources by government jurisdictions plus diplomatic negotiations with property owners and other light custodians, such as Florida Power and Light (FPL) and the New Smyrna Beach Utilities Commission (NSBUC). Volusia County and the cities have experienced some of these enforcement problems and have made some adjustments to correct. Beachfront light management has been one arena where the cities and County have worked cooperatively to share ideas and resources to improve their programs. Meanwhile, there is increasing public demand to increase enforcement of the lighting ordinance even further and to close some of the apparent gaps that result in the continuation of disorientation events.

ISSUE IDENTIFICATION

Several issues inherent to eliminating or minimizing artificial beachfront lighting along developed beaches, especially heavily developed urban areas as in some parts of Volusia County (Daytona Beach and Daytona Beach Shores), include crime and public safety, insurance liability, interior lighting of beachfront

structures, retrofit costs and the use of flashlights and lanterns on the beaches. An additional issue identified for Volusia County is the exemption from the County's lighting ordinance for existing development (building permit issued prior to May 17, 1990) for Daytona Beach and Daytona Beach Shores (Peterson, 1997).

Crime and Public Safety

In an effort to identify the relationship of artificial beachfront lighting and crime and public safety issues, two meetings were held with officials responsible for law enforcement on the beaches within the County. Attendees at these meetings included representatives from Volusia County Environmental Management Division, Beach Services and Code Enforcement; law enforcement for the County, Daytona Beach, Daytona Beach Shores, and Ormond Beach; and a condominium association. Three significant issues were identified during these meetings: beachfront crime, the Florida Convenience Business Security Act and highway driving safety. A discussion of each of these issues follows.

Crime. Beachfront crime is not uniformly distributed within Volusia County. The heavily populated urban areas of Daytona Beach, Daytona Beach Shores and Ormond Beach experience the most criminal activity while the other municipalities and unincorporated areas of the County boast a smaller crime rate. In these heavily populated urban areas, law enforcement officials generally agreed that the County's efforts to limit beachfront lighting could pose some crime prevention challenges. These officers would rather have bright white metal halide lights illuminating parking lots and other common areas rather than the sea turtle friendly LPS or other low voltage yellow lighting. A bright white light enables a law enforcement officer to see whether suspicious activities are taking place or to see if a suspect has a weapon or not, while LPS or other low voltage yellow lighting tends to distort colors and the officer's ability to clearly assess a potential or actual criminal situation.

Florida Convenience Business Security Act. A potential conflict could arise between the County's efforts to decrease artificial beachfront lighting and the State law set forth by the Florida Convenience Business Security Act (Florida Statute 812.171 - 812.176). This Florida Statute defines a convenience business as any place of business that is primarily engaged in the retail sale of groceries and/or gasoline and is open for business between the hours of 11 p.m. and 5 a.m. For security purposes, this State Law mandates, among other requirements, that a convenience business be equipped with a lighted parking lot illuminated at an intensity of a least two foot-candles per square foot at eighteen inches above the surface and a convenience business shall not have window tinting that reduces exterior or interior view in a normal line of sight. Peterson (1997) provides photographic examples of how lights at convenience stores can be managed so that the Florida Convenience Business Security Act can be followed, along with minimizing the amount of light illuminating the beach.

Highway Driving Safety. Each year the County authorizes FPL to turn off certain streetlights to minimize the amount of public lighting which illuminates the beach during sea turtle nesting season. The County's Environmental Management Division receives numerous complaints from County residents regarding driving safety along the darkened roadways, especially along SR A1A (Oceanshore Boulevard) in northern Volusia County. The streetlights in this area will no longer have to be turned off now that they have been

retrofitted with “cut-off” shields and amber acrylic lenses. The shields control the direction of the light onto the road while the lenses control the quality of light by filtering out disorienting short wavelengths. A nocturnal lighting survey indicated that these shields and lenses are very effective at minimizing the amount of public lighting spillover onto the beach. The result is that SR A1A in this vicinity is very dark. This leads to the issue of liability should an accident occur due to reduced light levels brought on by sea turtle conservation efforts.

Insurance Liability

Beachfront property owners, especially hotel, motel and condominium owners and operators, have expressed concern about the potential liability they could incur should someone on their property trip, fall or sustain an injury due to inadequate lighting. Volusia County does not encourage, support or advocate any measures which would cause hazardous conditions for beachfront residents or visitors. In this regard, the beachfront lighting ordinances in effect in Volusia County, including New Smyrna Beach and Ormond Beach, state that it is the beach that may not be illuminated during turtle nesting season, not the beachfront properties. Ways of illuminating beachfront property that will ensure the safety of residents and visitors, while minimizing the amount of light which reaches the beach include low profile luminaires, motion detector lighting, and redirecting, shielding and shading existing lighting.

In addition, the question of liability arises if an accident occurs due to reduced nighttime light levels from the efforts to minimize public street lighting which illuminates the beach. Numerous residents in northern Volusia County have complained about the reduced visibility along SR A1A due to the shields and lenses installed on the streetlights. To date, no accidents have occurred which have been blamed upon the streetlight management efforts, therefore, no precedent exists. For that reason, this is an outstanding issue which remains a concern for Volusia County.

Interior Lighting of Buildings

Several methods can be employed to minimize illumination of the beach from indoor lighting sources, such as turning off lights in beachfront rooms not in use, moving lamps away from beachfront windows, closing opaque curtains or blinds after dark, and window tinting. Volusia County and Ormond Beach’s lighting ordinances for new development require tinted glass on all windows of structures within line of sight of the beach. The lighting ordinance for Ormond Beach also allows blackout drapes or shade screens as an alternative to utilization of tinted glass; however, this assumes that the drapes or screens will be closed after dark, even though this is not stated in the ordinance. The lighting ordinance for New Smyrna Beach does not include any window tinting requirement for new development.

None of the lighting ordinances require beachfront residents or visitors to turn off lights in beachfront rooms not in use, move lamps away from beachfront windows or close opaque curtains or blinds after dark. The enforcement of these sort of measures would not only prove to be very difficult, but also would tend to fringe upon violation of privacy. For these reasons, Volusia County Environmental Management Division has determined that the efforts to minimize beachfront lighting from indoor lighting sources will

be accomplished through a vigorous public awareness campaign, as opposed to modifying the lighting ordinance.

Flashlights and Lanterns

Flashlights on the beach are considered a transient light source since they are usually used for a relatively short time. Flashlights normally contain a white, incandescent bulb, and their use around nesting or hatchling sea turtles can negatively affect a sea turtle's ability to locate the ocean. However, a flashlight that has a red filter placed over the lens (such as red plastic wrap which is readily available in grocery stores) still provides adequate light visible to humans but minimally affects a sea turtle's ability to locate the ocean. White, pressurized-fuel, glowing element lanterns, on the other hand, are not necessarily a transient source since they may be used on the beach for a longer period of time by people fishing or performing other activities at night.

During turtle nesting season, many people walking on the beach at night most of these people are, in fact, seeking to observe a nesting female or the emergence of hatchlings from a nest. Once again, to disallow flashlights or lanterns on the beaches of Volusia County during turtle nesting season is difficult. For this reason, Volusia County has determined that efforts to minimize the disruptive effects of flashlights and lanterns on sea turtles will be accomplished through a vigorous public awareness campaign which will discourage the use of lanterns and encourage the use of flashlights with a red filter on the lens.

Retrofit Costs

Paramount to any attempt to manage artificial beachfront lighting is the consideration of the retrofit costs for both private and public lighting. As discussed previously, the NSBUC has designed, constructed and installed "cut-off" shields for the public lighting in New Smyrna Beach and FPL has installed "cut-off" shields and lenses for the public lighting along SR A1A (Oceanshore Boulevard) in northern Volusia County. The retrofit costs for private beachfront lighting, which includes homes, condominiums and hotels/motels must be paid by the owners or managers of these facilities.

Cost estimates were obtained from local suppliers for motion detector security lighting and domed path lighting for decks and balconies and window tinting. The cost of motion detector security lighting ranged from \$12.90 for 110 degrees of coverage to \$27.75 for 240 degrees of coverage. A solar powered model was also available for \$79.90. The cost of a dusk-to-dawn shielded and directional mercury vapor light is \$38.88. A motion sensing adapter could be added to this light for approximately \$20.00, resulting in a shielded, directional motion detector security light for about \$59.00. A domed path light which would be ideal to provide safety lighting on balconies, decks and around pool areas retails for \$25.70 (Peterson, 1997).

The cost of residential window tinting which would reduce the light transmittance by 45 percent was \$1.70 per square foot (sf) for the film only or \$2.50 per square foot installed. The costs (rounded) of window tinting for a standard sliding glass door was \$60.00 for the tinting alone or \$89.00 installed. Window

tinging for a standard plate glass window was \$51.00 or \$75.00 installed (Peterson, 1997). In the past, FPL offered a financial incentive to residential homeowners by providing a cash discount to the total cost of installing window tinting on the windows of their homes. In Volusia County, FPL now only offers this discount for west facing windows, which are not in direct line of sight of the beach and would probably not provide any sea turtle conservation benefits if tinted. The total retrofitting cost for each facility can be determined by multiplying the unit cost by the number of windows.

Daytona Beach and Daytona Beach Shores Exemption

Volusia County has exempted Daytona Beach and Daytona Beach Shores from the lighting ordinance for existing development (Section 50-248), citing these areas as not likely to be utilized by sea turtles for nesting. Existing development is that which had a building permit issued prior to May 17, 1990. This exemption does not apply to new development (building permit issued subsequent to May 17, 1990). Daytona Beach and Daytona Beach Shores comprise the most developed, populated and commercial tourist beach area in the County, with many hotels, motels, high and low rise condominiums, and commercial establishments in this vicinity, both on and near the beach. In most cases, the beaches in these two towns are very brightly illuminated by the beachfront establishments in order to provide a safe and secure beach for their patrons. In addition, as with most densely developed areas, the lights on and near the beach also contribute to an urban "sky glow" at night when viewed from a few miles away.

Many factors must be considered prior to a decision on whether to include Daytona Beach and Daytona Beach Shores in the County's lighting ordinance for both existing and new development. Crime and public safety for residents and tourists in these areas are probably the most important factor for consideration. Daytona Beach and Daytona Beach Shores are one of the beachfront areas in the County which experience the most criminal activity due to the large population of permanent residents, transients and tourists. As discussed previously, law enforcement officials for these areas generally agree that any efforts to limit beachfront lighting in these two towns could pose some crime prevention challenges.

Another factor to be considered is the existing sea turtle nesting density in these areas. A brightly illuminated beach may deter a female sea turtle from emerging from the ocean to nest. It would be improper to assume that since the nesting densities are lower in Daytona Beach and Daytona Beach Shores, there is no need to limit beachfront lighting. Loggerhead turtles which nest in Volusia County are believed to belong to a genetically distinct population from those that nest south of Cape Canaveral (Bowen, 1997). The genetic importance of the northern loggerhead population warrants conservation of all of Volusia County's sea turtles.

The illumination of the beach in Daytona Beach and Daytona Beach Shores may have, in fact, caused the nesting in these areas to be low. If the artificial lighting on these beaches is minimized or eliminated, the nesting densities may increase (Witherington and Martin, 1996). Another important consideration, however, is that if light levels are reduced enough to encourage more nesting, it may not be reduced enough for more sensitive hatchlings. This circumstance may place a greater number of hatchlings at risk from disorientation and increase the need for caging, which is contrary to the principal objective of the BLMP.

INCIDENTAL TAKE PERMIT & THE BLMP

Another important sea turtle conservation issue in Volusia County involves public vehicular access to the beaches. Volusia County developed a Habitat Conservation Plan (HCP) to address and balance conflicting interests between public access to the beach and sea turtle protection. The result of this plan, after approval by the US Fish and Wildlife Service, was issuance of an Incidental Take Permit (ITP) that allows public vehicular access to continue under very specific circumstances intended to minimize the threat to sea turtles and other protected species.

The Incidental Take Permit relieves the County from responsibility for the incidental take of sea turtles resulting from public vehicular access as long as the HCP is being enforced and all terms and conditions of the permit are met. The potential for incidental take by vehicles on the beach includes both direct impacts (e.g. vehicle running over a hatchling) as well as habitat modifications and other non-lethal disruptions to normal sea turtle behavior (e.g. vehicle ruts). No direct sea turtle mortality resulting from vehicle traffic has been documented since the HCP has been in effect.

In contrast, the evidence of incidental take caused by artificial lighting is considerable. Almost 100 hatchlings were found dead on the beach because of disorientations in 1997, and hundreds more were taken by ghost crabs (Volusia Turtle Patrol, Volusia Sea Turtle Society reports). The Incidental Take Permit does not cover, or remove responsibility for, incidental take caused by artificial lighting, primarily because Volusia County is not solely responsible for the lights and because this cause of incidental take can presumably be corrected. The ITP does, however, include requirements for artificial light management where the County does have responsibility. Most of these permit conditions are measures above and beyond what Volusia County did voluntarily in previous years. These conditions include:

1. Perform monthly lighting surveys from April 1-October 31 each year & compile lists of infractions.
2. Develop a methodology for documenting and citing light sources that disorient sea turtles.
3. Survey all beachfront lights operated by the County and correct all lights deemed a problem for sea turtles.
4. Establish a training manual.
5. Hold at least two workshops on lighting and beach crime to provide information about the effects of enforcing the lighting ordinance and the effects on crime occurrences.
6. Develop and implement a comprehensive County-wide, long-term Beach Lighting Management Plan (BLMP).

ELEMENTS OF THE BLMP

This document represents the first phase of the Volusia County BLMP. The intent is to describe Volusia County's artificial light environment and resulting effects on sea turtles and to provide an implementation strategy for reducing impacts. The BLMP analyzes the effectiveness of existing ordinances and enforcement practices and the role of municipalities in light management efforts. It also presents recommendations for further evolution of, and improvement to, management of the beachfront lighting environment in Volusia County. When properly applied, the techniques contained in this manual are

intended to reduce the potential for disorientations and the need for manipulating sea turtle nests, allowing them to be left in place and the reproductive process to occur naturally without human intervention.

The Volusia County BLMP contains the following elements:

1. **Characterization of Existing Lighting Environment** - This section includes an assessment of upland development along the beachfront and the observed nighttime lighting environment. This assessment was conducted during July, 1997.
2. **Sea Turtle Nesting and Disorientations** - This section summarizes historical sea turtle nesting and disorientation records in relation to beachfront development. Trouble spots where disorientation events have repeated year after year are identified.
3. **Ordinance Review & Improvement** - This section evaluates the three ordinances currently in place in Volusia County (Volusia County, City of Ormond Beach, City of New Smyrna Beach) and provides recommendations for improving them.
4. **Enforcement Program Review** - This section proposes methods for analyzing the various levels of enforcement actions for both existing lights and proposed facilities. Enforcement process improvement recommendations are provided to reduce some of the problems experienced with enforcement of the lighting ordinance.
5. **Public Awareness Program** - This section provides a strategy for developing an education campaign by identifying target groups and providing sample materials. A technical assistance program is proposed for assisting coastal property owners with correcting specific lighting problems.
6. **Long Term Monitoring** - This section provides reasons for maintenance and evaluation of beachfront lighting throughout the term of the Incidental Take Permit. In addition, the importance of standardized disorientation reporting is discussed, as this is one of the primary means to alert lighting managers that a problem exists.
7. **Implementation Strategy** - A strategy for implementing the scope of work of the BLMP during Years 2 - 5 of the Incidental Take Permit is provided. This strategy is subject to change; however, the ultimate goal of providing safe nesting beaches during this time frame will remain unchanged.

CHARACTERIZATION OF EXISTING LIGHTING ENVIRONMENT

BLMP ZONES & JURISDICTIONS

The Volusia County coastline was divided into sections based upon government jurisdictions and major landmarks for the purposes of the BLMP (Table 1). The BLMP zones start at the southern boundary of the North Peninsula State Recreation Area (NPSRA) and end at Canaveral National Seashore (CNS), corresponding to the County Beaches identified in the Habitat Conservation Plan. The characterization of upland development and historical sea turtle activity are based on these zones and address references.

The Volusia County BLMP addresses light management in five municipalities and three unincorporated areas under Volusia County jurisdiction (Figure 1). The following abbreviations are sometimes used throughout the BLMP to refer to each jurisdictional area:

Ormond by the Sea	OBS
City of Ormond Beach	OB
City of Daytona Beach	DB
City of Daytona Beach Shores	DBS
Wilbur by the Sea	WBS
Town of Ponce Inlet	PI
City of New Smyrna Beach	NSB
Bethune Beach	BB

UPLAND DEVELOPMENT PATTERNS

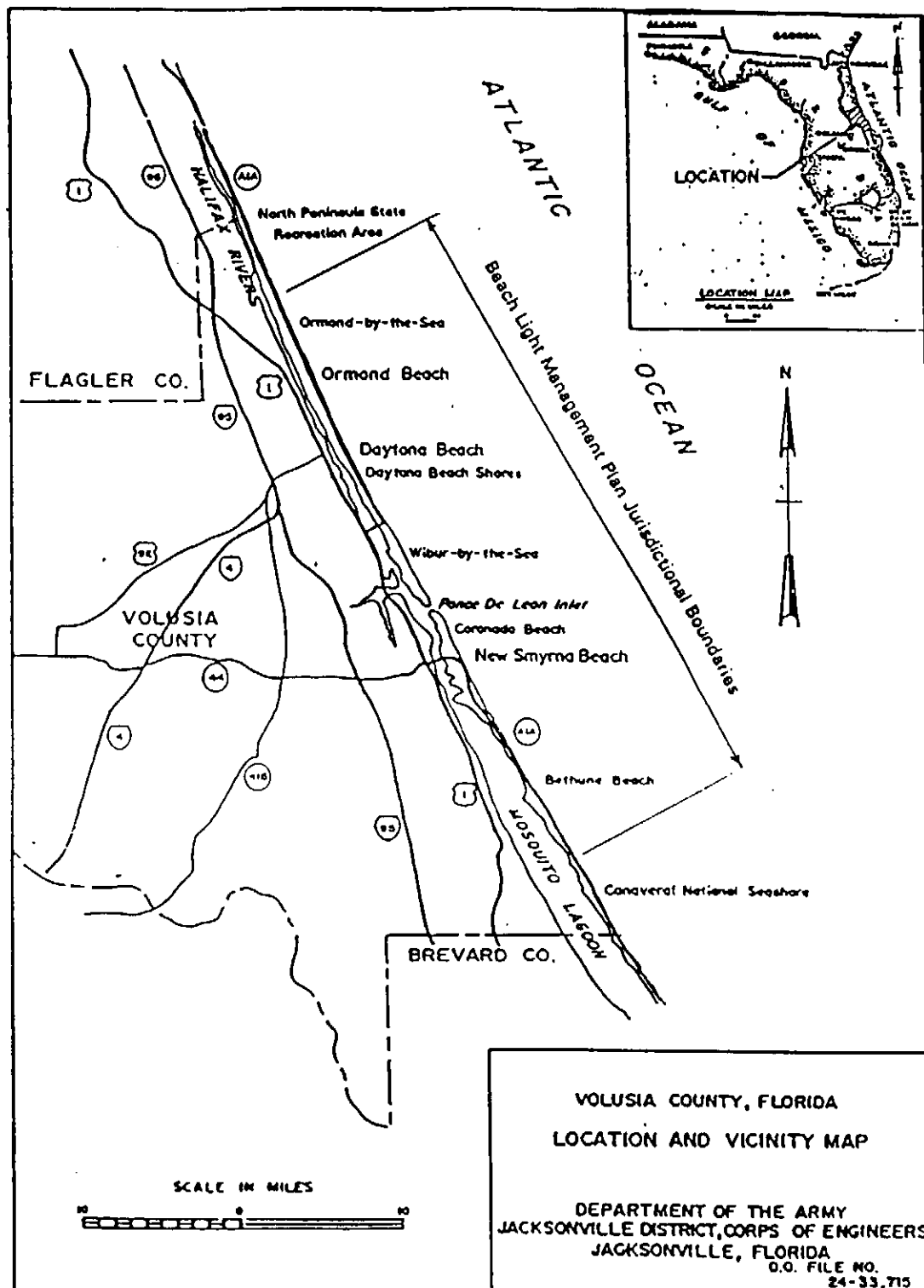
Understanding the existing beachfront development and associated lighting environment is critical to developing an approach to reduce lighting impacts in Volusia County. Consequently, one of the principal elements of the BLMP was a preliminary nighttime evaluation of the County's coastline. Results from this survey were combined with both historical sea turtle nesting and disorientation data to develop an approach to light management that will yield the greatest conservation value.

The upland development and coastal lighting within each zone was evaluated and described during nighttime surveys on July 28-29, 1997, performed by Volusia County Environmental Management staff, including an intern (Peterson, 1997). The intent of this preliminary, snapshot survey was to generally assess the type of upland development and patterns in the overall lighting environment, but not to identify every potential problem light. Hard copies of digital aerial photographs with addresses and cross streets superimposed provided information about the types and names of facilities referenced in the characterization survey (Appendix B).

Table 1. Division of Volusia County Beaches for purposes of the BLMP based on HCP beach management areas, jurisdiction and major landmarks. All lights are covered by ordinance except for Daytona Beach and Daytona Beach Shores existing facilities as of July 1, 1990.

HCP	BLMP	BOUNDARIES	ADDRESS BLOCKS	JURISDICTION
2	I	NPSRA - NC Lifeguard Station	4000-1600 Oceanshore Blvd.	Volusia County
	II	NC Lifeguard Station - Ormond Beach City Limits	1600-1010 Oceanshore Blvd.	Volusia County
	III	Ormond Beach City Limits - Granada Blvd.	1010-10 Oceanshore Blvd.	City of Ormond Beach
3	IV	Granada Blvd. - Daytona Beach City Limits	10-900 S. Atlantic Ave.	City of Ormond Beach
	V	Daytona Beach City Limits - Zelda Blvd.	3000-1400 N. Atlantic Ave.	City of Daytona Beach
4	VI a	Zelda - Daytona Beach Shores City Limits	1400 - 1900 S. Atlantic Ave.	City of Daytona Beach
	VI b	DB Shores City Limits - Florida Shores Blvd.	1900 - 2625 S. Atlantic Ave.	City of Daytona Beach Shores
5	VII	Florida Shores - Emilia Avenue	2637 - 3800 S. Atlantic Ave.	City of Daytona Beach Shores
6	VIIIa	Emilia Ave. - Wilbur by the Sea	3800 - 3850 S. Atlantic Ave.	City of Daytona Beach Shores
	VIIIb	Wilbur by the Sea - Ponce Inlet Town Limits	3850 - 4300 S. Atlantic Ave.	Volusia County
	VIIIc	Ponce Inlet Town Limits - Beach Street	4300 - 4890 S. Atlantic Ave.	Town of Ponce Inlet
7	IX	Beach Street - Ponce Inlet North Jetty	4890 - 5000 S. Atlantic Ave.	Town of Ponce Inlet
8	X	Ponce Inlet South Jetty - Crawford Rd.	All Ocean Dr. Beacon St. between Surf & Cortez	City of New Smyrna Beach
	XI	Crawford Rd. - 27th Ave.	600 - 100 N. Atlantic Ave. 100 - 3700 S. Atlantic Ave.	City of New Smyrna Beach
9	XIIa	27th Ave. - NSB City Limits	3700 - 4500 S. Atlantic Ave.	City of New Smyrna Beach
	XIIb	NSB City Limits - Bethune Beach	4500 - 5501 S. Atlantic Ave. 4800 - 4850 Saxon Dr.	Volusia County
	XIII	Bethune Beach - Canaveral Natl. Seashore	5501- higher S. Atlantic Ave.	Volusia County

Figure 1
Beach Light Management Plan
Jurisdictional Boundaries
Volusia County, Florida



LIGHTING CHARACTERIZATION SURVEY

The following is a characterization of the coastal lighting in Volusia County starting at the North Peninsula State Recreation Area (NPSRA) and moving south. The dates for this survey were July 28 and 29, 1997 and were conducted at night by Volusia County Environmental Management staff. The observations were tape recorded and transcribed.

I. NPSRA to North County Lifeguard Station (Natural Beach Area) **4000 - 1600 Oceanshore Boulevard, Ormond by the Sea**

The area from the NPSRA to the North County lifeguard station (1600 block of Oceanshore Blvd. or State Road A1A) consists of no structures east of SR A1A, streetlights on the west side of SR A1A, and a mixed use of single family homes, condominiums, restaurants, convenience stores, and other commercial establishments located on the west side of SR A1A. The majority of the structures are one and two-story buildings, with the exception of the condominiums, some of which are 6-8 stories.

Light problems identified included brightly lit business signs, security lights for commercial establishments, balcony lights from the condominiums, street lights along SR A1A, and street lights leading into subdivisions and from side streets intersecting with SR A1A.

The North County lifeguard station is the first structure on the east side of SR A1A. It is actually located on the beach itself, east of the dune system. Bicentennial Park located on the west side of SR A1A is the only other public facility in this section.

II. North County Lifeguard Station to Ormond Beach City Limits (Natural Beach Area) **1600 - 1010 Oceanshore Boulevard, Ormond by the Sea**

This area begins the development of structures east of SR A1A and just west of the dune system. The structures in this area consist of residential condominiums, timeshare condominiums, small motels, and single family residences. Some of the multi-family facilities include Ormond by the Sea, Ormondby, Regency, Traders Inn, Tiffany, Gemini, Seawinds, and Surfside Club North and South. There are no commercial establishments in this area.

Potential lighting problems consist of pool lights (particularly the globe lights), spotlights under the eaves of houses, and interior lights, especially at the condominiums. Balcony lights at the condominiums and motels do not appear to be a problem. Some of the pool globe lights have been painted black on the beach side but are showing signs of wear and do not cover enough of the globe to keep light from trespassing from the sides.

The street lights of SR A1A and commercial sign lights are visible from the beach from in between the structures on the beach but do not appear to cast a shadow on the beach.

III. Ormond Beach City Limits to Granada Boulevard Approach (Natural Beach Area)
1010 - 10 Oceanshore Boulevard, Ormond Beach

This entire area, approximately 2 miles long, consists of single family residences, except for five multi-family buildings at the north end. The beach in this area is very dark. Potential lighting problems are interior lights and spotlights under the eaves and in the corners of the homes. Several of the homes have switched their white exterior lights to yellow lights. One house in particular has numerous bright yellow lights on the beach side of the property.

At certain places in this area, the streetlights of SR A1A are visible from the beach, but don't appear to cast a shadow on the beach.

IV. Granada Boulevard Approach to Daytona Beach City Limits (Transitional Area)
10 - 900 S. Atlantic Avenue, Ormond Beach

This area begins the Transitional Beach Area, where vehicular access is allowed, and extends south to the Aliki Atrium at 901 S. Atlantic Avenue. The development in this area is characterized by multi-story condominiums and timeshare units, motels (both small and medium size) and single family residences, interspersed among each other.

There are several motels in this area that have replaced their white balcony lights with yellow lights, but the cumulative amount of the lights puts a yellow glow on the beach. This is especially true of the Granada Inn, the first structure south of the Granada Approach. In addition, there are numerous sites (both motels and condominiums) that have the globe lights in their pool areas. A majority of them have painted the backsides (facing the beach) black but the paint is beginning to fade and chip off. The first couple of condominiums south of Granada do not have balcony lights.

The ground floor of several of the motels in this area is for parking and there are ceiling mounted lights located in the parking area. The majority of these lights have been shielded on the beach side and the shields appear to effectively block light from shining on the beach.

The residential homes were dark during this survey and the only potential problem lighting would be interior lights and spotlights under the eaves.

Around the Cardinal Street Lifeguard Station there are primarily motels with numerous balcony lights, the majority of which are yellow lights. These motels are older units (probably 30 years old) and are two, three, and four stories high. The lights that were observed were balcony lights, underground (ground level, first floor) parking lights, and interior lights.

V. Daytona Beach City Limits to Zelda Boulevard Approach (Transitional Area)
3000 - 1400 N. Atlantic Avenue, Daytona Beach

Beachfront facilities just over the Ormond Beach/Daytona Beach city limits are two, three, and four story motels. These motels have more pool and patio lights than the motels observed in the Ormond area,

most of which are painted black on the beach side, but the paint is beginning to chip away because of the salt environment.

Moving south of these motels the area changes to tall (15-20 stories) condominiums. Each floor of these condominiums has a balcony light on each corner of the building. These lights don't appear to illuminate the beach but are clearly visible from the beach. The first floor of these units have bright lights in the pool/patio area.

Across from Belair Plaza are several large motels (6-10 stories) with balcony lights associated with every room, some of which are white and some are yellow. These buildings include the Holiday Inn, La Playa and the former Voyager Motel. The beach is illuminated brightly by these motels. Globe lights surround the pool/patio areas and these also illuminate the beach.

The Voyager Motel, a large unit, was undergoing extensive renovation during the survey and was dark at the time. Subsequently, this unit reopened as the Grand Seas Resort timeshare and the Volusia Turtle Patrol informed the County that they have done an excellent job of managing their lights, to the point where this facility may be used as a model for other motels on the beachside.

South of the Grand Seas Resort, the beach area becomes single family residential homes. Many of the homes in this area are older homes, although some of these structures are being torn down and replaced with larger, more expensive homes. The only lights visible during the survey were interior lights. In between the homes the street lights along SR A1A are visible from the beach, although they do not illuminate the beach.

Continuing south from the residential home section, the condominiums become prevalent again. These units have balcony lights on the north and south ends of each floor. These buildings are 8-10 stories high. There is one condominium, the Beachcomber Inn, in this area with major spotlights on the building and in the parking area. The beach is brightly illuminated.

South of this area the beach becomes single family residences (1900 - 1600 N. Atlantic Avenue). The homes in this area have more floodlights illuminating their properties and the beach than the residential sections to the north. This area of single family residences is about a mile in length and the homes in the southern end of the area were darker than the homes in the northern section.

The next section of the beach is a mixture of small (2-3 stories), older motels and large (15-20 stories) condominiums (1600 - 1400 N. Atlantic Avenue). Lights observed included balcony lights, pool lights and security lights on poles in the parking areas.

Via. Zelda Boulevard Approach to Daytona Beach Shores City Limit (Urban Area)
1400 N. - 1900 S. Atlantic Avenue, Daytona Beach

This area of the beach is characterized by both 2-3 story motels as well as larger motels such as the Desert Inn, Whitehall, and Holiday Inn Sunspree. All these sites have bright lights on the upper stories of the buildings (balcony lights and spotlights) and globe lights in the pool deck areas. The Desert Inn is a good example of a large motel with numerous globe lights in the pool deck area, while the Holiday Inn

Sunsprees has both the pool lights and the balcony lights. These are older motels that have been in the area for many years. The beach is brightly illuminated throughout this area. In between the motels the street lights along SR A1A are visible from the beach but it is impossible to tell if they illuminate the beach due to the lights associated with the motels.

The beachfront section from Seabreeze Boulevard to International Speedway Boulevard is referred to locally as the "Core Area" of the Daytona Beach tourism district. Just north of the Bandshell is Oceanfront Park. This park is very well lit although the lights do seem to have an orange/yellow glow to them. The Bandshell is well lit and it illuminates the beach. The Boardwalk area is well lit with bright white lights and neon lights. The Adams Mark hotel is located in this area and is one of the largest hotels on the beach. The Adams Mark does not have any balcony lights. The first two stories of this building are well lit as this is where the bars and restaurants are located.

The Main Street Pier is very well lighted and illuminates the beach on either side of it. The Pier is at the south end of the Boardwalk area.

South of the Pier there are more of the older motels, exhibiting the same lighting problems as those motels north of the Pier. Several of these motels have bars associated with them, with the corresponding neon signs in the windows of the establishments.

South of the International Speedway Boulevard approach the beach is characterized by small (1-2 story) motels interspersed with single family residences. The houses were fairly dark but the motels have numerous bright lights in the eaves of the buildings. To the south of this section is Revilo Park, which was not illuminated during the survey, but is proposed to be developed into a public park. To the south of the park is a six story motel (Howard Johnson's) with balcony lights on every room. Beyond this motel south of Lenox Avenue, the beachfront development again becomes the small motels and single family residences.

South of the Silver Beach approach the area is primarily motels but larger in size (4-6 stories). Tall lights in the parking areas, balcony lights on each room, globe lights in the pool deck area, and interior lights characterize this area of the beach.

Vib. Daytona Beach Shores City Limits to Florida Shores Boulevard (Urban Area)
1900 - 2625 S. Atlantic Avenue, Daytona Beach Shores

South of the Days Inn in Daytona Beach Shores are motels (6-8 stories) interspersed among condominiums and small motels (1-2 stories). Light characterization is the same as in the previous sections of the beach.

South of the Sun Viking Lodge in Daytona Beach Shores, the beachfront is characterized by large condominiums (15-20 stories high), small condominiums, and single family homes. Balcony lights don't seem to be a problem but there are spotlights under the eaves, interior lights, and globe lights in the pool deck areas. The beach is also brightly illuminated in this section.

VII. Florida Shores Boulevard Approach to Emilia Avenue Approach (Transitional Area)
2637 - 3800 S. Atlantic Avenue, Daytona Beach Shores

The Hilton Hotel begins this area of the beach with numerous balcony lights that illuminate the beach. The globe lights on the pool deck do not seem to be as much of a problem as some of the other globe lights associated with motels.

South of the Hilton Hotel the beach becomes single family residential. This area of the beach is dark, with the lights observed being associated with interior lights. A few homes did have bright spotlights located under the eaves. This area is approximately ½ mile in length.

Just south of the residential section is where the Oceans Condominiums are located. There are eleven of these high-rise condominiums. There are no balcony lights on these units but they have large globe lights on the pool area and seawall. The seawall is very high so the lights along here sit high off the beach. Because of the height of the seawall and the height of the condominiums, the street lights along SR A1A are not visible from the beach.

South of the Oceans Condominium complex the area consists of older two story motels with floodlights under the eaves and spotlights mounted on poles in the parking area. Beyond these units are smaller condominiums (8-10 stories). No balcony lights are associated with these sites, but there are the globe lights in the pool area. The Ramada Inn Surfside hotel is in this area which has large spotlights illuminating their deck.

South of the Ramada Inn the beach can be characterized as a mixed use of condominiums and motels, with a combination of older, smaller units interspersed with newer units that are higher in size (8-10 stories). There is also a Holiday Inn motel located here. The lights associated with these units are balcony lights that are bright white. The smaller buildings also have spotlights under the eaves. There is also a large condominium that appears to be very dark, including the pool deck area.

The motels in the Dunlawton Approach area are 6-8 stories in height, with no balcony lights but globe lights in the pool deck areas. Interior lights are an issue here also.

The Sunglow pier has lights all along its structure that illuminate the beach from the dune area to the end of the pier in the water. South of the pier is a mixture of smaller, older motels and newer, higher motels. Approximately 1/4 mile south of the pier condominiums start up again. Balcony lights do not appear to be a problem but there are elevated lights and globe lights in the pool deck areas.

VIII.	Emilia Avenue Approach to Beach Street Approach	(Natural Beach Area)
VIIIa	Emilia Ave. - Wilbur by the Sea	3800 - 3850 S. Atlantic Ave., DB Shores
VIIIb	WBS - Ponce Inlet Town Limits	3850 - 4300 S. Atlantic Ave., WBS
VIIIc	Ponce Inlet Town Limits - Beach Street	4300 - 4890 S. Atlantic Ave., Ponce Inlet

Entering this area from the north there are numerous high-rise condominiums with globe lights in the pool and parking areas but no balcony lights. Approximately ½ mile south of the Sunglow Pier at the southern city limits of Daytona Beach Shores, the condominiums stop and single family residences begin in unincorporated Wilbur by the Sea. The majority of the homes are dark, although there are instances of spotlights under the eaves and globe lights over a pool. The beach in this area can be considered very dark, with the only lights visible being interior lights of those houses where it appears that someone is home. The streetlights along SR A1A are visible from the beach but they do not cast a shadow on the beach.

There is a break in the homes as you get closer to the Beach Street approach where there is undeveloped land (Ponce Preserve), some of the only vacant land observed during the survey. This stretch of beach extends approximately 1/4 mile. After this there are several condominiums, including Southpoint and Sandcastle, which follow the typical pattern - no balcony lights but globe lights in the pool area, although the backsides of several pool lights have been painted black.

Brewster's Restaurant was located in this area but it closed for business in September 1997. This is the only commercial property in this area of the beach. This former restaurant is surrounded by condominiums, which are very dark, including the pool areas. The only light visible from these units is the interior lights. There is more undeveloped land interspersed among the condominiums. It could be assumed that these parcels of land will eventually be developed into condominiums; in fact, there is at least one unit under construction.

Past the last condominium the upland development again returns to single family residences. The homes in this area are close to SR A1A and have a good dune system built up between the back of the house and the beach itself. The beach is very dark and there does not appear to be a light issue with the homes in this section of the beach. The street lights along SR A1A are clearly visible from the beach because they are not shielded.

IX. Beach Street Approach to Ponce Inlet North Jetty (Transitional Area)
4890 - 5000 S. Atlantic Avenue, Ponce Inlet

This section of the beach can be characterized by no development, with the exception of a few homes just south of the Beach Street Approach. The Batelle marine paint test site and Lighthouse Point Park are located south of that section. This area of the beach is very dark; there were no lights observed illuminating the beach in this area.

X. Ponce Inlet South Jetty to Crawford Avenue Approach (Transitional Area)
Ocean Dr.; Beacon St.; N. Atlantic Ave. between Cortez & Crawford, New Smyrna Beach

From the south side of Ponce Inlet to the first condominium, Inlet Dunes, the beach is undeveloped and is part of Smyrna Dunes Park. Inlet Dunes condominium is a large (20 story) condominium that sits by itself behind the primary dune. The north side of this structure consists almost entirely of interior lighting; there are no balcony lights. There are three large red lights atop the structure, most likely for aircraft navigation. There are three globe lights over the pool/patio area that are painted black on the beach

side, but the paint is chipping. The south side of the structure has three vertical white accent lights that go from the first floor to the top of the building. These are highly visible from the beach.

South of the condominium is strictly single family residential homes which sit far off the beach, with a good dune structure between the back of the homes and the beach itself. The lights observed were all interior lights; there were no spot lights under the eaves, etc. The beach in this area is very dark.

Passing Beachway Approach the homes sit closer to the beach. Most of the homes were dark, although there was one home that had a spotlight under the eaves. Some street lights are visible from the beach but they do not appear to illuminate the beach and they are not of the magnitude of the street lights in the Daytona area.

The homes at the Crawford Approach sit right on the beach; there is very little dune in this area. Because of this, lights associated with these homes will be more problematic, although the homes did appear to be fairly dark. Interior lights were visible as well as the street lights sitting behind the homes; they are clearly visible from the beach.

XI. Crawford Avenue Approach to 27th Avenue Approach (Transitional Area)
600 - 100 N. Atlantic Ave.; 100 - 3700 S. Atlantic Ave.; Hill St., New Smyrna Beach

South of Crawford Avenue, condominiums become prevalent, with no balcony lights but interior lights were clearly visible. Globe lights in the pool area were also visible. There is also a large home with multiple spotlights under the eaves. In addition, there are several small motels in this area. The motels have balcony lights visible from the beach.

The Flagler Avenue beach approach is the heart of the commercial section of New Smyrna Beach on the beachside. There is a bar/restaurant right on the beach, and numerous commercial facilities along Flagler Avenue which cast a cumulative glow onto the beach. There is also a public parking lot on the south side of the approach, but the lights appeared to be well shielded.

South of the lifeguard station are multi-story motels and condominiums. These units do have balcony lights on them but only a few were lit. There are numerous globe lights over the pool areas that put out a glow onto the beach. Traveling farther south to 7th Street the beach becomes a mix of single family homes, condominiums and time share units. The homes appear to be dark. Problem lights associated with the condominiums are pole lights illuminating the parking areas and some balcony lights. Street lights along SR A1A are also visible.

There is a commercial establishment at 24th Street, Chases, which is a bar and restaurant, and although it is a business, the lights on the beachfront deck and building are well managed.

XII. 27th Avenue Approach to Bethune Beach (Natural Beach Area)
XIIa. 27th Ave. to NSB City Limits 3700 - 4500 S. Atlantic Ave., New Smyrna Beach
XIIb. NSB City Limits to Bethune Beach 4500 - 5501 S. Atlantic Ave.; 4800 - 4850 Saxon Dr.;
Van Kleeck Avenue; Bethune Beach

This area is characterized by high-rise condominiums and single family residences. There are some pole lights in the parking areas and globe lights over the pool area, with many of them painted black on the beach side. Balcony lights do not appear to be an issue. The issue of interior lighting appears to more problematic in this section than other sections of the beach. There is very little to no dune development in sections of this area. The single family residences were primarily dark.

South of the condominiums is an area of single family residential homes. The beach is very dark in this area. The only lights visible were interior lights of homes around the Hiles Avenue approach where residents appeared to be home. South of the approach, residential homes and numerous undeveloped lots were present. The beach south of Hiles along Van Kleeck is very dark.

South of where Saxon Boulevard meets A1A is an area consisting entirely of condominiums, ranging from low-rise (2 stories) to high-rise (6-8 stories). There appeared to be no problems with balcony lights; the problem lights are the common area lights, pool area lights, and a few eave lights. The lights in the area are well managed considering the extent of development. There are areas where the cumulative amount of lights from the condominiums cast a glow on the beach. These condominiums include Ocean Club North and South, Surfside, Southeaster, SeaWinds, Ocean View Towers, Tradewinds, Seascape Towers and Shoreham by the Sea. The Sandpiper Condominium is the last unit before entering the Bethune Beach area.

XIII. Bethune Beach to Canaveral National Seashore 5501 - higher S. Atlantic Avenue, Bethune Beach

(Natural Beach Area)

The north part of this area can be characterized as single family residences, with a combination of owner-occupied homes and rental homes. The rental homes are both seasonal and weekly. This makes the lighting issue problematic, because there is a large turnover of people occupying beachfront homes during the height of the nesting season. The homes sit behind the dune and on the west side of a road that fronts the beach. The beach in this area is very dark. The lights that were visible were the occasional interior light on a second floor of a home.

Just south of Mary Macleod Bethune Park is an area of high-rise condominiums, with globe lights over the pool area. Just south of the condominiums the beach turns into single family residences, both owner-occupied and rental units. In the southern part of this area the beach is heavily armored with rock revetments. The houses sit right on the beach and most of them have gazebo/walkovers that traverse the rocks down to the sand. There is no natural dune system in this part of the beach until you get to Canaveral National Seashore. The problem lights associated with this section of the beach are spotlights under the eaves and lights in the gazebos that are on the walkways located right over the rock revetments.

SUMMARY OF LIGHTING CHARACTERIZATION

Volusia County's coastline represents a broad range of lighting conditions and beachfront development characteristics. Certain sections of the beach, such as Daytona Beach and Daytona Beach Shores, were extremely bright while other sections were relatively dark, such as the area adjacent to Ponce de Leon Inlet.

Generally, the amount of light reaching the beach was related to:

- 1) The profile of beachfront development (i.e., height of structures),
- 2) The numbers and types of exterior lights,
- 3) The number of dwelling units per building (relates to interior lights),
- 4) The proximity of lighted structures to the beach,
- 5) The proximity of roadways to the beach, and
- 6) The density and height of vegetative buffers adjacent to the beach.

Generally, areas of single family residences had less light reaching the beach than areas where multi-family structures predominated. Highly commercialized areas, such the Daytona Beach Boardwalk, and areas dominated by large hotels and condominiums represent the worst cases of beachfront lighting as it relates to sea turtles. Not only does light from structures in these areas trespass onto the beach, in some instances it is intentionally directed onto the beach.

A number of characteristics germane to Volusia County and other urbanized coastal communities were identified. These conditions must be considered in any future attempts to reduce lighting impacts to nesting and hatchling sea turtles. They include:

- 1) Many areas of the coastline lack a substantial vegetated coastal strand to shield light from beach view. In many instances there is essentially no dune present and lighted structures abut the beach. The lack of a vegetated dune buffer is particularly problematic where roadways converge on the coastline, such as in Ormond by the Sea.
- 2) Many tall buildings are located near the coast. These structures typically harbor large numbers of exterior lights and have many windows within direct line of sight of the beach. The taller the building, the greater the potential for lighting problems, as there is nothing to block the light from reaching the beach. In some instances, intense spotlights on the tops and sides of buildings are likely to cause problems.
- 3) Large numbers of tourists and residents visit beachfront hotels, businesses and the Boardwalk, the Main Street and Sunglow piers and the beach itself at night. For security and safety reasons these areas are brightly illuminated.
- 4) Skyglow is a serious problem, particularly from Ormond Beach to Daytona Beach Shores and in New Smyrna Beach. All lights on the barrier island contribute to the amount of light that is reflected off clouds and sea mist. The cumulative effect of this errant lighting can be intense enough to cause disorientations where direct beachfront lighting is absent.

Even though there seems to be a large number of problem lights in Volusia County, they fall into a few categories of fixtures. Globe lights around pool decks, for example, were observed at numerous facilities. These fixtures have very poor suitability for sea turtle nesting beaches because the light is broadcast in all directions. This fixture is difficult to shield and cannot be redirected. The common practice of painting the beachfront side of these fixtures with black paint has proven to be inadequate because the paint is not impenetrable to light, especially once it starts to deteriorate in the salt air environment.

During renovations of the Voyager Motel, half-globe lights embedded in columns facing away from the beach were used instead of pole mounted globe lights. These fixtures direct the light towards the intended target (the pool deck) instead of wasting light by broadcasting it in all directions. If similar modifications were made at other condominiums and hotels, a significant contribution to reducing skyglow would be achieved.

Other categories of common problem fixtures observed included eave spotlights on the roofs of single family residences, multiple balcony lights at hotels and condominiums, ceiling mounted lights in parking garages, pole mounted lights in parking lots, and street lights visible between buildings. If generic retrofitting solutions can be identified for each type of light fixture and applied along the entire coastline, then the current intensity of the lighting environment will be reduced.

SEA TURTLE NESTING & DISORIENTATIONS IN VOLUSIA COUNTY

It is not surprising that sea turtle disorientation events occur every year in Volusia County because of the extent of artificial lights illuminating the beach even where proactive enforcement of a lighting ordinance is present. Evaluating the continuing frequency and location of sea turtle nests and disorientation events will assist with focusing light management activities to achieve the greatest conservation value.

SEA TURTLE MONITORING

Sea turtle activity is monitored by two not-for-profit organizations in Volusia County, the Volusia Turtle Patrol (VTP) and the Volusia Sea Turtle Society (VSTS). These groups of highly dedicated and trained volunteers are authorized by FDEP to perform daily sea turtle nesting surveys, respond to sea turtle strandings and document the occurrence of hatchling disorientation events. The VTP surveys the County Beaches north of Ponce Inlet and the VSTS is responsible for beaches south of the inlet.

The Volusia Turtle Patrol and the Volusia Sea Turtle Society have worked cooperatively with Volusia County for years to reduce the number of artificial lights illuminating the beach. Sea turtle data collected by them since 1988 were also provided to Volusia County for the purposes of preparing the Habitat Conservation Plan for beach driving (Table 2). Compared to counties on the east coast of Florida, sea turtle numbers in Volusia County are relatively low. The significance of Volusia County's sea turtles is not less important, however, because the recovery of the species depends on preserving the entire geographic distribution of nesting habitat.

Table 2. Annual Numbers of Sea Turtle Nests on Volusia County Beaches ¹, 1988-1997.

Year	Species				TOTAL
	Loggerhead	Green	Leatherback	Kemp's ridley	
1988	245	0	1	0	246
1989	283	0	0	0	283
1990	403	1	1	0	405
1991	384	3	2	0	389
1992	198	5	1	0	204
1993	338	0	0	0	338
1994	490	5	0	0	495
1995	443	0	0	0	443
1996	491	7	0	2	500
1997	336	5	4	0	345

¹ Survey area extends approximately 35.6 miles (57.3 km) from the south boundary of North Peninsula State Recreation Area to the north boundary of Canaveral National Seashore

The County's sea turtle monitoring program is now required by the Incidental Take Permit and is directed by a private consulting firm, Ecological Associates, Inc. (EAI) of Jensen Beach, Florida. EAI is

responsible for ensuring that sea turtle data are collected and analyzed using scientific and objective methods to permit an objective assessment of the relative successes and failures of the HCP sea turtle protection program. The VTP and VSTS cooperatively participated in a standardization program that allows for collation of data collected by both groups to conduct these HCP assessments. This monitoring program started in 1996, was continued in 1997 and included database entry of all nest locations by addresses and Global Positioning System (GPS) coordinates.

Daily surveys were conducted by the VTP and VSTS starting May 1 in 1996 and 1997. Every sea turtle crawl is recorded, including both nests and false crawls. All nests are conspicuously marked with stakes and flagging when they are discovered and the exact location is determined. This allows monitoring personnel to check each nest for evidence of hatchling emergence, as well as evidence of overwash and predation. This level of survey effort, including nest marking and daily nest checks, provides good information about hatchling emergences.

NEST SITE SELECTION BY ADULT SEA TURTLES

The distribution of original nest sites selected by adult females (before relocations) is consistent with adult turtles' preference for dark beaches over those that are artificially illuminated (Table 3). The greatest density of nest sites were in Ormond by the Sea (23%), Ponce Inlet (10%) and Bethune Beach (30%). These areas coincide with relatively dark sections predominated by single family residences. The only exception is in Ormond by the Sea where streetlights are immediately adjacent to the beach. The lowest nesting density occurred in the brightest locations of Daytona Beach (2%) and Daytona Beach Shores (3%). Many factors influence nest site selection, however, and monitoring nesting patterns alone is not enough to determine where lighting problems exist or have been fixed.

EVIDENCE OF ARTIFICIAL LIGHTS DISRUPTING NESTING ADULT SEA TURTLES

There has been some evidence of nesting adult sea turtles being affected by artificial lights in Volusia County, primarily transient sources of light. Anecdotal evidence collected during 1996 and 1997 included observations of factors that may have affected both nests and false crawls, including evidence of heavy pedestrian traffic around the nesting females, the presence of bright lights near a crawl or evidence of indirect return crawls (EAI, unpublished data). In 1996, 4 false crawls were attributed to street lights and 2 false crawls had abandoned egg chambers with many human footprints nearby, presumably people observing the nesting turtle possibly with flashlights. It is not known conclusively, however, that these factors caused these turtle behaviors because they were not directly observed. In 1997, an event was witnessed when pedestrians with camera flashes and flashlights caused a nesting female to become disoriented when returning to the ocean. Instead of the normal direct return crawl, it was angled down the beach. In addition, there were four other instances where nesting females took a long, non-direct return to the ocean. The reason(s) for this could not be determined.

Table 3. Original nest site selection by sea turtles (before relocations) in relation to Volusia County BLMP zones during 1996 - 1997.

BLMP Area	Sea Turtle Nests (All Species)			% of Nests - North Beach	% of Nests on County Beaches
	1996	1997	2 Year Average		
I	102	62	82	37%	19%
II	15	19	17	8%	4%
III	30	21	25.5	11%	6%
IV	15	6	10.5	5%	2%
V	9	4	6.5	3%	2%
VI a	6	6	6	3%	1%
VI b	8	6	7	3%	2%
VII	14	10	12	5%	3%
VIIIa	5	0	2.5	1%	1%
VIIIb	18	10	14	6%	3%
VIIIc	37	36	36.5	16%	9%
IX	2	8	5	2%	1%
North Total	261	188	224.5	100%	53%

Source: Volusia Turtle Patrol, Inc. and Ecological Associates, Inc.

BLMP Area	Sea Turtle Nests (All Species)			% of Nests - South Beach	% of Nests on County Beaches
	1996	1997	2 Year Average		
X	26	27	26.5	13%	6%
XI	35	14	24.5	12%	6%
XIIa	22	16	19	10%	5%
XIIb	62	40	51	26%	12%
XIII	94	60	77	39%	18%
South Total	239	157	198	100%	47%
County Beaches	500	345	422.5		

Source: Volusia Sea Turtle Society, Inc. and Ecological Associates, Inc.

DOCUMENTING HATCHLING DISORIENTATION EVENTS

Completing Disorientation Reports

Evidence of disrupted sea-finding in hatchlings can provide useful evidence of problem areas. This cannot be used as the only indication because many cases of hatchling disorientations go unnoticed. Hatchling tracks are easily obscured by wind, tides and rain. Diligent survey efforts are required to check each nest for evidence of hatchling tracks. Disorientation reports filed by monitoring personnel, therefore, represent the minimum number of the most conspicuous occurrences (Witherington & Martin, 1996).

There is no formal definition of what constitutes a sea turtle disorientation for monitoring personnel responsible for reporting such events. In Volusia County, one disorientation report is usually completed for each nest where any evidence of disrupted sea-finding behavior is observed. This is referred to as a "disorientation event". Hatchlings can take more than one day to emerge from a nest and if disorientation is evident each time, a separate report is completed for each emergence event. FDEP has provided standard report forms for recording evidence of these events and receives reports back from all coastal counties in Florida.

The FDEP incident report form includes information about probable lighting sources in the vicinity of the event. Occasionally, disorientation events are witnessed at night and the responsible lights are directly observed. Evidence of disorientations is normally, however, made during morning nesting surveys when the lights which may have caused the event are not apparent. A separate confirmation survey must be performed at night to determine which light sources may have been illuminated when the disorientation event occurred.

Sketches of an event are sometimes helpful in determining which lights may have contributed to the disorientation. The direction of the tracks and the location of building lights and streetlights in the vicinity provide useful information about where a problem may need to be corrected. In some sketches from Volusia County, all of the emerging hatchlings crawled as a group due west away from the ocean and towards an artificial light source in the immediate vicinity. In other cases, it is not possible to readily identify the problem lights which caused a particular event from a sketch or description of the event. Sometimes all emerging tracks head northeast or southeast towards the water but eventually end at the high tide line indicating all hatchlings successfully navigated to the ocean. When the tracks head due north, south or in both directions away from the nest, one or more buildings with potential problem lights may be located along the extent of the tracks. Other cases have been sketched depicting hatchling tracks circling in every direction, indicating they were not being attracted by a particular light source.

Disorientation Reports from Volusia County

Both the Volusia Turtle Patrol and the Volusia Sea Turtle Society document hatchling disorientation events every year using standardized FDEP report forms (Tables 4 & 5). These disorientation reports have been tracked by Volusia County since 1994. All of the reports from 1994-1997 were evaluated by Ecological Associates, Inc., the County's Protected Species Specialist. These data reveal that disorientation events occur year after year in some zones while in others, the occurrence is sporadic or even relatively absent.

Table 4. Number of hatchling disorientation events within each BLMP zone north of Ponce Inlet as reported by the Volusia Turtle Patrol, 1994-1997.

BLMP Area	Hatchling Disorientation Reports					Locations of Repeat Events ¹
	1994	1995	1996	1997	All Events	
I	4	7	13	8	32	3400-3180; 2900-2800; 2300-1800
II	4	2	4	10	20	Entire zone
III	2	0	2	8	12	700 block
IV	1	0	3	1	5	
V	0	0	0	1	1	
VI a	0	0	1	0	1	
VI b	0	1	1	1	3	
VII	1	0	0	2	3	
VIIIa	0	1	0	0	1	
VIIIb	3	0	0	0	3	
VIIIc	6	0	0	5	11	4 events in '97 at Eastwinds & Brewster's
IX	0	0	0	2	2	
North Total	21	11	24	38	94	

¹ More than one event in 1997 or repeat events in two years, including 1997.

Table 5. Number of hatchling disorientation events within each BLMP zone south of Ponce Inlet as reported by the Volusia Sea Turtle Society, 1994-1997.

BLMP Area	Hatchling Disorientation Reports					Locations of Repeat Events ¹
	1994	1995	1996	1997	All Events	
X	0	0	0	6	6	
XI	4	0	1	1	6	
XIIa	3	0	2	2	7	Moon Tide Condo (4139); 4300 block (Sea Dunes condos)
XIIb	4	2	1	4	11	4800-5300 (Saxon Dr. condos)
XIII	0	0	0	0	0	
South Total	11	2	4	13	30	

¹ More than one event in 1997 or repeat events in two years, including 1997.

Determining the Number of Hatchlings Involved

The number of individual hatchlings affected by artificial lighting is difficult to quantify. The most accurate count is obtained when either live or dead hatchlings are found on the beach or in the dune vegetation. Ninety-nine dead hatchlings were found on the beach in 1997, substantially higher than the previous three years (Table 6). An additional 152 hatchlings were found alive, some were released successfully but others eventually died.

The rest of the hatchlings either eventually made it to the water or disappeared down ghost crab holes. These were estimated by counting their tracks when they were discernible. Hatchling tracks are easily obscured by rain, wind, tides and pedestrian traffic before the morning surveys are conducted. In 21 cases where numerous tracks were evident but could not be accurately counted, the Volusia Turtle Patrol estimated the number of hatchlings involved by counting the number of hatched eggs left in the egg chamber. They assumed all hatchlings which emerged from the nest were disoriented. These estimates were adjusted slightly to account for live and dead hatchlings found still in the nest chamber that did not emerge, but were reported as being disoriented.

Table 6. Estimated number of hatchlings involved in disorientation events, 1994-1997.

	1994	1995	1996	1997
# of Events Reported	32	13	28	51
Estimated Number of Hatchlings Involved	1126	791	1375	2824
Number Found Dead on Beach	18	7	37	99
Number Found Alive on Beach	N/A ¹	146	22	152

¹ N/A= sufficient data not available to determine.

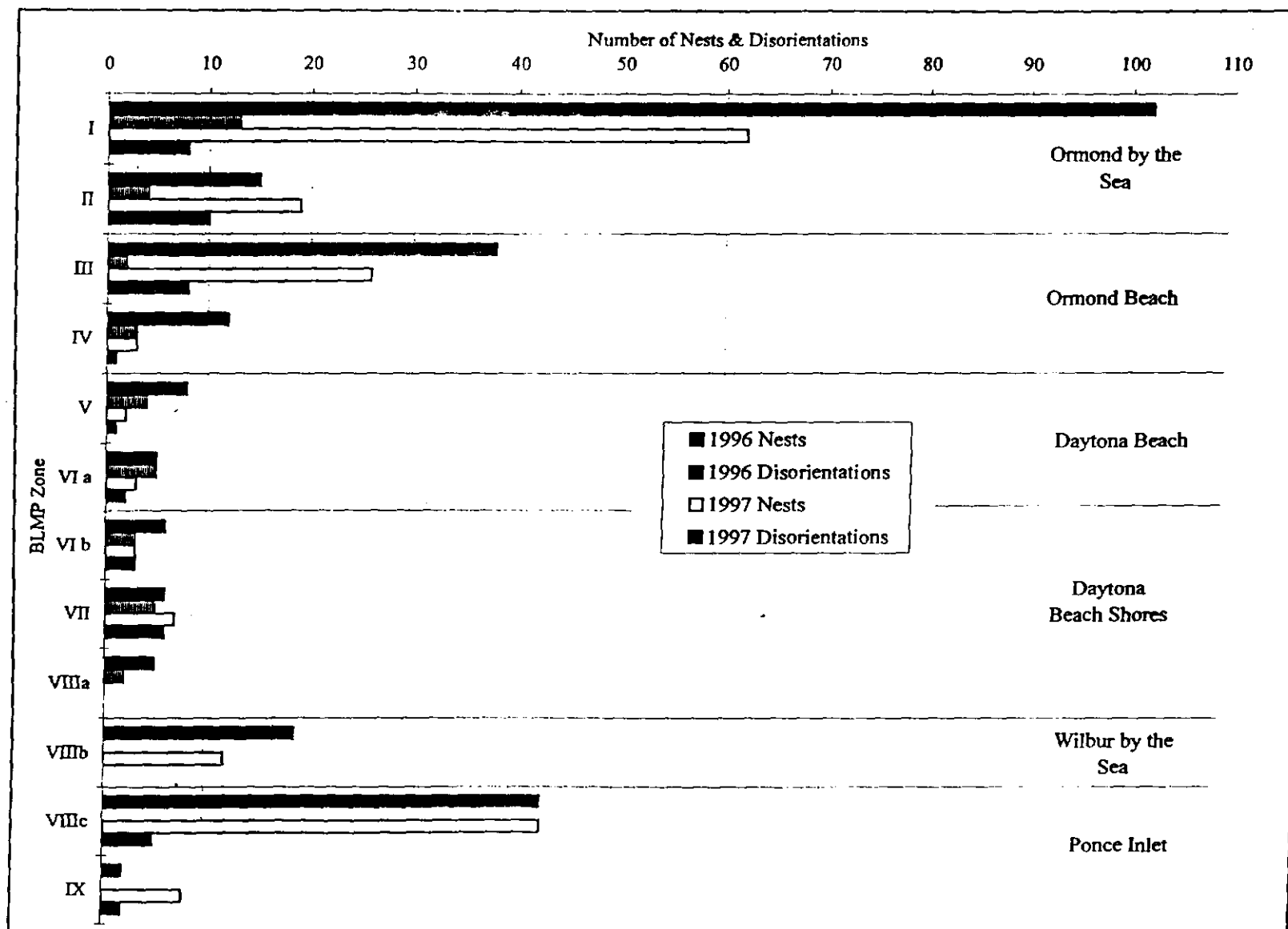
REGIONAL EVALUATION OF DISORIENTATION EVENTS

The following analysis was performed by EAI. It was based on available information and combined several records for a regional evaluation of the circumstances surrounding disorientation events. The information layers used for this evaluation include:

1. Locations of nests after relocations (1996-1997).
2. Locations of disorientation events (1994-1997).
3. Potential and actual lights mentioned in 1997 disorientation reports.
4. Other reports of problem lights from Volusia Turtle Patrol and Volusia Sea Turtle Society in 1997.
5. Reports of problem lights received from Volusia County Beach Services patrol officers while conducting routine nighttime patrols in 1997.
6. Code enforcement notifications (1993-1997).

This general analysis is based on jurisdictional areas and proceeds geographically from north to south. The jurisdictional areas north of the inlet surveyed by the Volusia Turtle Patrol include unincorporated Ormond by the Sea, Ormond Beach, Daytona Beach, Daytona Beach Shores, unincorporated Wilbur by the Sea, and Ponce Inlet (Figure 2). It was assumed for this application that all nests left *in situ* in Daytona Beach and Daytona Beach Shores would have been disoriented if they had not been caged. The disorientation event numbers include nests where the cages could not be deployed, missed nests that disoriented, plus all other caged nests where hatchlings actually emerged.

Figure 2. Number of sea turtle nests (after relocations) and disorientation events¹, north of Ponce Inlet, 1996-1997, Volusia County, Florida.



¹ Includes all caged nests where hatchlings emerged, assumes they would have disoriented.

Source: Ecological Associates, Inc.

Ormond by the Sea - North (Zone I)

The greatest proportion of nests that disoriented occurred in Ormond by the Sea (BLMP Zones I & II; Table 4). This stretch of beach normally provides habitat for 23% of all nests in the County and 52 disorientation events have been reported since 1994. Hatchlings also emerged successfully from many nests in this area indicating the lighting environment is not uniformly severe enough to guarantee disorientations, like in Daytona Beach and Daytona Beach Shores.

The repeat disorientation events that occurred in the north section of Ormond by the Sea (Zone I) were mainly attributed to the streetlights on the west side of A1A. Sketches of 1996 and 1997 events depict mostly circuitous tracks, indicating the cumulative glow from the streetlights prevent direct orientation in any particular direction. Other contributing lights reported since 1994 include commercial signs at two convenience stores, Marco's Restaurant, and the Ocean Village Camper Resort. During night surveys right after disorientation events, lights were also visible at condominiums on the west side of A1A, including Ocean House and Oceanside, and at the Seabridge subdivision entrance.

Shields were installed on some of the streetlights, but it was soon apparent that the shields did not wrap far enough around the light fixtures. In fact, the first disorientation of the summer occurred in front of three shielded street lights. Ten of the streetlights in this section were retrofitted with larger shields and tinted lenses north and south of Marlin Drive in June, but a disorientation event occurred just north of these lights in August and the tracks headed south. Just before this event, and also in 1996, the County resorted to selectively turning off streetlights in the vicinity of nests due to hatch to prevent disorientations, but this action did not address the cumulative effect of the streetlights that were left on.

After lengthy negotiations between the County, FPL, General Electric, FDOT, FDEP and the USFWS, a decision was made to install experimental lenses on all of the streetlights, in addition to shields. These negotiations centered around public highway safety issues and liability for disorientations if they continued after the retrofitting was complete. After the USFWS determined that a combination of flat, amber acrylic lenses and wider shields was an acceptable interim measure, the parts were ordered. All of the street lights from the 1900 block north were outfitted with the lenses and shields by September 18, 1997. Since the retrofitting did not occur until the end of the hatching season, the relative improvement to the lighting environment from the hatchlings' perspective cannot be evaluated until next summer. If these retrofitted lights successfully reduce the number of disorientations, then a significant improvement will be made to this important nesting beach.

Ormond by the Sea - South (Zone II)

The multi-family structures and lights located directly on the beach in this section observed during the lighting characterization study have contributed to multiple disorientation events every year since 1994. Only 2 events were reported in 1995, but 4 events were reported in 1994 and 1996 and 10 events in 1997. This beachfront area provides a case study of how problematic enforcement of the lighting ordinance can be, because code enforcement actions have been taken every year by Volusia County and good faith efforts have been made to correct the lights since 1993 at the same facilities, yet disorientations continue to occur in this area.

There were 19 sea turtle nests and 10 disorientations in this zone in 1997, including a missed nest. Apparently, no problem lights were reported in this area until after the disorientations started to occur in August. The first disorientation event occurred on August 11 and eight more events followed in quick succession until September 4. Sketches from at least five of these events indicate hatchling tracks went directly away from the ocean toward the dunes and buildings. The other events depicted hatchling tracks going in multiple directions indicating they were not able to orient in any particular direction, probably due to the effects of several lights.

One event occurred at the north end near the Ormond by the Sea condominium when hatchlings were apparently attracted to globes with yellow bug lights in them. Two events occurred near the Regency condominium. Lights observed at night included pole mounted pool lights, roof lights in the covered parking area and drive-through overhang, and 2 wall lights at the rear entry. All of these light sources were perceived by enforcement officials to be visible from the beach, but they were not illuminating it enough to cast discernible shadows. Lights must cause direct illumination of the beach to constitute a violation of the County's ordinance.

Two more events occurred near the Traders Inn and Tiffany condominiums. Hatchling tracks again went in multiple directions, with only a few going directly towards the ocean. Lights observed at night included globe, flood, pole and wall lights at the Tiffany and a balcony light at Traders Inn. These lights were determined to be illuminating the beach in violation of the ordinance and code enforcement advisory notifications were sent by the County.

Hatchlings were also disoriented in 1997 as they emerged from three nests near the Surfside Club North and South condominiums. The tracks from one nest (N82) went due west into the dune vegetation but tracks from the other two adjacent nests (N62 & N66) went north, northeast and southeast. These results indicate the lighting environment was not consistently the same between August 19 - September 4. Lights observed at night at these facilities included several lights at the north building which illuminated the entire rear of the condo and reflected onto the beach. Other lights were observed at night, including decorative, balcony, ground lights and a street light, but were perceived as not illuminating the beach. This is the fourth year in a row that disorientations have occurred at these facilities and they received Code Enforcement notifications each time. The manager of these facilities reported to the County in 1997 that the offending lights had already been corrected as a result of previous enforcement actions. A follow-up inspection by Beach Services indicated that no lights were illuminating the beach. In addition, the New Smyrna Beach Utilities department relocated and/or shielded two lights at this location that were felt to be problem lights.

Code enforcement advisory notices were sent to all facilities mentioned in the disorientation reports as soon as they were received, but this did not provide sufficient correction time before other nests started to hatch. Although the disorientation reports also indicated streetlights are visible during the day between the buildings, night surveys did not confirm that these lights illuminated the beach. These streetlights are not shielded because the light from them appears to be blocked by the buildings on the east side of A1A. The visibility and effect of the streetlights may become more apparent if the lights behind the buildings that are illuminating the beach are reduced.

City of Ormond Beach (Zones III-IV)

Nine disorientation events occurred in 1997 within the Ormond Beach city limits. Only 5 events occurred in this city in 1996. Eight of the 1997 events occurred between Neptune Drive and Granada Boulevard. Upland development where these nests were located is predominantly single family residences. Hatchlings during seven of these events crawled due south down the beach, presumably towards the urban skyglow of Ormond Beach.

Another nest located adjacent to a single family residence was disoriented by multiple lights at the property. The lights observed at night included ground, wall and pole mounted flood, globe and accent lights. The disorientation report indicated at least 16 unshielded, eave spot lights were present. According to County records, at least 3 of these spotlights are low-pressure sodium (LPS) fixtures installed by the property owner in 1995 after FDEP recommended them as appropriate for sea turtles. This lighting and the disorientation event demonstrate that it is not necessarily the type of light fixtures, but the quantity and direction of the light that matters to hatchlings. Even LPS fixtures should utilize the lowest wattage bulb possible and should be shielded or otherwise directed to limit the light to the intended target area.

Two disorientation events occurred adjacent to Granada Boulevard, a site of previous events in 1994 and 1996. Both of the 1997 events were attributed to lights at the Granada Inn. This facility has replaced multiple white balcony lights with yellow bug lights at the direction of the City and the Volusia Turtle Patrol. There was also a temporary roof flood light and an underground parking garage light reported at this facility. Either streetlights at the intersection of SR A1A and Granada Boulevard or the general glow from the adjacent commercial area also contributed to disorientations. Hatchlings that crawled up the Granada Boulevard approach ramp were crushed by highway traffic. After the first time this occurred in 1994, the City of Ormond Beach worked cooperatively with the USFWS to shield the streetlights at the intersection.

City of Daytona Beach (Zones V-VIa)

There were relatively few nests along the brightly illuminated beach in the City of Daytona Beach. The nests that were not relocated due to tidal inundation were targeted for caging to prevent disorientations. In spite of the intent to cage these nests, disorientations still occurred. In 1997, one nest emerged sooner than expected before the cage was installed and all of the tracks headed directly towards the Beachcomber Motel, presumably because of five roof spot lights. Fortunately, the Volusia Turtle Patrol was able to collect the hatchlings and release them alive on a darker beach. A disorientation also occurred in 1996 at the New Frontier Motel when high tides prevented deployment of the cage.

If the 8 nests in 1996 and 2 nests in 1997 where hatchlings emerged had not been caged, it can be assumed that these hatchlings would have been disoriented. Two disorientation reports filed in 1997 demonstrated this when hatchlings were taken out of cages, placed onto the beach next to the cage and they headed away from the ocean.

City of Daytona Beach Shores (Zones VIIb-VIIIa)

A total of 5 disorientation events have occurred within the City of Daytona Beach Shores since 1994. Most recently, hatchlings from a missed, unmarked nest were found crawling almost 70 meters due north and 240 meters due south of the nest. In 1996, hatchlings from a nest were disoriented when the cage could not be installed due to high storm tides. Hatchlings from two nests in 1995 started out towards the water, then veered back toward the artificial lights. Again, it can be assumed that all caged nests in this region would disorient if the restraining cages were not in place.

Wilbur by the Sea (Zone VIIIb)

This unincorporated area is entirely composed of single family residences. No disorientation reports have been filed for this region since 1994 even though the area supports at least 10 nests each year. Numerous code enforcement and Volusia Turtle Patrol actions to identify problem lights and notify the homeowners have been taken every year since then and appear to be successful in preventing disorientations. A few properties have repeatedly been reported with problem lights, but no disorientations occurred. Some of the factors contributing to the designation of "problem" lights include: (1) change in ownership of the property, (2) the lights were turned off during re-inspection, therefore no further action was taken, (3) there are rental properties in the area, resulting in high turnover of people who may not be aware of the need for light management, and (4) people have attempted different solutions (yellow bug lights, painting the backside of globes black, etc.) which were not totally effective.

Town of Ponce Inlet (Zones VIIIc-IX)

This section of beach was designated a Natural Beach Area and vehicular access was prohibited because it supports an average of 10% of all nesting in the County. There were seven disorientation events reported from the Town of Ponce Inlet in 1997. This occurred after two years of no disorientation reports in 1995 and 1996; there were 6 reports in 1994. Four of the events in 1997 occurred near Brewster's Restaurant and the Eastwinds condominium, even after the restaurant was closed. Deck lights at Brewster's plus interior and exterior lights at the adjacent Eastwinds condominium were also reported and observed at night. Tracks from two events headed directly towards these facilities, while tracks in the other two were not as directional. Urban skyglow to the north and the unshielded streetlights along SR A1A may have contributed to these events.

Code enforcement notifications were sent to Brewster's and Eastwinds in May and June, 1997, after the Volusia Turtle Patrol reported the lights that eventually caused the disorientations. Notifications were sent again after each disorientation event. Notifications were also sent by Volusia County to Brewster's in 1992, 1993, 1994 and 1995 and the facility was determined to be in compliance in 1995 after corrections were apparently made. According to County records, no notifications were sent in 1996 and no disorientations occurred. There was one nest laid near this facility in 1996, but it did not hatch. Over the last several years, the owners of Brewster's have tried several lighting alternatives in an attempt to resolve identified lighting problems.

The other three events occurred further south closer to Ponce Inlet. One event was right at the north jetty in Lighthouse Point Park, but no light was observed in the vicinity at night. Urban skyglow visible to the hatchlings across the open water of the inlet may have caused this event. Hatchlings from another nest laid behind dune vegetation were also disoriented. Tall vegetation is a natural factor that can prevent hatchlings from orienting correctly, even where only slight levels of artificial light cues are present.

All of the streetlights along SR A1A in Ponce Inlet were reported as visible from the beach during a night survey by Beach Services officers in June, 1997. These streetlights are not shielded. However, since they did not illuminate the beach, they are not out of compliance, and no further action was taken. Only one night survey after these disorientation events identified a streetlight as illuminating the beach in the area of the disorientation. Again, the contribution of the streetlights to the lighting environment may be masked by other lights. The custodians of these streetlights should be identified and encouraged to consider alternative fixtures or shields for these lights along an important nesting beach.

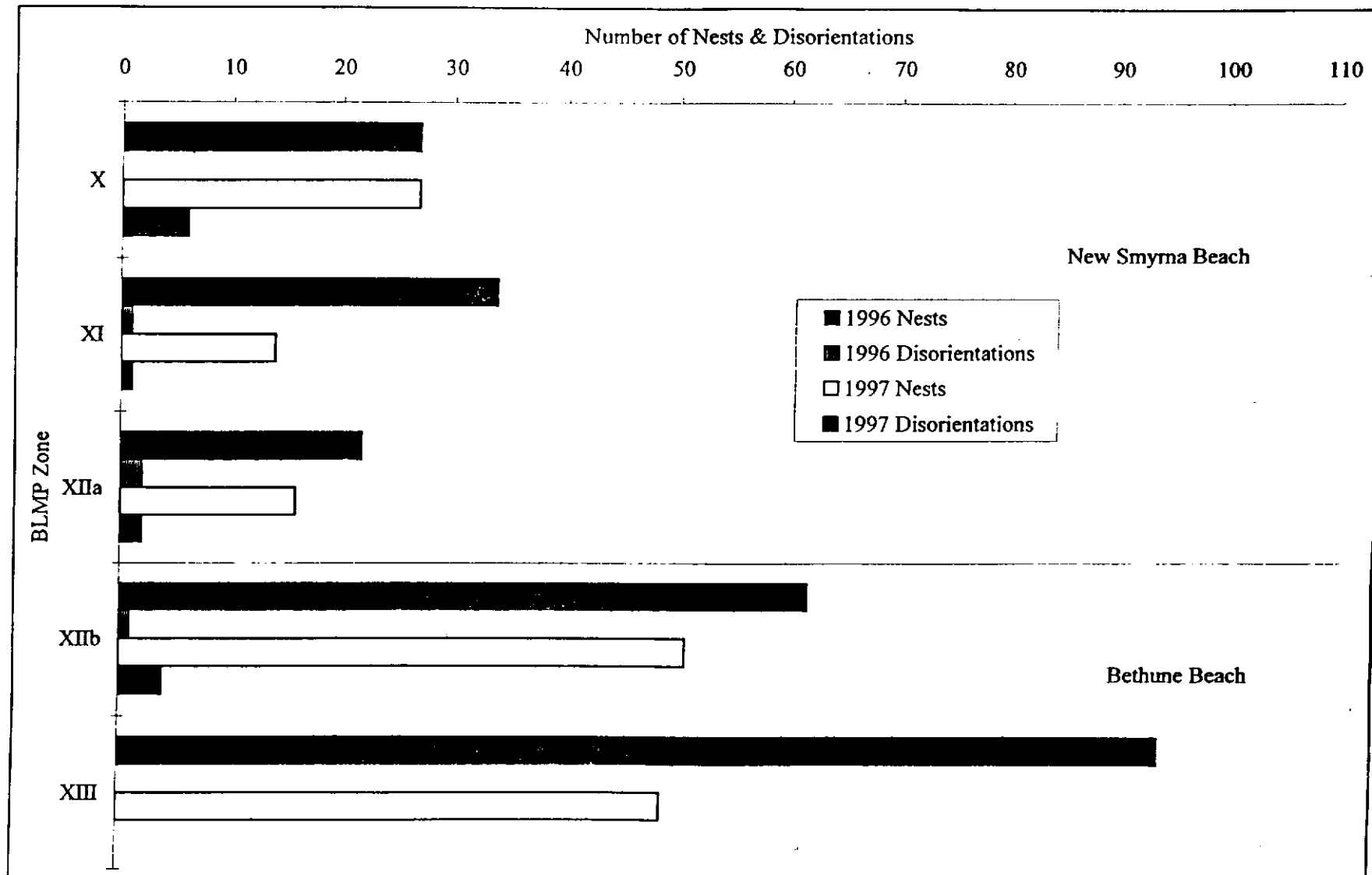
City of New Smyrna Beach (Zones X-XIIa)

Approximately 17% of all sea turtle nests in Volusia County were located in the City of New Smyrna Beach over the past two years. Relatively few disorientation reports are received from this section given the number of nests that are present (Figure 3).

No disorientation events were reported in the north end of the city from the inlet to Crawford Road, until 1997 when 6 events were reported. Urban skyglow during overcast conditions was reported as a factor in four of these events late in August. Bright lights on the side of the Inlet Condominium may have contributed to the overcast lighting environment that confused the hatchlings. These lights are reflected off the building and were perceived by enforcement officials to be visible but not illuminating the beach enough to cast a shadow.

Three other events were reported within the city limits further south. One was attributed to urban skyglow again because no apparent problem lights were observed and the tracks went in multiple, circling directions. The commercial area at Flagler Avenue was thoroughly searched for problem lights again. Although the streetlights at the Flagler Avenue parking lot were shielded, they had to be re-aligned because the sides of the lights were visible from the beach. This illustrates the continuous need for evaluation and maintenance of previously corrected lights.

Figure 3. Number of sea turtle nests (after relocations) and disorientation events, south of Ponce Inlet, 1996-1997, Volusia County, Florida.



Source: Ecological Associates, Inc.

Another event occurred behind the Moontide and Sunrise condominiums, the second one in two years. Multiple balcony lights at these facilities were reported by the Volusia Sea Turtle Society four times in May and July. These reports were forwarded to the City's code enforcement officer. Pool lights at the Sunrise were also observed to be on during the morning survey when the disorientation evidence was observed.

Another disorientation occurred behind the condominiums from Matthews Avenue to the Sea Dunes buildings. Problem lights were reported in May at the Hacienda del Sol, Colony Beach, and Sea Coast Gardens facilities. Many lights were observed on at night just after the disorientation event at Hacienda del Sol I & II, Colony Beach Club, Oceana Villas, Castle Reef and Sunrise condominiums. All of these observations were forwarded by Volusia County to the City of New Smyrna Beach.

Bethune Beach (Zones XIIb-XIII)

The unincorporated area of Bethune Beach begins at the Errol by the Sea condominium and ends at Canaveral National Seashore. This is an important nesting beach in Volusia County which supported 30% of all County nests in the past two years. In 1997, 100 nests were located in this area but only four disorientation reports were filed. All of the disorientations occurred behind the condominiums located along Saxon Drive where disorientations have been reported every year since 1994. County records indicate that only one problem light at these condominiums was observed and reported early in the summer before hatching activity began. Additional inspections and notifications were performed by Volusia County after the disorientation events occurred. Corrections were then made to many lights by facility managers and the New Smyrna Beach Utilities Commission, including moving pole lights away from the beach, painting globe lights, turning lights off and modifying shields. One condominium even installed drapes in a unit where interior lights were observed.

The Volusia Sea Turtle Society reported numerous lights at single family residences south of the condominiums. Volusia County Code Enforcement responded with notifications and no disorientations were subsequently reported. In fact, no disorientation reports have been filed for the south residential area of Bethune Beach since 1994.

The relatively low number of disorientation events south of Ponce Inlet may be attributed to the fact that approximately 84% of the beachfront facilities are single family residences. The actual number of disorientations may be higher than reported, however, particularly because this beach is not as accessible for surveying as the beach north of the inlet. Regardless of the survey effort, this community has been generally cooperative since the lighting ordinance was passed by implementing suggestions made by the VSTS and enforcement officials to minimize the amount of artificial light trespassing onto the beach.

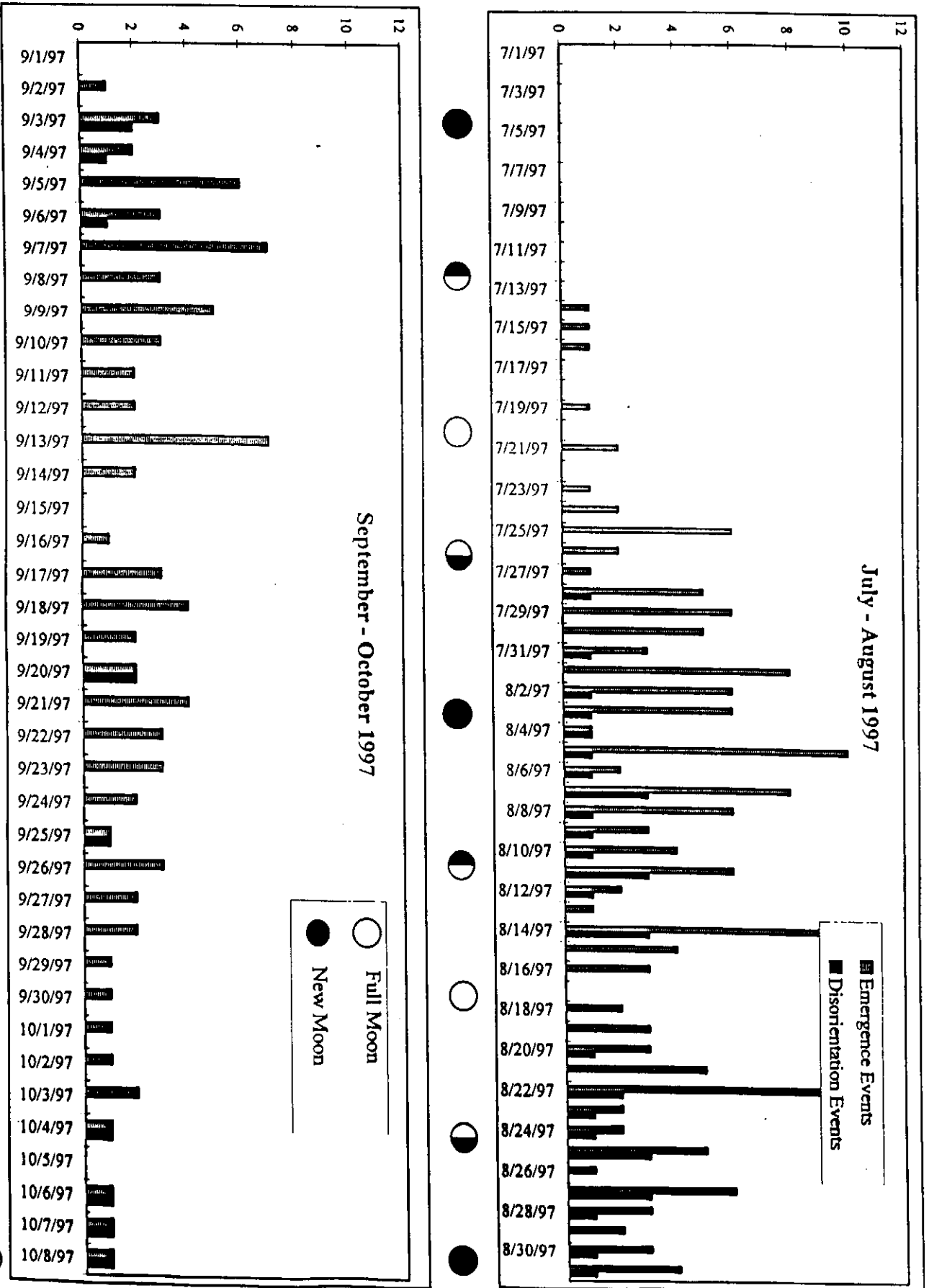
EFFECTS OF CLIMATE CONDITIONS & THE MOON ON 1997 DISORIENTATIONS

Urban skyglow seemed to be one factor explaining the increase in reports during 1997. Urban skyglow was reported as a possible contributing factor in disorientation reports both north and south of the inlet. This was particularly true for the north end of New Smyrna Beach where no disorientations had been reported

since 1994, but 7 events occurred in 1997. These events occurred during overcast conditions that scattered the cumulative urban light and affected nests located on apparently dark beaches. Further evidence that skyglow during overcast conditions caused disorientations came from the circuitous, wandering tracks of the hatchlings in multiple directions.

The dates of all known emergences from nests and the dates of disorientation events in 1997 were compared to lunar cycles to determine if the moon had any apparent effects on the lighting environment (Figure 4). Similar to results from other nesting beaches in Florida, the full moon did seem to lessen the effect of artificial lighting in Volusia County. Almost all of the disorientation events in 1997 occurred on nights before and after the new moon. No disorientations were reported during full moon phases. This finding partially explains why hatchlings from some nests emerge successfully while hatchlings from nearby nests are disoriented on another day. These naturally variable factors illustrate the need to manage as many beachfront lights as possible all summer long to minimize the effects of skyglow on sea turtle hatchlings. It is also apparent that hatchlings from many nests in Volusia County emerged successfully without any evidence of disorientation, even during new moon phases.

Figure 4. Comparison of all known hatchling emergence events, disorientation events and lunar phases, Volusia County, Florida, 1997.



SUMMARY OF PROBLEMS RELATED TO LIGHT MANAGEMENT

Based on the locations and repeat occurrences of the disorientation events since 1994, there seem to be several complicating factors related to enforcing lighting ordinances. These factors may partially explain why, in spite of repeated attempts to prevent them, disorientations continue to occur in Volusia County.

1. **Lights along the entire beachfront must be in compliance with the ordinance regardless of whether sea turtle nests are present in the immediate vicinity.** The cumulative effect of all beachfront lights along 36 miles of beach is the target of lighting ordinances, not just spot sources adjacent to sea turtle nests.
2. **Enforcement must take place over a large area with a multitude of transient occupants, owners, facility managers, tenants and artificial lights.** Repeated inspections must be made of the same property every year to ensure consistent compliance. Enforcement work must be conducted at night, a non-traditional work time for code enforcement employees. The entire process must also be diligently repeated every summer.
3. **Human perception of what constitutes a problem light varies.** It has already been established that humans and sea turtles perceive lights differently, and that using an objective device such as a light meter is not sufficient to determine if a light will be a problem for sea turtles. A compliance determination depends on human judgment. The people performing evaluations have varying levels of experience and training and have demonstrated different perceptions of what constitutes a violation in Volusia County. Law enforcement officers, for example, perceive lights in a context that includes considerations for crime, which is part of their job. Conservationists perceive the lights more from a sea turtle context. This human perception problem is complicated by the ordinance requirement that a light actually cast shadows onto the beach, and not just be visible. Property owners also perceive their lights differently than code enforcement officials, and appeals about the compliance determination are commonly made.
4. **Locating a responsible party for a particular light source can be problematic.** The Code Enforcement process requires that the responsible party of a problem light be notified in writing of the violation. On-the-spot determinations of responsibility cannot be made by simply looking at the light. Addresses are not posted on the beachside of buildings. Sometimes property owners at the location claim no association with the reported light and the process must be started all over again.
5. **Public opinion concerns about crime, security, roadway safety and insurance have deterred property owners and light custodians from reducing the amount of artificial light on their property.** Volusia County has been notified by insurance companies that liability for any claims resulting from a reduction in lighting will be attributed to the County. These parties are concerned about human interests which must be considered with any light correction recommendations. The assumption is also widely made that lights must be turned off to be in compliance. Actually, the intent of ordinances is to manage lights so they illuminate only the intended target and do not cast light onto the beach.
6. **Overall public awareness of options to correct problem lights is lacking.** Upon receipt of a notice that their lights are not in compliance with the ordinance, some property owners do not have

the expertise to correct the problem themselves. This is especially true for multi-family facilities with many individual units or complex electrical systems.

7. **Most code enforcement officials do not have the resources or technical expertise to assist light owners with this highly specialized arena.** It is not enough to simply inform a light owner that they are out of compliance with the ordinance. They must also receive sound and reasonable alternatives for correcting their specific problem.
8. **Some good faith recommendations were not applied or maintained correctly.** The primary example of this problem is the recommendation to replace white lights with yellow bug lights. This recommendation was ineffective where multiple yellow lights still illuminate the beach. Other recommended correction measures are temporary and must be re-evaluated every year and maintained if necessary. Shields can shift or fall off, paint must be re-applied and pole lights sometimes need to be re-aligned. Owners of these lights are understandably surprised when they continue to receive notices of violation after they made corrections recommended by the issuing authority.
9. **Additional staff other than code enforcement officers (planners, building inspectors and traffic engineers) must also be involved with enforcing the lighting ordinance.** Different enforcement processes are required for managing public versus private lights and for managing lights at existing facilities versus new, proposed facilities. These multiple enforcement arenas must be coordinated simultaneously.
10. **The management of public street lights must include consideration of highway safety standards, traffic enforcement and accident response.** Volusia County actively pursues turning off all unnecessary street lights at the beginning of the summer, but the remaining lights have consistently contributed to disorientation events. Attempts to change the types of fixtures were delayed when FPL and FDOT expressed concerns for these other criteria.
11. **Convenience stores must comply with the state Convenience Business Security Act (812.171-812.176, F.S.).** Creative solutions are required to be in compliance with both regulations, such as those installed by the Lil' Champ in Ormond Beach (Figures 5-8).
12. **The legal rights of citizens involved with code enforcement cases and the time frames allowed to resolve these cases is not correlated with the emergence of sea turtle hatchlings.** Not all lights can be identified and corrected before the beginning of hatchling emergence in July. This is because of the turnover in occupancy throughout the summer.



Figure 5
Shielded Roof Mounted Security Light



Figure 6
Unshielded Roof Mounted Security Lights

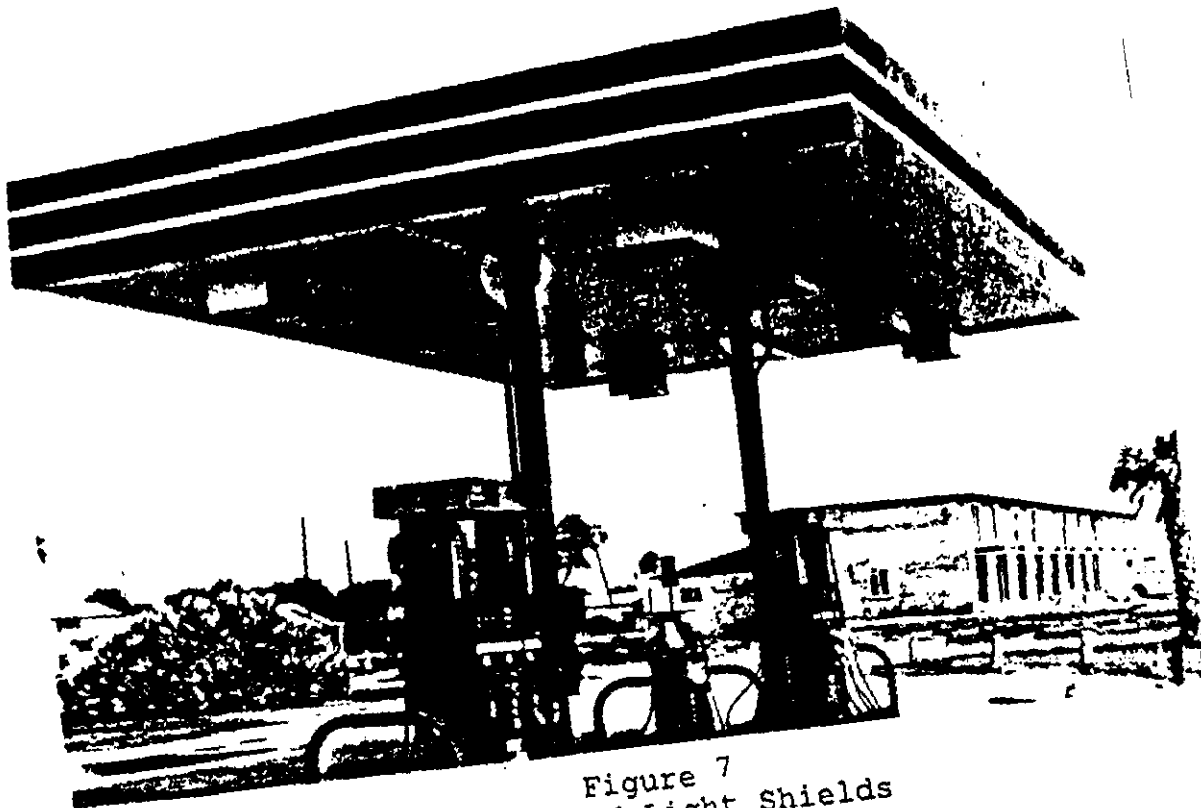


Figure 7
Gas Island Light Shields



Figure 8
Unshielded Gas Island Lights

Problem lights which are not discovered until the season has started are still allowed the same time frames for correction.

- 13. Close intergovernmental coordination is required between Volusia County and the cities of Ormond Beach, Daytona Beach, Daytona Beach Shores, New Smyrna Beach and the Town of Ponce Inlet.** While the County is directly responsible for management of the entire beach, it only has authority over upland development within the unincorporated areas of Ormond by the Sea, Wilbur by the Sea and Bethune Beach. The current role of the County in artificial light management inside the cities varies with each jurisdiction. Normally, the code enforcement processes of these jurisdictions are separate. This cooperation is especially important to reduce cumulative urban skyglow.

Considering the disruptive properties of artificial light within the sea turtle nesting habitat, and the potential biological and fiscal liabilities associated with nest relocation and caging programs, Volusia County will continue to work cooperatively with local communities and encourage them to share resources and information about reducing light pollution along the beach. Similarly, Volusia County will engage in a comprehensive public awareness program to encourage all coastal property owners in the County to begin voluntary compliance with the lighting modifications provided in this report.

Success of the BLMP will depend on a coordinated and cooperative effort among the County, municipalities, the Volusia Turtle Patrol, the Volusia Sea Turtle Society, coastal property owners and residents. State and federal agencies (FDEP & USFWS) must also participate because of their mandates to monitor and minimize incidental take caused by artificial lighting. The time required to effectively reduce lighting impacts in Volusia County to an extent that substantially reduces the need for nest caging and the occurrence of disorientations will ultimately depend on the public will and commitment of resources to address this important issue. Everyone must do their part to help protect Volusia County's valuable and irreplaceable natural resources.

EXISTING LIGHT MANAGEMENT ORDINANCES IN VOLUSIA COUNTY

MINIMUM ENVIRONMENTAL STANDARDS

Volusia County has adopted a series of minimum environmental standards for the county wide protection of natural resources. These environmental protection standards are mandated by the Volusia County Home Rule Charter and include requirements for wetlands, urban forestry, water conservation, well installation, storage of hazardous materials near public water supplies, beach and dune protection and sea turtle protection. This series of standards requires all government jurisdictions, including all municipalities and the County itself, to adopt enforcement ordinances to implement the standards.

The sea turtle minimum standards were adopted as model lighting management guidelines (Appendix A). Each municipality was required to either adopt an ordinance that incorporates these protection standards or, by not passing their own ordinance, they delegated authority to the County to enforce the standards within city limits. At present, there are no formal agreements between the cities and the County to coordinate these jurisdictional assignments, although informal working arrangements have been in place since the County's enforcement ordinance was adopted.

ENFORCEMENT ORDINANCES IN EFFECT

Jurisdiction for development and enforcement of light management ordinances along the beaches during the sea turtle nesting season is divided among the County and the beachfront communities, excluding the North Peninsula State Recreation Area (NPSRA) to the north and the Canaveral National Seashore (CNS) to the south which are under State and Federal jurisdiction, respectively. Ormond Beach regulates its own lighting, both public and private. New Smyrna Beach regulates its private lights and the New Smyrna Beach Utilities Commission regulates public lighting. Unincorporated portions of New Smyrna Beach are regulated by the County. Ponce Inlet operates under the County lighting ordinance, enforcing the ordinance for public lighting but delegating enforcement for private lighting to the County. All other unincorporated portions of the County are regulated by the County.

Volusia County has exempted Daytona Beach and Daytona Beach Shores from the lighting ordinance (Section 50-248), citing these areas as not likely to be utilized by sea turtles for nesting. This exemption does not apply to new development, but it does exempt all existing development that had a building permit issued prior to May 17, 1990, and all publicly owned lighting. A copy of the lighting ordinances for protection of threatened and endangered sea turtles for Volusia County, Ormond Beach and New Smyrna Beach are included in Appendix A. Each of these ordinances is discussed below as presented by Peterson (1997).

Volusia County

Volusia County adopted a beachfront lighting ordinance for unincorporated areas in 1990. The Volusia County criteria for determining if lights or a lighted sign artificially illuminate the beach is whether or not a human being standing on the beach casts a shadow. The County lighting ordinance for new development applies to single family and multi-family dwellings, signs, commercial or other structures, including any parking lots, dune walkovers or other outdoor lighting for property adjoining or abutting the beach. The ordinance requires all new development, within unincorporated areas and where authority has been delegated to the County, to be in compliance with the following:

- (1) Floodlights shall be shielded and wall-mounted light fixtures shall be fitted with hoods so that no light illuminates the beach.
- (2) Pole lighting shall be shielded in such a way that light will be contained within an arc of 3 to 73 degrees on the seaward side of the pole.
- (3) Low profile luminaries shall be used in parking lots, and such lighting shall be positioned so that no light illuminates the beach.
- (4) Dune crosswalks shall utilize low profile shielded luminaries.
- (5) Lights illuminating buildings or associated grounds for decorative or recreational purposes shall be shielded or screened such that they do not illuminate the beach, or turned off from 8:30 p.m. each night until sunrise each morning during the sea turtle nesting season.
- (6) Temporary security lights at construction sites shall not be mounted more than fifteen feet above the ground. Illumination from the lights shall in no case illuminate the beach.
- (7) Tinted glass, or any window film applied to window glass which meet the shading criteria for tinted glass, shall be installed on all windows of single or multi-story structures within line of site of the beach.
- (8) Lights illuminating signs shall be shielded or screened such that they do not illuminate the beach or, be turned off from 8:30 p.m. each night until sunrise each morning during the sea turtle nesting season.

The Volusia County lighting ordinance for existing development applies to all structures which had a building permit issued prior to May 17, 1990, within all unincorporated areas and inside city limits where authority has been delegated to the County. Daytona Beach and Daytona Beach Shores are exempt from the lighting standards for existing development. The ordinance for the exterior lighting of existing structures or signs which illuminate the beach requires compliance with the following:

- (1) Lights illuminating buildings or associated grounds for decorative or recreational purposes shall be shielded or screened such that they do not illuminate the beach, or turned off from 8:30 p.m. each night until sunrise each morning during nesting season.
- (2) Lights illuminating dune crosswalks of any area oceanward of the dune line shall be turned off after 8:30 p.m. each night until sunrise each morning during the nesting season.
- (3) Security lighting shall be permitted throughout the night so long as low-profile luminaries are used and screened in such a way that those lights do not illuminate the beach.
- (4) Lights illuminating signs shall be shielded or screened such that they do not illuminate the beach or, be turned off from 8:30 p.m. each night until sunrise each morning during the nesting season.

The Volusia County requirements for publicly owned lighting applies to all streetlights and lighting at parks and other publicly owned beach access areas in Ormond By-The-Sea, Wilbur By-The-Sea, and

Bethune Beach. The ordinance for public lighting requires compliance with the following:

- (1) Whenever possible, streetlights shall be located so that they will not illuminate the beach.
- (2) Lights at parks or other public beach access points shall be shielded or shaded or shall not be utilized during the nesting season of each year or turned off from 8:30 p.m. each night until sunrise each morning.

Ormond Beach

The Ormond Beach lighting ordinance for sea turtle protection applies to any artificial light emanating from existing or proposed structures and from any construction site. The ordinance is applicable from the area abutting the western right-of-way of State Road (SR) A1A, east to the Atlantic Ocean beach. The ordinance for new development applies to new construction and remodeling of an existing structure (building permit issued subsequent to June 5, 1990), when the remodeling includes any alteration of exterior lighting or any alteration of the primary dune face. The Ormond Beach lighting ordinance requires a Sea Turtle Protection Plan (STPP) be submitted to the Planning Department along with a request for a building permit, request for site plan approval or any other development permit. The STPP pertains mostly to permitting requirements which are beyond the scope of this document. Refer to Section 12.08.E. of the Ormond Beach lighting ordinance in Appendix A for more information.

The Ormond Beach ordinance specifications for new development are similar to the County's ordinance, except that there is no specific reference to any requirements on lights illuminating signs and an alternative to utilization of tinted glass can be blackout drapes or shade-screens. The Ormond Beach ordinance for new development also includes these additional compliance requirements:

- (1) No artificial public or private light source within or outside areas of influence shall directly illuminate areas seaward of the dune face.
- (2) The use of lights for safety and security purposes shall be limited to the minimum number required to reasonably achieve their functional roles.
- (3) The use of lighting solely for decorative or accent purposes, within line of sight of the beach, such as emanating from spotlights or floodlights, is prohibited.
- (4) Temporary security lighting is limited to the fewest number of lights reasonably necessary to provide adequate security and are restricted as follows:
 - a. Shall be mounted not more than fifteen feet above the ground,
 - b. Shall not illuminate areas outside of subject property,
 - c. Shall not directly illuminate areas seaward of the dune face unless protective/mitigative measures for lighting impacts are developed,

- d. Shall consist of either low pressure sodium vapor luminaries (LPS) or sensory-activated lights equipped with yellow lamps in areas of low volume of human activity. In areas of a high volume of human activity, LPS luminaries shall be used.

The Ormond Beach lighting ordinance specifications for existing development (building permit issued prior to June 5, 1990) are also similar to the County's ordinance, except that there is no specific reference to any requirements on lights illuminating signs and the use of LPS vapor luminaries is encouraged as substitutes for other lights. The Ormond Beach lighting ordinance for publicly owned lighting is also similar to the County's except that Ormond Beach states that streetlights shall be located, shielded, shaded or directed so that they will not directly illuminate the beach.

The Ormond Beach Ordinance is the only one with detailed application, enforcement, and appeal processes. A Sea Turtle Protection Plan (STPP) is required with building applications. A certified inspection of the lights must also be conducted prior to a Certificate of Occupancy being issued by the City.

New Smyrna Beach

The New Smyrna Beach lighting ordinance for sea turtle protection applies to public and private lighting along or adjacent to the Atlantic Ocean beach that illuminates the beach. The ordinance for new development applies to new construction (building permit issued after July 1, 1990). The New Smyrna Beach ordinance for new development is similar to the County's ordinance, except that there is no specific reference to any requirements on lights illuminating signs and new development permitted between October 22, 1986, and July 1, 1990, does not have to utilize window tinting. The New Smyrna Beach lighting ordinance for existing development (building permit issued prior to July 1, 1990) are also similar to the County's ordinance, except that there is no specific reference to any requirements on lights illuminating signs. The New Smyrna Beach lighting ordinance for publicly owned lighting is identical to the County's.

ENFORCEMENT PROCEDURES FOR EXISTING LIGHTS

Volusia County

Volusia County takes several measures to assist beachfront property owners and ensure compliance with the light management ordinances for both private and public lighting. These measures include a pre- turtle nesting season notification letter to the beachfront property owners, lighting surveys (both routine monthly and in response to a sea turtle hatchling disorientation report or a citizen complaint), ordinance violation procedures and public lighting management procedures. Each of these measures is discussed below.

Pre-Turtle Nesting Season Notification. Each year, approximately two weeks prior to the sea turtle nesting season, Volusia County sends out a letter informing all beachfront property owners and those in close proximity to the beach in unincorporated areas, of the upcoming sea turtle nesting season duration, the effect of lights on nesting and hatchling sea turtles, and the County lighting ordinance in effect during the sea turtle nesting season. This letter includes a list of suggested site modifications to reduce artificial lighting impacts on nesting and hatchling sea turtles. The towns of New Smyrna Beach and Ormond Beach send out a similar letter to property owners on a mailing list provided by the County Property Tax Appraiser. A copy of the Volusia County pre- turtle nesting season notification letter is included in Appendix C.

Lighting Surveys. The ITP requires that the County perform monthly lighting surveys along Volusia County beaches from April 1 to October 31 of each year. The Volusia County criteria for determining if lights or a lighted sign artificially illuminate the beach is whether or not a human being standing on the beach casts a shadow from the light. In 1997 the monthly lighting surveys were conducted by Beach Patrol officers trained to perform light evaluations. Besides the routine lighting surveys, a lighting evaluation is conducted in response to a sea turtle hatchling disorientation report, a citizen complaint or a violation reported to the Code Enforcement Officer (CEO). A copy of the Volusia County Beachfront Lighting Evaluation Form and the Procedures for Evaluating and Citing Problem Light Sources associated with disorientation events are included in Appendix D.

Code Enforcement. When a lighting evaluation survey indicates that any lights on a property are out of compliance with the lighting ordinance, enforcement procedures are implemented. If the non-compliant lights are located on private property in unincorporated areas of the County or in the Town of Ponce Inlet, the County CEO sends a Notice of Violation to each affected property owner, indicating the location(s) and type(s) of light involved. An example of the Notice of Violation letter is included in Appendix E. Property owners have ten days to bring the lighting into compliance with the County's lighting ordinance. Volusia County Zoning Compliance or Environmental Management Division staff or the PSS will make a site visit and/or offer guidance for correcting lighting problems, if requested. The CEO will provide the County Beach Patrol with a list of properties for which Notices of Violation have been sent and will identify lights requiring re-evaluation. A Beach Patrol officer conducts a follow-up inspection ten days following the notification letter and submits a report of findings to the CEO. If the light remains non-compliant, the case is forwarded to the Code Enforcement Board for a hearing. Violations of the County's lighting ordinance can result in a fine of up to \$250.00 per day for each day of non-compliance.

If the non-compliant lights are publicly controlled and in areas of County jurisdiction, the CEO will notify the appropriate Public Works Department, indicating the location(s) and type(s) of light involved. A Beach Patrol officer will conduct follow-up inspections of the problem light(s) ten days following the notification of the Public Works Department and will submit a report of findings to the CEO.

If the non-compliant lights are located in Ormond Beach or New Smyrna Beach, the CEO will forward a copy of the lighting evaluation survey form(s) to the appropriate municipal code enforcement department. The CEO and the PSS work cooperatively with local municipalities to assist in identifying and resolving known lighting problems.

Public Lighting Management. Florida Power and Light (FPL) provides the public lighting for the northern areas of the County and the New Smyrna Beach Utilities Commission (NSBUC) provides the public lighting south of Ponce Inlet. In this case, FPL and the NSBUC maintain and lease to the jurisdictional governmental agencies the equipment for public lighting on streets and beach ramps.

The County and the utility companies recognize that public lighting, if not properly managed, can present a serious hazard to the threatened and endangered species of sea turtles that nest on the County's beaches. For this reason, the utility companies and the respective jurisdictional governments began working toward a solution to minimize the negative effects of public lighting on sea turtle conservation efforts. In Spring, 1995, the NSBUC began installing "cut-off" lighting shields on all public lighting adjacent to the beach. Each shield is constructed of sheet metal which is attached to the seaward side of the lighting fixture and wraps around the fixture so that an arc of approximately 270 degrees of lighting is shielded from

illuminating the beach. These lighting shields were designed and constructed by the NSBUC. Nocturnal lighting surveys indicate these shields are extremely effective at directing the light straight downward rather than outward and towards the beach.

Volusia County has been working in cooperation with FPL to minimize the amount of public lighting which illuminates the beach during sea turtle nesting season. At the beginning of each sea turtle nesting season, the County authorizes FPL to turn off a number of streetlights leased by the County, beach ramp lights, and dune walkover lights. These remain off for the entire season. This list is reviewed by County personnel prior to the beginning of each sea turtle nesting season, in order to determine if any lights should be added or deleted from the list. When street lights that have been left on are reported as potential problems, the Volusia County Traffic Engineering department assists with code enforcement and correction by determining who is responsible for the light.

In addition, the County has been working with FPL to retrofit all public streetlights along Oceanshore Boulevard (SR A1A) in northern Volusia County with shields and amber acrylic lenses. The installation of these shields and lenses was completed in September, 1997. When comparing the two types of shields, those installed by NSBUC are longer and wrap around the lighting fixture to a greater degree, and thus redirect more light downward, than those provided by FPL. This is in part due to the fact that the Oceanshore Boulevard lights are located on the west side of SR A1A and the shields must be placed on the front of the fixtures. The NSBUC lights mostly point away from the beach and it is easier to fit a shield onto the back of the Cobra-head fixtures.

However, the combination of the shields and the lenses installed by FPL are expected to remedy street lighting problems in the north county area. Prior to the completion of the installation of the shields and lenses by FPL, streetlights along Oceanshore Boulevard that were located near a sea turtle nest that was scheduled to hatch were turned off ten days prior to the estimated hatch date (fifty days after the nest is laid).

Town of Ponce Inlet

Volusia County practices the same enforcement methods for existing private lights inside the Town of Ponce Inlet as in unincorporated areas. Although the County has assumed this responsibility for enforcement inside Town limits, there is no formal agreement between the two jurisdictions as to how this should be accomplished. All of the light management cases inside this municipality were resolved by County Code Enforcement staff. Since there have been no cases requiring a code board hearing, this jurisdictional issue has not been raised.

City of Ormond Beach

In 1997, this city received numerous complaints about a lack of enforcement over existing lights in spite of a strong ordinance. The City addressed this issue by re-evaluating their compliance determinations. They initiated enforcement actions against at least 17 properties and prepared to forward 3 of these to the City Code Enforcement Board. They investigated all problem lights reported by the County and the Volusia Turtle Patrol. They also performed routine surveys to monitor for new violations as well. The City also requested information about the projected hatching dates of nests within its jurisdictions to forward to property owners in the vicinity.

This jurisdiction is tackling the issue of yellow bug lights that were installed by many property owners at the suggestion of the Volusia Turtle Patrol and other technical guidance sources. A joint night time inspection was conducted with the County to resolve these cases and a determination was made that since the City recommended the replacement of white lights with yellow lights, it would not be fair for the property owners to continue to receive violation notices without another, more acceptable solution also being offered. To date, other solutions have not been developed.

City of New Smyrna Beach

This city also fields reports of problem lights from the County Beach Patrol officers and from the Volusia Sea Turtle Society. The City relies on these reports to identify problem lights, but does perform night time inspections to verify that an ordinance violation is present. City staff requests and receives technical assistance from Volusia County in determining if a light is in violation of the City's ordinances. The number of cases resolved successfully by staff and the number that have been forwarded to the City's Code Enforcement Board are presently not documented.

ENFORCEMENT PROCEDURES FOR PROPOSED LIGHTS

Volusia County

Volusia County Environmental Management Services is responsible for reviewing site plans for large projects. When a site plan for a new beachfront structure is submitted, the applicant will be advised of the lighting ordinance requirements and must revise the site plans to demonstrate compliance. After site plan approval has been obtained, building permits are required for actual construction. The County's processes of inspecting the new construction and lighting to ensure they are consistent with the site plan will be investigated further to see if they can be improved.

Smaller projects, such as renovations and construction of single family residences, which only require building permits, are reviewed by Growth Management Services. The County's enforcement ordinance does not specify how these applications should be reviewed for compliance with the lighting ordinance (Section 1206). The process of reviewing these smaller projects for compliance with the lighting ordinance also will be investigated further.

Incorporated Areas

All new construction in the municipalities is supposed to be in compliance with the minimum standards for sea turtle protection. The enforcement processes for new construction within the Cities of Ormond Beach and New Smyrna Beach need to be assessed. Although their ordinances have specific review and approval requirements, how the city staff assures these requirements are met has not been documented. The City of Daytona Beach has initiated a requirement that applicants discuss their projects with Volusia County Environmental Management staff to receive information about the ordinance criteria, but this City has retained site plan and construction approval authority. The degree of adherence to County guidelines within this city will be investigated further. There are no arrangements between the County and the City of Daytona Beach Shores to review new construction. Enforcement mechanisms in this jurisdiction for

new construction must also be assessed.

Volusia County presently does not review any building permit or site plan applications for projects in the Town of Ponce Inlet. The Town also does not apparently have an ordinance for new beachfront development that regulates electrical plans for sea turtle friendly lighting. Since there is no formal agreement between the Town of Ponce Inlet and the County, it is not clear which jurisdiction is responsible for reviewing proposed beachfront construction within the town limits. However, if new structures are to be built east of the state's Coastal Construction Control line, they must meet state FDEP lighting standards for sea turtle protection. This issue will be investigated further.

RECOMMENDED ENFORCEMENT PROCESS IMPROVEMENTS

ILLUMINATION VS. VISIBILITY

Volusia County's minimum standards for sea turtle protection require that lights cannot **illuminate** the beach. Although this seems straightforward, there are enforcement problems associated with this criteria. Illumination is typically evidenced by shadows on the beach. The extent to which a particular light may cast a shadow is dependent on the amount of ambient light present. This will vary from night to night. If many lights are present, it may be difficult to determine the extent to which each is responsible for the illumination observed on the beach. Some lights are not perceived as non-compliant until other lights in the vicinity are corrected.

For these and other reasons, the scientific community has developed a compliance criteria based upon a light source being **visible** from the beach. As noted by Witherington and Martin (1996), "Although the attributes that can make a light source harmful to sea turtles are complex, a simple rule has proven to be useful in identifying problem lighting under a variety of conditions:

An artificial light source is likely to cause problems for sea turtles if light from the source can be seen by an observer standing anywhere on the nesting beach."

Witherington and Martin (1996) reason that "If light can be seen by an observer on the beach, then the light is reaching the beach and can affect sea turtles. If any glowing portion of a luminaire (including the lamp, globe, or reflector) is directly visible from the beach, then this source is likely to be a problem for sea turtles."

The ultimate goal of any beach light management program is to use Best Available Technology (BAT) to provide necessary lighting while at the same time ensuring that this lighting is not detrimental to marine turtles. There are three key components of this BAT: (1) keep light off the beach, (2) reduce the total illumination to the minimal amount necessary to accomplish the purpose of the light, and (3) use a source of light that is minimally disruptive to turtles.

AMENDMENTS TO EXISTING ORDINANCES

Minimum Standards Ordinance

Changing the County's lighting ordinance to include light sources that are **visible** from the beach has far reaching ramifications. The number of lights that would be affected by this change is unknown (i.e. the source is visible but not illuminating the beach), but certainly the number of lights governed by the ordinance would increase, as all lights would fall under this criteria (white, yellow, red, blue, etc.). In addition, the management effort involved would also increase. However, the county recognizes that the existing ordinance needs to be strengthened to effectively protect sea turtles. Therefore, the county's Environmental Management Service Center will recommend amendments to the county's enforcement ordinance (see below).

County Enforcement Ordinance

The county's Environmental Management Service Center will recommend amendments to the county's enforcement ordinance to reflect that **light sources visible from the beach** will be prohibited. The approval process entails legal review, public notification and comment, and final decision by County Council. The revised ordinance will allow for a reasonable amount of time for affected parties to bring lights into compliance. Once approved, the revised ordinance will be provided to all coastal municipalities and promoted as a model ordinance for their consideration.

While this issue is being processed, official notifications will continue to be sent to the responsible property owner and/or owner of the light. Public awareness and public education materials, as well as official notices regarding ordinance matters, will be sent to both the owner and the lighting custodian. Lighting custodians include, but are not limited to, facility managers, residents, tenants and electric companies. Leaving door hangers is one effective way of immediately notifying the actual occupants of a property where a problem light is located. An example of a door hanger is included in Appendix F.

Another issue in the enforcement process is that of building inspections. The potential for an ordinance provision, like in the city of Ormond Beach's ordinance, for a nighttime lighting evaluation by a qualified person prior to final construction approval (e.g., issuance of a Certificate of Occupancy) will be evaluated. There needs to be some assurance that the lighting design included in a site plan or building permit application is adhered to and that, once installed, it effectively complies with the ordinance. This will require some type of internal mechanism (administrative policies) to ensure effective interdepartmental coordination. For example, the lighting evaluation could be added to a check list of Building Department requirements which must be satisfied prior to issuance of a Certificate of Occupancy (CO). Consequently, building inspectors must be trained to enforce the conditions of the ordinance.

FURTHER ASSESSMENT OF ENFORCEMENT PROCESSES

A survey strategy for additional documentation of the enforcement processes for both existing and proposed lights within each jurisdiction is provided in Appendix G. After the processes are more defined for each jurisdiction, then their effectiveness can be better assessed and additional recommendations for enforcement process improvements can be considered.

TRAINING FOR AND PERFORMING NIGHT EVALUATIONS

Consistency in the person(s) conducting lighting evaluations is essential for uniform management. The same person or group of people should perform the evaluations in the same area throughout the duration of the sea turtle season. This will encourage familiarization with lights observed at each facility and make compliance determinations consistent. Everyone performing light evaluations will utilize the same standard methods and forms for consistent interpretation and reporting (See **Lighting Evaluations**, next section). Training will continue for all persons involved in light survey evaluations. Actual "hands-on" lighting evaluations performed at night will be included in the training. City officials responsible for performing lighting surveys will be invited to participate. Periodic communication between jurisdictions will be scheduled throughout the summer. A collective understanding and perception of what constitutes

a non-compliant light source could then be developed.

PUBLIC LIGHTING

Public street lighting within direct line-of-sight of the beach adjacent to Natural Beach Areas (NBA's) should not be exempt from compliance with the ordinance. There are now a number of light management options available for addressing lighting problems along coastal roadways. Public lights that are directly visible from the beach in the NBA's, even if only between buildings, should have shields and/or amber lenses installed. In the areas of Daytona Beach and Daytona Beach Shores, until the exemption issue is resolved there is no conservation value in making changes to public lighting.

FPL is in the process of developing a Coastal Light Management Plan to address the issue of public lighting and Volusia County is participating in this interagency effort. A number of new innovative solutions are being explored in conjunction with that plan which will be shared with everyone involved with public light management in the County as they become available.

CASE TRACKING

The County could improve its information management system related to enforcement of the lighting ordinance. The existing system is useful only if it is possible to sort facility entries by region or jurisdiction. Duplicate entries for the same facility must be avoided to ensure all information for a given facility is entered in the same location for a comprehensive history. This tracking system should also allow comparison of actions taken in different years so that a facility's enforcement and correction history can readily be reviewed and shared with facility owners and managers. It may also be possible to incorporate GIS technology into the tracking system so comparisons can be made between enforcement efforts, sea turtle nesting and disorientation events within any year or between years. The County will work through the Protected Species Specialist and the volunteer turtle patrols to ensure that this happens.

INTERAGENCY COORDINATION

Formal agreements should be negotiated between the County and the various municipal governments. These negotiations should clarify what roles the County has and identify who is responsible for existing and new private lights and for public lights. If city officials need to access the beach by vehicle at night, these agreements will ensure compliance with the terms of the Incidental Take Permit for night time vehicle operation. Contractual arrangements should be considered where the cities are reliant on the County to perform services necessary for enforcement. Financial obligations could also be discussed and enforcement costs possibly shared among the jurisdictions. The County will meet with the municipalities to negotiate formal agreements.

DAYTONA BEACH & DAYTONA BEACH SHORES EXEMPTION

Many factors must be considered and negotiated prior to a decision to lift the current exemption for existing lights in Daytona Beach and Daytona Beach Shores. Crime and public safety are probably the

most important factors. Law enforcement officials for these areas generally agree that any efforts to limit beachfront lighting could pose some crime prevention challenges. In 1995 the county attempted to get the exemption removed and failed, in part due to the political opposition to lighting regulations in these heavily commercialized communities where nesting densities are very low. However, the County will continue to provide records of disorientations and known problem lights to light custodians in these areas.

New construction and renovation of existing structures in these two areas are not exempt from the county's lighting ordinance. The county is experiencing a coastal revitalization where older buildings are being replaced with newer, more modern structures. The Ocean Walk project in the core area of Daytona Beach is an example of this. It is estimated that over the next ten years the majority of the older buildings will either be replaced or renovated. The existing minimum standards ordinance addresses new construction and renovation. The county, working with the municipal building departments, will evaluate the buildings built after the ordinance cut-off date to ensure that these structures are in compliance.

In spite of the issues raised above, the county does believe that existing lighting in Daytona Beach and Daytona Beach Shores should be addressed. However, based upon the minimal number of nests that are laid in these areas and the magnitude of the number of lights visible from the beach and/or contributing to the overall sky glow, scarce resources should be directed to those areas that are likely to yield maximum benefit. Accordingly, the county will initiate round table discussions with these two municipalities to open up dialogue, identify all relevant issues, and develop alternatives and action items. To maximize the effectiveness of these discussions, U.S. Fish and Wildlife Service and the Florida Department of Environmental Protection must also participate. It is imperative that those agencies responsible for sea turtle conservation and recovery efforts campaign with the county on this issue, as local opposition to strict lighting regulations is a barrier that must be overcome.

PUBLIC SERVICE INFORMATION

Property owners, residents and visitors should be made aware of and have access to the same information as those located where ordinances are in effect to encourage voluntary light management in the absence of regulatory requirements. Examples of this type of information for general light pollution management are provided in the Appendices. (Also, see PUBLIC AWARENESS PROGRAM).

LIGHTING EVALUATIONS

The purpose of a lighting evaluation is to identify lights that are likely to alter the behavior of nesting or hatchling sea turtles. Initial evaluations are intended to be informative. They should provide sufficient detail about problem lights to facilitate appropriate remedial action. Through proper public awareness and education programs, most coastal lighting custodians (i.e. those responsible for operating and maintaining the lights) are typically amenable to resolving identified lighting problems. However, for those few who are reluctant to assist in the County's sea turtle conservation effort, strict and unambiguous ordinance language together with concordant enforcement effort may be needed. Subsequent lighting evaluations in conjunction with official correspondence serve as the documentary basis for enforcement action.

Volusia County currently has a methodology for evaluating beach front lighting as outlined in the previous section entitled "**Light Management Procedures**". It is recognized, however, that improvements can be made to this methodology. Volusia County's Protected Species Specialist, Ecological Associates, Incorporated, has developed a model for conducting lighting evaluations (Appendix H). This is a detailed plan for conducting this activity, and is very labor, time and resource intense. During the first year of this BLMP, Volusia County will evaluate the tasks outlined in this model, and adopt and put in place as many of the recommendations as feasible to improve upon the existing process for dealing with this issue. There are also other recommendations throughout this plan that will assist in improvement to lighting evaluations.

PUBLIC AWARENESS PROGRAM

Integral to the success of Volusia County's Beach Lighting Management Plan (BLMP) is a program to inform coastal property owners, facility managers, beachfront residents, and beach users of the goals, components, and responsibilities contained in the Plan. A considerable reduction in beachfront lighting may be achieved through voluntary compliance with recommended lighting modifications. Every light turned off, shielded, repositioned or otherwise modified reduces the cumulative amount of light reaching the beach.

Initial reaction to beachfront lighting regulations is often negative, as uninformed coastal residents envision transformation of their property to a dark, unsafe, living environment. In practice, lighting can be brought into a turtle-friendly mode without compromise to personal safety or interruption of normal daily routines. Depending on the number and types of lights present and their locations, potentially:

1. All lighting on the property can be maintained,
2. Costs for bringing lighting into compliance may be negligible, and
3. A long-term benefit may be realized through reduced energy expenditures.

Contrary to some public opinion, the primary objective of lighting ordinances is not to eliminate necessary lighting but to reduce and confine that light to the specific areas for which it is intended. If light is confined to areas landward of the primary dune, seawall, or other coastal feature defining the landward extent of the beach, and if the source of light (i.e. bulb) cannot be seen from the beach, the light will be compliant with most lighting ordinances.

There is no dictated fix for any specific lighting situation. Rather, affected residents can select from a suite of alternative solutions. Solutions can be as simple as turning a light off. The cost for resolving a problem will vary in relation to the complexity of the lighting alternative selected. The bottom line is that many lighting problems can be resolved without elaborate or expensive measures. Modifications to coastal lighting may ultimately result in a net savings to residents through reductions in monthly electric bills. Examples of citizen guides for managing beachfront lights are provided as Appendices I, J and K.

Prior to implementing a public awareness program, the County will organize interlocal government forums to identify available resources and partition the educational effort among participating communities. The existing program for designating Turtle-Friendly Establishments established by the volunteer turtle patrols should be evaluated and perhaps expanded through cooperation from the Chamber of Commerce, condominium associations and the local Hotel/Motel Associations.

Volusia County is a tourist destination. The beachfront is characterized by numerous hotels/motels, time-share units, rental condominiums, and single-family/duplex rental units. This results in a large turnover of occupants in these units, with the peak of the tourist period during the sea turtle nesting season. This provides lighting managers with a challenge to inform these visitors on the proper management of their lights. The County will develop a program to inform beach side visitors of the need to control lights for turtles. One concept is to include a placard in each rental room (see Appendix L for an example). The need to keep the visitors to Volusia County beaches educated on this issue will be an on-going challenge to the County.

COMPLIANCE ASSISTANCE PROGRAM

Informed citizens are the key to successful implementation of the BLMP. This information may be disseminated via general public awareness programs or direct official correspondence. In this section, general guidelines are offered for preparing official notices of violation and for developing a technical assistance program.

OFFICIAL CORRESPONDENCE

The following official correspondence regarding beachfront lighting will be sent to coastal property owners:

1. Annual Notification of the Start of the Sea Turtle Nesting Season - This correspondence is sent approximately two weeks prior to the start of nesting season (May 1).
2. Notification of Problem Lights (Public Service) - This would apply to those cases where lighting evaluations are performed in areas where no regulations are in place or when the evaluations are performed prior to an official compliance period (i.e., outside of the official nesting season established by ordinance). The notice includes a copy of the evaluation report, recommendations for resolving observed lighting problems, and a contact number for additional information or technical assistance. Recommendations for selecting a light management option are best made by the person performing the lighting evaluation but can be made by others based on photographic records of the evaluation. There are two separate practices involved in this area. The first deals with existing code violations, while the second deals with notifying a property owner with a "For Your Information" notice when they are not technically in violation of an ordinance or regulation.
3. Notification of Problem Lights (Code Violation) - This would apply to those cases where lighting evaluations are performed in areas where lighting regulations are in place and during the effective compliance period established by ordinance. In addition to the information provided in No. 2 above, this notice includes a compliance deadline and describes potential penalties for non-compliance. Typically, a copy of local regulations regarding the code enforcement process is attached (e.g., notices, non-compliance, penalties, appearances before governing boards, appeals, etc.).
4. Notification to Appear Before Code Enforcement Board - This notice is sent after a specified period (set by law) following the initial notification of violation and after a follow-up lighting evaluation has been performed and the lights in question are still in non-compliance. A copy of the second evaluation report is included along with instructions as to how the case will be handled.

Notifications and information provided to coastal property owners in areas where no lighting regulations are in effect are done as a courtesy to the affected party. The intent is to assist residents in their efforts to comply with the Endangered Species Act (ESA). Whether compliance with recommended lighting guidelines is voluntary or mandatory, everyone should understand that failure to properly manage lights on their property could result in legal action against them by the U.S. Fish and Wildlife Service (USFWS).

Prosecution under the ESA can be avoided as long as coastal property owners make a good faith effort to

correct identified lighting problems. The USFWS was recently asked how it would respond to a situation in which a party attempted unsuccessfully to resolve a coastal roadway lighting problem. The Service responded that as long as the responsible party followed recommended light management guidelines and continued to work cooperatively with the agencies to eliminate additional disorientations, it would not recommend prosecution (USFWS correspondence, 8/20/97). Thus, coastal property owners should understand that they can avoid both local and federal penalties by addressing lighting problems in a timely manner, by implementing recommended light management options, and by cooperating with the County, state and federal agencies in making additional lighting improvements, if necessary.

TECHNICAL ASSISTANCE

The establishment of a technical assistance program for affected coastal residents is critical to the County's efforts to minimize the amount of light reaching the sea turtle nesting habitat. Although the public awareness program and guidelines outlined above contain many simple "how-to" options for effectively managing light, there will undoubtedly be a number of residents who will need additional guidance in selecting the appropriate choice. Additionally, many residents will have questions regarding ordinance requirements and compliance deadlines.

The County will ensure that sufficient resources are available to effectively administer this program. Although demands on the program will be most intense during implementation of the BLMP, some degree of technical guidance will be required as long as the County manages lights for sea turtles.

The person in charge of the technical assistance program might be required to perform the following services:

1. Assist with performing lighting evaluations.
2. Serve as liaison between those performing lighting evaluations and those involved with code enforcement activities.
3. Based on lighting evaluation reports, provide recommendations for effective light management.
4. Develop and maintain a source list of lighting supply companies, lighting engineers and lighting consultants and provide these to coastal lighting custodians upon request.
5. Perform site visits, as needed, to provide guidance to affected property owners in dealing with unique or complex lighting problems.
6. Provide expert testimony at Code Enforcement proceedings.
7. Assemble, maintain, review and summarize ancillary data pertaining to the effectiveness of BLMP light minimization efforts.
8. Provide residents with information about the BLMP.
9. Furnish affected coastal property owners with applicable ordinance regulations and compliance timetables.
10. Coordinate light management efforts with the municipalities.

LONG-TERM MONITORING

Coastal communities have implemented good coastal lighting regulations without establishing a standard monitoring and compliance program. For light management to be effective, the County, in cooperation with municipal governments, must dedicate the human resources needed to routinely monitor the beach for lighting violations and ensure that violations are dealt with in a fair, diplomatic and consistent manner.

LIGHT MAINTENANCE EVALUATIONS

Annual light maintenance evaluations are needed during years 2-5 of the Incidental Take Permit for the following reasons:

1. There are changes in ownership of coastal properties,
2. New residents take up occupancy in condominiums and rental properties,
3. Light management responsibilities change hands (e.g., managers of condos, hotels, etc.)
4. New lights are added to existing structures,
5. Lighting systems are changed as buildings are repaired or remodeled, and
6. New facilities are built near the beach.

At least two county-wide maintenance evaluations will be conducted each year. The first evaluation will occur prior to the official beginning of the sea turtle nesting season as established by governing regulations (currently May 1). This will provide managers, tenants, and property owners with the information they need to modify or replace lights before they have an appreciable affect on nesting turtles. During the nesting-hatching season, lighting problems that seemed to have been remedied may reappear because owners have been forgetful or because ownership has changed. For this reason, a midseason lighting inspection will be conducted. This will take place in early June to allow sufficient time for any necessary corrective measures before the majority of hatchlings begin to emerge from nests in July. Both maintenance lighting evaluations should follow the same procedures as presented elsewhere in this manual (Lighting Evaluations).

DISORIENTATION REPORTING

One of the key activities that is used to alert the County that a problem light exists is the disorientation reports received from the volunteer turtle patrols. These reports are used as the mechanism to instigate the enforcement process. Because of this, it is imperative that these reports be as consistent and accurate as possible. In the past there has been some discrepancies in the reporting of disorientations as to what is truly a disorientation caused by a light, and not just an act of nature. For example, when all but one or two hatchlings emerge from a nest and correctly orient toward the ocean, disorientation reports have been filed against a particular light or lights for the one or two hatchlings that did not orient properly. A standardization must be developed when instances like this occur so the County knows when the lighting enforcement actions must commence. The County, through its Protected Species Specialist, will work cooperatively with FDEP, the Volusia Turtle Patrol and Volusia Sea Turtle Society to develop methods for standardized and reliable disorientation reports to evaluate disorientation events.

IMPLEMENTATION STRATEGY

The following is the implementation schedule for Volusia County's Beach Lighting Management Plan. This schedule is subject to change.

Year Two of the ITP

1. Review and document all lighting ordinance enforcement processes for existing lights. Also review new construction minimum standards compliance and enforcement processes in all areas of the county for large and single-family residential projects. Recommend improvement processes where applicable.

Responsible Party: Environmental Management and Growth Management
Target Date: 3Q98

2. Provide special assistance to facilities located in repeat disorientation event areas identified in this document. This will be accomplished by determining each facility's willingness to cooperate with retrofitting, conducting detailed inventories of problem lights, and offering alternative solutions. These assessments should be started as soon as possible.

Responsible Party: Environmental Management with support from the PSS
Target Date: 2Q98

3. Establish a technical lighting point of contact for assisting beachfront residents in managing their lights and for responding to citizens who receive Notice of Violation letters.

Responsible Party: Environmental Management and Growth Management
Target Date: 2Q98

4. Refine the night lighting evaluations to improve this function. Improve the training/expertise of staff performing these evaluations.

Responsible Party: Protected Species Specialist
Target Date: 2Q98

5. Hold round table discussions with the cities of Daytona Beach and Daytona Beach Shores, USFWS, and FDEP to identify the issues surrounding the beach front lighting in these areas.

Responsible Party: Environmental Management with support from County Manager's Office
Target Date: 3Q98

6. Amend the county lighting ordinance to include light sources that are visible from the beach and submit to County Council for approval.

Responsible Party: Environmental Management
Target Date: 2Q98

7. Formulate a plan for implementing a public information program to educate private homeowners on the use of exterior and interior beachfront lighting. Develop and distribute educational materials.

Responsible Party: Environmental Management with support from Community
Information/PSS/ Volunteer/Turtle Patrols

Target Date: 3Q98

8. Develop a public information program for use by hotel/motel and condominium managers to assist them in managing their lights. Identify and showcase those establishments that have done an outstanding job of making their lights "turtle friendly".

Responsible Party: Environmental Management

Target Date: 3Q98

9. Explore feasibility of private sector sponsors for funding public education programs.

Responsible Party: Environmental Management

Target Date: 4Q98

10. With the assistance of the County's PSS, standardize disorientation reporting with FDEP and the volunteer turtle patrols.

Responsible Party: Protected Species Specialist

Target Date: 2Q98

11. Continue to monitor FPL's coastal roadway lighting management program to ensure Volusia County stays informed about best available streetlight technology.

Responsible Party: Environmental Management/Protected Species Specialist

Target Date: On-going

12. In conjunction with USFWS, develop program evaluation methodology, with an emphasis on measurable, attainable, and scientifically supportable criteria.

Responsible Party: Environmental Management/USFWS

Target Date: 4Q98

Year Three of the ITP

1. Implement the annual lighting maintenance and evaluation program.

Responsible Party: Environmental Management/Protected Species Specialist

Target Date: 4Q99

2. Provide funding for distribution of sea turtle/lighting brochures, etc., to hotels/motels (door hangers, room placards, light switch plate covers, etc.) if it could not be established through private sources.

Responsible Party: Environmental Management
Target Date: 1Q99

Year 4 & 5 of the ITP

1. Develop and implement a mitigation plan for addressing any unresolvable areas/issues after all of the above attempts to manage coastal lighting for sea turtles have been made.

PROGRAM EVALUATION

The ability to evaluate the success or failure of any management plan is critical. However, there has not been enough history in light management programs to develop concrete evaluation methods. Three program success alternatives have been identified:

1. Reduction in the number of hatchling disorientations.
2. Reduction in the number of lighting violations.
3. Field Bioassay Study.

Volusia County will work with USFWS in identifying realistic, measurable criteria for evaluating the success of the BLMP.