National Park Service
U.S. Department of the Interior

Gateway National Recreation Area – Sandy Hook Unit
Sandy Hook, New Jersey

Gateway National Recreation Area – Sandy Hook Unit

Automated Fee Entrance Plaza and Intelligent Transportation System Technical Requirements

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I. Introduction

The Volpe National Transportation Systems Center (Volpe Center) is providing technical support to Sandy Hook, a unit of the Gateway National Recreation Area, in the planning and concept development for possible Intelligent Transportation Systems (ITS) automation solutions to the Sandy Hook entrance plaza. Sandy Hook park staff believes that fee collection operations, vehicle and pedestrian data collection, and park visitor experience can be improved with an ITS solution that includes automated vehicle access, visitor counting (both vehicular and pedestrian), and traveler information. This study evaluates system technologies, concepts, and approaches.

The New Jersey Department of Transportation (NJDOT) is in the process of replacing the Shrewsbury Drawbridge located just outside the park entrance. The bridge serves 80% of the 2.5 million annual visitors to Sandy Hook. As requested by the park, the NJDOT bridge replacement project will provide safe bicycle and pedestrian access to the park and realign the park entrance road and fee plaza to significantly improve security and traffic flow into the park. To date, the project has moved forward with little regard to the sequencing plan agreed to by all stakeholders. The NJDOT contractor has begun construction on the bridge and the Sandy Hook fee plaza and entrance area has been demolished and temporarily realigned. In preparation for the new plaza that will be located within the realigned road corridor, ITS technical requirements are needed.

This report provides technical requirements for the recommended ITS solutions and its subsystems, components, and communications. Since Sandy Hook staff is still evaluating the future direction of the ITS solutions for the park, the Volpe Center staff has attempted to provide solid technical guidelines for ITS sub-systems with enough specificity to describe performance requirements. The overall ITS concept includes requirements for integration into a seamless, user-friendly system and emphasizes usability requirements. The intent is that this requirements document can be used as a basis for a request for proposals (RFP). However, this is not intended to be a document that can be "cut and pasted" into an RFP without embellishment and clarification by Sandy Hook staff to describe operational preferences and integration with other legacy and planned equipment and processes.

Additionally, the Volpe Center will give brief recommendations for pilot testing of key ITS subsystems.

II. Background

In 2007, the Volpe Center prepared a technical study on approaches to automating the Sandy Hook entrance fee plaza. The report included an examination of several technology areas, including:

- Automated entry
- Pedestrian/cyclist counting
- Vehicle counting
- Traveler information and variable message signs
- Parking payment approaches
- CCTV

Some of the key technology approaches to automated entry and fee payment were magnetic stripe, Radio Frequency Identification (RFID), EZ-Pass transponders, bar code and smart cards. After reviewing the report, Sandy Hook management chose a proximity RFID approach at all entry lanes as a low-cost yet robust approach to automated entrance that will allow for expansion in the future as business needs dictate.

Additionally, some electronic directional signage as well as an electronic parking lot availability sign is desired. This document provides technical requirements for these technologies and also some information on a more accurate parking management system to enable park staff to efficiently close and re-open the park.

III. Intelligent Transportation System

The overall ITS system must seamlessly integrate all the subsystems on a common workstation with a common graphical user interface (GUI). The GUI should allow a user to monitor system availability, set parameters for the subsystems and update information as necessary, remotely check and reset/update system components, and monitor any alarm conditions and take corrective action.

Additionally, the single user workstation will allow staff to drill down into data generated by any of the ITS sub-systems (for example, checking the number and type of visitors who are in the park). Therefore, the ITS system must have the ability to accept real time data from the subsystems including highly dynamic data such as vehicle and pedestrian counters, RFID entry system, and CCTV cameras. The ITS hardware can be located in any park building either at the entry plaza or elsewhere as directed by park staff. Network connectivity will be required so that its information will be accessible to NPS management. Devices which provide input to the system will either be hardwired (if located nearby) or transmitted via TCP/IP from a local device controller.

Note: An additional component of this system not specified here is the automated parking management system. Alternatives for this system, which may include a subsystem to ensure fee payment by beachgoers, will be determined as a follow-up task, but the ITS platform will need to be capable of integrating information from that component, and the requirements listed below will need to be augmented to ensure that integration into the ITS platform is seamless.

Technical requirements for the overall ITS system:

- Workstation to operate on standard 110v, 60Hz AC power
- Standard Microsoft Windows-based computer workstation
- Component connectivity via Microsoft TCP/IP networking using existing NPS network infrastructure
- Server and network components must be powered via a Universal Power Supply (UPS) that will provide power for at least 6 hours following a power outage and to protect against power surges
- Enterprise-level database platform for storing various component data
- Secure remote login capability
- Secure remote access to all system components
- Ability to set varying levels of system access
- Server hard drive at least 200GB, providing at least 36 months local storage of events
- User-friendly GUI with point and click icon-based navigation
- 19 inch low-glare LCD monitor
- Complete written user manuals and training guides (for overall ITS as well as each sub-system)
- Vendor to provide 8 hour training course on 2 separate occasions to train selected staff
- Ability to page/text users, technicians, and managers to provide alerts for selected conditions or system problems
- National Park Service retains all data rights for entire ITS system (and all sub-systems)
- All hardware and software is the property of National Park Service

- Any and all license fees will be fully explained

IV. Automated RFID Entry Control

Sandy Hook project manager and staff have expressed a desire to have an automated entry control system at the fee plaza geared toward park staff and tenants, allowing 24/7 access control. RFID entry control technology is very mature, and is used in various access control applications. Sandy Hook is particularly well-suited to RFID technology due to its exposure to the elements including sand and salt air. Operating at 125 KHz, RFID systems are contactless, providing enhanced system availability and a low maintenance, accurate system.

RFID technology is widely available and provides a stable platform to operate in the current use case as well as migration to new applications due to the robust data storage on the proximity tags. Examples of expanded applications would be to provide automated access to season pass holders, added purchase function at concession stands and other retail locations in the park, and even day pass automation.

The readers must read tags within 300 milliseconds and the read range must be at least 5 cm, with reliable reading at distances up to 50cm. The tags may be oriented in any direction (except on edge) to achieve a successful read. This will allow for a high degree of user friendliness by eliminating the need for any specific orientation of the tag to the reader. An RFID system gives Sandy Hook management the ability to create restrictions on individual tags as they see fit. For example, time and date restrictions, lockout of an individual tag, changing parameters when desired, etc. This management flexibility is inherent in any RFID system procured.

The system processor enclosure can be located in the first (largest) entry booth in the new entry plaza design. Appropriate power and network communication must be available in the booth. Figure 1 shows the layout of the RFID readers and gates.

The gates used at the fee plaza must be reliable, fast opening and closing, and capable of being overridden both locally and remotely.

Technical requirements for the RFID system:

- Operating frequency: 125 KHz
- System must operate on 110VAC
- System based on Microsoft Windows
- Compatible with ITS database described above
- System must include two-way intercom with Help button to 24 hour staff
- Reader and intercom must be intended for harsh, outdoor environment to prevent sand, salt air, rain, etc. from affecting reader performance
- All outdoor electronic equipment required to be in National Electrical Manufacturers Association (NEMA) category 4 protective enclosure
- RFID tag must be read in less than 300 ms from a range of at least 5 cm and up to 50cm with a read reliability of 99%+
- RFID system must open the automated lane gates within 1 second of successful read and with a reliability of 99%+
- Ability to dynamically set and change parameters on tags, including the ability to place individual tags or multiple tags on “negative lists”
- Ability to record and store 36 months of access data on ITS database
- Ability to program system acknowledgement by individual assigned user
- RFID system must include tag graphics assistance and ability to customize tag graphics
- RFID System and intercom must be powered via a Universal Power Supply (UPS) that will provide power for at least 6 hours following a power outage and to protect against power surges

Technical requirements for the fee plaza gates:

- Must operate on 110VAC
- Must have a manual override in the event of a power, network or RFID system failure
- Must open an 8 foot gate arm in less than 2.0 seconds
- Must be triggered to open on valid card read by RFID system
- Must be triggered to close on exit sensor activation
- Open and close operation must be able to be remotely overridden both locally and remotely
- Gate arms must be easily replaced if broken
- Include spares for readers, gates, and gate sub-systems (e.g. arm motor) as well as 24 month system maintenance warranty

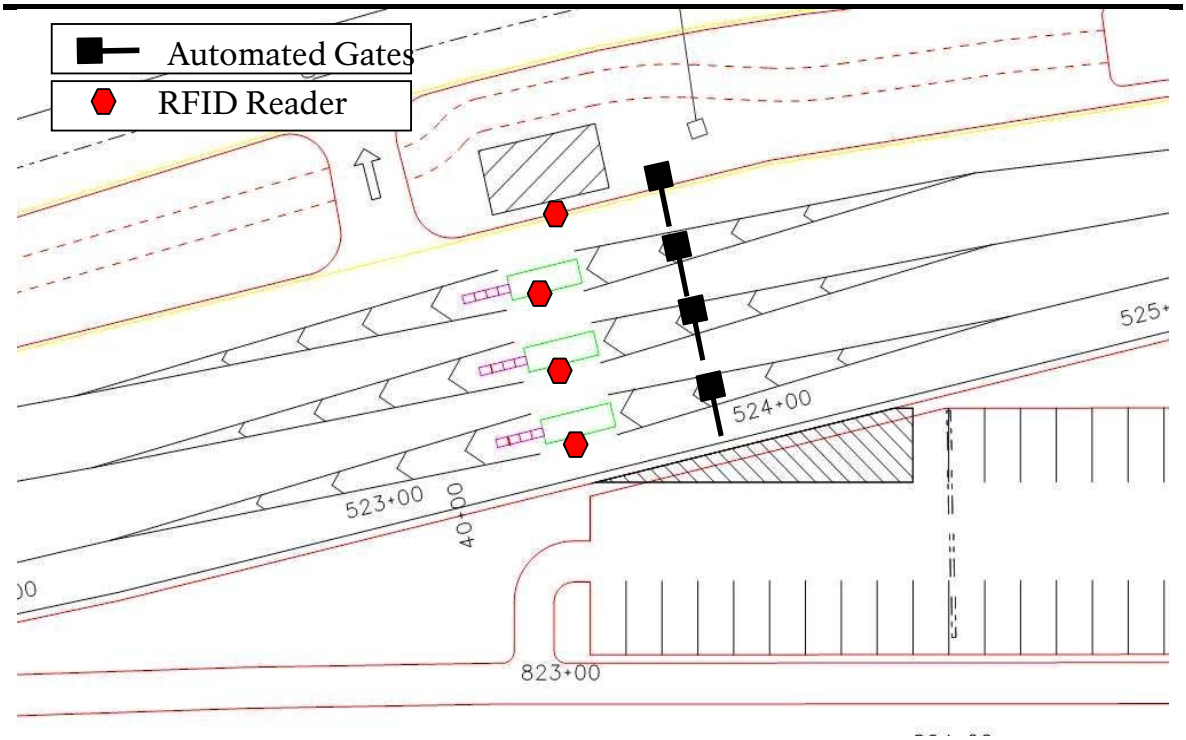


Figure 1: RFID Gate and Reader Layout

V. Vehicle Counters

Sandy Hook management has expressed a desire to maintain an accurate count of the number of vehicles in the park. This can be accomplished through the use of loop detectors at the park entry lanes (just before two lane entry opens to the multi-lane fee plaza) and the park exit lanes. See Figure 2 for these locations.

Placing the loop detectors at these locations will provide an accurate figure of the number of vehicles on the park land and number of vehicle entering through each lane. Staff can quickly

access the number of vehicles through the ITS workstation. This overall vehicle count can provide a rough count of the number of parked vehicles by simply developing an algorithm that calculates open parking capacity from the likely percentage of all vehicles that are traveling to the Sandy Hook beaches. While this is not a fine-grained analysis, it is a simple way to augment the experiential knowledge of the park staff regarding parking lot fill rates.

The vehicle count will be derived from six detectors: the four entry lane counters, which will give an accurate count of the number of vehicles actually entering the park, and the two exit vehicle counters. The vehicle sensors at in the fee plaza lanes serve several other purposes as well. They trigger the gate to close as each vehicle departs, and they can be used as an accounting mechanism for any fee collection process.

Sandy Hook also has an existing system that transmits park entry data to a centralized National Park Service location in Colorado. Real time parking data generated by the vehicle counters must be integrated into the current system data format.

Technical requirements for vehicle counters:

- Real-time upload to ITS system of count of vehicles entering and leaving the park
- Must have Cat5 Ethernet and RS232 interface
- ITS system resolves accurate, real time calculation of net number of vehicles in the park
- Utilizes standard inductive loop detector technology for sensor input
- Operate on 110VAC
- Detect and count accuracy within 1% of actual
- Site visit needed to determine exact location of loop detectors and pedestrian detector

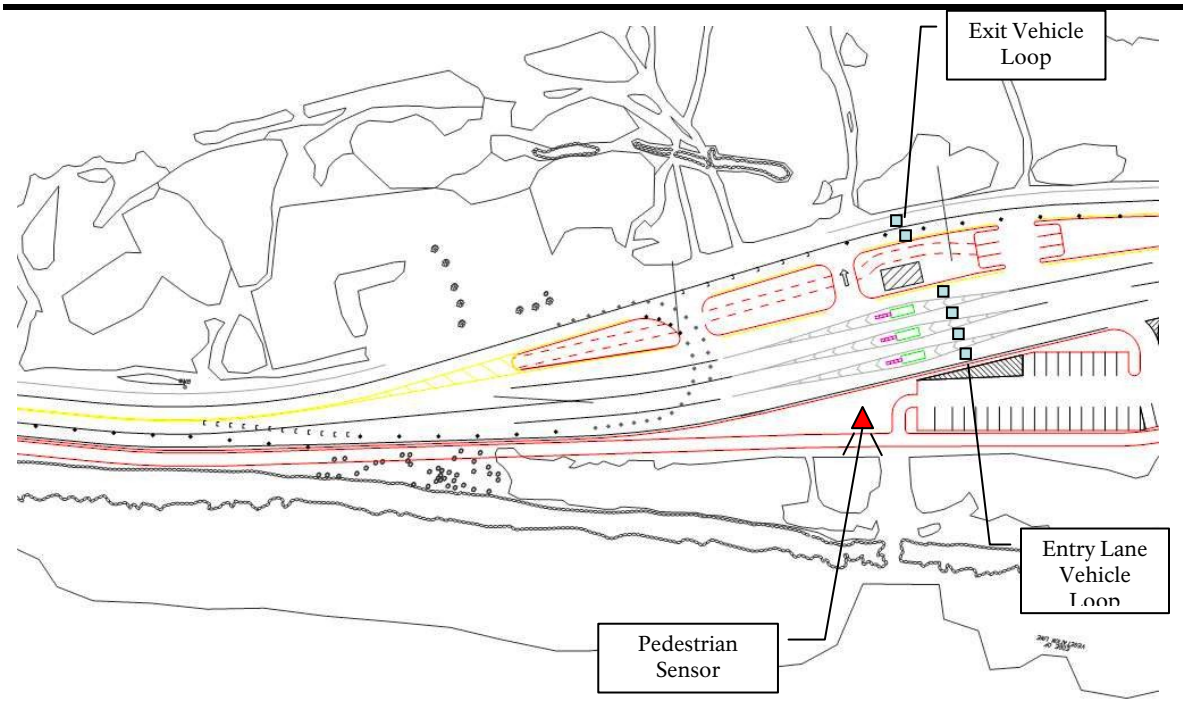


Figure 2: Vehicle and Pedestrian Counter Layout

VI. Variable Message Signs

There will be four types of variable message signs (VMS) located at the park entry plaza will serve several functions. First, there will be a lane usage sign to prepare approaching vehicles for the lanes they need to use as they enter the park. There will also be lane status signs above each lane. An Electronic sign will also be used at the plaza to indicate parking lot availability. Finally, there will be a general purpose message sign that will display appropriate messages as determined by the park management.

The Lane Usage sign will be placed at the side of the roadway at the head of the entry plaza where vehicles fan out to the four entry lanes. It will carry a message such as "Season pass holders keep left", or "Beach Parking Full – Use U-Turn".

The Parking Availability sign is a large sign, approximately 6 feet by 8 feet, and will list all of the parking lots and indicate if they are OPEN or FULL. It will be controlled manually by Park personnel at the entry plaza, who will know with high degree of accuracy when lots become full based on the traffic volume data and by communication from staff at the entrance of the lots as the last spaces are claimed.

The General Purpose sign will be adjacent to the Parking Availability sign and will carry the same dimensions. It will be used to announce special events, warn of approaching weather systems or indicate hours of operation. This sign can display several repeating screens to support multiple simultaneous messages.

Ideally, the Parking Availability and General Purpose signs would be placed on the Plaza canopy roof, just above the lane indicator signs. However, if the canopy structure cannot support these signs, they will need to be placed on the side of the road to the right of the fee plaza.

Lane Status signs can be placed above the individual booths, mounted beneath the roof overhang of the canopy above each lane. The size will be specified so that messages can be easily read by drivers, but the signs shall not reduce the height clearance of the plaza lanes. The signs would carry messages such as "Season Pass Holders" or "Cash and Season Passes". Additionally, they will have color indicators (e.g., "Open" message in green, "Closed" message in red) to provide easy recognition of open and closed. See Figure 3 for sign locations.

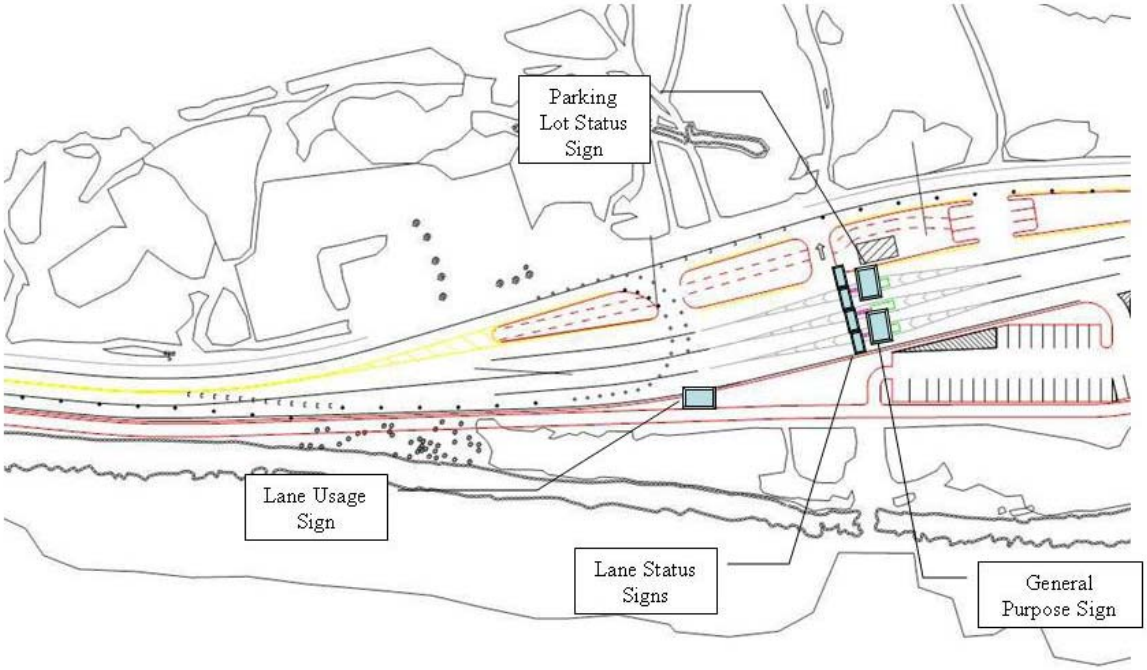


Figure 3: Entry Plaza Sign Layout

Technical Requirements for Signs:

- For Variable Message Park Entry Sign, at least 6 standard messages as well as custom message ability
- For Parking Availability Sign, large enough to list all parking lots and capability to toggle "open" and "closed" for each lot both manually and automatically.
- For Lane Usage signs, ability to control message from the entrance station to allow visual recognition by park staff to ensure consistency and safety
- Remote operation of all signs from ITS workstation
- Must possess a secure Ethernet interface so that content can be controlled remotely via the internet
- Ability to output data to New Jersey traveler information system
- Day/Night Readable
- 110VAC
- Equipment reliability of 95%+

VII. Pedestrian Counter

Sandy Hook is a prime destination for bicyclists, roller bladers, joggers and other pedestrians. The park management has the desire to also have information on the number of non-vehicular visitors that are inside the park at any given time.

There are numerous technologies available to count pedestrians; however active infrared sensors seem to be the best fit for the Sandy Hook application. They work well in outdoor environments with adverse conditions, have a sufficient read range and can detect direction of travel with the use of twin beams. Additionally, concealing the sensors using landscaping will not be an issue due

to the long read range. However, the technology cannot distinguish the various types of pedestrians and would simply give net counts entering and leaving.

The various sensor options are relatively inexpensive and the best approach may be to test additional sensor types if the active infrared sensors do not give the desired result. The placement of the counter is highlighted in Figure 2 above.

- Technical Requirements for pedestrian counter:
- Read range of at least 10 feet
- Ability to differentiate direction of pedestrian traffic (i.e., determine entry and exit
- Keep a running count of number of pedestrians in the park (i.e. continually calculate park attendance from entries minus exits)
- Counters connect to ITS system via Ethernet
- Ability to reset system count manually at park staff discretion
- Reliability of 95+%

VIII. Closed Circuit Television

Closed circuit television cameras will give park staff the ability to see traffic issues remotely as well as the ability to observe any incidents at the park entry such as accidents, crime, or other incidents. Cameras will have the capability to zoom in on license plates for staff to record plate numbers as necessary.

The camera system will be linked in to the main ITS system and will stream real time video of the entry plaza area. Additionally, a digital video recording (DVR) system will be added to automatically record events at the entry plaza for future retrieval by park staff.

At a minimum, 14 fixed cameras are recommended to cover the entire entry area of the park. Four cameras can be mounted to light poles to cover the areas at either end of the entry plaza. All cameras would point generally toward the entry plaza: on the west side of the plaza, one from the north looking southeast (which can also monitor the volume of approaching traffic); one from the south looking northeast; on the east side of the plaza, one from the north looking southwest and one from the south looking northwest.

One camera in each fee collection booth is recommended to provide protection for staff. Also, in front of each booth, a camera will be focused on the rear license plate of each arriving vehicle.

The Gatehouse is adjacent to the entry plaza and given the use of this building as the Fee Administration Building, where daily receipts are counted and stored while awaiting deposit, coverage of this building or at minimum a selected room with an additional camera may be desired. Also, a camera is needed to monitor the driveway and entry door to Building 438.

The camera and lighting sub-system will be tied into the sub-system viewing and recording system head end through the conduits to be installed during the entry plaza construction (see Appendix A for conduit diagram). Figure 4 shows the placement of lights and CCTV cameras.

Technical requirements for the CCTV system:

- Digital Video Recording system with sufficient disk space to store 30 days of video from each camera at a rate of at least 7.5 frames per second
- Capable of burning video segments to removable media which can be viewed on any computer for investigations and prosecution
- Capability to stream video to other authorized computers on the Sandy Hook network
- Capability of adding additional cameras and recorders

- Appropriate construction or housing for cameras to withstand sandy, wet, and salt air environment
- Ability for sensor input to increase frame rate and tag video segments
- 480 line resolution
- Varifocal lens
- Autoswitching color/black & white for day/night use
- 0.2 lux nighttime rating
- DVR and Camera power supply must operate on 110VAC and be powered via a Universal Power Supply (UPS) that will provide power for at least 6 hours following a power outage and to protect against power surges
- Cameras must operate on 24VAC
- Equipment reliability of 95%+

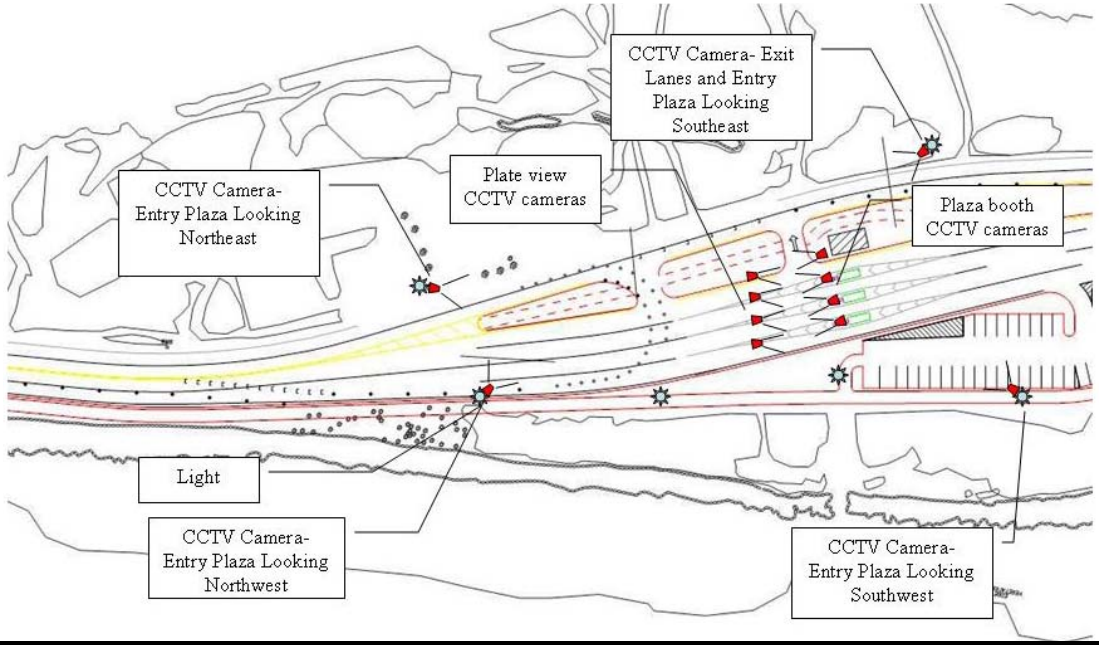


Figure 4: CCTV Camera and Light Layout

IX. Additional Standards and Specifications

In implementing the technologies described in this report, it is important that the following standards and specifications be adhered to:

- Uniform Manual of Traffic Control Devices (UMTCD)
- Title III Regulations of the *Americans with Disabilities Act of 1990*
- National Electrical Code (NEC) (NFPA 70)
- Standards and Specifications of the New Jersey Department of Transportation (NJDOT)

X. Conclusion

Sandy Hook has been afforded an excellent opportunity to improve the overall infrastructure of the park through the Shrewsbury Drawbridge replacement project. While the construction has created traffic issues during ingress and egress that Sandy Hook staff has had to deal with, the

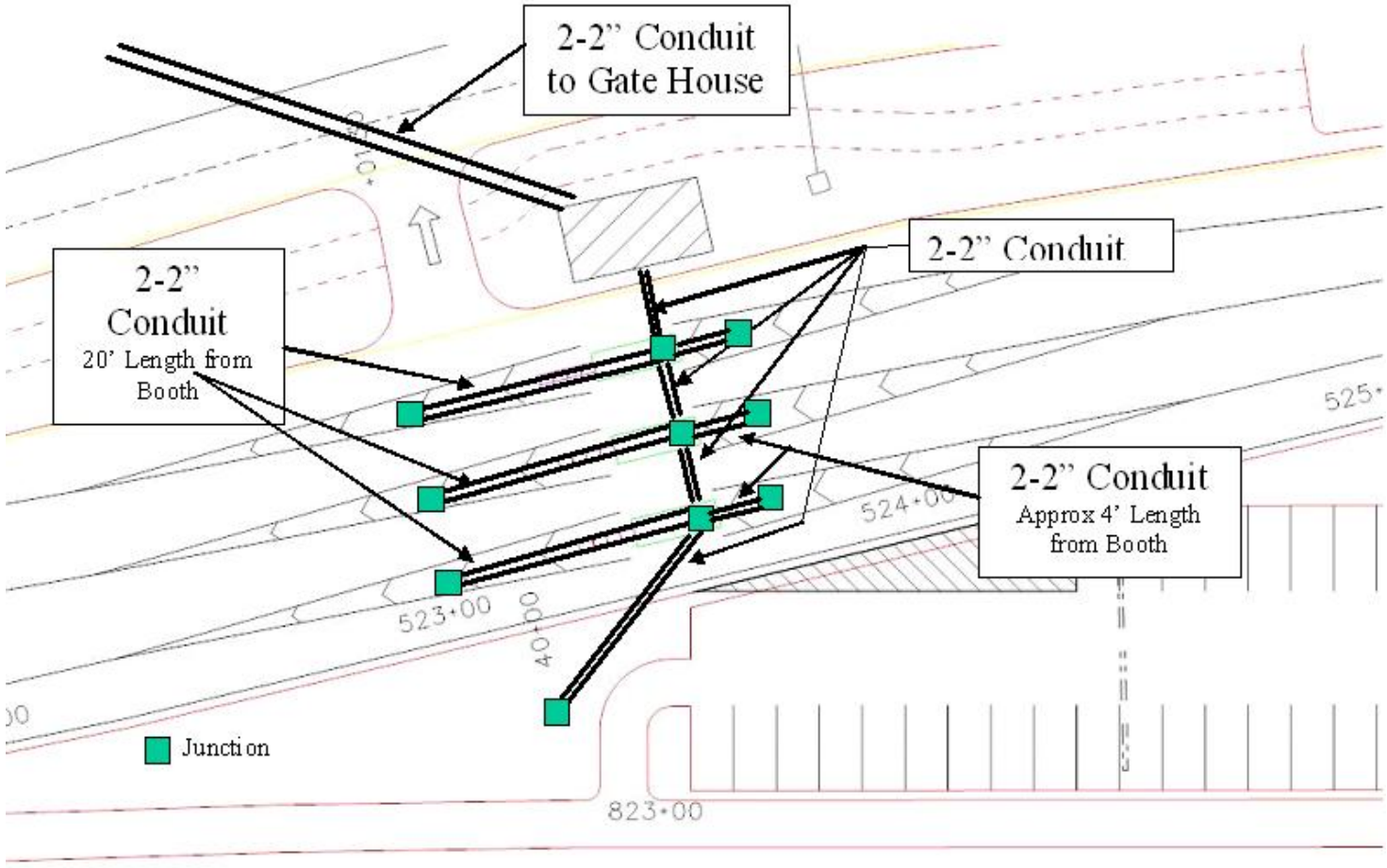
benefit of a new fee plaza which will be ready to add the ITS systems covered in this document will provide staff with a valuable opportunity to upgrade traffic management, safety and security at the park entrance, and operational data gathering ability of the park staff.

While this technical requirements document is the final deliverable within the scope of this project, Volpe has a recommendation for an interim step to a full implementation of an ITS system. Volpe recommends that Sandy Hook management consider a limited pilot test of select sub-systems that it deems are most important to the safe and efficient operation of the park and specifically the fee plaza and parking lots.

The RFID Entry system outlined in Section IV can be piloted to ensure that this system, which will be used multiple times a day by staff and park tenants, is appropriate to the needs of the park. RFID is a very mature technology and is inexpensive to acquire and install. A pilot approach can be used to install one reader and gate at a temporary booth to test the capabilities of the system and throughput impacts with a limited number of staff and tenant users. Efficiency of operations, data gathering abilities and operational impact can be examined and extrapolated to gauge its ability to management's needs. Another pilot project could be to install a temporary vehicle counter and display this information to park ranger staff to see if they can correlate the vehicle count with the filling of parking lots. It may turn out that the arrival count is the only data they need in order to accurately predict the lot fill times.

These pilots can be performed in low season and even before final construction of the final fee plaza. Piloting new ITS subsystems is a critical step to ensuring these systems support operational requirements as expected, and will identify inadequacies that can be addressed as part of the full implementation of these systems.

XI. Appendix A: Conduit Drawing



XII. Appendix B: Lighting Diagram