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CPTED, SUSTAINABILITY, NEW TECHNOLOGY, AND GREEN CONCEPTS PROVIDING EFFECTIVE, LOW-COST, PERIMETER SECURITY FOR WATER/WASTEWATER FACILITIES

The intent of this paper is to provide a brief insight into the use of **CPTED** (Crime Prevention **t**hrough Environmental Design) together with new Security Technology that will allow water and wastewater facilities to incorporate Sustainability and Green concepts into an effective, low cost perimeter security site plan.

Perimeter Security:

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Perimeter Security:

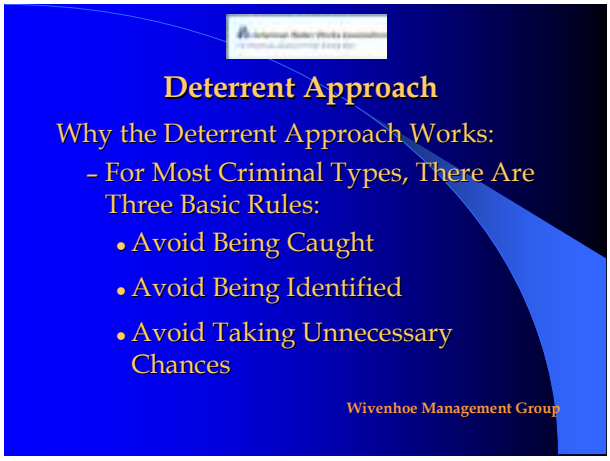
A major goal in any effective security plan is to secure the perimeter of a facility thereby establishing a base for a number of key security parameters being:

Deter Adversaries
Detect Adversaries
Delay Adversaries

The Security Industry has understood the inherent value of a sound, and professionally designed perimeters for many years, and the ensuing success of such perimeters deterring potential criminals and others from choosing a particular property as a target of opportunity.

Coupled with good detection, and associated actions following detection, security perimeters provide a relatively low cost solution for entities such as water and wastewater system facilities as well as industrial users who are charged with protecting large geographic areas where such areas are both remote and often unmanned.

Utilizing the **Deterrent Approach** which has been the core of good security practice throughout the security industry for certainly, the last 30 to 40 years with new security technology and the principles of **CPTED** as well as meeting **Sustainability** and **Green** concepts, it is now possible to implement effective, low cost protection which is not only very successful in its designed intent but is actually welcomed by the public in general.



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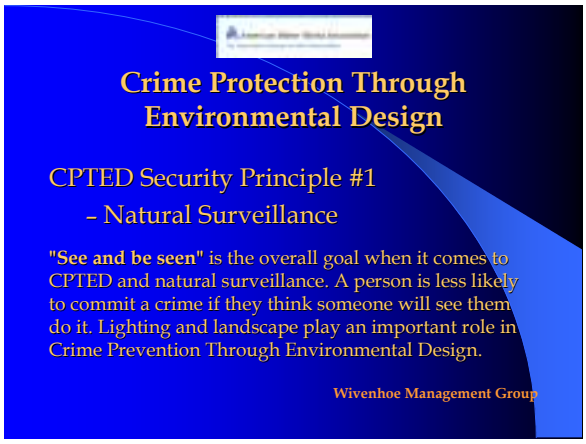
Perimeter Security:

The Deterrent Approach works for three primary reasons, being:

A majority of Criminals including Terrorists of all types follow three basic rules:

1. **They have no wish to be caught**
2. **They have no wish to be identified**
3. **They do not take unnecessary risks**

As a result these same individuals or groups when studying and observing a specific "target" are very unlikely to proceed with a designated entity if they find that such an entity appears to have a sound perimeter defense that includes obvious CCTV Surveillance systems, well maintained fencing, CPTED principles applied throughout the facility, good lighting, and effective intruder detection.



CPTED which stands for Crime Protection through Environmental Design has been defined by the National Crime Prevention Institute as the following:

"CPTED is the proper design and effective use of the built environment which may lead to a reduction in the fear and incidence of crime, and an improvement of the quality of life."

Applying the four major principles or strategies of CPTED is believed to have led to a reduction in criminal activity in some communities by as much as 40 percent.

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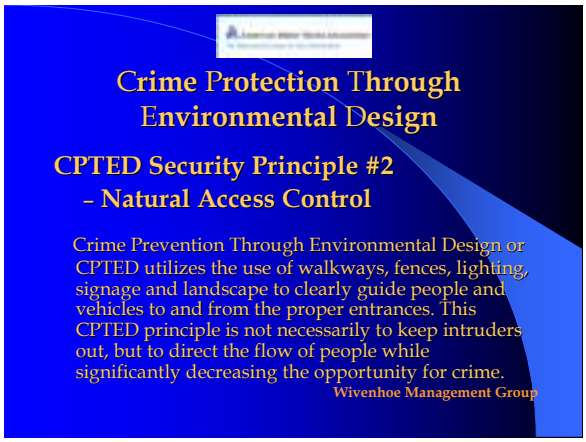
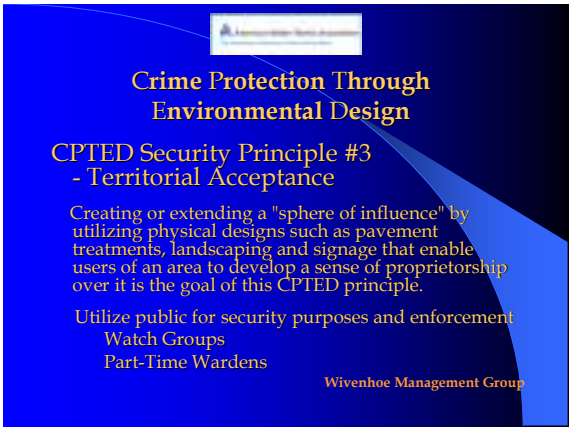
CPTED Security Principle #1:

Termed **Natural Surveillance**, this is a design concept whose major function is keeping intruders readily visible and observable. Main features of this principle is to heighten and maximize the visibility of people, parking areas and building entrances; doors and windows that look out on to a street or roadway, well traversed pathways or parking areas; pedestrian-friendly pavements and/or streets, and good nighttime lighting.



CPTED Security Principle #2:

Considered as **Natural Access Control**, this principle is directed mainly at decreasing crime opportunity by denying access to crime targets and creating a perception of risk to possible adversaries or offenders. The primary methodology is to design access routes, building entrances, and area gateways in such a manner that public routes are clearly indicated, and private areas are discouraged with structural elements.



CPTED Security Principle #3:

Referred to as **Territorial Reinforcement**, this physical design is intended to create or extend a sphere of influence. By having users of the area develop a sense of territorial control, potential adversaries or offenders are discouraged by the degree of user control observed. Features of this principle include well defined property lines, the clear distinction of private spaces from public spaces, and the use of landscape development, pavement design, entrance or gateway treatments, and "CPTED" fences.

CPTED Security Principle #4:

The fourth principle is known as **Target Hardening** with the intent being to prevent entry or access to necessary infrastructure in such a manner that the adversary or offender will be required to devote vital time to overcoming such obstacles that will again, discourage such people from unauthorized entry or access.

From experience of participating in many water and wastewater vulnerability assessments, Target Hardening would only apply to where there was a single point of failure, access to a potent quantity of chlorine gas (weapon of mass destruction) or where a significant amount of clean water as an example could be compromised.

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Sustainability and Green Concepts:

A second part of this paper relates to combining CPTED principles with the goals of **Sustainability Design** and the integration of **Green Concepts**. The intent being to harness renewable resources, minimize any environmental impact, relate people to the natural environment, and wherever possible, do so in an Eco-Friendly manner.

The question might then be asked of exactly how does low cost, perimeter security for the water and wastewater industries come about under such circumstances. The answer is in the application and implementation of new security technology, typically of a wireless nature that is able to operate in large geographic, hostile, and/or remote areas via a combination of wireless mesh networks, "WiFi" hot centers, and further utilizing the Deterrent Approach to security.

New Security technology allows IP addressable devices such as cameras, detection devices that may be fence-based, ground-based or involving video motion detection, audio alarm equipment, and many other devices to be connected over a wireless network and/or utilizing a "WiFi" Internet connection, and thus able to function in a similar manner to hardwired equipment.

There is also the added advantage that a third generation Wireless Mesh Network also permits common communication between law enforcement whether local, State, or Federal, First Responders, Emergency Management personnel and other local or Federal agencies.

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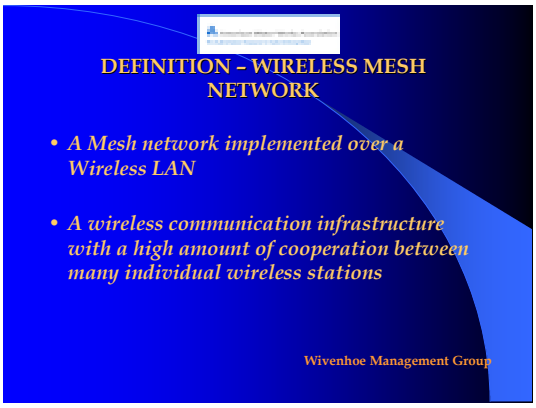
Wireless Mesh Networks:

As can be seen in the next slide diagram, the concept and coverage of a Wireless Mesh Network is based on the use of a series of key computer servers that in turn service a number of "Appliances" that link the actual devices which can be a myriad of equipment such as CCTV cameras, digital or analog, light fixtures, access control card readers, perimeter intrusion sensors, alarm sensors, audible sirens and horns or a host of other like equipment.



Two definitions of a Wireless Mesh Network are those shown in the Slide above but essentially the strength of such a network is not only the wireless nature of the system and its ability to feed wireless communication to and from devices or security systems but also in its ability to provide considerable reliability.

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Wireless Mesh Networks:

This is achieved by the fact that virtually all "appliances" and devices are able to form a wireless communication grid system between them. In this way, should a fault develop in the signal connection between any two points, the grid system is able to reroute the signal via any combination of other hubs and directions.

New Security Technology:

The key to providing both low cost perimeter security systems and allowing a client to incorporate Sustainability Design and Green Concepts is the utilization of new Security Technology. Included in this series of developments are the above shown technologies.

New Digital and Analog* Cameras encompass exceptional **low light capability** which in turn reduce the typical foot candle requirements for lighting in CCTV Camera Surveillance areas.

*** Included in the new technology are various wireless converter units that permit a new or existing analog camera to be converted to an IP addressable camera and as a result, able to exist on the new Wireless Mesh Network. It also allows a client to maintain their investment in existing equipment.**

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New Security Technology:

CCTV Recording & Control Capability:

A further area of development that is having significant impact on power requirements, the ability to record, view, and control different cameras performing different tasks is that involving digital video recorders, and direct server recording. It is now possible to utilize Wireless Mesh Networks to provide the means of allowing individual cameras to send data and be controlled from both remote monitoring stations, and to record directly onto hard drives with memory capacity measured in the tens of terabits of data.

The ability to send video data over a Wireless Mesh Network also takes away the necessity to have local digital video recorders or even local control equipment thus reducing power and installation requirements at site.

Integrated Security Systems:

In terms of perimeter security, particularly at unmanned and remote sites, the technology that is now incorporated into security systems whereby one system is able to interact with one or more additional systems provides the means to allow automatic functions of significant extent when a alarm signal is identified.

Couple this to the advent of Wireless Technology and Wireless Mesh Networks, and it is now possible to provide automatic response upon the triggering of an alarm at the perimeter whereby additional lighting illuminates an area, intrusion alarms trigger loud audible sirens or horns that will alert any nearby residence or passing police vehicle, etc.

False alarms are kept to a minimum by the use of dual intrusion technology, and a monitoring point that may be a significant distance away is able to control local security systems and take appropriate action as required.

Solar Energy:

Many developments have taken place with the use of solar energy to provide a local sustainable power source for perimeter security systems. Examples of this are to be seen on many roadways where CCTV Surveillance cameras are monitoring major highways such as the Pennsylvania Turnpike beyond Valley Forge and are powered by solar cell devices.

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New Security Technology:

IP Addressable Devices:

IP addressable cameras, control panels for security management systems (electronic access control and alarm monitoring, various types of motion sensors, etc., combined with wireless innovation which reduce the installation requirements of such systems by a large factor, are further enhanced by the implementation of Green concepts in their manufacture by the elimination of lead as an example in electronic circuit boards.

The slide shown above is an example of a typical solar field panel but compare this to the next slide which illustrates a Solar Energy Concentrator.

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New Security Technology:

Solar Concentrator

The unit shown has been developed by an Australian company, and uses a non reflective coated optical acrylic Fresnel lens to capture the light from an area 500 times that of the solar cell and focus it onto a triple junction solar cell. Each hexagonal shaped Fresnel lens (segment) is about 5.5 inches long on each side with the solar cell located beneath the lens.

In this slide a Wireless Mesh Camera is illustrated, and as can be seen is essentially no different to traditional exterior dome cameras. The difference being that it is an IP addressable camera connected into the system via the Wireless Mesh Network. More recent developments include Wide Dynamic Range IP Cameras. These are fixed cameras that have a wide dynamic range up to 100 dB, perform in a digital pan/tilt/zoom manner without any moving parts, include multi-zone motion detection, privacy zones, 0.4 lux low light performance, cover a wide area from a perimeter point of view, and perhaps even more interesting, enables the recording and playback of high resolution images using affordable, network storage with no client software required.

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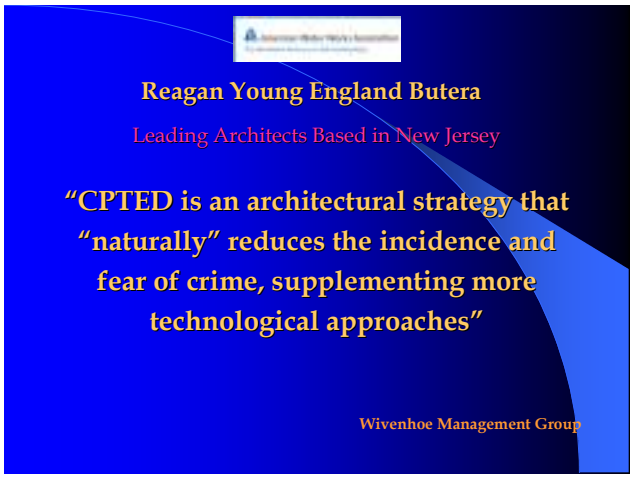
New Security Technology:

The slide shown above captures two examples of solar powered cameras that have actually been developed for residential use, and as can be seen are both compact and visually appealing. Similar industrial designs are available.



Many of the concepts and developments covered in this presentation and paper are now being actively implemented and utilized by a wide cross section of security, construction, industrial, architectural, and environmental professionals.

The quotation shown above is by Regan Young, managing partner of Regan Young England Butera, a leading architect group based in Mt. Holly, New Jersey.

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Sustainability and Green:

As per the above slide, the intent is to implement perimeter security systems that also contribute to attributes of **Sustainable Design** specifically related to power requirements, environmental impact, and which place people in harmonious partnership with the natural landscape and environment. **Green Concepts** is the active interaction and Eco-Friendly aspects as they apply to Infrastructure, Services, Systems Engineering, the Environment itself or other forms of Development. This is achieved in this case through the following:

Low Cost Perimeter Security:

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Low Cost Security Security:

Application of CPTED Concepts:

The application of CPTED design concepts supports both Sustainability Design and Green Concepts by utilizing the natural environment and landscape design in a manner that negates in many cases, the need for power driven systems, additional lighting, vehicle restraint measures or other non-sustainable ventures.
CPTED examples include the installation of lesser cost fencing, the design of roadways avoiding straight line approach and thus avoiding the need to provide vehicle restraint systems or speed bumps, etc., that would take away from the natural environment, and likely require non-sustainable power linkage.

Utilizing natural features of the topography will minimize the need for man-made roadways that require extensive equipment to apply more difficult grading requirements, bridges or tunnels, and other features that would increase the degree of trenching, use of heavy vehicles, etc.

Use of Wireless Mesh Networks:

By utilizing Wireless Mesh Networks, it is possible to very significantly reduce cable and trenching requirements as well as eliminating various types of control boxes and recording devices on a local level. The ability to transmit video and other types of signals from a local source over a Wireless Mesh arrangement, and further use software packages on servers either locally or one a central basis, as well as recording large amounts of video data directly onto hard drives in place of digital video recorders again, reduces the overall cost of such systems.

Use of "WiFi" Centers & Utilization of the Internet:

This permits authorized law enforcement personnel, emergency management and first responders to access a variety of data via secure Websites, and thus have invaluable information on what might be happening at a remote site in terms of what triggered a serious alarm condition. Having such knowledge will aid response times for such personnel to arrive at a site and deal with the problem.

In turn, by having more efficient, and informed response, and where required, the need for elaborate "hardening" security measures is reduced if not eliminated.

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Low Cost Security Security:

IP Addressable Security Devices:

Clearly by being able to "drop-in" IP addressable devices ranging from cameras to audible alarms, and from light fixtures to security management control boxes there are substantial savings in running cable and in preparing trenches to run the cable through.

In addition, such systems provide tremendous flexibility as to where items such as cameras can be placed and may further reduce cost by being able to use fewer units to achieve design criteria for a particular security system. It should also be noted that many of these devices now incorporate "green" electronic circuit boards where lead is no longer used in the manufacture of such equipment.

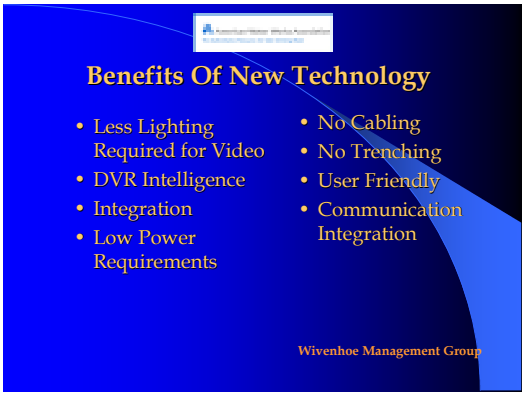
Deterrent Approach to Security:

Utilizing the industry proven **Deterrent Approach** to securing an area or facility coupled to implementation of a Wireless Mesh Network, and further incorporating IP addressable security devices will significantly reduce the cost of a perimeter security system, in some cases by 50% or better.

In the unlikely event that such systems fail to deter an unauthorized intruder, the respective perimeter security system will be able to detect the presence of such an individual or group, trigger immediate response in terms of additional lighting and audible alarm, and more importantly provide instant communication to a monitoring point of what is taking place at the site.

In addition, by virtue of the Wireless Mesh Network, local law enforcement will also be alerted to the situation and will be able to respond in appropriate manner.

New Security Technology:



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Low Cost Security Security:

New Security Technology:

As can be seen in the slide above, the low cost benefits of new security technology are significant.

Solar Power Reliability:

Reliability is a very important factor in designing a security system. As an example of Solar Power reliability, the slide above shows a solar panel that is located 7,000 feet up in the Himalayas. It is one of several panels that support a wireless mesh network in the town of Dharamsala.

The Mesh is a light-infrastructure, low-cost wireless network that is made up of recycled parts, solar panels, and strong equipment to keep monkey's from literally hacking into the network with their teeth.

Industry Quote:

The quote shown below is by Ken Burris of Environmental Resources Management (ERM). Ken is the Global Water and Wastewater Director for ERM, and like many of his colleagues is a firm believer in protecting water purification and wastewater treatment systems while incorporating the goals of Sustainability.

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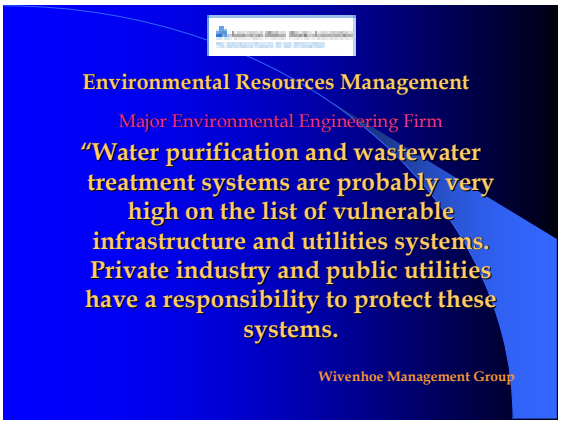
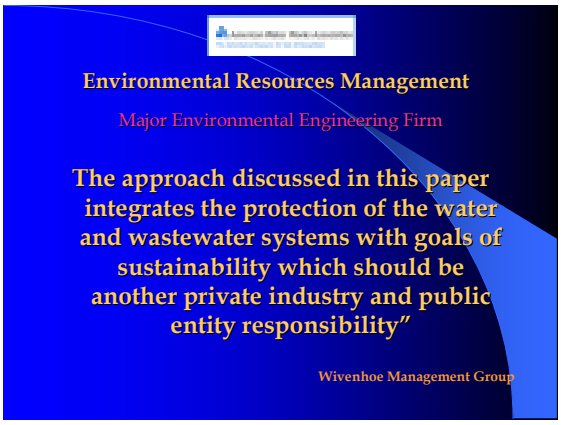
Industry Quote:





<u>Security Issues Addressed by the Approach of this Paper:</u>

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Security Issues Addressed by the Approach of this Paper:

From experience of participating in more than 140 water and wastewater Vulnerability Assessments, the author found the issues covered in the Slide above in one form or another at virtually all of the sites involved.

Straight Roadway Leading to Infrastructure:

In a majority of cases, driving a heavy vehicle at speed with sufficient momentum will do untold damage to any form of infrastructure, particularly aging pump stations, treatment plant buildings, storage areas for chlorine gas cylinders, and many other types of building. The application of CPTED principles will alleviate this particular problem.

Open Areas:

Again, applying CPTED principles with possible discreet surveillance and detection systems, open areas can be adapted for public use without lowering the integrity of the water or wastewater facility.

Clean Water Access:

Discreet surveillance and the application of CPTED principles will protect Clean Water Access.

Lighting:

Use of Wireless Mesh Networks combined with Sustainable Design and Security System Integration permit modest lighting until an intruder is detected when additional lighting can be brought into play, and then reset after an appropriate time.

No Deterrent:

Utilizing a Wireless Mesh Network together with CPTED principles, employing appropriate perimeter security systems as already touched-on in this paper that include reliable intrusion detection, and incorporating Sustainable Design and Green Concepts will provide a strong deterrent to any “would-be” intruder.

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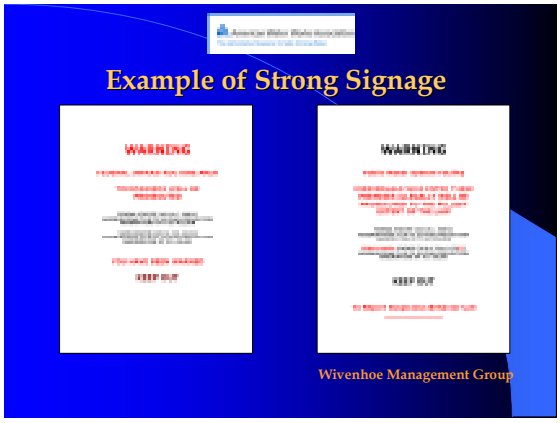
Security Issues Addressed by the Approach of this Paper:



Weak Signage:

This is easily overcome by adopting signage similar to the two examples shown above which feature severe penalties that exist both at the local State level and on a Federal level. It has been proven that a majority of people considering trespass into a site will think **twice** when confronted by such signage.

No Detection:

Wireless Mesh Networks combined with both Video and other Intrusion Detection systems guarantee that where an individual or group is not deterred from entering a restricted area, the intrusion will be detected, and will trigger certain pre-programmed actions as well as being monitored at an appropriate location thereby providing the necessary response.

Unmanned Remote Sites:

The following slide illustrates a sound solution to remote sites that are also likely to be unmanned particularly in the evenings and at weekends. A Wireless Mesh Network coupled to CPTED principles, and utilizing new security technology permit such a solution to be incorporated at modest cost, and further meeting Sustainable Design and Green Concepts.

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Security Issues Addressed by the Approach of this Paper:

Detection:

Detection is vitally important in any protection system as without detection there can be no response. Whether utilizing the Deterrent Approach or not, it is essential that a reliable and effective means of intruder detection be employed.

It should be noted that the use of a Wireless Mesh Network allows formidable Video, Microwave, PIR, Photo-Electric, Fence Intrusion or Sound Activated intrusion devices to be used without many of the equally formidable traditional installation costs of such systems.

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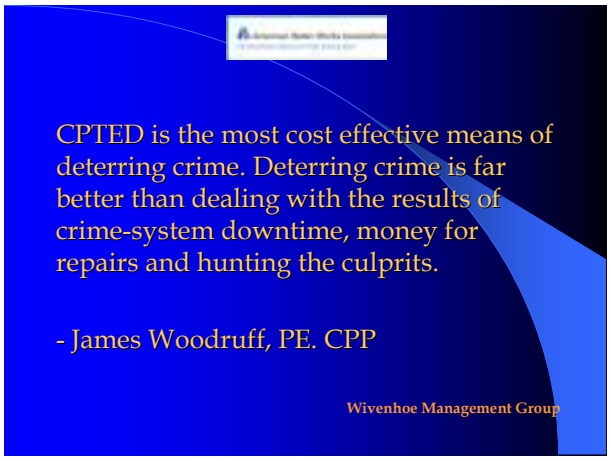
Security Issues Addressed by the Approach of this Paper:

Industry Quote:

The following quote is by James Woodruff, P.E., CPP, the head of American Consulting Engineers and a respected expert in perimeter security design.



In Summary:

It is strongly recommended that water and wastewater facilities and systems consider the use of their natural resources in a security manner employing CPTED principles; that in addition, they consider new security technology providing effective protection but also incorporating Sustainable Design and Green Concepts.

It is further strongly recommended that such facilities consider the Deterrent Approach which when combined with the above will provide successful, low-cost security solutions.

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In Summary:

Questions:

The author will be happy to answer any questions or provide further information via the following means:

David S. McCann **Wivenhoe Management Group**