



GOOSE GUARDIAN PILOT PROGRAM REPORT Ft. Logan National Cemetery

This Pilot Program Report documents the results of Pilot Program Procedure & Agreement (“**Pilot**”) dated February 2, 2011 between TKO Enterprises, Inc. (“**TKO**”) and Fort Logan National Cemetery (“**Ft. Logan**”), hereafter, the (“**Site**”). The Pilot began on Friday, February 18, 2011 at 4:00pm and was completed on April 22, 2011.

1. Overview

TKO is developing a new product called the Goose Guardian (“**Product**”) which TKO intends to make commercially available. The Product includes a combination of hardware and software designed to effectively prevent Canada geese from trespassing into areas where their droppings create a nuisance. TKO provided all support necessary for the deployment and operation of the Product and consulted with Ft. Logan regarding the placement of the Product(s) at the Site. Ft. Logan agreed to provide access to portions of its grounds, AC outlets and observe goose activity to facilitate TKO’s conduct of the Pilot Program.

2. Product Functionality and availability

2.1. Prototype

Ft. Logan entered into the Pilot with the understanding that TKO had not completed its final product development efforts or quality assurance review of the Product and that the Product was still subject to revisions and modification.

2.2. Pilot Units

TKO provided two (2) prototype units for the Pilot. Given the deployment locations, collected data and Product performance, two units proved sufficient to demonstrate the efficacy of the Product.

3. Product Deployment

Ft. Logan and TKO identified two candidate locations to deploy the Product to conduct the Pilot.

3.1. Ceremonial Area

The Ceremonial Area is located in and around the flag pole, adjacent to Veterans Lake. A retaining wall sits between the Lake and flagpole that forces the geese to enter the area at the southwest end of wall where they come out of the lake. The feeding path takes them through a somewhat constricted corridor where they then graze in the Ceremonial Area. The objective for this deployment location is to prevent the geese from habituating the Ceremonial Area and keeping them west of the retaining wall along the south shoreline of Veterans Lake.

The Pilot began at the Ceremonial Area where the Product was continuously operating for 14 days, from February 18, 2011 until March 4, 2011. The two Pilot units were moved to the second location at on March 4, 2011 and were moved back to the Ceremonial Area at on March 7, 2011. During this (weekend) period, dummy units were substituted for the Pilot

units at the Ceremonial Area. The dummy units consisted of Pilot unit enclosures with no electronics or hazing devices.

3.2. Committal Shelter B

Committal Shelter B (Shelter B) is situated adjacent to Memorial Lake that attracts numerous geese. The geese habitually exit the pond to feed and their feed path crosses through the Shelter B area and the service sidewalk associated with the Shelter. As the geese progress through the Shelter and sidewalk areas, it becomes littered with droppings. The objective for this deployment location is to prevent the Shelter and sidewalk area from becoming habitually being littered with goose droppings.

The two Pilot units were moved to Shelter B on March 4, 2011 and were removed on March 7, 2011. This was a weekend trial period that proved successful and the units were returned to Shelter B on March 11, 2011 where they operated continuously for 42 days until the end of the Pilot on April 22, 2011.

An economic value can be assigned to Shelter B. With regular consistency (more often daily) the geese pass through the two Committal shelters, littering the Shelter services area, service sidewalk and parking lot with droppings. This situation requires Ft. Logan staff to clean these areas before the first service of the day, which is routinely scheduled for 9:00am. The resources required for the clean up involves a full-time maintenance employee for an hour and half. The operations rate for an employee is \$20/hour for an annual expense of \$7,800, which does not include the cost to repair any damage to the grounds caused by geese or clean up for special events.

3.3. Location Preparation

Preparation of each location varied based on the location characteristics.

3.3.1. Ceremonial Area Preparation

The area leading from the Veterans Lake in the field of view of the Product and into the Ceremonial Area was cleaned prior to the beginning of the Pilot. The surface of this area is covered in grass and, since this area was habituated by geese, it was littered with goose droppings. The existing droppings were removed using landscape blowers and rakes by Ft. Logan personnel.

3.3.2. Committal Shelter B

The objective for the Committal Shelter B was to keep the service sidewalk clear of goose droppings. The service sidewalk is used daily for funeral services during the week and therefore was cleared of goose droppings at the beginning of each Pilot period.

4. Product operation

4.1. Software

TKO deployed the Product in a fully configured and operational condition at the commencement of the Pilot program. It was anticipated that software adjustments and revisions would occur during the Pilot. During the pilot period, several software modifications were made to the Product and are described below.

4.1.1. Trigger threshold

To minimize the number of possible triggers of the hazing device that result from non-

geese events (false-positives), the threshold was set high to begin the Pilot. A high threshold setting reduces the Product's ability to trigger on the presence of geese. Initial data proved the trigger threshold was too high and it was lowered on March 3, 2011, which was the thirteenth day of the Pilot.

4.1.2. File management

The Product was configured to collect images for various events related to objects appearing the field of view, which ranges from anything moving to the detection of objects that cause the hazing device to trigger. Several changes were made to software that relate to the capture, storage and transfer of the collected images. These changes did not have a direct effect on the device performance and were completed by February 25, 2011.

4.1.3. Scheduler

A scheduler was added to the software that allows for the definition of periods of time that the hazing device is inhibited and does not activate. The Product still collected images for any detection events, but the hazing device did not activate if the event occurred within an inhibited time defined by the scheduler. The scheduler was added on March 7, 2011

4.1.4. Horizon Cropping

A Product feature was activated on February 25th, 2011 where the upper portion of the field of view was excluded from algorithm analysis. Activating this feature reduced the rate of false-positives.

4.1.5. Incremental algorithm revisions

As projected prior to the beginning of the Pilot, improvements were made to processing algorithms by primarily adding more training images collected from the Pilot Site. These incremental improvements increased the detection rate and reduced false-positives.

4.1.6. Hazer active and hold off time

The hazer is active for a specified amount of time when a goose is detected. Similarly the hazer is inhibited for a specified amount of time after activation. Both of these times are configurable. After review of initial hazer activation images, it was determined that the tuber hazer was not active long enough to effectively deter the subjects. It also appeared that the inhibit time for both hazers could be reduced. These changes were made on March 3rd, 2011 and subsequent hazing events showed improved performance.

4.2. Security

The Products were secured to the ground using a ground anchor and key lock to prevent theft. The security method proved effective during the Pilot as the units remained in position. There was evidence that the units were tampered with during the Pilot, but were unharmed.

4.3. Power

The deployed Products were powered using existing AC outlets supplied by Ft. Logan and extension cords provided by TKO.

4.4. Periodic Inspections

TKO performed periodic inspections of the deployed Products to verify their operation and observe performance. Ft. Logan staff also provided regular observation and inspection for goose droppings.

5. Performance Evaluation

The purpose of the Pilot was to test the effectiveness of the Product's ability to protect designated features from being desecrated by Canada goose feces. The Product's performance was evaluated using three (3) methods: Observation, Inspection and Analysis.

5.1. Observation

The observational evaluation was contemplated to include visual and video observation. Video observation proved to be impractical and was thus limited to visually observing the Product's operation. Ft. Logan staff were informed of the Pilot and asked to note any events that they observed which included positive, negative and false events.

5.2. Inspection

Inspection involved period examination of the deployment locations for the presence of goose feces. This was performed by both TKO and Ft. Logan personnel. TKO inspection included date stamped pictures at both locations.

5.3. Analysis

The Product provided the ability to record images, both pre- and post-event, with time stamps, which produced a record of activity in the field of view of the Product.

6. Results

The objective to the Pilot was to demonstrate the effectiveness of the Product. The test protocol used generated measureable Product performance data that addresses the effectiveness of the Product.

6.1. Ceremonial Area Results

The Ceremonial Area is relatively remote from traffic areas so the primary results are given by the inspection and analysis aspects of the performance evaluation.

6.1.1. Observation

Observation of the initial deployment showed the Product had a low detection rate. As noted in paragraph 4.1.1 above, the threshold was initially set high to minimize the false positive rate. No other notable observations were reported due primarily to the remote location. The principal measureable result for this location came from the inspection and analysis components.

6.1.2. Inspection

Inspection of the Ceremonial Area provided an effective assessment of the Product's performance. As shown in the Ceremonial Area Image Record Appendix, the location was devoid of any goose droppings at the beginning of the Pilot. Ft. Logan staff cleaned the goose egress area prior to the beginning of the Pilot. The Product was operated continuously for 14 days and at the end of this period, the Product was replaced by dummy units. The dummy units were comprised of the Product's enclosure with no electronics or hazing device included. The location was inspected after approximately 40 hours and it was found to be littered with goose droppings. Refer to the Ceremonial Area Image Record Appendix for a visual presentation of this result.

6.1.3. Analysis

The Pilot units have the ability to save images and record events in an internal log file. Analysis of the images showed a low detection rate during the initial Pilot period but after the threshold was decreased, the positive detection rate approached 100%. The initial false-positive rate was also high, but this was dramatically reduced when the horizon cropping was enabled. Incremental adjustments in the detection algorithms

continued to reduce the false-positive rate such that it was observed to be at an acceptable level when the units were moved to Shelter B.

6.2. Shelter B

Shelter B is a centrally located structure with a high degree of human traffic and hosts burial services that are important not to disturb. Initial test deployment of the Product was conducted 14 days into the Pilot and spanned a weekend when burial services are not conducted at the Shelter. A software 'scheduler' was added to the Product software to automatically disable the hazer from 9:00am to 3:00pm during the week, which is when services are conducted at the Shelter. Following the weekend trial period, the Pilot units were deployed at Shelter B on March 11, 2011 where they operated continuously for the remainder of the Pilot (42 days).

6.2.1. Observation

A false-positive event was observed during the weekend trial deployment. Following this event, no other false-positive events were reported.

6.2.2. Inspection

During the weekend trial deployment, the Pilot units triggered many times to scare away approaching geese. The deployment scenario is provided in the Shelter B Image Record Appendix attached to this report. The location was inspected after approximately 40 hours and there were no goose droppings found on the portion of the service sidewalk protected by the Product. Referencing the Shelter B Image Record Appendix, the noted tree line provided a natural barrier for the egress area that was protected by the Product. On the other side of the tree line, another egress point was used by the geese and dropping were found at the far, east end of the service sidewalk. It was originally recommended that the Shelter B area use up to 5 units to provide adequate protection but this result suggested the area could have been completely protected by using only 3 units.

The location was inspected daily during the week throughout the 42 day operating period at Shelter B. No goose droppings were noted on the service sidewalk or Shelter during this period.

It should be noted that for approximately the last three weeks of this 42 day period, the goose population was reduced to only the resident geese, meaning the same birds were being detected and hazed. This fact provides evidence that the geese are unlikely to become habituated to the hazing device rendering it ineffective. The hazing remained effective for the entire 42 day period.

6.2.3. Analysis

Analysis of the image and log record showed numerous trigger events at the Shelter B location, indicating geese were present and attempting to trespass on the service sidewalk according to their historical pattern. During the hazer disable periods, the Product continued to monitor the field of view. Services at Shelter B were not continuous from 9am to 3pm, five days a week. Therefore, the area was vacant at times during the hazer disabled period. During these periods, geese were detected but not hazed and yet they did not trespass on the service sidewalk. The most likely periods of egress are mornings and evenings and this result suggests that these periods may be sufficient to maintain a necessary level of protection.

6.3. Product Operation

The Pilot ran continuously for 63 days. During that time the Product performed without interruption or failure, proving to be very reliable. Non-production software was added to the

Pilot units to support remote monitoring and the unit experienced sporadic communication issues early on but these issues did not impact the Product's operation.

7. Conclusion

Overall, the Pilot program was successful and conclusively demonstrated the effectiveness of the Product and its ability to prevent Canada geese from trespassing into areas where they cause a nuisance. Furthermore, during the last 30 days of the Pilot, only resident geese were present at the Site, which means the same geese were being effectively hazed repeatedly and confirms the long-term effectiveness of the Product's resistance to potential habituation.

The views expressed in this Pilot Program Report do not necessarily represent the views of the National Cemetery Administration, the Department of Veterans Affairs, or the United States.

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Image Record Appendix: Ceremonial Area



The Ceremonial Area



Goose Population



Area of Egress from the lake



Goose Guardian placement



Approaching geese as seen from the Goose Guardian...



...continuing the march

Image Record Appendix: Ceremonial Area (continued)



Hazing device activates...



...Scaring the geese back to the lake



Egress area after 14 days of operation



Closer look at the condition of the turf



Egress area 1 ½ days after removing the Product



Closer look after 1 ½ days

Image Record Appendix: Shelter B



Geese egress from the lake



Goose Guardian placement at Shelter B



View of placement from the Shelter/service sidewalk



Service sidewalk after 1 1/2 days – Note the tree line



View toward Shelter at tree line – Note droppings



Sidewalk past the tree line