ODOR CONTROL STUDY – INTERIM SUMMARY FINDINGS
(for public distribution)
UNIVERSITY AREA JOINT AUTHORITY
STATE COLLEGE, PA

INTRODUCTION

The Spring Creek Pollution Control Facility (SCPCF) located at 1576 Spring Valley Road in State College, PA began operation in July of 1969. Since its original construction, the facility has undergone several upgrades and additions to accommodate regional development. The last substantial upgrade (Stage 6 Additions and Modification) was completed in 2004 and was designed for an average daily flow of 9.0 million gallons per day (mgd). Wastewater generated in five municipalities (Patton Township, Ferguson Township, College Township, Harris Township, and State College Borough) is conveyed to the facility through a collection and conveyance system consisting of gravity lines and pumping stations. In addition to wastewater, the facility accepts waste activated sludge (WAS) from nearby treatment plants as well as septage, which are received at the septage receiving building. Figure 1 illustrates the layout of the SCPCF.

Off-site odor emissions from the facility have resulted in complaints from community residents. In 2014, the Authority commissioned an Odor Control Study to identify and characterize odors to better develop a solution for the minimization of off-site nuisance emissions. This interim report has been prepared to provide a status of the study and present results obtained, to date.

FACILITY OVERVIEW

The facility is comprised of liquid and solids treatment processes. The liquid treatment process begins with preliminary treatment, consisting of mechanical screening and grit removal within the Headwork Building (Figure 1: Process 1). Screening is used to remove large objects (i.e. rags and other debris) that could damage downstream equipment or interfere with efficient wastewater treatment. Screenings removed from the waste stream are washed to remove organic material and then compacted. Following screening, grit is removed using a vortex system and then classified to separate the grit from organics. The screenings and grit are temporarily collected in small dumpsters within the Headworks Building and then transferred to a larger on-site dumpster for ultimate disposal at a landfill.

Following preliminary treatment, the wastewater undergoes primary clarification, which involves the separation and removal of suspended solids and floatable scum. Settled solids, known as primary sludge, is generated from primary clarification and subsequently pumped to the dewatering building, where it is temporarily stored and then blended with waste activated sludge prior to dewatering. The wastewater

continues on to the treatment tanks, where organic biological reduction of organics and nutrients occurs. Waste activated sludge (WAS), or biomass, is removed in the secondary clarifiers and pumped to the dewatering building. A portion of the clarified effluent is filtered through an anthracite media and then disinfected using ultraviolet light. Another portion of the clarified effluent undergoes advanced water treatment using microfiltration and reverse osmosis to produce reclaimed water that is reused locally for laundering, car washing, irrigation and stream augmentation.

The solids treatment component includes primary and waste activated sludge storage, blending dewatering (Figure 1, Process 8) and treatment. Primary and waste activated sludge are stored in mixed holding tanks and then blended before being dewatered using centrifuges. The dewatered sludge is conveyed to the composting facility (Figure 1, Process 9) where it is blended with wood chips and composted using an aerated, in-bay agitation process. Biosolids generated from the process are beneficially reused as a soil amendment.

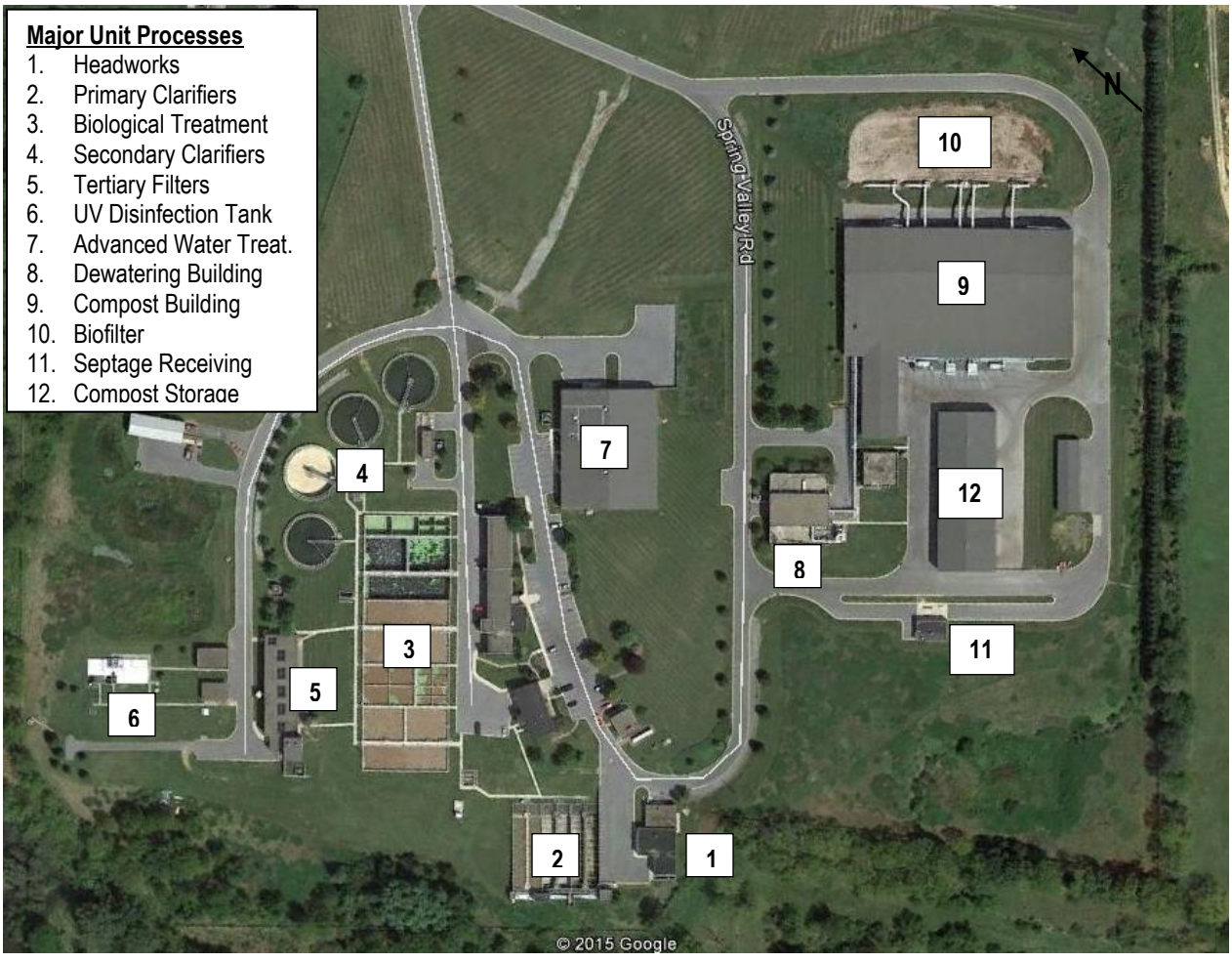

Figure 1: Aerial View of the SCPCF Illustrating the Facility Layout and Identification of Unit Processes (Image Source: Google Earth)

EXISTING ODOR CONTROL FACILITIES

Air exhausted from the dewatering building and the sludge holding tanks passes through a decommissioned chemical scrubber. The scrubber exhaust fan is functional and collects air from the dewatering building and the covered sludge holding tanks and exhausts it through a 24'-0" tall, 42" diameter stack. Under full operation, atomized chemical solutions of sodium hydroxide (NaOH) and sodium hypochlorite (NaOCl) would be misted into a reaction chamber to react with the odorants in the air stream. However, the chemical feed system has not been operational due to habitual maintenance issues (nozzle corrosion and excessive scaling due to hard water). The odor control system at the dewatering complex was designed for an air flow rate of 16,000 cubic feet per minute (cfm). The odor removal efficiency of the scrubber is not known.

The Authority is currently evaluating a short term alternative to utilize the existing air piping and scrubber for application of a chemical oxidizer. The existing equipment could be modified to obtain some level of odor reduction as an interim step. If effective, this alternative could become a long term solution.

Air from the composting facility is exhausted through a biofilter with a surface area of approximately 26,215 square feet (ft^2). Five fans operate at 26,200 cfm each (131,000 cfm combined) to collect air from the building and distribute it through a lateral system under the biofilter. A misting system in the distribution header provides dust control and ammonia reduction. The existing media has been in operation for approximately five years. Typical media life is five years. Table 1 provides design criteria for the existing biofilter.

Table 1: Compost Building Biofilter Design Criteria

Surface Area	26,215 ft^2
Air Flow (per fan)	26,200 cfm
Air Flow (total)	131,000 cfm
Air Flow Rate	5 cfm/ft^2
Static Pressure	9 inWC
Media	Wood Chip, Leaf Compost
Media Depth	4'-0"

Air flow measurements were taken across the surface of the biofilter on two dates (August 21, 2014 and October 27, 2014) in a grid pattern at 24 different locations. Measurements varied widely between 0.7 cfm/ft^2 and 5.5 cfm/ft^2. Total air flow estimates were 63,000 cfm and 46,000 cfm on the two dates, respectively; substantially lower than the design total air flow of 131,000 cfm. The header static pressure recorded on the two dates was greater than 11 inches of water column. The high static pressure and lower flow rates are indicative of air flow impedance. While collecting air flow measurements, short circuiting of the biofilter was observed at several locations, suggesting that odorous air was passing through the media untreated. Therefore it was recommended that the Authority take actions to improve biofilter air

flow.

Throughout the progression of the study, the Authority has made the following corrections and or modifications to improve biofilter performance:

- Cleaned distribution laterals
- Replaced header drain valve
- Reduced building air exchanges
- Rototilled the top 8" inches of filter media
- Repaired the misting system
- Improved building air flow transfer
- Improved air flow to the compost bays
- Altered cleaning procedures to minimize dust
- Modified the compost mix design to reduce odorant generation potential
- Increased frequency of media monitoring (pH, moisture content)

In the near future the Authority intends to add additional media to the surface of the biofilter to return the total media depth to the design criteria.

STUDY ODJECTIVES

The objectives of this study were to:

- Identify major odor sources at the SCPCF
- Evaluate offsite migration of odors
- Acquire a high level of community input
- Establish a site perimeter for odor emissions that will minimize neighborhood odor issues
- Evaluate on-site operation and maintenance protocols that may be impacting odors
- Evaluate the efficacy of existing odor control systems
- Identify and evaluate alternative odor remediation systems
- Develop budgetary costs for recommended alternatives

PUBLIC OUTREACH

A public participation program was developed to inform the community of the odor control study and obtain input regarding off site odors. A public meeting was held on August 20, 2014 at 6:00 PM to introduce odor assessment factors. Information specific to the meeting was published in the Centre Daily Times and invitations were mailed to residents in close proximity to the facility. Approximately 25 local residents attended and were provided with a tour of the SCPCF.

An Odor Observation Data Collection Sheet (Appendix A) was developed and provided to the community to record and report odor observations. Odor observations submitted to the Authority were tracked and mapped using ODOR TRACK'R™ a database offered by St. Croix Sensory, Inc as a member

subscription, web-based application repository for odor data with the capability to sort, filter and geographically display odor data using Google Earth images. To date, the Authority has logged 152 observations, the majority of which have originated from the south east at a distance of less than 1,000 feet from the facility property boundary (approximately 2,000 ft from the nearest unit process, composting). The observations have been submitted by 37 observers. If observations are reported during normal operating hours, the Authority's staff typically travels to the location to further evaluate the observation.

In response to community input, the Authority is working to develop a web-based process for the submission of the Odor Observation Data Collection Sheets. Moreover, the sheets are being revised to eliminate unnecessary data that may not be known (i.e. weather data). The Authority's staff currently utilizes available historic weather data to complete the reports based on date and time data.

ODOR IDENTIFICATION

An on-site sampling program was developed to quantify and characterize odor emissions from potential sources at the SCPCF. The program included on-site and perimeter field olfactometry using human sensory testing, and odorant testing using laboratory analyses. Human sensory testing was conducted by the Penn State Odor Assessment Laboratory (PS-OAL) and included odor detection threshold, hedonic tone, and character. Odorant testing was conducted by ALS Environmental, Simi Valley, CA and included the following parameters:

- Amines (dimethyl, ethyl, methyl, and Trimethyl)
- Reduced Sulfur Compounds (mercaptans, dimethyl disulfide, dimethyl sulfide, hydrogen sulfide).
- Acids (acetic, butyric, propionic)

In addition, ammonia testing was completed by the PS-OAL using an INNOVA photoacoustic gas analyzer.

Three sampling events were planned: summer, fall and spring. The summer sampling event was completed on August 21, 2014 and the fall sampling event was completed on October 27, 2014.

A review of potential sources of odor emissions suggested the following primary sources:

1. Biofilter North
2. Biofilter South
3. Composting Building
4. Compost Curing Pile
5. Fresh Wood Chip Pile
6. Dewatering Building
7. Headworks Building – Screening Room
8. Headworks Building – Grit Removal Room
9. Primary Clarifier (Discharge Channel)

10. Main Pump Station (located off-site along Trout Road)

Secondary Sources included:

A. Compost Discharge Bay Out Loading
B. Headworks Short Term Refuse Container
C. Dewatered Solids Conveyor
D. Septage Receiving
E. Primary Splitter Box
F. Biological Tanks
G. Secondary Splitter Box
H. Return Activated Sludge Channels
I. Plaint Drain Station

Field olfactometry, human sensory testing and odorant testing was completed at all ten (10) primary sources during the first sample event. The results of the first sample event were used to prioritize sources for subsequent sampling events. Field olfactometry and human sensory testing was completed at Primary Sources 1, 2, 3, 6, and 9 during the second event. The third and final sampling was conducted on April 20, 2015. Results are being tabulated.

Odorant testing identified the presence of reduced-sulfur compounds, volatile fatty acids, amine compounds, and ammonia in air samples collected immediately adjacent to selected treatment units in the parts per billion (ppb) range. Although odor detection thresholds vary for specific compounds, the human olfactory system is capable of detecting odors within the lower ppb range; in some cases, exceeding the detection limit of analytical equipment.

Human sensory testing was conducted to identify the detection adjacent to primary odor sources. Figure 2 illustrates the measured detection threshold (D/T) at primary odor sources during the first two sampling events.

Figure 2: Detection Threshold for Primary Odor Sources from Sample Event #1 and (Sample Event #2)

Odor emission rates were estimated for each primary odor source using odor units and the corresponding unit exhaust discharge. The sources were then ranked based on the potential for odor emission. Figure 3 displays estimated odor emission rates and primary source rankings.

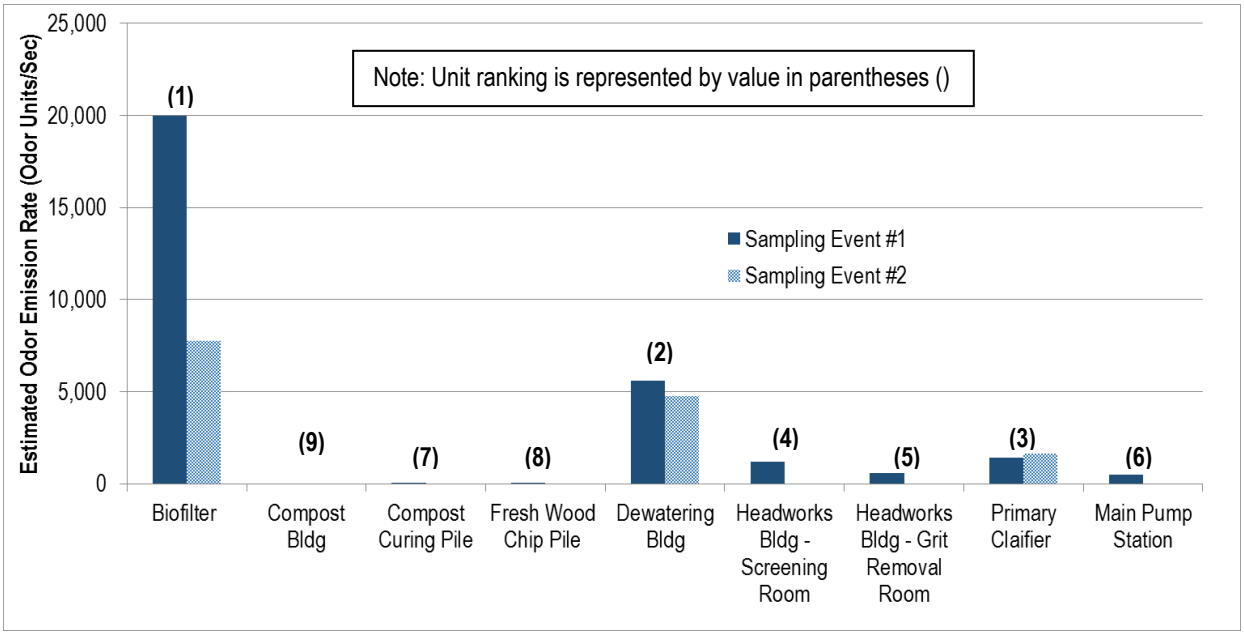

Figure 3: Estimated Odor Emission Rate and Unit Ranking For Potential Mitigation Efforts from Two Sampling Events. Note: The compost building is exhausted through the biofilter. Therefore, no direct emissions are expected.

Field olfactometry was completed at perimeter and off-site locations during the first and second sampling events. Four observations were collected at each location. For the second sampling event, the locations were selected, in part, based on observations received from the community. Moreover, field measurements were collected in the evening to coincide with the highest frequency of community based observations. During the second sampling event, odor dilutions to thresholds (D/T) at Locations 4, 5, 6, and 9 exceeded the commonly accepted nuisance threshold (D/T = 7). Locations 4 and 5 had D/Ts between 50 and 55, while locations 6 and 9 had D/Ts between 15 and 20. Figure 4 illustrates the locations of field olfactometry measurements during the Fall Sampling Event.

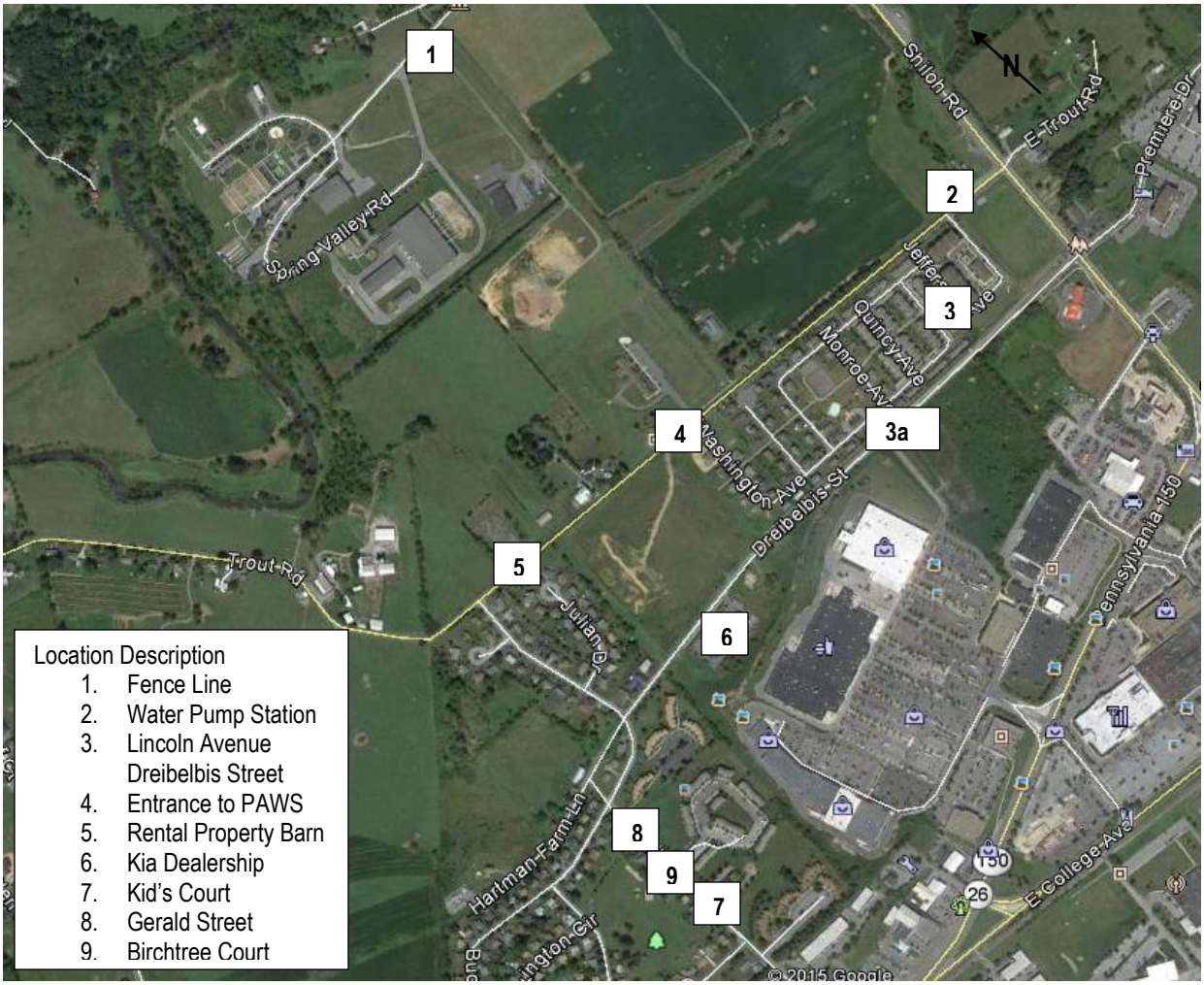

Figure 4: Location of Perimeter and Off-Site Field Olfactometry Observations during the Second Sampling Event on October 27, 2014.

AIR DISPERSION MODELING

Air dispersion modeling calculations will be developed using actual flux (i.e. exhaust fan air flow rates) data to predict the impact of odorous emissions from multiple sources. Primary model output will utilize a frequency distribution of wind direction and speed to determine the probabilistic plumes. The model will be used to establish on-site treatment levels to minimize off-site nuisance observations. The calculations will be completed once all data has been collected and tabulated.

ALTERNATIVES IDENTIFICATION AND EVALUATION

Following data collection and interpretation, odor reduction alternatives will be identified and evaluated for short term and long term implementation. A focus will be placed on the reduction of odor generating potential through operation and maintenance control. The Authority has begun to take actions to reduce odor formation and emissions through enhanced or modified operation and maintenance procedures. Once completed, add-on odor control technologies will be identified and evaluated using a first level

capital/operation and maintenance cost analysis.

INTERIM SUMMARY AND CONCLUSION

Primary odor sources at the SCPCF were identified and evaluated using human sensory testing and odorant testing. After two rounds of sampling, the biofilter and the dewatering building were found to have considerably higher potential to result in off-site nuisance odors when compared to other primary sources. Therefore, odor reduction alternatives will be identified and evaluated for these sources.

Field olfactometry at off-site locations has corroborated observations by community members, indicating that off-site odors, on occasion, exceed nuisance levels (D/T > 7).

The Authority has been actively making process improvements or maintenance modifications to reduce odor generation. The majority of their efforts have been focused on the compost building and biofilter; however, modifications have been made plant wide.

The community's involvement has been beneficial in compiling data to assist with the development of dispersion modeling to predict off-site migration of odors. Observations from residents have helped identify location and timing of off-site odor emissions.

The third sampling event was completed on April 20, 2015. Results are being tabulated.

SCHEDULE FOR COMPLETION OF ODOR CONTROL STUDY

The Odor Control Study is on schedule as presented at the onset of the project and is projected to maintain on schedule throughout completion. The original schedule was:

1.	**Task #1**		
	-	Project Kick-Off and SCPCF Tour	July 2014
	-	Interviews with Facility Management	July 2014
2.	**Task #2**		
	-	Odor Tracking System Setup	July 2014
	-	Odor Tracking System Training	August 2014
3.	**Task #3**		
	–	Initial Public Meeting	August 2014
4.	**Task #4 and Task #5**		
	–	Summer Sampling Event	August 2014
	–	Fall Sampling Event	October 2014
	–	Spring Sampling Event	April 2015
5.	**Task #6**		
	–	Odor Data Interpretation	May 2015
6.	**Task #7**		
	–	Air Dispersion Modeling	June 2015
7.	**Task #8**		
	–	Identify Treatment Technologies	July 2015
8.	**Task #9**		
	–	Capital/O&M Cost Analysis	August 2015
9.	**Task #10**		
	–	Report and Presentation	September 2015