APPENDIX N

KEMPER COUNTY IGCC PROJECT COOLING TOWER IMPACT ASSESSMENTS

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AECOM Environment
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May 15, 2009

Mr. Scott McMillan
Southern Company Services
600 North 18th Street, Bin 14N-8195
Birmingham, AL 35291

Subject: Cooling Tower Analysis – Kemper County IGCC Project
Kemper County, Mississippi

Dear Mr. McMillan,

AECOM has completed modeling of the wet mechanical draft cooling towers proposed for the Kemper County IGCC Project located in Kemper County, Mississippi. The purpose of the modeling analysis was to predict salt deposition rates associated with cooling tower drift and the potential for ground-level fogging and icing associated with visible vapor plumes.

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For fogging/icing, the SACTI model results consist of the number of hours/year of fogging and icing estimated by the SACTI model for the five years of meteorology modeled. The fogging/icing results are summarized in this report in a table as well as overlaid on area satellite images. The salt deposition rates estimated by SACTI are provided in units of kg/km^2-month representing the annual average monthly deposition rate for the period analyzed. The salt deposition results presented in this report were converted to lb/acre/month and shown as isopleths overlaid on area satellite images.

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Seasonal salt deposition rates (in units of lb/acre/month) estimated by SACTI are illustrated as contour plots in Figures 2 through 5 defined based on meteorological convention as follows:

- Figure 2: Winter - December, January, February
- Figure 3: Spring - March, April, May
- Figure 4: Summer - June, July, August
- Figure 5: Fall - September, October, November

In addition, salt deposition rates for the worst-case month, April, are shown in Figure 6. Annual average deposition rates are shown in Figure 7.

All figures also note the location and magnitude of the maximum modeled salt deposition values which occur on the facility property for all cases.

Please contact Brian Stormwind at 978-589-3154 or Thomas Pritcher at 919-872-6600 if you have any questions or comments concerning this report.

Yours sincerely,

Brian Stormwind
Senior Air Quality Meteorologist
brian.stormwind@aecom.com

Thomas Pritcher, P.E
Air Quality Program Manager
thomas.pritcher@aecom.com

Table 1: Gasification Cooling Tower

Parameter	Value	
Height of Fan Stack (Feet)	63.6	
Height of Fan Deck (Feet)	49.6	
Length of Tower (Feet)	270	
Width of Tower (Feet)	123	
Exit Diameter of a Single Fan Stack (Feet)	40	
Number of Cells	10	
Total (All Cells) Heat Rejection Rate (Btu/hr) (1)	$1{,}140 \times 10^6$	
Total (All Cells) ***Input*** Air Flow Rate (lb/hr) (1)	56,000,000	
Total Water Circulation Rate (gallons per minute)	120,000	
Drift Rate Efficiency (%)	0.0005 %	
Cooling Water Total Dissolved Solids (ppm) (2)	1,500	
Drift Rate (gallons per minute)	0.60	
Droplet Distribution: Droplet Size versus Mass Fraction	Drop Size (μm)	Percent Mass Larger
	10	88
	15	80
	35	60
	65	40
	115	20
	170	10
	230	5
	375	1
	525	0.2

(1) Representative of full load operation.
(2) Concentration in blow-down based on 5 cycles of concentration.

Table 2: Combined Cycle Cooling Tower

Parameter	Value	
Height of Fan Stack (Feet)	63.6	
Height of Fan Deck (Feet)	49.6	
Length of Tower (Feet)	323	
Width of Tower (Feet)	123	
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Number of Cells	12	
Total (All Cells) Heat Rejection Rate (Btu/hr) [(1)]	$1,650 \times 10^6$	
Total (All Cells) ***Input*** Air Flow Rate (lb/hr) [(1)]	67,200,000	
Total Water Circulation Rate (gallons per minute)	150,000	
Drift Rate Efficiency (%)	0.0005 %	
Cooling Water Total Dissolved Solids (ppm) [(2)]	1,500	
Drift Rate (gallons per minute)	0.75	
Droplet Distribution: Droplet Size versus Mass Fraction	Drop Size (µm)	Percent Mass Larger
	10	88
	15	80
	35	60
	65	40
	115	20
	170	10
	230	5
	375	1
	525	0.2

(3) Representative of full load operation.
(4) Concentration in blow-down based on 5 cycles of concentration.

Table 3: Ground-level Plume Fogging (Hours/Year) – Annual Average Based on 5-years Modeled

Distance (meters) (1)	Plume Heading															
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
100	2.5	1.0	0.4	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	1.8
200	3.4	0.4	0.7	0.0	0.1	0.0	0.1	0.1	0.4	0.1	0.0	0.0	0.0	0.1	0.1	1.5
300	0.6	0.2	0.3	0.0	0.1	0.0	0.0	0.1	0.4	0.1	0.0	0.0	0.0	0.1	0.0	0.3
400	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
500	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
600	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
700	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
800	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
900	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1100	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1200	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1300	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1400	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1500	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(1) Relative to the center location of the cooling towers.

Figure 1: Ground-level Fogging Results

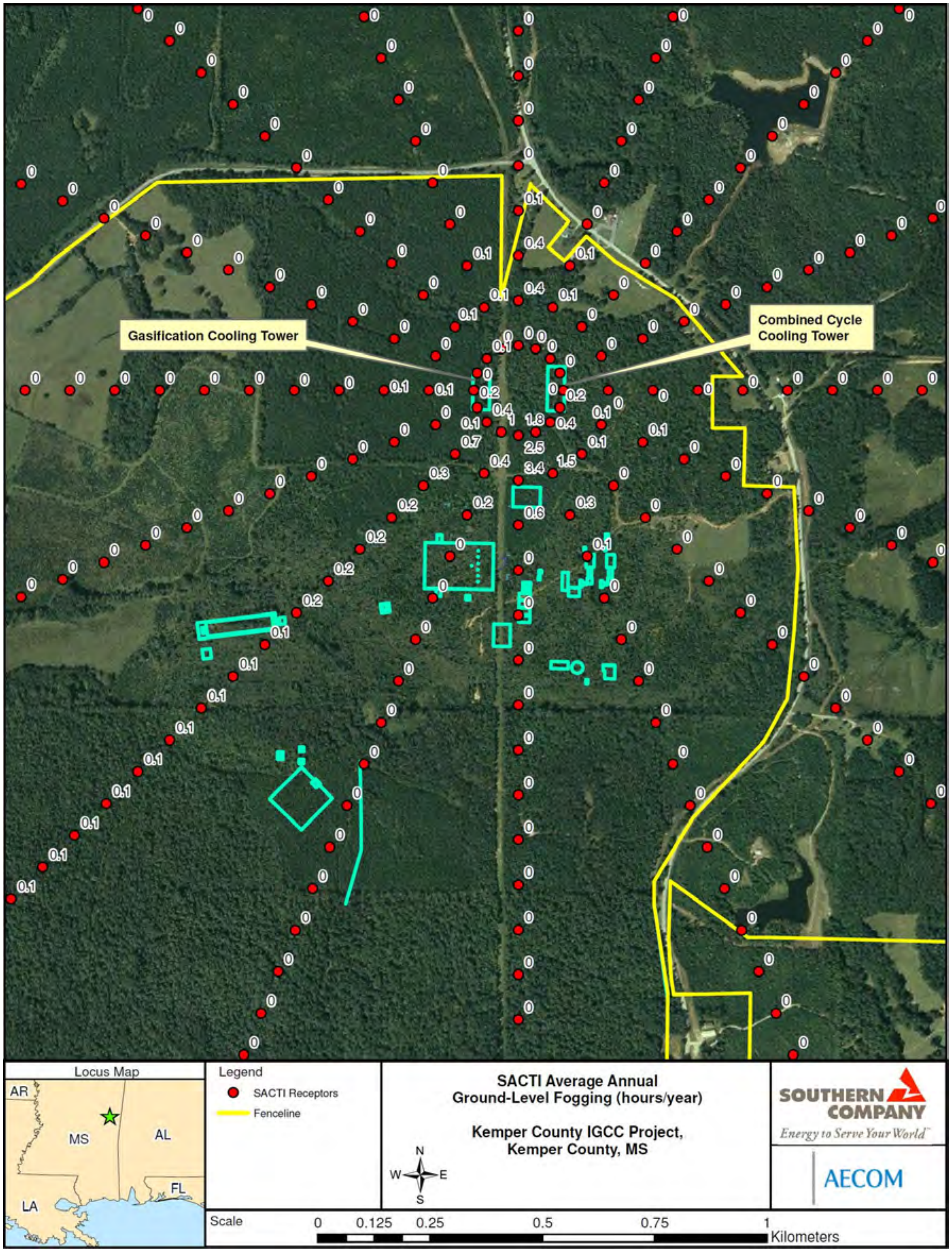

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Figure 2: Salt Deposition - Winter

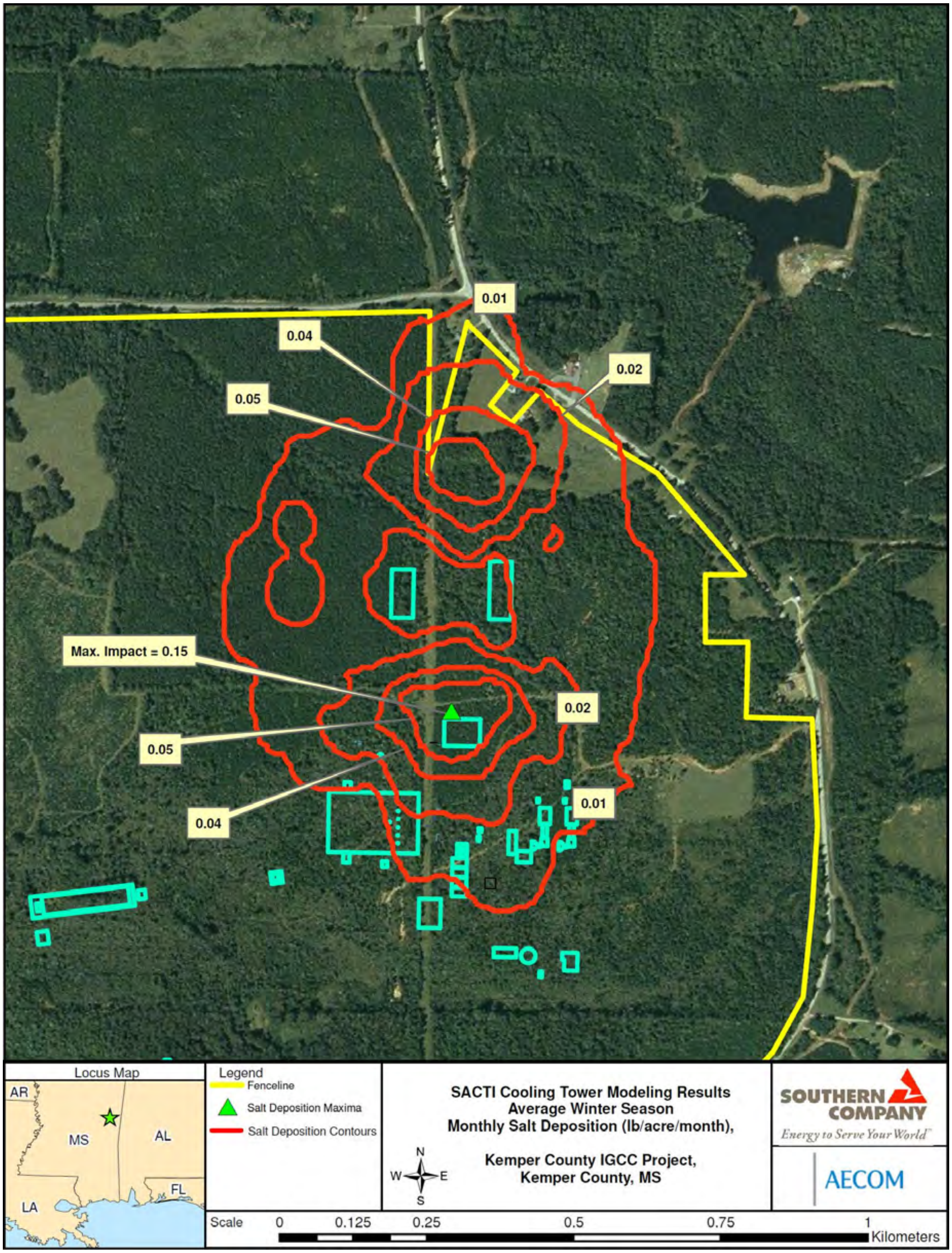


Figure 3: Salt Deposition - Spring

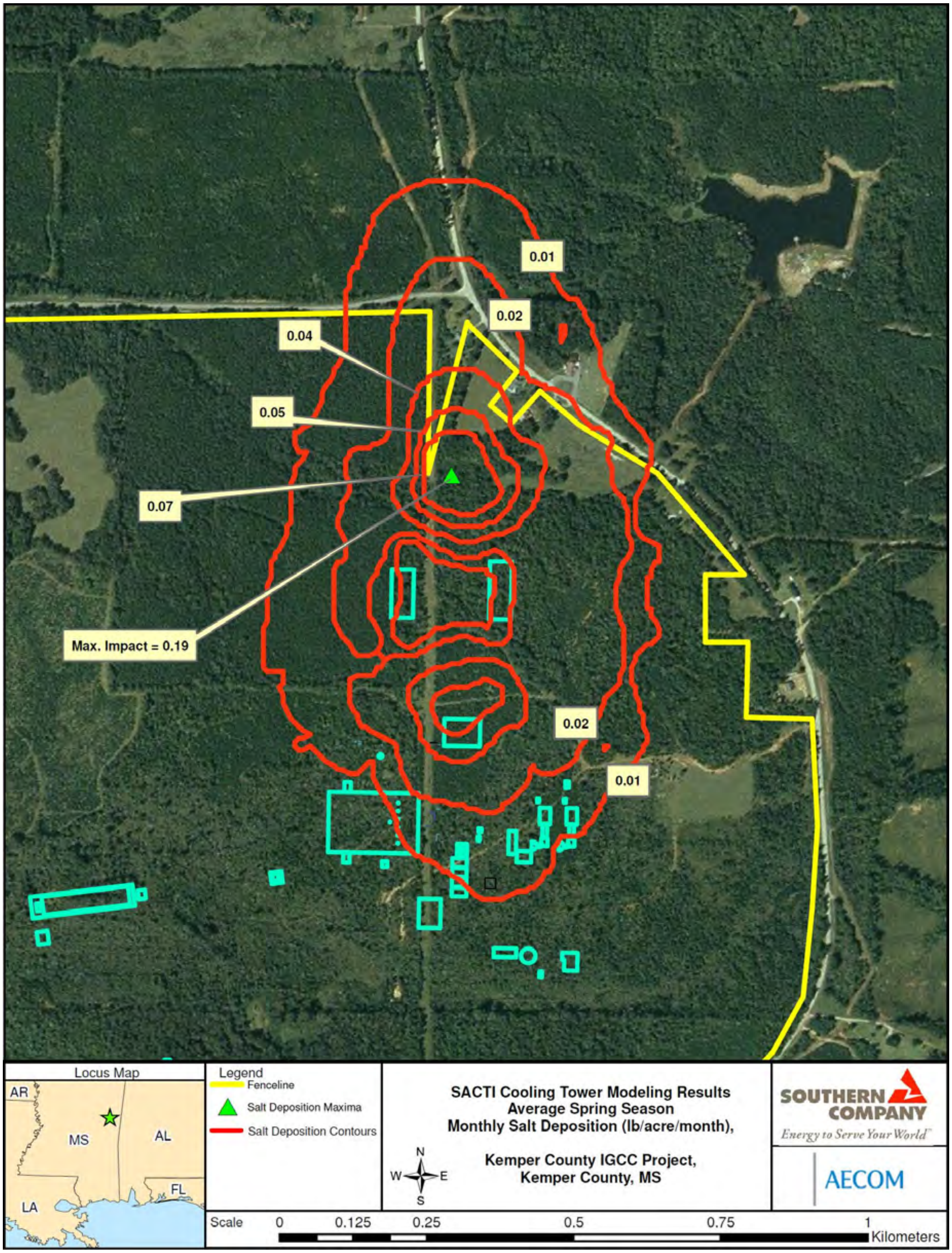


Figure 4: Salt Deposition - Summer

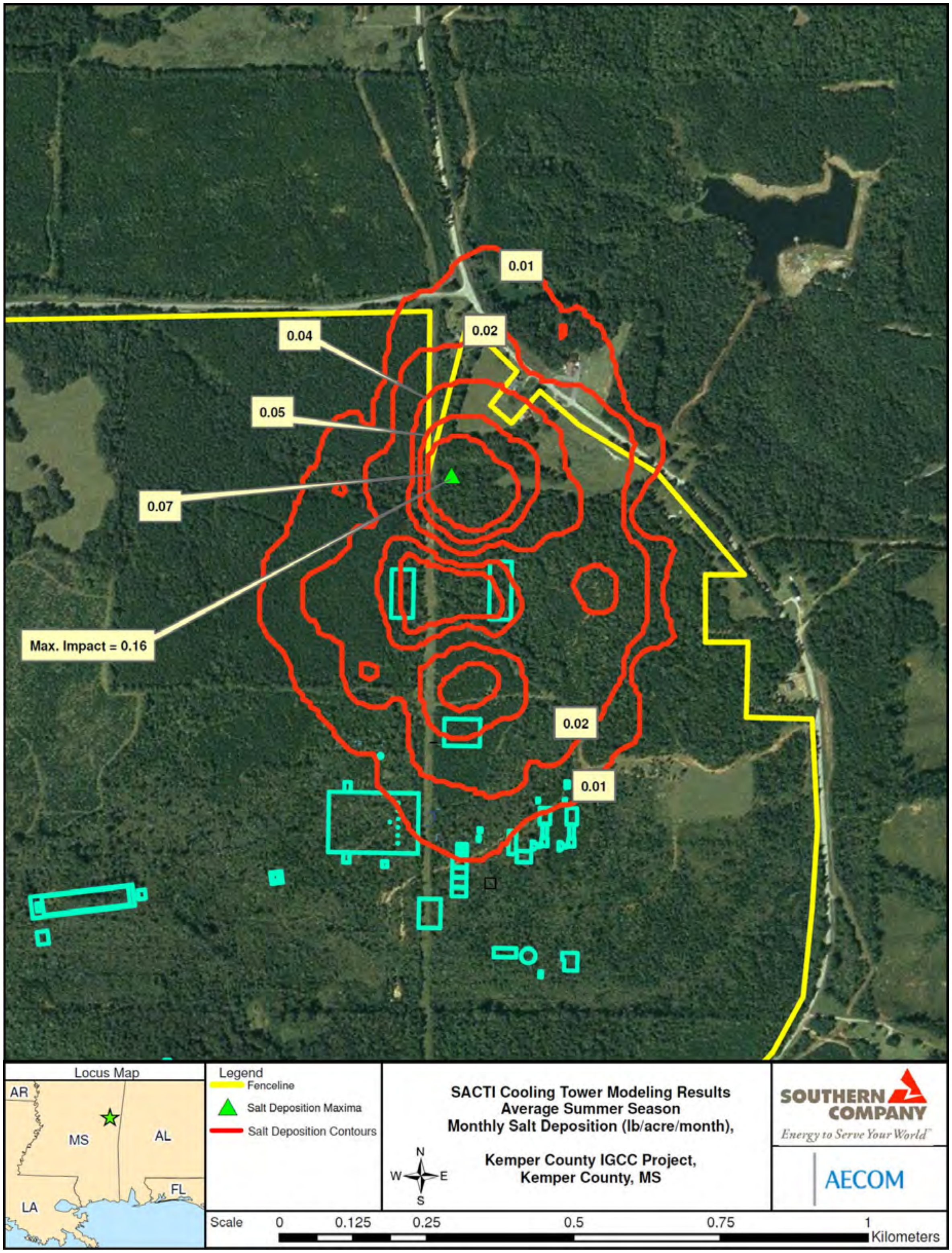


Figure 5: Salt Deposition - Fall

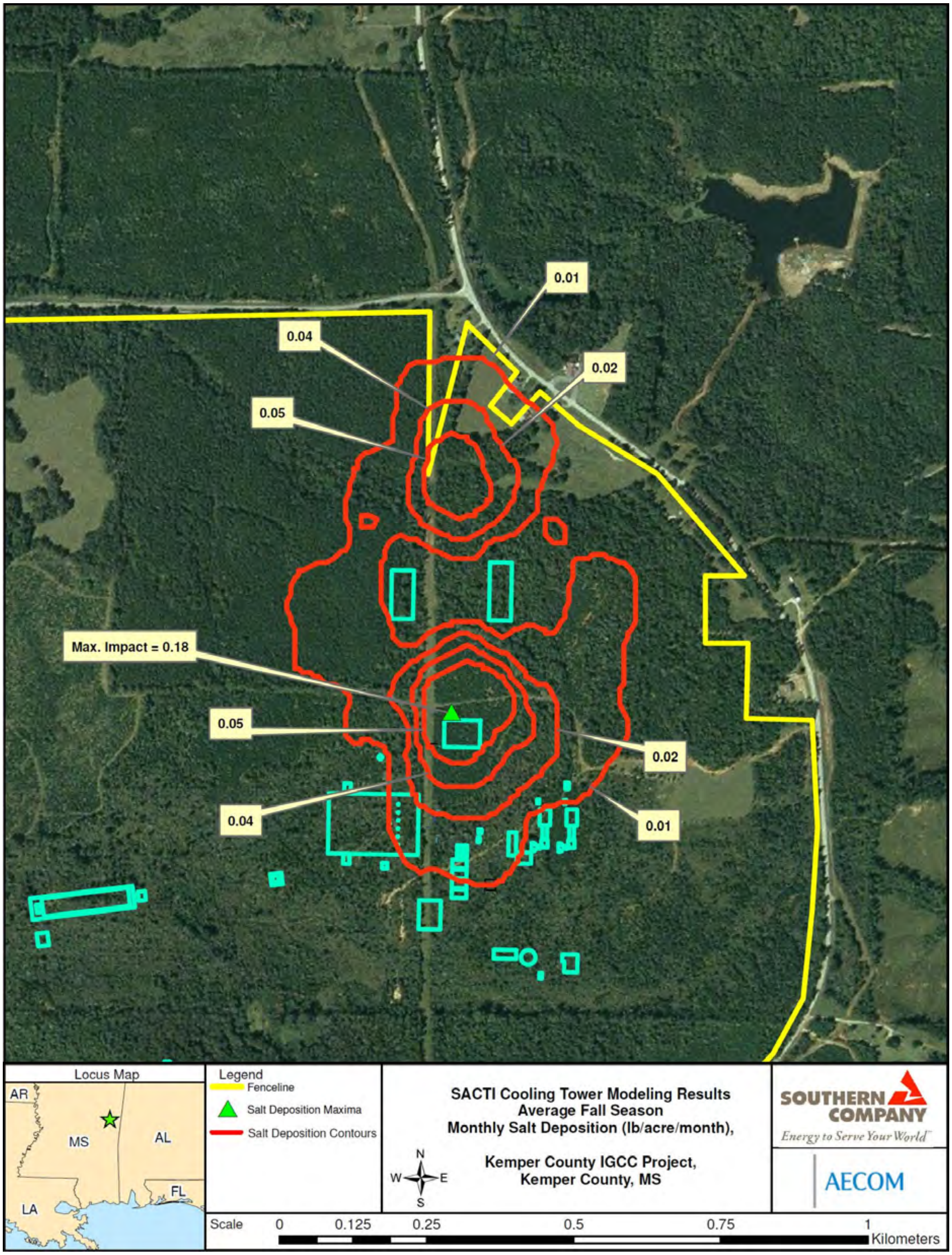


Figure 6: Salt Deposition – April (Worst-case Month)

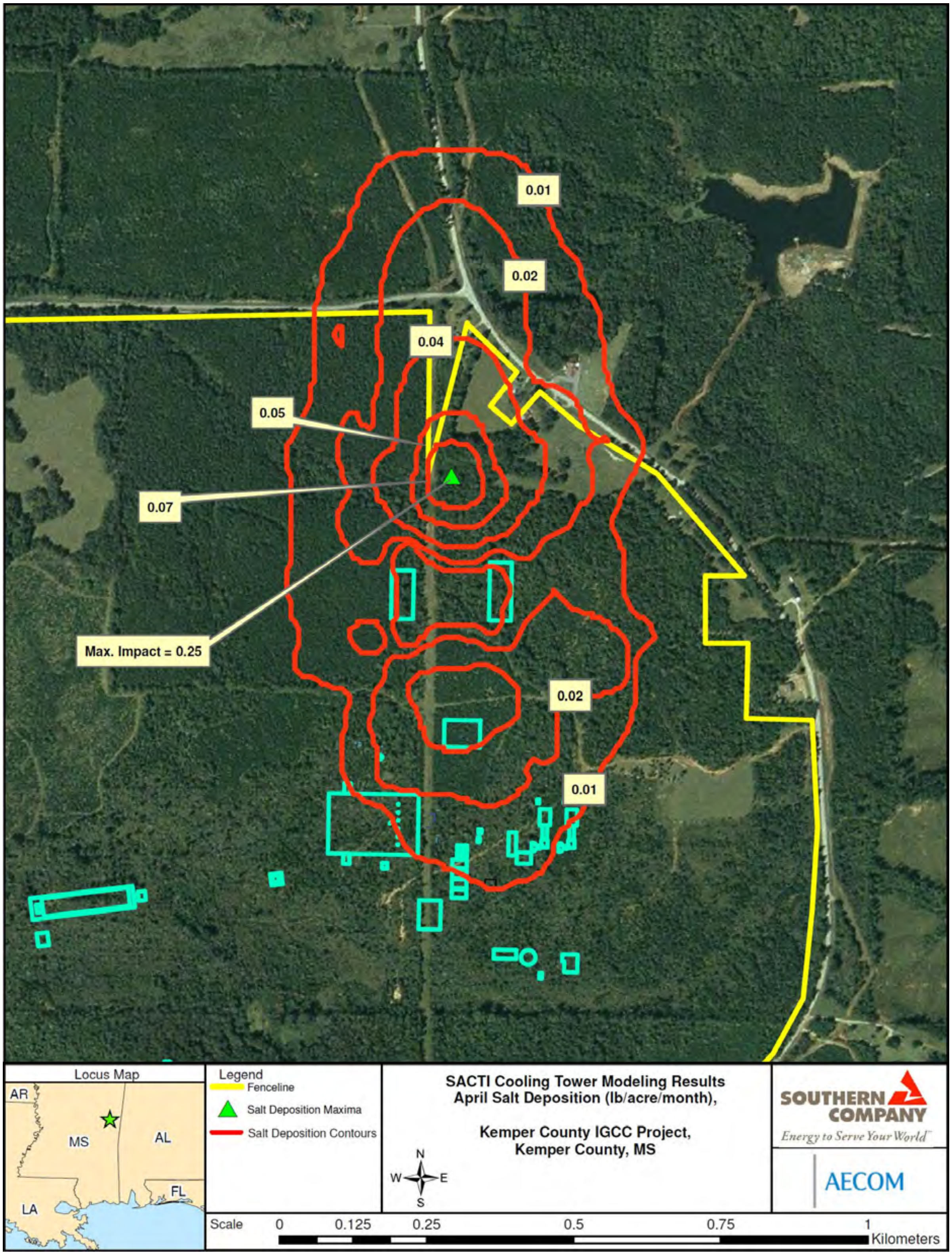
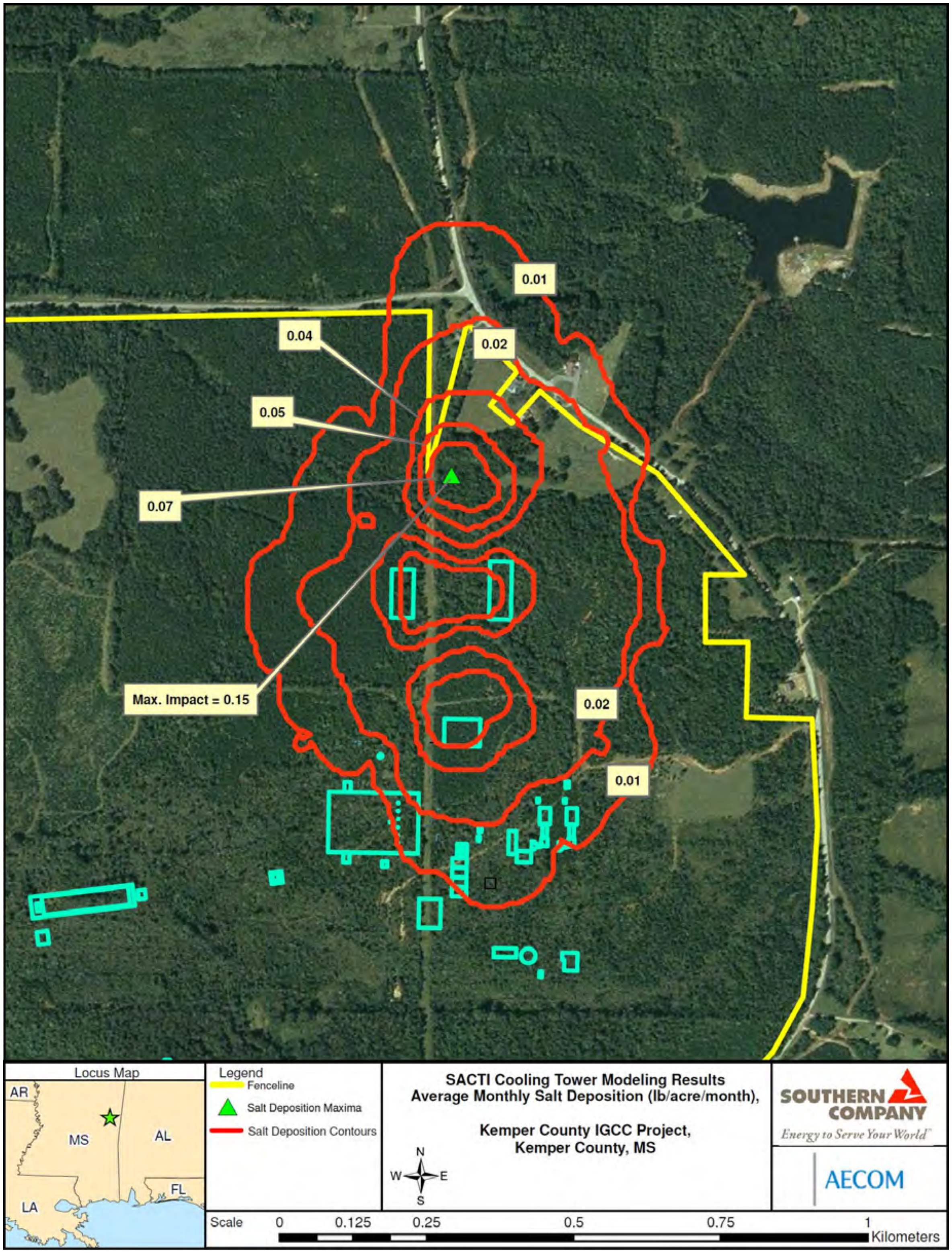


Figure 7: Salt Deposition – Annual (Average All Seasons)



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400	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
500	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
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700	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
800	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
900	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1100	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1200	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1300	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1400	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1500	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(1) Relative to the center location of the cooling towers.

Figure 1: Ground-level Fogging Results

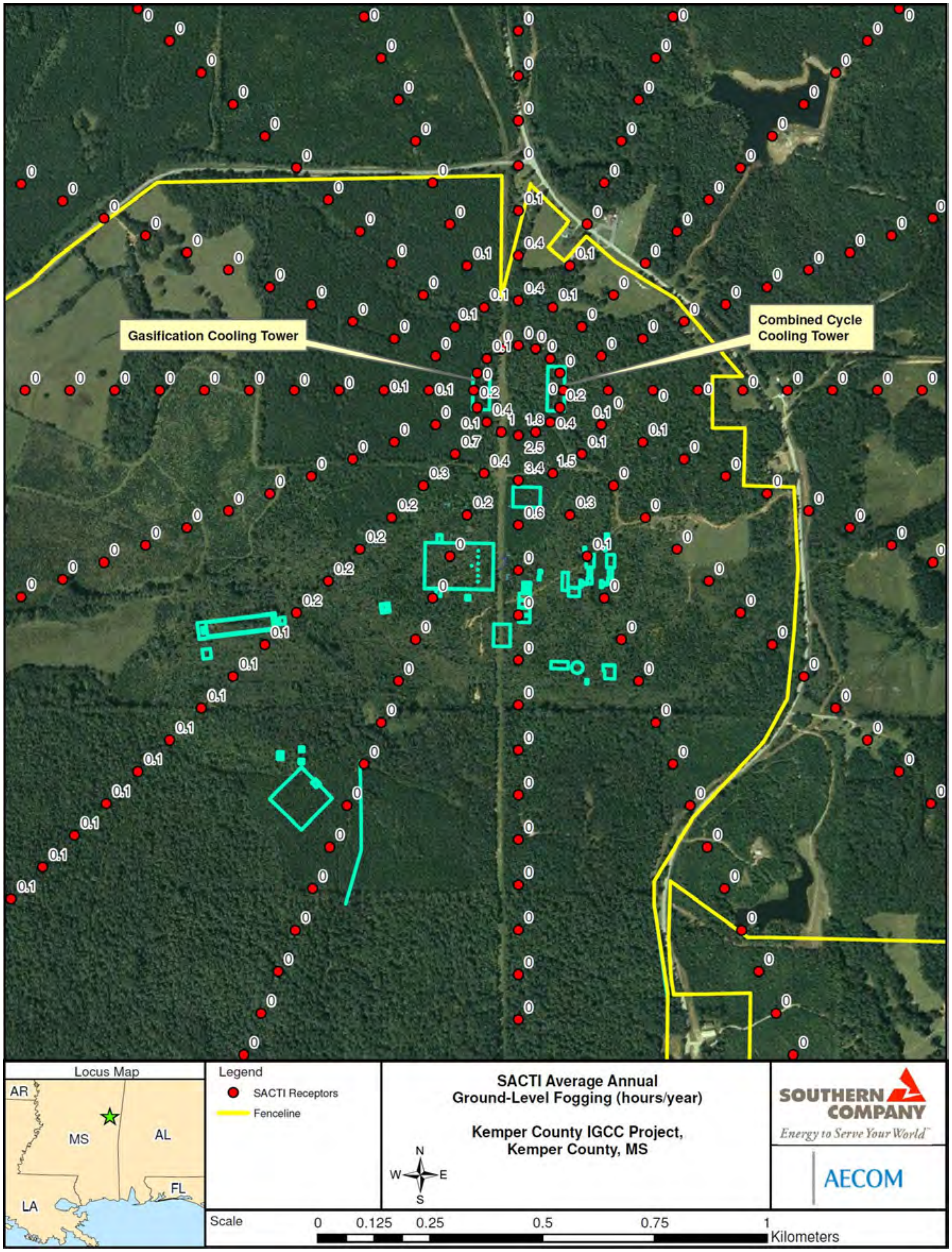

Figure 2: Salt Deposition - Winter

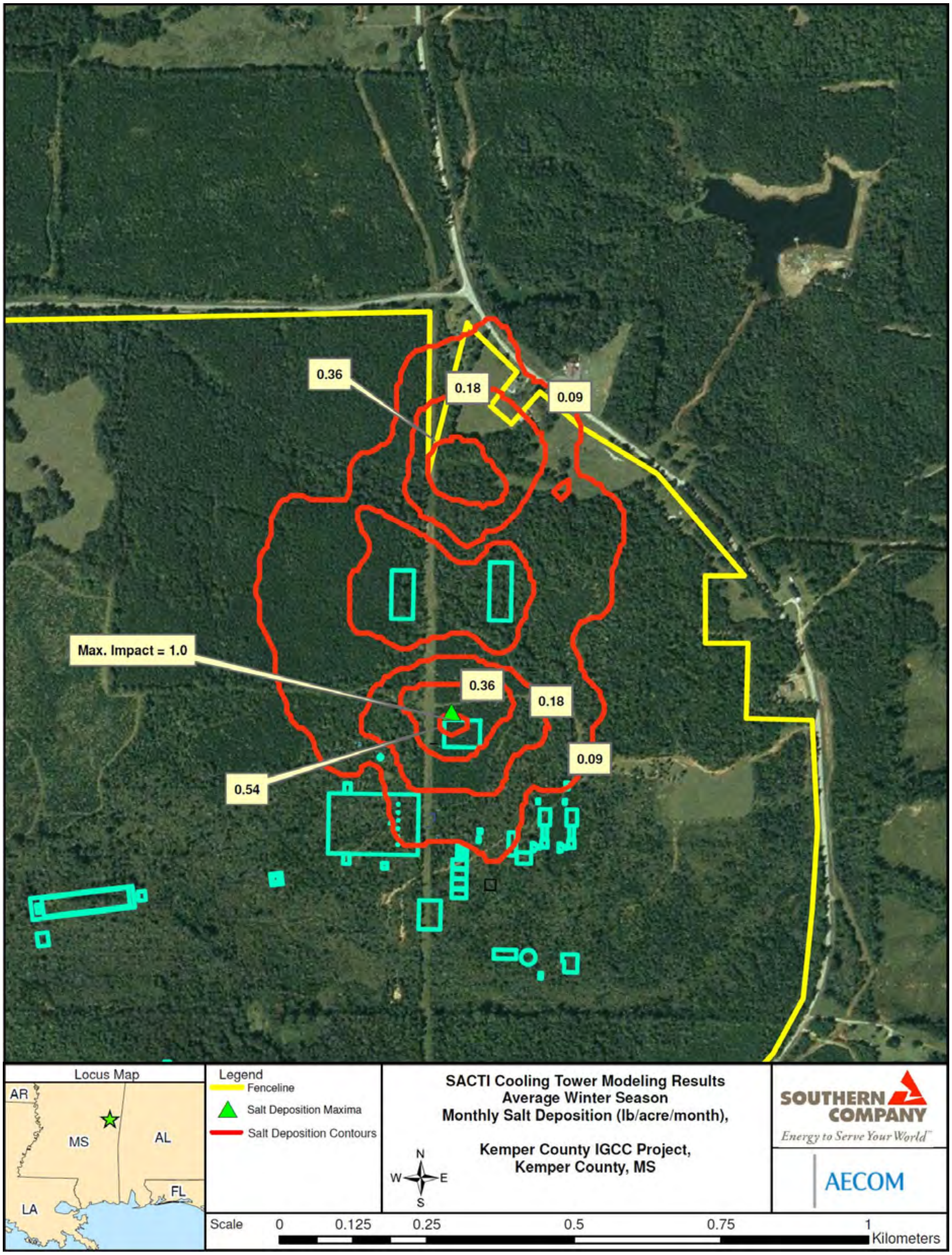

Figure 3: Salt Deposition - Spring

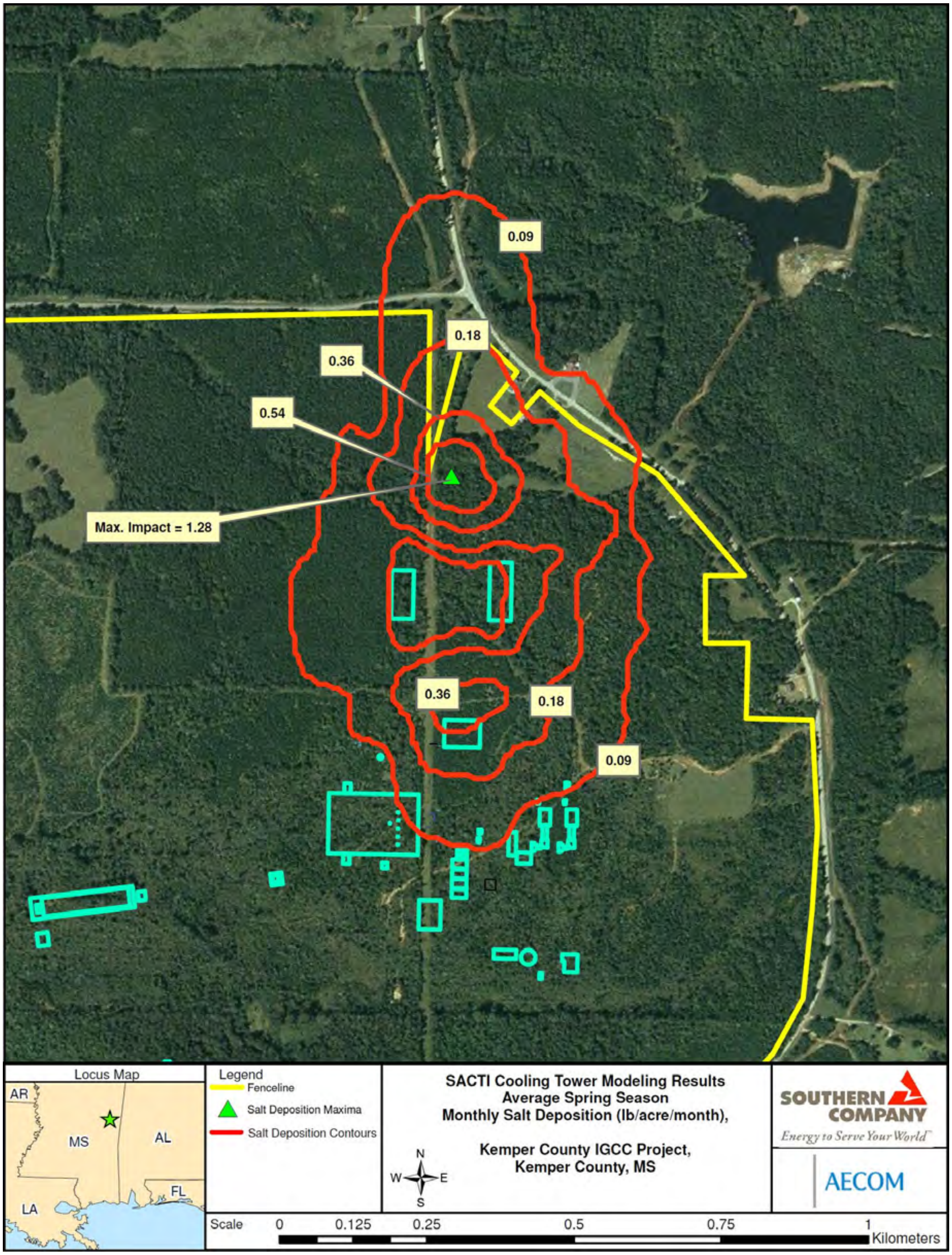

Figure 4: Salt Deposition - Summer

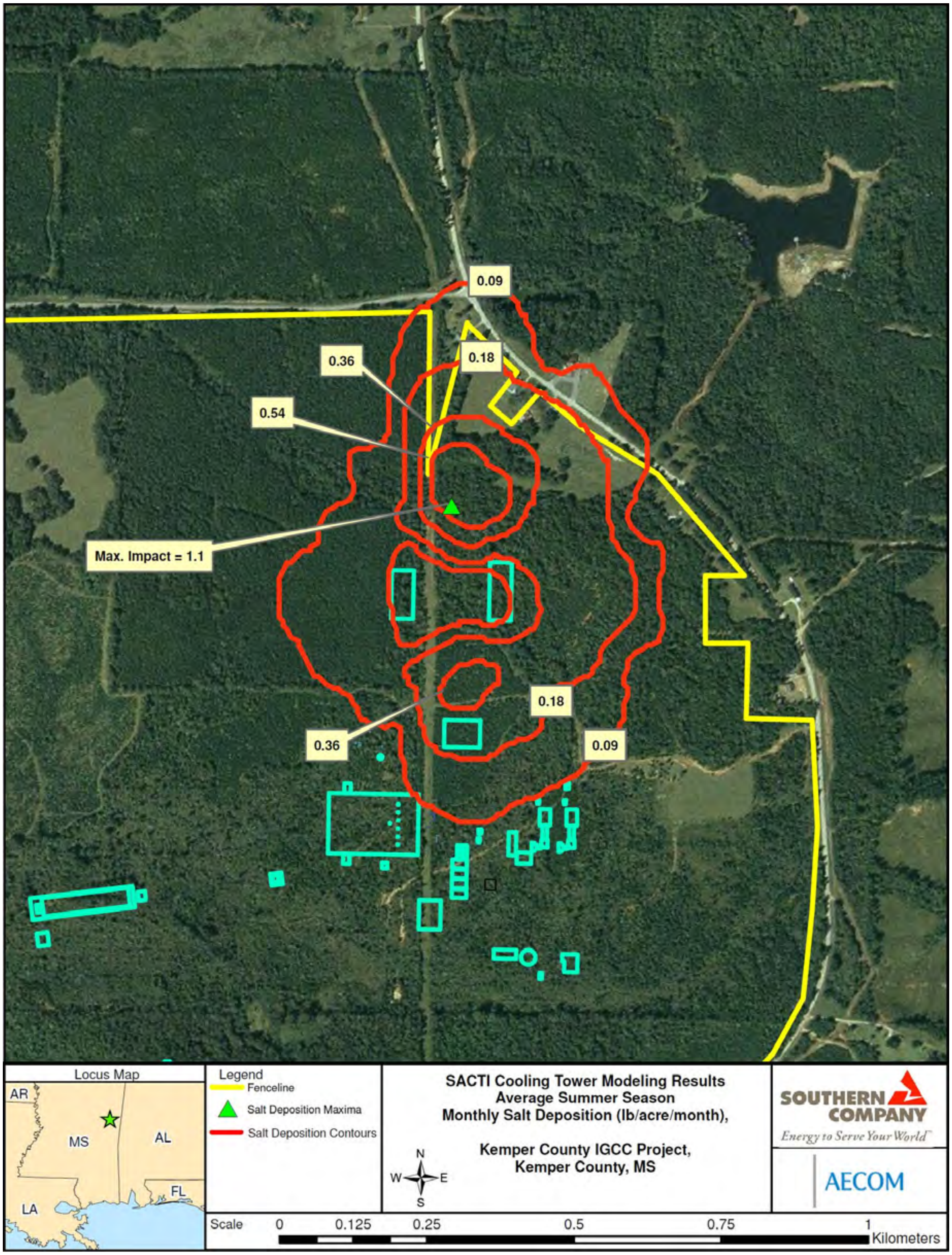

Figure 5: Salt Deposition - Fall

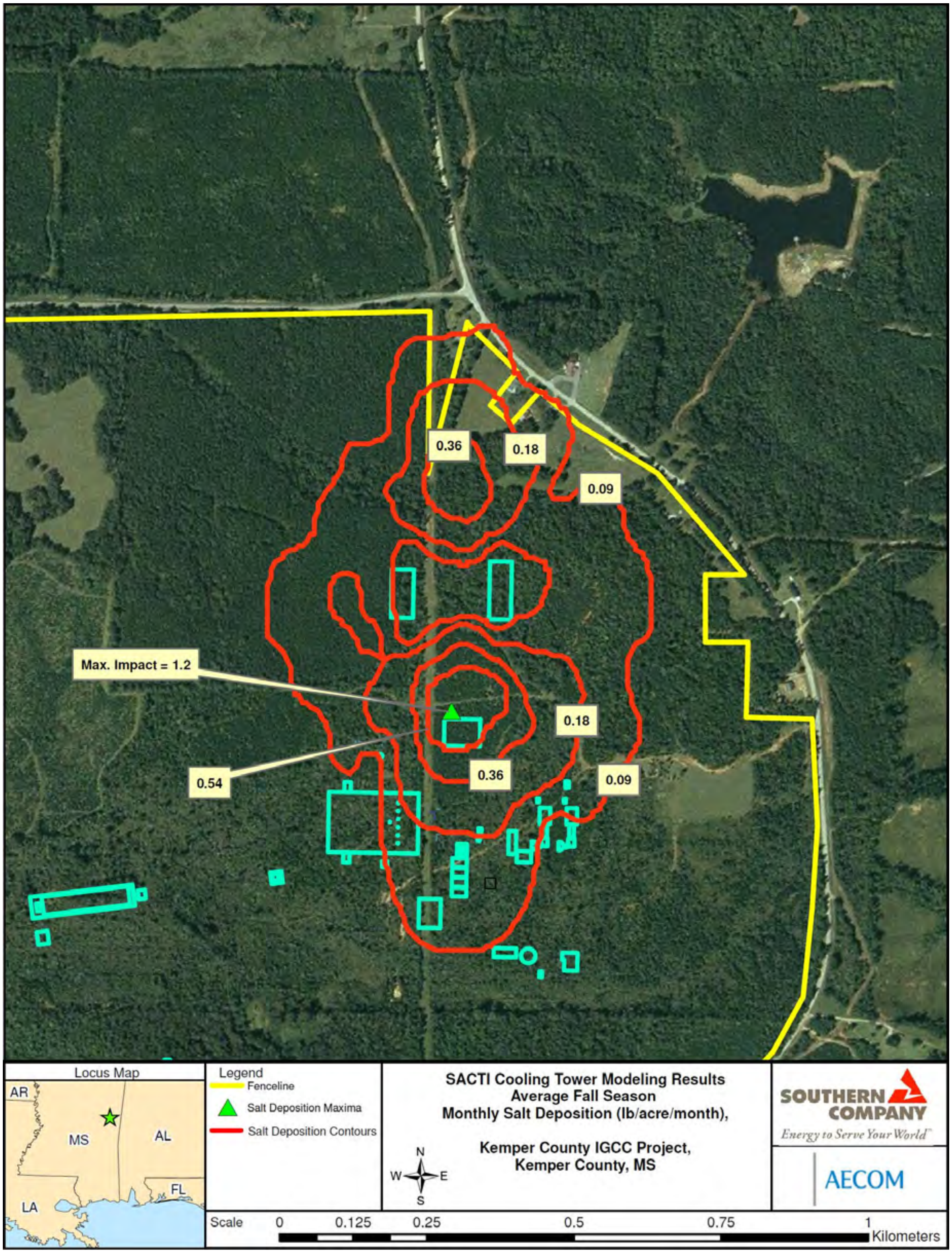

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Figure 6: Salt Deposition – April (Worst-case Month)

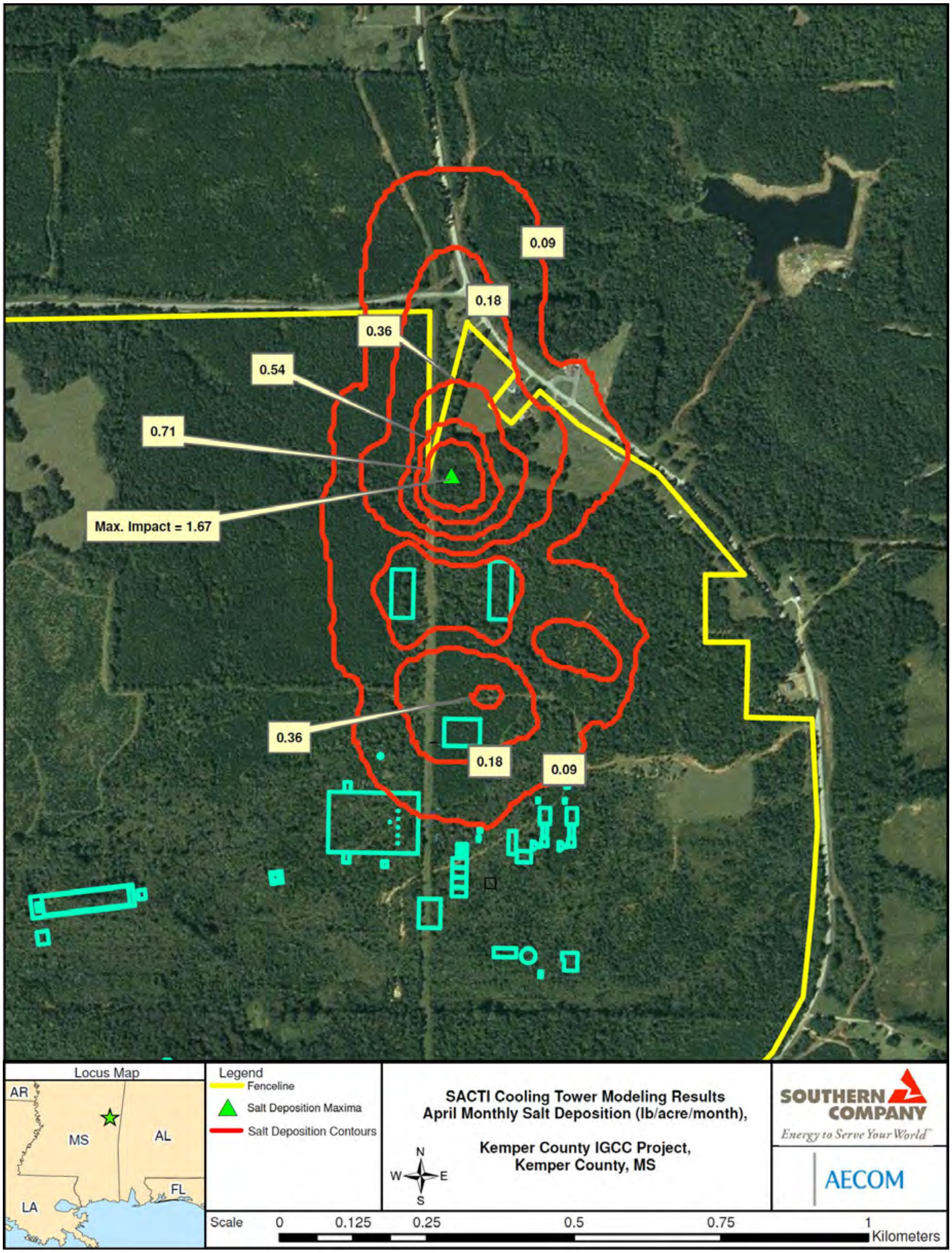
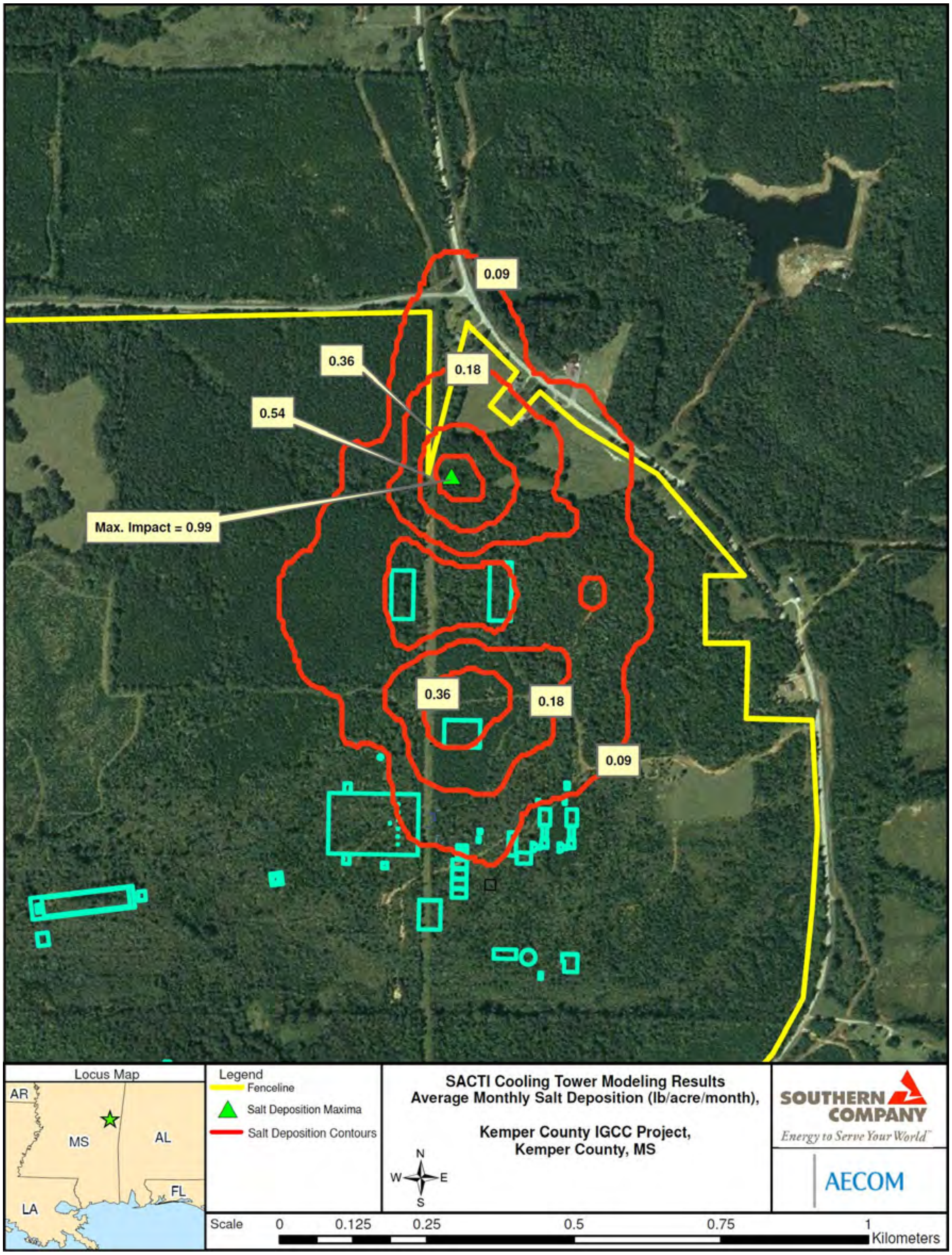


Figure 7: Salt Deposition – Annual (Average All Seasons)



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May 15, 2009

Mr. Scott McMillan
Southern Company Services
600 North 18th Street, Bin 14N-8195
Birmingham, AL 35291

Subject: Cooling Tower Analysis – Kemper County IGCC Project
Kemper County, Mississippi

Dear Mr. McMillan,

AECOM has completed modeling of the wet mechanical draft cooling towers proposed for the Kemper County IGCC Project located in Kemper County, Mississippi. The purpose of the modeling analysis was to predict salt deposition rates associated with cooling tower drift and the potential for ground-level fogging and icing associated with visible vapor plumes.

Overview of Modeling Approach

AECOM applied the Seasonal and Annual Cooling Tower Impacts (SACTI, Version 9/30/90) model to assess the potential for ground-level fogging and icing impacts as well as to predict salt deposition rates associated with the proposed wet mechanical draft cooling towers. SACTI was developed by the Electric Power Research Institute (EPRI). SACTI is a validated model designed for assessing cooling tower plume impacts and is widely accepted by state agencies for regulatory applications.

Cooling tower "fogging" occurs when the condensed water vapor plume comes in contact with the ground for short periods of time near the tower. Although this potential impact is referred to as fogging, it is not the type of area-wide atmospheric fogging that is generally thought of when the term "fog" is used. Cooling tower plume touchdown or fogging is transient and localized. The SACTI model estimates the number of hours per year that ground-level fogging will occur at specified receptor locations. Ground-level icing is predicted to occur when a visible plume touches the ground under subfreezing weather conditions. The atmospheric conditions associated with predictions of ground-level fogging are high winds (≥10 m/sec) and high relative humidity or low atmospheric saturation deficits. The high winds, which cause aerodynamic downwash of the condensed vapor plume, are the primary factor in transporting the plume to the ground.

Salt deposition refers to the salt deposited in the areas surrounding the cooling tower as a result of cooling tower operation. It results from the fallout of droplets from the cooling tower plume which contains salts in the form of dissolved solids. The droplets, primarily consisting of water, are mechanically generated in the cooling tower and are a small fraction of the tower water flow rate. The amount of salt deposition is proportional to the mass of droplets released from the tower to the atmosphere as drift and the concentration of salts in the drift droplets.

The drift deposition model in SACTI consists of four sub-models: plume dispersion, breakaway, evaporation, and deposition. During the model development phase, the model developers conducted an extensive analysis of droplet evaporation and review of existing available drift models at that time. Based on that research, the SACTI model developers developed an improved treatment of drop dynamics and thermodynamics which was incorporated into the drift model. The drift model was tested with data from the 1977 Chalk Point Dye Tracer Study. This study, which provided the best data on cooling tower drift deposition at that time, involved the use of a fluorescent dye in the cooling tower/condenser water flow so as to be able to distinguish cooling tower drift deposition at the ground from other sources such as the plant stack. The study showed that the drift model performed within a factor of 3 of observed data.

For fogging/icing, the SACTI model results consist of the number of hours/year of fogging and icing estimated by the SACTI model for the five years of meteorology modeled. The fogging/icing results are summarized in this report in a table as well as overlaid on area satellite images. The salt deposition rates estimated by SACTI are provided in units of kg/km^2-month representing the annual average monthly deposition rate for the period analyzed. The salt deposition results presented in this report were converted to lb/acre/month and shown as isopleths overlaid on area satellite images.

Model Input Data

SACTI requires hourly meteorological data including measurements of temperature, relative humidity, wind speed, and wind direction. Consistent with requirements for regulatory air quality modeling, five years of meteorological data (1991-1995) from the nearest representative National Weather Service Station (NWS), Meridian, MS were used in the SACTI modeling. The SACTI model also requires twice daily mixing heights from the closest representative upper air station, Jackson, MS (also consistent with requirements for regulatory air quality modeling).

Consistent with SACTI model requirements, the model was applied with a polar receptor grid centered with respect to the two cooling towers. The receptors were placed along 16 equally spaced radials (22.5 degree increments) at 100 meter increments out to 10 kilometers.

The cooling tower performance data required by SACTI were provide by Southern Company and are summarized in Tables 1 and 2 for the two towers.

Model Results

The cooling tower fogging results are summarized in Table 3. The table lists the annual average hours/year fogging at each receptor location based on the 5-years modeled. There were no hours of icing estimated by SACTI. The fogging results are illustrated in Figure 1 which shows the hours/year of fogging noted next to each receptor location. As shown in Figure 1, all predicted fogging occurrences are limited to receptors within the proposed facility boundary.

Seasonal salt deposition rates (in units of lb/acre/month) estimated by SACTI are illustrated as contour plots in Figures 2 through 5 defined based on meteorological convention as follows:

- Figure 2: Winter - December, January, February
- Figure 3: Spring - March, April, May
- Figure 4: Summer - June, July, August
- Figure 5: Fall - September, October, November

In addition, salt deposition rates for the worst-case month, April, are shown in Figure 6. Annual average deposition rates are shown in Figure 7.

All figures also note the location and magnitude of the maximum modeled salt deposition values which occur on the facility property for all cases.

Please contact Brian Stormwind at 978-589-3154 or Thomas Pritcher at 919-872-6600 if you have any questions or comments concerning this report.

Yours sincerely,

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Table 1: Gasification Cooling Tower

Parameter	Value	
Height of Fan Stack (Feet)	63.6	
Height of Fan Deck (Feet)	49.6	
Length of Tower (Feet)	270	
Width of Tower (Feet)	123	
Exit Diameter of a Single Fan Stack (Feet)	40	
Number of Cells	10	
Total (All Cells) Heat Rejection Rate (Btu/hr) (1)	1,140 x 10^6	
Total (All Cells) ***Input*** Air Flow Rate (lb/hr) (1)	56,000,000	
Total Water Circulation Rate (gallons per minute)	120,000	
Drift Rate Efficiency (%)	0.0005 %	
Cooling Water Total Dissolved Solids (ppm) (2)	85,000	
Drift Rate (gallons per minute)	0.60	
Droplet Distribution: Droplet Size versus Mass Fraction	Drop Size (μm)	Percent Mass Larger
	10	88
	15	80
	35	60
	65	40
	115	20
	170	10
	230	5
	375	1
	525	0.2

(1) Representative of full load operation.
(2) Concentration in blow-down based on 5 cycles of concentration.

Table 2: Combined Cycle Cooling Tower

Parameter	Value	
Height of Fan Stack (Feet)	63.6	
Height of Fan Deck (Feet)	49.6	
Length of Tower (Feet)	323	
Width of Tower (Feet)	123	
Exit Diameter of a Single Fan Stack (Feet)	40	
Number of Cells	12	
Total (All Cells) Heat Rejection Rate (Btu/hr) (1)	$1,650 \times 10^6$	
Total (All Cells) ***Input*** Air Flow Rate (lb/hr) (1)	67,200,000	
Total Water Circulation Rate (gallons per minute)	150,000	
Drift Rate Efficiency (%)	0.0005 %	
Cooling Water Total Dissolved Solids (ppm) (2)	85,000	
Drift Rate (gallons per minute)	0.75	
Droplet Distribution: Droplet Size versus Mass Fraction	Drop Size (μm)	Percent Mass Larger
	10	88
	15	80
	35	60
	65	40
	115	20
	170	10
	230	5
	375	1
	525	0.2

(3) Representative of full load operation.
(4) Concentration in blow-down based on 5 cycles of concentration.

Table 3: Ground-level Plume Fogging (Hours/Year) – Annual Average Based on 5-years Modeled

Distance (meters) (1)	Plume Heading															
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
100	2.5	1.0	0.4	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	1.8
200	3.4	0.4	0.7	0.0	0.1	0.0	0.1	0.1	0.4	0.1	0.0	0.0	0.0	0.1	0.1	1.5
300	0.6	0.2	0.3	0.0	0.1	0.0	0.0	0.1	0.4	0.1	0.0	0.0	0.0	0.1	0.0	0.3
400	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
500	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
600	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
700	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
800	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
900	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1100	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1200	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1300	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1400	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1500	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

(1) Relative to the center location of the cooling towers.

Figure 1: Ground-level Fogging Results

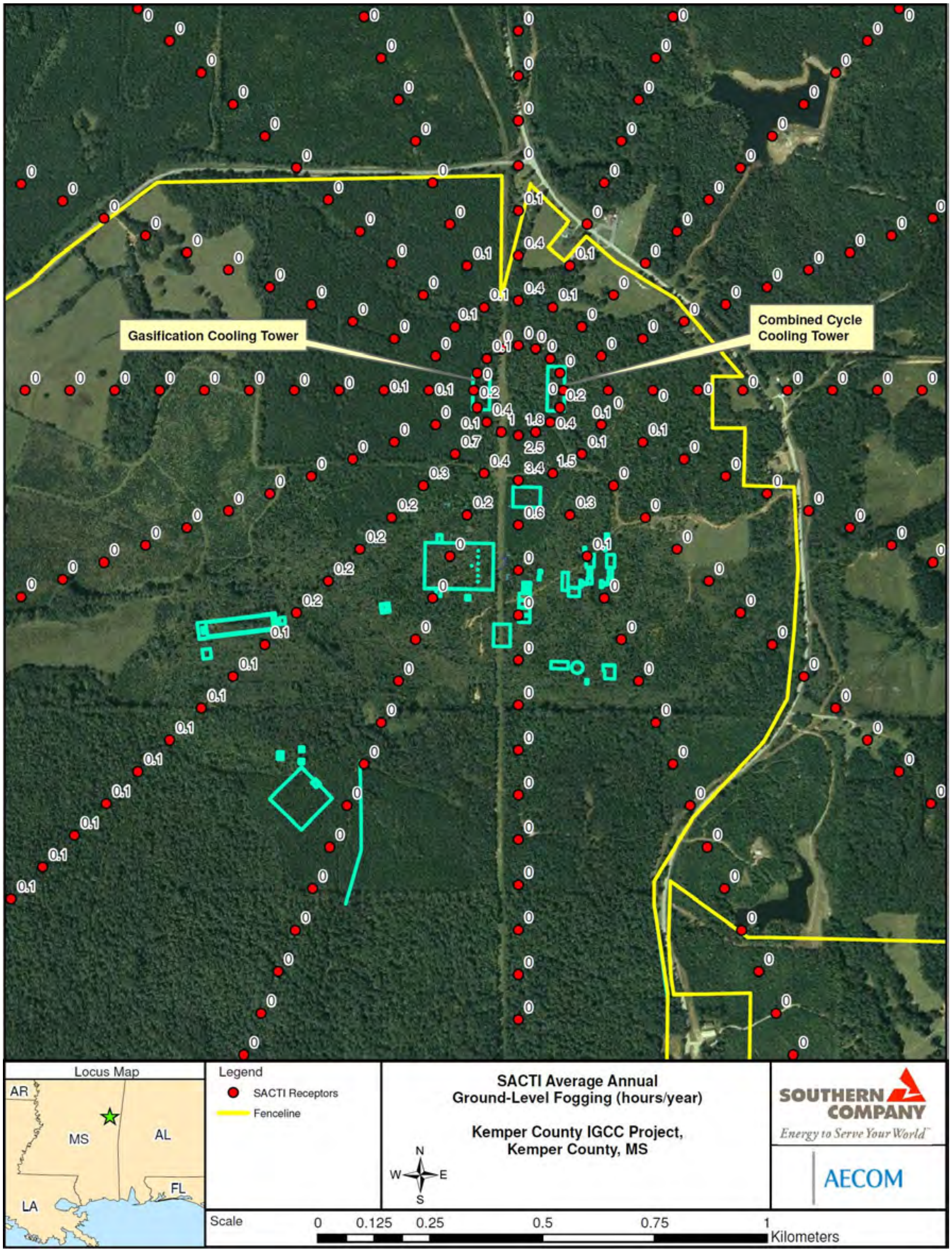

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Figure 2: Salt Deposition - Winter

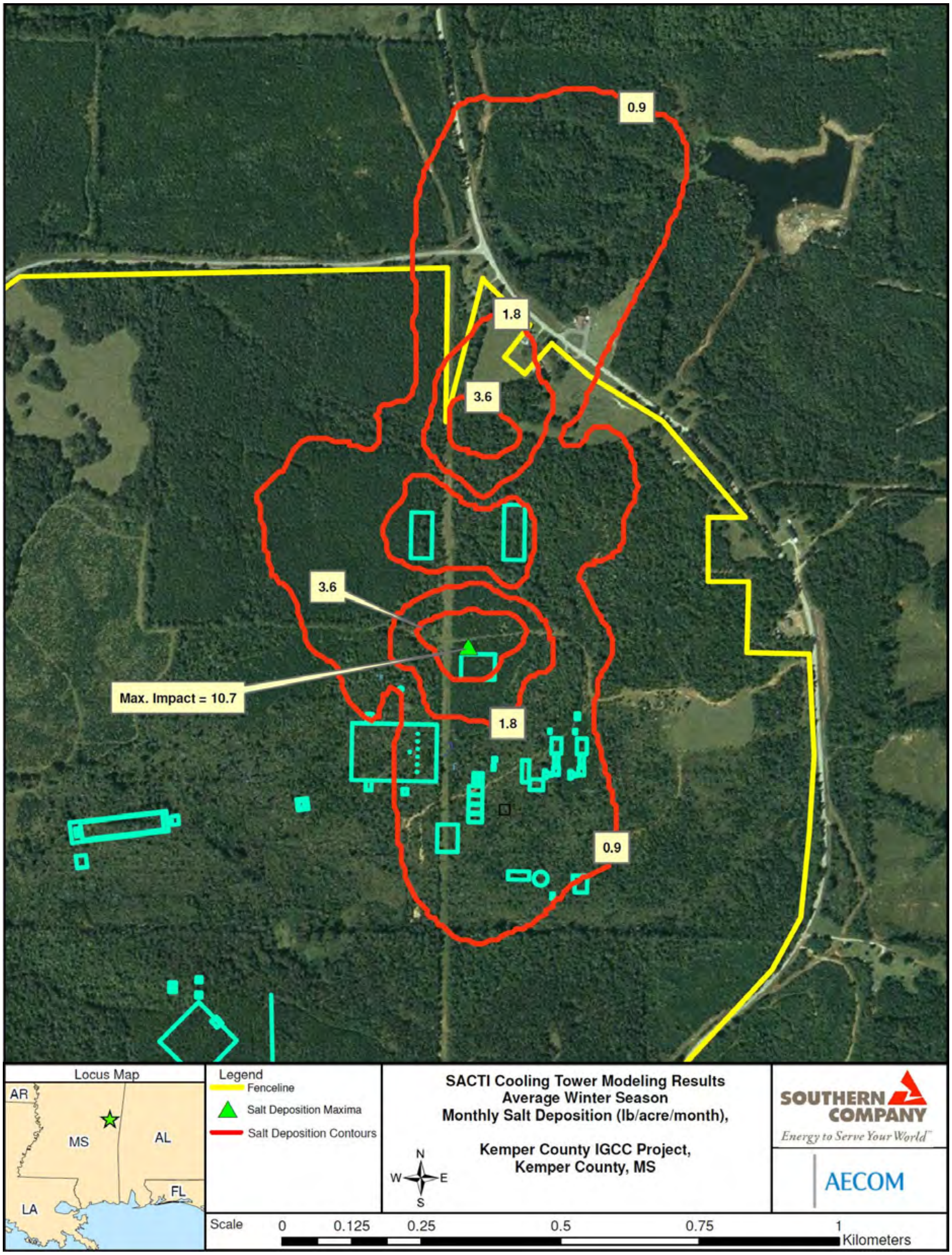


Figure 3: Salt Deposition - Spring

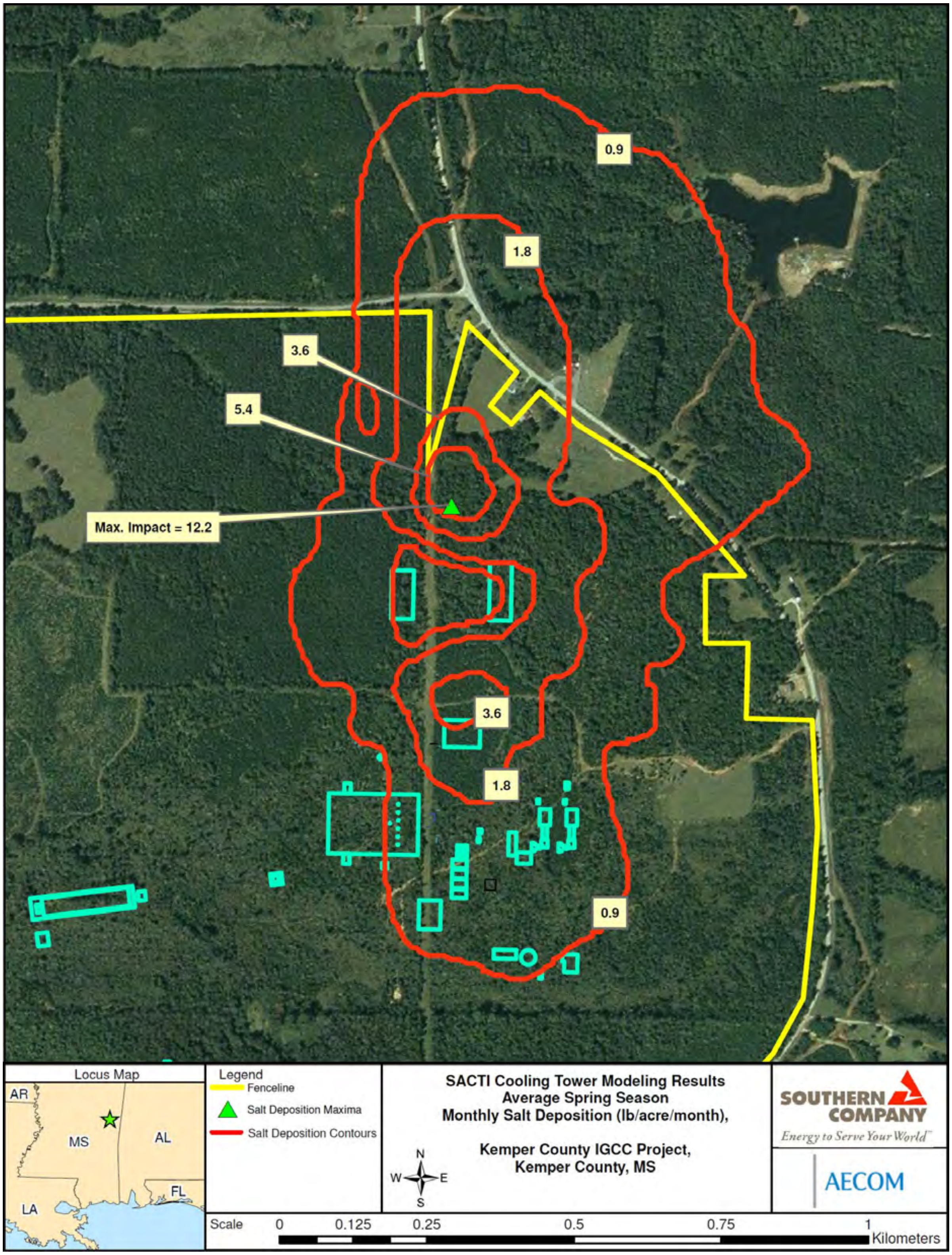


Figure 4: Salt Deposition - Summer

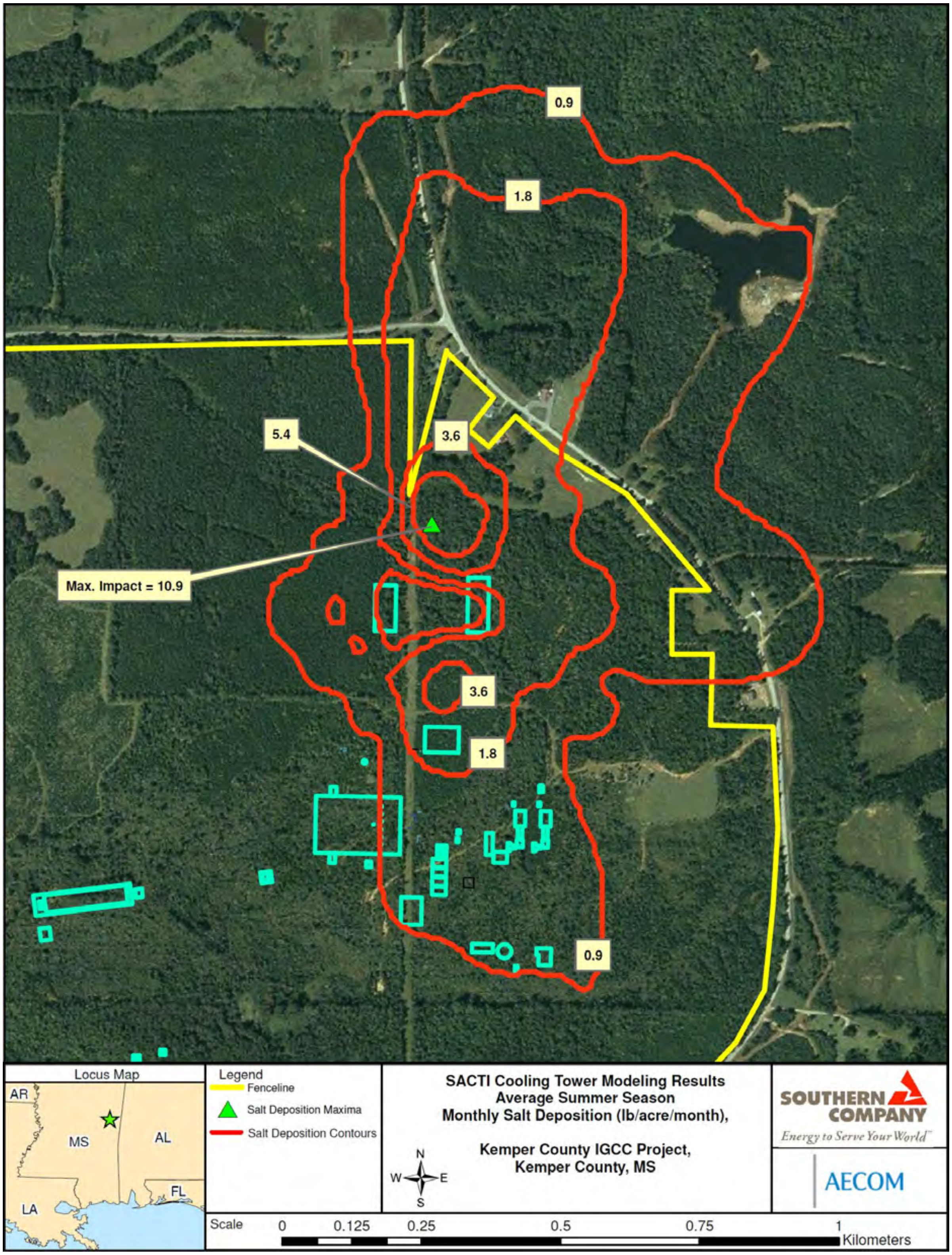


Figure 5: Salt Deposition - Fall

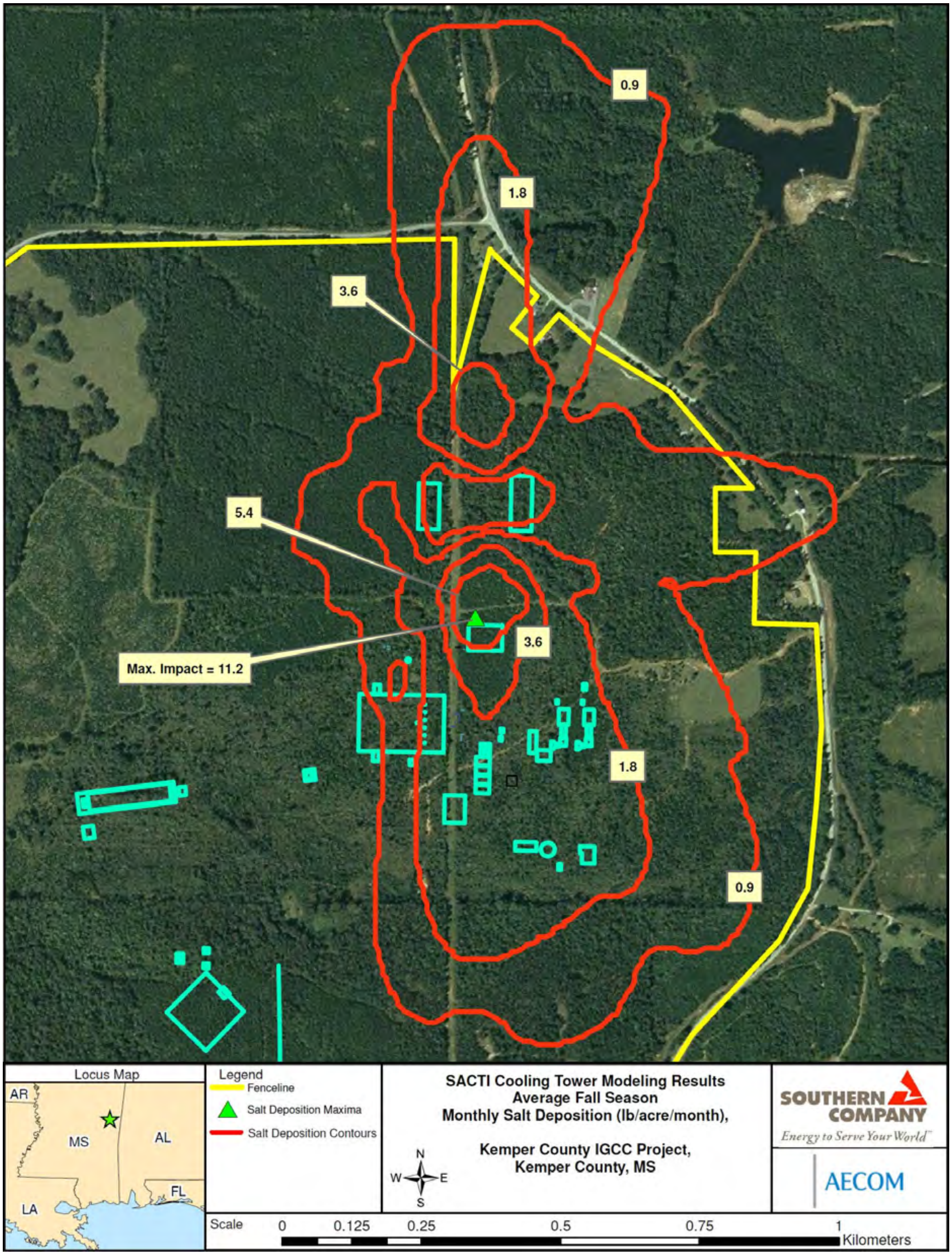


Figure 6: Salt Deposition – April (Worst-case Month)

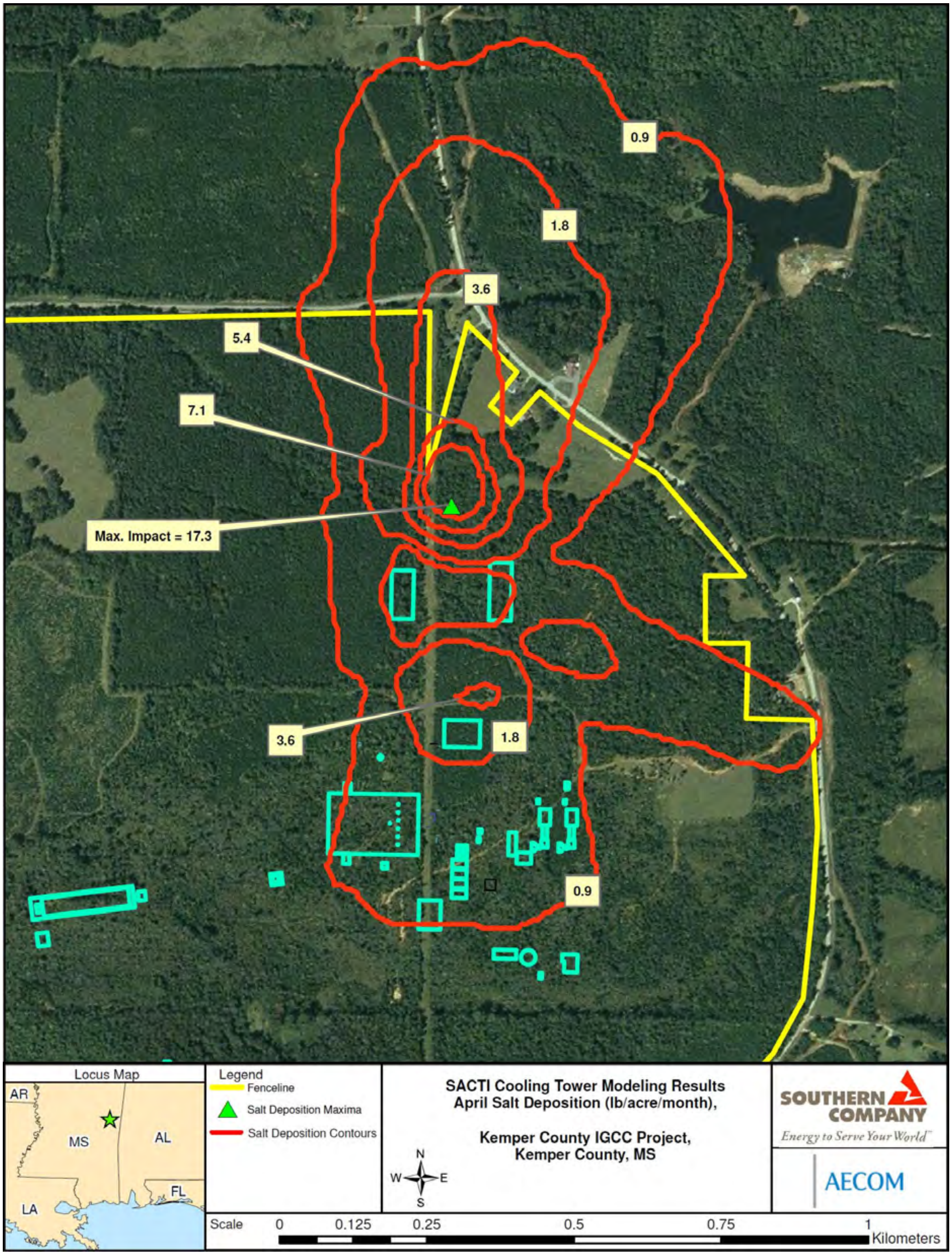
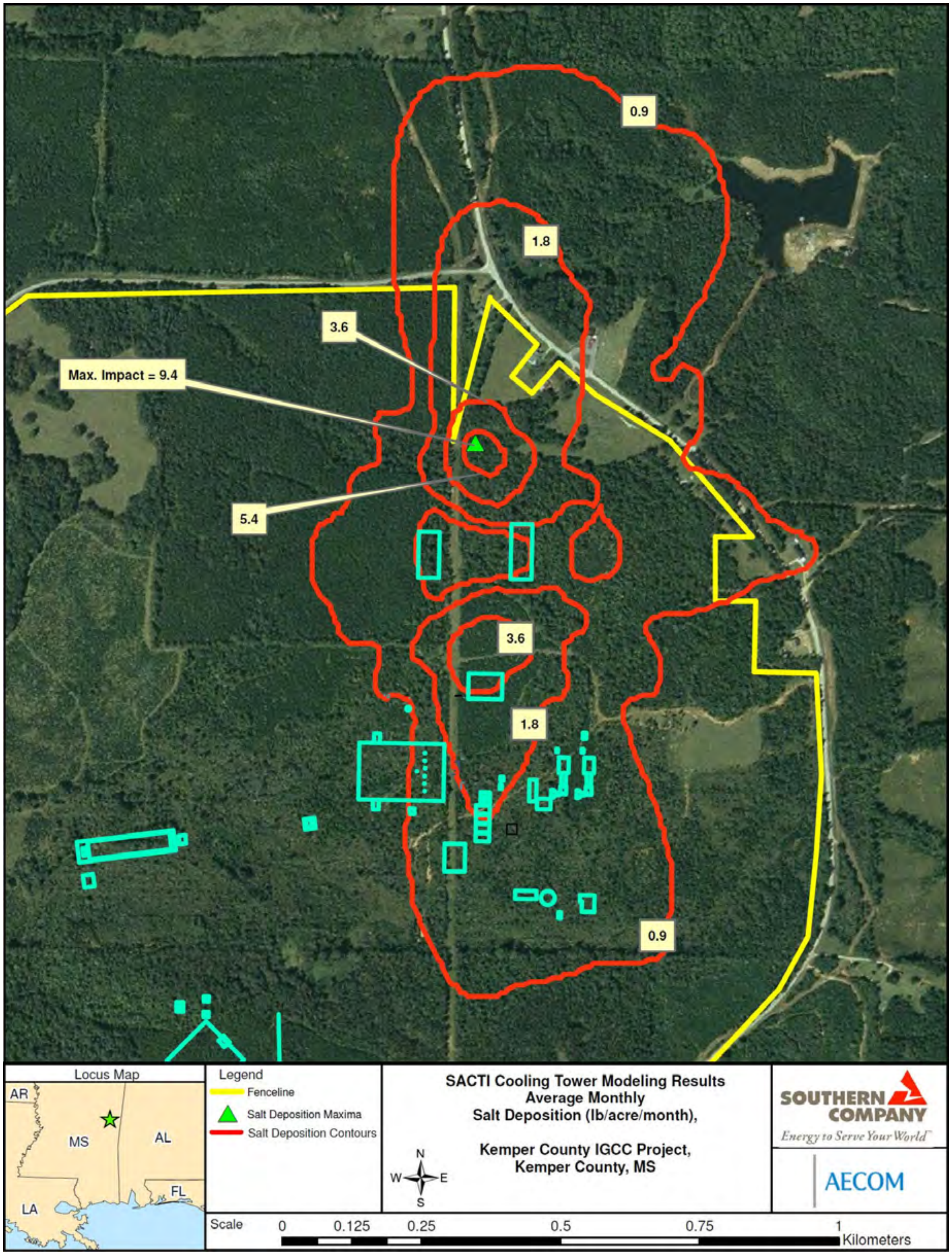


Figure 7: Salt Deposition – Annual (Average All Seasons)



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