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Salinity Inventory and Tolerance Screening in Utah Agriculture

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SALINITY INVENTORY AND TOLERANCE SCREENING IN UTAH AGRICULTURE

by

Austin Hawks

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in

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ABSTRACT

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by

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Soil salinity, a yield-limiting condition, has plagued crop production for centuries by reducing crop productivity. Research has introduced methods for successfully managing soil salinity. This research discusses the adaptation of established management methods to create new soil salinity management techniques.

One adapted technique is an automated crop screening apparatus. A new design was created and successfully used in rapidly screening two strawberry cultivars to determine their tolerance to salinity. Screening crops and determining their tolerance to yield-limiting conditions are essential in managing soil salinity.

Another salinity management tool used in this research was electromagnetic induction (EMI). EMI was used to complete a basin-scale inventory over an 18,000 ha study area in Cache County, Utah. The data obtained during the inventory were used to create EMI calibration models and a basin-scale map showing the spatial distribution of apparent soil electrical conductivity (EC_a).

These new methods for crop tolerance screenings and basin-scale salinity inventories will assist in successfully managing soil salinity and decrease its effect on the global food supply.

(75 Pages)

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Austin Hawks

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CHAPTER 1

INTRODUCTION

Agriculturists have used irrigation for 2,500 years (13). Harnessing water has turned some of the warmest, fertile, and arid climates into major agriculture commodity contributors. Irrigation is profitable and a vital agriculture practice (18). However, a negative byproduct of irrigation is the total amount of soluble salts in the soil, or soil salinity (4).

Crops use irrigation water and return pure water to the atmosphere through transpiration and evaporation. Salts from the water are left behind, further increasing the salinization of soil (3). Salts may also be present in a soil profile due to the parent material from which the soil derived, the degree to which the soil weathers, or from amendments added to the soil (7).

As salinity levels increase, the osmotic potential decreases, shifts the permanent wilting point, and decreases plant-available water. Salinity greatly impacts agriculture by increasing crop injury, affecting plant growth, decreasing productivity, and limiting yield (1, 8, 9). At higher levels, salts can induce plant toxicity (18). Salinity can make fertile lands barren and can often lead to loss of habitat and reduction of biodiversity (5).

Over the years salinity issues have been partially overcome by reclaiming crop land, and breeding, and selecting salt-tolerant crops (18). The reclamation of salinized soils has been used for decades where salts are moved through the soil profile through irrigation (12, 14). Crop breeding allows the superior genes in a salt-tolerant crop to be passed on to a less tolerant crop. Crop selection involves choosing a particular crop variety that will produce a respectable yield under saline conditions, compared to its varietal counterparts. Crop selection has been utilized in agriculture for decades in efforts to maintain crop yield and agriculture sustainability in salinized soils (10).

Electrical conductivity (EC), the ability of a soil to conduct an electrical current, is one of the most valuable measurements in agriculture sustainability (3, 11, 16). A common EC measurement is the electrical conductivity of a soil paste (EC_e). EC_e is traditionally obtained in the lab from a dry soil sample saturated with distilled water and made into a paste. The water added to the soil dissolves salts located within the aggregate pores of the soil and brings the salts into solution. The solution is extracted from the paste and EC is measured (15, 17).

Another reliable EC measurement frequently used in field characterization is apparent soil electrical conductivity (EC_a), also known as bulk soil electrical conductivity or the depth-weighted average of a soil's conductivity (2, 3, 6). A popular non-invasive method for obtaining EC_a is determined by aboveground measurements from an electromagnetic induction (EMI) device (19).

Utah is no exception to the salinity problems present around the globe. There is ample evidence of saline soil and water conditions in the state, however, there is not sufficient understanding of the distribution, extent, or severity of the salt-affected soils and water resources within the state. Additionally, new standards need to be developed for selecting salt tolerant crops and landscape plants in Utah's semi-arid, gypsiferous, and calcareous soil and water conditions.

Chapter 2 discusses the development and validation of an automated system designed for crop tolerance screenings and the comparison of two strawberry cultivars in response to their salinity tolerance. Chapter 3 is a paper that discusses the use of EMI in a basin-scale inventory and assessment of the distribution of EC_a in the Bear River Watershed, Cache County, Utah.

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CHAPTER 2

COMPARING STRAWBERRY SALT-TOLLERENCE USING A LOW VOLUME NEAR-COUNTINUOUS GRADIENT DOSING SYSTEM [z]

Abstract

Strawberries (*Fragaria* × *ananassa* Duch.) are a high value crop well suited to local small-acreage production for direct sales. However, low tolerance to alkaline and saline conditions often limits where they can be grown. A rapid method for tolerance screening would be useful for identifying cultivars suited to the marginal soil conditions found in many arid and semi-arid regions. Tolerance testing historically required a tedious and time-consuming delivery process that limited the number of genotypes and replications that could be reasonably screened. A double emitter source (DES), or double drip line system, was adapted to automatically deliver 15 treatment levels, providing a near-continuous gradient dosing system. The system was then tested on the strawberry cultivars 'Allstar' and 'Ovation'. Differences in salinity tolerance were apparent in both leaf injury and plant mortality, indicating that the system provides a simple and quick method for tolerance testing.

Introduction

The success of a crop variety is largely due to its ability to adapt to diverse site-specific growing conditions (6). Drought, salinity, nutrient deficiencies, and toxicities are some conditions that are becoming more prevalent in agricultural soils (7). Tolerance experiments have long been used to determine crop varieties and cultivars that produce

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[z] Hawks, Cardon, and Black. 2009. J. Amer. Pomol. Society 63:136-141.

high yields under unfavorable conditions, a crucial factor in maintaining global food supply.

Early tolerance experiments were tedious and time-consuming, limiting the number of replications and treatments that could be included (2). Aragues et al. (1) reviewed many different delivery systems used in tolerance experiments. Though every system was structurally different, the authors classified the systems into three delivery types. First are drip irrigation systems where the treatment is injected directly into one irrigation line, and where delivery is controlled by emitters with the same delivery rate. These systems involve a mixing manifold and have become known as drip injection irrigation systems (DIS). The second mixes treatment and non-treatment solutions in the air using sprinklers in a double or triple line source. The third are drip irrigation systems that contain two separate irrigation lines and sets of emitters containing either a treatment or non-treatment. This type of system is known as a double emitter source (DES) or double drip line system (1). The DES system is a flexible and relatively cost effective screening tool due to its feasibility, adaptability, and precise delivery capability (2, 4). A DES system was adapted to provide a near-continuous gradient dosing system (NCGDS) to maximize the number of treatment levels and minimize labor.

The objectives of this study were two-fold: 1. To test the effectiveness and flexibility of the NCGDS treatment delivery system; 2.To use the NCGDS system to selectively screen two strawberry (*Fragaria* × *ananassa* Duch.) cultivars for their tolerance of saline, calcareous soil conditions in the semi-arid western U.S.

Methods

A drip irrigation system was assembled in a greenhouse with two supply laterals. Nutrient solution was added to the main supply line using a commercial injector (Dosatron Model-DI16; Dosatron, Clearwater, Fla.). This main supply line was then split, with one line going through a pressure regulator and then into the nutrient solution delivery lateral. The second line went through a second injector pump (Chemalizer Model-CP33; Chemilizer Products, Largo, Fla.) which added calcium chloride solution before passing through a pressure regulator and then continuing into the treatment supply line. The result was two parallel supply lines, one containing nutrient solution, the other nutrient solution + calcium chloride, with both lines regulated to 1.4 bar. A diagram of the dosing system is shown in Fig. 2.1.

The greenhouse was divided into sixteen blocks in a 3.8 m x 5.6 m space and the nutrient delivery lateral and treatment delivery lateral were piped to each block. To control the low volume irrigation cycles, a misting/propagation controller (Superior Controls, Valencia, Calif.) was used to actuate solenoid valves, irrigating each block for the desired interval (30 seconds in this study).

To control the nutrient and treatment dosages, drip emitters of various design flow rates were used (Rain Bird Xeri-Bug emitters and pressure-compensating modules; Rain Bird Corp., Tucson, Ariz.). The emitters were coupled together to provide each location with the same volume of total solution but varying amounts of treatment solution. The total output of all coupled emitters was designed to equal 53 L/h, or approximately 0.44 L per 30 sec irrigation cycle. A total of 15 treatment levels were made possible by combining emitters of the various flow rates. Treatment levels were randomized within each block. Emitter combinations and the resulting tested flow rates and electrical conductivity of the leachate (EC_e) are shown in Table 2.1. Calcium chloride solution was used for salinity treatments in this experiment to mimic soil chemical conditions that are present in highly calcareous soils (3).

Bare-root dormant strawberry plants of 'Allstar' and 'Ovation' were obtained from a commercial nursery (Nourse Farms, South Deerfield, Mass.) and established in 1.71 L plastic pots containing a soilless potting medium (equal parts peat:vermiculite). Plants were grown for 17 wk, and were fertigated using nutrient solution alone. Pre-initiated flowers were removed upon emergence. Plants were then assigned to one of 15 treatments and 8 replications, in a randomized complete block design. The combination of emitters from the nutrient and the treatment lines was placed in the pots and the system was run for 15 wks, covering the bulk of the vegetative growthstage. To minimize compounding factors in growth and carbon partitioning, blossoms and runners were removed from each plant on a weekly basis. At the end of 15 wk, 5 treatment levels were selected for destructive harvest (treatments 1, 4, 7, 10, and 13) for which average leachate EC_e ranged from 1.51 to 6.35 dS/m (Table 2.1).

To normalize genetic differences in growth habit, injury index ratios were created by dividing the number of injured leaves by the total number of leaves produced, and the injured leaf mass by total leaf mass.

Results and discussion

There was a significant increase ($P < 0.0001$) in the ratio of the number of injured to non-injured leaves for both cultivars at every treatment level (Fig. 2.2). The two cultivars did not differ significantly ($P = 0.7434$) in their leaf count injury ratios at most levels. Plants at treatment level 13 (leachate EC_e = 6.35 dS/m) exhibited a drastic decrease in total leaf count for both cultivars (comparing the average total leaf counts for level 13 against the average leaf counts for all other levels, 'Allstar' had a 45% reduction and 'Ovation' had a 49% reduction in total leaf counts). The visual evidence of the decreased leaf count can be seen in Fig. 2.3. At this treatment level, many 'Ovation' plants had died before the destructive harvest was performed.

Though we made every attempt to normalize differences between cultivars, an important visual observation was that 'Allstar' had larger leaves and much more leaf area compared to 'Ovation'. Though this was partially due to varietal differences, it was prevalent and considered worth noting. In performing the leaf counts at harvest, it was also noted that the new leaves of 'Ovation' were not fully developed whereas 'Allstar' consistently had fully developed tri-foliate leaves.

The injured to non-injured leaf mass index was found to be significantly different (P = 0.0092) between the two cultivars. 'Ovation' had a much higher injured to non-injured leaf mass index than 'Allstar' (Fig. 2.4). It was noted that an increase in salinity treatment resulted in a decrease in mean leaf weight for both cultivars. Some of the dead or injured leaf material may be from natural senescence. It was assumed, however, that the rate of natural senescence was equivalent in the cultivars. At the higher ECs, a substantial difference in leaf mass was seen between the two cultivars. The small, undeveloped leaves produced by 'Ovation' at the higher salinity levels did not likely benefit plant growth.

Though the majority of the treatment levels were above the published yield reduction threshold for strawberry (5), treatment level 10 (leachate EC_e = 5.51 dS/m) appeared to be a critical level for leaf injury in both cultivars in that it appeared to be near the threshold for plant growth. Beyond this salinity level, plant biomass and leaf count severely dropped due to an increase in plant death, which suggests that an EC_e of 5.51 dS/m is the 100% death limit for strawberry.

The destructive harvest was only performed for 5 of the 15 treatment levels, due to observable salinity effects along the near-continuous gradient. The analysis confirmed the abovenoted observations by providing a strong statistically reliable result (Fig. 2.2 and 2.4). Using a smaller number of treatment levels speeds up data analysis and collection, allowing rapid assessment of crops. However, the large number of treatment levels is ideal to visually assess the effects of the treatment.

Summary

A near-continuous gradient, low-volume dosing system (NCGDS) was successfully created. The NCGDS is not limited solely to salinity experiments and can be used to perform an assortment of tolerance experiments where low volume applications and a range of treatment levels are desired. All of the parts for this system are easily accessible, relatively easy to install and can be adapted by the user to meet different needs.

The NCGDS system was used to screen two strawberry cultivars for salinity tolerance. In both cultivars, an increase in salinity treatments caused a decrease in leaf count and leaf mass. A significant difference was found in the ratio of injured to total leaf mass between the two cultivars. 'Ovation' produced a greater mass of injured leaves, which suggests that 'Allstar' would be more tolerant than 'Ovation' in Utah's calcareous, saline environments.

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Table 2.1. Treatment levels and drip emitter combinations to provide nutrient and treatment solutions.

Treatment level	Emitter combinations [y]		Actual flow rate-treatment (L/h)	Leachate EC_e (dS/m)
	Nutrient L/h	Treatment L/h	Mean ± SE	Mean ± SE
1	45.4 , 7.6	0	0.00 ± 0.00	1.51 ± 0.05
2	45.4 , 3.8	3.8	3.50 ± 0.05	2.12 ± 0.11
3	45.4	7.6	7.00 ± 0.05	2.52 ± 0.12
4	37.9 , 3.8	7.6 , 3.8	10.50 ± 0.05	2.86 ± 0.13
5	37.9	7.6 , 7.6	14.30 ± 0.25	3.62 ± 0.18
6	26.5 , 7.6	18.9	19.00 ± 0.05	3.56 ± 0.17
7	26.5 , 3.8	18.9 , 3.8	23.10 ± 0.28	4.05 ± 0.23
8	26.5	26.5	24.40 ± 0.05	4.04 ± 0.18
9	18.9 , 3.8	26.5 , 3.8	27.50 ± 0.10	5.12 ± 0.24
10	18.9	26.5 , 7.6	32.00 ± 0.05	5.51 ± 0.25
11	7.6 , 7.6	37.9	35.40 ± 0.09	5.3 ± 0.18
12	7.6 , 3.8	37.9 , 3.8	41.40 ± 0.09	6.24 ± 0.18
13	7.6	45.4	42.30 ± 0.21	6.35 ± 0.17
14	3.8	45.4 , 3.8	49.70 ± 0.33	7.17 ± 0.18
15	0	45.4 , 7.6	51.80 ± 0.38	7.69 ± 0.20

[y] Emitters of noted manufacturer-specified flow rates were paired to achieve desired flow rates. Pairs are separated by a comma.

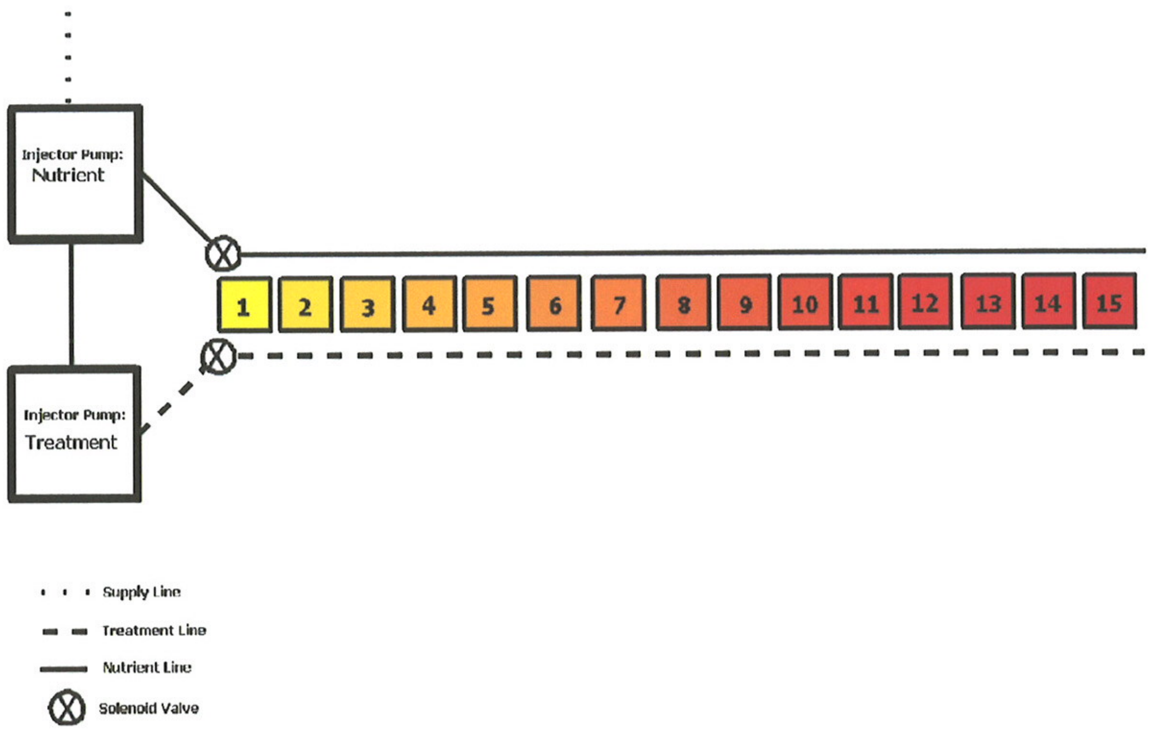

Fig. 2.1. Plumbing schematic for the near-continuous gradient dosing system. All 15 levels of treatment recevied the same amount of nutrients but varying amounts of treatment.

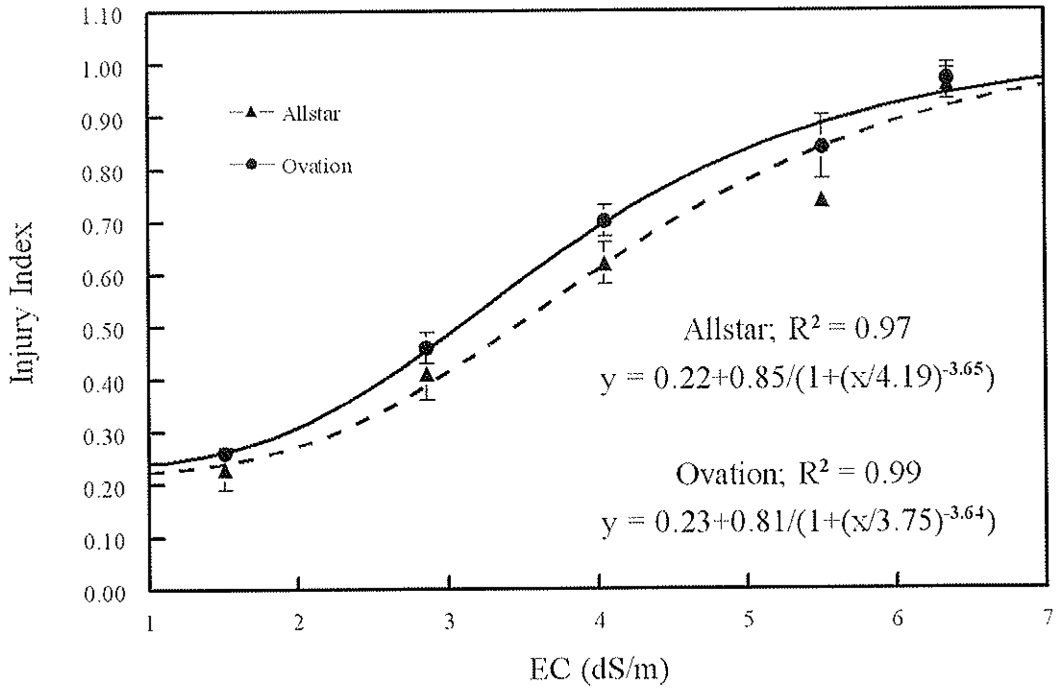

Fig. 2.2. Leaf count injury index comparison for two strawberry cultivars growing under saline conditions.

Fig. 2.3. Comparative photos of selected individual blocks at the time of destructive harvest. 'Ovation'(top) and 'Allstar' (bottom) at treatment level 1, 8, and 15 (left to right).

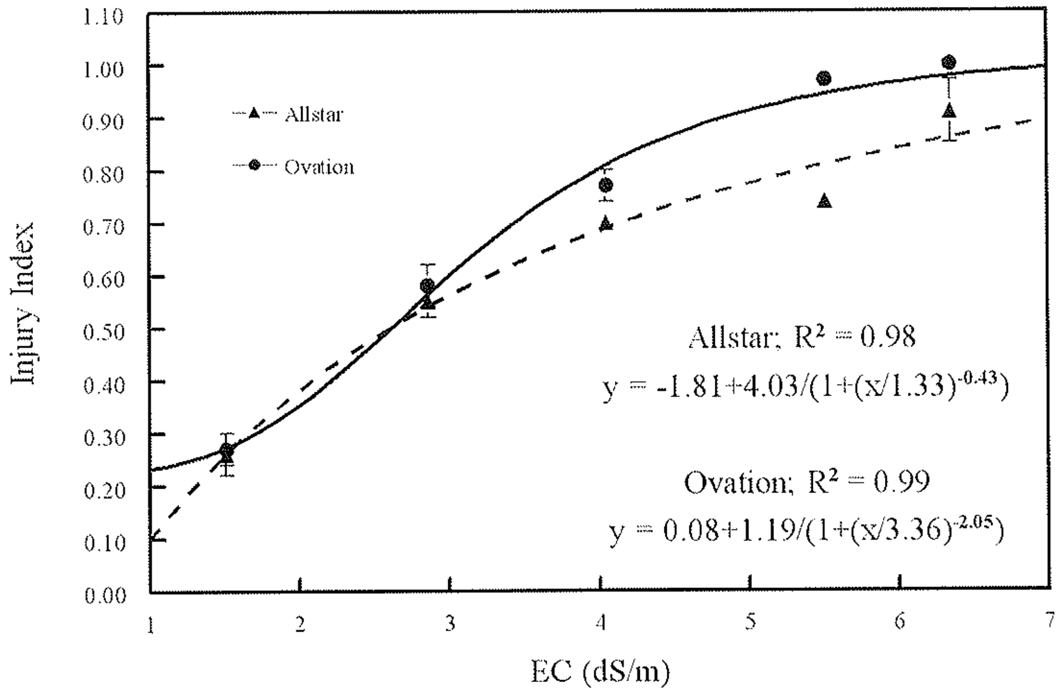

Fig. 2.4. Leaf mass injury index comparison for two strawberry cultivars growing under saline conditions.

CHAPTER 3

MAPPING THE EXTENT AND SEVERITY OF SOIL SALINITY IN THE BEAR RIVER BASIN, UTAH

Abstract

Electromagnetic induction (EMI) has been a valuable tool in categorizing soil properties at field-scale levels. Using EMI in basin-scale studies and inventories is essential for managing soil conditions that affect the global food supply. A regional-scale EMI survey was performed in the Bear River Basin in Utah using the Geonics EM-38 DD in the traditional hand-carrying method and with an automated apparent electrical conductivity (EC_a) measurement apparatus. Utilizing the data acquired from the inventory, calibration models were created to predict EC_a, and a prediction map was created to display the spatial distribution of EC_a at the basin-scale. Basin-scale EMI calibration models and predictive maps can aid in regional management and monitoring of soil salinity and other soil properties.

Introduction

For years researchers have attributed the threat the global food supply is under due to the growing population (8, 21). To overcome the demand, models have been created for crop production under varying irrigation techniques, nutrient concentration, salinity, and other yield limiting conditions in order to predict crop yields and manage productivity (2, 15, 16, 20, 25). A popular tool researchers have used in observing and assessing limiting soil conditions for modeling and monitoring the effects of various crop management methods, is electromagnetic induction (EMI).

The EMI method is a direct measure of the apparent electrical conductivity (EC_a) of the soil, also known as the depth-weighted average of soil conductivity or bulk soil conductivity (7, 18). The depth of measurement depends on the type of EMI probe used. To obtain the EC_a of a soil, a primary magnetic field is transmited from the probe using multiple induction coils. Each coil induces current through the soil which, in turn, generates a secondary magnetic field proportional to the electrical conductivity of the medium (24). The strength of the secondary magnetic field is measured and converted to EC_a (8). Measuring EC_a is possible due to the ability of an electrical current to pass through soil along three pathways: a liquid solution phase pathway, a solid–liquid phase pathway, and a solid pathway (28).

The EC_a measurement is influenced by several soil properties (5). As a result, researchers have been able to calibrate EMI readings to many soil properties including nutrient concentration, soil mineralogy, water content, and salinity (3, 4, 11, 23, 33, 34). Desirable features of EMI include the following: it is non-invasive, it offers instantaneous readings, it provides rapid assessments of soil properties within a soil profile, and it is less labor intensive than traditional soil inventory methods. Consequently, EMI is an extremely valuable tool in investigative soil inventories (19).

Much of the current EMI research has dealt primarily with field-scale calibrations and inventories (14, 22, 35). As site-specific studies have greatly aided the progression and understanding of EMI methods, many researchers have identified a great need to use EMI for basin-scale inventories (27, 37). Basin-scale EMI inventories could provide an understanding of the distribution of soil properties influencing EC_a. An understanding of this distribution could aid, for instance, in tracking the effects of drought on salinity. An

EMI generated map of soil properties is one tool researchers can use to provide spatial input used to predict long-term plant growth, the agriculture-related economics for a basin, or identify locations that may need intense physical surveying. Utilizing this tool in field and basin-scale research will better identify methods of managing environmental conditions for meeting global demands on the food supply (13).

This paper focuses on the process of developing a baseline regional EMI inventory for Cache County, Utah and utilizing the data collected from the inventory to create a basin-scale map displaying the spatial distribution of EC_a.

Study area

The EMI inventory was performed in Cache County, Utah located approximately 130 km north of Salt Lake City, Utah (Fig. 3.1). Cache County is a large producer of agricultural commodities including: dairy products and livestock, winter and spring wheat, dry beans, feed corn, and alfalfa hay (17). Agricultural fields in the north-western half of the county that receive irrigation water primarily from the Bear River, Cub River, an associated alluvial aquifer or canal, were designated as the study area, totaling approximately 18,000 ha.

The Bear River headwaters are located in the Uinta Mountains, Utah. The river meanders through Wyoming, Idaho, and then back into Utah where it terminates in the Great Salt Lake. The Cub River is a tributary to the Bear River and is fed by mountain streams in the Bear River Range in southwestern Idaho and northern Utah. Agricultural producers rely heavily on the Bear River for their irrigation needs (12).

Cache County's seasonal precipitation and average temperatures place it in a xeric moisture regime and mesic soil temperature regime, with the mean annual precipitation at

45 cm with a mean annual temperature of about 10° C (26). The sampled locations were primarily lacustrine deposits formed during the Lake Bonneville period, or on more recent alluvium overlying these lacustrine deposits (32). All sites sampled were either in current production or in a fallow cycle and were irrigated by flood or sprinkler.

Methods

Field inventories

With the help of the Cache County Extension agent, producers dispersed through the study area were contacted about potential survey sites. A visit was made to each producer and survey sites were determined. The EMI inventory began in the fall of 2007 and ended in the summer of 2009 and the majority of the fields were measured in the summer of 2008. During this survey period 35 fields totaling 500 ha were surveyed. Within those 35 fields, 74 points were selected from which physical soil samples were obtained for calibration model development.

The EMI probe used in this study was the Geonics EM-38 DD (Geonics Inc. Mississauga, Ontario). The EMI probe was coupled with a Trimble AG GPS 114 (Trimble Navigation Limited, Sunnyvale, Calif.) and an Allegro DOS (Juniper Systems Inc., Logan, Utah) field computer to simultaneously log GPS points with remotely sensed EC_a points. The EM-38 DD is capable of measuring electrical conductivity to a depth of 1.5 m in the vertical orientation (EM_V) and 0.75 m in the horizontal orientation (EM_H). The EMI probe is fully portable and has an LCD screen to instantaneously view EC_a readings (1) (Fig. 3.2). The EM-38 DD is constructed with two EMI devices installed perpendicular to one another which has the advantage of reading the horizontally (EM_H) and vertically (EM_V) positioned coils simultaneously (31).

Rather than hand-carry the probe through every field, a mobile EC_a measurement apparatus was created to transport the EM-38 DD and GPS antenna with an all-terrain vehicle (ATV) (Fig. 3.3). The mobile EC_a measurement apparatus was constructed from 0.2 m PVC pipe and wood runners to create a sled. The meter was housed within the PVC pipe and supported 0.15 m above the ground by the sled. Similar to the cart designed by Freeland et al. (14) the GPS receiver was attached directly to the sled to consistently ensure accurate geo-referenced positions in conjunction with the EMI readings. The tongue of the sled was made from 5 cm PVC pipe and allowed the sled to be towed 3.6 m behind an ATV. The long tongue eliminated instrument interference while operating the ATV and was more than twice the distance suggested by Geonics (6). The tongue was attached using a PVC tee fitting which allowed the sled to ride along the contours of the field and also allowed the tongue to be removable for easy transport. Similar to other mobile EC_a measurement apparatuses, no metal was used in construction in order to prevent interference and adverse affects on the performance of the EM-38 DD (9, 14, 34).

Upon entering a new inventory site, descriptive metadata were recorded including: how the inventory was performed (manual or mobile), crop present in the field, irrigation type, field size, field topography, and any unique characteristics of the field (powerlines, canals, and pivot tower locations). Field moisture content was obtained by removing five soil samples each at the surface (MCS) and to a depth of 0.3 m (MC1) and placed into sampling tins. The cans were weighed, dried in an oven for 24 hours at 105°C, and then re-weighed to determine the average moisture content of the field at the two depths.

The EM-38 DD was adjusted using the protocols established by Geonics at the beginning of each survey to ensure normalization of instrument measurements from field to field (24). To assist in the adjustment methods and ensure proper instrument height during initial adjustment, a wooden pedestal was fabricated and used at every survey location (28).

Each field was then surveyed by hand, or with the owner's permission, by an ATV equipped with the sled. The entire field was surveyed along 30 m transects to evaluate the degree of variation in EC_a of the field. Soil samples were taken in all fields and used as calibration points to determine soil properties which may influence EC_a measurements. Calibration point frequency was determined by monitoring the display on the Allegro and observing the variation in EC_a during an inventory. If little variation was seen in EC_a measurements during the inventory, two calibration points, representing the EC_a average and a high EC_a value, were selected. However, if large variation was seen in EC_a measurements during the survey, three to five calibration points were selected and extracted from the field. The average value was used to give an average representation of the fields EC_a. The high value was used to determine the soil property that most influenced the high EC_a reading.

A reduced number of points were sought in this study due to the study area size and time constrains in sampling. Recently, the approach in site-specific inventories has been to inventory a field with EMI and use statistical programs to determine calibration sampling point locations and frequency. This method involves returning to the field after an inventory has been completed to obtain the calibration samples (9, 10). Though this gives an optimal balanced distribution of sample points in site specific inventories, this is not a practical approach for basin-scale EMI assessments due to the time-dependent conditions of soil moisture content, temperature, as well as access to survey sites (27).

At each calibration point, a soil sample was extracted every 0.3 m with a bucket auger (Surface, 0.3 m, 0.6 m, 0.9 m, 1.2 m, and 1.5 m). At each depth, the temperature of the soil was recorded and the sample was placed in a re-sealable plastic bag, and soil samples were air dried in a greenhouse. After drying, large soil aggregates were broken apart with a soil grinder and sifted using a 2.00 mm sieve to prepare the samples for laboratory analysis.

Saturated pastes were prepared for each sample, and saturation percentage (SP) and EC were determined for all calibration samples using the Hach soil, irrigation water (SIW) kit (Hach Co., Loveland, Colo.). The Hach SIW kit utilizes the "Bureau of Soils" cup method which is an accurate test for determining EC_e, and ideal when sample size is large (28, 30). This method involves filling a cup of known geometry and volume, having electrodes on opposing ends, with a previously prepared saturated soil paste. The electrodes are connected to a conductivity meter and the electrical conductivity of the soil paste (EC_p) is read (29). The EC_p value, temperature, and weight of the filled sample cup were entered into Hach's SIW software program, and EC_{eSIW} and SP were calculated for the sample. A recent paper by Wittler et al. (37) found a very strong linear relationship of EC_{eSIW} to the electrical conductivity of the saturated paste extract (EC_e). Because EC_e is the universal measure of EC for most crop and soil studies, the Wittler et al. (37) equation was used on all of the EC_{eSIW} results to convert them to EC_e.

Model development

The depth-weighted equations (EQ.1 and EQ. 2) established by Rhoades et al. provide the theoretical depth-distribution of the influence of soil properties on the surface measurement of EC_a. The overall EC_a value is a measurement of all soil factors that influence EC_a on homogeneous ground. At the specified depths, the EC_a is weighted based upon a given depths contribution to the overall EC_a as determined from the EM-38 DD in either the horizontal (EQ. 1) or vertical (EQ. 2) position at the soil surface (28).

$$EM_H = 0.43EC_{a,\,0\text{-}0.3} + 0.21EC_{a,\,0.3\text{-}0.6} + 0.1EC_{a,\,0.6\text{-}0.9} + 0.06EC_{a,\,0.9\text{-}1.2} + 0.20EC_{a,\,>1.2} \quad \text{[EQ. 1]}$$

$$EM_V = 0.17EC_{a,\,0\text{-}0.3} + 0.21EC_{a,\,0.3\text{-}0.6} + 0.14EC_{a,\,0.6\text{-}0.9} + 0.10EC_{a,\,0.9\text{-}1.2} + 0.38EC_{a,\,>1.2} \quad \text{[EQ. 2]}$$

Thirty fields were randomly selected from all sampled fields and used in creating the calibration models and predictive EC_a map (Table B.1). The respective weightings were applied to the EC_e, SP, MCS, and MC1 for each calibration sample based on the depth the sample was extracted from to account for their contribution to the known EC_a. Datasets were created for the five specified individual depths as well as for all depths, by combining the depth-weighted EC_e and SP measurements from each calibration site.

In the depth-weighted equations (EQ. 1 and EQ. 2), soil at a depth greater than 1.2 m contributes 20% and 38% of the EC_a measured in the horizontal and vertical position, respectively. To account for the large influence that soil at these greater depths has on EC_a, the EC_e and SP values were averaged for the 1.2 m and 1.5 m calibration samples.

Multiple regression was then performed with SAS, a statistical software program, (Version 9.3; SAS Institute Inc., Cary, N. C.) using the Proc Reg function, to estimate

EM_V using the observed EM_H values, MCS, MC1, EC_e and SP. Data were analyzed for normality, homoscedasticity, and collinearity between the variables.

Calibration models were created for each of the five specified depths, characterizing the soil properties influencing EC_a at a specified depth, and a full model of all measured depths, giving an overview of the soil properties influencing EC_a throughout the entire soil profile. The calibration models were used to predict EM_V values for the validation calibration points.

Model validation

The five remaining fields from the main inventory data set were used as the validation dataset in authenticating the accuracy of the calibration models (Table B.2). Datasets and data were created and analyzed identically using the procedures outlined in the model development.

Field-scale map development

Field-scale EM_V distribution maps were created in ArcMAP (Version 9.2; ESRI, Redlands, Calif.) using all recorded EMI points from the field inventories (Table C.1). Individual points and world imagery were used to create shape file perimeter boundaries of the individual fields. The points were interpolated and then clipped to the field boundaries. Field-scale surface EM_V maps were given to the producers, along with a summary of their individual field results in appreciation for their cooperation and to assist them in developing their own soil management practices.

Basin-scale map development

An EM_V basin-scale map was created using the accumulated EM_V data, to give a predictive regional visual overview of EM_V in the study area. To create the dataset for the map, the average EM_V of all EMI points obtained during the inventory was calculated individually for each of the 30 fields used in developing the calibration models (Fig. 3.4 and Table B.1).

The calculated field average EM_V value was geo-referenced to the appropriate field by assigning the average value to an arbitrary center point in the field. All other EMI points were removed from the field leaving one point to represent the average EM_V for the entire field. Attaching a geographic location to the field average does not imply that it represents the actual EM_V at that specific point in the field, but is the average of all EM_V points in the field. The averages were only used in creating the basin-scale map.

The EM_V field averages were statistically interpolated in ArcMap (Version 9.2; ESRI, Redlands, Calif.), clipped to a perimeter shape file of the study area, and overlaid on a digital elevation map of the northern portion of Cache County, Utah (Fig. 3.7).

Basin-scale map validation

To determine the precision of the predictive map, data from the five validation fields were used (Fig. 3.4 and Table B.2). The same methods were used on the validation fields that were used in producing the predictive map. The points were layered over the predictive map and the relation of validation points to the interpolated values of the predictive points was determined using the "Extract Values to Points" function in ArcMAP (Version 9.2; ESRI, Redlands, Calif.).

Results and discussion

Model development

Upon running the initial regression statistics for the full model of all measured depths, the variables, MCS and MC1 were found to be non-significant and were rejected in developing the model. The variables EM_H, EC_e, and SP resulted in a model with a significantly high F-test (381.08), with a good R^2 value (0.95), a root mean squared error (RMSE) of 9.54, and a low Mallows' Cp (Cp) value (4.0). The data met all tests for normality and homoscedasticity. Collinearity was not found between any variables in the full model.

The full model:

$$EM_V = -3.25 + 1.22_{EM_H} + 3.74_{EC_e} + 0.27_{SP} \quad [EQ. 3]$$

Moisture contents (MCS and MC1) were intuitively included as variables in the analysis due to the strong influence of moisture content on EC_a as noted in previous EMI inventories but they were not found to be significant in our basin-scale calibration model for all measured depths (4, 5). Soil moisture content may not be as influential in basin-scale EMI calibrations. Possible reasons for this may include high variability in: 1) the moisture content in fields over a basin, 2) soil textures and water holding capacity, and 3) irrigation practices and methods resulting in wildly variable soil moisture conditions over the basin (27).

The individual depth calibration models all resulted in an excellent prediction of EM_V at their respective depths and details of their statistical significance can be found in Table 3.1. Where moisture content was non-significant in the full model, both MCS and MC1 were found to be significant at their respective depths (EQ. 4 and EQ. 5). At the 0.6

m depth it was found that if SP was included in the model it resulted in a F-test of 337.03, a R^2 of 0.95, and a RMSE of 10.09. When SP was removed from the regression it mirrored a similar R^2 (0.95), RMSE (10.02), and a higher F-test (513.57). The influence SP has on EC_a is directly correlated to a soil's texture, which is associated with the water holding capacity and nutrient retention of a soil, and consequently SP was included in the 0.6 m model (EQ. 9) (4, 11, 23).

The significance of SP at the 0.6 m depth is likely due to a consistent change in texture that was imposed on the study area during Lake Bonneville deposition cycles. This suggests that the spatial correlation and accuracy of basin-scale calibrations may be limited to the average geophysical conditions that are present in a basin or specific study area, and thus requiring regionally specific calibration of the EMI method.

The variable EM_H was rejected from the >1.2m model due to its collinearity with EC_e. Soil properties at this depth do not sufficiently affect the EM_H measurement and consequently EM_H was excluded in this model (Eq. 8) (1). The >1.2m model resulted in the lowest, but still significant, F-test (75.91) and R^2 (0.72), along with the largest RMSE (22.96). In comparing these results to the other calibration models, it suggests that EM_H is an important variable in obtaining highly significant basin-scale calibration models.

The surface model:

$$EM_V = 3.70 + 1.48_{EM_H} + -9.18_{EC_e} + 341.39_{MCS} \quad \text{[EQ. 4]}$$

The 0.3 m model:

$$EM_V = 2.85 + 1.42_{EM_H} + 3.13_{EC_e} + 213.18_{MC1} \quad \text{[EQ. 5]}$$

The 0.6 m model:

$$EM_V = 5.89 + 1.41_{EM_H} + 9.00_{EC_e} + 0.21_{SP} \quad \text{[EQ. 6]}$$

The 0.9 m model:

$EM_V = 2.14 + 1.28_{EMH} + 31.75_{ECe} + 1.11_{ECe}$ [EQ. 7]

The >1.2 m model:

$EM_V = 6.85 + 34.50_{ECe} + 1.17_{SP}$ [EQ. 8]

Model validation

To evaluate each calibration model the RMSE and Willmott's d-index were calculated for the validation dataset (36). Willmott's d-index is intended to be a descriptive measure of agreement between observed and predicted values in a model.

$$d = 1 - \left[\frac{\sum_{i=1}^{N}(P_i - O_i)^2}{\sum_{i=1}^{N}\left[|P_i'| + |O_i'|\right]^2}\right]$$ [EQ. 9]

where P and O are the predicted and the observed values, respectively, and $(P_i' = P_i - O_m)$, $(O_i' = O_i - O_m)$, and O_m is the mean observed value.

The index (d) results in a value between 1.0 (perfect agreement) and 0.0 (total disagreement). The predicted EM_V values were plotted against the observed EM_V values for the full model (Fig. 3.5) and the individual depth models (Fig. 3.6). All models resulted in a Willmot's d-index close to 1.0 (Table 3.1). The smallest d-index, though still significant, was seen in the >1.2m model (0.83). This adds to the suggestion that EM_H is a significant variable in basin-scale inventories and calibrations.

Basin-scale map

An EM_V map was made for the study area (Fig. 3.7), which indicated that the southern end of the study area had higher average EM_V readings and the northern portion of the study area had lower average EM_V readings. An isolated pocket of high EM_V

appeared in the middle of an eastern portion of the study area. Upon further investigation it was found that a field near that location produced one of the highest average EM_V readings (76.24), compared to the mean EM_V value (48.42) of all fields used in the prediction map. It could be expected that this higher reading had an influence on the statistical interpolation of the map, but is also likely to be a regionally significant soil condition specific to the study area.

Basin-scale map validation

The validation map point values were plotted against the extracted predicted values from the map for each depth. Willmott's d-index was again used in determining the significance of the relationship between the predicted and observed values. The map resulted in a d-index close to 1.0 (Table 3.2), indicating the predictive map is a good representation of EM_V distribution of the study area. This predictive map indicates that EMI is capable of providing a confident prediction of EC_a distribution at the basin-scale. This map can now serve as a valuable tool by being used as baseline data to track spatial and temporal changes in water supply, water quality, water allocation, or irrigation changes. It can also be overlaid with crop distribution maps to determine quantifiable impacts of soil conditions on productivity, economics, and soil salinity management at the basin-scale.

Summary

A baseline inventory of EMI was completed in Cache County, Utah. In performing the inventory, successful EMI calibrations were produced for basin-scale EM_V assessments in Cache County at all measured depths (full model) and at the individual depths. The baseline inventory gives a general overview of soil properties, including EC_e, present in Cache County. More basin-scale inventories need to be performed within the state of Utah and throughout the world to have greater understanding of the distribution of soil properties that could affect crop yield and economics.

From the inventory a basin-scale map displaying the distribution of EM_V in Cache County, Utah was created. The map resulted in a good visual representation of the distribution of EM_V. This study shows that EMI calibrations and distribution maps can be created on a regional scale and have respectable accuracy. The development of basin-scale maps and EMI calibrations are key in predicting and measuring the long-term effects of environmental conditions on soil properties.

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Table 3.1. Descriptive statistics for the EMI calibration models.

Depth	Model				Validation	
	F-test	R^2	RMSE	Cp	d-index	RMSE
Full	381.08	0.95	9.54	4.0	0.99	3.53
Surface	324.61	0.94	10.3	4.0	0.99	4.35
0.3	314.12	0.94	10.46	4.0	0.99	4.83
0.6	513.57	0.95	10.02	3.0	0.99	4.19
0.9	387.63	0.95	9.47	4.0	0.99	3.31
>1.2	75.91	0.72	22.96	3.0	0.83	6.56

Table 3.2. Descriptive statistics for the EMI prediction map.

Observation	Mean	SE	d-index	RMSE
predicted	44.04	10.53	0.94	9.80
observed	48.42	7.31	—	—

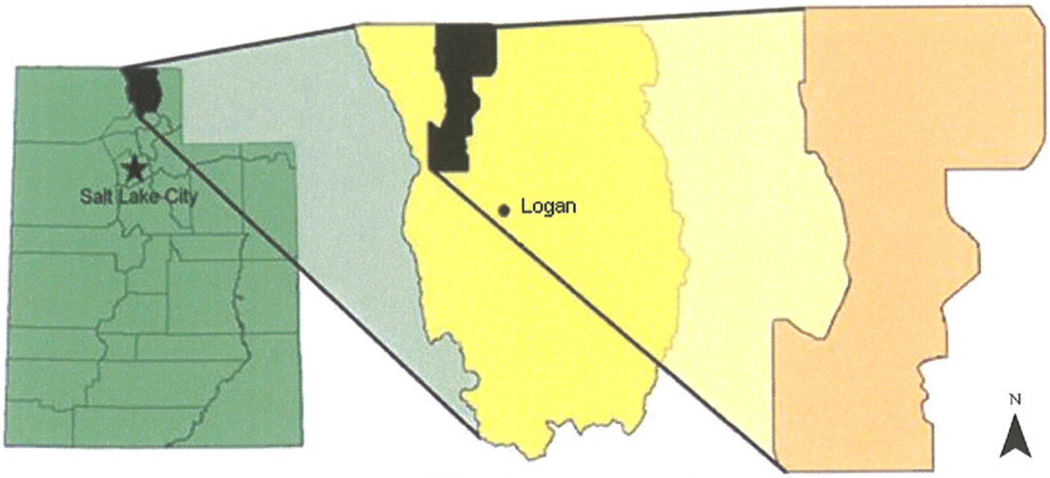

Fig. 3.1. The study area for the salinity inventory was located in the northwestern portion of Cache County, Utah.

Fig. 3.2. The EM-38 DD prepared for a manual survey.

Fig. 3.3. The mobile EC_a measurement apparatus with the EM-38 DD prepared for a survey.

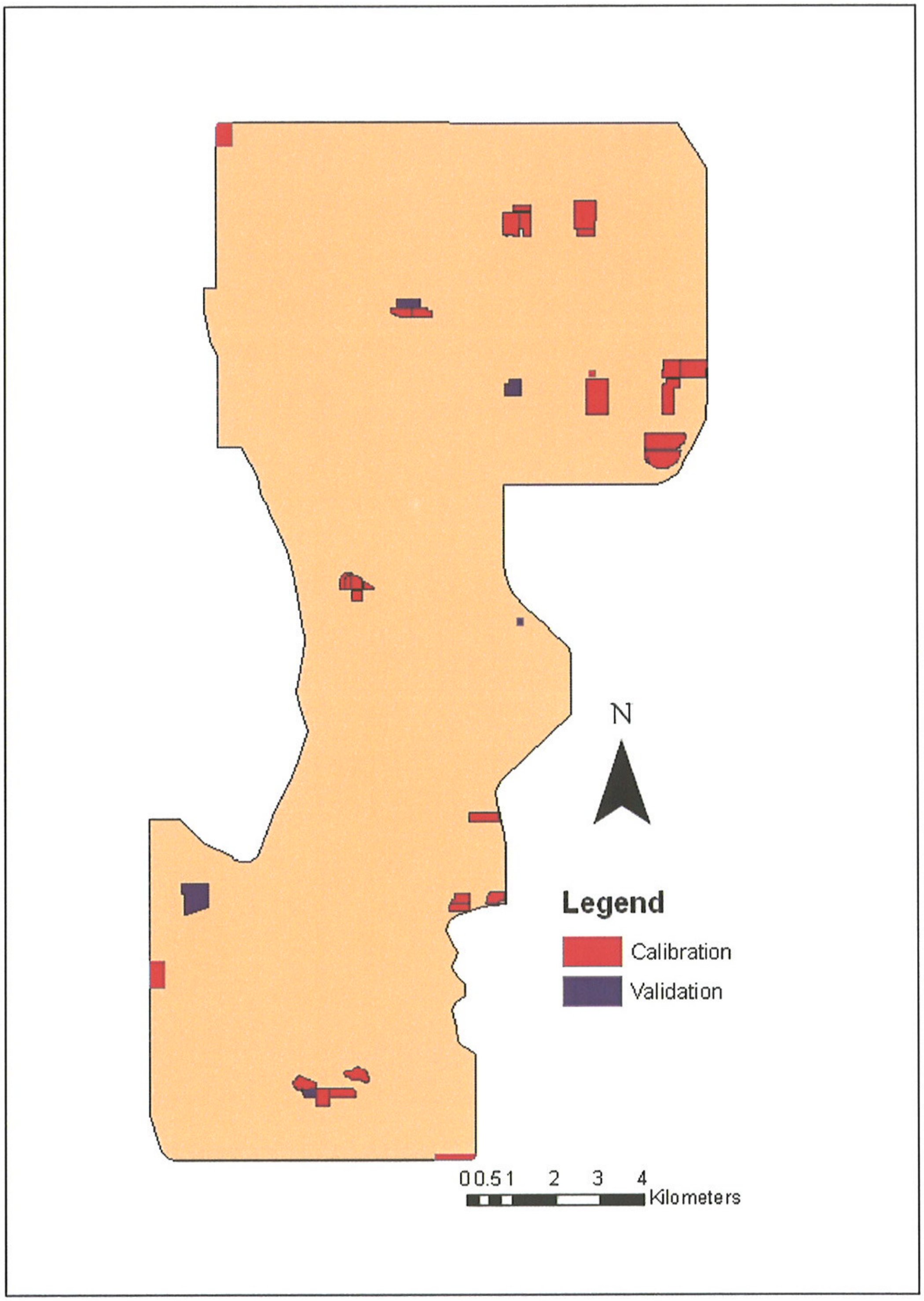

Fig. 3.4. Calibration and validation sample sites in the study area.

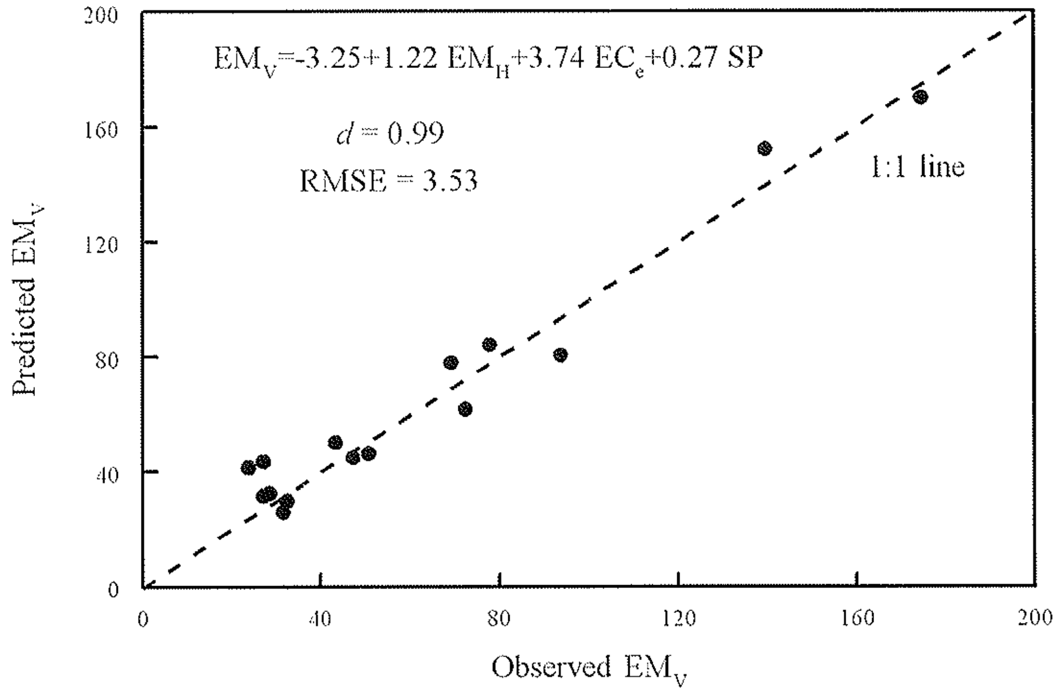

Fig. 3.5. Predicted and observed values of EM_V for the full model.

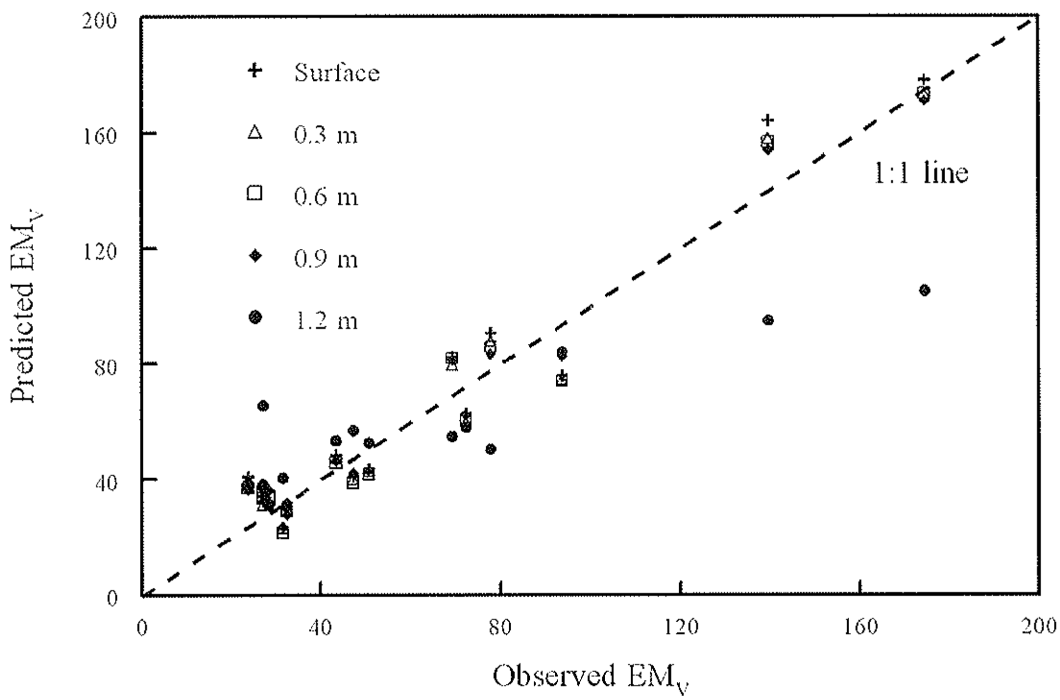

Fig. 3.6. Predicted and observed values of EM_V for the individual depth models.

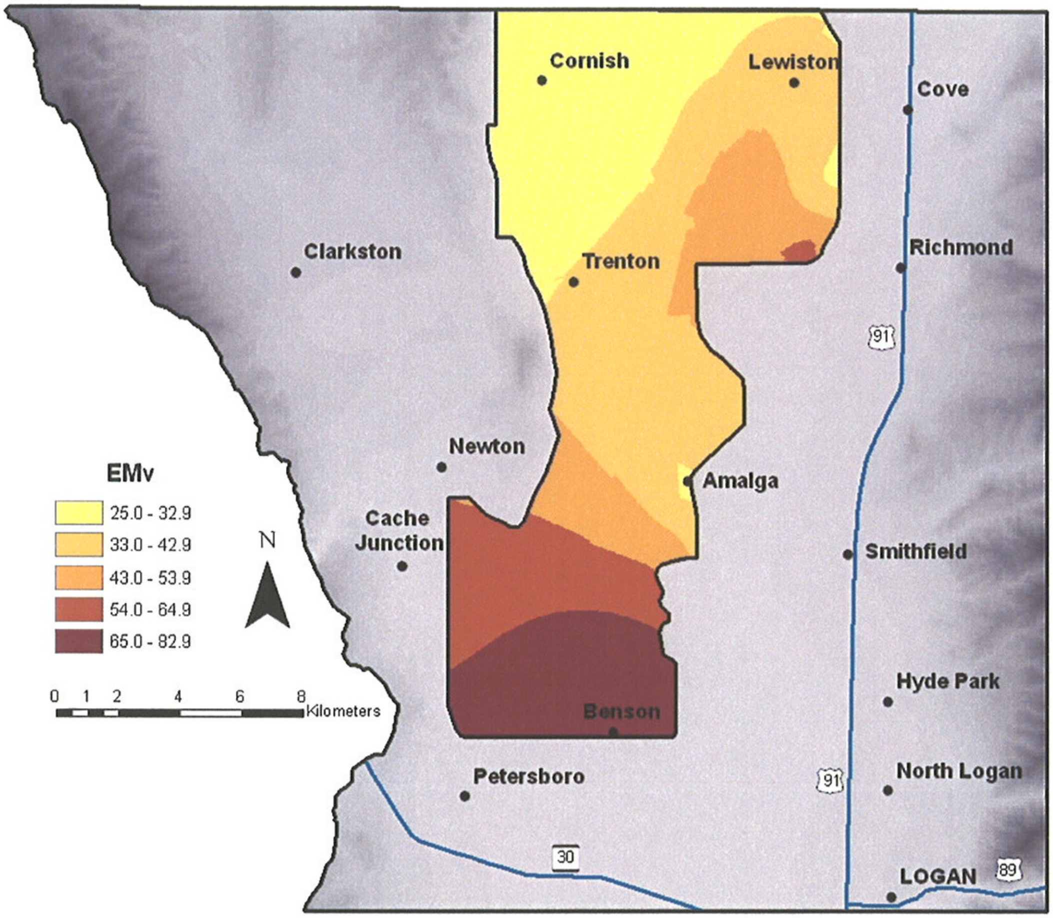

Fig. 3.7. Spatial distribution of EM_v in the study area.

CHAPTER 4

CONCLUSIONS AND SUMMARY

The use of automated systems in crop selection clearly has advantages compared to traditional methods in providing an increased number of replications, requiring less time and allowing for rapid turnaround time for crop selection of countless varieties and cultivars. An automated system (NCDGS) was created for a near-continuous gradient of treatments and low volume dosing applications.

The NCGDS system was used in screening two strawberry cultivars for salinity tolerance. It was found that Allstar would be more tolerant than Ovation in Utah's calcareous, saline environments based on the ratio of injured to total leaf mass between the two cultivars.

In addition, a regional inventory of EC_a was completed and EM_V calibration models were developed for Cache County, Utah. The models were tested and found to be a good fit for predicting EM_V at the basin-scale. A regional map was produced from the data obtained during the inventory to visually represent the distribution of EM_V through the study area. The inventory and map can aid in tracking the effects of drought, on soil water quality, predicting the effect of long term drought on salt-impacted water use, plant growth, water balance, and the economics of the study area.

These papers discuss new advancements and methods for managing, measuring, and monitoring salinity in Utah agriculture. The data obtained through the baseline basin-scale inventory and the creation of new standards for screening salt-tolerant crops are vital tools that can be utilized for managing salt-affected soils.

APPENDICES

Appendix A.

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November 16, 2009

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To Permissions Editor:

I am preparing my thesis in the Department of Plants, Soils, and Climate at Utah State University. I hope to complete me degree in the Fall of 2009. An article, Comparing Strawberry Salt Tolerance Using A Low Volume Near-Continuous Gradient Dosing System, of which I am first author, and which appeared in your journal 63(4):136-141 2009, reports an essential part of my thesis research. I would like permission to reprint it as a chapter in my thesis. (Reprinting the chapter may necessitate some revision.) Please note that USU sends theses to Bell & Howell Dissertation Services to be made available for reproduction.

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Date 16 Nov. 2009

Appendix B.

Prediction map, EM_v validation and calibration data

TABLE B.1. Prediction map data set of field average EM_v values.

		UTM	
Field	Avg. EM_V	Northing	Easting
CJA1	60.77	4630456.8160	417797.7760
JCA1	27.54	4650073.3832	419359.7718
JWA2	42.39	4627964.1668	421672.4161
JWA3	88.31	4628231.4481	421289.8442
JWG1	56.58	4628049.2317	422113.4129
JWP1	105.71	4628456.7796	422469.6449
KJA1	91.61	4626499.8610	425037.5687
MSA2	25.22	4645721.7884	423920.6045
MSA3	23.75	4645731.0203	423513.9805
MSA4	50.21	4639299.2024	422482.6644
MSA5	33.09	4639508.2293	422713.1671
MSG1	30.52	4639605.2035	422452.3030
MSG2	36.37	4639627.1176	422134.7676
MSG3	36.15	4639609.7062	422263.9011
PLA1	76.24	4644333.6048	427812.8261
RWA1	38.77	4643782.2997	427982.5621
RWA2	32.46	4647772.7656	425981.7497
RWC1	67.65	4642376.1246	429444.6671
RWG1	52.71	4647528.9820	427728.9108
RWG2	35.28	4647977.3666	427702.4185
RWG4	22.29	4644436.1540	430410.1774
RWG5	24.97	4644426.0016	429626.3995
RWG6	42.64	4647791.2219	426309.5439
RWG7	17.07	4648090.5416	426265.8258
RWG8	60.33	4642783.2742	429490.7382
RWP1	30.10	4643820.8180	429557.3698
SMA1	21.79	4634286.8305	425378.5262
SMG1	69.12	4632473.4466	424844.5655
SMG2	45.83	4632254.0988	424814.1996
SMG3	28.28	4632463.9581	425605.0352

TABLE B.2. Prediction map, validation data set of field average EM_v values.

Field	Avg. EM_V	UTM Northing	UTM Easting
JL70	51.99	4632484.2599	418796.2382
JWA1	79.45	4628037.5700	421391.9900
LFC1	27.45	4638756.0246	426128.9446
MSA1	18.78	4645945.1083	423623.3428
RWG3	45.52	4644010.2787	426042.9254

Appendix C.

Calibration samples, complete data

Table C.1. Calibration sample complete data, including field measurement and laboratory analysis. [x]

A	B	C	D	E	F	G	H	I	J	K	L	M
7/29/09	CJA1	0	1	59.5	0.85	0.10	—	20.0	39.63	19.63	4630653.4600	418013.6500
7/29/09	CJA1	1	1	48.6	0.97	—	0.15	20.3	39.63	19.63	4630653.4600	418013.6500
7/29/09	CJA1	2	1	44.9	1.37	—	—	17.3	39.63	19.63	4630653.4600	418013.6500
7/29/09	CJA1	3	1	49.4	0.97	—	—	15.4	39.63	19.63	4630653.4600	418013.6500
7/29/09	CJA1	4	1	79.4	2.52	—	—	14.2	39.63	19.63	4630653.4600	418013.6500
7/29/09	CJA1	5	1	22.8	1.15	—	—	13.9	39.63	19.63	4630653.4600	418013.6500
7/29/09	CJA1	0	2	52.3	1.14	0.10	—	21.7	100.88	63.13	4630943.3710	417823.9640
7/29/09	CJA1	1	2	52.7	0.81	—	0.15	22.0	100.88	63.13	4630943.3710	417823.9640
7/29/09	CJA1	2	2	78.8	3.91	—	—	20.0	100.88	63.13	4630943.3710	417823.9640
7/29/09	CJA1	3	2	76.4	3.07	—	—	18.0	100.88	63.13	4630943.3710	417823.9640
7/29/09	CJA1	4	2	85.1	3.39	—	—	16.2	100.88	63.13	4630943.3710	417823.9640
7/29/09	CJA1	5	2	74.2	4.26	—	—	15.2	100.88	63.13	4630943.3710	417823.9640
7/29/09	CJA1	0	3	63.0	0.61	0.10	—	20.3	62.25	34.50	4630847.9440	417956.3570
7/29/09	CJA1	1	3	46.4	1.24	—	0.15	20.3	62.25	34.50	4630847.9440	417956.3570
7/29/09	CJA1	2	3	47.8	1.68	—	—	19.1	62.25	34.50	4630847.9440	417956.3570
7/29/09	CJA1	3	3	48.6	1.10	—	—	18.2	62.25	34.50	4630847.9440	417956.3570
7/29/09	CJA1	4	3	45.9	1.08	—	—	16.5	62.25	34.50	4630847.9440	417956.3570
7/29/09	CJA1	5	3	48.1	0.99	—	—	14.8	62.25	34.50	4630847.9440	417956.3570
7/30/09	JCA1	0	1	40.7	0.47	0.11	—	27.3	37.50	17.50	4649820.8382	419569.1313
7/30/09	JCA1	1	1	27.8	0.84	—	0.15	19.3	37.50	17.50	4649820.8382	419569.1313
7/30/09	JCA1	2	1	29.6	0.67	—	—	18.4	37.50	17.50	4649820.8382	419569.1313
7/30/09	JCA1	3	1	29.5	1.50	—	—	16.9	37.50	17.50	4649820.8382	419569.1313

[x] Abbreviations for columns are as follows: (A) Survey date, (B) Field, (C) Sample depth, (D) Sample number, (E) Saturation percentage, (F) EC_{esiw}, (G) Water content surface, (H) Water content 0.3m, (I) Sample temperature °C, (J) Vertical EC_a, (K) Horizontal EC_a, (L) UTM northing, and (M) UTM easting

A	B	C	D	E	F	G	H	I	J	K	L	M
7/30/09	JCA1	4	1	31.1	0.41	—	—	16.3	37.50	17.50	4649820.8382	419569.1313
7/30/09	JCA1	5	1	27.0	0.72	—	—	14.6	37.50	17.50	4649820.8382	419569.1313
7/30/09	JCA1	0	2	57.0	0.63	0.11	—	23.7	40.13	23.88	4649666.7878	419555.0941
7/30/09	JCA1	1	2	46.6	0.72	—	0.15	19.9	40.13	23.88	4649666.7878	419555.0941
7/30/09	JCA1	2	2	42.7	0.62	—	—	17.6	40.13	23.88	4649666.7878	419555.0941
7/30/09	JCA1	3	2	47.0	0.45	—	—	17.7	40.13	23.88	4649666.7878	419555.0941
7/30/09	JCA1	4	2	26.5	0.81	—	—	16.6	40.13	23.88	4649666.7878	419555.0941
7/30/09	JCA1	5	2	27.0	0.72	—	—	15.9	40.13	23.88	4649666.7878	419555.0941
10/26/07	JL70	0	15	50.6	0.45	0.12	—	13.9	93.63	45.25	4632388.7641	419048.1808
10/26/07	JL70	1	15	65.3	0.50	—	0.14	13.3	93.63	45.25	4632388.7641	419048.1808
10/26/07	JL70	2	15	77.5	1.28	—	—	13.0	93.63	45.25	4632388.7641	419048.1808
10/26/07	JL70	3	15	86.6	3.53	—	—	13.0	93.63	45.25	4632388.7641	419048.1808
10/26/07	JL70	4	15	88.1	2.38	—	—	13.0	93.63	45.25	4632388.7641	419048.1808
10/26/07	JL70	0	16	55.3	0.38	0.12	—	13.9	47.13	21.38	4632248.4986	418834.6718
10/26/07	JL70	1	16	54.9	0.33	—	0.14	13.3	47.13	21.38	4632248.4986	418834.6718
10/26/07	JL70	2	16	62.8	0.34	—	—	13.0	47.13	21.38	4632248.4986	418834.6718
10/26/07	JL70	3	16	85.3	0.52	—	—	13.0	47.13	21.38	4632248.4986	418834.6718
10/26/07	JL70	4	16	85.4	0.46	—	—	13.0	47.13	21.38	4632248.4986	418834.6718
10/26/07	JL70	0	17	69.9	0.26	0.12	—	13.9	32.38	15.00	4632779.7586	418738.3110
10/26/07	JL70	1	17	47.2	0.31	—	0.14	13.3	32.38	15.00	4632779.7586	418738.3110
10/26/07	JL70	2	17	45.3	0.31	—	—	13.0	32.38	15.00	4632779.7586	418738.3110
10/26/07	JL70	3	17	40.5	0.24	—	—	13.0	32.38	15.00	4632779.7586	418738.3110
10/26/07	JL70	4	17	36.3	0.16	—	—	13.0	32.38	15.00	4632779.7586	418738.3110
10/26/07	JL70	0	18	57.6	0.45	0.12	—	13.9	50.63	23.25	4632464.8204	418645.0555
10/26/07	JL70	1	18	71.5	0.32	—	0.14	13.3	50.63	23.25	4632464.8204	418645.0555
10/26/07	JL70	2	18	64.2	0.54	—	—	13.0	50.63	23.25	4632464.8204	418645.0555
10/26/07	JL70	3	18	66.3	0.70	—	—	13.0	50.63	23.25	4632464.8204	418645.0555

A	B	C	D	E	F	G	H	I	J	K	L	M
10/26/07	JL70	4	18	63.5	0.86	—	—	13.0	50.63	23.25	4632464.8204	418645.0555
10/26/07	JL70	0	19	58.9	0.29	0.12	—	13.9	31.50	9.50	4632132.4160	418622.2053
10/26/07	JL70	1	19	55.6	0.37	—	0.14	13.3	31.50	9.50	4632132.4160	418622.2053
10/26/07	JL70	2	19	50.7	0.32	—	—	13.0	31.50	9.50	4632132.4160	418622.2053
10/26/07	JL70	3	19	63.7	0.23	—	—	13.0	31.50	9.50	4632132.4160	418622.2053
10/26/07	JL70	4	19	54.6	0.26	—	—	13.0	31.50	9.50	4632132.4160	418622.2053
10/26/07	JL70	0	20	54.4	0.39	0.12	—	13.9	77.63	54.75	4632575.3022	419006.4003
10/26/07	JL70	1	20	58.0	0.39	—	0.14	13.3	77.63	54.75	4632575.3022	419006.4003
10/26/07	JL70	2	20	67.4	0.31	—	—	13.0	77.63	54.75	4632575.3022	419006.4003
10/26/07	JL70	3	20	76.6	0.37	—	—	13.0	77.63	54.75	4632575.3022	419006.4003
10/26/07	JL70	4	20	70.0	0.48	—	—	13.0	77.63	54.75	4632575.3022	419006.4003
10/26/07	JL70	0	21	58.4	0.34	0.12	—	13.9	43.25	26.38	4632580.7515	418846.8125
10/26/07	JL70	1	21	58.1	0.31	—	0.14	13.3	43.25	26.38	4632580.7515	418846.8125
10/26/07	JL70	2	21	62.4	0.35	—	—	13.0	43.25	26.38	4632580.7515	418846.8125
10/26/07	JL70	3	21	74.3	0.30	—	—	13.0	43.25	26.38	4632580.7515	418846.8125
10/26/07	JL70	4	21	78.9	0.41	—	—	13.0	43.25	26.38	4632580.7515	418846.8125
10/26/07	JL70	0	22	59.6	0.37	0.12	—	13.9	27.13	18.75	4632695.1155	418531.4764
10/26/07	JL70	1	22	77.3	0.41	—	0.14	13.3	27.13	18.75	4632695.1155	418531.4764
10/26/07	JL70	2	22	70.4	0.77	—	—	13.0	27.13	18.75	4632695.1155	418531.4764
10/26/07	JL70	3	22	71.4	0.97	—	—	13.0	27.13	18.75	4632695.1155	418531.4764
10/26/07	JL70	4	22	69.2	1.63	—	—	13.0	27.13	18.75	4632695.1155	418531.4764
6/27/08	JWA1	0	1	43.3	0.20	0.13	—	33.5	23.75	20.88	4628116.0939	421481.1408
6/27/08	JWA1	1	1	42.1	0.38	—	0.13	23.1	23.75	20.88	4628116.0939	421481.1408
6/27/08	JWA1	2	1	35.1	0.17	—	—	20.6	23.75	20.88	4628116.0939	421481.1408
6/27/08	JWA1	3	1	37.9	0.63	—	—	22.8	23.75	20.88	4628116.0939	421481.1408
6/27/08	JWA1	4	1	37.6	0.49	—	—	15.6	23.75	20.88	4628116.0939	421481.1408
6/27/08	JWA1	5	1	37.2	0.87	—	—	14.0	23.75	20.88	4628116.0939	421481.1408

A	B	C	D	E	F	G	H	I	J	K	L	M
6/27/08	JWA1	0	2	51.8	0.37	0.13	—	27.9	139.63	103.88	4628092.9811	421248.7034
6/27/08	JWA1	1	2	60.1	1.11	—	0.13	20.9	139.63	103.88	4628092.9811	421248.7034
6/27/08	JWA1	2	2	53.2	1.96	—	—	20.5	139.63	103.88	4628092.9811	421248.7034
6/27/08	JWA1	3	2	76.0	2.78	—	—	17.5	139.63	103.88	4628092.9811	421248.7034
6/27/08	JWA1	4	2	96.7	2.24	—	—	21.6	139.63	103.88	4628092.9811	421248.7034
6/27/08	JWA1	5	2	90.3	3.77	—	—	17.1	139.63	103.88	4628092.9811	421248.7034
6/27/08	JWA1	0	3	44.5	0.41	0.13	—	34.5	69.00	49.00	4628038.0516	421446.7776
6/27/08	JWA1	1	3	42.8	1.34	—	0.13	22.1	69.00	49.00	4628038.0516	421446.7776
6/27/08	JWA1	2	3	43.3	4.00	—	—	19.0	69.00	49.00	4628038.0516	421446.7776
6/27/08	JWA1	3	3	53.8	2.84	—	—	16.9	69.00	49.00	4628038.0516	421446.7776
6/27/08	JWA1	4	3	71.7	2.08	—	—	17.1	69.00	49.00	4628038.0516	421446.7776
6/27/08	JWA1	5	3	44.5	0.33	—	—	14.3	69.00	49.00	4628038.0516	421446.7776
6/27/08	JWA1	0	4	48.6	0.76	0.13	—	34.6	174.63	113.75	4627983.0002	421306.5564
6/27/08	JWA1	1	4	53.1	3.27	—	0.13	25.8	174.63	113.75	4627983.0002	421306.5564
6/27/08	JWA1	2	4	65.7	3.86	—	—	22.1	174.63	113.75	4627983.0002	421306.5564
6/27/08	JWA1	3	4	105.5	3.11	—	—	18.4	174.63	113.75	4627983.0002	421306.5564
6/27/08	JWA1	4	4	97.6	3.48	—	—	18.9	174.63	113.75	4627983.0002	421306.5564
6/27/08	JWA1	5	4	117.9	3.09	—	—	13.9	174.63	113.75	4627983.0002	421306.5564
6/27/08	JWA2	0	1	46.6	0.38	0.04	—	36.5	40.13	21.75	4627834.1585	421603.6736
6/27/08	JWA2	1	1	40.4	0.21	—	0.08	40.1	40.13	21.75	4627834.1585	421603.6736
6/27/08	JWA2	2	1	37.6	0.54	—	—	24.5	40.13	21.75	4627834.1585	421603.6736
6/27/08	JWA2	3	1	79.8	0.86	—	—	20.7	40.13	21.75	4627834.1585	421603.6736
6/27/08	JWA2	4	1	82.7	1.68	—	—	18.1	40.13	21.75	4627834.1585	421603.6736
6/27/08	JWA2	5	1	92.1	1.84	—	—	17.5	40.13	21.75	4627834.1585	421603.6736
6/27/08	JWA2	0	2	56.2	0.23	0.04	—	28.6	96.50	51.38	4627841.3035	421579.4483
6/27/08	JWA2	1	2	38.3	0.26	—	0.08	22.4	96.50	51.38	4627841.3035	421579.4483
6/27/08	JWA2	2	2	37.6	0.88	—	—	23.0	96.50	51.38	4627841.3035	421579.4483

A	B	C	D	E	F	G	H	I	J	K	L	M
6/27/08	JWA2	3	2	74.4	2.30	—	—	19.2	96.50	51.38	4627841.3035	421579.4483
6/27/08	JWA2	4	2	82.7	1.46	—	—	18.0	96.50	51.38	4627841.3035	421579.4483
6/27/08	JWA2	5	2	82.8	1.64	—	—	15.1	96.50	51.38	4627841.3035	421579.4483
6/27/08	JWA2	0	3	45.9	0.18	0.04	—	27.6	15.00	7.38	4628113.8361	421673.7394
6/27/08	JWA2	1	3	37.6	0.19	—	0.08	23.7	15.00	7.38	4628113.8361	421673.7394
6/27/08	JWA2	2	3	30.0	0.86	—	—	19.0	15.00	7.38	4628113.8361	421673.7394
6/27/08	JWA2	3	3	30.8	0.47	—	—	18.5	15.00	7.38	4628113.8361	421673.7394
6/27/08	JWA2	4	3	36.2	0.31	—	—	16.4	15.00	7.38	4628113.8361	421673.7394
6/27/08	JWA2	5	3	83.2	0.64	—	—	14.6	15.00	7.38	4628113.8361	421673.7394
6/27/08	JWA3	0	1	43.4	0.13	0.04	—	29.9	116.25	65.38	4628273.4970	421250.2512
6/27/08	JWA3	1	1	44.0	4.26	—	0.08	24.0	116.25	65.38	4628273.4970	421250.2512
6/27/08	JWA3	2	1	35.4	6.86	—	—	20.9	116.25	65.38	4628273.4970	421250.2512
6/27/08	JWA3	3	1	61.5	4.46	—	—	18.5	116.25	65.38	4628273.4970	421250.2512
6/27/08	JWA3	4	1	65.8	4.02	—	—	19.3	116.25	65.38	4628273.4970	421250.2512
6/27/08	JWA3	5	1	80.3	2.92	—	—	18.3	116.25	65.38	4628273.4970	421250.2512
6/27/08	JWA3	0	2	36.4	0.25	0.04	—	28.6	57.50	20.13	4628212.1905	421502.9591
6/27/08	JWA3	1	2	27.6	0.28	—	0.08	22.3	57.50	20.13	4628212.1905	421502.9591
6/27/08	JWA3	2	2	28.4	0.29	—	—	20.6	57.50	20.13	4628212.1905	421502.9591
6/27/08	JWA3	3	2	41.1	0.75	—	—	18.5	57.50	20.13	4628212.1905	421502.9591
6/27/08	JWA3	4	2	70.7	1.66	—	—	17.0	57.50	20.13	4628212.1905	421502.9591
6/27/08	JWA3	5	2	55.5	1.65	—	—	14.9	57.50	20.13	4628212.1905	421502.9591
6/27/08	JWA3	0	3	51.1	0.13	0.04	—	29.7	43.38	12.50	4628168.3189	421104.2986
6/27/08	JWA3	1	3	40.7	0.50	—	0.08	25.2	43.38	12.50	4628168.3189	421104.2986
6/27/08	JWA3	2	3	41.8	2.52	—	—	22.0	43.38	12.50	4628168.3189	421104.2986
6/27/08	JWA3	3	3	45.8	4.08	—	—	19.0	43.38	12.50	4628168.3189	421104.2986
6/27/08	JWA3	4	3	80.7	3.22	—	—	17.6	43.38	12.50	4628168.3189	421104.2986
6/27/08	JWA3	5	3	81.6	2.08	—	—	14.7	43.38	12.50	4628168.3189	421104.2986

A	B	C	D	E	F	G	H	I	J	K	L	M
10/28/08	JWG1	0	1	53.3	0.29	0.07	—	7.9	153.75	87.63	4627986.2067	421877.8128
10/28/08	JWG1	1	1	46.1	2.13	—	0.10	10.7	153.75	87.63	4627986.2067	421877.8128
10/28/08	JWG1	2	1	52.6	5.21	—	—	11.7	153.75	87.63	4627986.2067	421877.8128
10/28/08	JWG1	3	1	53.9	6.90	—	—	12.6	153.75	87.63	4627986.2067	421877.8128
10/28/08	JWG1	4	1	65.2	5.73	—	—	13.4	153.75	87.63	4627986.2067	421877.8128
10/28/08	JWG1	5	1	69.7	3.52	—	—	13.9	153.75	87.63	4627986.2067	421877.8128
10/28/08	JWG1	0	2	43.3	0.43	0.07	—	7.8	35.50	17.00	4628109.4699	422216.5527
10/28/08	JWG1	1	2	44.4	0.94	—	0.10	11.3	35.50	17.00	4628109.4699	422216.5527
10/28/08	JWG1	2	2	34.6	0.40	—	—	11.2	35.50	17.00	4628109.4699	422216.5527
10/28/08	JWG1	3	2	33.5	0.46	—	—	12.1	35.50	17.00	4628109.4699	422216.5527
10/28/08	JWG1	4	2	36.2	0.50	—	—	12.6	35.50	17.00	4628109.4699	422216.5527
10/28/08	JWG1	5	2	43.4	0.34	—	—	12.8	35.50	17.00	4628109.4699	422216.5527
10/28/08	JWP1	0	1	59.6	0.41	0.10	—	12.7	57.38	32.88	4628308.2095	422662.3617
10/28/08	JWP1	1	1	47.6	1.33	—	0.13	11.0	57.38	32.88	4628308.2095	422662.3617
10/28/08	JWP1	2	1	93.2	1.02	—	—	13.2	57.38	32.88	4628308.2095	422662.3617
10/28/08	JWP1	3	1	33.8	0.55	—	—	14.1	57.38	32.88	4628308.2095	422662.3617
10/28/08	JWP1	4	1	32.8	0.74	—	—	14.7	57.38	32.88	4628308.2095	422662.3617
10/28/08	JWP1	5	1	38.9	0.32	—	—	14.7	57.38	32.88	4628308.2095	422662.3617
10/28/08	JWP1	0	2	60.8	5.49	0.10	—	11.1	261.25	169.63	4628473.9934	422253.6042
10/28/08	JWP1	1	2	79.1	6.83	—	0.13	11.9	261.25	169.63	4628473.9934	422253.6042
10/28/08	JWP1	2	2	74.0	4.33	—	—	13.0	261.25	169.63	4628473.9934	422253.6042
10/28/08	JWP1	3	2	52.2	7.19	—	—	13.5	261.25	169.63	4628473.9934	422253.6042
10/28/08	JWP1	4	2	38.4	16.70	—	—	14.9	261.25	169.63	4628473.9934	422253.6042
10/28/08	JWP1	5	2	40.4	13.30	—	—	15.2	261.25	169.63	4628473.9934	422253.6042
8/12/09	KJA1	0	1	46.0	1.10	0.09	—	19.0	125.00	76.88	4626513.0591	424436.6814
8/12/09	KJA1	1	1	48.0	6.06	—	0.11	21.1	125.00	76.88	4626513.0591	424436.6814
8/12/09	KJA1	2	1	38.1	8.84	—	—	19.9	125.00	76.88	4626513.0591	424436.6814

A	B	C	D	E	F	G	H	I	J	K	L	M
8/12/09	KJA1	3	1	44.9	6.57	—	—	18.8	125.00	76.88	4626513.0591	424436.6814
8/12/09	KJA1	4	1	25.6	9.18	—	—	17.8	125.00	76.88	4626513.0591	424436.6814
8/12/09	KJA1	5	1	40.1	4.51	—	—	17.2	125.00	76.88	4626513.0591	424436.6814
8/12/09	KJA1	0	2	52.4	1.04	0.09	—	19.0	80.88	32.38	4626635.9300	424443.5960
8/12/09	KJA1	1	2	55.2	3.33	—	0.11	20.5	80.88	32.38	4626635.9300	424443.5960
8/12/09	KJA1	2	2	41.1	4.02	—	—	20.0	80.88	32.38	4626635.9300	424443.5960
8/12/09	KJA1	3	2	42.3	3.56	—	—	18.9	80.88	32.38	4626635.9300	424443.5960
8/12/09	KJA1	4	2	47.9	4.06	—	—	18.2	80.88	32.38	4626635.9300	424443.5960
8/12/09	KJA1	5	2	43.7	3.73	—	—	17.3	80.88	32.38	4626635.9300	424443.5960
8/12/09	LFC1	0	1	33.0	0.45	0.06	—	19.5	27.13	17.50	4638739.9744	426127.9954
8/12/09	LFC1	1	1	35.1	0.55	—	0.06	20.1	27.13	17.50	4638739.9744	426127.9954
8/12/09	LFC1	2	1	33.6	1.09	—	—	20.5	27.13	17.50	4638739.9744	426127.9954
8/12/09	LFC1	3	1	47.0	0.95	—	—	19.6	27.13	17.50	4638739.9744	426127.9954
8/12/09	LFC1	4	1	28.4	0.72	—	—	19.0	27.13	17.50	4638739.9744	426127.9954
8/12/09	LFC1	5	1	24.4	1.31	—	—	18.1	27.13	17.50	4638739.9744	426127.9954
7/25/08	MSA1	0	1	55.6	0.23	0.05	—	34.1	28.50	17.50	4645897.9382	423473.7301
7/25/08	MSA1	1	1	34.8	0.66	—	0.06	21.4	28.50	17.50	4645897.9382	423473.7301
7/25/08	MSA1	2	1	31.9	1.68	—	—	19.4	28.50	17.50	4645897.9382	423473.7301
7/25/08	MSA1	3	1	30.9	2.14	—	—	18.5	28.50	17.50	4645897.9382	423473.7301
7/25/08	MSA1	4	1	34.0	0.30	—	—	20.5	28.50	17.50	4645897.9382	423473.7301
7/25/08	MSA1	5	1	34.7	0.20	—	—	15.5	28.50	17.50	4645897.9382	423473.7301
7/25/08	MSA2	0	1	33.3	0.13	0.03	—	33.8	28.25	12.13	4645777.2103	423819.2203
7/25/08	MSA2	1	1	32.7	0.11	—	0.07	21.6	28.25	12.13	4645777.2103	423819.2203
7/25/08	MSA2	2	1	27.7	0.48	—	—	19.2	28.25	12.13	4645777.2103	423819.2203
7/25/08	MSA2	3	1	27.4	0.74	—	—	18.0	28.25	12.13	4645777.2103	423819.2203
7/25/08	MSA2	4	1	34.5	0.75	—	—	16.4	28.25	12.13	4645777.2103	423819.2203
7/25/08	MSA2	5	1	31.2	1.05	—	—	15.1	28.25	12.13	4645777.2103	423819.2203

A	B	C	D	E	F	G	H	I	J	K	L	M
7/25/08	MSA3	0	1	38.5	0.14	0.04	—	35.3	23.75	13.88	4645803.1715	423341.3777
7/25/08	MSA3	1	1	30.4	0.25	—	0.06	23.6	23.75	13.88	4645803.1715	423341.3777
7/25/08	MSA3	2	1	37.2	0.16	—	—	21.2	23.75	13.88	4645803.1715	423341.3777
7/25/08	MSA3	3	1	34.8	0.36	—	—	19.7	23.75	13.88	4645803.1715	423341.3777
7/25/08	MSA3	4	1	35.1	0.57	—	—	17.9	23.75	13.88	4645803.1715	423341.3777
7/25/08	MSA3	5	1	27.6	1.20	—	—	16.3	23.75	13.88	4645803.1715	423341.3777
7/25/08	MSA3	0	2	38.3	0.11	0.04	—	32.9	31.75	19.13	4645731.7464	423401.1259
7/25/08	MSA3	1	2	28.5	0.39	—	0.06	20.5	31.75	19.13	4645731.7464	423401.1259
7/25/08	MSA3	2	2	36.1	0.97	—	—	19.3	31.75	19.13	4645731.7464	423401.1259
7/25/08	MSA3	3	2	29.8	1.64	—	—	17.6	31.75	19.13	4645731.7464	423401.1259
7/25/08	MSA3	4	2	28.0	1.63	—	—	16.0	31.75	19.13	4645731.7464	423401.1259
7/25/08	MSA3	5	2	27.3	0.42	—	—	15.2	31.75	19.13	4645731.7464	423401.1259
7/26/08	MSA4	0	1	49.9	0.28	0.05	—	21.8	52.25	24.88	4639403.4012	422538.3132
7/26/08	MSA4	1	1	44.0	0.21	—	0.10	22.8	52.25	24.88	4639403.4012	422538.3132
7/26/08	MSA4	2	1	53.6	0.47	—	—	19.2	52.25	24.88	4639403.4012	422538.3132
7/26/08	MSA4	3	1	35.6	1.46	—	—	16.1	52.25	24.88	4639403.4012	422538.3132
7/26/08	MSA4	4	1	33.1	1.92	—	—	14.8	52.25	24.88	4639403.4012	422538.3132
7/26/08	MSA4	5	1	32.3	1.43	—	—	14.4	52.25	24.88	4639403.4012	422538.3132
7/26/08	MSA4	0	2	41.1	0.87	0.05	—	20.0	71.13	53.50	4639353.8666	422431.8664
7/26/08	MSA4	1	2	39.2	4.01	—	0.10	20.6	71.13	53.50	4639353.8666	422431.8664
7/26/08	MSA4	2	2	30.9	2.30	—	—	18.7	71.13	53.50	4639353.8666	422431.8664
7/26/08	MSA4	3	2	34.2	1.28	—	—	17.3	71.13	53.50	4639353.8666	422431.8664
7/26/08	MSA5	0	1	42.4	0.21	0.05	—	23.7	34.63	24.38	4639531.5533	422735.8593
7/26/08	MSA5	1	1	43.1	0.20	—	0.11	22.2	34.63	24.38	4639531.5533	422735.8593
7/26/08	MSA5	2	1	47.3	0.78	—	—	19.2	34.63	24.38	4639531.5533	422735.8593
7/26/08	MSA5	3	1	36.2	0.85	—	—	16.6	34.63	24.38	4639531.5533	422735.8593
7/26/08	MSA5	4	1	29.8	1.03	—	—	15.1	34.63	24.38	4639531.5533	422735.8593

A	B	C	D	E	F	G	H	I	J	K	L	M
7/26/08	MSA5	5	1	33.4	0.17	—	—	14.2	34.63	24.38	4639531.5533	422735.8593
8/14/08	MSG1	0	1	51.1	0.99	0.12	—	15.8	21.38	17.63	4639623.3891	422524.9516
8/14/08	MSG1	1	1	42.9	1.44	—	0.12	17.3	21.38	17.63	4639623.3891	422524.9516
8/14/08	MSG1	2	1	49.4	0.89	—	—	16.5	21.38	17.63	4639623.3891	422524.9516
8/14/08	MSG1	3	1	45.3	0.37	—	—	15.5	21.38	17.63	4639623.3891	422524.9516
8/14/08	MSG1	4	1	24.9	0.61	—	—	14.2	21.38	17.63	4639623.3891	422524.9516
8/14/08	MSG1	4	1	30.5	1.34	—	—	14.2	21.38	17.63	4639623.3891	422524.9516
8/14/08	MSG1	5	1	29.9	0.10	—	—	13.6	21.38	17.63	4639623.3891	422524.9516
8/14/08	MSG1	0	2	59.2	0.43	0.12	—	15.4	48.63	39.50	4639482.2470	422400.3500
8/14/08	MSG1	1	2	50.1	1.17	—	0.12	16.7	48.63	39.50	4639482.2470	422400.3500
8/14/08	MSG1	2	2	51.5	0.49	—	—	15.2	48.63	39.50	4639482.2470	422400.3500
8/14/08	MSG1	3	2	45.0	0.43	—	—	13.7	48.63	39.50	4639482.2470	422400.3500
8/14/08	MSG1	4	2	26.6	0.89	—	—	12.7	48.63	39.50	4639482.2470	422400.3500
8/14/08	MSG1	5	2	36.1	0.26	—	—	12.3	48.63	39.50	4639482.2470	422400.3500
8/14/08	MSG2	0	1	45.2	0.38	0.08	—	18.0	56.88	38.88	4639587.5362	422156.1177
8/14/08	MSG2	1	1	33.1	1.52	—	0.12	19.0	56.88	38.88	4639587.5362	422156.1177
8/14/08	MSG2	2	1	29.1	1.25	—	—	18.5	56.88	38.88	4639587.5362	422156.1177
8/14/08	MSG2	3	1	31.1	1.45	—	—	17.3	56.88	38.88	4639587.5362	422156.1177
8/14/08	MSG3	0	1	38.0	0.16	0.11	—	18.3	28.13	14.63	4639726.1175	422314.5109
8/14/08	MSG3	1	1	32.9	0.15	—	0.08	17.1	28.13	14.63	4639726.1175	422314.5109
8/14/08	MSG3	2	1	27.8	0.67	—	—	16.8	28.13	14.63	4639726.1175	422314.5109
8/14/08	MSG3	3	1	29.2	1.54	—	—	16.1	28.13	14.63	4639726.1175	422314.5109
8/14/08	MSG3	4	1	30.9	0.83	—	—	15.5	28.13	14.63	4639726.1175	422314.5109
8/14/08	MSG3	5	1	30.8	0.83	—	—	14.9	28.13	14.63	4639726.1175	422314.5109
8/14/08	MSG3	0	2	49.8	3.55	0.11	—	18.8	57.25	49.63	4639516.0777	422263.8804
8/14/08	MSG3	1	2	43.1	3.71	—	0.08	18.3	57.25	49.63	4639516.0777	422263.8804
8/14/08	MSG3	2	2	41.2	1.42	—	—	17.7	57.25	49.63	4639516.0777	422263.8804

A	B	C	D	E	F	G	H	I	J	K	L	M
8/14/08	MSG3	3	2	29.0	0.84	___	___	16.6	57.25	49.63	4639516.0777	422263.8804
8/14/08	MSG3	4	2	32.5	0.29	___	___	15.8	57.25	49.63	4639516.0777	422263.8804
8/14/08	MSG3	5	2	30.2	1.00	___	___	15.2	57.25	49.63	4639516.0777	422263.8804
7/30/09	PLA1	0	1	42.0	3.51	0.07	___	19.0	104.63	66.75	4644311.3476	427783.4194
7/30/09	PLA1	1	1	40.8	3.73	___	0.13	20.4	104.63	66.75	4644311.3476	427783.4194
7/30/09	PLA1	2	1	36.9	8.29	___	___	17.8	104.63	66.75	4644311.3476	427783.4194
7/30/09	PLA1	3	1	35.3	9.78	___	___	16.8	104.63	66.75	4644311.3476	427783.4194
7/30/09	PLA1	4	1	38.8	9.98	___	___	15.4	104.63	66.75	4644311.3476	427783.4194
7/30/09	PLA1	5	1	32.8	11.20	___	___	14.4	104.63	66.75	4644311.3476	427783.4194
7/30/09	PLA1	0	2	35.6	0.42	0.07	___	19.0	55.88	24.13	4644376.9310	427828.3172
7/30/09	PLA1	1	2	36.4	0.23	___	0.13	19.7	55.88	24.13	4644376.9310	427828.3172
7/30/09	PLA1	2	2	34.9	0.55	___	___	18.3	55.88	24.13	4644376.9310	427828.3172
7/30/09	PLA1	3	2	31.5	1.05	___	___	16.3	55.88	24.13	4644376.9310	427828.3172
7/30/09	PLA1	4	2	28.8	2.00	___	___	15.2	55.88	24.13	4644376.9310	427828.3172
7/30/09	PLA1	5	2	30.9	2.93	___	___	14.5	55.88	24.13	4644376.9310	427828.3172
7/25/08	RWA1	0	1	42.8	0.16	0.04	___	24.5	28.38	23.88	4644121.5822	428149.6282
7/25/08	RWA1	1	1	36.0	0.14	___	0.10	21.8	28.38	23.88	4644121.5822	428149.6282
7/25/08	RWA1	2	1	34.3	0.50	___	___	21.4	28.38	23.88	4644121.5822	428149.6282
7/25/08	RWA1	3	1	29.7	1.08	___	___	17.5	28.38	23.88	4644121.5822	428149.6282
7/25/08	RWA1	4	1	29.9	2.00	___	___	15.6	28.38	23.88	4644121.5822	428149.6282
7/25/08	RWA1	5	1	27.5	0.90	___	___	14.1	28.38	23.88	4644121.5822	428149.6282
7/25/08	RWA1	0	2	43.3	0.13	0.04	___	28.9	54.75	40.63	4643985.6570	427923.8446
7/25/08	RWA1	1	2	49.3	0.37	___	0.10	23.6	54.75	40.63	4643985.6570	427923.8446
7/25/08	RWA1	2	2	56.4	2.43	___	___	20.6	54.75	40.63	4643985.6570	427923.8446
7/25/08	RWA1	3	2	36.6	1.69	___	___	17.4	54.75	40.63	4643985.6570	427923.8446
7/25/08	RWA1	4	2	32.1	1.05	___	___	15.4	54.75	40.63	4643985.6570	427923.8446
7/25/08	RWA1	5	2	34.0	7.38	___	___	14.6	54.75	40.63	4643985.6570	427923.8446

A	B	C	D	E	F	G	H	I	J	K	L	M
7/25/08	RWA1	0	3	41.2	0.38	0.04	—	36.1	123.75	90.63	4643685.6557	427745.7469
7/25/08	RWA1	1	3	68.9	1.61	—	0.10	27.3	123.75	90.63	4643685.6557	427745.7469
7/25/08	RWA1	2	3	78.1	3.16	—	—	26.3	123.75	90.63	4643685.6557	427745.7469
7/25/08	RWA1	3	3	65.5	1.90	—	—	20.2	123.75	90.63	4643685.6557	427745.7469
7/25/08	RWA1	4	3	64.0	2.53	—	—	23.0	123.75	90.63	4643685.6557	427745.7469
7/25/08	RWA1	5	3	45.7	2.48	—	—	18.0	123.75	90.63	4643685.6557	427745.7469
7/26/08	RWA2	0	1	37.0	0.16	0.04	—	27.7	57.13	28.38	4647692.7050	426111.1210
7/26/08	RWA2	1	1	36.5	1.85	—	0.09	21.0	57.13	28.38	4647692.7050	426111.1210
7/26/08	RWA2	2	1	30.8	1.71	—	—	19.1	57.13	28.38	4647692.7050	426111.1210
7/26/08	RWA2	3	1	29.4	1.56	—	—	16.6	57.13	28.38	4647692.7050	426111.1210
7/26/08	RWA2	4	1	29.1	2.57	—	—	15.1	57.13	28.38	4647692.7050	426111.1210
7/26/08	RWA2	5	1	31.6	1.48	—	—	14.7	57.13	28.38	4647692.7050	426111.1210
7/26/08	RWA2	0	2	33.4	0.21	0.04	—	25.1	30.75	13.50	4647928.0610	426055.8610
7/26/08	RWA2	1	2	30.8	0.91	—	0.09	20.2	30.75	13.50	4647928.0610	426055.8610
7/26/08	RWA2	2	2	27.6	2.04	—	—	18.6	30.75	13.50	4647928.0610	426055.8610
7/26/08	RWA2	3	2	28.0	1.69	—	—	16.6	30.75	13.50	4647928.0610	426055.8610
7/26/08	RWA2	4	2	31.6	1.05	—	—	15.3	30.75	13.50	4647928.0610	426055.8610
7/26/08	RWA2	5	2	38.8	0.60	—	—	14.7	30.75	13.50	4647928.0610	426055.8610
7/26/08	RWA2	0	3	41.6	0.15	0.04	—	25.7	34.25	15.75	4647911.4510	426004.3240
7/26/08	RWA2	1	3	37.6	0.17	—	0.09	20.3	34.25	15.75	4647911.4510	426004.3240
7/26/08	RWA2	2	3	29.0	2.22	—	—	18.8	34.25	15.75	4647911.4510	426004.3240
7/26/08	RWA2	3	3	26.9	1.90	—	—	16.6	34.25	15.75	4647911.4510	426004.3240
7/26/08	RWA2	4	3	31.0	0.70	—	—	15.7	34.25	15.75	4647911.4510	426004.3240
7/26/08	RWA2	5	3	32.0	0.40	—	—	14.5	34.25	15.75	4647911.4510	426004.3240
9/30/08	RWC1	0	1	59.0	0.25	0.08	—	16.0	136.25	80.88	4642455.7047	429509.6107
9/30/08	RWC1	1	1	72.3	0.51	—	0.13	14.5	136.25	80.88	4642455.7047	429509.6107
9/30/08	RWC1	2	1	76.5	1.79	—	—	13.9	136.25	80.88	4642455.7047	429509.6107

A	B	C	D	E	F	G	H	I	J	K	L	M
9/30/08	RWC1	3	1	74.8	2.96	—	—	13.9	136.25	80.88	4642455.7047	429509.6107
9/30/08	RWC1	4	1	100.5	4.43	—	—	13.9	136.25	80.88	4642455.7047	429509.6107
9/30/08	RWC1	5	1	113.2	4.22	—	—	13.9	136.25	80.88	4642455.7047	429509.6107
9/30/08	RWC1	0	2	55.8	0.36	0.08	—	18.9	29.75	21.63	4642526.7359	429758.5237
9/30/08	RWC1	1	2	47.1	0.28	—	0.13	14.3	29.75	21.63	4642526.7359	429758.5237
9/30/08	RWC1	2	2	66.2	0.37	—	—	14.2	29.75	21.63	4642526.7359	429758.5237
9/30/08	RWC1	3	2	95.9	0.61	—	—	14.2	29.75	21.63	4642526.7359	429758.5237
9/30/08	RWC1	4	2	97.2	1.09	—	—	14.2	29.75	21.63	4642526.7359	429758.5237
9/30/08	RWC1	5	2	104.0	0.79	—	—	14.1	29.75	21.63	4642526.7359	429758.5237
9/9/08	RWG1	0	1	42.1	3.10	0.10	—	18.8	51.63	27.25	4647505.0835	427570.4913
9/9/08	RWG1	1	1	32.8	1.13	—	0.14	17.7	51.63	27.25	4647505.0835	427570.4913
9/9/08	RWG1	2	1	36.6	0.66	—	—	17.9	51.63	27.25	4647505.0835	427570.4913
9/9/08	RWG1	3	1	31.4	1.30	—	—	17.8	51.63	27.25	4647505.0835	427570.4913
9/9/08	RWG1	4	1	28.5	1.06	—	—	17.5	51.63	27.25	4647505.0835	427570.4913
9/9/08	RWG1	5	1	29.8	0.52	—	—	17.3	51.63	27.25	4647505.0835	427570.4913
9/9/08	RWG1	0	2	38.4	9.01	0.10	—	17.7	74.50	52.00	4647596.3075	427841.1965
9/9/08	RWG1	1	2	36.5	1.65	—	0.14	17.2	74.50	52.00	4647596.3075	427841.1965
9/9/08	RWG1	2	2	29.9	1.59	—	—	17.1	74.50	52.00	4647596.3075	427841.1965
9/9/08	RWG1	3	2	28.5	1.86	—	—	16.9	74.50	52.00	4647596.3075	427841.1965
9/9/08	RWG1	4	2	30.1	1.41	—	—	16.8	74.50	52.00	4647596.3075	427841.1965
9/9/08	RWG1	5	2	40.1	0.39	—	—	16.9	74.50	52.00	4647596.3075	427841.1965
9/9/08	RWG2	0	1	44.0	1.83	0.10	—	20.2	63.13	35.13	4647737.2234	427646.4486
9/9/08	RWG2	1	1	35.7	3.19	—	0.13	18.4	63.13	35.13	4647737.2234	427646.4486
9/9/08	RWG2	2	1	38.3	1.13	—	—	18.7	63.13	35.13	4647737.2234	427646.4486
9/9/08	RWG2	3	1	34.6	1.04	—	—	18.4	63.13	35.13	4647737.2234	427646.4486
9/9/08	RWG2	4	1	31.4	1.71	—	—	18.2	63.13	35.13	4647737.2234	427646.4486
9/9/08	RWG2	5	1	34.4	1.12	—	—	18.0	63.13	35.13	4647737.2234	427646.4486

A	B	C	D	E	F	G	H	I	J	K	L	M
9/9/08	RWG2	0	2	39.5	0.24	0.10	—	17.7	24.88	1.50	4647841.2193	427900.9983
9/9/08	RWG2	1	2	34.6	0.16	—	0.13	16.0	24.88	1.50	4647841.2193	427900.9983
9/9/08	RWG2	2	2	38.0	0.12	—	—	15.9	24.88	1.50	4647841.2193	427900.9983
9/9/08	RWG2	3	2	37.9	0.09	—	—	15.6	24.88	1.50	4647841.2193	427900.9983
9/9/08	RWG2	4	2	30.5	0.09	—	—	15.3	24.88	1.50	4647841.2193	427900.9983
9/9/08	RWG2	5	2	34.1	0.04	—	—	15.3	24.88	1.50	4647841.2193	427900.9983
9/9/08	RWG2	0	3	36.6	0.29	0.10	—	20.3	24.50	8.13	4648234.5130	427928.4837
9/9/08	RWG2	1	3	30.6	0.75	—	0.13	18.5	24.50	8.13	4648234.5130	427928.4837
9/9/08	RWG2	2	3	32.9	0.28	—	—	18.7	24.50	8.13	4648234.5130	427928.4837
9/9/08	RWG2	3	3	36.7	0.13	—	—	18.5	24.50	8.13	4648234.5130	427928.4837
9/9/08	RWG2	4	3	31.0	0.14	—	—	18.4	24.50	8.13	4648234.5130	427928.4837
9/11/08	RWG3	0	2	50.5	0.26	0.08	—	21.0	72.13	37.13	4644006.9234	426111.2273
9/11/08	RWG3	1	2	63.0	0.14	—	0.09	16.7	72.13	37.13	4644006.9234	426111.2273
9/11/08	RWG3	2	2	37.5	0.67	—	—	16.9	72.13	37.13	4644006.9234	426111.2273
9/11/08	RWG3	3	2	58.7	1.41	—	—	16.8	72.13	37.13	4644006.9234	426111.2273
9/11/08	RWG3	4	2	63.9	1.33	—	—	15.9	72.13	37.13	4644006.9234	426111.2273
9/11/08	RWG3	5	2	57.5	1.38	—	—	15.4	72.13	37.13	4644006.9234	426111.2273
9/11/08	RWG4	0	1	44.8	0.65	0.08	—	22.8	14.25	3.75	4644604.3386	430433.0450
9/11/08	RWG4	1	1	44.0	0.20	—	0.09	18.3	14.25	3.75	4644604.3386	430433.0450
9/11/08	RWG4	2	1	40.9	0.45	—	—	18.5	14.25	3.75	4644604.3386	430433.0450
9/11/08	RWG4	3	1	36.4	0.60	—	—	17.7	14.25	3.75	4644604.3386	430433.0450
9/11/08	RWG4	4	1	29.8	0.62	—	—	16.9	14.25	3.75	4644604.3386	430433.0450
9/11/08	RWG4	5	1	28.1	1.34	—	—	16.4	14.25	3.75	4644604.3386	430433.0450
9/11/08	RWG4	0	2	49.4	0.14	0.08	—	20.1	36.50	19.63	4644282.5386	430027.0722
9/11/08	RWG4	1	2	35.7	1.26	—	0.09	17.2	36.50	19.63	4644282.5386	430027.0722
9/11/08	RWG4	2	2	35.3	1.36	—	—	17.2	36.50	19.63	4644282.5386	430027.0722
9/11/08	RWG4	3	2	27.6	1.01	—	—	16.5	36.50	19.63	4644282.5386	430027.0722

A	B	C	D	E	F	G	H	I	J	K	L	M
9/11/08	RWG4	4	2	28.5	0.65	___	___	16.2	36.50	19.63	4644282.5386	430027.0722
9/11/08	RWG4	5	2	27.6	0.79	___	___	15.8	36.50	19.63	4644282.5386	430027.0722
9/11/08	RWG5	0	1	55.0	0.39	0.08	___	21.5	23.75	7.50	4644361.5585	429695.4735
9/11/08	RWG5	1	1	31.6	0.27	___	0.05	16.3	23.75	7.50	4644361.5585	429695.4735
9/11/08	RWG5	2	1	32.2	1.70	___	___	16.3	23.75	7.50	4644361.5585	429695.4735
9/11/08	RWG5	3	1	31.2	0.27	___	___	15.4	23.75	7.50	4644361.5585	429695.4735
9/11/08	RWG5	4	1	31.6	0.38	___	___	14.9	23.75	7.50	4644361.5585	429695.4735
9/11/08	RWG5	5	1	32.4	1.29	___	___	14.5	23.75	7.50	4644361.5585	429695.4735
9/11/08	RWG5	0	2	45.9	0.17	0.08	___	20.2	38.13	19.63	4644301.2033	429587.4060
9/11/08	RWG5	1	2	28.8	2.20	___	0.05	17.1	38.13	19.63	4644301.2033	429587.4060
9/11/08	RWG5	2	2	31.8	6.81	___	___	16.5	38.13	19.63	4644301.2033	429587.4060
9/11/08	RWG5	3	2	39.5	2.37	___	___	15.9	38.13	19.63	4644301.2033	429587.4060
9/11/08	RWG5	4	2	32.5	1.69	___	___	15.0	38.13	19.63	4644301.2033	429587.4060
9/11/08	RWG5	5	2	32.8	1.50	___	___	14.8	38.13	19.63	4644301.2033	429587.4060
9/17/08	RWG6	0	1	38.0	0.13	0.04	___	22.8	53.88	36.38	4647941.6553	426391.7999
9/17/08	RWG6	1	1	39.3	1.11	___	0.09	17.7	53.88	36.38	4647941.6553	426391.7999
9/17/08	RWG6	2	1	31.0	1.92	___	___	17.1	53.88	36.38	4647941.6553	426391.7999
9/17/08	RWG6	3	1	32.5	1.33	___	___	16.6	53.88	36.38	4647941.6553	426391.7999
9/17/08	RWG6	4	1	30.0	1.38	___	___	16.2	53.88	36.38	4647941.6553	426391.7999
9/17/08	RWG6	5	1	29.3	1.33	___	___	16.8	53.88	36.38	4647941.6553	426391.7999
9/17/08	RWG6	0	2	46.9	1.15	0.04	___	22.8	91.63	72.13	4647544.8430	426315.0019
9/17/08	RWG6	1	2	33.8	1.61	___	0.09	17.7	91.63	72.13	4647544.8430	426315.0019
9/17/08	RWG6	2	2	29.2	3.37	___	___	17.1	91.63	72.13	4647544.8430	426315.0019
9/17/08	RWG6	3	2	39.8	2.40	___	___	16.6	91.63	72.13	4647544.8430	426315.0019
9/17/08	RWG6	4	2	26.2	4.30	___	___	16.2	91.63	72.13	4647544.8430	426315.0019
9/17/08	RWG6	5	2	32.4	2.49	___	___	15.8	91.63	72.13	4647544.8430	426315.0019
9/17/08	RWG7	0	1	48.1	0.65	0.03	___	22.8	25.50	17.75	4648134.2640	426065.5963

A	B	C	D	E	F	G	H	I	J	K	L	M
9/17/08	RWG7	1	1	29.3	1.17	—	0.06	17.7	25.50	17.75	4648134.2640	426065.5963
9/17/08	RWG7	2	1	35.5	0.34	—	—	17.1	25.50	17.75	4648134.2640	426065.5963
9/17/08	RWG7	3	1	28.7	0.67	—	—	16.6	25.50	17.75	4648134.2640	426065.5963
9/17/08	RWG7	4	1	31.8	0.26	—	—	16.2	25.50	17.75	4648134.2640	426065.5963
9/17/08	RWG7	5	1	31.4	0.18	—	—	15.8	25.50	17.75	4648134.2640	426065.5963
9/17/08	RWG7	0	2	38.9	0.27	0.03	—	22.8	9.38	11.38	4648110.9195	426174.1814
9/17/08	RWG7	1	2	25.3	0.62	—	0.06	17.7	9.38	11.38	4648110.9195	426174.1814
9/17/08	RWG7	2	2	29.5	0.59	—	—	17.1	9.38	11.38	4648110.9195	426174.1814
9/17/08	RWG7	3	2	25.8	0.32	—	—	16.6	9.38	11.38	4648110.9195	426174.1814
9/17/08	RWG7	4	2	26.9	0.22	—	—	16.2	9.38	11.38	4648110.9195	426174.1814
9/17/08	RWG7	5	2	31.1	0.06	—	—	15.8	9.38	11.38	4648110.9195	426174.1814
9/30/08	RWG8	0	1	44.1	0.38	0.08	—	18.8	35.88	23.63	4642773.9353	429829.4330
9/30/08	RWG8	1	1	39.5	0.22	—	0.09	17.5	35.88	23.63	4642773.9353	429829.4330
9/30/08	RWG8	2	1	42.5	0.27	—	—	16.7	35.88	23.63	4642773.9353	429829.4330
9/30/08	RWG8	3	1	64.9	0.31	—	—	16.4	35.88	23.63	4642773.9353	429829.4330
9/30/08	RWG8	4	1	46.8	0.29	—	—	15.9	35.88	23.63	4642773.9353	429829.4330
9/30/08	RWG8	5	1	51.8	0.21	—	—	15.7	35.88	23.63	4642773.9353	429829.4330
9/30/08	RWG8	0	2	54.0	0.40	0.08	—	17.7	101.63	67.13	4642721.0527	429345.7787
9/30/08	RWG8	1	2	66.1	1.16	—	0.09	15.4	101.63	67.13	4642721.0527	429345.7787
9/30/08	RWG8	2	2	90.0	2.12	—	—	15.2	101.63	67.13	4642721.0527	429345.7787
9/30/08	RWG8	3	2	107.1	3.32	—	—	14.9	101.63	67.13	4642721.0527	429345.7787
9/30/08	RWG8	4	2	107.0	2.73	—	—	14.9	101.63	67.13	4642721.0527	429345.7787
9/30/08	RWG8	5	2	107.3	2.53	—	—	14.9	101.63	67.13	4642721.0527	429345.7787
9/18/08	RWP1	0	1	46.3	0.25	0.06	—	22.3	26.75	15.38	4643960.2093	429674.9689
9/18/08	RWP1	1	1	32.4	0.14	—	0.10	18.1	26.75	15.38	4643960.2093	429674.9689
9/18/08	RWP1	2	1	30.7	0.12	—	—	17.6	26.75	15.38	4643960.2093	429674.9689
9/18/08	RWP1	3	1	30.2	0.37	—	—	16.9	26.75	15.38	4643960.2093	429674.9689

A	B	C	D	E	F	G	H	I	J	K	L	M
9/18/08	RWP1	4	1	26.8	1.22	___	___	16.4	26.75	15.38	4643960.2093	429674.9689
9/18/08	RWP1	5	1	32.1	0.72	___	___	16.1	26.75	15.38	4643960.2093	429674.9689
9/18/08	RWP1	0	2	45.0	0.19	0.06	___	22.6	39.25	22.88	4644099.4481	429683.5481
9/18/08	RWP1	1	2	45.4	0.11	___	0.10	17.4	39.25	22.88	4644099.4481	429683.5481
9/18/08	RWP1	2	2	33.2	0.58	___	___	16.8	39.25	22.88	4644099.4481	429683.5481
9/18/08	RWP1	3	2	33.1	1.29	___	___	16.1	39.25	22.88	4644099.4481	429683.5481
9/18/08	RWP1	4	2	33.0	2.17	___	___	15.6	39.25	22.88	4644099.4481	429683.5481
9/18/08	RWP1	5	2	33.2	3.17	___	___	15.3	39.25	22.88	4644099.4481	429683.5481
7/24/08	SMA1	0	1	49.5	0.23	0.06	___	33.2	16.88	15.88	4634250.3291	425334.5978
7/24/08	SMA1	1	1	43.6	0.21	___	0.10	27.2	16.88	15.88	4634250.3291	425334.5978
7/24/08	SMA1	2	1	28.3	0.52	___	___	22.7	16.88	15.88	4634250.3291	425334.5978
7/24/08	SMA1	3	1	32.9	0.13	___	___	19.2	16.88	15.88	4634250.3291	425334.5978
7/24/08	SMA1	4	1	48.8	0.04	___	___	19.0	16.88	15.88	4634250.3291	425334.5978
7/24/08	SMA1	5	1	31.1	0.14	___	___	21.3	16.88	15.88	4634250.3291	425334.5978
7/24/08	SMA1	0	2	47.2	0.25	0.06	___	30.6	40.38	32.50	4634283.2989	425046.8557
7/24/08	SMA1	1	2	49.5	0.69	___	0.10	25.0	40.38	32.50	4634283.2989	425046.8557
7/24/08	SMA1	2	2	53.7	0.37	___	___	20.3	40.38	32.50	4634283.2989	425046.8557
7/24/08	SMA1	3	2	55.3	0.31	___	___	17.9	40.38	32.50	4634283.2989	425046.8557
7/24/08	SMA1	4	2	48.3	0.40	___	___	19.3	40.38	32.50	4634283.2989	425046.8557
7/24/08	SMA1	5	2	46.6	0.44	___	___	17.1	40.38	32.50	4634283.2989	425046.8557
8/12/08	SMG1	0	1	59.2	0.59	0.12	___	17.5	72.50	41.50	4632503.1960	424926.4281
8/12/08	SMG1	1	1	56.8	0.28	___	0.12	19.2	72.50	41.50	4632503.1960	424926.4281
8/12/08	SMG1	2	1	54.3	0.38	___	___	18.7	72.50	41.50	4632503.1960	424926.4281
8/12/08	SMG1	3	1	51.2	0.40	___	___	17.8	72.50	41.50	4632503.1960	424926.4281
8/12/08	SMG1	4	1	36.8	1.51	___	___	16.3	72.50	41.50	4632503.1960	424926.4281
8/12/08	SMG1	5	1	50.6	1.04	___	___	15.3	72.50	41.50	4632503.1960	424926.4281
8/12/08	SMG1	0	2	49.2	0.59	0.12	___	18.3	118.13	72.13	4632403.6689	424627.1814

A	B	C	D	E	F	G	H	I	J	K	L	M
8/12/08	SMG1	1	2	42.1	0.87	—	0.12	19.9	118.13	72.13	4632403.6689	424627.1814
8/12/08	SMG1	2	2	65.7	0.88	—	—	18.9	118.13	72.13	4632403.6689	424627.1814
8/12/08	SMG1	3	2	72.9	0.87	—	—	17.7	118.13	72.13	4632403.6689	424627.1814
8/12/08	SMG1	4	2	68.2	1.60	—	—	16.5	118.13	72.13	4632403.6689	424627.1814
8/12/08	SMG1	5	2	60.7	2.03	—	—	15.4	118.13	72.13	4632403.6689	424627.1814
8/12/08	SMG2	0	1	54.3	0.35	0.12	—	16.1	49.75	23.13	4632305.5811	424602.7574
8/12/08	SMG2	1	1	45.0	0.37	—	0.10	18.4	49.75	23.13	4632305.5811	424602.7574
8/12/08	SMG2	2	1	56.6	0.31	—	—	17.7	49.75	23.13	4632305.5811	424602.7574
8/12/08	SMG2	3	1	53.0	0.59	—	—	16.9	49.75	23.13	4632305.5811	424602.7574
8/12/08	SMG2	4	1	48.6	0.86	—	—	16.4	49.75	23.13	4632305.5811	424602.7574
8/12/08	SMG2	5	1	49.8	0.72	—	—	14.7	49.75	23.13	4632305.5811	424602.7574
8/12/08	SMG3	0	1	53.2	0.35	0.16	—	25.9	45.75	25.13	4632546.8994	425501.6523
8/12/08	SMG3	1	1	43.7	2.85	—	0.12	19.6	45.75	25.13	4632546.8994	425501.6523
8/12/08	SMG3	2	1	36.8	0.94	—	—	18.7	45.75	25.13	4632546.8994	425501.6523
8/12/08	SMG3	3	1	35.4	0.58	—	—	17.1	45.75	25.13	4632546.8994	425501.6523
8/12/08	SMG3	4	1	33.7	0.65	—	—	16.0	45.75	25.13	4632546.8994	425501.6523
8/12/08	SMG3	5	1	35.9	0.30	—	—	15.8	45.75	25.13	4632546.8994	425501.6523
8/12/08	SMG3	0	2	44.5	0.32	0.16	—	22.7	25.13	10.88	4632460.3058	425757.6554
8/12/08	SMG3	1	2	50.7	0.48	—	0.12	20.5	25.13	10.88	4632460.3058	425757.6554
8/12/08	SMG3	2	2	37.5	0.82	—	—	19.6	25.13	10.88	4632460.3058	425757.6554
8/12/08	SMG3	3	2	35.0	0.25	—	—	18.2	25.13	10.88	4632460.3058	425757.6554
8/12/08	SMG3	4	2	29.3	0.13	—	—	17.0	25.13	10.88	4632460.3058	425757.6554
8/12/08	SMG3	5	2	30.9	0.08	—	—	16.0	25.13	10.88	4632460.3058	425757.6554