HYDROGEOLOGY
GEOLOGY

ENVIRONMENTAL SCIENCES
SOILS

EDWIN ANDREWS & ASSOCIATES, P.C.
CONSULTING HYDROGEOLOGISTS
P.O. BOX 30653
RALEIGH, N.C. 27622 - 0653
PHONE: (919) 783 - 8395
FAX: (919) 783 - 0151

April 6, 2005

Mr. Robert D. Swain
Community Properties, Inc.
1000 St. Albans Drive, Suite 400
Raleigh, N.C. 27609

Re: Preliminary Soil Assessment for Reuse
Phase I - Meadowview PUD for Chatham County
Project No. RW-2404

Dear Mr. Swain:

The site analysis for the proposed irrigation of reclaimed water on open land at The Meadowview PUD site in Chatham County, North Carolina, confirms that the site can accommodate 250,000 gallons per day of reclaimed water on 240 acres. The soils were mapped on the site to evaluate the native material that will be used to construct the irrigation areas. Based on an overlay and interpolation of the S&EC (Soil and Environmental Consultants) soil map with the proposed irrigation map, two soil associations were identified by Soil and Environmental Consultants (separate report by Mr. Jim Beeson, N.C.L.S.S.).

These soil associations were described as: Georgeville-Tatum comprising 104 irrigated acres; and Cid-Lignum comprising 136 irrigated acres (Table No. 1, Soil Descriptions). Preliminary hydraulic conductivity measurements were made during the fall of 2004 by Soil and Environmental Consultants to determine the average drainage coefficients needed for a loading rate determination (Table No. 2, Ksat Analysis Results - S&EC Consultants). Georgeville silt loam is described as a Typic Kanhapludult which is a very deep, well drained moderately permeable soil containing low shrink swell clay fraction (Kaolinitic) in the NRCS soil data sheet. The Tatum silt loam is classified and described as a Typic Hapludult deep, well drained moderately permeable soil containing low to moderate shrink swell clay fraction from the NRCS soil data sheet

The second largest area of the site was mapped as Georgeville-Tatum well drained moderately permeable soils. The Georgeville-Tatum soils were selected for irrigation due to drainage characteritics. Ksat analysis of this soil indicates that an irrigation system could be constructed on this soil to accommodate 0.35 inches per week of irrigation on an average annual basis. A water balance analysis using the results of the Ksat analyses calculates that 104 acres could accommodate 143,000 gallons per day with 93.6 days of storage of reclaimed water (13,381,587 gallons).

The Cid-Lignum soils were selected for lower rate irrigation because of limited drainage

characteristics. A total of 136 acres were selected and mapped by Soil & Environmental Consultants, Inc.. Ksat analysis of this soil indicates that an irrigation system could be constructed on this soil to accommodate 0.2 inch per week of irrigation on an average annual basis (10.4 in/yr). A water balance analysis using the results of the Ksat analyses calculates that 136 acres could accommodate 107,000 gallons per day with 157.2 days of storage of reclaimed water (16,823,524 gallons).

While this soil analysis and water balance is correct for the site as mapped, this report is preliminary. The report may change if areas are reshaped or rerouted. Final construction and irrigated areas will be evaluated to verify the loading analyses and water balance analyses used in this preliminary report.

Areas from each of these two soils were investigated to characterize the underlying hydrogeologic framework using Resistivity Analysis (Attachment A - Geophysical Survey by ATS International) and test wells were constructed by Graham & Currie Well Drilling. The Georgeville-Tatum series soils were intersected by transects 1, 6 and 7, whereas the Cid-Lignum was predominantly intersected by tracts 2, 3, 4 and 5. The geophysical analysis revealed evidence of major thrust faulting and fracture at several locations throughout the site. The areas were underlain by metamudstone were present in the northwest corner of the site. Whereas metamorphosed granitic rock occur in the areas that comprise the center and southeastern portion of the site. Borings and test wells numbered 1, 3, and 4 were located in the area mapped as “”Metamorphosed Granitic Rock” (from the “Geologic Map of North Carolina” 1985 on-line - http://www.geology.enr.state.nc.us/ Boring number 2 was described as “aphanitic gray rock from the “air-rotary” cuttings. This description reflects the metamudstone associated with Volcanic Metaconglomerates. Detailed analysis of these types of features will be made in the detailed hydrogeologic analysis for review by the Aquifer Protection Section of the Division of Water Quality.

Analysis of the test wells indicated a range of hydraulic conductivity from 1.42 to 5.58 feet per day. These values and major fractures will be placed into a model, calibrated to measured water levels, for review by hydrogeologists in the Aquifer Protection Section.

I sincerely hope that this information is helpful with your review.

Very truly yours,
Edwin E. Andrews III, P.G., N.C.L.S.S.

EDWIN ANDREWS & ASSOCIATES, P.C.
Consulting Hydrogeologist and Soil Scientist
EEA/sba
encl.

Water Balance for: BUCK MTN SOUTH

SCENARIO4A CID LIGNUM

meadcid136

10.04 IN/YR

Input ==>

Output =>

Thornthwaite Potential Evapotranspiration Method — **Manually entered PET data**

Enter Site Latitude: **34.00** degrees Latitude

	Average Monthly Temp. (degrees F)	Daylight Hours divided by 12	Heat Index (I)	Calculated PET (degrees F)	Potential ET (in/mo)
January	45.9	0.88	1.93	0.46	0.93
February	48.3	0.85	2.46	0.61	1.40
March	54.4	1.03	3.98	1.33	2.17
April	62.7	1.09	6.41	2.53	3.30
May	70.3	1.20	8.96	4.23	4.34
June	76.9	1.20	11.40	5.69	4.80
July	80.7	1.22	12.89	6.74	4.65
August	79.5	1.16	12.41	6.08	4.03
September	74.6	1.03	10.52	4.42	3.30
October	64.8	0.97	7.08	2.56	1.86
November	55.8	0.87	4.36	1.25	1.20
December	48.3	0.86	2.46	0.61	0.62
TOTAL =			84.86	36.51	32.60

☐ << == Check Box to use Thornthaite Method

☑ <<== Check Box to use Manually entered PET data.

PAN Evaporation Data (used for RainFall IN and Evaporation Out of Lagoon)

Location of PAN Data: **Lumberton, NC**

Enter PAN Multiplication Factor: **0.70** <<== 0.70 recommended

	PAN Evaporation Data (in/mo)	PAN Evap. Data X Mult. Factor (in/mo)
January	1.06	0.74
February	2.15	1.51
March	3.51	2.46
April	6.55	4.59
May	8.08	5.66
June	8.67	6.07
July	8.29	5.80
August	6.90	4.83
September	5.57	3.90
October	4.07	2.85
November	2.32	1.62
December	1.49	1.04
TOTAL =	58.66	41.06

☑ <<== Check Box to account for Rain - Evap. in/out of Lagoon

12 0.03

9588.086308

6.532025903

747.15 gpd/ac

10.04 in/yr

Spray Irrigation Area = **136** acres

Lagoon Area = **0** acres

WWTP Design Flow = **107,000** GPD

Limiting Soil Ksat = **0.0200** inch/hour

Drainage Coefficient = **0.1**

Kv = Ksat * (Drainage Coeff.) = 0.048 inch/day

	# of Days in Month (days)	Average Monthly Rain (in/mo)	Rainfall Runoff 0.18 (in/mo)	RainFall Infiltrating Soil (in/mo)	Potential ET (in/mo)	Constant Vertical Drainage (in/mo)	Maximum Allowable Irrigation (in/mo)	Ratio of Monthly Influent to WWTP Design Flow (ratio)	Actual WWTP Monthly Influent Flow (GPD)	Actual "RainFall - ET" Accumulated into/out of Lagoon itself: in (GPD ave.)	Actual "RainFall - ET" Accumulated into/out of Lagoon itself: in (Gallons)	Monthly WWTP Accumulated Volume to be disposed of: in (Gallons)	Monthly WWTP Accumulated Volume to be disposed of: in (in/mo)	Max. Allowable Irrigation Application Factor	Unfactored Monthly Spray (in/mo)	Actual Monthly Spray Irrigation Rate: Factored Monthly Spray (in/mo)	Actual Monthly Spray Irrigation Rate: Max. Irrig. Rate (Y or N)	Actual Monthly Spray Irrigation Rate: Monthly Accumul. Gallons	Total Storage Required (inch)	Total Storage Required (gallons)
January	31	5.16	0.93	4.23	0.93	1.49	0.00	1.00	107,000.0	0.0	0.0	3,317,000.0	0.90	0.30	0.00000	0.00000	N	0	3.42070	12,633,387
February	28	4.70	0.85	3.85	1.40	1.34	0.00	1.00	107,000.0	0.0	0.0	2,996,000.0	0.81	0.50	0.00000	0.00000	N	0	4.23191	15,629,387
March	31	3.76	0.68	3.08	2.17	1.49	0.57	1.00	107,000.0	0.0	0.0	3,317,000.0	0.90	1.00	0.57480	0.57480	Y	2,122,863	4.55525	16,823,524
April	30	1.18	0.21	0.97	3.30	1.44	3.77	1.00	107,000.0	0.0	0.0	3,210,000.0	0.87	1.00	3.77240	3.77240	Y	13,932,303	1.65201	6,101,220
May	31	5.57	1.00	4.57	4.34	1.49	1.26	1.00	107,000.0	0.0	0.0	3,317,000.0	0.90	1.00	1.26060	1.26060	Y	4,655,673	1.28954	4,762,547
June	30	7.74	1.39	6.35	4.80	1.44	0.00	1.00	107,000.0	0.0	0.0	3,210,000.0	0.87	1.00	0.00000	0.00000	N	0	2.15870	7,972,547
July	31	2.96	0.53	2.43	4.65	1.49	3.71	1.00	107,000.0	0.0	0.0	3,317,000.0	0.90	1.00	2.72349	3.05683	N	11,289,547	0.00000	0
August	31	6.13	1.10	5.03	4.03	1.49	0.49	1.00	107,000.0	0.0	0.0	3,317,000.0	0.90	1.00	0.49140	0.49140	Y	1,814,848	0.40673	1,502,152
September	30	1.40	0.25	1.15	3.30	1.44	3.59	1.00	107,000.0	0.0	0.0	3,210,000.0	0.87	1.00	1.27589	1.27589	N	4,712,152	0.00000	0
October	31	7.34	1.32	6.02	1.86	1.49	0.00	1.00	107,000.0	0.0	0.0	3,317,000.0	0.90	1.00	0.00000	0.00000	N	0	0.89813	3,317,000
November	30	5.30	0.95	4.35	1.20	1.44	0.00	1.00	107,000.0	0.0	0.0	3,210,000.0	0.87	0.50	0.00000	0.00000	N	0	1.76729	6,527,000
December	31	1.99	0.36	1.63	0.62	1.49	0.48	1.00	107,000.0	0.0	0.0	3,317,000.0	0.90	0.30	0.47620	0.14286	N	527,613	2.52256	9,316,387
TOTAL =	365	53.23	9.58	43.65	32.60	17.52	13.88	12.00			0.0	39,055,000.0	10.57		10.57	10.57		39,055,000		

1.00
1.50
2.00
2.00
2.00
1.50
1.00

☑ <<== Check "Spray Factors Box" if any Factors OTHER than 1.00 used.

☐ <<== Check "Factors Reset Box" to reset all Factors back to 1.00

Results:

Total Storage Required of **4.56** inches = **157.2** days of Storage

Notes:

Spray Irrigation Monthly Application Factor = a forcing factor by which the "normally" Actual Spray Irrigation Rate is multiplied by, with the Storage Required being re-calculated to account for this factor.

Formulas:

(Max. Allowable Irrigation) = (ET) + (Drainage) - (Rain)

(Monthly Excess) = (Max. Allowable Irrigation) - (Monthly Influent Waste Volume)

where: (- Monthly Excess) = water that must be stored in Storage Pond

where: (+ Monthly Excess) = extra water that can be spray irrigated out of Storage Pond

Water Balance for: BUCK MTN SOUTH

SCENARIO 4A GEORGEVILLE/TATUM

IPgeorge104.54ac

18 in/yr

Input ==>

Output =>

Thornthwaite Potential Evapotranspiration Method — Manually entered PET data

Enter Site Latitude: **34.00** degrees Latitude

	Average Monthly Temp. (degrees F)	Daylight Hours divided by 12	Heat Index (I)	Calculated PET (degrees F)	Potential ET (in/mo)
January	45.9	0.88	1.93	0.46	0.93
February	48.3	0.85	2.46	0.61	1.40
March	54.4	1.03	3.98	1.33	2.17
April	62.7	1.09	6.41	2.53	3.30
May	70.3	1.20	8.96	4.23	4.34
June	76.9	1.20	11.40	5.69	4.80
July	80.7	1.22	12.89	6.74	4.65
August	79.5	1.16	12.41	6.08	4.03
September	74.6	1.03	10.52	4.42	3.30
October	64.8	0.97	7.08	2.56	1.86
November	55.8	0.87	4.36	1.25	1.20
December	48.3	0.86	2.46	0.61	0.62
TOTAL =			84.86	36.51	32.60

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Enter PAN Multiplication Factor: **0.70** <<== 0.70 recommended

	PAN Evaporation Data (in/mo)	PAN Evap. Data X Mult. Factor (in/mo)
January	1.06	0.74
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March	3.51	2.46
April	6.55	4.59
May	8.08	5.66
June	8.67	6.07
July	8.29	5.80
August	6.90	4.83
September	5.57	3.90
October	4.07	2.85
November	2.32	1.62
December	1.49	1.04
TOTAL =	58.66	41.06

☑ <<== Check Box to account for Rain - Evap. in/out of Lagoon

12 0.03

9588.086308

6.532025903

Spray Irrigation Area = **104** acres

Lagoon Area = **3** acres

WWTP Design Flow = **143,000** GPD

Limiting Soil Ksat = **0.0600** inch/hour

Drainage Coefficient = **0.075**

Kv = Ksat * (Drainage Coeff.) = 0.108 inch/day

	# of Days in Month (days)	Average Monthly Rain (in/mo)	Rainfall Runoff 0.20 (in/mo)	RainFall Infiltrating Soil (in/mo)	Potential ET (in/mo)	Constant Vertical Drainage (in/mo)	Maximum Allowable Irrigation (in/mo)			Ratio of Monthly Influent to WWTP Design Flow (ratio)	Actual WWTP Monthly Influent Flow (GPD)	Actual "RainFall - ET" Accumulated into/out of Lagoon itself		Monthly WWTP Accumulated Volume to be disposed of			Max. Allowable Irrigation Application Factor	Unfactored Monthly Spray (in/mo)	Actual Monthly Spray Irrigation Rate: Factored Monthly Spray (in/mo)	Actual Monthly Spray Irrigation Rate: Max. Irrig. Rate (Y or N)	Actual Monthly Spray Irrigation Rate: Monthly Accumul. Gallons	Total Storage Required (inch)	Total Storage Required (gallons)
												in (GPD ave.)	in (Gallons)	in (Gallons)	in (in/mo)								
January	31	5.16	1.03	4.13	0.93	3.35	0.15	----------	----------	1.00	143,000.0	11,610.5	359,926.0	4,792,926.0	1.70	----------	1.00	0.15000	0.15000	Y	423,634	3.89224	10,992,583
February	28	4.70	0.94	3.76	1.40	3.02	0.66	----------	----------	1.00	143,000.0	9,296.1	260,290.5	4,264,290.5	1.51	----------	1.00	0.66400	0.66400	Y	1,875,287	4.73814	13,381,587
March	31	3.76	0.75	3.01	2.17	3.35	2.51	----------	----------	1.00	143,000.0	3,424.3	106,152.9	4,539,152.9	1.61	----------	1.00	2.51000	2.51000	Y	7,088,810	3.83536	10,831,930
April	30	1.18	0.24	0.94	3.30	3.24	5.60	----------	----------	1.00	143,000.0	-9,246.6	-277,398.8	4,012,601.2	1.42	----------	1.00	5.25614	5.25614	N	14,844,531	0.00000	0
May	31	5.57	1.11	4.46	4.34	3.35	3.23	----------	----------	1.00	143,000.0	-226.0	-7,006.3	4,425,993.7	1.57	----------	1.00	1.56715	1.56715	N	4,425,994	0.00000	0
June	30	7.74	1.55	6.19	4.80	3.24	1.85	----------	----------	1.00	143,000.0	4,537.8	136,133.2	4,426,133.2	1.57	----------	1.00	1.56720	1.56720	N	4,426,133	0.00000	0
July	31	2.96	0.59	2.37	4.65	3.35	5.63	----------	----------	1.00	143,000.0	-7,471.4	-231,613.8	4,201,386.2	1.49	----------	1.00	1.48762	1.48762	N	4,201,386	0.00000	0
August	31	6.13	1.23	4.90	4.03	3.35	2.47	----------	----------	1.00	143,000.0	3,416.4	105,908.5	4,538,908.5	1.61	----------	1.00	1.60713	1.60713	N	4,538,909	0.00000	0
September	30	1.40	0.28	1.12	3.30	3.24	5.42	----------	----------	1.00	143,000.0	-6,786.3	-203,588.8	4,086,411.2	1.45	----------	1.00	1.44691	1.44691	N	4,086,411	0.00000	0
October	31	7.34	1.47	5.87	1.86	3.35	0.00	----------	----------	1.00	143,000.0	11,802.4	365,873.2	4,798,873.2	1.70	----------	1.00	0.00000	0.00000	N	0	1.69918	4,798,873
November	30	5.30	1.06	4.24	1.20	3.24	0.20	----------	----------	1.00	143,000.0	9,982.6	299,476.7	4,589,476.7	1.63	----------	1.00	0.20000	0.20000	Y	564,845	3.12422	8,823,504
December	31	1.99	0.40	1.59	0.62	3.35	2.38	----------	----------	1.00	143,000.0	2,488.7	77,150.3	4,510,150.3	1.60	----------	1.00	2.37600	2.37600	Y	6,710,364	2.34517	6,623,291
TOTAL =	365	53.23	10.65	42.58	32.60	39.42	30.10			12.00			991,303.7	53,186,303.7	18.83			18.83	18.83		53,186,304		

1.00
1.50
2.00
2.00
2.00
1.50
1.00

☐ <<== Check "Spray Factors Box" if any Factors OTHER than 1.00 used.

☑ <<== Check "Factors Reset Box" to reset all Factors back to 1.00

Results:

Total Storage Required of **4.74** inches = **93.6** days of Storage

Notes:

Spray Irrigation Monthly Application Factor = a forcing factor by which the "normally" Actual Spray Irrigation Rate is multiplied by, with the Storage Required being re-calculated to account for this factor.

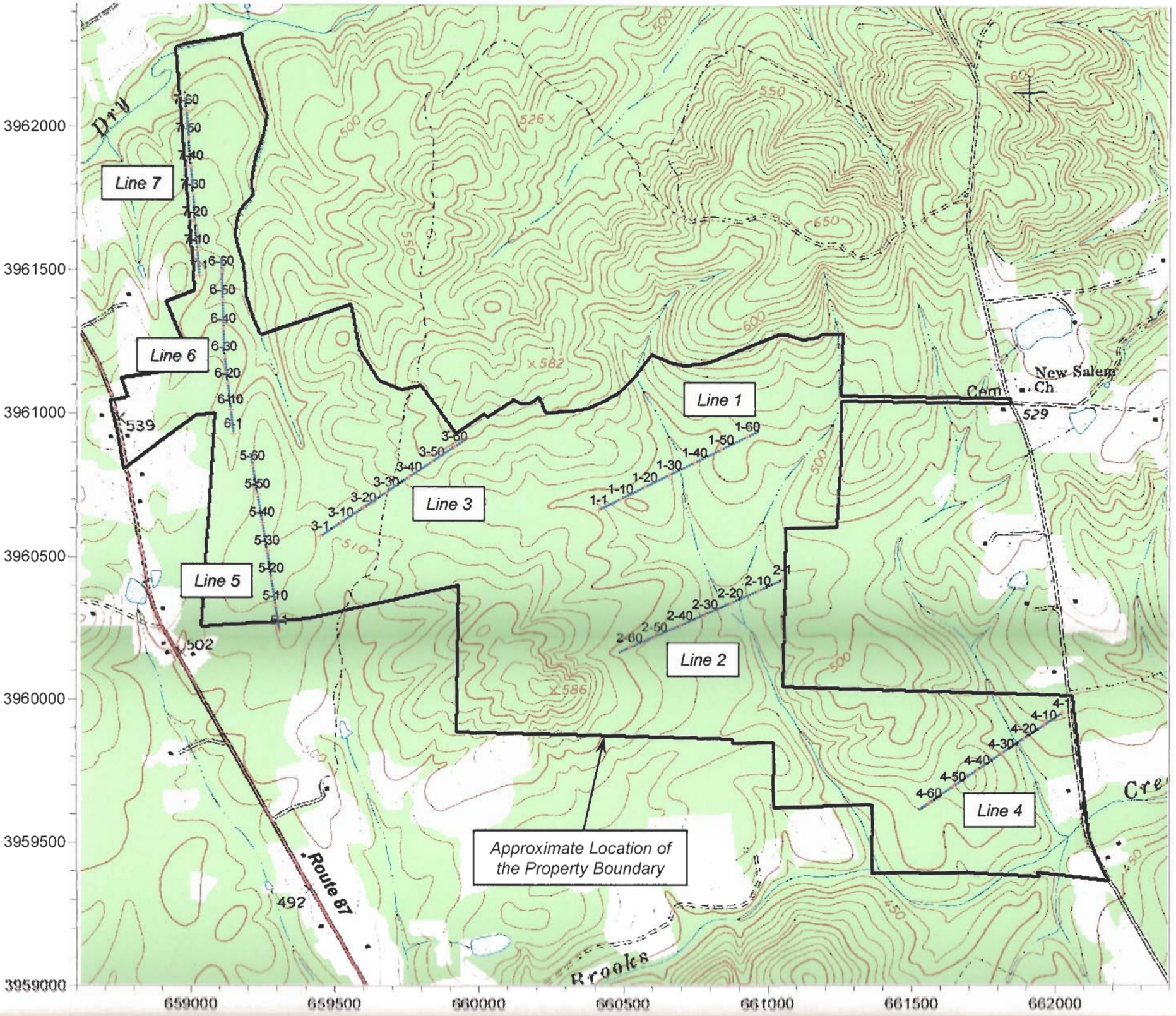
Formulas:

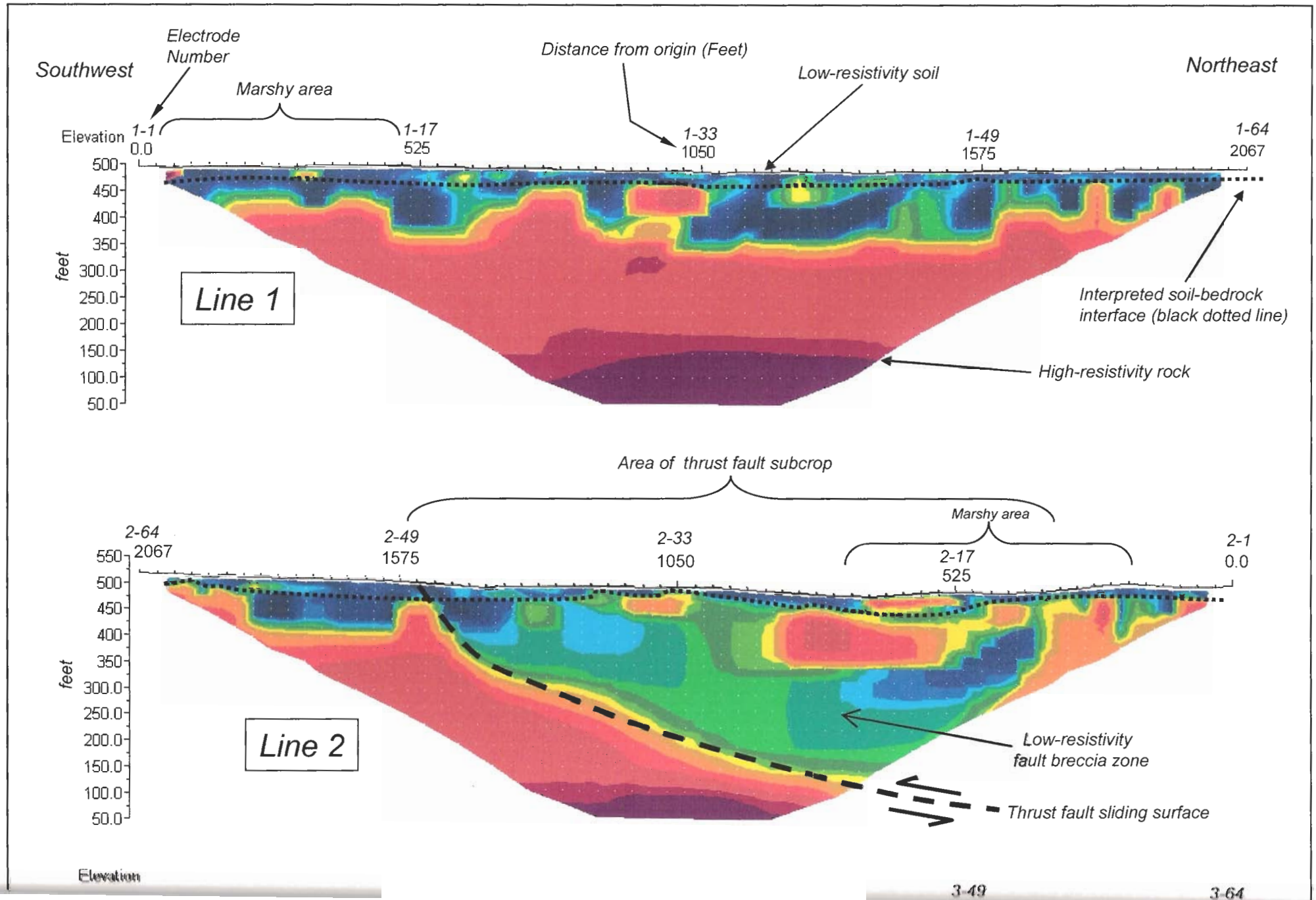
(Max. Allowable Irrigation) = (ET) + (Drainage) - (Rain)

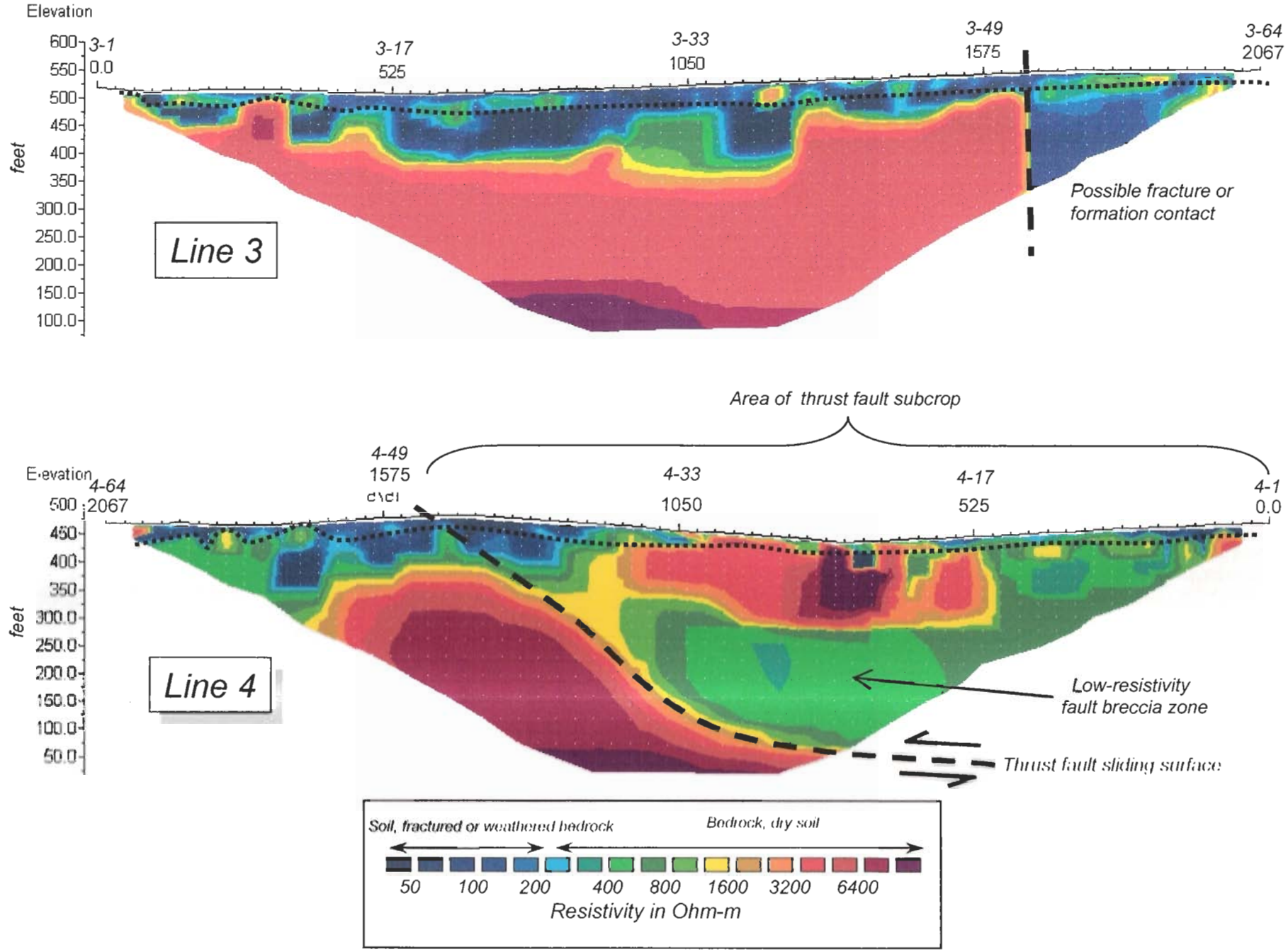
(Monthly Excess) = (Max. Allowable Irrigation) - (Monthly Influent Waste Volume)

where: (- Monthly Excess) = water that must be stored in Storage Pond

where: (+ Monthly Excess) = extra water that can be spray irrigated out of Storage Pond


Line 7
Line 6
Line 5
Line 3
Line 1
Line 2
Line 4
Approximate Location of the Property Boundary
Route 87
New Salem
Ch
Cem
Dry
Brooks
539
502
492
529
3962000
3961500
3961000
3960500
3960000
3959500
3959000
659000
659500
660000
660500
661000
661500
662000


Southwest
Electrode Number
Marshy area
Distance from origin (Feet)
Low-resistivity soil
Northeast
Elevation
1-1
0.0
1-17
525
1-33
1050
1-49
1575
1-64
2067
500
450
400
350
300.0
250.0
200.0
150.0
100.0
50.0
feet
Line 1
Interpreted soil-bedrock interface (black dotted line)
High-resistivity rock
Area of thrust fault subcrop
Marshy area
2-64
2067
2-49
1575
2-33
1050
2-17
525
2-1
0.0
550
500
450
400
350
300.0
250.0
200.0
150.0
100.0
50.0
feet
Line 2
Low-resistivity fault breccia zone
Thrust fault sliding surface
Elevation
3-49
3-64

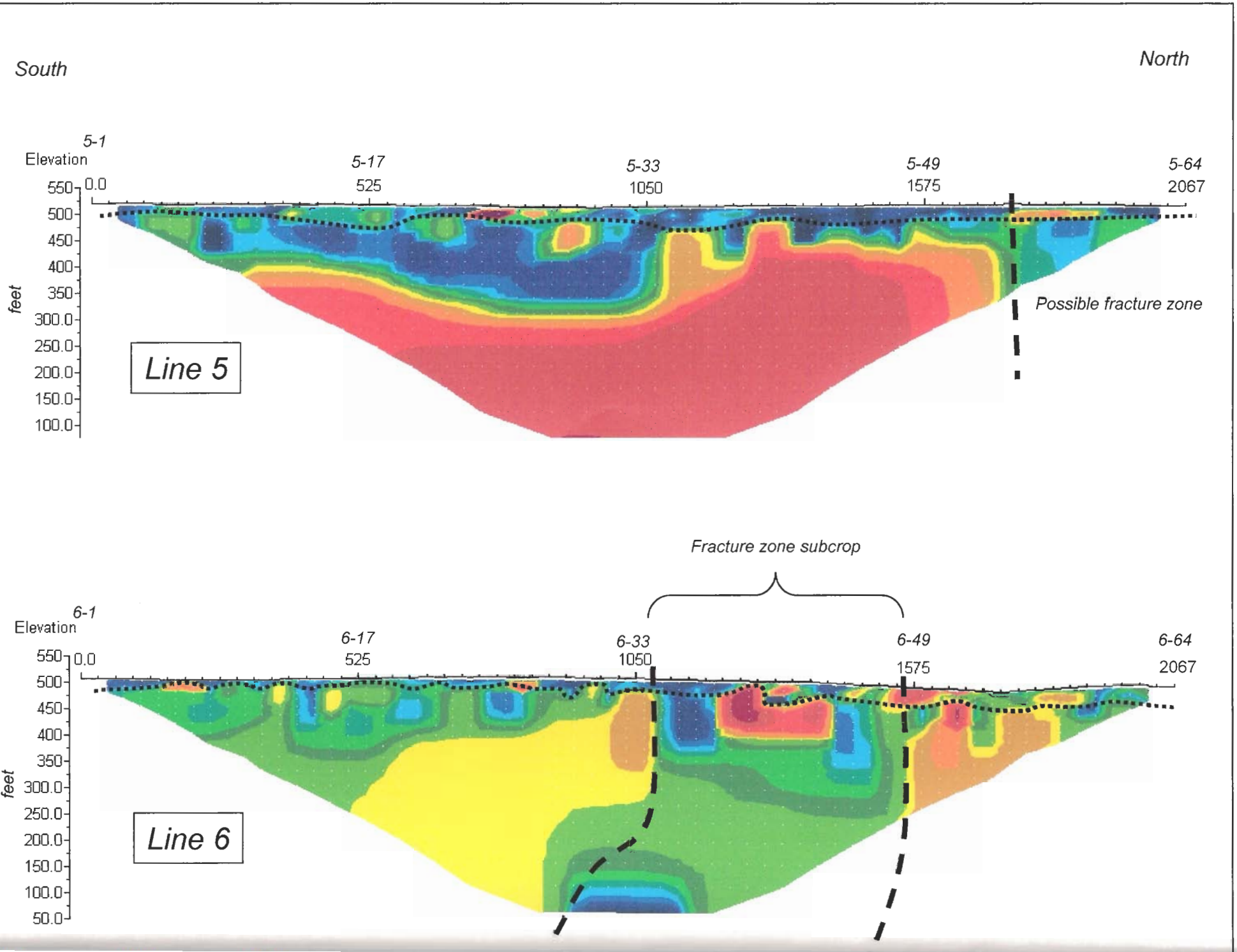


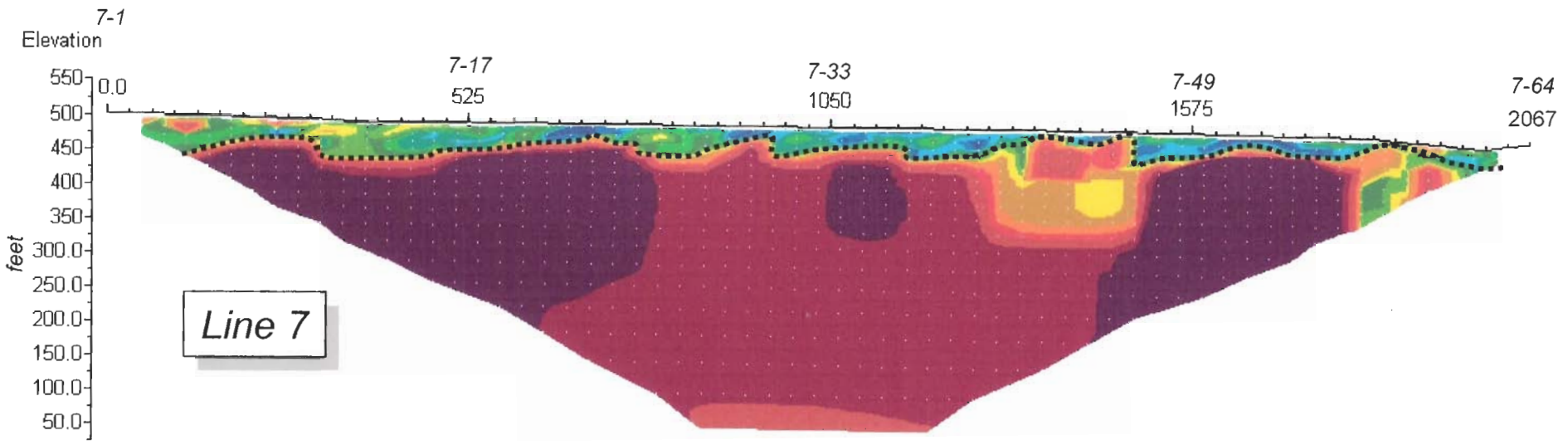
Report Title:
Bedrock and Fracture Study for the Proposed Buck Mountain IP Tract Land Application Project, Chatham County, NC

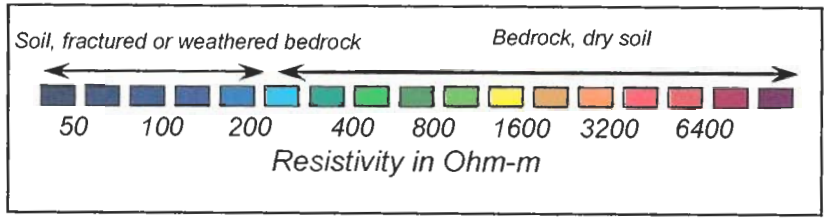
File Name: *Buck Mtn fig pt ppt*

Figure 6. Results of the resistivity sections for Lines 1 through 4

ATS **International**
Advanced Technical Services
Christiansburg, VA


South
North
5-1
Elevation
0.0
5-17
525
5-33
1050
5-49
1575
5-64
2067
550
500
450
400
350
300.0
250.0
200.0
150.0
100.0
feet
Line 5
Possible fracture zone
Fracture zone subcrop
6-1
Elevation
0.0
6-17
525
6-33
1050
6-49
1575
6-64
2067
550
500
450
400
350
300.0
250.0
200.0
150.0
100.0
50.0
feet
Line 6





Report Title: *Bedrock and Fracture Study for the Proposed Buck Mountain IP Tract Land Application Project, Chatham County, NC*	
File Name:	*Buck Mtn tb pt.ppt*
Date:	*12/13/04*
Draftsman:	*CMP*

Figure 7. Results of the resistivity sections for Lines 5, 6 and 7 illustrating the interpreted subsurface geology.

ATS International
Advanced Technical Services
Christiansburg, VA
540-382-8861

Engineering Geology, Hydrology, and Geophysics
Computer Modeling and Visualization