Well-to-Wheel Analysis of Cellulosic Ethanol Produced via Coskata Process

May Wu

Center for Transportation Research

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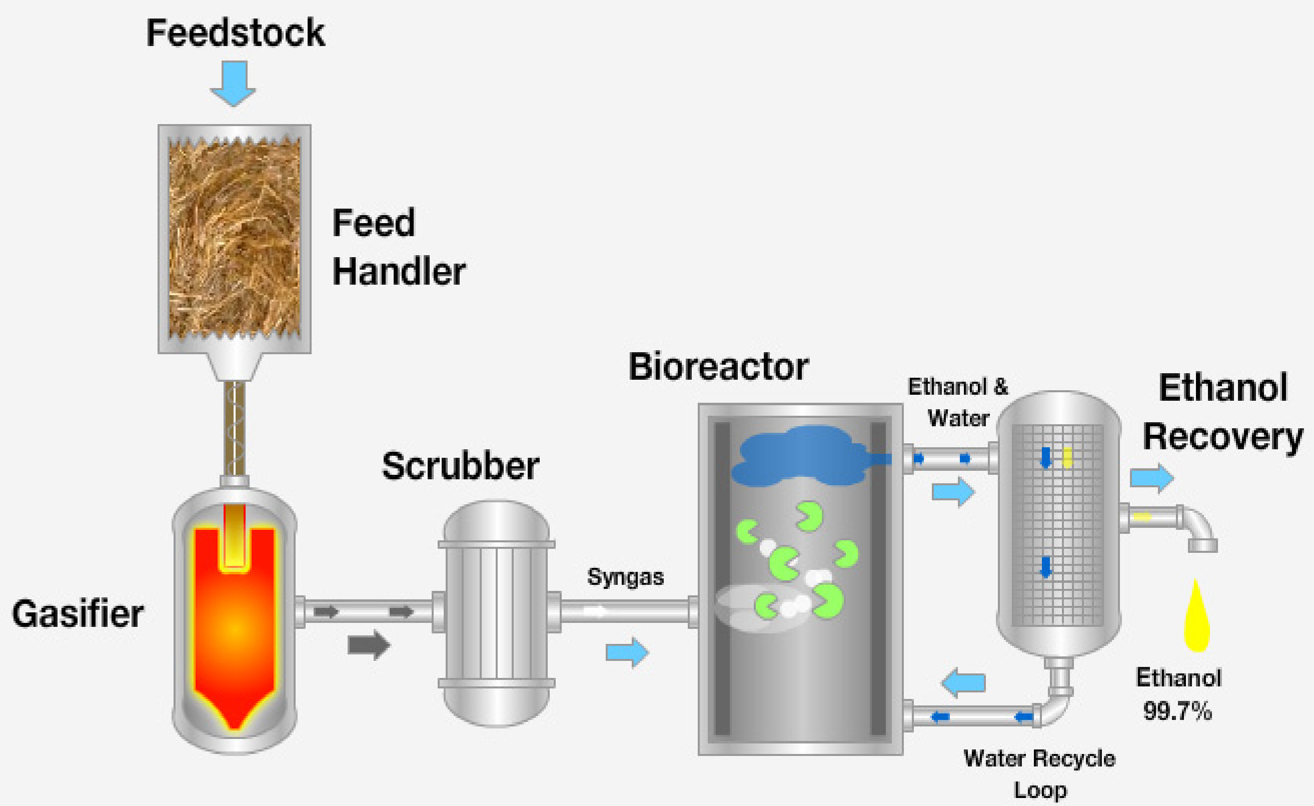
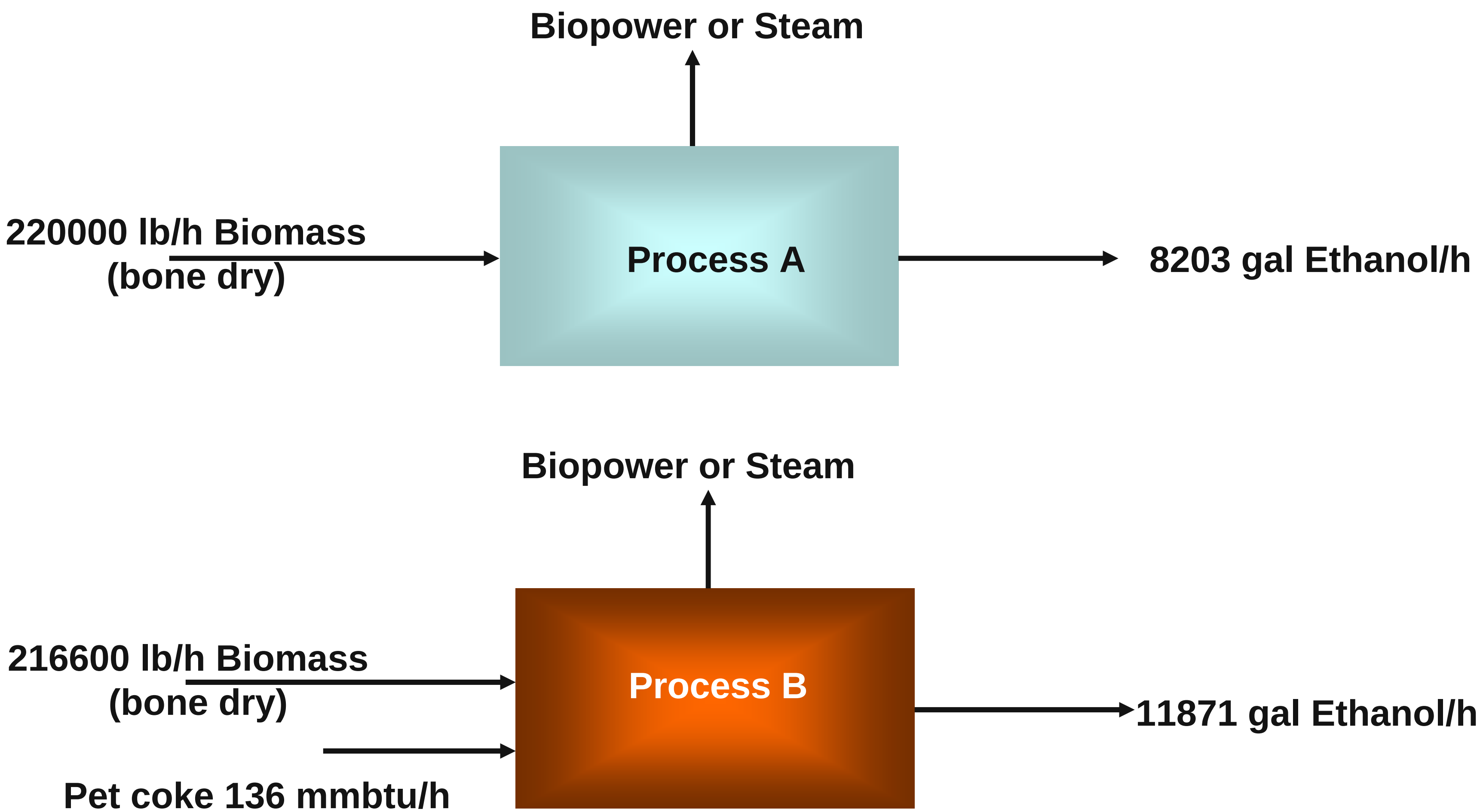
The Coskata Process



WTW Analysis for Coskata Process

- Feed moisture content: 20% and 40%
- Process design variation: Process A and B
- Production options
  - Stand alone plant
    - *No co-gen: produce ethanol, purchase electricity from grid*
    - *Co-gen: produce ethanol and electricity generation through flue gas heat recovery*
  - Co-locate – excess steam export to a co-locating plant
  - Co-feeding
    - *Forest residue woodchips with supplemental fuels*
      - pet coke (9% btu share)
      - coal (8% btu share)
- Conventional gasoline (baseline case)

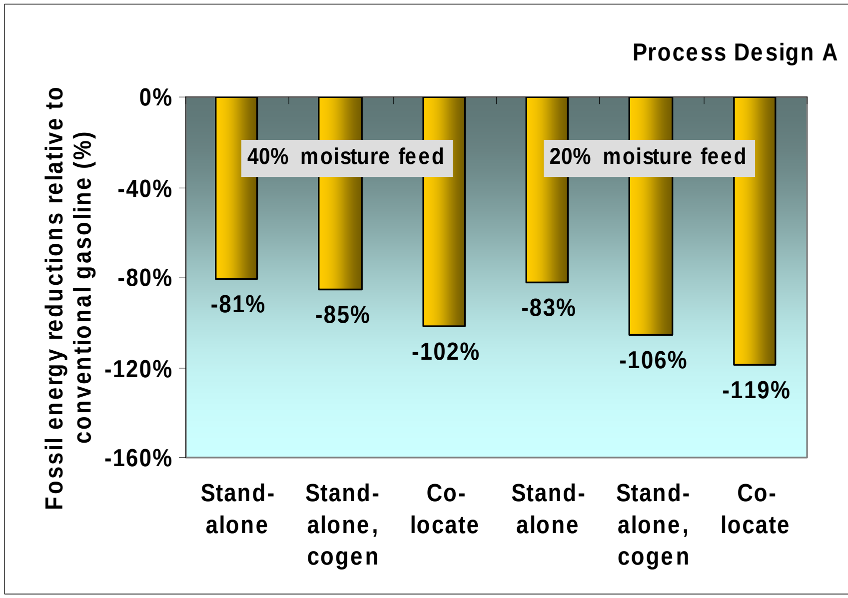
Syngas-to-Ethanol Production Process Energy Input/Output

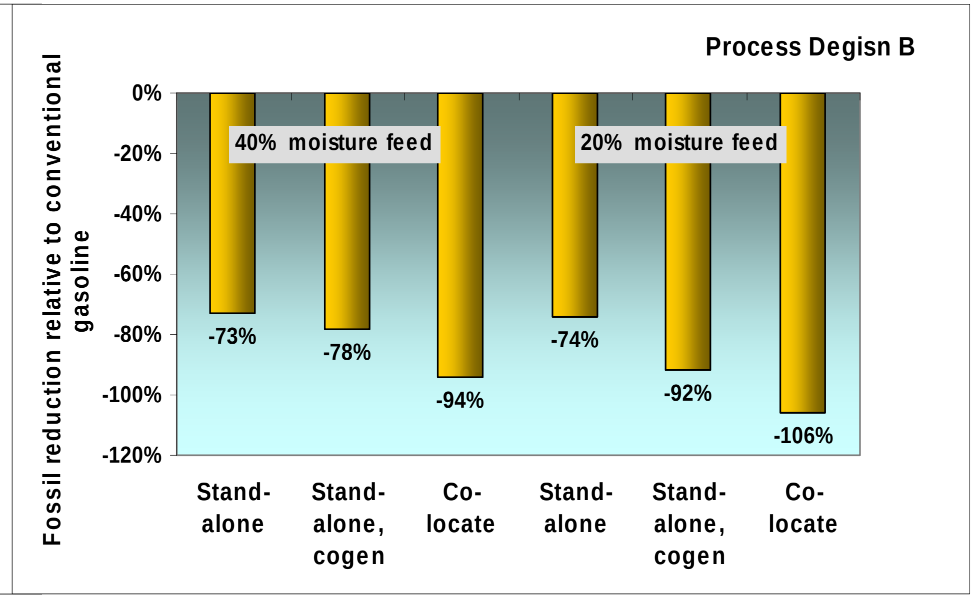


Major Assumptions

- Forest wood residue as feedstock
- Feedstock collection and transport using GREET default feedstock pathway for forest wood residue
- Petroleum, natural gas, and coal production process based on GREET default value
- Electricity: US average mix
- Electricity generation from off-gas via gas turbine with 40% efficiency
- Electricity generation from steam turbine with 75% efficiency
- Excess electricity is exported to replace US average mix electricity
- Steam is generated using a natural gas (NG) boiler with 80% efficiency
- Excess steam to be exported to displace steam generated from NG fired boiler
- Results are expressed as million Btu of ethanol to examine the effect of fuel ethanol alone without the influence of vehicle fuel economy nor gasoline denaturant
- Time frame: Year 2010

Fossil Energy Reduction Profile from Coskata Process Represents Typical Second Generation Fuel Ethanol

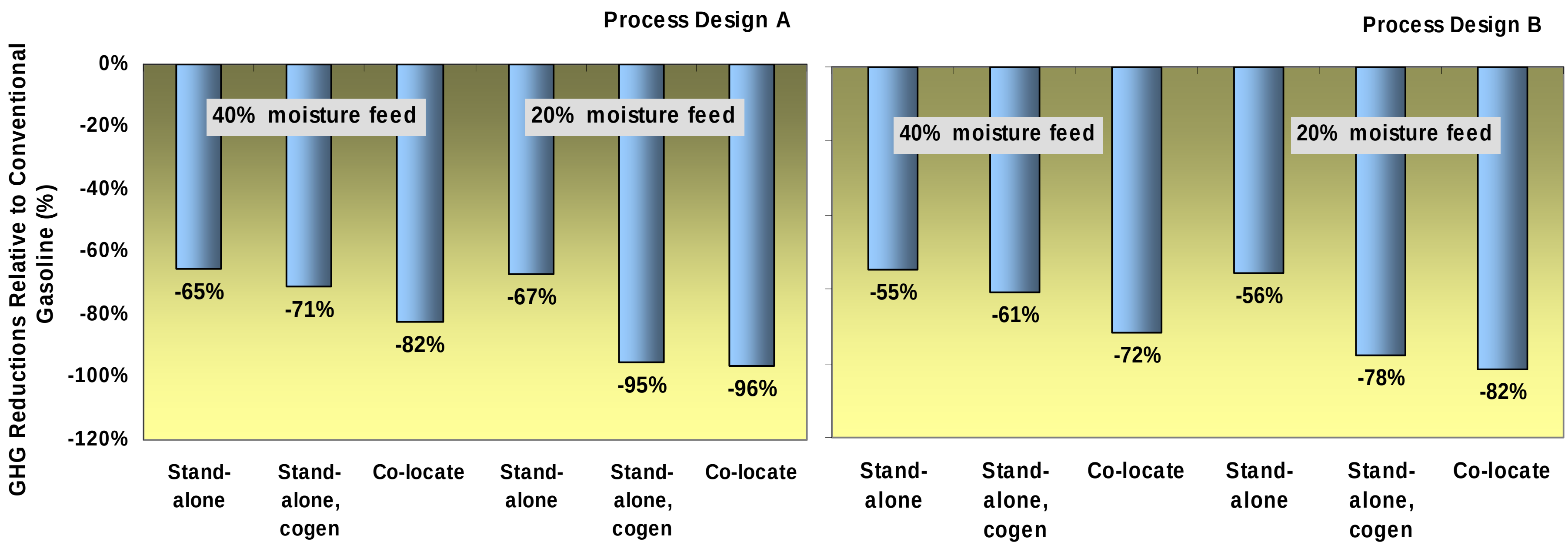




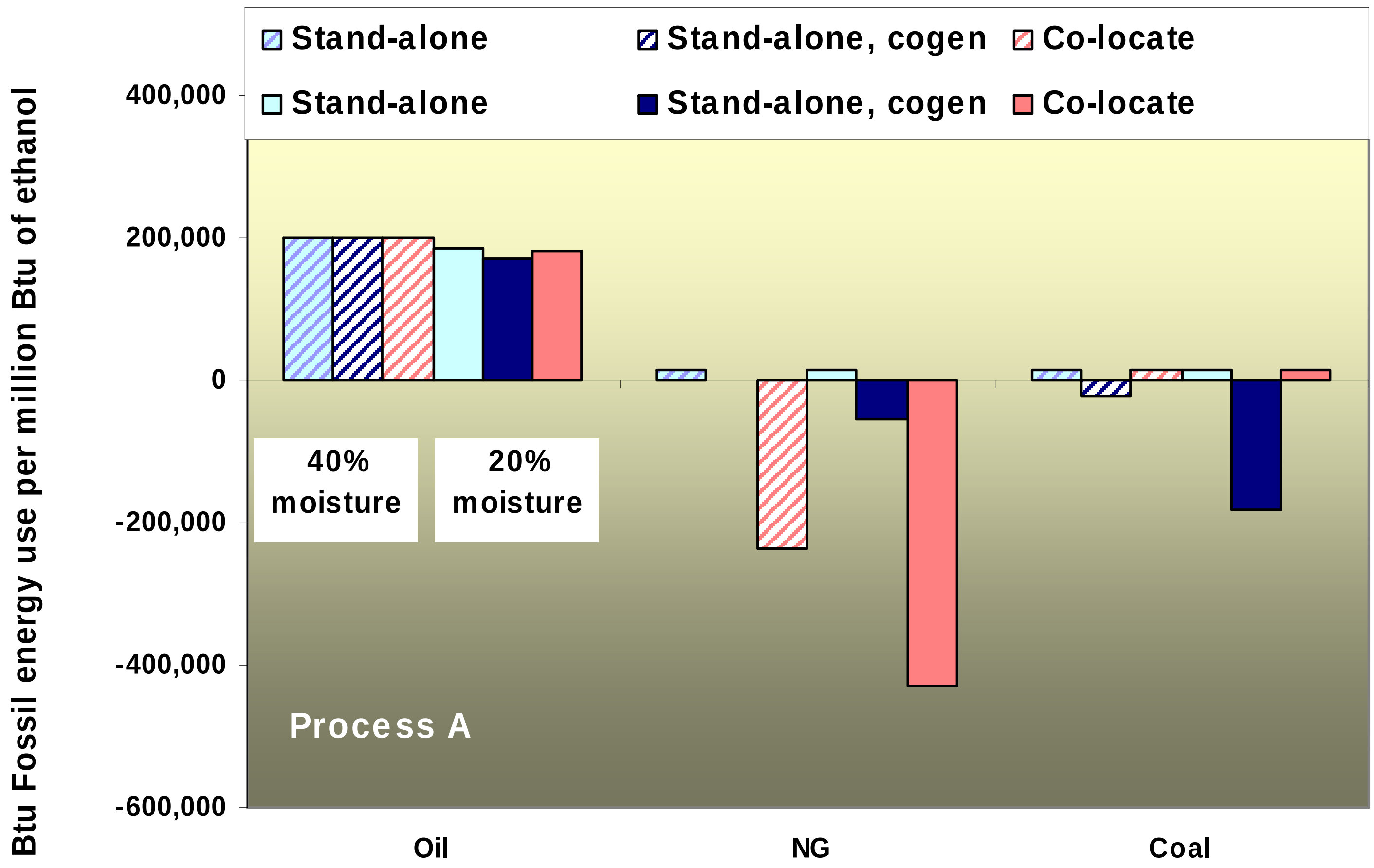
- Oil Reduction:

Process Design A 81% -84% Process Design B 71% - 74%

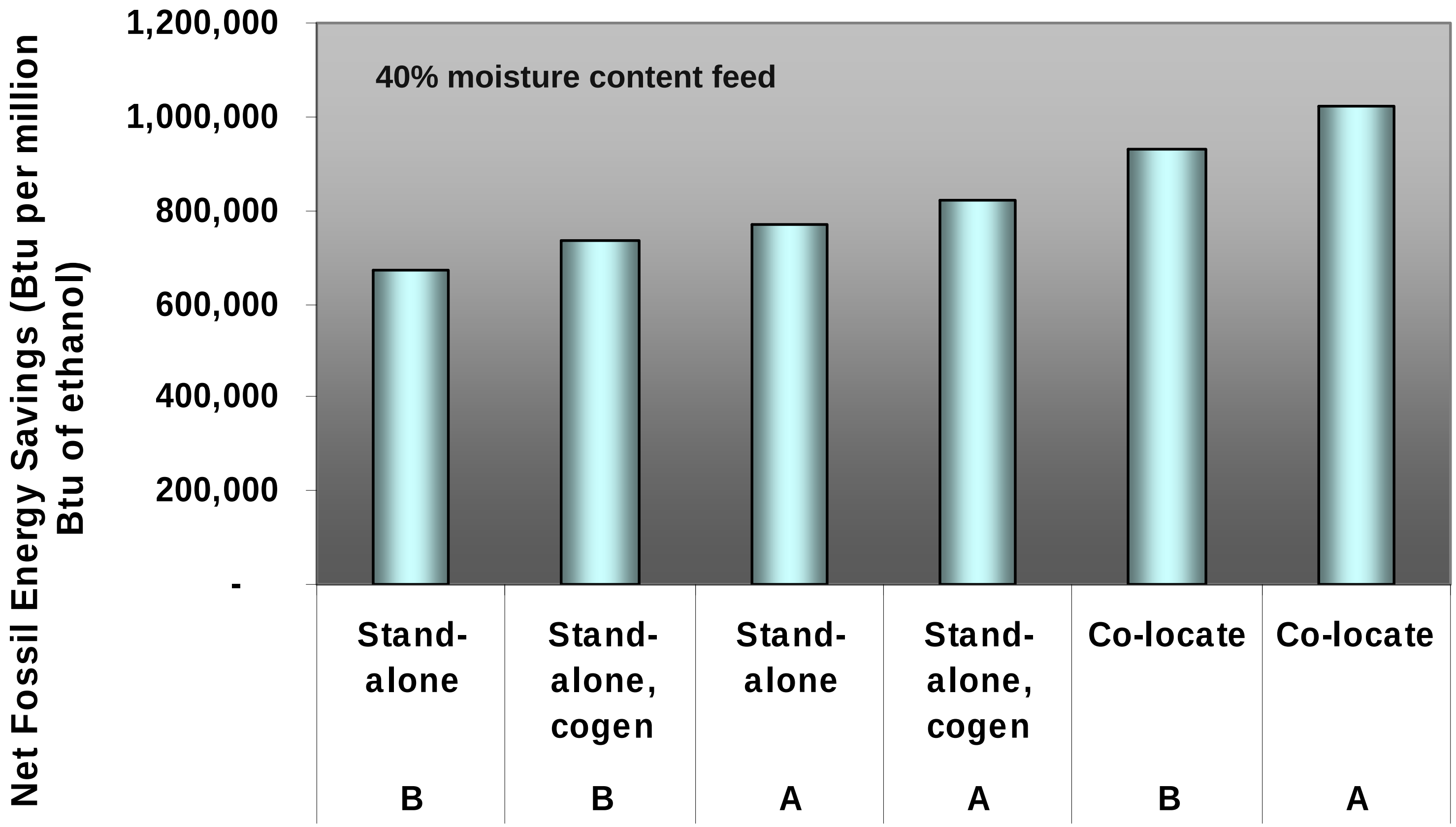
Electricity Co-Generation and Steam Export Avoided 61%-96% of Greenhouse Gases Burden



The Amount and the Type of Fossil Energy Savings are Sensitive to the Choice of Production Options



Syngas-to-Ethanol Process Design and Production Options Achieved Positive Net Energy Balance



Net Energy Balance defined as one million Btu fuel ethanol – Btu of fossil inputs to produce ethanol

Conclusions

- Both Stand alone with co-gen and Co-locate with steam export cases can achieve substantial oil and fossil savings from wells to wheels
  - Oil: 71% - 84%
  - Fossil: 73% - 100%

- The cases examined are able to avoid significant greenhouse gas burdens 61% - 96% in comparison with conventional gasoline, when co-gen or steam export is selected.

- The syngas-to-ethanol fermentation process represents a typical second generation biofuel energy and emission profile and is comparable with other woodchip based biofuel production process.

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Nashville TENNESSEE

January 14, 2009

Coskata, Inc.
Attn: Ms. Loula Merkel
Manager, Government Affairs
4575 Weaver Pkwy, Suite 100
Warrenville, IL 60555

Re: Initial Hydrogeologic Information
Project Flagship
Crossroads of America Industrial Park
Greene County, Alabama
TTL Project No. 100108-040

Dear Ms. Merkel:

This letter report provides Coskata, the industrial prospect for Project Flagship, with initial hydrogeologic information regarding the potential yield(s) and chemical characteristics of major aquifers at the Crossroads of America Industrial Park in Greene County, Alabama. The Industrial Park is on an approximate 1,300-acre parcel of land near Boligee, Alabama. Interstate 20/59 divides the property into two parcels that are in Sections 11,12, 13, 14, and 24, Township 21 North, Range 1 West and Sections 18 and 19, Township 21 North, Range 1 East on the Boligee, Alabama U.S.G.S. 7.5 minute topographic quadrangle (Figure 1).

TTL reviewed information in Alabama Geological Survey publications to develop this information regarding the geology and water resources of Greene County, Alabama. General information is provided about the characteristics of the three principal aquifers that were identified. The three geologic formations with aquifers from which a properly constructed well might yield 500 gallons per minute (GPM)–about 700,000 gallons per day (GPD)–at the Industrial Park site are the Eutaw, Gordo, and Coker Formations. Summaries of the lithologic and water-availability characteristics of these formations, from shallowest to deepest, are provided as attachments to this letter report.

There are several aquifers within the Eutaw Formation, which is about 400 feet thick. Aquifers within the upper Eutaw Formation might yield at least 100 GPM but the main aquifer is typically a coarse-grained sand and gravel aquifer that is within the lower 200 feet of the Eutaw Formation and might yield about 700,000 GPD to a properly constructed well. Water from the Eutaw Formation in the general southern part of the site has been rated by the Alabama Geological Survey as "poor" because it likely will contain 500 to 1000 mg/L (milligrams per Liter) of chloride and greater than 500 mg/L of total dissolved solids (TDS). Water in the general northern part of the site was rated as "good" due predominantly to a decrease in chloride concentrations.

The major aquifer of the about 300-foot thick Gordo Formation is within the lower 150 to 200 feet of the Formation. A properly constructed well might produce 700,000 GPD from the major aquifer of the Gordo Formation. Water in the Gordo Formation in the area of the site has been rated by the Alabama Geological Survey as "good to fair" because of chloride (250-500 mg/L) and TDS (500-1000 mg/L). The entire thickness of the Gordo Formation should be tested to determine the most productive sediments that could yield water with the lowest concentrations of chloride and TDS.

The Coker Formation is the most favorable formation from which to obtain water with less than 500 mg/L chloride in the site area, although it is the deepest of the three formations. The Coker Formation is 600 to 900 feet thick in Greene County. Sands in the lower part of the Formation comprise the major aquifer. In a publication by the Alabama Geological Survey, the authors postulated that the Coker aquifer might yield as much as 700,000 GPD to a properly constructed well but noted that the Coker Formation had not been tapped because of its excessive depth and the availability of water from shallower aquifers.

The chemical characteristics of the water that likely is available from each aquifer should be compared to the characteristics of the water that will be needed for the processes at the facility. An option to improve the quality of the water and/or to increase the overall production of water is to use a multi-zone well or several single-zone wells. Thus, a well might be completed in each of or a combination of the aquifers and the water from each aquifer segregated and/or blended to correspond to the intended use at the facility. Likewise, a single well might be constructed that is screened in each of or a combination of the aquifers to produce a blended water that meets the requirements at the facility. Decisions about the uses of multiple screenings within a single well and/or multiple wells that produce from separate zones should be based on further hydraulic evaluations and discussions with knowledgeable hydrologists of appropriate agencies and with knowledgeable drillers to avoid creating detrimental effects on the water qualities of each aquifer (for example, by upward/downward leakance).

Consideration should be given to obtaining water from the lower-quality aquifers (Eutaw and Gordo Formations) to preserve the fresher water of the Coker Formation for use as drinking water if water-quality or well-interference factors do not dictate the source of groundwater at the facility.

The information that was used to compile the above information is attached to this letter report. Please note that the information in this letter is general. A more detailed analysis of data and information from which to estimate the potential yields and chemical characteristics of the aquifer can be accomplished through discussions with personnel of the Alabama Geological Survey and more detailed study of published and unpublished data and information. **TTL** appreciates the opportunity to assist you by compiling this information and is hopeful that we will be allowed to assist you in selecting a water supply(ies) for Project Flagship. Please contact Jim Bambarger at 205.345.0816 if we can be of further assistance.

Yours truly,

TTL, Inc.

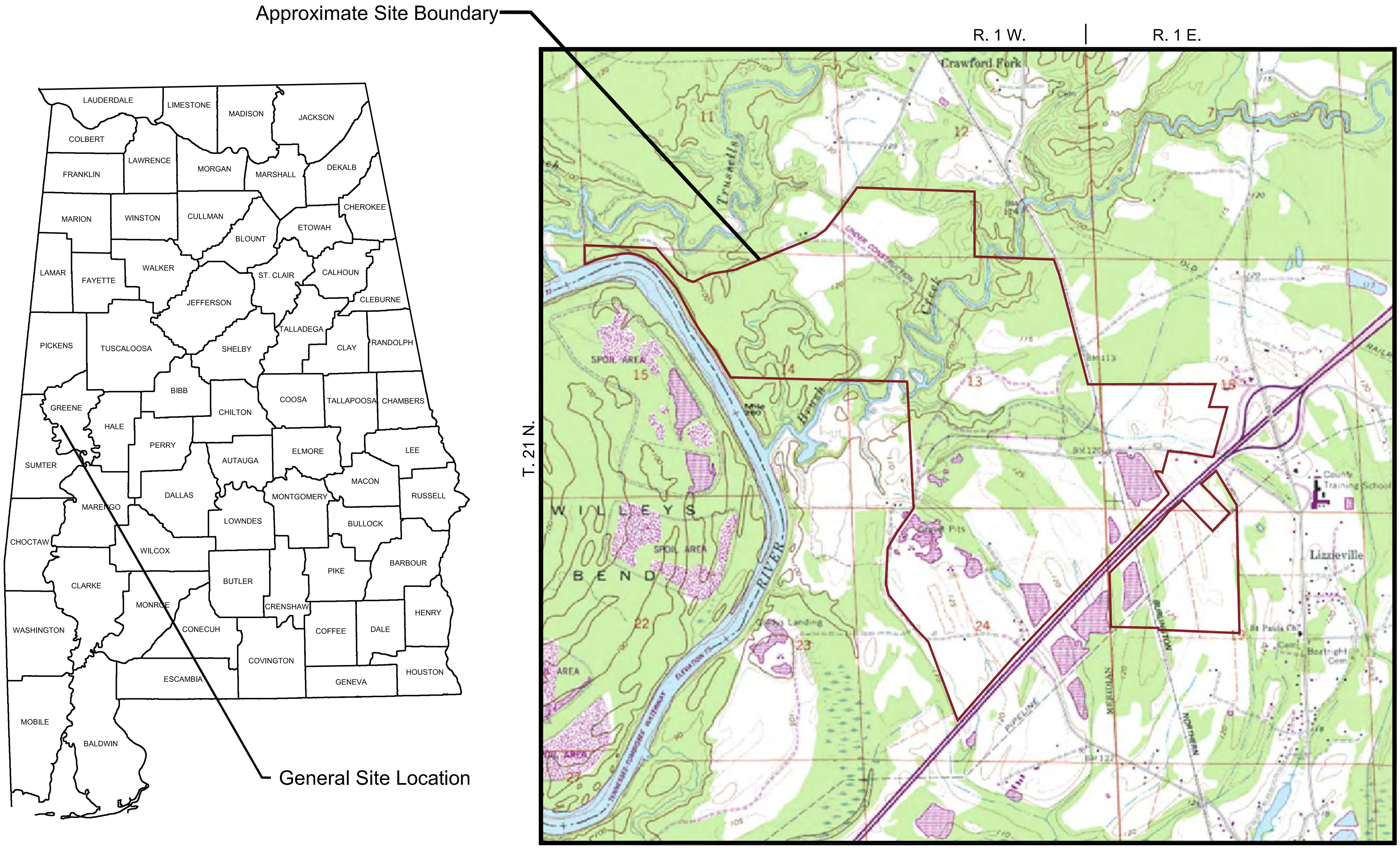
Tola B. Moffett

Tola B. Moffett, Ph.D., P.G., P.E.

James C. Bambarger, P.E.

Attachments

ATTACHMENTS



Source: USGS Boligee 7.5 Minute Quadrangle Map, 1970 (Photorevised 1987)

TTL
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TTL PROJECT NO: 100108-040
PROJECT DATE: June, 2008

Figure 1. Site Location and Topographic Map
Sec. 11, 12, 13, 14 & 24, T. 21 N., R. 1 W. and Sec. 18 & 19, T. 21 N., R. 1 W.
of the Boligee 7.5 Minute Quadrangle Map
Crossroads of America Industrial Park
Boligee, Greene County, Alabama

N
1" = 3000'
(Approximate)

F:\Secretary\2008\100108\040 Crossroads of America\Phase I ESA\08-040 Fig 1 Topo.dwg

ENVIRONMENTAL GEOLOGY OF AN AREA IN WEST-CENTRAL ALABAMA

Compiled by Paul H. Moser and Michael J. Keener

PREPARED FOR
ALABAMA DEVELOPMENT OFFICE
STATE PLANNING DIVISION
BY
GEOLOGICAL SURVEY OF ALABAMA

P. E. LaMoreaux, State Geologist

ENVIRONMENTAL DIVISION
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ATLAS SERIES 7

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ABSTRACT

This study presents the environmental data necessary to plan for development brought on by the construction of the Tennessee-Tombigbee Waterway.

The study area includes all of Sumter County and those parts of Greene and Pickens Counties adjacent to the Tombigbee River. Land use is now limited to crops, pasture, forest and related industries. Substantial supplies of surface water and ground water are available and should encourage economic development. Sand and gravel are available for construction; abundant chalk and clay are available for use as lightweight aggregate. Energy sources in this area have not been fully developed. A coal-fired steam plant provides electricity to surrounding areas and a narrow band of lignite that has not been developed occurs in Sumter County.

This area has the potential to become more productive; therefore, this report provides information on the area's positive characteristics and enumerates its limiting factors so that development will be accomplished in an orderly and efficient manner.

University, Alabama

1975

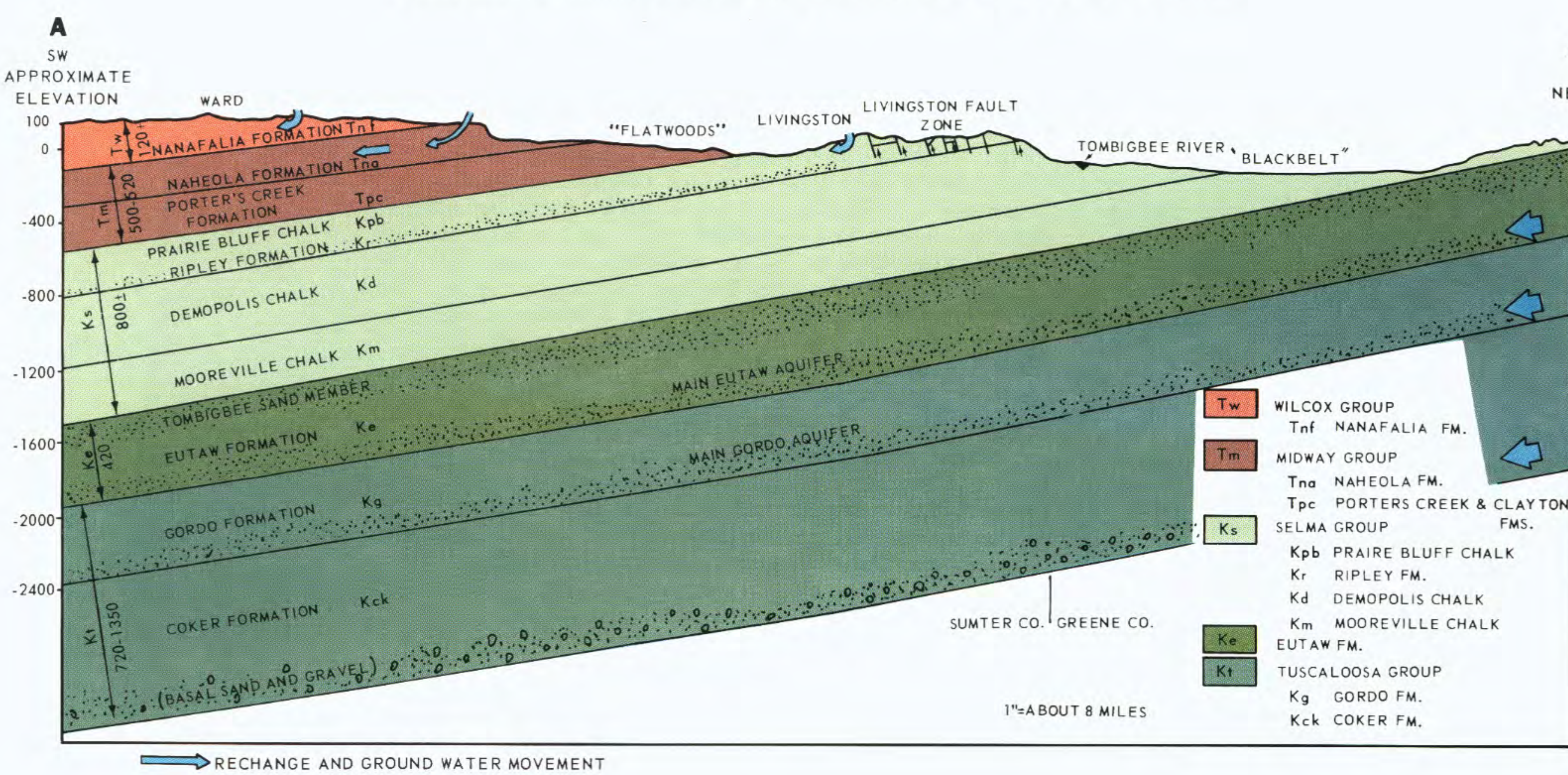
Ground Water

OCCURRENCE AND MOVEMENT

Ground water in west Alabama occurs under water-table and artesian conditions. Water-table conditions occur in the extreme northeast and southwest parts of the area and in river valleys where the water-bearing formations are not confined by impermeable formations. However, most of the ground water is obtained from wells tapping sand and gravel beds in the Eutaw and Gordo Formations. These formations are overlain by the relatively impermeable chalk of the Selma Group, which confines the water and causes it to occur under artesian pressure. When this confining bed is penetrated by a well, hydrostatic pressure forces water to rise above the top of the aquifer. If hydrostatic pressure is sufficient, a flowing artesian well will result.

Since the sedimentary formations in the study area dip toward the southwest, the aquifers are at progressively greater depths in that direction. Regional movement of ground water generally conforms to the dip of the formations.

A SCHEMATIC HYDROGEOLOGIC CROSS SECTION OF PART OF WEST ALABAMA



AVAILABILITY IN EUTAW FORMATION

Sand and gravel aquifers in the Eutaw Formation supply more water than any other unit in the study area. This formation is about 400 feet thick and several aquifers within it yield large quantities of water. The main aquifer consists of coarse-grained sand and gravel that occurs in the lower 200 feet of the formation. Since the formation dips to the southwest at approximately 35 feet per mile, depths to all aquifers increase in that direction.

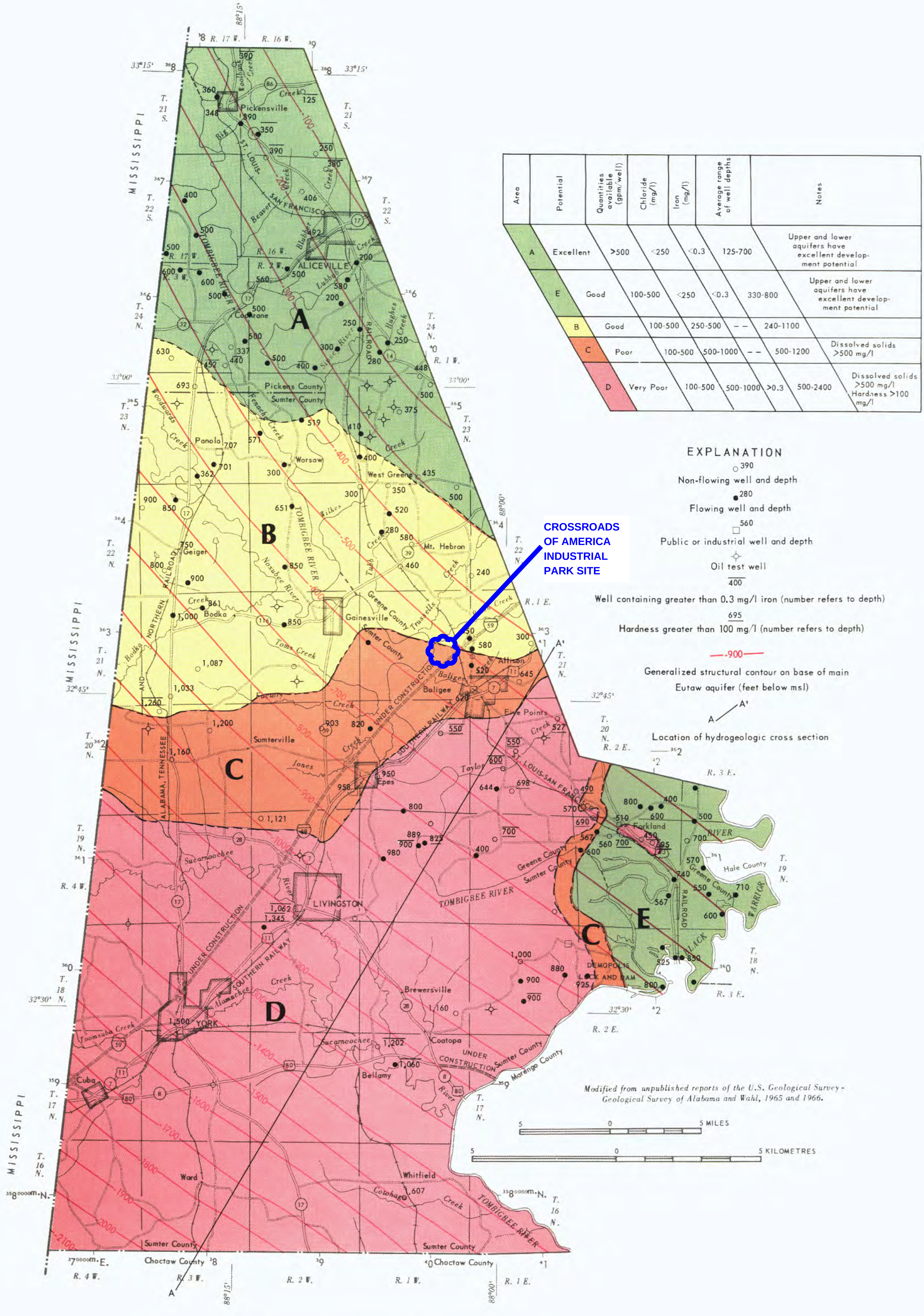
Structure contours were drawn on the base of the main aquifer. To obtain the depth to the base of the aquifer, add the elevation of the well site to the contour line nearest the site. For example: At Gainesville the average elevation is 130 feet above mean sea level; the nearest structure contour is -600 feet. Therefore, 600 feet plus 130 feet equals 730 feet-the projected depth to the base of the main Eutaw aquifer. Since this aquifer is about 150 feet thick, the well should be completed between 580 and 730 feet below land surface. Properly constructed wells in this basal Eutaw aquifer should yield more than 500 gpm per well. The expected chemical quality of ground water can also be determined from this map. For instance, Gainesville is located in area B, where chlorides range between 250 and 500 milligrams per liter (mg/1).

The best potential for development of the Eutaw Formation exists in areas A and E on the accompanying map. Aquifers capable of yielding 500 gpm per well are present in the lower Eutaw, and more than 100 gpm per well in the upper Eutaw. In area A several wells penetrating the main aquifer have been test-pumped at 600 gpm. Immediately southeast of Forkland, in area E, is an area of highly minerlized ground water that yields poor quality water to drilled wells.

AVAILABILITY IN GORDO FORMATION

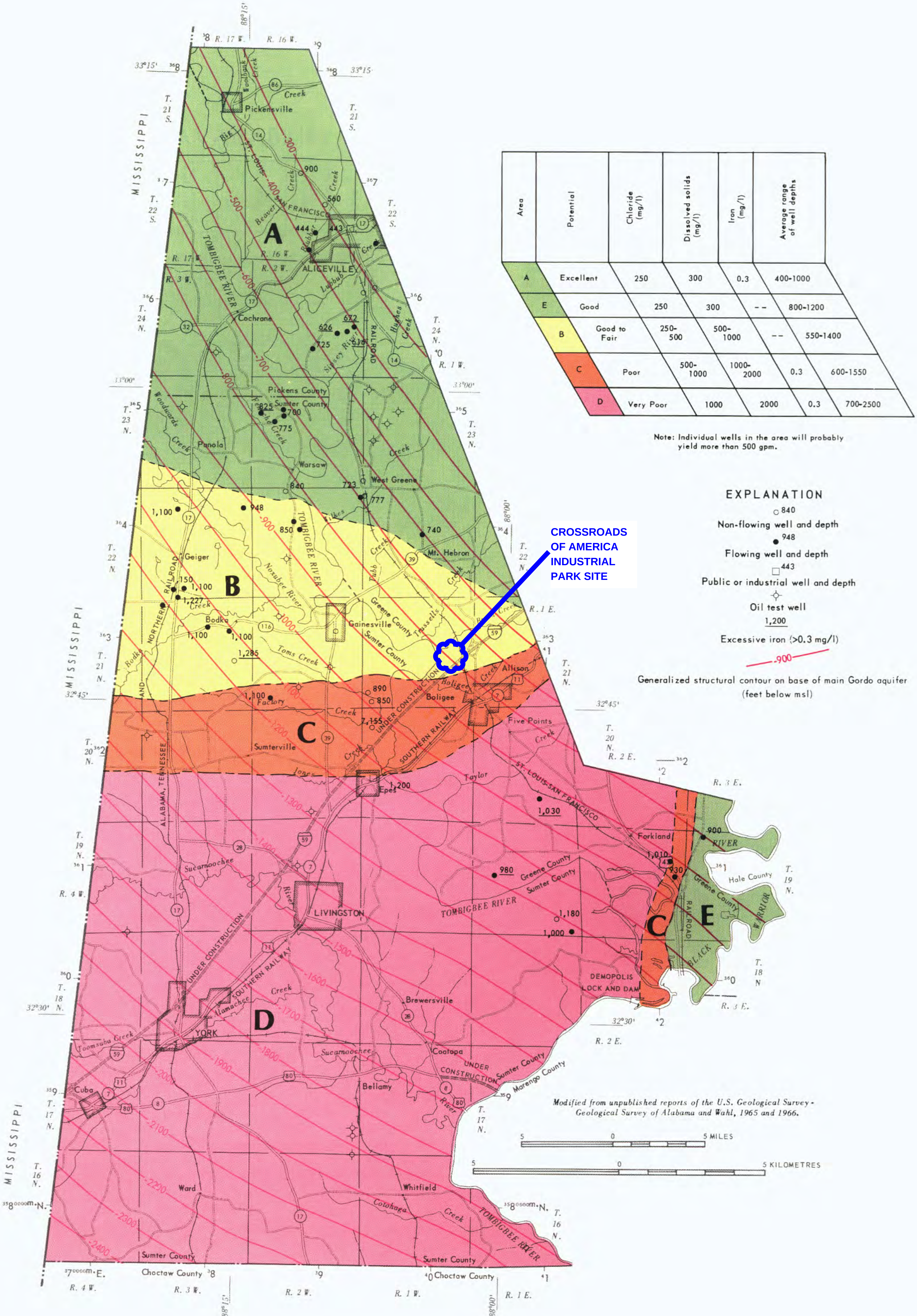
The Gordo Formation, which underlies the Eutaw Formation, ranges in thickness from approximately 280 feet in Greene County to between 300 and 450 feet in Sumter County. Water-bearing sands occur throughout the formation, but the major aquifer is the lower 150 to 200 feet. The structure contours indicate that the aquifer dips to the southwest at approximately 40 to 45 feet per mile. Therefore, depths to the base of the aquifer range from less than 400 feet in the northeast, near Aliceville, to more than 2,700 feet in the southwest extremity of the area. However, the Gordo has not been tapped by many wells in the central and southern parts of Sumter County (area D) because of its depth and the probability of obtaining mineralized water.

Records indicate that properly constructed wells in the basal Gordo aquifer might produce more than 500 gpm throughout most of the area. Sand beds in the upper part of the formation are relatively thin and generally yield smaller quantities of water. Therefore, if large capacity wells are desired, the entire thickness of the formation should be tested to determine the most productive aquifer containing the best quality water.



Area	Potential	Quantities available (gpm/well)	Chloride (mg/l)	Iron (mg/l)	Average range of well depths	Notes
A	Excellent	>500	<250	<0.3	125-700	Upper and lower aquifers have excellent development potential
E	Good	100-500	<250	<0.3	330-800	Upper and lower aquifers have excellent development potential
B	Good	100-500	250-500	– –	240-1100	
C	Poor	100-500	500-1000	– –	500-1200	Dissolved solids >500 mg/l
D	Very Poor	100-500	500-1000	>0.3	500-2400	Dissolved solids >500 mg/l Hardness >100 mg/l

AVAILABILITY OF GROUND WATER IN THE EUTAW AQUIFER



Area	Potential	Chloride (mg/l)	Dissolved solids (mg/l)	Iron (mg/l)	Average range of well depths
A	Excellent	250	300	0.3	400-1000
E	Good	250	300	--	800-1200
B	Good to Fair	250-500	500-1000	--	550-1400
C	Poor	500-1000	1000-2000	0.3	600-1550
D	Very Poor	1000	2000	0.3	700-2500

AVAILABILITY OF GROUND WATER IN THE GORDO AQUIFER

AVAILABILITY IN COKER FORMATION

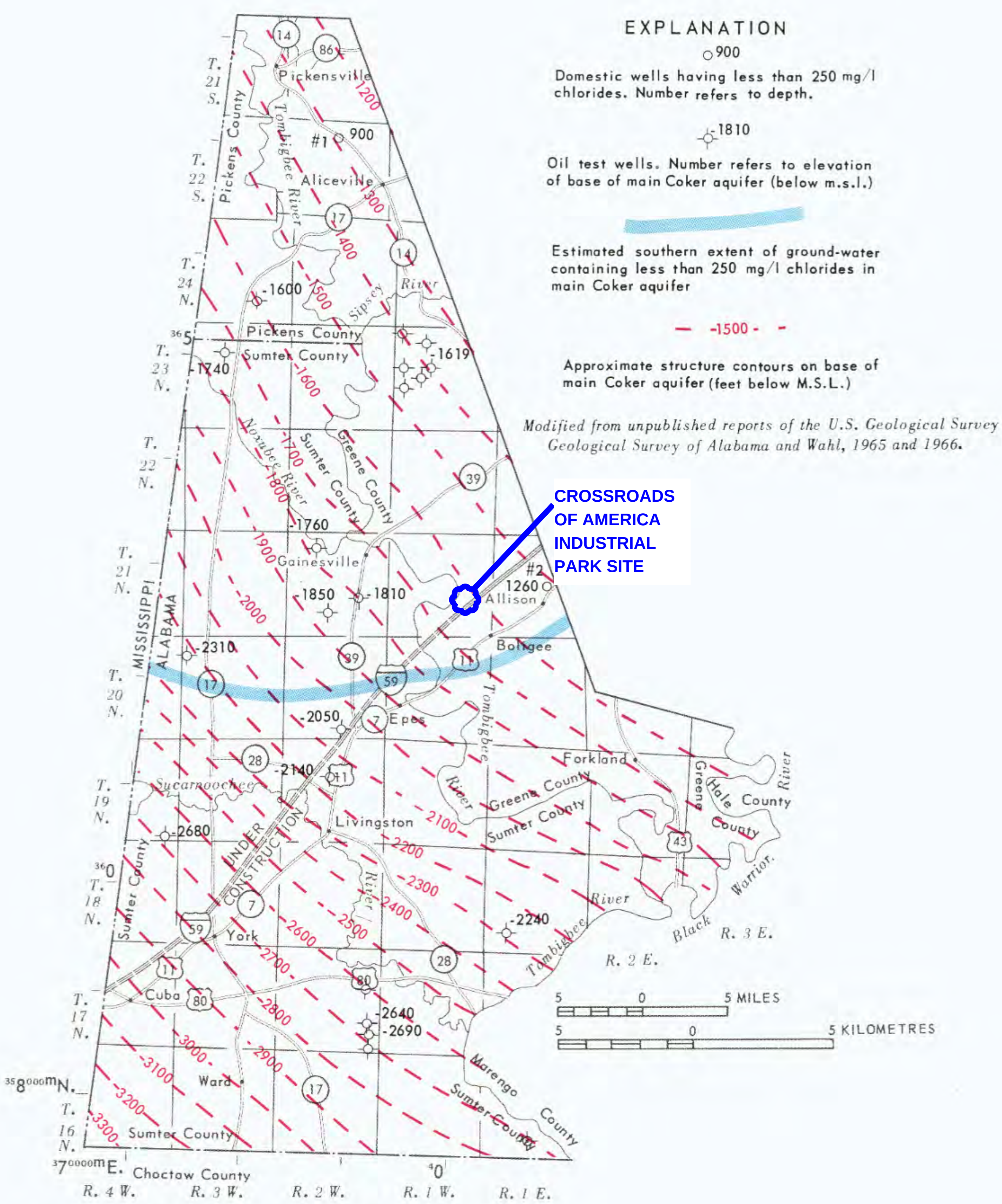
The Coker Formation is the deepest of the three main water-bearing formations in the study area and the one that has been least developed. It underlies the Gordo Formation and has an estimated thickness of 600 to 900 feet. The thickness and potentially the most important aquifer within the Coker is about 200 feet thick and occurs approximately 100 to 200 feet above the base of the formation. Minor aquifers occur above this unit in thin localized sand beds.

The generalized structure map can be used to determine the approximate drilling depths necessary to develop this main aquifer. The map shows that depths to the base of the water-bearing sands increase from 1,450 feet in the northeast to over 3,500 feet in the southwest, indicating that the main aquifer dips 35 feet per mile to the southwest. Although only two water wells have been drilled into the Coker Formation in the study area, the ground water has been estimated to be good quality and is plentiful. Wells in adjacent areas indicate that the main aquifer probably will be capable of yielding 500 gpm per well; the minor Coker aquifers yield 100 to 300 gpm per well.

Previous studies have shown that in parts of west Alabama ground water in the Coker Formation is less mineralized than water in the overlying aquifers. Chemical analyses and sample and electric logs from water wells and oil test wells in southern Pickens and western Greene Counties indicate that basal sand and gravel beds of the Coker contain large quantities of potable water (less than 500 mg/1 total dissolved solids).

For example, domestic well number 2, in Greene County northeast of Allison, is 1,260 feet deep and was flowing 20 gpm in 1965. Chemical analyses of this well showed a chloride content of 23 mg/1 and 178 mg/1 total dissolved solids. Overlying aquifers in this area frequently contain more than 500 mg/1 chlorides. Projection of this data into Sumter County indicates that potable water within the Coker Formation may extend into central Sumter County.

The southern extent of ground water in the main Coker aquifer has been estimated, and wells need to be drilled to test the quality and quantity of the ground water to the north and south of this line to determine the true extent of usable ground water in the Coker Formation. Should it be proven that water in the Coker Formation is usable, its presence would represent a very significant addition to the natural resources of west-central Alabama.



POTENTIAL FRESH WATER SUPPLY IN COKER FORMATION

TERTIARY AQUIFERS

Sediments of Tertiary age crop out in southwestern Sumter County. Aquifers occur in the Naheola Formation, Nanafalia Formation, and Tuscahoma Sand. These formations dip to the southwest at approximately 35 feet per mile. Artesian wells occur in the valley of Alamuchee Creek, south of Cuba.

The Naheola Formation is about 200 feet thick and depths to the base of the formation range from 20 feet in the outcrop area to over 600 feet in the southwest corner of Sumter County. The sand in the upper part of the formation is a source of small to moderate ground water supplies. The most productive well in the formation yields about 40 gpm at Cuba. Water from the Naheola is soft, generally low in dissolved solids, but locally has a very high iron content.

The Nanafalia Formation overlies the Naheola and is approximately 120 feet thick. The basal 40 feet of the formation may yield as much as 50 gpm per well in Sumter County. The best potential for development is in the southernmost part of Sumter County near Kinterbish, where ground water occurs under artesian pressure. Water from the Nanafalia is generally soft, and low in dissolved solids and chlorides. Locally, iron content may be high.

The Tuscahoma Sand overlies the Nanafalia Formation and ranges from 0 to 200 feet thick. Locally, the basal part of the formation may yield as much as 10 gpm of water per well. This formation has not been substantially developed in the study area, and future potential is probably limited to domestic and stock supplies.

ALLUVIUM AQUIFERS

These deposits are widespread and crop out principally in and along the major streams valleys in the study area. The alluvial deposits may be as much as 70 feet thick but generally range from 25 to 50 feet, and are underlain by deposits of Cretaceous or Tertiary age. Ground water in these deposits occurs under water-table conditions and water levels respond quickly to local precipitation, which varies throughout the year. Wells are usually shallow (15 to 40 feet deep) and are developed for domestic and stock needs.

Locally, sand and gravel deposits are capable of yielding as much as 10 gpm to individual wells. These deposits have not been developed for municipal and industrial supplies. However, wells of large capacity could probably be constructed along the Tombigbee and Sipsey Rivers where the deposits yield water that is generally soft and low in mineral content. Locally, however, water is high in iron and may have to be treated before use.

GENERAL AVAILABILITY

The ground-water availability map is a generalized guide to the quantity and quality of water of the entire study area. This map has been derived from availability maps on previous pages and from information derived from water and oil test wells in areas adjacent to the study area. The areas have been rated from good to poor based on the potential for developing from 100 to more than 500 gpm of water of good quality. For more detailed information on drilling depths at specific locations, the reader should refer to the aforementioned availability maps.

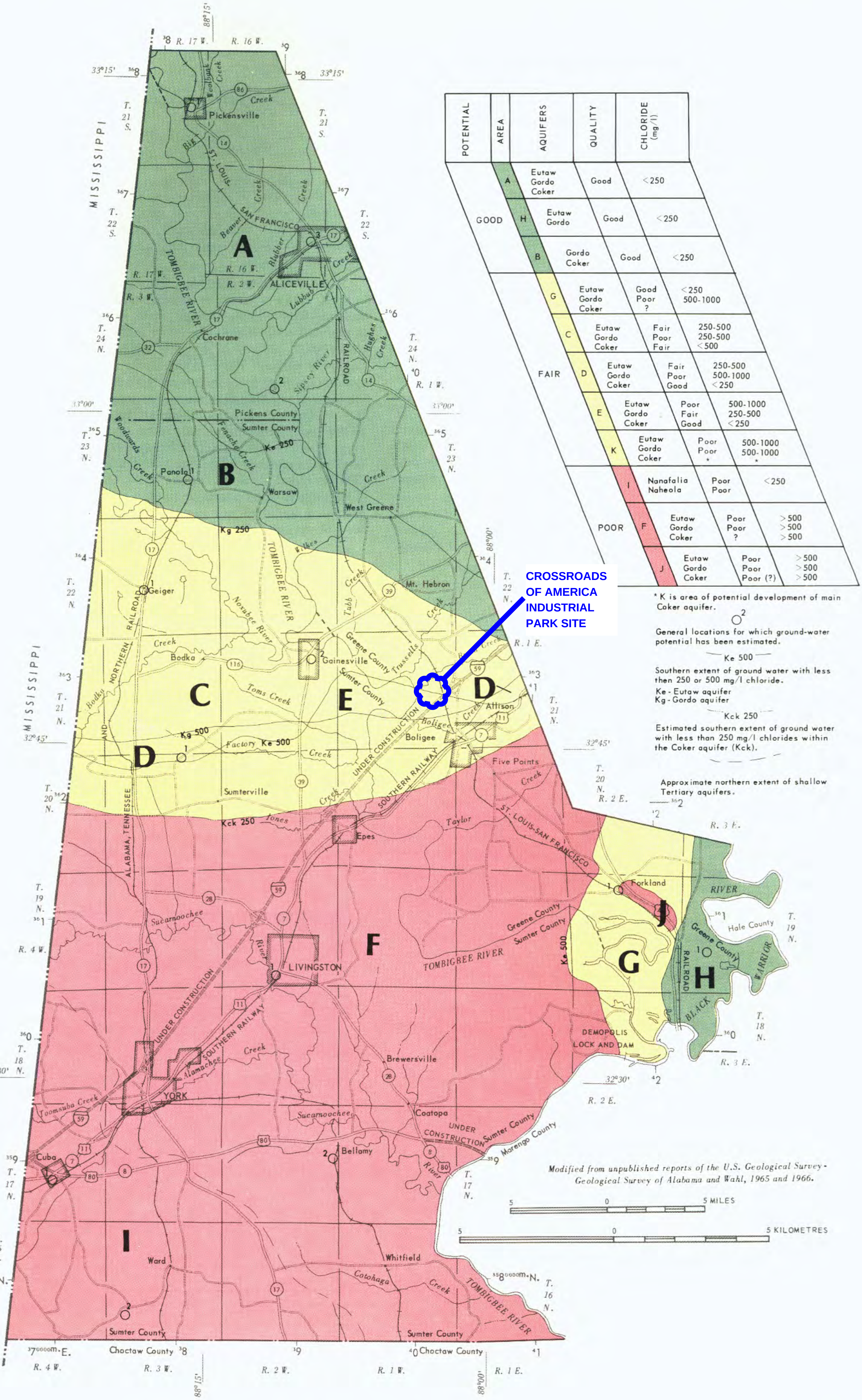
The table of selected drilling sites is intended to give the user a general idea of the location of the most favorable areas for obtaining a specific quantity and quality of ground water. The sites listed on the chart are located on the general ground-water availability map; the potentials for each of the areas have been averaged from data from existing wells or estimated from hydrologic projections.

The evidence of the presence of potentially potable water in area K is based almost completely on the interpretation of electric logs. The quality and quantity of water in the Coker aquifer can only be inferred to be better than that in overlying aquifers. Test wells must be drilled in south Sumter County to determine if this water is fresh.

ESTIMATED GROUND WATER POTENTIAL AT SELECTED SITES IN THE STUDY AREA

	E S T I M A T E D				
			Quality of water (mg/l)		
Site number (see map) Town name and county Ground elevation	Aquifer, and depth (in feet) to the base of that aquifer	Yield per well (gpm)	Hardness	Iron (Fe)	Chloride (Cl)
A-1 Pickensville, Pickens Co. 150	Ke 375 Kg 550 Kck 1050	100-300 >500 >500	Soft Soft Soft	<0.3 < .3 < .3	< 250 < 250 < 250
A-2 Vienna, Pickens Co. 125	Ke 450 Kg 725 Kck 1225	>500 >500 >500	Soft Soft Soft	May be high < .3 < .3	< 250 < 250 < 250
A-3 Aliceville, Pickens Co. 171	Ke 355 Kg 490 Kck 1475	600 600	Soft Soft	< .3 > .3	< 250 < 250
B-1 Panola, Sumter Co. 175	Ke 725 Kg 1050 Kck 1550	>500 >500 >500	Soft Soft Prob. Soft	----- ----- -----	300-350 < 250 < 250
C-1 Geiger, Sumter Co. 165	Ke 890 Kg 1240 Kck 2090	>500 >500 >500	Soft Soft Soft	< .3 < .3 < .3	350-400 300-350 < 250
C-2 Gainesville, Sumter Co. 130	Ke 730 Kg 1050 Kck 1850	>500 >500 >500	Soft Soft Soft	< .3 < .3 < .3	350-400 400± < 250
D-1 Hamner, Sumter Co. 250	Ke 1130 Kg 1500 Kck 2000	>500 >500 >500	Mod. Hard Mod. Hard -----	----- ----- -----	500± 250-500 < 250
F-1 Livingston, Sumter Co. 150	Ke 1230 Kg 1630 Kck 2420	>500 >500 >500	Very Hard Mod. Hard -----	> .3 ----- -----	>3000 > 500 > 500±
F-2 Bellamy, Sumter Co. 100	Ke 1430 Kg 1870 Kck 2670	>500 >500 >500	Very Hard ----- -----	> .3 ----- -----	>5000 > 500 > 500
I-1 Cuba, Sumter Co. 200	Tn 160 Ke 1950	0-50 >500	Soft Very Hard	----- -----	< 20 > 500
I-2 Kinterbish, Sumter Co. 300	Tna 190 Tn 400 Ke 2200	0-10 0-10 >500	Soft Soft Very Hard	> .3 .3± -----	< 20 < 20 > 500
G-1 Forkland, Greene Co. 150	Ke 750 Kg 1100 Kck 1950	100-500 >500 >500	Soft Very Hard -----	----- ----- -----	< 250 > 750 > 500
H-1 Birdeye Church, Greene Co. 100	Ke 700 Kg 1050 Kck 2000	100-500 >500 >500	Soft Soft Soft (?)	----- ----- .3(?)	< 250 < 250 250(?)

Aquifer designation: Ke - Eutaw; Kg - Gordo; Kck - Coker; Tna - Nanafalia; Tn - Naheola



POTENTIAL	AREA	AQUIFERS	QUALITY	CHLORIDE (mg/l)
GOOD	A	Eutaw Gordo Coker	Good	< 250
	H	Eutaw Gordo	Good	< 250
	B	Gordo Coker	Good	< 250
FAIR	G	Eutaw Gordo Coker	Good Poor ?	< 250 500-1000
	C	Eutaw Gordo Coker	Fair Poor Fair	250-500 250-500 < 500
	D	Eutaw Gordo Coker	Fair Poor Good	250-500 500-1000 < 250
	E	Eutaw Gordo Coker	Poor Fair Good	500-1000 250-500 < 250
	K	Eutaw Gordo Coker	Poor Poor *	500-1000 500-1000 *
POOR	I	Nanafalia Naheola	Poor Poor	< 250
	F	Eutaw Gordo Coker	Poor Poor ?	> 500 > 500 > 500
	J	Eutaw Gordo Coker	Poor Poor Poor (?)	> 500 > 500 > 500

GENERAL GROUND WATER AVAILABILITY

WATER QUALITY

The chemical quality of ground water is primarily determined by the type and solubility of rock formations present, length of time that water remains in contact with each formation, and amount and type of organic material in the soil.

The quality of ground water may restrict its use for municipal, industrial, domestic, or irrigation supplies. The amount of dissolved minerals that can be tolerated is not easily defined, because of the many diverse uses of ground water. The U.S. Public Health Service has established standards to control the quality of water supplied by common carriers. Water of poorer quality is used for domestic purposes in some parts of the study area because water that meets the Public Health quality standards is not available.

The chemical quality of ground water in west Alabama ranges from good to poor, with ground water of the best quality occurring in the northern third of the area. The most serious quality problem is the presence of excessive chlorides and dissolved solids. Many domestic and some public-supply wells in the Eutaw and Gordo aquifers in the southern half of the study area yield water containing more than 500 mg/1 chlorides and 1,000 mg/1 dissolved solids; this is double the U.S. Public Health Services recommended levels for drinking water. Since Livingston and York do not have ground water of good quality they must obtain their water from surface-water sources.

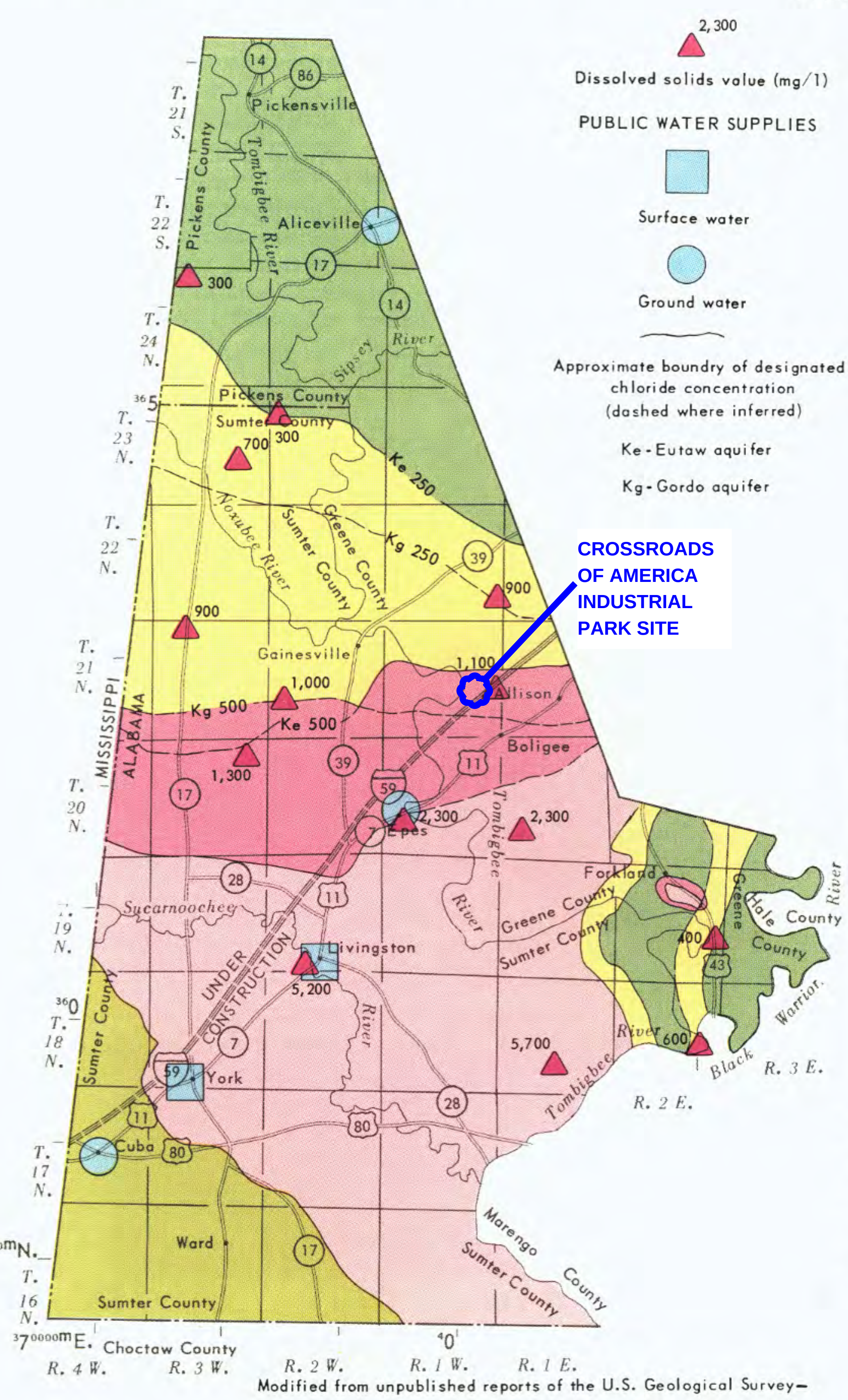
Hardness, a term commonly used to described water quality, is a measure of the concentrations of calcium and magnesium salts in the water. The hardness classification most commonly used is:

0-60 mg/1	Soft
61-120 mg/1	Moderately hard
121-180 mg/1	Hard
+180 mg/1	Very hard

High hardness values occur in water from the Eutaw and Gordo Formations in the central and southern parts of the study area, where high chloride concentrations also occur. Hardness greater than 180 mg/1 causes scale in boilers, destroys soap to form soap curds, and also destroys detergents and dyestuffs.

Water containing more than 0.3 mg/1 iron may be discolored, cause straining of laundry and household fixtures, and may have an objectionable taste. Excessive iron is a problem in certain areas, especially in the area of high chlorides, but its occurrence is erratic and boundaries cannot be precisely defined. Water in the Gordo Formation is more mineralized than water in the overlying Eutaw Formation in the eastern extreme of the study area, just west of the Black Warrior River. In this area, therefore, better wells are completed in the Eutaw Formation. In the areas where chlorides range from 250 to 500 mg/1, chloride concentration may exceed that recommended by the U.S. Public Health Service (250 mg/1). but wells of adequate quality can be constructed if they are properly engineered and if local residents have become accustomed to water containing higher concentrations of chlorides.

GENERALIZED GROUND WATER QUALITY



Modified from unpublished reports of the U.S. Geological Survey—Geological Survey of Alabama and Wahl, 1965 and 1966.

EXPLANATION

	Chloride (mg/l)	Dissolved solids (mg/l)	Iron (mg/l)	Hardness
	<250	<300 may be locally high	<0.3	soft
	250-500	300-1000	<0.3	soft-mod. hard
	500-1000	1000-2300	>0.3	soft-hard
	>1000	2300-6000	>0.3	hard-very hard
	<20 in shallow Tertiary aquifers	<300	>0.3	soft

WATER QUALITY AND EFFECTS

Chemical constituent	Recommended upper limit of concentration (mg/l)*	Notes
Iron (Fe)	0.3	Causes red stains of clothing and porcelain Affects color and taste of beverages.
Chlorides (Cl)	250	Large amounts with sodium, gives salty taste. Increases corrosiveness of water.
Dissolved solids	500	Includes all materials in solution in the water. If no water of better quality is available, quantities of up to 1000 mg/l is considered as acceptable without detrimental effects on humans.
Nitrate (NO_3)	45	Hazardous for infants
Sulfate (SO_4)	250	May have laxative effect on new users
Fluoride (F)	1.5	May cause mottling of teeth—especially in childern

*U.S. Public Health Service, Drinking Water Standards, 1962.

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Table 1. Alabama In-Stream Narrative Standards for Fish and Wildlife Designation

Parameter	Min. Value	Avg. Value	Max. Value	Unit	Comment
BOD		30 (30-day)	45 (7-day)	mg/l	Equal secondary treatment performance
Color					Shall not cause toxicity or unreasonably affect aesthetic values of the waters
Dissolved O_2	5			mg/l	
Fecal Coliform			548	Colonies/100 ml	
Odor					Shall not cause toxicity or unreasonably affect aesthetic values of the waters
pH	6		8.5		Shall not deviate one unit form the normal
Taste					Shall not cause toxicity or unreasonably affect aesthetic values of the waters
Temperature			90	°F	Maximum in-stream increase above ambient temperature shall not exceed 5 °F
TSS		30 (30-day)	45 (7-day)	mg/l	Equal secondary treatment performance
Toxicity					Shall not be acutely or chronically toxic as demonstrated by testing
Turbidity				NTU	Shall not exceed 50 NTU above background levels

Table 2. Project Design Assumptions

Parameter	Unit	Value	Comment
Expected effluent flowrate	MGD	0.44	Expected total wastewater flowrate
Average River flow	cfs	7137	Tombigbee River at Cochrane, USGS
7Q10 Tombigbee flow	cfs	500	ADEM supplied value
1Q10 Tombigbee flow	cfs	tbd	
Hardness	mg/l	50	Presumed value
pH		7	Presumed value

Table 3. Alabama In-stream Criteria for Toxic Pollutants and Estimated Discharge Limits

Pollutant	Presumed Value		Criteria		Estimated Discharge Limit at Maximum Discharge		Estimated Discharge Limit at Average Discharge	
			Acute	Chronic	Acute	Chronic	Acute	Chronic
	Hardness	pH	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Nickel	50	7	260.49	48.94				
Zinc	50	7	65.13	65.66				
Selenium			20	5				

Table 4. Estimated Mass Discharge Limits

Pollutant	Daily Max.		Monthly Average	
	Lbs/day	Kg/day	Lbs/day	Kg/day
Nickel	0.021	0.0095	0.017	0.0077
Zinc	0.24	0.11	0.20	0.090
SeO_4	0.075	0.034	0.063	0.029
BOD	23	10.4	19	8.6
COD	453	205	379	172
TSS	0		0	

EXECUTIVE SUMMARY

TTL, Inc. (**TTL**) was authorized by Mr. Jeffrey Burgard of Coskata, Inc. to perform a Phase I Environmental Site Assessment (ESA) on an approximate 235-acre parcel of land located within the Crossroads of America Industrial Park in Boligee, Alabama. The subject property is located in Sections 13 and 24, Township 21 North, Range 1 West and Sections 18 and 19, Township 21 North, Range 1 East on the Boligee, Alabama U.S.G.S 7.5-minute topographic Quadrangle (see Figure 1 and Figure 2).

TTL understands that Coskata requested this ESA as part of their due diligence prior to purchasing/leasing the subject property (Site) and to obtain landowner liability protection afforded under CERCLA (Comprehensive Environmental Response Compensation Liability Act).

As part of the Phase I ESA, **TTL** completed a walking reconnaissance of the Site on August 10, 2009. A vehicular reconnaissance of the surrounding properties was accomplished on the same date. **TTL** also reviewed a radius search report of state/federally regulated sites provided by Environmental Data Resources (EDR), Inc., historical aerial photographs for the area of the Site dating to 1973, and historical topographic maps dating to 1970. Additionally, **TTL** interviewed persons familiar with the Site and its current/historical usage. The following summarizes **TTL**'s findings for this Phase I ESA.

Summary of Findings

The Site is located west and south of Exit 32, north of I-20/59 South, in Greene County, Alabama (Figures 1 and 2). The irregularly shaped Site is comprised of approximately 235 acres. The property is accessed from Greene County Road 89 (Industrial Park Road). Alabama & Gulf Coast Railroad runs along the eastern boundary of the Site. The property consists of various landscape types including open fields, ponds resulting from former borrow and gravel pit operations, and small patches of hardwood and pine timber. A railroad spur from the Alabama & Gulf Coast Railway is located near the northern Site boundary. The only current use of the Site is for agricultural fields and hunting.

Review of the radius search report of regulated sites prepared by EDR indicates that the subject property is not listed in any of the databases searched by EDR. There were no nearby regulated facilities identified by EDR within the search radii specified in ASTM E 1527-05.

TTL did observe four areas of the Site containing a small amount of illegally disposed solid waste (landfilling). These four areas where trash and debris were observed are near the boundary of the Site and are labeled on Figure 2 as trash/debris. A small amount of trash and debris including scrap metal, glass bottles, aluminum cans, shingles, burned plastic, etc. was observed near the tree line of the eastern Site boundary. Several empty 1-gallon plastic containers, two mattresses, aluminum cans, and several plastic and glass bottles were observed along the southwestern Site boundary. A small trash pile consisting of paper, plastic, wood scraps, and household garbage was observed near the northwestern Site boundary. Several discarded tires and wooden fence posts were also observed near the northwestern boundary of the Site. All four of the locations where trash and debris were observed appeared to be one time events where local residents drove in and discarded their trash and miscellaneous debris onto the Site. **TTL** considers these four locations of trash/debris to be de minimis and do not constitute a recognized environmental concern (REC).

TTL did not identify any past or present, recognized environmental conditions (RECs) relative to the subject Site. Based on the findings of our Phase I ESA of the Site, it is TTL's opinion that no further environmental assessment of the Site is warranted at this time; however, TTL recommends that the trash and debris located on the Site be removed from the Site and recycled or disposed of properly.