JACKSONVILLE
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ST. JOHNS RIVER
POWER PARK

SITE CERTIFICATION APPLICATION

ENVIRONMENTAL INFORMATION
DOCUMENT

VOLUME 3

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ENVIRONMENTAL INFORMATION DOCUMENT

FOR

JACKSONVILLE ELECTRIC AUTHORITY

ST. JOHNS RIVER POWER PARK

UNITS 1 & 2

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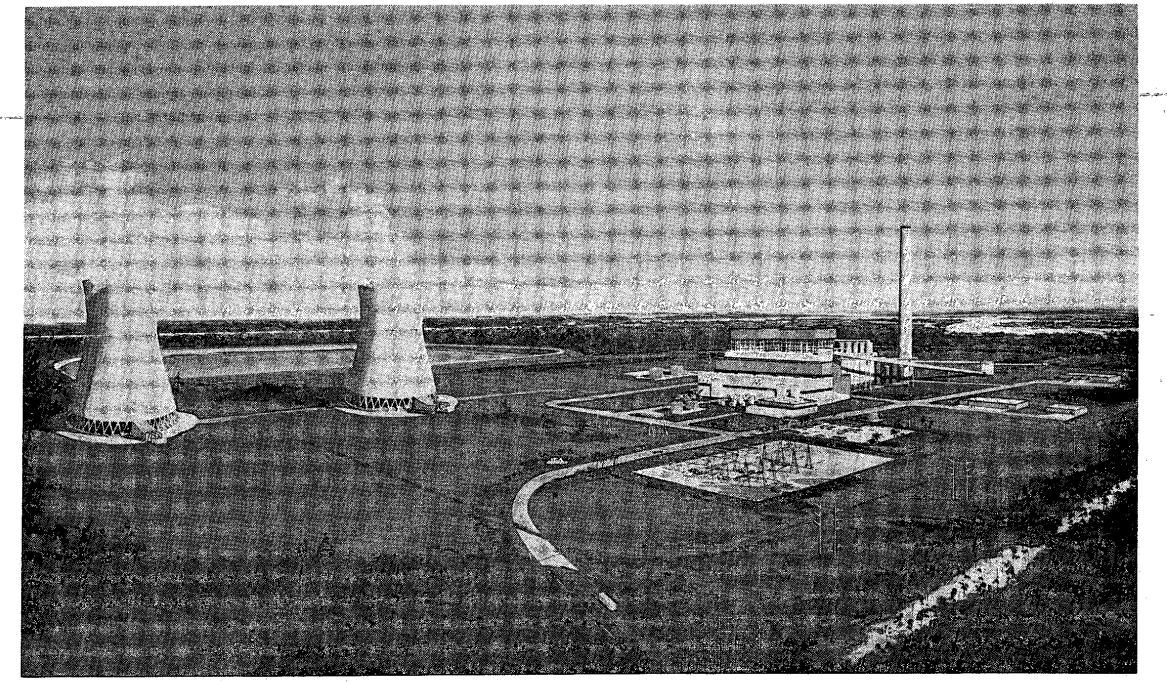

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TERRESTRIAL ECOLOGY

APPENDIX A

TERRESTRIAL ECOLOGY

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APPENDIX A

TERRESTRIAL ECOLOGY

A.1 INTRODUCTION

This appendix contains information pertinent to the terrestrial ecology of the proposed plant and coal unloading sites. The detailed information presented is intended to serve as a supplement to that which appears in Sections 2.9 and 5.3.5. The flora and fauna of the proposed plant site are described in Section A.2. Section A.3 contains a description of the flora and fauna of the proposed coal unloading site. A brief literature review of the sensitivity of various species of vegetation to selected trace elements is presented in Section A.4. The methods, assumptions and calculations used to determine the trace element releases and projected soil enrichment from the proposed plant are presented in Section A.5. The last section (A.6) contains the references cited in the preceding sections.

A.2 FLORA AND FAUNA OF THE PROPOSED PLANT SITE

A.2.1 Vegetation Communities

Nine major vegetation communities were identified within the boundaries of the proposed plant site (Figure A-1), including: pine flatwoods, grassy scrub, grassy scrub/pine flatwoods, hardwood swamp, hardwood hammock, bottomland hardwood, bayhead, cypress swamp, and salt marsh. The woody and herbaceous species observed in each of these vegetation types are listed in Tables A-1 and A-2. The pine flatwoods, grassy scrub/pine flatwoods, hardwood hammock, and hardwood swamp comprise the largest percentage of the proposed site. The remaining types (cypress swamp, bayhead, salt marsh and bottomland hardwood) occupy a smaller percentage of the proposed site than the others, but exhibit different characteristics. Each type is briefly discussed, with emphasis given to those occupying large areas of the site and to those considered to be unique or of some ecological importance.

A.2.1.1 Pine Flatwoods

The pine flatwoods vegetation type occupies approximately 504 acres or 30 percent of the proposed site (Figure A-1). This type is prevalent in the northern portion of the site, where it is typical of the pine flatwoods commonly found throughout northern Florida.

The two soils that support the pine flatwoods vegetation type are Leon fine sand and Pottsburg fine sand. Both of these soils are nearly level, somewhat poorly drained. The Pottsburg fine sand soil occurs at slightly higher elevations than the Leon fine sand. Natural fertility in both these soils is low, while the organic matter content is medium in the Leon fine sand and low in the Pottsburg fine sand. Under intensive management, these soils have a moderately high potential for growing longleaf and slash pines (Stem et al., 1978).

The pine flatwoods canopy is composed primarily of slash pine (Pinus elliotti) with sporadic occurrences of long leaf pine (Pinus palustris). The understory is dominated by ink berry (Ilex glabra), saw palmetto (Serenoa repens), sparkleberry (Vaccinium arboreum), and fetter-bush (Lyonia lucida). In the herbaceous layer, the predominant species observed were bracken fern (Pteridium aquilinum), wire grass (Aristida stricta), beard grass (Andropogon sp.), star grass (Aletris spp.), dollar grass (Hydrocotyle sp.), and candy root (Polygala spp.).

A.2.1.2 Grassy Scrub/Pine Flatwoods

Grassy scrub/pine flatwoods vegetation type occupies about 363 acres or 22 percent of the proposed site (Figure A-1). The area has been disturbed by fire in the past, which may explain the persistance of the few pines, however, the soil moisture and groundwater conditions tend to favor the hardwood species typically found in drier habitats.

Predominant soils supporting the grassy scrub/pine flatwoods vegetation type are Leon fine sand, Ortega fine sand and Pottsburg fine sand. Leon and Pottsburg fine sand types are nearly level poorly drained soils, while the Ortega fine sand is nearly level to gently sloping and is moderately well drained. The natural fertility of all three types is low, as is the organic matter content for the Ortega fine sand and Pottsburg fine sand. The Pottsburg and Ortega fine sands have a moderately high potential for growing longleaf and slash pine under intensive management. The Leon fine sand has a moderate potential for growing longleaf and slash pine, under intensive management (Stem et al., 1978).

The grassy scrub/pine flatwoods do not have a well developed canopy. In the drier sites, the few canopy level trees are dominated by turkey oak (Quercus laevis). In more moist areas, turkey oak is replaced by slash pine as the dominant species. The turkey oak canopy averaged 15 feet in height, while the slash pine canopy ranged from 20 to 25 feet in height. Quantitative information on canopy level species in the grassy scrub/pine

flatwoods vegetation type are summarized in Table A-3. The high importance values for both turkey oak and slash pine are misleading in that they would lead one to believe that they were common in the sampling area. However, as indicated by frequency data, these species were only recorded in one of the four sampling quadrats which is indicative of their sporadic occurrence.

The grassy scrub/pine flatwoods shrub layer is characterized by ink berry, stagger-bush (Lyonia ferruginea), sand live oak (Quercus geminata), turkey oak, saw palmetto, bamboo (Smilax laurifolia), and squaw-huckleberry (Vaccinium stamineum). Quantitative data for this vegetation type is summarized in Table A-4.

The predominant herbaceous species recorded in the grassy scrub/pine flatwood vegetation type include: beard grass, wire grass, ink berry, fetter-bush, bracken fern, sand live oak, turkey oak, wild bamboo (Smilax auriculata), goldenrod (Solidago sp.), Vaccinium sp., and squaw-huckleberry. The other species recorded as well as other quantitative data are listed in Table A-5.

A.2.1.3 Grassy Scrub

The grassy scrub vegetation type occupies about 24.5 acres or 1.5 percent of the proposed site (Figure A-1). This type differs from the grassy scrub/pine flatwood according to the density of pine trees present. Areas classified as grassy scrub are almost completely devoid of canopy trees. Leon fine sand soil type is the predominant substrate in this vegetation type. It is nearly level, poorly drained, low in natural fertility, with a medium amount of organic matter content. This soil has moderate potential for growing longleaf and slash pine (Stem et al., 1978) under intensive management.

The canopy level is notably absent, but a well developed shrub and to a lesser degree, herbaceous level, are common. The characteristic shrubs are saw palmetto, ink berry, southern bay-berry (Myrica cerifera), and

fetter-bush. The herbaceous level is dominated by beard grass, wire grass, ink berry, fetter-bush, bracken fern, ragweed (Solidago sp.), and blueberry (Vaccinium sp.). Other shrub and herbaceous species common to the grassy scrub areas are listed in Tables A-4 and A-5.

A.2.1.4 Hardwood Swamp

The hardwood swamp vegetation type occupies two separate areas, one in the northern portion of the site and one in the southern portion. Combined, these two stands total approximately 100 acres or 6 percent of the proposed site. Both areas drain into the salt marsh via small streams. The water level within each of the two areas varies seasonally. During the wet season, these hardwood swamp areas may be locally flooded with up to 20 inches of water. In dry periods, the level of standing water is reduced or restricted to depressions. During drought periods, standing water is absent from the depressions. However, approximately 12-15 inches of saturated soil remains within these depressions.

The hardwood swamp vegetation type occurs predominantly on two soils, the Lynn Haven fine sand and the Wesconnett fine sand. These soils are nearly level and poorly drained. Natural fertility of the Lynn Haven fine sand soil is low, while the organic matter content is medium. In the Wesconnett fine sand, natural fertility is moderate and the organic matter content high. Under intensive management, the Lynn Haven fine sand has a moderate potential for slash and longleaf pine, while the Wesconnett fine sand has a high potential for growing slash and longleaf pine provided that water control is employed (Stem et al., 1978).

The hardwood swamp canopy is characterized by red maple (Acer rubrum), button bush (Cephalanthus occidentalis), black gum (Nyssa biflora), and southern bay-berry (Myrica cerifera). A few large specimens of pond cypress (Taxodium ascendens) were also recorded, although from the frequency and density results (Table A-6) this species is not common and

occurs sporadically throughout this vegetation type. Other species recorded during the field sampling and pertinent quantitative data are listed in Table A-6.

The shrub level of the hardwood swamp is composed primarily of red maple, button bush, Virginia willow (Itea virginica), fetter-bush, southern bay berry, poison ivy (Rhus radicans), bamboo, and sparkleberry. Other species recorded in this vegetation type are listed in Table A-7. In some areas of the hardwood swamp, the shrub layer is quite dense. Southern bay berry, poison ivy, and fetter bush form dense thickets. In areas with standing water, the shrubs recorded, with the exception of button bush, are typically found growing out of dead stumps or other high areas not inundated by the standing water.

The herbaceous level in this vegetation type is not as diverse as in other types. This is due primarily to the variations in water level. During the wet season, the predominant herbaceous species recorded was bladderwort (Utricularia sp.). In dry periods, lizzard's tail (Saururus cernuus) replaces bladderwort as the predominant species in some areas. Loblolly bay (Gordonia lasianthus), Virginia willow, royal fern (Osmunda regalis), poison ivy, and Virginia netted fern (Woodwardia virginica) were some of the other species frequently recorded or found to exhibit high cover values. These species, with the exception of the ferns, typically occurred on high, nontlooded areas during the wet season, or on the swamp floor when the standing water subsided. The other species recorded during the field surveys are listed in Table A-8.

A.2.1.5 Hardwood Hammock

Hardwood hammocks typically occur near or adjacent to salt marshes in the east and southeastern portion of the proposed site (Figure A-1). This vegetation type occupies about 415 acres or 25 percent of the proposed site. The predominant soil type is the Ortega fine sand. Other soil types within the hardwood hammock include: Kershaw fine sand, Leon fine sand,

and Mandarin fine sand. The Ortega fine sand soil is moderately well drained. The natural fertility and organic matter are low. Kershaw fine sand is excessively well drained, also with very low natural fertility and organic matter. Leon fine sand is poorly drained, low in natural fertility, and medium in organic matter content. Mandarin fine sand is somewhat poorly drained soil, low in natural fertility and low to medium in organic matter content. The potential for growing long leaf and slash pine, under intensive management is moderately high for the Ortega fine sand, moderate for Leon and Mandarin fine sand, and low for the Kershaw fine sand (Stem et al., 1978).

The predominant canopy species are water oak (Quercus nigra), live oak (Quercus virginiana), scrub hickory (Carya tomentosa), and sparkleberry. The average canopy height was estimated to be 60 feet. The other species recorded as well as quantitative data are listed in Table A-9.

The shrub level of this vegetation type was found to be the most diverse of any vegetation type sampled on the proposed site. Some of the more common species include: hickory (Carya sp.), french mulberry (Calicarpa americana), loblolly bay, witch-hazel (Hamamelis virginiana), scrub holly (Ilex opaca), fetter-bush, southern bay-berry, red bay (Persea borbonia), water oak, saw palmetto, sparkleberry, squaw-huckleberry, and muscadine (Vitis rotundifolia). Other species sampled, frequency of occurrence and cover class values are listed in Table A-10.

The hardwood hammock herbaceous layer was also more diverse than most of the other communities sampled. Species characteristic of this vegetation type include: hickories, witch-hazel, Virginia willow, fetter-bush, Panicum sp., water oak, live oak, bamboo, and muscadine. The presence of leaf litter and bare ground are also characteristic of this hardwood hammock type. Other species encountered are listed in Table A-11.

A.2.1.6 Bottomland Hardwood

The bottomland hardwood vegetation type occurs along three streams in the southern portion of the site. These streams drain into the salt marsh. It is a poorly defined vegetation type and resembles components of both the pine flatwoods and hardwood hammock in species composition. This community type occupies approximately 79.9 acres or 4.8 percent of the site (Figure A-1).

The Leon fine sand is the soil type which supports this vegetation type. Typically, this soil is nearly level, poorly drained, low in natural fertility, with a medium amount of soil organic matter content. Under intensive management, the Leon fine sand has a moderate potential for growing long leaf and slash pine (Stem et al., 1978).

The species found within this association are common to both pine flatwoods and hardwood hammocks. However, the species composition is unique. For example, the pines common in flatwoods only occur sporadically. The predominant canopy trees include: red maple, American elm (Ulmus americana), water oak, southern magnolia (Magnolia grandiflora) and black gum. Common shrubs include button bush, willow (Salix sp.), southern bay-berry, and bluestem palmetto (Sabal minor). The herbaceous vegetation is sparse, but is characterized by royal fern, cinnamon fern (Osmunda cinnamomea), netted chain fern (Woodwardia areolata), golden-club (Orontium aquaticum), jack-in-the-pulpit (Arisaema triphyllum), Rubus sp. and green briar (Smilax sp.).

A.2.1.7 Bayhead

Bayhead vegetation borders a hardwood swamp and a cypress/gum swamp. The bayheads form a transition zone between the pine flatwoods or grassy scrub/pine flatwoods and the swamps (cypress and hardwood). These areas are subject to seasonal flooding. This community type occupies approximately 28.3 acres or 1.7 percent of the site (Figure A-1).

Soil types occurring within the bayhead vegetation type include: Leon fine sand, Lynn Haven sand, and Wesconnett fine sand. Each of these types are nearly level poorly drained soils. Natural fertility is low for the Leon fine sand and the Lynn Haven fine sand and moderate for the Wesconnett fine sand. Organic matter content is medium in the Leon fine sand and high in both the Lynn Haven and Wesconnett fine sand. The potential for growing long leaf and slash pine under intensive management is moderate for the Leon fine sand, moderately high for the Lynn Haven sand, and high for the Wesconnett fine sand (Stem et al., 1978).

The bayhead canopy is composed predominately of broadleaf evergreen trees including: loblolly bay and red bay. Other predominant species include: red maple, sweetgum (Liquidambar styraciflua), black gum, and southern bay berry (Table A-12).

The shrub level is characterized by loblolly bay, Virginia willow, fetter-bush, sweetgum, southern bay berry, red berry, and green briar. Other species recorded are listed in Table A-13. The predominant species recorded in the herbaceous level are loblolly bay, Virginia willow, fetter-bush, Sphagnum sp., and muscadine. Other species recorded are listed in Table A-14.

A.2.1.8 Cypress Swamp

Cypress swamps on the proposed site occur as small depressions within the pine flatwood vegetation type. These isolated cypress swamps are important to surrounding pine flatwoods in that they aid in drainage and in nutrient retention. This vegetation type occupies about 40.1 acres or 2.4 percent of the site (Figure A-1).

Cypress swamps occur on Wesconnett fine sand soil type, the extent of which corresponds to the boundaries of the cypress swamp. This soil type is typically level or nearly so, very poorly drained, and occurs in shallow depressions and large drainageways. Natural fertility is moderate and the

organic matter content high. The Wesconnett fine sand has a high potential for growing long leaf and slash pines under intensive management programs (Stem et al., 1978).

In terms of species composition, two different cypress swamp areas occur on the proposed site. One type is composed primarily of pure cypress while the other is a mixture of cypress and blackgum. The cypress/blackgum swamps appear to be more common to the southern portion of the proposed site. The canopy level of this cypress swamp variation is composed of blackgum and pond cypress (Taxodium ascendens). Data on these and the other two species recorded are listed in Table A-15. A dense shrub layer composed of ink berry, fetter-bush, and bamboo, was common within this swamp type. The herbaceous level was sparse except in areas where the shrubs were sparse or absent. The characteristic herbaceous species were fetter-bush, cinnamom fern, Sphagnum sp., and Virginia chain fern. A complete listing of the shrub and herbaceous plants recorded in this vegetation type are listed in Tables A-16 and A-17.

Cypress swamps, occurring on the northern portion of the proposed site, are characterized by having more cypress than gum. Pond cypress (Taxodium ascendens) is the species which makes up the cypress portion of the canopy. Pond pine (Pinus serotina) was also found to be a significant component of the cypress area (Table A-18). The shrub level in this cypress area was not as developed or as thick as that found in the cypress-gum type. Common species observed include: button bush, ink berry, pond cypress, bald cypress, and Vaccinuim sp. (Table A-19). Due to the seasonal flooding in this type of cypress stand, the herbaceous level is poorly developed. In wetter months when standing water is prevalent, the herbaceous level is characterized by bladderworts, narrow leaved sagittaria (Sagittaria graminae), Carex, sp., and pipewort (Eriocaulon compressum). During drier periods when the water level has subsided, cinnamon fern and Virginia chain fern comprise a large portion of the herbaceous level. Other herbaceous species observed in this vegetation type are listed in Table A-20.

A.2.1.9 Salt Marsh

Salt marsh borders the eastern edge of the proposed site. With the exception of several small areas in the south and southeastern portions of the proposed site, the salt marsh is largely outside the boundaries of the proposed site. The portion of salt marsh within the site boundaries occupies 41 acres or 2.5 percent of the site (Figure A-1). The soil supporting the salt marsh is the Tisonia mucky peat. This soil is a level to nearly level, very poorly drained soil. The natural fertility is low and the organic matter very high. This soil is not suitable for growth of long leaf and slash pines due to the inundation by salt water, which retards tree growth (Stem et al., 1978).

Predominant salt marsh vegetation is black rush (Juncus roemerianus) and cord grass (Spartina alterniflora). A number of shrub and canopy species were observed at the border of the salt marsh and the adjacent high ground. The common shrub species includes: groundsel-tree (Baccharis halimifolia), dahoon (Ilex cassine), marsh elder (Iva frutescens), and southern bay-berry. Herbaceous species were observed in areas inundated during high tide, as well as in areas above the high tide mark. Coast bacopa (Bacopa monnieri), sea oxeye (Borrichia frutescens), and perennial salt wort (Salicornia virginica) occurred within the high tide zone, while white sweet clover (Melilotus alba) and vetch (Vicia acutifolia) were common on high ground bordering the salt marsh.

A.2.2 Wildlife Habitats

Nine habitat types are present on the proposed plant site. Hardwood swamp, hardwood hammock, pine flatwood and grassy scrub/pine flatwood make up the majority of the site comprising approximately 83 percent of the total area with the cypress swamp, bottomland hardwood, bayhead, grassy scrub, and salt marsh accounting for the remainder. Similar vegetative communities were combined because of their common use by faunal species. Mammals, birds, reptiles and amphibians observed during the course of the study are presented in Tables A-21, A-22, A-23, and A-24.

A.2.2.1 Hardwood Hammock

The hardwood hammock is a common climax community in northern and central Florida. Rich sandy soils, typical of these habitats, are best developed where limestone or phosphate outcrops occur. The absence of a single dominant stress factor contributes to a high floral and faunal species diversity in this community's more mature successional stages (Stem et al., 1978).

Mature ecosystems are typically occupied by rather specialized organisms with longer and more complicated life histories than those animals found in communities in earlier developmental stages. Mineral cycles are more conservative and the internal symbiosis of the community is well developed. All of this contributes to ecosystem stability and an ability to resist external perturbations (Odum, 1971).

Detritus food chains characteristic of these areas form complicated weblike patterns comparable to the linear food chains found in pioneer communities. Odum estimated that only 5 to 10 percent of the annual net primary production is grazed in forest and old-field communities, leaving 90 percent or more to be metabolized or stored in the soil-litter subsystem (Odum, 1963; Bray, 1964).

Soil macrobiota, though comprising a small part of the soil by weight, are important in maintaining the soil as a healthy functioning part of the ecosystem. Large insects, earthworms and other organisms included in this group are a valuable food resource for many of this habitat's residents. Snails and centipedes are included in the diets of both the cotton mouse (Peromyscus gossypinus) and golden mouse (Peromyscus nuttalli) (Martin et al., 1951). Both were captured during the trapping effort with the cotton mouse being frequently caught during the spring sampling.

The burrow of the eastern mole (Scalopus aquaticus) was a common sight throughout these upland communities. This species feeds primarily on the larger invertebrates which occupy the soil-litter interface. The green anole (Anolis carolinensis), six-lined racerunner (Cnemidophorus sexlineatus), southeastern five-lined skink (Eumeces inexpectatus), ground skink (Scincella lateralis), oak toad (Bufo quercicus), and southern toad (Bufo terrestris) were all observed during the sampling effort.

During the fall migration, groups of Ruby-crowned Kinglets (Regulus calendula), Tufted Titmice (Parus bicolor) and Carolina Chickadees (Parus carolinensis) along with the Red-bellied (Centurus carolinus) and Downy Woodpeckers (Picoides pubescens) were observed. The mature oaks and hickories with their associated insect communities provide food and cover for these birds. Species seen during the summer sampling trip and assumed nesting in the area included Red-eyed Vireos (Vireo olivaceus), Tufted Titmice, Carolina Chickadees, Blue Jays (Cyanocitta cristata), Carolina Wrens (Thryothorus ludovicianus) and Blue-gray Gnatcatchers (Polioptila caerulea).

A.2.2.2 Pine Flatwoods (Pine Flatwoods, Grassy Grassy Scrub, Scrub/Pine Flatwood)

The pine flatwoods represents an intermediate developmental stage between an old field community and a mature hardwood forest. Slash pine flatwoods require periodic fire to reduce competition from invading hardwood species. Bobolinks (Dolichonyx oryzivorus), Eastern Meadowlarks (Sturnella magna), Song Sparrows (Melospiza melodia) and Field Sparrows (Spizella pusilla) all were observed in the pine flatwoods feeding on the seeds produced by the numerous weedy species present. The grassy understory provides excellent habitat for the Bobwhite Quail (Colinus virginianus). Seeds comprise the majority of the adult birds diet while the young feed primarily on various small invertebrates (Martin et al., 1951). A brood of approximately eight birds was flushed during the July sampling trip. Numerous Bachman's Sparrows (Aimophia aestivalis) were observed and heard singing during the summer sampling.

Only two species of amphibian were found in the pine flatwoods. The pine woods treefrog (Hyla femoralis) was heard from April to early September. Eastern spadefoot toads (Scaphiopus holbrooki) construct their shallow protective burrows in the sandy soils this habitat provides. Several of these toads were caught in drift fences during the course of the study. Gopher tortoise (Gopherus polyphemus) burrows were also a conspicuous part of these sandy upland areas.

Six other species of reptile were found, with the green anole the most noticeable. The six-lined racerunner, southern black racer (Coluber constrictor priapus), northern mole skink (Eumeces eumeces similis), eastern glass lizard (Ophisaurus ventralis) and southern fence lizard (Sceloporus undulatus undulatus) all were either captured or observed.

The cotton rat (Sigmodon hispidus) was the most commonly observed mammal in the pine flatwoods. Trapping results are presented in Table A-25. Typical population sizes range from 10 to 12 per acre and fluctuate from year to year. Their diet consists chiefly of green vegetation but cotton rats will prey on the eggs of ground-nesting birds (Burt and Grossenheider, 1976). Several cotton mice were also captured and armadillos (Dasypus novemcinctus) were observed in this habitat type on the northern portion of the site.

The pine flatwood is in the earliest successional stage of any major on-site community. These areas have the lowest species diversity and exhibit the greatest susceptibility to external perturbations. Food chains are simple and linear with the role of detritus in nutrient regeneration less important than in the more mature areas (Odum, 1969).

A.2.2.3 Hardwood Swamp (Hardwood Swamp, Cypress Swamp, Bottomland Hardwoods, Bayheads)

Fauna residing in this habitat have adapted to fluctuating water levels characteristic of these areas. Nutrients made available by periodic flooding along with the many subhabitat types present result in a relatively high species diversity.

Typically, mammals found in these swamps are limited to the more arboreal species or individuals suited in other ways to coping with the standing water that is present most of the year. The cotton mouse which nests in trees or stumps is a common resident and was frequently captured. Cotton rats were also taken even though this rodent typically prefers the drier pine flatwood habitats (Table A-25).

The Florida cottonmouth (Agkistrodon piscivorus) was observed in both the hardwood and cypress areas. The various frogs, small mammals and snakes present make up the majority of this reptile's diet. The bronze frog (Rana clamitans), Florida cricket frog (Acris gryllus), and southern leopard frog (Rana sphenocephala) all reside in the hardwood and cypress swamps. Several species of water snake (Nerodia sp.) typically occupy these areas but only the Florida water snake (Nerodia fasciata pictiventris) was observed.

The diverse structure of the canopy and subcanopy provides a variety of niches with Tufted Titmice (Parus bicolor), Black-and-white Warblers (Mniotilta varia) and Cardinals (Cardinalis cardinalis) being regularly recorded. Two Yellow-billed Cuckoo (Coccyzus americanus) were also observed feeding in this area.

The bayhead forest is a hydric habitat with an animal community similar to the hardwood and cypress swamps. These areas are dominated by broadleaf evergreen trees and are subject to seasonal flooding. The droppings of the marsh rabbit (Sylvilagus palustris) were found on numerous logs and stumps. Raccoon sign were also observed.

The cotton mouse was most frequently caught in the small mammal traps located in the more mature bayhead area sampled. The cotton rat was trapped more frequently in the younger bayhead habitat (Table A-25).

Systematic searches resulted in no reptiles being recorded. However, the Florida cottonmouth and certain of the water snakes are typical bayhead inhabitats and may occur in low numbers. Frogs were conspicuous in both numbers and types with six different species being observed along with one salamander.

The mature bayheads were frequented by many bird species found in other hardwood swamp communities. These species included Hermit Thrushes (Catharus guttatus), Downy Woodpeckers, Ruby-crowned Kinglets, Cardinals, Blue Jays (Cyanocitta cristata), Red-eyed Vireos (Vireo olivaceus) and White-eyed Vireos (Vireo griseus). The numerous rodents present are likely a major food resource in the diets of the various hawks and owls inhabiting these areas. The younger bayhead had a slightly different bird community including several species not encountered in the more mature community. This was probably due to the more extensive shrub zone found in these younger habitats.

A.3 FLORA AND FAUNA OF THE PROPOSED COAL UNLOADING SITE

A.3.1 Vegetation Communities

The proposed coal unloading facility will occupy an approximate 55 acre site on Blount Island. An additional 31 acres will be used to construct a rail line connecting this site to the proposed power plant. Blount Island has been severely disturbed in the last 10 to 15 years. As a result, the remaining areas of natural vegetation are restricted to the periphery of the island, primarily along the old river channel, and along the remnants of Alligator Creek. Six major vegetation types were identified on Blount Island (Figure A-2), including: mixed hardwood, grassy scrub, Myrica shrub, Baccharis shrub, water/beach, and salt marsh. Five of these six, grassy scrub, Myrica shrub, water/beach, Baccharis shrub and salt marsh occur within the boundaries of the proposed unloading facility. For the purpose of summarizing the common woody and herbaceous species observed on Blount Island, the six vegetation types identified were combined into one type termed riparian (see Tables A-1 and A-2). Each of the six types will be discussed from the perspective of Blount Island and of the proposed unloading facility site.

A.3.1.1 Grassy Scrub

The grassy scrub vegetation type has developed on areas filled with dredge spoil. This vegetation type occupies approximately 560 acres or 37.1 percent of Blount Island. Large open areas or sand flats occur sporadically throughout this vegetation type. Within the proposed unloading facility site, the grassy scrub occupies about 80 acres or 58 percent of the total site area.

The predominant soil type supporting this and the other vegetation types identified on Blount Island is arents. The arents soil type is a nearly level, poorly drained soil which has been reworked by man-made earth moving operations. The natural fertility of this soil is low and organic matter is variable.

The characteristic species include: beard grass (Andropogon spp.), butterfly pea (Centrosema virginianum), mexican-tea (Chenopodium ambrosiodes), spurge nettle (Cnidoscolus stimulosus), button weed (Diodia virginiana), dog fennel (Eupatorium compositifolium), bladder-pod (Glottidium vesicarium), pennywort (Hydrocotyle sp.), bog buttons (Kostelezkya virginica), lippia (Lippia nodiflora), white sweet clover (Melilotus alba), ground cherry (Physalis viscosa), pokeweed (Phytolacca rigida), sea oats (Uniola paniculata), and cocklebur (Xanthium strumarium).

A.3.1.2 Mixed Hardwood

The mixed hardwood vegetation type occurs primarily along the banks of the St. Johns River, although there are some isolated occurrences in the north central part of the island (Figure A-2). This type occupies 65 acres or 4.3 percent of Blount Island. The mixed hardwood vegetation type does not occur within the boundaries of the proposed coal unloading facility site. The soil type is the arents which has been described previously.

The predominant species in this vegetation type are live oak (Quercus virginiana), cabbage palm (Sabal palmetto), tung tree (Aleurites fordii) and a few sporadic occurrences of slash pine (Pinus elliotti) and long leaf pine (Pinus palustris). Vines such as Rubus sp., Vitis sp. and Virginia creeper (Parthenocissus quinquefolia) are also common in this type. Shrubs such as Myrica sp. and Baccharis sp. occasionally form a narrow but dense understory. Even though this vegetation type borders the St. Johns River, the elevation of these species is 2-3 feet above mean sea level.

A.3.1.3 Myrica Shrub

The myrica shrub vegetation type consists of small, sporadically occurring stands dominated by southern bay-berry (Myrica cerifera) (Figure A-2). This type occupies about 45 acres or 3 percent of Blount Island. In the boundaries of the proposed coal unloading site, the myrica shrub type

occupies 10.5 acres or 7.7 percent of the total area. Soil on which this vegetation type occurs is similar to that found on most of the island and described previously.

In addition to southern bay-berry, this vegetation type is characterized by tung tree and camphor-tree (Cinnamomum camphora). Individuals of these two species occur sporadically within the southern bay-berry stands and are typically taller than the southern bay-berry. The southern bay-berry ranges from 6 to 10 feet in height while the tung tree and camphor-tree can be as high as 20 feet. Due to the density of the canopy formed by the southern bay-berry, the number of species in the herbaceous level is much reduced. Some of the characteristic species include mexican-tea and pokeweed.

A.3.1.4 Baccharis Shrub

The Baccharis shrub vegetation type consists of relatively large areas of groundsel-tree (Baccharis halimifolia) which occur along the central portion of Blount Island. In general, this vegetation type can be characterized as a low shrub cover ranging from 2 to 6 feet in height. It occupies about 63 acres or 4.2 percent of Blount Island. Within the boundaries of the proposed coal unloading facility site, the Baccharis shrub type occupies about 28.7 acres or 21 percent of the total site area.

In addition to groundsel-tree, other species characteristic of this vegetation type include: saltwort (Salicornia sp.), beard grass (Andropogon sp.), cattail (Typha latifolia), Batis maritima, salt marsh mallow (Kostelezkya virginica) and dog fennel (Eupatorium compositifolium). The saltwort and cattail form distinct areas within that portion of the Baccharis shrub community occurring within the proposed facility site. These areas may be remnants of communities which developed during the disposal of dredge spoil.

A.3.1.5 Salt Marsh

The salt marsh vegetation type occurs on the southern half of Blount Island. It basically occurs in two distinct areas, one along Alligator Creek and one along the channel to the Offshore Power Systems (OPS) site (Figure A-2). The salt marsh community type occupies about 40 acres or 2.6 percent of Blount Island. Approximately 13 acres occur within the boundaries of the proposed coal unloading facility, constituting 10 percent of the total site area. Predominant species observed were black rush (Juncus roemerianus), cord grass (Spartina alterniflora) and Panicum sp.

A.3.2 Wildlife Habitats

Blount Island was dramatically changed when, during the 1950's, a ship channel was dredged, creating the island. Dredge spoil was deposited on marshy areas and in what was then the Back River. This resulted in the establishment of a pioneer community of weed and grass species. The area has been maintained in an early successional stage by continuing disturbance.

The ponds to the east and west of the transmission line splitting Blount Island are heavily used by a variety of wading birds. Great Blue Herons, Snowy Egrets, Louisiana Herons and Great Egrets were regularly observed feeding in these areas. The Juncus-Spartina community bordering many of the wetlands provides excellent habitat for the Clapper Rail with numerous Red-winged Blackbirds (Agelaius phoeniceus) also in evidence.

Killdeer (Charadrius vociferus) and Cattle Egrets (Bubulcus ibis) were common in the grassy areas bordering the roads and open areas. At low tide, various plovers, sandpipers, gulls and terns used the exposed beaches along the St. Johns River. The transmission line towers provided nesting structures for at least two pairs of osprey. While being a highly disturbed habitat, Blount Island provides niches for a variety of bird species (Table A-26).

Persons working on the island reported that eastern diamondback rattlesnakes (Crotalus adamanteus), Florida cottonmouths, southern black racers, eastern garter snakes (Thamnophis sirtalis sirtalis), and corn snakes (Elaphe guttata guttata) inhabit the area in varying numbers. A snake thought to be a yellow rat snake (Elaphe obsoleta quadrivittata) was observed during the field work but was not positively identified. The only mammal positively identified was the marsh rabbit whose droppings were present over a large portion of the island. Other small rodents are also thought to be present but none were observed.

A.4 SENSITIVITY OF VEGETATION TO SELECTED TRACE ELEMENTS

A.4.1 Introduction

This Section presents a summary of a literature review pertaining to the effects of selected trace elements on plant species. It does not address impacts from the proposed plant.

The selection of the 18 trace elements discussed in the following section was based upon reported high concentrations in coal, capability for volatilization during combustion, potential for toxicity, and existence of regulatory guidelines. The information presented in this appendix section addresses the sensitivity of vegetation to trace elements as reported in the literature. The assessment of effects associated with the deposition of these trace elements from the proposed plant is presented in Section 5.3.5.5, Trace Elements. A summary of the concentrations of selected trace elements found to be toxic to vegetation typical of the proposed site area is presented in Table A-29. If sufficient information existed, each trace element selected for study was addressed according to its value as an essential plant nutrient, the characteristic toxicity symptoms, injury threshold values, storage within plant tissue, and potential mobility within the food chain.

A.4.2 Sensitivity Review

A.4.2.1 Arsenic

Arsenic (As) is not considered to be an element essential for plant growth, although low concentrations in some cases have been reported to promote growth. Toxicity in plants is dependent on the concentration of soluble As and not on the total As concentration in soils (Valkovic, 1975). The free elemental form is not considered to be as toxic as many of the associated compounds such as arsonite and arsenate (Gough and Shacklette, 1976).

Most plants can tolerate total As concentrations in soils ranging from 1-40 ppm. Soil As concentrations greater than 2 ppm, soluble form, have been shown to cause damage to alfalfa and barley (Van de caveye et al., 1936). Plants appear to be the most sensitive to arsenic at the seedling stage since high As concentrations have been demonstrated to arrest germination and reduce seed viability (Chapman, 1966). Arsenic generally accumulates in plant roots and not in above ground portions of the plant. As such, As is not likely to be injested by grazing animals.

A.4.2.2 Beryllium

Beryllium (Be) is considered to be very toxic to plants. Toxicity symptoms are exhibited in both roots and above ground portions, with root symptoms being most prominent. In bush beans, toxic symptoms are manifest as a browning of the roots within a five day period along with the failure to resume normal elongation. Above ground portions also appear to be stunted but without loss of normal foliage coloration (Romney et al., 1962). Toxic levels for bush bean were found to range from 3 to 5 ppm Be in nutrient solution and in excess of 1 ppm in soil (Romney et al., 1962).

A.4.2.3 Boron

Boron (B) is an essential element for plant growth. It plays a major role in both growth and enzymatic processes. Injury symptoms due to excess B in soils are manifest as a yellowing of the leaf tip. At higher concentrations, symptoms appear as a progressive necrosis of the leaf beginning at the tip and finally spreading between the lateral veins and the midrib.

The differential between essential and toxic amounts of B is small. Boron concentrations of 0.05-0.10 ppm in solution culture are reported as safe for plants while concentrations of 0.5-1 ppm are toxic for B sensitive

plants (Kothny, 1973). Toxic concentrations vary between plant species. For example, corn exhibits injury symptoms when the B tissue concentration is 25 ppm, while cotton leaves can accumulate 1625 ppm B before symptoms are observed (Kothny, 1973).

A.4.2.4 Cadmium

Cadmium (Cd) is not considered to be an essential element for plant growth. It is readily absorbed by plants from the soil via the roots or from the air through the stomata. In general, the effects of toxic Cd concentrations appear to be localized in leaf tissue. Toxicity symptoms are usually manifest as either foliar chlorosis or necrosis. Cadmium concentrations of 1 ppm are considered to be nontoxic (Valkovic, 1975 and Hutchinson and Czyrska, 1972). Some depression in growth rates has been observed when Cd concentrations in plant tissue reach 2 ppm.

A.4.2.5 Chromium

Chromium (Cr) is not considered to be an essential element for plant growth. However, the addition of 0.1-0.5 ppm Cr to soils has been noted to stimulate growth of lettuce and corn seedlings (Chapman, 1966). The presence of chromium has also been observed to increase nitrogen fixation in peas (Chapman, 1966).

Chromium toxicity to vegetation is a function of the chemical form, solubility, and concentration. Chromium, as chromic or chromate, in concentrations of 8-16 ppm has been found to cause chlorosis in sugar beets grown in sand cultures (Chapman, 1966). Chromate (Cr^{+6}) at concentrations between 0.03 and 64 ppm have been observed to inhibit the growth of algae (NAS, 1974). Some mosses or bryophytes have been observed to accumulate amounts of Cr as high as 12,000 ppm without exhibiting injury symptoms (NAS, 1974).

A.4.2.6 Cobalt

There is no evidence that cobalt (Co) is essential for higher plants (Valkovic, 1975). Cobalt is reported to be extremely toxic to plants (Bowen, 1966). Concentrations as low as 0.1 ppm in solution cultures results in toxic effects on many crop species (Chapman, 1966). Symptoms of Co toxicity to plants include depressed growth, chlorosis, necrosis and even death.

A.4.2.7 Copper

Copper (Cu) is commonly regarded as a macronutrient, that which is essential for plant growth in large quantities. Copper tends to accumulate in plant tissues, where it can often reach toxic levels. Symptoms of Cu toxicity are exhibited as foliar chlorosis (Gough and Shacklette, 1976). Toxic symptoms have been observed when tissue concentrations reach 20 ppm (Chapman, 1966 and Valkovic, 1975). Toxicity has also been observed in snap beans when tissue levels exceed 40 ppm (Walsh *et al.*, 1972). Inhibition of growth was observed in cauliflower, lettuce, potato, and carrot when tissue concentrations ranged from 0.5-50 ppm Cu acetate (Bell and Rickard, 1974). Chapman (1966) lists alfalfa, clover, poppy, spinach, gladiolus, corn, bean, and squash as being sensitive to Cu. Copper tends to accumulate in plants, primarily in root tissue, where it is unavailable to grazing herbivores. Hemkes and Hartman (1973) report that some grain species can accumulate up to 15 ppm Cu which may be a hazard to grazing sheep.

A.4.2.8 Fluorine

Fluorine (F) is not considered to be an essential element for plant growth. Atmospheric uptake is thought to be the main avenue for F accumulations in plants. Toxic foliar symptoms are marginal necrosis and interveinal chlorosis. Plants sensitive to fluoride at a concentration of 1.0-5.0 ppb for several days include: apricots (Chinese and royal), prune,

corn, ponderosa pine, some citrus varieties, and a few species of gladioli (Treshow, 1969). A general threshold concentration for F in the atmosphere is reported to range from 0.007-0.10 ppm (Yamazoe, 1970), although some sensitive species were found to be affected by concentrations of less than 0.001 ppm. McCune et al. (1974) have determined that acceptable limits for F in the atmosphere would be 0.005-0.01 ppm for 2 to 4 hour peak concentration and 0.003-0.006 ppm for 30-60 day period.

A.4.2.9 Lead

Lead (Pb) is found in most all plants, although it is nonessential for growth (Chapman, 1966; Valkovic, 1975; Gough and Shacklette, 1976). Lead generally enters the plant through leaf stomata and accumulates in the leaf. Leaf surfaces, particularly those that are hairy or rough tend to accumulate large amounts of lead. Plants vary in their sensitivity to lead. Many plants tolerate high concentrations of Pb, while others exhibit retarded growth at 10 ppm in solution culture (Valkovic, 1975). Orange seedlings grown on soil with Pb concentrations ranging from 150-200 ppm did not exhibit adverse effects (Chapman, 1966). Some shrubs have been reported to absorb large amounts of lead without exhibiting toxicity symptoms. Lettuce was also found to accumuate over 2 ppm Pb without toxic symptoms (Bovay, 1971).

A.4.2.10 Manganese

Manganese (Mn) is an essential element for plant growth. It can be toxic in high concentrations, although it is less toxic than a number of other trace elements. Toxic concentrations in soils have been rarely observed but when present they tend to occur in acidic or poorly drained soils. Reuther et al. (1949) found that 1000 ppm Mn in leaves of valencia oranges was toxic. Alfalfa grown in acid soil with more than 50 ppm exchangeable Mn exhibited toxicity symptoms (Foy, 1964).

A.4.2.11 Mercury

Mercury (Hg) is not an essential element for plant growth. Mercury compounds have been used as seed fungicides. Plants grown from these seeds have been found to contain higher than normal Hg concentrations. In general, Hg is not concentrated in plants grown on soils containing normal levels of Hg. Soil bound Hg is typically not available for plant uptake, although many plants cannot prevent the uptake of gaseous Hg through the roots (Huckabee and Jansen, 1975). Most higher vascular plants are resistant to toxicity from high Hg concentrations even though high concentrations are present in plant tissue. Concentrations of 0.5-50 ppm ($HgCl_2$) were found to inhibit the growth of cauliflower, lettuce, potato, and carrots (Bell and Rickard, 1974). In algae, a $HgCl_2$ concentration of 3.5 ppm caused a 98 percent reduction in chlorophyll synthesis.

A.4.2.12 Molybdenum

Molybdenum (Mo) is an essential element for plants. Molybdenum toxicity is rarely observed in the field since most plants seem to be able to tolerate high tissue concentrations (Allaway, 1968; Johnson, 1966). It has been observed that Mo uptake and accumulation is generally higher in legumes than in grasses and further that legumes grown on poorly drained soils have higher Mo tissue concentration than those grown on well drained soils (Kubota *et al.*, 1967). A Mo concentration of 5 ppm in nutrient solution was found to be toxic to clover and lettuce (Warington, 1950).

A.4.2.13 Nickel

Nickel (Ni) is an element not essential for plant growth. It is reported that nickel enters the plant primarily through the root system and is deposited in leaf tissue (Chapman, 1966; Tiffin, 1971). Toxicity symptoms resemble iron deficiency symptoms. The symptoms are typically manifest as a chlorosis which in severe cases is followed by necrosis and death of the plant (Chapman, 1966).

It is reported that Ni concentrations in excess of 50 ppm in plants are toxic, although some plants endemic to serpentine soils may contain up to 6100 ppm (NAS, 1975). Concentrations of Ni reported to result in yield reductions are 60 ppm in oats (500 ppm in the soil), 28 ppm in oat straw, and 44 ppm in alfalfa (NAS, 1975).

A.4.2.14 Selenium

Selenium (Se) is nonessential for plant growth although it has been reported to stimulate the growth of a few plants at very low concentrations (Chapman, 1966). The absorption and accumulation of Se by plants is dependent upon the concentration and distribution of Se in the soil, chemical nature, seasonal variation in rainfall, plant species, growth stage, physiological condition of the plant, and presence of other soil components.

The primary indication of excess selenium in plants is growth inhibition. In grains, toxicity symptoms may be manifested by a chlorosis of some or all the leaves. It has been reported that cereal grains and onions may accumulate 30 ppm Se without toxic effects, although grasses, clovers, and vegetables have a much lower tolerance (5 ppm) (Lisk, 1972). It should be noted that the literature contains conflicting reports on the levels of Se considered to be toxic.

A.4.2.15 Strontium

Strontium (Sr) is not essential for plant growth. It is rarely considered to be toxic to plants except in the absence of calcium (Bowen, 1966). Very little information is reported in the literature regarding Sr toxicity to plants.

A.4.2.16 Tin

Tin (Sn) is reported to be very toxic to plants (Bowen, 1966). There is no further information reported in literature regarding the toxic effects of Sn on vegetation.

A.4.2.17 Vanadium

Vanadium (V) is considered to be generally nonessential for higher plants (Chapman, 1966). Some plants such as cabbage may accumulate high levels of V (50 ppm) without exhibiting toxicity symptoms (Gough and Shacklette, 1976). Scharrer and Schropp (1935) found that V was toxic to germinating seeds, but was even more toxic to plants at later growth stages. The addition of 10 ppm V (calcium vanadate) to sandy soil was found to result in a decrease in the growth of orange seedlings (Chapman, 1966). When the concentration was increased to 150 ppm, all the plants died. Chapman (1966) has concluded that V concentrations greater than 0.5 ppm in nutrient solutions are toxic to plants and that additions of V to soils has produced toxicity to a variety of crop plants.

A.4.2.18 Zinc

Zinc (Zn) is not an essential element for growth of higher plants. Zinc is absorbed primarily by the roots and is translocated to leaf tissue, although the primary storage area appears to be the roots. Toxic symptoms may be manifest by foliar chlorosis, which is caused by Zn interference with iron uptake. It is reported that 12.5 percent total Zn in soil will stunt most vegetation (Gough and Shacklette, 1976). Toxicity levels were found to vary considerably between species. Symptoms have been observed in oat leaves when concentrations ranged from 1700-7500 ppm, and in tomato leaves when concentrations ranged from 526-1489 ppm (Chapman, 1966). Zinc toxicity has been found to vary with the soil type. Sandy soils were found to be the most toxic and clay loam soils the least (Chapman, 1966).

A.5 COMPUTATON OF TRACE ELEMENT RELEASE AND PROJECTED SOIL ENRICHMENT

The results of the air quality modelling of stack effluents provide a basis for predicting concentrations of selected trace elements released from the proposed plant. A steady-state diffusion model, calibrated to the atmosphere of the Jacksonville area assessed the potential effects on air quality for a radial distance of 5 km from the stack. The predicted ambient air concentrations of trace elements can be calculated by dividing trace element emission rates by SO_2 emission rates. The resulting ratios are reported in Table A-30. The maximum predicted ambient trace element concentration on an annual basis can be calculated from the maximum predicted ambient SO_2 concentration by multiplying the SO_2-trace element ratio by the maximum predicted ambient SO_2 contribution of the plant alone (2 ug/m^3). This maximum SO_2 concentration is predicted to occur 4.5 km to the southwest of the proposed stack location. Assuming a deposition velocity of 0.1 cm/sec (3.15×10^4 m/yr), the deposition flux is the product of the deposition velocity and the ambient trace element concentration (Table A-30). Assuming that trace element deposited on soil surfaces do not penetrate any further than 25 cm, a basis is provided for predicting average annual increases in soil trace element levels that could potentially result from operation of the proposed plant.

The projected soil concentration increase is based on the maximum SO_2 concentration. To use this concentration, it must be assumed that the meteorological conditions, which result in this concentration, occur throughout the year and that the plant operates at 100 percent full load throughout the year. Additionally, it was assumed that the flue gas desulfurization (FGD) and the electrostatic precipitators (ESP) have no effect on the trace element stream leaving the stack. For example, some elements adhere to particulate matter and in that state would be removed by the ESP (99.78 percent removal efficiency).

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Table A-1
WOODY PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Acer rubrum L.	Red maple					C			C	C	
Albizia julibrissin Durazzini	Silk tree		O								
Ampelopsis arborea (L.) Koehne	Pepper vine				U	U					O
Aleurites fordii Hemsl.	Tung tree										C
Aralia spinosa L.	Devils walking stick				U						
Baccharis halimifolia L.	Groundsel-tree				C(b)			C(b)			C
Befaria racemosa Vent.	-	C	C			U					
Calicarpa americana L.	French mulberry	U	U		C						
Carpinus caroliniana Walter	Ironwood				O						
Carya tomentosa Nutt.	Scrub hickory				C						
Ceanothus americanus L.	New Jersey tea				U						
Ceanothus itermedius Pursh	Red root		U								
Cephalanthus occidentalis L.	Button bush					C	C		C	U	
Cinnamomum camphora (L.) Nees & Eberm.	Camphor-tree									O	C
Cornus stricta Lam.	Stiffcornel dogwood					O					
Crataegus sp. L.	-				O						
Diospyros virginiana L.	Persimmon		C		U						
Gaylussacia frondosa (L.) T&G	Dangleberry		U								
Gordonia lasianthus (L.) Ellis	Loblolly bay		U	C		C	U			C	
Hamamelis virginiana L.	Witch-hazel				C						
Hypericum fascinculatum Lam.	St. John's wort	C	C								

Table A-1 (Continued)
WOODY PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Ilex cassine L.	Dahoon				U	C		C(b)			
Ilex glabra (L.) Gray	Ink berry	C	C	C	U	C	C		U	U	
Ilex opaca var. arenicola Aiton	Scrub holly		O		U						
Itea virginica L.	Virginia willow				U	C			C		
Iva frutescens L.	Marsh elder						C(b)				O
Juniperus silicicola (small) Bailey	Southern red-cedar				O						O
Kalmia hirsuta Walter	-	C									
Liquidambar styraciflua L.	Sweetgum				C	C				C	
Lonicera japonica Thunberg	Honeysuckle				O	O					
Lyonia ferruginea (Walt.) Nutt	Stagger-Bush				C						
Lyonia ligustrina (L.) DC	Male-berry						U				
Lyonia lucida (Lam.) K. Koch	Fetter-bush	C	C	C	C	U	U			U	
Magnolia grandiflora L.	Southern magnolia				U				U		
Magnolia virginiana L.	Sweet bay				U	U				C	
Myrica cerifera L.	Southern bay-berry			U	C	C		C(b)		C	C
Nyssa biflora Walt.	Black gum			U	U	C	C			C	
Osmanthus americana (L.) Gray	Devilwood			O	O						
Parthenocissus quinquefolia (L.) Planchon	Virginia creeper				U	O					U
Persea borbonia (L.) Sprengel	Red bay				C	C				C	
Persea palustris (Raf.) Sarg.	Swamp bay					U	U			U	
Pinus elliottii Engelm.	Slash pine		C	C					U	U	

Table A-1 (Continued)
WOODY PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Pinus palustris Miller	Long leaf pine		C	C							
Pinus serotina Michaux	Pond pine					O	O				
Pityothamnus sp. Small	Dog apple	O	O								
Prunus serotina Ehrhart	Black cherry				U						O
Quercus geminata Small	Sand live oak	U	C								
Quercus hemisphaerica Bartr.					C						
Quercus laevis Walt.	Turkey oak	U	C								
Quercus marilandica Muench	Blackjack oak		U								
Quercus minima (Sarg.) small	Dwarf live oak	C	C								
Quercus nigra L.	Water oak				C	C			U	U	
Quercus pumila Walt.	Running oak		U	U	U						
Quercus virginiana Mill.	Live oak		U		C						C
Rhus copallina L.	Winged sumac	C	C	C							U
Rhus radicans L.	Poison ivy			O	C	C			C	O	O
Rubus sp. L.	-	C	C		C	U					
Sabal palmetto Lodd. ex Schultes	Cabbage palm				O		O(b)	C(b)	O		C
Salix nigra Marshall	Black willow					C			O		C
Serenoa repens (Bartram) Small	Saw palmetto	C	C	C	c	U			U	U	O
Smilax auriculata Walt.	Wild bamboo	U	C	U							
Smilax bona-nox L.	Catbrier		U		C						
Smilax laurifolia L.	Bamboo		U		C	C	C		C	C	O
Smilax rotundifolia L.	Greenbrier				U	U					
Taxodium ascendens Brongn.	Pond cypress					U	C				
Taxodium distichum (L.) Richard	Bald cypress						U				

Table A-1 (Continued)
WOODY PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Vaccinium sp. L.	-	C	C		C				U	U	
Vaccinium arboreum Marshall	Sparkleberry		U	U	C	U					
Vaccinium elliotii Chapman	-	C	C								
Vaccinium myrsinites Lam.	-	C	C								
Vaccinium stamineum L.	Squaw-huckleberry				C						
Vaccinium tenellum Aiton	-				U						
Vitis sp.	-										U
Vitis rotundifolia Michaux	Muscadine	C	C	C	C	C			C	C	O
Zanthoxylum clava-herculis L.	Hercules-club										U

a GS - grassy scrub
GSPF - grassy scrub/pine flatwood
PF - pine flatwood
HH - hardwood hammock
HS - hardwood swamp
CS - cypress swamp
SM - salt marsh
BH - bottomland hardwood
B - bayhead
R - riparian (Blount Island)

b At border of two vegetation types

C - common - readily apparent with little or no searching within a given vegetation type
U - uncommon - present in such numbers that a moderate amount of effort must be expended to verify its occurrence within a given vegetation type
O - occasional - present in such few numbers that its occurrence can not be determined with any degree of certainty within a given vegetation type

Table A-2
HERBACEOUS PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Aletris farinosa L.	White star-grass	C	C	C							
Aletris lutea Small	Yellow star-grass	C	C	C							
Aletris obovata Nash	Stargrass	O	O	O							
Allium bivalve (L.) Kuntze	False garlic	C	U								
Alternanthera philoxeroides (Martius) Grisebach	Alligator-weed						O				
Amianthium muscaetoxicum (Walter) Gray	Fly-poison		O	O							
Amorpha fruticosa L.	Lead plant										U
Andropogon sp. L.	Beard grass	C	C	C							C
Apocynum cannabinum L.	Indian hemp						U				
Arisaema triphyllum (L.) Schott	Jack-in-the-pulpit				O	O			U	U	
Aristida sp. L.	Three awn grass	C	C				O				
Asclepias cinerea Walt.	-	U	C	C							
Asclepias michauxii Dene.	Weak stemmed milkweed	U	U	U							
Asclepias humistrata Walt.	-	U	U	U							
Asclephias tuberosa L.	Butterfly-weed	C	C	C							
Asclepias verticillata L.	-	U	U	U							
Aster reticulatus Pursh	White-topped aster	O	C								
Bacopa monnieri (L.) Pennell	Coast bacopa							C			C
Berlandiera pumila (Michx) Nutt.	Green eyes	C	C	O							O
Bonamia patens var. augustifolia (Nash) Skinners	-	C	C								O

Table A-2 (Continued)

HERBACEOUS PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Borrichia frutescens (L.) DC.	Sea oxeye							C			C
Buchnera floridana Gandoger	-	U	U								
Callicarpa americana L.	French mulberry				C						O
Calopogon pulchellus (Salisbury) R. Brown	Grass pink	O	O								
Carex glaucesens Ell.	-					C	C				
Centrosema virginianum (L.) Bentham	Butterfly pea	C	C								C
Chamaelirium luteum (L.) Gray	Blazing-star	U	U								
Chenopodium ambrosiodes L.	Mexican-tea										C
Cirsium horridulum Michaux	Yellow thistle	U	C								
Cleistes divaricata L (Ames)	Rose orchid	O	O								
Clematis reticulata Walt.	Leather-flower	U	U								
Clitoria mariana L.	Butterfly pea	U	U								
Cnidoscolus stimulosus (Michx.) Engelm. & Gray	Spurge nettle	C	C	C							U
Commelina erecta L.	Dayflower	U	C								
Conopholis americana	Squaw-root				O						
Crotalaria rotundifolia (Walt.) Poir.	Rabbit-bells	C	C								
Crotalaria sagittalis L.	Rattlebox	U	C								

Table A-2 (Continued)

HERBACEOUS PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Dichromena latifolia Baldw.	White top sedge	U	C				U			U	C
Diodia virginiana L.	Buttonweed		C								C
Drosera leucantha Shinners	Sundew	C	C								
Dulichium arundinaceum (L.) Britton	-	C	C								
Erigeron philadelphicus L.	Daisy fleabane	C	C								U
Erigeron vernus (L.) T.&G.	Robins-plantain	U	U								
Eriocaulon compressum Lam.	Pipewort	C	C				C				
Eryngium prostratum Nutt.	Creeping eryngium	U	U	U							
Eryngium yuccifolium Michx.	Rattlesnake master	C	C								O
Erythrina herbacea L.	Coral bean				O						
Eupatorium compositifolium Walt.	Dog funnel	C	C								C
Galactia elliottii Nuttall	Galactia	C	C								C
Glottidium vesicarim (Jacq.) Harper	Bladder-pod	U	C								C
Gnaphalium purpureum L.	Cudweed	O	U	O							C
Graminae sp.	-						U				
Habenaria ciliaris (L.) R. Br.	Yellow-fringed orchid	O	O								
Heteranthera reniformis R.&P.	Mudplantain						U			O	
Hibiscus aculeatus Walt.	Pineland hibiscus		O								

Table A-2 (Continued)

HERBACEOUS PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Houstonia procumbens (J.F. Gmelin) Standby	-	O	O								O
Hydrocotyle umbellata L.	Pennywort	C	C	O	O		U		O	O	C
Hypericum gentianoides (L.) BSP	Pineweed	C	C	U							
Hypericum mutilum L.	-	C	C	U							
Ipomea pandurata (L.) G.F.W. Mayer	Man-root	U	U								
Juncus roemerianus Scheele	Black rush						O	O			C
Kostelezkya virginica (L.) Gray	Salt marsh mallow	C	C								U
Krigia virginica (L.) Willd.	Dwarf dandelion	C	C								
Lachnanthes caroliniana (Lam.) Dandy	Redroot		C	U							
Lachnocaulon anceps (Walt.) Morong.	Bog buttons		U	U							
Lemna minor L.	Duckweed					C	C		O	O	
Lippia nodiflora (L.) Michaux.	Lippia	U	C	U							C
Lobelia nuttallii R. & S.	-	O	O								
Ludwigia maritima Harper	-		O			O					
Lupinus villosus Willd.	Lupine		O								
Lycopodium alopecivisides L.	Foxtail clubmoss	U	U	U							
Lygodesmia aphylla (Nutt.) DC.	Flowering straws	U	C	U							
Melilotus alba Desr.	White sweet clover		C			C		C[(b)]			C

Table A-2 (Continued)

HERBACEOUS PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Nymphaea odorata Aiton	Water lily			U			U		O		
Nymphoides sp. Hill	Floating heart					C	C				
Oenthera laciniata Hill	Evening primrose	C	C	C							C
Opuntia drummondii Graham	Fragile cactus										U
Orontium aquaticum L.	Golden-club								O		
Osmunda cinnamomea L.	Cinnamon fern	O	U	U	U	C	C		C	C	
Osmunda regalis (Willd.) Gray	Royal fern					C	U		U	U	
Panicum sp. L.	-	C	C		U	U					
Peltandra sagittaefolia (Michaux) Morong.	White arum					O	O		O		
Phlox drummondii Hooker	Annual phlox	C	C	U							
Physalis viscosa L.	Ground cherry									C	
Phytolacca rigida Small	Pokeweed	U	U	U						U	C
Pinguicula caerulea Walt.	Violet butterwort	U	U	C							
Pinguicula lutea Walt.	Yellow butterwort	U	U	U							
Pinguicula pumila Michaux.	Dwarf butterwort	U	C	C							
Pityothamnus sp. Small	Dog apple	O	U								
Pluchea purpurascens (Swartz) DC.	Camphorweed							O			C
Pluchea rosea Godfrey	Marsh fleabane							O			O
Polygala cymosa Walt	Tall milkwort	O	O	O							
Polygala grandiflora Walt.	-		U	U							
Polygala incarnata L.	Candy root		O								

Table A-2 (Continued)

HERBACEOUS PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Polygala lutea	Candy weed	C	C	C							
Polygala nana (Michx.) D.C.	Bachelor's-button	C	C	C							
Polygonum hydropiperiodes Michx.	Water pepper		U			U	U		U		
Polygonum lapathifolium L.	Dock-leaved smartweed					U	U		U		
Polypodium polypodioides (L.) Watt.	Resurrection fern					O			O		
Pontederia cordata L.	Pickerel-weed					U	U		C		
Proserpinaca pectinata Lam	-		U			C	C				
Pteridium aquilinum (L.) Kuhn	Bracken fern	C	C								O
Pterocaulon pycnostachyum (Michx.) Ell.	Black root	C	C	U							
Pyrrhopappus carolinianus (Walter) D.C.	False dandelion	U	C								U
Rhexia alifanus Walt.		C	C	C							
Rhexia lanceolata Walt		C	C	C							
Rhexia marina var. purpurea Michx.		C	C	C							
Rudbeckia hirta L.	Black-eyed susan	C	C	C							C
Sagittaria graminea Michaux.	Narrow-leaved sagittaria					U	C				
Salvia lyrata L.	Lyre-leaved sage	U	C	U							U
Salicornia virginica L.	Perennial saltwort							C			C
Samolus parviflorus Raf.	Water pimpernel	U	U								

Table A-2 (Continued)

HERBACEOUS PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Sarracenia minor Walt.	Hooded pitcher plant	U	U	O							
Saururus cernuus L.	Lizzard's-tail					C	C		C	C	
Schrankia microphylla (Soland. ex Smith) Macbr.	Sensitive briar	C	C	U							
Scleria triglomerata Michaux.	Nut rush		U			C	C		C		
Sisyrinchium albidum Raf.	Blue-eyed-grass	C	C	C							
Solidago sp. L.	Goldenrod	C	C	C	U						C
Sparganium americanum Nutt.	Bur-reed					U	U				
Spartina alterniflora Loisel	Cord grass							C			
Sphagnum sp.	Peat moss					C	C		U	U	
Sprianthes cernua (L.) Richard	Autumn-tresses		U	U	U						
Sprianthes gracilis (Bigelow) Beck	Slender ladies'-tresses		U	U	U						
Sprianthes virnalis Englem. & Gray	Spring ladies'-tresses		U	U	U						
Spirodela polyrhiza	Queen's-delight					U	U				
Stillingia sylvatica Garden	-	U	U								
Tillandsia usneoides L.	Spanish moss			U	U	C	C				
Tradescantia rosea var. rosea Vent.	Spiderwort	U	U	U							
Tragopogon pratensis L.		U	U								
Typha latifolia L.	Cat-tail	C[(b)]				C	C	C	U	U	U
Uniola paniculata L.	Sea oats										O

Table A-2 (Continued)

HERBACEOUS PLANT SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Species		Vegetation Type[a]									
Scientific Name	Common Name	GS	GSPF	PF	HH	HS	CS	SM	BH	B	R
Utricularia inflata Walt.	Floating bladderwort					C	C				
Utricularia purpurea Walt.	Purple bladderwort					U	U				
Utricularia subulata L.	Bladderwort		U								
Verbena brasiliensis Vellozo	-	O	C[b]	U							O
Vicia acutifolia Ell.	Vetch		U				C[b]				
Woodwardia areolata (L.) Moore	Netted chain fern				C	C			U	C	
Woodwardia virginica (L.) Smith	Virginia netted fern				C	C			U	C	
Xanthium strumarium L.	Cocklebur										C
Xyris ambigua Beyrich	Yellow-eyed-grass	C	C	C			C				

a GS - grassy scrub
GSPF - grassy scrub/pine flatwood
PF - pine flatwood
HH - hardwood hammock
HS - hardwood swamp
CS - cypress swamp
SM - salt marsh
BH - bottomland hardwood
B - bayhead
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b At border of two vegetation types

C - common - readily apparent with little or no searching within a given vegetation type
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O - occasional - present in such few numbers that its occurrence can not be determined with any degree of certainty within a given vegetation type

Table A-3

CANOPY DATA FOR THE GRASSY SCRUB/PINE FLATWOODS VEGETATION TYPE

Species	Density (No/m^2)	Dominance (m^2/ha)	Frequency (%)	Relative Density (%)	Relative Dominance (%)	Relative Frequency (%)	Importance Value
Nyssa biflora	0.0025	0.11	25	4.8	2.2	20	27
Persea borbonia	0.0025	0.33	25	4.8	6.5	20	31.3
Pinus elliotti	0.02	3.55	25	38.1	70.2	20	128.3
Quercus laevis	0.025	1.01	25	47.6	16.3	20	83.9
Quercus nigra	0.0025	0.06	25	4.8	0.9	20	25.7

Table A-4

SHRUB DATA FOR THE GRASSY SCRUB/PINE FLATWOODS VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter	Spring	Summer
Befaria racemosa	25	-	-	+
Gordonia lasianthus	25	-	-	+
Ilex glabra	75	3	3	4
Lyonia ferruginea	50	-	-	+
Lyonia lucida	25	2	1	2
Myrica cerifera	25	-	+	-
Osmanthus virginiana	25	2	1	4
Persea palustris	25	1	-	3
Pinus palustris	25	r	+	+
Pteridium aquilinum	25	-	-	2
Quercus geminata	50	2	1	1
Quercus laevis	50	1	1	2
Serenoa repens	75	2	2	2
Smilax auriculata	25	-	-	+
Smilax bona-nox	24	+	-	+
Smilax laurifolia	50	-	+	+
Vaccinium arboreum	25	-	4	-
Vaccinium myrsinites	25	-	-	+
Vaccinium staminum	50	-	+	3

a r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

Table A-5

HERBACEOUS DATA FOR THE GRASSY SCRUB/PINE FLATWOODS VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter	Spring	Summer
Andropogon, sp.	50	1	1	2
Aristida stricta	75	3	-	3
Eupatorium compositifolium	25	-	r	+
Galactia elliotti	25	-	+	1
Graminae sp.	25	1	1	-
Ilex glabra	50	2	2	2
Lyonia lucida	50	2	1	1
Myrica cerifera	25	-	-	+
Osmunda cinnamomea	25	-	3	-
Panicum sp.	25	+	1	-
Pityothamnus sp.	25	-	r	-
Pteridium aquilinum	100	-	1	2
Quercus geminata	50	1	+	2
Quercus laevis	50	1	+	-
Rhus radicans	25	-	r	-
Schrankia microphylla	25	-	-	+
Smilax auriculata	50	+	1	1
Smilax laurifolia	25	-	+	+
Solidago sp.	50	1	-	-
Vaccinium sp.	75	+	3	-
Vaccinium myrsinites	25	-	r	-
Vaccinium staminum	50	-	-	2
Woodwardia virginica	25	-	-	1
Xyris ambigua	25	-	+	-
Bare ground	50	2	-	-
Leaf litter	50	3	-	-
Dead tree	25	-	5	-

a r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

Table A-6

CANOPY DATA FOR THE HARDWOOD SWAMP VEGETATION TYPE

Species	Density (No/m^2)	Dominance (m^2/ha)	Frequency (%)	Relative Density (%)	Relative Dominance (%)	Relative Frequency (%)	Importance Value
Acer rubrum	0.074	18.01	100	46.2	60.6	25	131.8
Cephalanthus occidentalis	0.042	1.52	100	26.2	5.1	25	56.3
Myrica cerifera	0.004	0.21	40	2.5	0.7	10	13.2
Nyssa biflora	0.028	3.95	100	17.5	13.3	25	55.8
Pinus elliottii	0.002	0.36	20	1.2	1.2	5	7.4
Quercus nigra	0.004	0.71	20	2.5	2.4	5	9.9
Taxodium ascendens	0.006	4.95	20	3.8	16.7	5	25.5

Table A-7

SHRUB DATA FOR THE HARDWOOD SWAMP VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter[b]	Spring	Summer
Acer rubrum	80		1	1
Cephalanthus occidentalis	80		2	2
Gordonia lasianthus	40		2	2
Itea virginica	100		2	1
Lyonia lucida	100		2	1
Myrica cerifera	100		2	2
Nyssa biflora	20		r	+
Rhus radicans	80		1	-
Rubus sp.	20		2	1
Smilax sp.	40		+	1
Smilax laurifolia	60		+	+
Vaccinium sp.	20		1	1
Vaccinium arboreum	20		r	-
Vaccinium myrsinites	20		r	-
Open water	20		3	-
Dead tree	40		3	-

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a r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

b No winter survey conducted, since this area was not within initial site boundaries

Table A-8

HERBACEOUS DATA FOR THE HARDWOOD SWAMP VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter[b]	Spring	Summer
Gordonia lasianthus	40		1	-
Ilex glabra	20		+	-
Itea virginica	80		1	1
Ludwigia maritima	20		-	1
Nymphoides sp.	20		1	-
Osmunda cinnamomea	20		1	-
Osmunda regalis	20		3	+
Panicum sp.	20		+	-
Rhus radicans	40		1	+
Saururus cernuus	80		1	2
Smilax sp.	20		-	1
Smilax laurifolia	20		+	-
Utricularia sp.	80		3	3
Vaccinium sp.	20		r	-
Vitis rotundifolia	20		r	+
Woodwardia areolata	20		1	1
Woodwardia virginica	20		-	2
Open water	60		4	5
Moss	20		+	-
Bare ground	20		5	5
Dead tree	20		5	3

a r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

b No winter survey conducted, since this area was not within initial site boundaries

Table A-9

CANOPY DATA FOR THE HARDWOOD HAMMOCK VEGETATION TYPE

Species	Density (No/m^2)	Dominance (m^2/ha)	Frequency (%)	Relative Density (%)	Relative Dominance (%)	Relative Frequency (%)	Importance Value
Carya tomentosa	0.026	4.38	80	26.0	21.6	23.5	71.1
Nyssa biflora	0.002	0.13	20	2.0	0.6	5.9	8.5
Persea borbonia	0.004	0.30	40	4.0	1.5	11.8	17.3
Prunus serotina	0.002	0.57	20	2.0	2.8	5.9	10.7
Quercus nigra	0.046	6.49	80	46.0	32.0	23.5	101.5
Quercus virginiana	0.018	8.34	80	18.0	41.2	23.5	82.7
Vaccinium arboreum	0.002	0.04	20	0.2	0.2	5.9	90.8

Table A-10

SHRUB DATA FOR THE HARDWOOD HAMMOCK VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter	Spring	Summer
Aralia spinosa	20	-	+	-
Calicarpa americana	20	-	-	2
Carya sp.	60	+	1	1
Ceanothus americana	40	1	+	1
Gordonia lasianthus	40	1	1	2
Hamamelis virginiana	60	+	1	2
Ilex sp.	40	2	-	-
Ilex glabra	20	+	-	2
Ilex opaca	40	1	-	2
Itea virginica	40	-	+	+
Liquidambar styraciflua	20	+	1	2
Lyonia ferruginea	40	1	1	+
Lyonia lucida	40	+	2	3
Magnolia grandiflora	20	1	1	2
Myrica cerifera	40	2	2	2
Osmanthus americana	20	-	-	1
Osmunda cinnamomea	20	-	2	-
Persea borbonia	60	1	+	1
Prunus serotina	20	1	+	2
Quercus nigra	60	1	1	2
Quercus virginiana	40	2	2	-
Serenoa repens	80	3	3	3
Smilax bona-nox	40	+	-	+
Smilax laurifolia	60	+	+	-
Vaccinium arboreum	80	2	2	2
Vaccinium staminum	60	-	1	2
Vitis rotundifolia	60	+	1	1

a r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

Table A-11

HERBACEOUS DATA FOR THE HARDWOOD HAMMOCK VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter	Spring	Summer
Carex sp.	20	-	+	+
Carpinus caroliniana	20	+	-	-
Carya sp.	40	r	+	+
Clitoria mariana	20	-	+	2
Graminea sp.	20	+	+	-
Hamamelis virginiana	60	+	1	2
Ilex glabra	20	+	+	-
Ilex opaca	20	-	1	-
Itea virginica	40	+	+	+
Lyonia lucida	40	2	1	2
Osmunda cinnamomea	20	+	2	2
Panicum sp.	40	-	+	1
Persea borbonia	20	1	+	-
Prunus serotina	20	-	+	-
Quercus nigra	80	1	2	2
Quercus virginiana	100	1	2	1
Rubus sp.	20	+	+	1
Serenoa repens	20	1	1	1
Smilax sp.	80	+	+	+
Smilax bona-nox	20	-	-	1
Vaccinium sp.	20	+	1	1
Vitis rotundifolia	80	-	1	1
Woodwardia areolata	20	+	2	2
Leaf litter	40	5	-	5
Bare ground	100	-	3	5
Dead branch	20	2	-	-

[a] r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

Table A-12

CANOPY DATA FOR THE BAYHEAD AND HARDWOOD SWAMP VEGETATION TYPE

Species	Density (No/m^2)	Dominance (m^2/ha)	Frequency (%)	Relative Density (%)	Relative Dominance (%)	Relative Frequency (%)	Importance Value
Acer rubrum	0.04	6.94	100	25.8	16.9	21.1	63.8
Gordonia lasianthus	0.015	0.96	50	9.7	23.6	10.5	43.8
Liquidambar styraciflua	0.0275	2.61	50	17.7	6.4	10.5	34.6
Magnolia virginiana	0.0025	2.62	25	1.6	6.4	5.3	13.3
Myrica cerifera	0.0175	0.52	75	11.3	1.3	15.8	28.4
Nyssa biflora	0.04	14.4	100	25.8	38.8	21.1	84.7
Persea borbonia	0.01	5.36	50	6.4	13.1	10.5	30.0
Pinus elliottii	0.0025	6.54	25	1.6	15.9	5.3	22.8

Table A-13

SHRUB DATA FOR THE BAYHEAD AND HARDWOOD SWAMP VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter	Spring	Summer
Acer rubrum	25	-	+	-
Cephalanthus occidentalis	50	-	+	1
Cornus stricta	25	+	2	1
Gordonia lasianthus	75	2	2	2
Ilex glabra	25	-	-	1
Itea virginica	100	1	1	1
Liquidambar styraciflua	75	2	+	1
Lyonia lucida	100	2	2	2
Myrica cerifera	100	2	2	2
Nyssa biflora	25	-	+	-
Osmunda cinnamomea	25	-	+	1
Osmunda regalis	50	-	4	3
Persea borbonia	50	1	-	2
Polypodium polypodioides	25	-	2	-
Rhus radicans	50	-	+	-
Saururus cernuus	25	-	+	-
Smilax sp.	75	1	1	1
Vaccinium arboreum	50	1	1	2
Vitis rotundifolia	50	+	+	1

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a r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

Table A-14

HERBACEOUS DATA FOR THE BAYHEAD AND HARDWOOD SWAMP VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter	Spring	Summer
Carya sp.	40	r	+	+
Ceratophyllum demersum	25	-	-	2
Gordonia lasianthus	50	1	1	1
Itea virginica	75	-	1	1
Lyonia lucida	100	1	+	1
Myrica cerifera	25	-	-	+
Nymphoides sp.	25	1	1	1
Nyssa biflora	25	-	+	-
Osmunda cinnamomea	25	-	-	+
Osmunda regalis	50	3	3	+
Persea borbonia	50	+	-	+
Rhus radicans	25	-	+	-
Sparganium americanum	25	1	-	-
Sphagnum sp.	75	-	1	1
Vaccinium sp.	25	1	-	-
Vitis rotundifolia	50	+	+	1
Woodwardia areolata	50	2	1	1
Bare ground	50	5	4	-
Leaf litter	50	-	5	4
Open water	25	-	3	-

[a] r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

Table A-15

CANOPY DATA FOR THE CYPRESS-GUM SWAMP VEGETATION TYPE

Species	Density (No/m^2)	Dominance (m^2/ha)	Frequency (%)	Relative Density (%)	Relative Dominance (%)	Relative Frequency (%)	Importance Value
Nyssa biflora	0.195	13.1	100	66.1	56.8	33.3	156.2
Persea borbonia	0.01	0.46	50	3.4	1.9	16.7	22.0
Pinus elliotti	0.01	2.82	50	3.4	12.2	16.7	32.3
Taxodium ascendens	0.08	6.67	100	27.1	28.9	33.3	89.3

Table A-16

SHRUB DATA FOR THE CYPRESS-GUM SWAMP VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter	Spring	Summer
Cephalanthus occidentalis	50	-	+	1
Gordonia lasianthus	50	1	1	1
Ilex glabra	100	3	2	3
Juncus romerianus	50	-	1	1
Lyonia lucida	100	4	3	3
Myrica cerifera	50	-	+	2
Osmunda cinnamomea	100	-	1	-
Persea borbonia	50	1	+	+
Serenoa repens	50	3	2	3
Smilax laurifolia	100	+	+	1
Taxodium ascendens	50	-	+	-
Vaccinium sp.	50	-	+	s

a r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

Table A-17

HERBACEOUS DATA FOR THE CYPRESS-GUM SWAMP VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter	Spring	Summer
Cephalanthus occidentalis	50	-	-	r
Dulichium arundinaceum	50	-	+	+
Ilex glabra	50	+	1	1
Lyonia lucida	100	2	2	1
Osmunda cinnamomea	100	-	2	1
Polygonum hydropiperoides	50	-	-	+
Sagittaria graminae	50	-	-	r
Serenoa repens	50	3	2	-
Smilax laurifolia	50	-	+	-
Sphagnum sp.	100	-	4	3
Woodwardia virginica	100	-	-	1
Leaf litter	50	-	-	5
Open water	100	5	3	-

[a] r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

Table A-18

CANOPY DATA FOR THE CYPRESS SWAMP VEGETATION TYPE

Species	Density (No/m^2)	Dominance (m^2/ha)	Frequency (%)	Relative Density (%)	Relative Dominance (%)	Relative Frequency (%)	Importance Value
Nyssa biflora	0.01	0.54	33	3.7	2.1	14.2	20.0
Pinus serotina	0.03	5.99	100	11.1	23.2	42.9	77.2
Taxodium ascendens	0.23	19.32	100	85.2	74.7	42.9	202.8

Table A-19

SHRUB DATA FOR THE CYPRESS SWAMP VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter[b]	Spring	Summer
Cephalanthus occidentalis	67		1	1
Ilex glabra	67		1	+
Lyonia ferruginea	33		-	r
Myrica cerifera	33		+	1
Nyssa biflora	33		1	-
Smilax sp.	33		+	-
Taxodium ascendens	67		1	1
Taxodium distichum	67		+	1
Vaccinium sp.	67		1	1
Stump	33		2	2

a r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

b No winter survey conducted, since this area was not within initial site boundaries.

Table A-20

HERBACEOUS DATA FOR THE CYPRESS SWAMP VEGETATION TYPE

Species	Frequency of Occurrence %	Mean Cover Class by Season[a]		
		Winter[b]	Spring	Summer
Carex sp.	67		+	+
Dulichium arundinaceum	67		+	-
Eriocaulon compressum	67		1	-
Graminea sp.	33		+	-
Lyonia lucida	33		+	-
Nyssa sp.	33		+	-
Osmunda cinnamomea	67		3	-
Panicum sp.	67		-	1
Pontederia cordata	33		-	1
Sagittaria graminae	67		-	1
Sphagnum sp.	100		2	3
Utricularia sp.	67		3	2
Utricularia purpurea	67		1	2
Woodwardia virginica	67		-	2
Stump	33		1	1
Open water	67		4	4

a r = solitary
+ = <1%
1 = 1-5%
2 = 6-25%
3 = 25-50%
4 = 51-75%
5 = 76-100%

b No winter survey conducted, since this area was not within initial site boundaries.

TABLE A-21

MAMMALIAN SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Scientific Name	Common Name	Hardwood Hammock	Pine Flatwoods [a]	Hardwood Swamp [b]	Saltmarsh	Relative Abundances [c]
Dasypus novemcinctus	armadillo		X			C
Didelphis marsupialis	opossum		X			C
Lutra canadensis	river otter			X		C
Peromyscus gossypinus	cotton mouse	X	X	X		C
Peromyscus nuttalli	golden mouse	X				C
Procyon lotor	raccoon			X	X	C
Scalopus aquaticus	eastern mole	X				C
Sciurus carolinensis	eastern gray squirrel	X				C
Sigmodon hispidus	hispid cotton rat		X	X		C
Sylvilagus palustris	marsh rabbit			X	X	C

a Includes pine flatwoods, grassy scrub, and scrub/flatwood.

b Includes hardwood swamp, cypress swamp, bottomland hardwood including creeks, and bayhead.

c Relative abundances; C= Common

TABLE A-22
BIRD SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Family	Scientific Name a/	Common Name	Season Observed on Site: Fall	Winter	Spring	Summer	Regional Relative Abundance b/	Nests in Florida c/
Hardwood Hammock								
Cuculidae	Coccyzus erythropthalmus	Black-billed Cuckoo		X			Uncommon transient	
Strigidae	Strix varia	Barred Owl				X	Common resident	X
Picidae	Colaptes auratus	Common Flicker		X		X	Common resident	X
	Melanerpes carolinus	Red-bellied Woodpecker	X	X		X	Common resident	X
	Picoides pubescens	Downy Woodpecker		X			Fairly common resident	X
Tyrannidae	Sayornis phoebe	Eastern Phoebe	X	X			Common winter visitor	
	Myiarchus crinitus	Great Crested Flycatcher			X	X	Common summer resident	X
Corvidae	Cyanocitta cristata	Blue Jay		X	X	X	Common resident	X
Paridae	Parus carolinensis	Carolina Chickadee	X	X	X	X	Common resident	X
	Parus bicolor	Tufted Titmouse	X		X	X	Common resident	X
Mimidae	Toxostoma rufum	Brown Thrasher			X	X	Common resident	X
Troglodytidae	Thryothorus ludovicianus	Carolina Wren	X	X	X	X	Common resident	X
Turdidae	Turdus migratorius	Robin		X			Common winter visitor	X
	Catharus guttata	Hermit Thrush	X	X			Common winter visitor	
Sylviidae	Polioptila caerulea	Blue-gray Gnatcatcher		X	X	X	Common resident	X
	Regulus calendula	Ruby-crowned Kinglet	X	X			Common winter visitor	
Bombycillidae	Bombycilla cedrorum	Cedar Waxwing		X			Common winter visitor	
Vireonidae	Vireo griseus	White-eyed Vireo	X	X	X	X	Common resident	X
	Vireo olivaceus	Red-eyed Vireo			X	X	Common summer resident	X
Parulidae	Mniotilta varia	Black-and-white Warbler		X	X		Fairly common winter visitor	
	Vermivora celata	Orange-crowned Warbler	X				Fairly common winter visitor	
	Parula americana	Northern Parula Warbler			X	X	Common summer resident	X
	Dendroica dominica	Yellow-throated Warbler			X		Fairly common resident	X
	Dendroica pinus	Pine Warbler	X	X			Common resident	X
	Seiurus aurocapillus	Ovenbird			X		Fairly common winter visitor	X
	Geothlypes trichus	Common Yellowthroat	X	X	X	X	Common resident	X
	Setophaga ruticilla	American Redstart			X		Fairly common transient	X
Thraupidae	Piranga rubra	Summer Tanager			X	X	Common summer resident	X
Fringillidae	Cardinalis cardinalis	Cardinal	X	X	X	X	Common resident	X
	Pipilo erythrophthalmus	Rufous-sided Towhee	X	X	X	X	Common resident	X
	Zonotrichia albicollis	White-throated Sparrow	X	X			Common winter visitor	
Hardwood Swamp d/								
Accipitridae	Buteo lineatus	Red-shouldered Hawk			X	X	Fairly common resident	X
Cuculidae	Coccyzus americanus	Yellow-billed Cuckoo			X	X	Common summer resident	X
Picidae	Dryocopus pileatus	Pileated Woodpecker	X				Fairly common resident	X
	Melanerpes carolinus	Red-bellied Woodpecker				X	Common resident	X
	Picoides pubescens	Downy Woodpecker		X			Fairly common resident	X
Tyrannidae	Myiarchus crinitus	Great Crested Flycatcher			X	X	Common summer resident	X
Hirundinidae	Progne subis	Purple Martin				X	Common summer resident	X
Corvidae	Cyanocitta cristata	Blue Jay		X			Common resident	X
	Corvus ossifragus	Fish Crow			X		Common resident	X
Paridae	Parus carolinensis	Carolina Chickadee	X				Common resident	X
	Parus bicolor	Tufted Titmouse		X	X		Common resident	X
Troglodytidae	Thryothorus ludovicianus	Carolina Wren	X	X	X		Common resident	X

TABLE A-22
BIRD SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Family	Scientific Name [a/]	Common Name	Season Observed on Site: Fall	Winter	Spring	Summer	Regional Relative Abundance [b/]	Nests in Florida [c/]
Hardwood Hammock								
Cuculidae	Coccyzus erythropthalmus	Black-billed Cuckoo		X			Uncommon transient	
Strigidae	Strix varia	Barred Owl				X	Common resident	X
Picidae	Colaptes auratus	Common Flicker		X		X	Common resident	X
	Melanerpes carolinus	Red-bellied Woodpecker	X	X		X	Common resident	X
	Picoides pubescens	Downy Woodpecker		X			Fairly common resident	X
Tyrannidae	Sayornis phoebe	Eastern Phoebe	X	X			Common winter visitor	
	Myiarchus crinitus	Great Crested Flycatcher			X	X	Common summer resident	X
Corvidae	Cyanocitta cristata	Blue Jay		X	X	X	Common resident	X
Paridae	Parus carolinensis	Carolina Chickadee	X	X	X	X	Common resident	X
	Parus bicolor	Tufted Titmouse	X		X	X	Common resident	X
Mimidae	Toxostoma rufum	Brown Thrasher			X	X	Common resident	X
Troglodytidae	Thryothorus ludovicianus	Carolina Wren	X	X	X	X	Common resident	X
Turdidae	Turdus migratorius	Robin		X			Common winter visitor	X
	Catharus guttata	Hermit Thrush	X	X			Common winter visitor	
Sylviidae	Polioptila caerulea	Blue-gray Gnatcatcher		X	X	X	Common resident	X
	Regulus calendula	Ruby-crowned Kinglet	X	X			Common winter visitor	
Bombycillidae	Bombycilla cedrorum	Cedar Waxwing		X			Common winter visitor	
Vireonidae	Vireo griseus	White-eyed Vireo	X	X	X	X	Common resident	X
	Vireo olivaceus	Red-eyed Vireo			X	X	Common summer resident	X
Parulidae	Mniotilta varia	Black-and-white Warbler		X	X		Fairly common winter visitor	
	Vermivora celata	Orange-crowned Warbler	X				Fairly common winter visitor	
	Parula americana	Northern Parula Warbler			X	X	Common summer resident	X
	Dendroica dominica	Yellow-throated Warbler			X		Fairly common resident	X
	Dendroica pinus	Pine Warbler	X	X			Common resident	X
	Seiurus aurocapillus	Ovenbird			X		Fairly common winter visitor	X
	Geothlypes trichus	Common Yellowthroat	X	X	X	X	Common resident	X
	Setophaga ruticilla	American Redstart			X		Fairly common transient	X
Thraupidae	Piranga rubra	Summer Tanager			X	X	Common summer resident	X
Fringillidae	Cardinalis cardinalis	Cardinal	X	X	X	X	Common resident	X
	Pipilo erythrophthalmus	Rufous-sided Towhee	X	X	X	X	Common resident	X
	Zonotrichia albicollis	White-throated Sparrow	X	X			Common winter visitor	
Hardwood Swamp [d/]								
Accipitridae	Buteo lineatus	Red-shouldered Hawk			X	X	Fairly common resident	X
Cuculidae	Coccyzus americanus	Yellow-billed Cuckoo			X	X	Common summer resident	X
Picidae	Dryocopus pileatus	Pileated Woodpecker	X				Fairly common resident	X
	Melanerpes carolinus	Red-bellied Woodpecker				X	Common resident	X
	Picoides pubescens	Downy Woodpecker		X			Fairly common resident	X
Tyrannidae	Myiarchus crinitus	Great Crested Flycatcher			X	X	Common summer resident	X
Hirundinidae	Progne subis	Purple Martin				X	Common summer resident	X
Corvidae	Cyanocitta cristata	Blue Jay		X			Common resident	X
	Corvus ossifragus	Fish Crow			X		Common resident	X
Paridae	Parus carolinensis	Carolina Chickadee	X				Common resident	X
	Parus bicolor	Tufted Titmouse		X	X		Common resident	X
Troglodytidae	Thryothorus ludovicianus	Carolina Wren	X	X	X		Common resident	X

TABLE A-22
(Continued)

BIRD SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Family	Scientific Name [a]	Common Name	Fall	Winter	Spring	Summer	Regional Relative Abundance [b]	Nests in Florida [c]
Salt Marsh								
Ardeidae	Ardea herodias	Great Blue Heron	X	X	X	X	Common resident	X
	Butorides striatus	Green Heron	X	X	X	X	Common resident	X
	Florida caerulea	Little Blue Heron			X	X	Common resident	X
	Bubulcus ibis	Cattle Egret			X	X	Common resident	X
	Casmerodius albus	Great Egret	X	X	X	X	Common resident	X
	Egretta thula	Snowy Egret	X	X	X	X	Common resident	X
	Hydranassa tricolor	Louisiana Heron	X	X	X	X	Common resident	X
	Nycticorax nycticorax	Black-crowned Night Heron				X	Fairly common resident	X
Ciconiidae	Mycteria americana	Wood Stork				X	Locally common resident	X
Threskiornithidae	Eudocimus albus	White Ibis			X	X	Locally common resident	X
Accipitridae	Buteo jamaicensis	Red-tailed Hawk		X			Fairly common resident	X
	Circus cyaneus	Marsh Hawk		X			Uncommon winter visitor	X
Pandionidae	Pandion haliaetus	Osprey	X	X	X	X	Fairly common resident	X
Rallidae	Rallus longirostris	Clapper Rail			X	X	Common resident	X
Scolopacidae	Actitis macularia	Spotted Sandpiper			X		Fairly common transient	
Alcedinidae	Megaceryle alcyon	Belted Kingfisher		X			Fairly common resident	X
Icteridae	Agelaius phoeniceus	Red-winged Blackbird	X	X	X	X	Common resident	X
	Quiscalus quiscula	Common Grackle	X	X	X	X	Common resident	X
	Cassidix major	Boat-tailed Grackle	X	X	X	X	Common resident	X
Fringillidae	Ammodramus savannarum	Grasshopper Sparrow		X	X		Fairly common winter visitor	X
Borrow Pit								
Podicipedidae	Podilymbus podiceps	Pied-billed Grebe		X				
Ardeidae	Ardea herodias	Great Blue Heron			X		Common resident	X
	Butorides striatus	Green Heron			X	X	Common resident	X
	Casmerodius albus	Great Egret		X			Common resident	X
	Egretta thula	Snowy Egret		X	X		Common resident	X
	Hydranassa tricolor	Louisiana Heron			X	X	Common resident	X
	Nycticorax nycticorax	Black-crowned Night Heron			X	X	Fairly common resident	X
Pandionidae	Pandion haliaetus	Osprey		X	X		Fairly common resident	X
Laridae	Larus philadelphia	Bonaparte's Gull		X			Fairly common winter visitor	
	Sterna albifrons	Least Tern			X		Fairly common resident	X
Alcedinidae	Megaceryle alcyon	Belted Kingfisher		X			Fairly common resident	X
Rookery [d]								
Anhingidae	Anhinga anhinga	Anhinga			X	X	Common resident	X
Ardeidae	Florida caerulea	Little Blue Heron			X	X	Common resident	X
	Bubulcus ibis	Cattle Egret			X	X	Common resident	X
	Casmerodius albus	Great Egret			X	X	Common resident	X
	Egretta thula	Snowy Egret			X	X	Common resident	X
	Hydranassa tricolor	Louisiana Heron			X	X	Common resident	X
	Nycticorax nycticorax	Black-crowned Night Heron			X	X	Fairly common resident	X
	Nyctanassa violacea	Yellow-crowned Night Heron			X		Fairly common resident	X
	Butorides striatus	Green Heron				X	Common resident	X
Ciconiidae	Mycteria americana	Wood Stork				X	Locally common resident	X
Threskironithidae	Eudocimus albus	White Ibis			X	X	Locally common resident	X

TABLE A-22
(Continued)

BIRD SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Family	Scientific Name [a]	Common Name	Season Observed on Site				Regional Relative Abundance [b]	Nests in Florida [c]
			Fall	Winter	Spring	Summer		
Mimidae	Dumetella carolinensis	Gray Catbird	X	X	X		Common winter visitor	X
	Mimus polyglottos	Mockingbird	X				Common resident	X
Turdidae	Turdus migratorius	American Robin	X	X			Common winter visitor	X
	Catharus guttata	Hermit Thrush		X			Common winter visitor	
Sylviidae	Regulus calendula	Ruby-crowned Kinglet	X	X			Common winter visitor	
Vireonidae	Vireo griseus	White-eyed Vireo	X			X	Common resident	X
	Vireo olivaceus	Red-eyed Vireo			X	X	Common summer resident	X
Parulidae	Mniotilta varia	Black-and-white Warbler		X	X		Fairly common winter visitor	
	Protonotaria citrea	Prothonotary Warbler			X	X	Fairly common summer visitor	X
	Vermivora celata	Orange-crowned Warbler	X				Fairly common winter visitor	
	Dendroica pinus	Pine Warbler	X				Common resident	X
	Dendroica coronata	Yellow-rumped Warbler	X	X			Common winter visitor	X
	Geothlypis trichas	Common Yellowthroat	X		X	X	Common resident	X
	Setophaga ruticilla	American Redstart			X		Fairly common transient	X
	Molothrus ater	Brown-headed Cowbird			X		Common winter visitor	X
Fringillidae	Cardinalis cardinalis	Cardinal		X	X	X	Common resident	X
	Passerina ciris	Painted Bunting				X	Common summer resident	X
	Pipilo erythrophthalmus	Rufous-sided Towhee	X	X	X	X	Common resident	X
	Spizella pusilla	Field Sparrow			X		Fairly common winter visitor	X
	Melospiza georgiana	Swamp Sparrow	X	X			Common winter visitor	
Pine Flatwoods [e]								
Cathartidae	Coragyps atratus	Black Vulture				X	Common resident	X
Phasianidae	Colinus virginianus	Bobwhite			X	X	Common resident	X
Caprimulgidae	Chordeiles minor	Common Nighthawk				X	Common summer resident	X
Picidae	Colaptes auratus	Common Flicker			X		Common resident	X
	Picoides pubescens	Downy Woodpecker	X				Fairly common resident	X
Corvidae	Corvus brachyrhynchos	Common Crow		X		X	Fairly common resident	X
Sittidae	Sitta pusilla	Brown-headed Nuthatch		X		X	Fairly common resident	X
Troglodytidae	Troglodytes aedon	House Wren			X		Common winter visitor	
	Thryothorus ludovicianus	Carolina Wren			X		Common resident	X
Mimidae	Mimus polyglottos	Mockingbird			X		Common resident	X
Turdidae	Turdus migratorius	American Robin		X			Common winter visitor	X
	Sialia sialis	Eastern Bluebird			X		Fairly common resident	X
Sylviidae	Polioptila caerulea	Blue-gray Gnatcatcher				X	Common resident	X
Parulidae	Dendroica coronata	Yellow-rumped Warbler	X	X			Common winter visitor	
	Dendroica pinus	Pine Warbler		X			Common resident	X
	Geothlypis trichus	Common Yellowthroat	X				Common resident	X
	Setophaga ruticilla	American Redstart			X		Fairly common transient	X
Icteridae	Dolichonyx oryzivorus	Bobolink			X		Common transient	
	Sturnella magna	Eastern Meadowlark			X		Common summer resident	X
Fringillidae	Guiraca caerulea	Blue Grosbeak			X	X	Fairly common summer resident	X
	Pipilo erythrophthalmus	Rufous-sided Towhee	X	X	X	X	Common resident	X
	Aimophila aestivalis	Bachman's Sparrow		X	X	X	Fairly common resident	X
	Spizella pusilla	Field Sparrow			X		Fairly common winter visitor	X
	Melospiza georgiana	Swamp Sparrow	X				Common winter visitor	
	Melospiza melodia	Song Sparrow		X			Common winter visitor	

TABLE A-22
(Continued)

BIRD SPECIES OBSERVED ON THE PROPOSED PLANT SITE

Family	Scientific Name a/	Common Name	Season Observed on Site: Fall	Winter	Spring	Summer	Regional Relative Abundance b/	Nest in Florida c/
Anatidae	Aix sponsa	Wood Duck			X	X	Common resident	X
Cathartidae	Coragyps atratus	Black Vulture				X	Common resident	X
Rallidae	Gallinula chloropus	Common Gallinule				X	Common resident	X
Corvidae	Corvus ossifragus	Fish Crow				X	Common resident	X
Parulidae	Protonotaria citrea	Prothonotary Warbler			X	X	Fairly common summerresident	X

a/ From: American Ornithologists Union (1957), American Ornithologists Union (1973), American Orithologists Union (1976)

b/ From: Austin (1975) and Johnson et al.(1974)

c/ From: Florida Audubon Society (1976)

d/ Hardwood Swamp includes hardwoop swamp, cypress swamp, bottomland hardwood and bayhead.

e/ Pine Flatwoods includes pine flatwoods, scrub/flatwood, and grassy scrub.

f/ Observations made during spring and summer only

TABLE A-23

REPTILES OBSERVED ON THE PROPOSED PLANT SITE

Scientific Name	Common Name	Hardwood Hammock	Pine Flatwoods [a]	Hardwood Swamp [b]	Saltmarsh	Relative Abundance [d]
Agkistrodon piscivorus	Florida cottonmouth			X		C
Alligator mississippiensis	American alligator			X		C
Anolis carolinensis	green anole		X			C
Anolis sagrei	brown anole	X				C
Cnemidophorus sexlineatus sexlineatus	six-lined racerunner	X	X			C
Coluber constricter priapus	southern black racer		X			C
Eumeces eumeces similis	northern mole skink		X			U
Eumeces inexpectatus	southeastern five-lined skink	X				C
Gopherus polyphemus	gopher tortoise		X			C
Ophisaurus ventralis	eastern glass lizard		X			C
Nerodia fasciata pictiventris	Florida water snake			X		C
Sceloporus undulatus undulatus	southern fence lizard		X			C
Scincella lateralis	ground skink	X				C [c]

[a] Includes pine flatwoods, grassy scrub, and scrub/flatwood.

[b] Includes hardwood swamp, cypress swamp, bottomland hardwood including creeks, and bayhead.

[c] Not listed, by Ashton, 1978. Species was common on the proposed plant site.

[d] Relative abundances taken from Ashton, 1978; C = Common, U = Uncommon

TABLE A-24

AMPHIBIANS OBSERVED ON THE PROPOSED PLANT SITE

Scientific Name	Common Name	Hardwood Hammock	Pine Flatwoods [a]	Hardwood Swamp [b]	Saltmarsh	Relative Abundance [c]
Bufo quercicus	oak toad	X				C
Bufo terrestris	southern toad	X				C
Hyla femoralis	pinewoods treefrog		X			C
Scaphiopus holbrooki	eastern spadefoot		X			C
Hyla crucifer bartramiana	southern spring peeper			X		C
Limnaoedus ocularis	little grass frog			X		C
Pseudacris ornata	ornate chorus frog			X		U
Acris gryllus dorsalis	Florida cricket frog			X		C
Rana clamitans clamitans	bronze frog			X		C
Hyla cinerea	green treefrog			X		C
Rana sphenocephala	southern leopard frog			X		C
Gastrophryne carolinensis	eastern narrow-mouth frog		X	X		C
Plethodon glutinosus	slimy salamander			X		C
Siren lacertina	greater siren			X		C

a Includes pine flatwoods, grassy scrub, and scrub/flatwood.

b Includes hardwood swamp, cypress swamp, bottomland hardwood including creeks, and bayhead.

c Relative abundances taken from Ashton, 1978; C = Common, U = Uncommon

TABLE A-25

SMALL MAMMAL TRAPPING RESULTS [a/]

Scientific Name	Common Name	DECEMBER				MAY					
		Pine Flatwoods (M1)[b]	Hardwood Hammock (M2)	Young Bayhead (M3) Hardwood Swamp	Mature Bayhead (M4)	Pine Flatwoods (M1)	Pine Flatwoods[c] (M6)	Hardwood Hammock (M2)	Young Bayhead (M3)	Mature Bayhead (M4) Hardwood Swamp	Hardwood Swamp[c] (M3)
Sigmodon hispidus	cotton rat	16	0	19	0	13	3	0	14	1	8
Peromyscus gossypinus	cotton mouse	0	1	4	13	0	3	8	7	43	15
Peromyscus nuttalli	golden mouse	0	0	0	0	0	0	1	0	0	0

a Numbers represent captures per 100 trapnights and are based on a 120 trapnight effort (40 traps for 3 nights) except where noted.

b Code used for sampling locations in Figure 6.2-19.

c Numbers based on a 60 trapnight effort (20 traps for 3 nights).

TABLE A-26

BIRD SPECIES OBSERVED ON BLOUNT ISLAND

Family	Scientific Name [a/]	Common Name	Season Observed on Site [b/] Spring	Summer	Regional [c/] Relative Abundance	Nests in [d/] Florida
Anhingidae	Anhinga anhinga	Anhinga		X	Common resident	X
Ardeidae	Ardea herodias	Great Blue Heron	X	X	Common resident	X
	Butorides striatus	Green Heron	X	X	Common resident	X
	Florida caerulea	Little Blue Heron	X	X	Common resident	X
	Bubulcus ibis	Cattle Egret	X	X	Common resident	X
	Casmerodius albus	Great Egret	X	X	Common resident	X
	Egretta thula	Snowy Egret	X	X	Common resident	X
	Hydranassa tricolor	Louisiana Heron	X	X	Common resident	X
	Nycticorax nycticorax	Black-crowned Night Heron		X	Fairly common resident	X
	Ixobrychus exilus	Least Bittern	X		Fairly common resident	X
Ciconiidae	Mycteria americana	Wood Stork	X	X	Locally common resident	X
Threskiornithidae	Eudocimus albus	White Ibis	X	X	Locally common resident	X
Anatidae	Anas discors	Blue-winged Teal		X	Common winter visitor	
Cathartidae	Cathartes aura	Turkey Vulture	X	X	Common resident	X
Accipitridae	Buteo jamaicensis	Red-tailed Hawk	X		Fairly common resident	X
	Circus cyaneus	Marsh Hawk	X		Uncommon winter visitor	X
Pandionidae	Pandion haliaetus	Osprey	X	X	Fairly common resident	X
Phasianidae	Colinus virginianus	Bobwhite		X	Common resident	X
Rallidae	Rallus longirostris	Clapper Rail	X	X	Common resident	X
	Fulica americana	American Coot	X		Common winter visitor	X
Charadriidae	Charadrius semipalmatus	Semipalmated Plover	X		Fairly common resident	
	Charadrius wilsonia	Wilson's Plover	X	X	Fairly common summer resident	X
	Charadrius vociferus	Killdeer	X	X	Common resident	X
	Pluvialis squatarola	Black-bellied Plover	X		Common winter visitor	
	Charadrius melodius	Piping Plover	X		Fairly common winter visitor	
Scolopacidae	Actitis macularia	Spotted Sandpiper	X	X	Fairly common transient	
	Tringa flavipes	Lesser Yellowlegs	X		Fairly common winter visitor	
	Catoptrophorus semipalmatus	Willet	X	X	Common resident	X
	Calidris minutella	Least Sandpiper	X		Fairly common winter visitor	
	Calidris pusillus	Semipalmated Sandpiper	X		Fairly common winter visitor	
	Calidris mauri	Western Sandpiper	X		Common winter visitor	
	Limnodromus griseus	Short-billed Dowitcher	X		Fairly common winter visitor	
Recurvirostridae	Himantopus mexicanus	Black-necked Stilt		X	Rare transient	X
Laridae	Larus argentatus	Herring Gull	X		Common winter visitor	
	Larus atricilla	Laughing Gull	X		Fairly common resident	X
	Sterna albifrons	Least Tern	X	X	Fairly common resident	X
	Sterna caspia	Caspian Tern	X	X	Fairly common resident	X
Rynchopidae	Rynchops niger	Black Skimmer	X	X	Common resident	X
Columbidae	Zenaida macroura	Mourning Dove	X	X	Common resident	X
	Columbina passerina	Ground Dove	X	X	Common resident	X
	Columba livia	Rock Dove		X	Common resident	X
Caprimulgidae	Chordeiles minor	Common Nighthawk		X	Common summer resident	X
Alcedinidae	Megaceryle alcyon	Belted Kingfisher	X		Fairly common resident	X
Tyrannidae	Tyrannus tyrannus	Eastern Kingbird	X		Common summer resident	X
Hirundinidae	Riparia riparia	Bank Swallow	X		Uncommon transient	
	Hirundo rustica	Barn Swallow	X		Common transient	X
Corvidae	Cyanocitta cristata	Blue Jay	X		Common resident	X
	Corvus ossifragus	Fish Crow	X	X	Common resident	X
Mimidae	Mimus polyglottos	Mockingbird	X	X	Common resident	X
Laniidae	Lanius ludovicianus	Loggerhead Shrike	X	X	Common resident	X
Sturnidae	Sturnus vulgaris	Starling	X	X	Common resident	X
Ploceidae	Passer domesticus	House Sparrow		X	Common resident	

Table A-26
(Continued)

BIRD SPECIES OBSERVED ON BLOUNT ISLAND

Family	Scientific Name a/	Common Name	Season Observed on Site b/ Spring	Summer	Regional c/ Relative Abundance	Nests in d/ Florida
Icteridae	Dolichonyx oryzivorus	Bobolink	X	X	Common transient	
	Sturnella magna	Eastern Meadowlark		X	Common resident	X
	Agelaius phoeniceus	Red-winged Blackbird	X	X	Common resident	X
	Quiscalus major	Boat-tailed Grackle	X	X	Common resident	X
	Quiscalus quiscula	Common Grackle	X	X	Common resident	X
Thraupidae	Piranga rubra	Summer Tanager	X	X	Common summer resident	X
Fringillidae	Cardinalis cardinalis	Cardinal	X	X	Common resident	X
	Passerina ciris	Painted Bunting	X	X	Common summer resident	X
	Pipilo erythrophthalmus	Rufous-sided Towhee	X	X	Common resident	X

a/ From: American Ornithologists Union (1957), American Ornithologists Union (1973), American Ornithologists Union (1976)

b/ Observations made during spring and summer only.

c/ From: Austin (1975) and Johnson et al.(1974)

d/ From: Florida Audubon Society (1976)

Table A-27

ROOKERY CENSUS RESULTS

Species	Active Nests in Sampling Period[a]		
	June	July	August
Cattle Egret	136	326	76
Snowy Egret	136	48	18
Great Egret	42	16	8
Little Blue Heron	0	10	2
Louisiana Heron	184	130	42
Black-Crowned Night Heron	52	16	6
White Ibis	126	80	10
Anhinga	2	2	0
Unidentified Nests[c]	692	240	2
Unidentified Nestlings[d]	244	90	42
Total	1614	958	206

a Methodology is described in Section 6.2.10.2.
b White Ibis eggs have distinctive characteristics and were thus identified.
c Nests with eggs that could not be identified were placed in this category.
d Nestlings that could not be identified were placed in this category.

Table A-28

WILDLIFE SPECIES ON FEDERAL AND STATE ENDANGERED OR THREATENED SPECIES LIST

Scientific Name	Common Name	Status[a]			
		State	Federal	Plant	Proposed Coal Offloading Facility
Alligator mississippiensis	American alligator	SSC	T	X	-
Gopherus polyphemus	Gopher tortoise	SSC		X	-
Drymarchon corais couperi	Eastern indigo snake	T	T	-	-
Mycteria americana	Wood Stork	E		X	X
Haliaeetus leucocephalus	Bald Eagle	T	E	-	-
Sterna albifrons	Least Tern	T		-	X

a SSC = species of special concern, T = threatened, E = endangered

Source: Nesbitt, 1980; personal communication, Florida State Game and Freshwater Fish Commission, Gainesville, Florida.

Table A-29

CONCENTRATIONS OF SELECTED TRACE ELEMENTS FOUND TO BE TOXIC TO VEGETATION TYPICAL OF THE PLANT SITE REGION

Trace Element/Species	Element Source	Source Concentration	Plant Part	Tissue Concentration (ppm)	Results	Reference
Arsenic						
Potato	-	-	Peel of tuber	24	Toxic	Sihlbom and Fredriksson (1960)
Potato	-	-	Peeled potato	1	Toxic	Sihlbom and Fredriksson (1960)
Lemon	-	-	Seedlings	11	Toxic	Liebig et al. (1959)
Beryllium						
Alfalfa	Nutrient solution	2 ppm	Tops, roots	-	Retarded growth	Romney and Childress (1965)
Boron						
Orange	Field	-	Leaves	200	Toxic	Chapman and Vanselow (1955)
Alfalfa	Sand	-	Leaves	516-996	Toxic	Eaton (1944)
Cabbage	Sand	-	Inner Leaves	60-110	Toxic	Eaton (1944)
Cabbage	Sand	-	Outer Leaves	440-1152	Toxic	Eaton (1944)
Corn	Sand	-	Leaves	179	Toxic	Eaton (1944)
Cadmium						
Corn	Nutrient solution	-	Tops	160	50% decrease in photosynthesis	Carlson et al. (1975)
Chromium						
Corn	-	-	Leaves	4-8	Toxic	Soane and Saunders (1959)
Cobalt						
Citrus	-	-	Leaves	11	Toxic	Vanselow (1966)
Copper						
Orange	Field	-	Leaves	23	Toxic	Reuther and Smith (1954)
Citrus	Sandy soil	150 ppm total Cu	-	-	Soil pH 5-toxic	Reuther and Smith (1953)
Fluorine						
Tomato	Field fumigation	0.6 ug/m^3 continuously	Leaves	193.7	No symptoms	MacLean et al. (1977)
Sweet corn	HF in air	2-3 ppb	-	-	Threshold limit	Nat. Res Council (1971)
Susceptible species	Air - 1 day	3-4 ug/m^3	-	-	Threshold limit	Nat. Res Council (1971)
Lead						
Corn	Solution culture	2000 ppm	Leaves	450	80% decrease in photosynthesis	Bazzaz et al. (1974)
Corn	Solution culture	4000 ppm	Leaves	350	48% decrease in photosynthesis	Bazzaz et al. (1974)
Potato	Nitrient solution	50 ppm	Plant	-	Death one week	Frear (no date)

Table A-29 (Continued)

CONCENTRATIONS OF SELECTED TRACE ELEMENTS FOUND TO BE TOXIC TO VEGETATION TYPICAL OF THE PLANT SITE REGION

Trace Element/Species	Element Source	Source Concentration	Plant Part	Tissue Concentration (ppm)	Results	Reference
Manganese						
Valencia orange	Field	-	Tops	1000	Toxic	Reuther et al. (1949)
Alfalfa	Acid soil in pots	50 ppm exchangeable Mn	-	-	Toxic	Foy (1964)
Mercury						
Potato	-	0.5-50 ppm	-	-	Inhibit growth	Bell and Rickard (1974)
Molybdenum						
Tomato	Nutrient solution	10 ppm	-	-	Toxic	Arnon and Stout (1939)
Nickel						
Corn	Nutrient solution	-	Tops	290-350	50% decrease in photosynthesis	Carlson et al. (1975)
Selenium						
Tomato	Sand culture	-	Leaves	191	Toxic	Neiswander and Morris (1940)
Vanadium						
Alfalfa	Sand	550 ppm	-	-	Decreased growth	Jha (1969)
Zinc						
Orange	Field	-	Leaves	300	Toxic	Reuther and Smith (1954)
Tomato	Nutrient solution	-	Leaves	526-1489	Toxic	Lyon et al. (1943)

Source: U.S. Fish and Wildlife Service (1978)

Table A-30
PROJECTED TRACE ELEMENT CONCENTRATIONS

Trace Elements	Concentration[a] in Coal (ppm)	Projected Stack Emission Rate[b] (gm/sec)	Element to SO_2 Ratio[c]	Maximum Predicted Trace Element Concentration[d] (ug/m^3)	Deposition Flux[e] ($g/m^2/yr$)	Projected Soil Concentration Increase[f] (mg/kg/yr)
Arsenic	25	2.52	2.21×10^{-3}	4.42×10^{-3}	1.39×10^{-4}	3.71×10^{-4}
Beryllium	1.3	1.31×10^{-1}	1.15×10^{-4}	2.3×10^{-4}	7.24×10^{-6}	1.93×10^{-5}
Boron	42	4.23	3.72×10^{-3}	7.44×10^{-3}	2.34×10^{-4}	6.24×10^{-4}
Cadmium	0.24	2.42×10^{-2}	2.12×10^{-5}	4.25×10^{-5}	1.34×10^{-6}	3.57×10^{-6}
Chromium	20	2.02	1.77×10^{-3}	3.54×10^{-3}	1.12×10^{-4}	2.98×10^{-4}
Cobalt	9.8	9.88×10^{-1}	8.68×10^{-4}	1.74×10^{-3}	5.48×10^{-5}	1.46×10^{-4}
Copper	18	1.81	1.59×10^{-3}	3.18×10^{-3}	1.00×10^{-4}	2.67×10^{-4}
Fluorine	89	8.97	7.88×10^{-3}	1.58×10^{-2}	4.98×10^{-4}	1.33×10^{-3}
Lead	59	5.94	5.22×10^{-3}	1.04×10^{-2}	3.28×10^{-4}	8.74×10^{-4}
Manganese	18	1.81	1.59×10^{-3}	3.18×10^{-3}	1.00×10^{-4}	2.67×10^{-4}
Mercury	0.2	2.02×10^{-2}	1.77×10^{-5}	3.54×10^{-5}	1.12×10^{-6}	2.98×10^{-6}
Molybdenum	4.6	4.64×10^{-1}	4.07×10^{-4}	8.14×10^{-4}	2.56×10^{-5}	6.82×10^{-5}
Nickel	15	3.02	2.65×10^{-3}	5.3×10^{-3}	1.67×10^{-4}	4.45×10^{-4}
Selenium	4.0	4.03×10^{-1}	3.54×10^{-4}	7.08×10^{-4}	2.23×10^{-5}	5.94×10^{-5}
Strontium	130	13.10	1.15×10^{-2}	2.3×10^{-2}	7.25×10^{-4}	1.93×10^{-3}
Tin	2.0	2.02×10^{-1}	1.77×10^{-4}	3.54×10^{-4}	1.12×10^{-5}	2.98×10^{-5}
Vanadium	38	3.83	3.36×10^{-3}	6.72×10^{-3}	2.12×10^{-4}	5.65×10^{-4}
Zinc	25	2.52	2.21×10^{-3}	4.42×10^{-3}	1.39×10^{-4}	3.70×10^{-4}

a Source: Gluskoter et al. (1977)
b Based on coal consumption rate of 3.5×10^6 tons/year
c SO_2 emission rate of 1138.3 g/sec
d Based on maximum predicted ambient SO_2 concentrations of 2 ug/m^3 on an annual basis, which is contribution of proposed plant without any of the additional emission sources, and assuming that all emissions are unaffected by FGD and electrostatic precipitator systems
e Based on deposition velocity of 0.1 cm/sec
f Assumes element mixes in top 25 cm soil and soil bulk density is 1.5 g/cm^3.

Soil concentration increase per year in mg of trace element per kg of soil is equal to:

$$\text{Deposition Flux } (g/m^2/yr) \frac{1\ m^2}{10^4\ cm^2} \times \frac{10^6\ ug}{g} \times \frac{1}{25\ cm} \times \frac{1}{1.5\ g/cm^3} = \frac{mg/kg/yr}{3.75 \times 10^5}$$

(U.S. Fish and Wildlife Service, 1978)

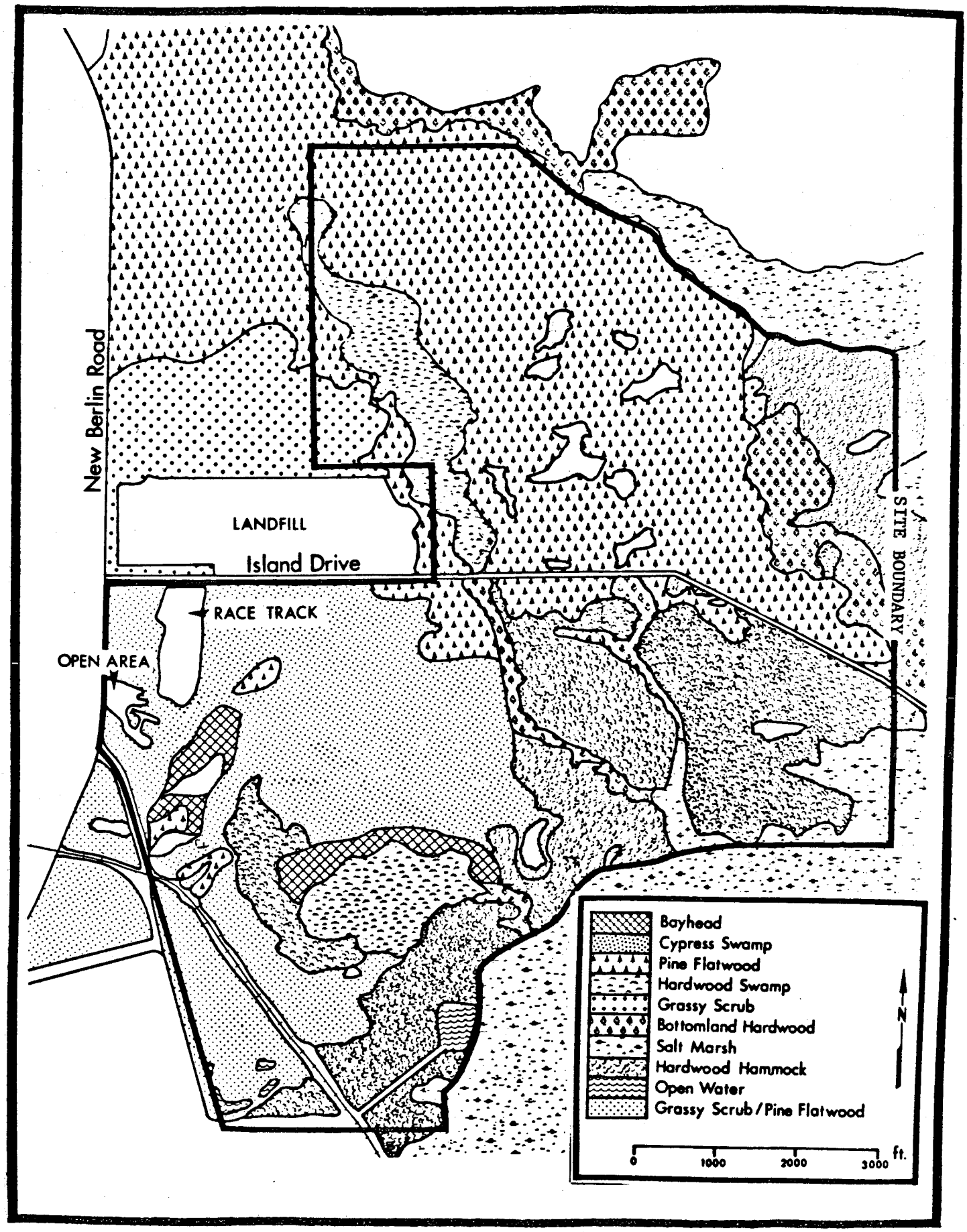

Figure A-1 Vegetation Communities of the Proposed Plant Site

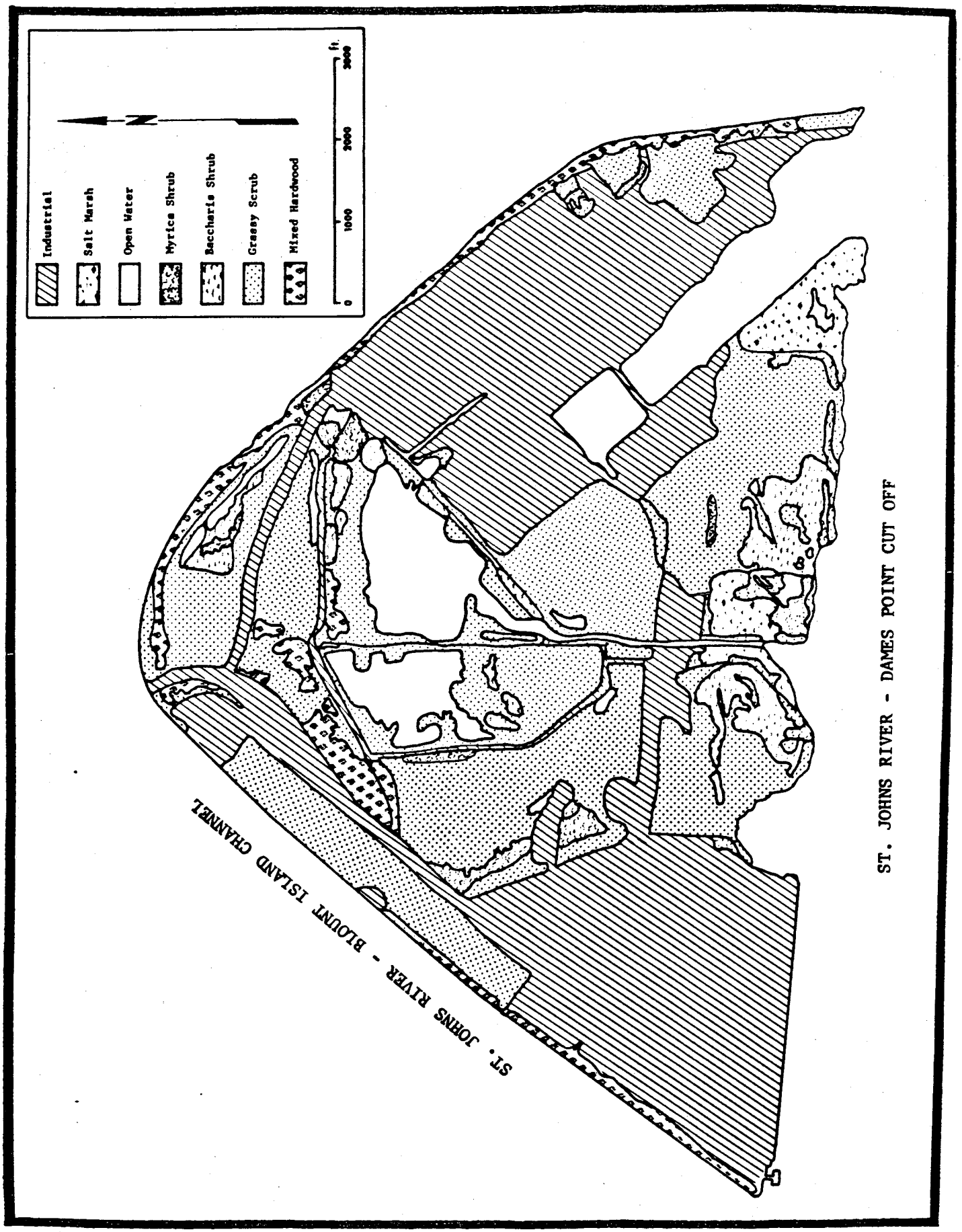

Figure A-2 Vegetation Communities of Blount Island

B

AQUATIC ECOLOGY

APPENDIX B

AQUATIC ECOLOGY

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APPENDIX B

AQUATIC ECOLOGY

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AQUATIC ECOLOGY

B.1 INTRODUCTION

The material contained in Appendix B is a synoposis of field and laboratory analyses performed during the aquatic ecology pre-application monitoring program. Also included is a summary of relevant toxicities for significant indigenous species. Life histories of commercially important species found in the St. Johns River estuary are presented in Section B.2. Tables B-1 through B-3 list spawning habits of commercially important species while B-4 through B-27 and Figures B-1 through B-16 are arranged according to each of the following six categories:

1. Mesozooplankton
2. Macrozooplankton
3. Benthic Nekton and Invertebrates
4. Ichthyoplankton and Nekton Larvae
5. Adult and Juvenile Nekton
6. Toxicity

Each discipline is separated based on sampling gear (Section 6.2.4.2). Organisms found in each sample were noted regardless of their classification as plankton or nekton. The blue crab, Callinectes sapidus, is an example of this concept. As noted in its life history (Section B.2), the blue crab is a euryhaline invertebrate which spends its larval stages (zoea and megalops) in the planktonic community while juvenile and adult stages are spent on the bottom or swimming in the water column. In accordance with this behavior, C. sapidus was caught using the following gear:

1. ichthyoplankton net tows - 363 micron mesh size
2. benthic invertebrate - ponar dredge
3. otter trawl

4. beach seines - 1/4-inch mesh size
5. experimental gill nets
6. electroshocking

and numbers were noted and listed in the Appendix B tables and figures.

B.2 LIFE HISTORIES OF THE COMMERCIALLY IMPORTANT NEKTON

Shellfish

The commercially important shrimps (white shrimp, Penaeus setiferus; brown shrimp, Penaeus aztecus; pink shrimp, Penaeus duorarum) and the commercially important crabs (blue crabs, Callinectes sapidus and Callinectes similis) have similar spawning strategies but different mating habits. C. similis, a closely related but much smaller (about 74 mm maximum carapace width) blue crab, has been grouped with C. sapidus because of the difficulty incurred when attempting to separate early juveniles. Trachypenaeus constrictus is deleted from the life history discussion because the adult size, about 92 mm standard length, is too small for it to be considered of commercial valve. Both penaeid shrimp and blue crabs mature in the St. Johns River, but prefer more offshore, higher salinity waters of the Georgia Bight for spawning. Peak spawning of the penaeid shrimp occurs in the summer, whereas blue crabs spawn in all but the coldest months of the year. Such reproductive cycles are genetically programmed to take advantage of optimal food supplies and other favorable conditions on the nursery grounds to insure rapid growth rates and maximum survival. Year class strength for a species is determined by conditions encountered by young while in nursery areas.

Spawning of penaeid shrimp occurs in deep offshore waters during the spring and summer with brown shrimp preferring slightly greater depths than white or pink shrimp (Pearson, 1939; Williams, 1955, 1965; Kutkuhn, 1966). Brown shrimp, also, may breed year-round (Pearson, 1939; Williams, 1965). The life cycles of the pink and brown shrimp are very similar to the life cycles of the white shrimp which has been studied extensively (Williams, 1955, 1965; Pearson, 1939; Dobkin, 1961) and is presented below. White shrimp breed and spawn on the continental shelf at depths of approximately 30-100 feet. Eggs are demersal and are laid at or near the bottom. A single female may lay one-half to one million eggs at a single spawning.

Left undisturbed by currents or turbulence, eggs lay on the bottom and hatch into the first naupliar stage in about 12 hours. Nauplii are phototaxic and are collected most often in the surface plankton. Following five naupliar stages, larvae pass through three protozoeal stages which concentrate in subsurface waters. Subsequently, the third protozoea produces the first mysis stage. The first post-larva follows the second mysis stage. It is about halfway through the second post-larval stage that the young shrimp enter estuaries such as the St. Johns. Larvae are transported landward by tidal and wind-generated currents. Second post-larvae penetrate to the fresher, less saline portions of the estuary where they feed and grow rapidly. As growth proceeds, the young shrimp move into increasingly more saline waters until they re-enter the ocean. After approximately five months residence in the estuary, shrimp are large enough to enter the commercial fishery. Average adult length is about 190 mm. Shrimp that remain through the winter in estuaries like the St. Johns River escape reduced water temperature by burrowing in the mud.

In the study area of the St. Johns River estuary, post-larvae were observed to increase during the late spring and peak in late summer (Figure B-12). Of the juvenile and adult commercial shrimp captured during this study, white shrimp were taken in all four seasons of the year and pink shrimp only during the fall and winter, whereas brown shrimp were collected just during the spring (Tables B-15 and B-17). Kutkuhn (1966) listed the white shrimp as the commercial shrimp most dependent upon the estuary and the brown shrimp as spending the shortest period in the estuary. However, Williams (1955) stated that the pink shrimp was the only penaeid to overwinter in somewhat similar estuaries in North Carolina. Data collected in the present survey (Table B-17) support both suppositions and additionally demonstrate that white shrimp utilize the St. Johns River estuary during the winter season.

Blue crabs have a similar life history pattern, but with a more protracted spawning period (Williams, 1965). Mating occurs in waters of reduced salinity well up in the estuary between May and October. Though

females mate only once in their life cycle, immediately following their last molt, they continue to produce fertile eggs throughout their life (about 3 years). Viable sperm are stored in the spermathecae of the female. Sperm are released from spermathecae and fertilize the eggs during each spawning act. Though the first spawn of eggs is deposited and carried in the "sponge" as the female crab moves down the estuary toward the higher salinity spawning ground, subsequent spawns occur on the spawning grounds as the female never returns to the upper estuary. The sponge is attached to the female under the abdominal body segments. The eggs in a sponge may number between 700,000 and 2,000,000. Spawning grounds are located in more saline waters at the mouth of the estuary or a short distance offshore. Normally, mating and spawning areas are distinct and spawning grounds might be better referred to as hatching grounds. Males remain in the reduced salinity areas of the upper estuary and are reproductively inactive after their final molt.

Eggs which are still attached to the "sponge" hatch into the first larval stage about 15 days after the sponge is deposited. Larvae or zoea pass through 7 stages, requiring 31-49 days. Zoea are planktonic and depend upon currents to be transported into estuaries (Leary, 1964) such as the St. Johns River. The seventh zoea molts into a megalops. The megalops stage lasts 6-20 days and it is during this stage that migration up into the estuary occurs. Molting of the megalops produces the first crab stage or "juvenile". Juvenile blue crabs become mature in about 14 months following 18-20 molts.

Tagatz (1968a) described the spawning seasons of the blue crab in the St. Johns River. Spawns occur over an eight- or nine-month period with only the coldest months excluded. Sponge crabs appeared in February or March and were most abundant from March through September. Early larval stages enter the estuary in waves for four to five months following spawning. In the present study crab zoea and megalops were not identified to genus or species because of deficiencies in the literature; however,

most of the crab zoea and megalops were believed to be Uca spp., fiddler crabs, or Sesarma spp., marsh crabs, because of contributions made by the creeks (Table B-6). The greatest densities of juvenile and adult crabs were present in the study area during the spring and summer.

The food habits of the blue crab (Callinectes sapidus) were discussed in Williams (1965). Blue crabs are omnivores preferring fresh to putrid flesh. They consume a variety of food items including fish, large and small bottom animals, some vascular plant material, and organic detritus. The diet also may include oysters, clams, and tunicates. Maximum size is about 200 mm carapace width.

Finfish

As with the commercially important shrimp and crabs of the St. Johns River, most intensive spawning in the commercially important finfishes occurs during the winter through the summer months (Tables B-10 and B-11). Depending upon the species, spawning occurs in the estuary or in waters contiguous to the estuary.

Spawning is triggered by a number of physical parameters, primarily water temperature and length of photoperiod. Reproductive rhythms in fishes, as with nekton, are instinctively programmed in the genetic makeup of the fish to obtain maximum benefit from the food chains and physical factors in nursery areas. The high productivity of estuaries such as the St. Johns River is well documented. By riding the photosynthetic pulses, phytoplankton abundance, which control zooplankton abundance, into estuarine habitats, species attempt to insure an abundant food supply and amiable physical conditions for optimum survival of young. The conditions actually experienced by the young of a species ultimately determine survivorship and year class strength. Influxes of adults onto spawning grounds and larvae onto nursery grounds are initiated as the daily photoperiod begins to increase in the winter and lasts through the long daylight hours of summer.

All species discussed herein (Table B-2) are pelagophils (Balon, 1975), i.e., males and females congregate and eggs and milt are released into the water column where fertilization takes place. Once eggs are fertilized, hatching time is species specific, varying with ambient environmental conditions, particularly water temperature. Newly hatched larvae of most species retain a portion of the yolk from the egg and are referred to as yolk-sac larvae. The larvae derive nourishment from this yolk reserve until the development of mouth-parts and digestive tract is complete. When the yolk has been depleted, larvae begin exogenous feeding and are referred to, here, as post-larvae. Predatory species such as the sciaenids generally begin to feed on small zooplankters with the size of the preferred food item increasing as the post-larval size increases. Clupeids, e.g., Brevoortia spp., are facultative herbivores consuming predominantly phytoplankton, but ingesting whatever is filtered from the water. When post-larvae have acquired the full compliment of adult characteristics, they are referred to as juveniles. Many times a dietary shift accompanies this morphological change. In the sciaenids, the diet would shift to larger invertebrate and/or small vertebrate species. As juveniles gain in size, the diet more closely parallels that of the adult. Menhaden, Brevoortia spp., would have little dietary change. When fish become reproductively active, they are termed adults.

The estimated number of eggs produced by a mature female (fecundity) ranges from a low of 38,000 in Brevoortia tyrannus, Atlantic menhaden, to 6 million in large Pogonias cromis, black drum (Table B-3). A single mature female of most of the included commercial species would be expected to produce greater than 100,000 eggs per spawning season. Fishes with such high fecundity can be expected to have a high mortality rate with relatively few individuals surviving to reproductive age. Dietrich, Jr. (1979) reporting on the Atlantic menhaden which he estimated produce an average 400,000 - 500,000 eggs per female, estimated that 78 - 282 individuals survived for each one million eggs produced. Though the larger species generally produce more absolute numbers of eggs per individual,

these species tend to mature later (older age), have longer life spans, and have smaller populations than smaller less fecund species. The smaller species, however, are characterized by short life spans and larger populations, so that the number of recruits produced per spawning season is much greater.

The criteria used in determining which fish species to include in the life history listing were: (1) impingement at the Northside Station as determined from data presented in JEA (1976) and Rehm et al. (1975); (2) the numbers of individuals captured in trawl, gill net, and seine samples collected during this study (Tables B-14 through B-17); and (3) the densities of larvae occurring in the ichthyoplankton as determined from this study (Tables B-10 and B-11).

The dominant economically valuable species of fish inhabiting the St. Johns River study area were members of the Family Sciaenidae (the drums). This trend parallels the findings of JEA (1976) and Rehm, et al. (1975). Croaker (Micropogonias undulatus), spot (Leiostomus xanthurus), weakfish (Cynoscion regalis), spotted seatrout (Cynoscion nebulosus), red drum (Sciaenops ocellata), and black drum (Pogonias cromis) support major commercial fisheries along the eastern seaboard of the United States. Additionally, the red drum, spotted seatrout, and weakfish support a substantial sport fishery. With the exception of croaker, the post-larvae and early juveniles of the commercially important sciaenids leave the estuary in early winter and descend rapidly into deeper bays and the ocean.

Those species which were found infrequently and whose life history were not included were gulf flounder (Paralichthys albigutta), southern flounder (P. lethostigma), summer flounder (P. dentatus), striped mullet (Mugil cephalus), white mullet (M. curema), silver seatrout (Cynoscion nothus), northern kingfish (Menticirrhus saxtilis), southern kingfish (M. americanus), gulf kingfish (M. littoralis), and channel catfish (Ictalurus punctatus). Though there are sizable commercial or sport fisheries for these species, the paucity of individuals impinged, captured

in otter trawls, gill nets, and beach seines, or netted in ichthyoplankton samples indicates that losses would produce negligible effects in area populations. Mullet (Mugil cephalus and Mugil curema), which were observed in large numbers in the study area, spawn offshore and post-larvae are advanced developmentally when they enter the estuary. Juvenile mullet feed close to the shoreline and are rapid, proficient swimmers, and thus can avoid capture and any deleterious mechanical or heat effects of the plant. A single M. cephalus was collected in entrainment samples in the present study and none were enumerated in 1973 - 1974 impingment studies conducted by Rehm et al. (1975). The silver seatrout, Cynoscion nothus, does not reach sufficient size to be important to either the commercial or sport fisheries (Ginsberg, 1931).

Weakfish and spotted seatrout are characterized by high fecundity. Both species are reported to utilize estuaries for spawning (Herman, 1963; Tabb, 1966; Hildebrand and Cable, 1934; Pearson, 1941), however, Hildebrand and Cable (1934) reported weakfish to spawn principally at sea. Merriner (1976) found peak spawning in weakfish from late April through June with possibly a second lesser spawning taking place in July or August. The present study in the St. Johns River estuary collected weakfish larvae from early April through August (the end of the study period) with a major peak in May and a minor peak in August (Figure B-3). Juvenile and adult weakfish were captured in all seasons as were spotted seatrout (Tables B-15 through B-17). Tagatz (1968b) reported weakfish and spotted seatrout present from May to August and March to October, respectively, whereas McClane (1955) found spotted seatrout present year-round. The present study in the St. Johns River estuary collected spotted seatrout larvae from early May through the termination of the study in August (Figure B-6). A minor peak occurred in late May and a major peak in August. Tabb (1966), Hildebrand and Cable (1934) and Pearson (1929) reported spawning from early spring until October with a peak in April. Tabb (1966) summarized the relationship of the spotted seatrout with the estuary. He concluded that the long expanses of Florida beaches separating major estuaries serve as effective isolation barriers creating nearly isolated populations that are dependent upon local conditions for success.

Copepods, amphipods, isopods, shrimps, crabs, worms, and fish constitute the major portion of the diet of weakfish which are greater than 40 mm in length (Welsh and Breder, 1923). Individuals attain an average length of 17 cm by the end of the first year of life (Hildebrand and Cable, 1934) and reach a maximum length of 25-30 cm (Ginsberg, 1929). Spotted seatrout feed mainly on fish and shrimp and are about 13 cm in length at one year old. During years 2 and 3, growth slows to 10 cm per year. Subsequent growth is approximately 5 cm per year. Spotted seatrout spawn for the first time at the end of their second year (Pearson, 1929).

Red and black drum are spawned near the mouths of inlets and bays with tidal currents transporting larvae and young into shallower estuarine waters (Pearson, 1941; Frisbie, 1961; Joseph et al., 1964). Red drum spawn from July to December along the Atlantic coast (Johnson, 1978). The young spend one to several months in the estuarine habitat, grassy coves, and lagoons (Mansueti, 1960; Pearson, 1929). Larval red drum were collected only during the August sampling, however, adults and juveniles were taken in the fall and spring (Tables B-10, B-14 and B-15). Combined data from Tagatz (1968b) and McClane (1955) indicate that adults or juveniles are present in the St. Johns River thoughout the year. Black drum primarily spawn from March to May (Frisbie, 1961), but may have a secondary effort from late July through November (Pearson, 1929). Young move into intercoastal waters and tidal creeks shortly after hatching (Joseph et al., 1964; Frisbie, 1961), but move toward deeper water when they reach a length of about 10 mm (Pearson, 1941). Black drum larvae were present in the study area from early April to early June (present study: Figure B-9). No adult or juvenile black drum was collected in the present study, though Tagatz (1968b) reported collecting black drum in various months throughout the year. Black drum were listed as a major component of the ichthyofauna by JEA (1976).

Pearson (1929) described growth and food habits in red and black drum. Penaeus spp. are the favorite food of the red drum with the blue crab ranking second. Some fish are consumed. Large red drum are able to

capture fish of considerable size. In feeding habit the red drum occupies a position intermediate between the spotted seatrout and black drum. Red drum spend their first year in the estuary and attain a length of about 34 cm. By the end of their second year they have grown to 50 cm and increase about 10 cm per year thereafter. Maturity occurs in the fourth or fifth year at greater than 75 cm length and 10 pounds weight. Maximum size is to 1.5 meters. Black drum perfer small mollusks and clams, principally Mulinia spp., and feed primarily over muddy bottom. Small black drum prey on softer items such as fishes, annelid worms, and smaller crustaceans. Black drum reach approximately 25 cm by age 1; 37 cm by age 2; 50 - 60 cm by year 4 or 5; and 75 - 85 cm by 7 to 9 years age. First spawning takes place when black drum are two years of age and greater than 30 cm length.

On the Atlantic coast spot and croaker spawn principally offshore during the winter, and winter and fall, respectively. In the St. Johns River estuary, spot were collected from December through April and croaker from November until May (Figure B-7). These results compare well with the findings of Kjelson and Johnson (1976) and White and Chittenden (1977). Juvenile and adult spot and croaker were collected during all seasons except fall and year-round, respectively (Tables B-14 through B-17) which closely parallels the results of Tagatz (1968b). In the Carolinean Province, croaker have high mortality, a short life span, and do not reach sufficient size to support a commercial food fishery (White and Chittenden, 1977), however, Christmas and Waller (1973) point out that croaker are a major industrial fish in the northern Gulf of Mexico.

In warm-temperate waters the croaker life span is probably only 1 to 2 years with fish reaching an average length of 15.8 cm at age 1. Those individuals surviving to two years of age reach an average of 27.4 cm. Croaker mature at 14 - 18 cm. The observed mortality in the Carolinean Province was about 96 percent (White and Chittenden, 1977). From 14 - 20 cm, annelids are the preferred food followed by shrimp and fish. At greater than 20 cm the diet is composed of shrimp, annelids, fish, crabs, and mollusks by decreasing preference (Pearson, 1929). Williams (1978)

listed Mulinia lateralis as an important seasonal food item for both croaker and spot. Spot at 16 - 22 mm feed mainly on copepods (Kjelson and Johnson, 1976) and thereafter consume principally small crustaceans (Welsh and Breder, 1923). Spot reach 13 - 14 cm by age 1 year; 19 - 22 cm by 2 years; and 26 - 28 cm by 3 years. Spawning occurs for the first time at the end of the second year at about 21 cm (Pearson, 1929).

The Atlantic menhaden, Brevoortia tyrannus, Family Clupeidae, supports a sizable commercial fishery in the area with a processing plant being located in Fernandina Beach, Florida. Colton, Jr. et al. (1979), Nelson et al. (1977), Reintjes and Pacheco (1966), and Herman (1963) have described spawning and the early life history of the Atlantic menhaden. Menhaden are spawned over the continental shelf from October through March during their fall and winter southward migration. The Gulf Stream forms the seaward boundary of the region of most intensive spawning. The early larval phases are subject to passive drift, but with the development of fin rays, entrance into the estuary is controlled by the larvae and independent of water movement. Larvae enter estuaries in the South Atlantic states from December to May at a length of 18-22 mm. Only fish of up to two years of age are abundant along the Florida-Georgia coasts with older fish migrating to more northern latitudes (Nicholson, 1978; Dryfoos et al., 1973). During 1979-80 sampling (Figure B-5), larval and juvenile menhaden were collected in ichthyoplankton samples from the fall through the spring with largest densities in the spring. Juvenile and adult menhaden were taken year-round (Tables B-14 through B-17). Tagatz (1968b) collected Atlantic menhaden from late summer into the early fall and McClane (1955) found the yellowfin menhaden (Brevoortia smithi) present year-round.

Lengths of 8.5 - 15.0 cm are attained during the menhaden's second winter. Maturity is gained in the season following the third winter (Hildebrand, 1963).

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Table B-1

SPAWNING AREA AND SEASON FOR COMMERCIALLY IMPORTANT SPECIES OF SHELLFISH FREQUENTING THE ST. JOHNS RIVER ESTUARY

Species	Spawning Season	Spawning Location	Life History References
White Shrimp (*Penaeus setiferus*)	March-September	Offshore	Pearson, 1939; Williams, 1955, 1965; Kutkuhn, 1966.
Pink Shrimp (*Penaeus duorarum*)	May-Summer	Offshore	Williams, 1955, 1965; Kutkuhn, 1966.
Brown Shrimp (*Penaeus aztecus*)	Year-round (?)	Offshore	Williams, 1955, 1965; Kutkuhn, 1966.
Blue Crabs (*Callinectes sapidus* and *C. similis*)	December-October	Offshore: occasionally bays	Leary, 1964; Tagatz, 1968a.

Table B-2

SPAWNING AREA AND SEASON FOR COMMERCIALLY IMPORTANT SPECIES OF FINFISH FREQUENTING THE ST. JOHNS RIVER ESTUARY

Species	Spawning Season	Spawning Location	Life History References
Menhaden (*Brevoortia tyrranus*)	October-March	Continental shelf	Colton, Jr. *et al.*, 1979; Nelson *et al.*, 1977; Reintjes and Pacheco, 1966; Herman, 1963.
Croaker (*Micropogonius undulatus*)	September-late March	Offshore and near passes	Colton, Jr. *et al.*, 1979; White and Chittenden, 1977; Pearson, 1929.
Spot (*Leiostomus xanthurus*)	December-March	Continental shelf; proximity of mouths of passes	Colton, Jr. *et al.*, 1979; Kjelson and Johnson, 1976; Pearson, 1941.
Weakfish (*Cynoscion regalis*)	March-August	Offshore; in or near inlets	Colton, Jr. *et al.*, 1979; Merriner,1976; Herman, 1963; Hildebrand and Cable, 1934.
Red Drum (*Sciaenops ocellata*)	July-December	Outer coasts; near passes and channels	Mansueti, 1960; Johnson, 1978; Pearson, 1941.
Black Drum (*Pogonias cromis*)	March-May	Mouths of bays and inlets	Joseph *et al.*, 1964; Frisbie, 1961; Pearson, 1941.
Spotted Seatrout (*Cynoscion nebulosus*)	Early Spring - October	Bays and lagoons	Tabb, 1966; Hildebrand and Cable, 1934; Pearson, 1941.

Table B-3

FECUNDITY OF THE COMMERCIALLY IMPORTANT FINFISH SPECIES KNOWN TO FREQUENT THE ST. JOHNS RIVER ESTUARY

Common Name	Scientific Name	Number of Eggs Produced per Spawn per Female
Spotted Seatrout	*Cynoscion nebulosus*	500,000 - 600,000
Weakfish	*Cynoscion regalis*	45,000 - 1,726,000
Spot	*Leiostomus xanthurus*	70,000 - 90,000
Croaker	*Micropogonias undulatus*	to 180,000
Black Drum	*Pogonias cromis*	6,000,000[a]
Red Drum	*Sciaenops ocellata*	2,500,000 - 3,500,000[a]
Atlantic Menhaden	*Brevoortia tyrannus*	38,000 - 631,000

a Data for a single individual

Source: Johnson, 1978 and Jones *et al.*, 1978

Table B-4

SEASONAL MESOZOOPLANKTON MEAN DENSITIES (ORGANISMS PER CUBIC METER)
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS NEAR NORTHSIDE GENERATING STATION

SAMPLING METHOD = 202 MICRON MESH PLANKTON NET TOW

FALL 1979.

TYPE	SCIENTIFIC NAME	STATION BCK	EP1	EP2	EP3	SCK
Calanoid Copepod	Acartia tonsa	263.91	110.06	79.55	52.49	184.83
	Centropages hamatus	.16	.	.	.	.
	Copepod nauplii	.25	.61	.44	1.33	.02
	Copepodite	.08	.10	.	.	.
	Eurytemora affinis	.05	.02	.06	.	.02
	Paracalanus parvus	10.36	6.58	.82	5.58	.71
	Psuedodiaptomus coronatus	1.61	.57	1.04	.24	.56
Cyclopoid Copepod	Coryacea spp.	.	.	.	.02	.01
	Oithona brevicoris	.69	.85	.06	.03	.30
	Oithona nana	.24	.	.06	.	.06
	Oithona spp.	.	.02	.	.	.
	Saphirella tropica	.13	.02	.02	.	.
Harpacticoid Copepod	Ergasilus spp.	.04	.04	.15	.01	.04
	Euterpina acutifrons	.11	.	.02	.06	.02
Cladoceran	Bosmina longirostris	.09	.08	.14	.02	.13
Meroplankton	Sagitta spp.	.09	.	.	.09	.01
	Cirriped cypris	.39	.04	.10	.	.
	Cirriped nauplii	7.17	17.89	12.98	36.21	2.34
	Crab zoea	.	.08	.12	.06	.30
	Cumacean	.02	.	.	.02	.
	Isopoda spp.	.93	.10	.05	.	.11
	Larval fish	.	.	.02	.	.
	Mysid spp.	.02	.	.	.	.01
	Nematode	.02	.	.	.	.
	Polychaete larvae	5.00	.22	.14	.15	1.05
	Postlarval gastropod	.05	.	.02	.	.
	Postlarval pelecypod	.07	.	.	.	.
Parasitic Zooplankton	Argulus spp.	.	.	.02	.	.
TOTAL		291.48	137.27	95.80	96.31	190.55

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-4
(Continued)
SEASONAL MESOZOOPLANKTON MEAN DENSITIES (ORGANISMS PER CUBIC METER)
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS NEAR NORTHSIDE GENERATING STATION

SAMPLING METHOD = 202 MICRON MESH PLANKTON NET TOW

WINTER 1980.

TYPE	SCIENTIFIC NAME	STATION BCK	EP1	EP2	EP3	SCK
Calanoid Copepod	Acartia tonsa	198.48	86.81	115.32	136.58	306.49
	Centropages hamatus	.	483.62	95.91	.43	.
	Centropages typicus	326.17	44.26	.	2.14	120.47
	Copepod naupli	6.08	67.43	4.46	4.84	5.98
	Eurytemora affinis	.	.	.	.02	1.54
	Labidocera neri	.47	12.48	.60	.	1.62
	Paracalanus parvis	68.36	187.03	34.82	11.76	37.81
	Psuedodiaptomus coronatus	.	.	.04	.	1.24
	Tortanus setacaudatus	2.49	12.87	.23	.	.11
Cyclopoid Copepod	Coryacea spp.	2.05	12.58	1.83	1.21	.83
	Oithona setigera	3.55	30.42	1.05	1.47	1.03
	Saphirella tropica	.	.	.26	.05	.
Harpacticoid Copepod	Euterpina actifrons	1.57	6.52	.45	.39	1.84
	Unidentified harpacticoid	.	.	.	.	.11
Cladoceran	Podon polyphemoides	4.90	43.18	1.98	4.95	3.25
Meroplankton	Amphipod spp.	.18	.83	.22	.	.10
	Sagitta spp.	2.03	5.73	.59	.55	1.25
	Cirriped cypris	9.19	6.47	1.36	.37	15.94
	Cirriped naupli	22.62	81.57	23.69	84.20	14.14
	Pelecypod veliger	.	4.03	.	.	2.09
	Crab zoea	.	.80	.	.	.
	Cumacean	.	.12	.	.	.10
	Fish egg	.	.12	.	.	.
	Isopoda spp.	.29	1.02	.	.04	.11
	Larval fish	.	.48	.	.	.
	Megalops	.10	.12	.	.	.10
	Mysid spp.	.	.	.	.03	.
	Polychaete larvae	13.16	50.52	11.86	12.05	29.40
Parasitic Zooplankton	Lernae spp.	1.80	4.55	1.94	.21	1.21
TOTAL		663.49	1,143.55	296.62	261.30	546.75

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-4
(Continued)

SEASONAL MESOZOOPLANKTON MEAN DENSITIES (ORGANISMS PER CUBIC METER)
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS NEAR NORTHSIDE GENERATING STATION

SAMPLING METHOD = 202 MICRON MESH PLANKTON NET TOW

SPRING 1980.

TYPE	SCIENTIFIC NAME	STATION BCK	EP1	EP2	EP3	SCK
Calanoid Copepod	Acartia tonsa	6,517.33	4,136.21	3,449.66	4,087.27	907.24
	Centropages hamatus	.	126.50	.	.	.
	Copepod nauplii	3.95	28.15	1.62	16.78	.
	Eucalanus longiseta	2.28	.	.	.	.
	Labidocera neri	12.55	4.93	.	.	.
	Paracalanus parvus	574.63	216.42	178.10	134.97	147.03
	Psuedodiaptomus coronatus	9.13	3.46	.	8.97	.
	Tortanus setacaudatus	11.92	24.57	17.37	16.78	.
Cyclopoid Copepod	Oithona brevicoris	2.28	3.20	1.62	.	.
Harpacticoid Copepod	Ergasilus spp.	.	.	1.66	.	.
	Euterpina acutifrons	8.52	11.80	3.28	2.24	2.25
Meroplankton	Sagitta spp.	9.12	.	.	1.86	.
	Cirriped cypris	155.98	24.07	37.54	44.71	36.17
	Cirriped nauplii	1,907.90	728.05	614.29	958.75	832.01
	Crab zoea	143.53	23.22	34.49	32.03	20.00
	Fish egg	123.65	43.98	42.35	56.13	23.56
	Isopoda spp.	2.28	.	.	.	.
	Larval fish	2.28	.	3.59	.	.
	Postlarval gastropod	6.83	3.76	.	.	.
	Postlarval pelecypod	2.27	.	.	.	.
TOTAL		9,496.44	5,378.33	4,385.59	5,360.48	1,968.25

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-4
(Continued)
SEASONAL MESOZOOPLANKTON MEAN DENSITIES (ORGANISMS PER CUBIC METER)
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS NEAR NORTHSIDE GENERATING STATION

SAMPLING METHOD = 202 MICRON MESH PLANKTON NET TOW

SUMMER 1980.

TYPE	SCIENTIFIC NAME	STATION BCK	EP1	EP2	EP3	SCK
Calanoid Copepod	Acartia tonsa	9,591.66	13,753.64	9,990.76	63,407.04	6,882.76
	Copepod nauplii	.	1.37	1.59	11.89	.
	Copepodite	.76	.	.	.	.
	Lapidocera neri	.	6.49	.77	12.53	.
	Paracalanus parvus	181.60	222.50	68.77	87.94	114.92
	Psuedodiaptomus coronatus	199.49	142.31	174.18	337.30	142.13
	Temora turbinata	.	78.17	12.83	62.62	.
Cyclopoid Copepod	Corycaea spp.	.76	.	.	.	.
	Oithona setigera	28.68	21.94	21.59	50.35	22.30
	Saphirella tropica	1.47	.	.	.	.
Harpacticoid Copepod	Euterpina acutifrons	106.13	18.98	5.14	12.53	40.81
Cladoceran	Daphnia spp.	5.16	2.76	4.59	24.73	3.72
	Evadne nordmanni	2.32	.	9.68	.	5.20
Meroplankton	Amphipod spp.	.	.	.	.	.76
	Sagitta spp.	11.02	5.50	6.97	.	15.66
	Cirriped cypris	271.69	41.91	35.85	25.67	99.47
	Cirriped naupli	3,997.97	1,125.85	1,020.35	4,700.30	2,265.37
	Pelecypod veliger	2.84	.	.	.	.
	Crab zoea	117.43	33.58	30.12	320.46	950.99
	Fish egg	23.88	7.85	45.24	12.83	19.37
	Isopoda spp.	.73	.	1.50	.	.
	Larval fish	6.70	.	4.44	.	2.94
	Larval shrimp	5.47	2.71	.	.	.
	Megalops	.	5.12	.	.	.
	Mysid spp.	.71	.	.	.	8.18
	Polychaete larvae	16.25	4.11	13.67	.	5.93
	Postlarval gastropod	.71	.	6.11	.	4.43
	Postlarval pelecypod	305.54	27.49	24.11	199.01	118.87
TOTAL		14,878.97	15,502.28	11,478.25	69,265.19	10,703.80

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-4

(Continued)

SEASONAL MESOZOOPLANKTON MEAN DENSITIES (ORGANISMS PER CUBIC METER)
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS NEAR NORTHSIDE GENERATING STATION

SAMPLING METHOD = 202 MICRON MESH PLANKTON NET TOW

ENTRAINMENT: WINTER 1980 THROUGH SUMMER 1980.

TYPE	SCIENTIFIC NAME	SEASON		
		WINTER	SPRING	SUMMER
Calanoid Copepod	Acartia tonsa	375.17	2,579.22	835.08
	Centropages hamatus	-	3.74	-
	Copepod naupli	-	-	2.32
	Eucalanus longiseta	-	3.74	-
	Eurytemora affinis	.62	-	-
	Labidocera neri	-	3.74	-
	Paracalanus parvus	4.33	314.56	43.18
	Psuedodiaptomus coronatus	10.51	307.94	116.93
	Tortanus setacaudatus	1.86	157.53	-
Cyclopoid Copepod	Oithona brevicoris	-	3.74	-
	Oithona setigera	-	-	6.49
	Saphirella tropica	-	7.68	-
Harpacticoid copepod	Euterpina acutifrons	1.20	11.21	44.49
Cladoceran	Podon polyphemoides	.58	-	-
Meroplankton	Amphipod spp.	2.39	11.21	2.11
	Sagitta spp.	-	7.86	-
	Cirriped cypris	17.53	257.12	68.05
	Cirriped naupli	-	76.46	143.66
	Crab zoea	.58	19.66	25.03
	Cumacean	1.20	22.80	-
	Fish egg	-	26.53	-
	Isopod spp.	-	26.60	-
	Larval fish	-	-	1.99
	Mysid spp.	2.43	139.38	2.05
	Polychaete larvae	4.25	-	2.11
	Postlarval gastropod	-	90.30	2.32
	Postlarval pelecypod	-	-	26.29
TOTAL		422.64	4,071.00	1,322.11

Location of the cooling water discharge canal for the Northside Generating Station shown in Figure 2.8-4

Table B-5

MESOZOOPLANKTON SPECIES OCCURRENCE BY SEASON
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

TYPE	SCIENTIFIC NAME	SEASON			
		FALL 1979	WINTER 1980	SPRING 1980	SUMMER 1980
Calanoid Copepod	Acartia tonsa	+	+	+	+
	Centropages hamatus	+	+	+	-
	Centropages typicus	-	+	-	-
	Copepod naupli	+	+	+	+
	Copepodite	+	-	-	+
	Eucalanus longiseta	-	-	+	-
	Eurytemora affinis	+	+	-	-
	Labidocera neri	-	+	+	+
	Paracalanus parvus	+	+	+	+
	Psuedodiaptomus coronatus	+	+	+	+
	Temora turbinata	-	-	-	+
	Tortanus setacaudatus	-	+	+	-
Cyclopoid Copepod	Coryacea spp.	+	+	-	+
	Oithona brevicoris	+	-	+	-
	Oithona nana	+	-	-	-
	Oithona setigera	-	+	-	+
	Oithona spp.	+	-	-	-
	Saphirella tropica	+	+	+	+
Harpactocoid Copepod	Ergasilus spp.	+	-	+	-
	Euterpina acutifrons	+	+	+	+
	Unidentified harpacticoid	-		-	-
Cladoceran	Bosmina longirostris	+	-	-	-
	Daphnia spp.	-	-	-	+
	Evadne nordmanni	-	-	-	+
	Podon polyphemoides	-	+	+	-
Meroplankton	Amphipod spp.	-	+	+	+
	Sagitta spp.	+	+	+	+
	Cirriped cypris	+	+	+	+
	Cirriped naupli	+	+	+	+
	Pelecypod veliger	-	+	-	+
	Crab zoea	+	+	+	+
	Cumacean	+	+	+	-
	Fish egg	-	+	+	
	Isopod spp.	+	+	+	+
	Larval fish	+			
	Larval shrimp	-	-	-	+
	Megalops	-	+	-	+
	Mysid	+	+	+	+
	Nematode	+	-	-	-

Table B-5
(Continued)
MESOZOOPLANKTON SPECIES OCCURRENCE BY SEASON
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

TYPE	SCIENTIFIC NAME	SEASON			
		FALL 1979	WINTER 1980	SPRING 1980	SUMMER 1980
Meroplankton	Polychaete larvae	+	+	+	+
	Postlarval gastropod	+	-	+	+
	Postlarval pelecypod	+	-	+	+
Parasitic Zooplankton	Argulus spp.	+	-	-	-
	Lernae spp.	-	+	-	-

Table B-6

AVERAGE MEAN DENSITIES FOR MACROZOOPLANKTON
IN THE ST. JOHNS RIVER AND CONTIGUOUS
CREEKS NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW
DENSITIES IN ORGANISMS PER CUBIC METER

FALL 1979.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	EP1	EP2	EP3	SCK
Brachyura	Larval Crab	Crab zoea	.10	.09	.16	.22	.24
	Postlarval Crab	Non-portunid megalops	.	.	.04	.	.
Caridea	Larval Shore Shrimp	Caridean zoea	.10	.	.	.	.
Chaetognatha	Arrowworm	Sagitta spp.	12.54	6.90	5.00	3.73	6.15
Cnidaria	Hydroid	Hydromedusae	.53	.33	.17	.10	.07
Penaeidae	Lucifer Shrimp	Lucifer faxoni	.	.09	.	.	.
	Shrimp	Acetes americanus	.	.05	.	.	.
Peracarida	Cumacean	Cumacean spp.	.74	1.35	.44	.41	.70
	Isopod	Isopoda spp.	.10	.	.	.	.
	Mysid	Mysid shrimp	5.53	10.23	11.63	6.63	8.02
	Scud	Amphipoda spp.	.25	.31	.22	.52	.80
Pisces	Fish Egg	Fish egg	.	.	.04	.19	.
Polychaeta	Bristle Worm	Polychaeta spp.	.	.	.	.07	.05
Portunidae	Postlarval Crab	Portunid megalops	.	.04	.09	.04	.08
TOTAL			19.88	19.39	17.79	11.91	16.10

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-6
(Continued)
AVERAGE MEAN DENSITIES FOR MACROZOOPLANKTON
IN THE ST. JOHNS RIVER AND CONTIGUOUS
CREEKS NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW
DENSITIES IN ORGANISMS PER CUBIC METER

WINTER 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	EP1	EP2	EP3	SCK
Caridea	Larval Shore Shrimp	Caridean zoea	-	-	-	-	.07
Chaetognatha	Arrowworm	Sagitta spp.	.65	12.08	7.22	12.24	2.56
Cnidaria	Hydroid	Hydromedusae	-	.16	.13	-	.05
Mollusca	Sea Slug	Nudibranchia	-	-	-	-	.07
Penaeidae	Shrimp	Acetes americanus	-	.04	.19	.04	-
Peracarida	Cumacean	Cumacean	-	.80	.78	.79	.45
	Isopod	Isopoda spp.	-	.04	-	-	-
	Mysid	Mysid Shrimp	3.22	17.70	32.20	22.24	7.28
	Scud	Amphipoda spp.	1.47	.70	.30	.42	3.18
Platyhelminthes	Flatworm	Platyhelminthes	-	.18	-	-	-
Polychaeta	Bristle Worm	Polychaeta spp.	.06	.03	-	-	-
Stomatopoda	Mantis Shrimp zoea	Squilla empusa zoea	-	.29	.05	-	-
Thalassinoidea	Larval Mud Shrimp	Upogebia zoea	-	.04	.14	.04	.05
TOTAL			5.40	32.07	41.01	35.77	13.70

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-6
(Continued)
AVERAGE MEAN DENSITIES FOR MACROZOOPLANKTON
IN THE ST. JOHNS RIVER AND CONTIGUOUS
CREEKS NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW
DENSITIES IN ORGANISMS PER CUBIC METER

SPRING 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	EP1	EP2	EP3	SCK
Brachyura	Larval Crab	Crab zoea	745.38	48.61	70.51	51.12	49.42
	Postlarval Crab	Non-portunid megalops	1.10	10.28	3.94	3.68	.79
Caridea	Adult Shore Shrimp	Caridean shrimp	.	2.11	.49	.36	.06
	Larval Shore Shrimp	Caridean zoea	22.20	7.10	2.83	2.77	3.47
	Larval Snapping Shrimp	Alpheus zoea	.	.46	.	.	.
	Long-eyed Shrimp	Ogyrides spp.	.	.	.07	.	.
	Mud Shrimp	Ogyrides zoea	1.40	.	.12	.09	2.03
Chaetognatha	Arrowworm	Sagitta spp.	4.84	16.31	13.07	23.09	2.32
Cnidaria	Hydroid	Hydromedusae	4.93	2.62	6.65	5.58	.34
	Larval Cnidarian	Ephyra	.	.	.	.16	.
Echinodermata	Brittle Star Larvae	Ophiuroid larvae	.	.	.	.	.06
Mollusca	Larval Clam	Larval Pelecypoda	.10	.29	.	.	.10
	Snail	Gastropoda	.17	8.31	4.20	3.49	.22
Penaeidae	Shrimp	Acetes americanus	.	.09	.	.	.
Peracarida	Cumacean	Cumacean	3.40	7.56	6.63	6.57	16.85
	Isopod	Isopoda spp.	.	.07	.	.	.
	Mysid	Mysid shrimp	88.81	471.53	251.16	282.51	33.54
	Scud	Amphipoda spp.	.81	1.98	.94	2.12	.66
Pisces	Fish Egg	Fish egg	77.70	49.69	59.20	29.76	57.82
Polychaeta	Bristle Worm	Polychaeta	.16	.22	.12	.41	.
Thalassinoidea	Larval Mud Shrimp	Callianassa zoea	.07	.95	.81	1.06	.10
	Adult Mud Shrimp	Callianassa spp.	.	.14	.	.	.
	Larval Mud Shrimp	Upogebia zoea	.16	1.36	.71	3.03	.10
TOTAL			951.23	629.68	421.44	415.82	167.88

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-6
(Continued)
AVERAGE MEAN DENSITIES FOR MACROZOOPLANKTON
IN THE ST. JOHNS RIVER AND CONTIGUOUS
CREEKS NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW
DENSITIES IN ORGANISMS PER CUBIC METER

SUMMER 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	EP1	EP2	EP3	SCK
Brachyura	Larval Crab	Crab zoea	1,407.84	549.42	288.78	269.49	125.35
	Postlarval Crab	Non-portunid megalops	3.14	6.55	3.56	1.99	4.48
Caridea	Adult Shore Shrimp	Caridean Shrimp	.	.44	.10	.05	.08
	Adult Snapping Shrimp	Alpheus spp.	.08	.	.	.	.
	Larval Shore Shrimp	Caridean zoea	13.31	2.53	3.02	2.78	4.21
	Larval Snapping Shrimp	Alpheus zoea	.	.09	.	.	.
	Mud Shrimp	Ogyrides zoea	65.64	.89	9.16	2.75	13.36
Chaetognatha	Arrowworm	Sagitta spp.	20.43	49.27	49.66	42.46	33.84
Cnidaria	Hydroid	Hydromedusae	.15	.74	.26	.45	.44
Echinodermata	Brittle Star Larvae	Ophiuroid larvae	.19	.16	.	.	.
Mollusca	Larval Clam	Larval Pelecypoda	5.34	1.18	.06	.	2.58
	Sea Butterfly	Cresis asicula	.	1.34	.40	.39	.
	Snail	Gastropoda	.	.88	.	.	.
Penaeidae	Lucifer Shrimp	Lucifer faxoni	.43	4.42	2.83	.54	.25
	Shrimp	Acetes americanus	.22	1.01	1.66	.95	.51
Peracarida	Cumacean	Cumacean	10.28	6.22	6.98	5.33	35.46
	Isopod	Isopoda spp.	.	.76	.	.09	.17
	Mysid	Mysid shrimp	49.02	61.78	72.46	141.75	94.87
	Scud	Amphipoda spp.	.81	1.61	.10	.40	.90
Pisces	Fish Egg	Fish Egg	8.97	21.52	32.97	18.96	20.99
Polychaeta	Bristle Worm	Polychaeta	.15	1.20	.77	.54	.24
Portunidae	Postlarval Crab	Portunid megalops	.12	.	.	.	.
Stomatopoda	Mantis Shrimp Zoea	Squilla empusa zoea	.	.08	.	.	.
Thalassinoidea	Larval Mud Shrimp	Callianassa zoea	.20	1.06	.67	.56	.07
	Larval Mud Shrimp	Upogebia zoea	.75	2.34	1.32	.68	.13
TOTAL			1,587.10	715.50	474.78	490.15	337.91

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-6
(Continued)

AVERAGE MEAN DENSITIES FOR MACROZOOPLANKTON
IN THE ST. JOHNS RIVER AND CONTIGUOUS
CREEKS NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW
DENSITIES IN ORGANISMS PER CUBIC METER

ENTRAINMENT: WINTER 1980 THROUGH SUMMER 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON		
			WINTER	SPRING	SUMMER
Actiniaria	Sea Anemone	Actiniaria	-	-	.23
Brachyura	Larval Crab	Crab zoea	-	12.11	100.38
	Postlarval Crab	Non-Portunid megalops	-	.72	19.38
Caridean	Adult Shore Shrimp	Caridean shrimp	-	.27	-
	Larval Shore Shrimp	Caridean zoea	-	1.48	7.23
	Mud Shrimp	Ogyrides zoea	-	.04	3.28
Chaetognatha	Arrowworm	Sagitta spp.	1.77	7.66	69.36
Cnidaria	Hydroid	Hydromedusae	-	.15	.30
Copepoda	Fish Louse	Caligus spp.	.08	-	-
Mollusca	Larval Clam	Larval Pelecypoda	-	.14	.61
	Sea Hare	Aplysia spp.	-	-	.11
	Sea Slug	Nudibranchia	-	.02	-
	Snail	Gastropoda	-	-	.29
Penaeidae	Lucifer Shrimp	Lucifer faxoni	-	-	2.90
	Shrimp	Acetes americanus	-	.06	1.38
Peracarida	Cumacean	Cumacean	1.30	4.36	22.17
	Mysid	Mysid Shrimp	10.98	30.81	273.76
	Scud	Amphipoda spp.	1.10	.59	5.33
Pisces	Fish Egg	Fish egg	-	31.34	33.97
Polychaeta	Bristle Worm	Polychaeta	-	.04	2.61
Pyncogonidae	Sea Spider	Pycnogonidae spp.	-	.03	-
Thalassinoidea	Larval Mud Shrimp	Callianassa zoea	-	.04	.23
	Adult Mud Shrimp	Callianassa spp.	-	-	.20
	Larval Mud Shrimp	Upogebia zoea	-	.06	.39
TOTAL			15.23	89.92	544.07

Location of the cooling water discharge canal
for the Northside Generating Station
shown in Figure 2.8-4

Table B-7

MACROZOOPLANKTON SPECIES OCCURRENCE BY SEASON
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON			
			FALL 1979	WINTER 1980	SPRING 1980	SUMMER 1980
Actiniaria	Sea Anemone	Actiniaria	-	-	-	+
Brachyura	Larval Crab	Crab zoea	+	-	+	+
	Postlarval Crab	Non-Portunid crab megalops	+	-	+	+
Caridea	Adult Shore Shrimp	Caridean Shrimp	-	-	+	+
	Adult Snapping Shrimp	Alpheus spp.	-	-	-	+
	Larval Shore Shrimp	Caridean zoea	+	+	+	+
	Larval Snapping Shrimp	Alpheus zoea	-	-	+	+
	Long-Eyed Shrimp	Ogyrides spp.	-	-	+	-
	Mud Shrimp	Ogyrides zoea	-	-	+	+
Chaetognatha	Arrowworm	Sagitta spp.	+	+	+	+
Cnidaria	Hydroid	Hydromedusae	+	+	+	+
	Larval Cnidarian	Ephyra	-	-	+	-
Copedoda	Fish Louse	Caligus spp.	-	+	-	-
Echinodermata	Brittle Star Larvae	Ophiuroid larvae	-	-	+	+
Mollusca	Larval Clam	Larval Pelecypoda	-	-	+	+
	Sea Butterfly	Cresis asicula	-	-	-	+
	Sea Hare	Aplysia sp.	-	-	-	+
	Sea Slug	Nudibranchia	-	+	+	-
	Snail	Gastropoda	-	-	+	+
Penaeidae	Lucifer Shrimp	Lucifer faxoni	+	-	-	+
	Shrimp	Acetes americanus	+	+	+	+
Peracardia	Isopod	Isopod spp.	+	+	+	+
	Mysid	Mysid shrimp	+	+	+	+
	Cumacean	Cummacea	+	+	+	+
	Scud	Amphipoda spp.	+	+	+	+
Pices	Fish Egg	Fish egg	+	-	+	+
Platyhelminthes	Flatworm	Platyhelminthes	-	+	-	-
Polychaete	Bristle Worm	Polychaete	+	+	+	+
Portunidae	Postlarval Crab	Portunid crab megalops	+	-	-	+

Table B-7 (Continued)

MACROZOOPLANKTON SPECIES OCCURRENCE BY SEASON
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON			
			FALL 1979	WINTER 1980	SPRING 1980	SUMMER 1980
Pyncogonida	Sea Spider	Pycnogonida spp.	-	-	+	-
Stomatopoda	Mantis Shrimp Zoea	Squilla empusa zoea	-	+	-	+
Thalassinoidea	Larval Mud Shrimp	Callianassa zoea	-	-	+	+
	Adult Mud Shrimp	Callianassa spp.	-	-	+	+
	Larval Mud Shrimp	Upogebia zoea	-			

Table B-8

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

FALL 1979.

SAMPLING METHOD = PONAR DREDGE

TYPE	SCIENTIFIC NAME	STATION						
		BCK	DCK	EP1	EP2	EP3	MCV	SCK
Amphipoda	Amphipoda (fragments)	.32	.	.	.		.	.
	Corophium lacustre	.32	535.78	.	.	.96	.	2.23
	Gammaridian Sp. E.	.32	.	.	.	.	.	.
	Gammarus mucronatus	.	.96	.	.	.	.	.
	Neohaustorius spp.	.	.	.	.	.	80.05	.
Bryozoa	Bryozoan colony	.	.	.	.32	.	.	.
Caridea Shrimp	Natantia (fragments)	.	.	4.15	.	.	.32	.
	Ogyrides spp.	.	.	1.91	.	.32	.	.
	Palaemonetes pugio	.	.	.	.	.	.	1.28
	Alpheus heterochelis	.	.	.	.	.	.	1.28
Cirripedia	Balanus balanus	.32	.	.	.	.	.	.
	Balanus improvisus	1.28	.	.	.	.	.	.
Isopoda	Cyathura spp.	1.28	17.54	.	.	.	.32	.
	Edotera spp.	.	5.10	.	.	.	1.91	.
Mollusca	Modiolus demissus	.	.32	.	.	.	.	.
	Mulinia lateralis	.	.	1.28	.64	.32	.32	.
	Tagelus divisus	.32	.	.	.	.	.	.
	Tellina spp.	.32	.	.	.	.	.	.
	Diodora spp.	.	.	.	.	.	.32	.
	Illyanassa obsoleta	.32	.	.32	.	.32	.	.
Nematoda	Nematode Sp. A.	.	.	.64	.	.	.	.
	Nematode Sp. B.	.64	.	.	.	.	.	.
	Nematode Sp. C.	1.91	.	.	.	.	.	.
Oligochaeta	Oligochaeta A	.64	.	.	.	.	.	.
Pisces	Symphurus plagiusa	.	.32	.	.	.32	.	.
	Leptocephala (larval forms)	.	.	.	.	.	.32	.
	Gobiosoma spp.	.	.	.	.	.	.	1.28
Polychaeta	Capitella capitada	.	.	.	.	.	5.10	.
	Neresis succinus	5.74	29.02	.64	.	.	.	.64
	Polychaete (fragments) - not counted	.00	.	.00	.	.	.00	.
	Sphaerodorida Sp. A.	.32	.	.	.	.	.	.

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

FALL 1979 (Cont'd).

TYPE	SCIENTIFIC NAME	STATION BCK	DCK	EP1	EP2	EP3	MCV	SCK
Rhynchocoela	Rhynchocela Sp. A.	.64	.	.	.	.	.	.
	Rhynchocoela Sp. B.	.64	.	.	.	.	.	.
Sipcunculida	Sipunculida Sp. A.	.	.	.32	.	.	.	.
Grapsid	Grapsidae (juvenille)	.	.64	.	.	.	.	.
	Grapsidae Sp. A.	.	.96	.64	.	.	.	.
Portunid	Callinectes ornatus	.	.32	.	.	.	.	.
	Callinectes sapidus	.	1.28	.	.	.	.	.
Xanthid	Panopeus herbstii	.	.64	.	.	.	.	.32
TOTAL		15.31	592.87	9.89	.96	2.23	88.66	7.02

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SOUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

WINTER 1980.

TYPE	SCIENTIFIC NAME	STATION						
		BCK	DCK	EP1	EP2	EP3	MCV	SCK
Amphipoda	Amphipoda (Fragments)	.	.	.32	.	.64	.	.32
	Corophium lacustre	.32	148.93	.	.32	.	30.94	.
	Gammarus mucronatus	1.91	3.19	4.15	.	.	.	.
	Monoculodes edwardsii	9.25	.	.	.	.	.	.
Caridean Shrimp	Natantia (Fragments)	.	.	.	.	.32	.	.
	Ogyrides spp.	.	.	21.37	.	.	.	.
	Palaemonetes pugio	.	.	.	.	.32	.	.
	Alpheus heterochelis	.	.	.64	.	.	.	.
Cirripedia	Balanus balanus	.	.	.32	.	.	7.65	.
Echinodermata	Ophiuroidea (Juvenille)	.	.	.32	.	.	.	.
	Ophiuroidea Sp. A.	.	.	47.52	.	.	.	.
Hirudinea	Calliobdella vivda	.	.	.32	.	.	.	.
	Malmiana philotherma	.	.	.	.	.32	.	.
Isopoda	Cyathura spp.	.	16.90	.32	.64	5.42	6.38	.
	Edotera spp.	.	1.28	.32	.	.	.64	.
Mollusca	Cryptopleura costata	.	.	.	.	.96	.	.
	Mercenaria mercenaria	.	.	.32	.	.	.	.
	Modiolus americanus	.	.	.32	.	.	.	.
	Modiolus demissus	.	.	.	.	.32	.	.
	Mulinia lateralis	123.74	.64	48.48	561.30	5,865.86	22.64	23.60
	Tagelus divisus	.32	.	.	.	.	.96	.
	Tellina spp.	57.09	.	.	.	.	.	99.82
	Crassostrea virginia	.	.	.32	.	.	.	.
	Anachis translirata	.	.	.	.32	.	.	.
	Elysia chlorotica	13.71	.	.64	.	.	.	.
	Epitonium rupicola	.	.	.32	.	.	.	.
	Illyanassa obsoleta	.32	.	1.28	.	.	.	.
	Nassarius vibax	.	.	.64	.	.	.	.
	Ovetalla myosotsis	.	.	.32	.	.	.	.
	Polinices duplicalus	.	.	1.28	.64	5.74	.	.

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

WINTER 1980 (Cont'd).

TYPE	SCIENTIFIC NAME	STATION BCK	DCK	EP1	EP2	EP3	MCV	SCK
Nematoda	Nematode (fragments) - not counted	.	.	.	.	.	.	.00
	Nematode Sp. A.	.	.	.	.	.	.	.96
Nephropsidae	Upogebia affinis	.	.	.	.	.	.32	.
Oligochaeta	Oligochaeta Sp. B.	.	.	.	.	.	.	6.38
	Oligochaeta Sp. C.	.	.	.	.	.	.	.64
	Oligochaeta Sp. D.	.	.	.	.	.	.	.64
	Terebellida Sp. A.	.	.	.	.	.32	.	.
	Terebellida Sp. B.	.	.	.	.	.32	.	.
Penaeidae	Panaleus setiferous	.	.	.64	.	.	.	.
Pisces	Symphurus plagiusa	.	.32	.	.	.	.32	.
	Leptocephala (larval forms)	.	.	.	.	.	.	.64
Platyhelminthes	Hoploplanidae spp.	.	.	8.93	.	.64	.	.
	Platahelminthes Sp. B.	.	.	.	.32	.	.	.
Polychaeta	Aphrodita spp.	.	.	.32	.	.	.	.
	Arbellidae Sp. A.	.	60.59	1.91	.	.	200.28	.
	Arbellidae Sp. B.	.	.	.32	.	.	.	.
	Arbellidae Sp. C.	.	.	.32	.	.	.	.
	Capitella capitada	.	.	4.15	1.28	1.59	31.89	.
	Capitella spp.	.	.	.	.	.	4.78	.
	Chaetopterus variopedatus	.	.	.	.	.32	.	.
	Glycera dibranchiata	1.59	.	6.06	11.80	2.55	.	.32
	Laenereis culveri	.	.	5.10	.	.	.	.
	Neresis succinus	10.52	11.80	9.89	5.42	12.76	32.85	11.16
	Odonotosyllis spp.	.	.	.64	.	.	.	.
	Paranois spp.	.	172.22	.	.	.	.	.
	Pectinaria gouldii	.	.	30.62	1.91	.96	.	.
	Polychaete (fragments) - not counted	.00	.00	.00	.00	.00	.00	.00
	Polycirrus spp.	.64	.	84.83	.96	1.59	.	.
	Polydora spp.	.	.	.	.	.64	.	.
	Sebellidae Sp. A.	.	.	.	.	.64	.	.
	Websterineresis tridentata	2.87	.	.64	.	.	.	4.15
Rhynchocoela	Cerebratulus spp.	.	.	3.83	1.59	3.83	.32	.
	Rhynchocela Sp. A.	.	.	.	.	.32	.	.64
	Rhynchocoela Sp. B.	.	.	.	.	.	.	.96
	Rhynchocoela Sp. C.	.	.	.	.	.32	.	.

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

WINTER 1980 (Cont'd).

TYPE	SCIENTIFIC NAME	STATION BCK	DCK	EP1	EP2	EP3	MCV	SCK
Diogenid	Clibanarius vitlatus	.	.	.	.	.	.32	.
Grapsid	Grapsidae (juvenille)	.	.	.32	.	.	.	.
	Grapsidae Sp. A.	.32	.	.	.	.	.	.
Portunid	Callinectes sapidus	.64	.	.	.	.	.	.
Xanthid	Panopeus herbstii	.	.	1.59	.	.	.	.
	Panopeus occidentalis	.	.	1.91	.	.	.	.
	Xanthid (fragments)	.64	.	.32	.	.	.	.
	Rithropanopeus harrisii	.	.	.	.	.	.96	.
TOTAL		223.88	415.87	291.81	586.49	5,906.68	341.24	150.21

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

SPRING 1980.

TYPE	SCIENTIFIC NAME	STATION BCK	DCK	EP1	EP2	EP3	MCV	SCK
Amphipoda	Amphipoda (fragments)	.	.	.	.	.	.	.96
	Corophium lacustre	142.88	1,630.95	.	.	.	341.24	.96
	Gammarus mucronatus	.	4.46	.	.	.	39.23	2.23
	Monoculodes edwardsii	.	.	.	.	.	3.19	.
	Neohaustorius spp.	.	.	.	.	.	.64	.
Bryozoa	Bryozoan colony	.	.	.	.32	.	.	.
Caridean Shrimp	Natantia (fragments)	.	.	.00	.32	.	.	.
	Ogyrides spp.	.	.	.	.64	.	.	.
	Alpheus heterochelis	.	.	.	.	.	.64	.64
Cirripedia	Balanus balanus	.96	3.83	.	.96	.	4.78	.
Cumacea	Diastylis polita	5.10	.	.	.	.	7.97	.
Echinodermata	Ophiuroidea Sp. A.	.	.	.32	.	.	.	.
Isopoda	Cyathura spp.	7.34	72.08	.	.	.	9.89	.
	Edotera spp.	.	.64	1.28	.	.96	2.55	.
Mollusca	Cryptopleura costata	17.86	.	.	.	.	59.64	.
	Modiolus americanus	.	.	.	.	.96	.	.
	Mulinia lateralis	141.28	291.17	1,556.32	383.98	11,095.80	85.15	29.66
	Tagelus divisus	2.55	.	.	.	.	.96	.
	Tellina spp.	.	.	.	.	.	.	82.92
	Dendronotus spp.	.	.32	.	.	.	.	.
	Illyanassa obsoleta	2.55	.	1.91	.	.	.	.
	Nassarius trivittatus	.	.	.	.	.64	.	.
	Polinices duplicalus	.	.	.64	4.78	5.74	.	.
Mysid Shrimp	Mysid (fragments)	.	.	.	.	.96	.	.
Nematoda	Nematoda (fragments) - not counted	.	.	.00	.	.	.	.
Oligochaeta	Oligochaeta Sp. C.	.	.	.96	.	.	.	.
	Oligochaeta Sp. D.	.	.	1.59	.	.	.	.
Penaeidae	Penaeus aztecus	.	.	.	.	.	.	.32
	Penaeus spp.	.	.	.	.	.	.32	.

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

SPRING 1980 (Cont'd).

TYPE	SCIENTIFIC NAME	STATION BCK	DCK	EP1	EP2	EP3	MCV	SCK
Pisces	Symphurus plagiusa	.	.	.64	.	.	.	.
	Tricnectes maculatus	.	.	.32	.	.	.	.
Polychaeta	Capitella capitada	.	.	.	1.59	1.91	.	.
	Capitella spp.	.	.	6.38	8.29	9.25	7.97	.
	Glycera dibranchiata	.	.	.64	2.87	3.83	2.23	.
	Neresis succinus	56.13	23.28	1.91	.64	4.15	20.41	2.23
	Pectinaria gouldii	.64	.	4.15	.32	.	.	.
	Polychaeta (fragments) - not counted	.00	.00	.00	.00	.00	.00	.00
	Polycirrus spp.	.	.	4.46	.64	.32	.	.
Rhynchocoela	Cerebratulus spp.	.	.	.	.64	10.21	.	.
	Rhynchocoela (fragments) - not counted	.	.	.00	.	.	.	.
	Rhynchocoela Sp. B.	.	.	.	.	.96	.	.
Goneoplacid	Speocarcinus carolinensis	.	.32	.	.	.	.	.
Pagurid	Pagurus longicarpus	.	.	.32	.	.	.	.
Portunid	Callinectes sapidus	.32	.	.	.32	.	1.28	.
	Portunas gibbesi	.	.	.64	.	.	.	.
Xanthid	Eurypanopeus abbreviatus	.	.	.	.	.	.	.32
	Eurypanopeus spp.	.	.	.	.	.	.96	.
	Panopeus herbstii	.64	.	.	.	.	.96	.
	Xanthid (fragments)	.	.	.96	.	.	.	.
	Rithropanopeus harrisii	.32	.32	.	.	.	.	.
TOTAL		378.56	2,027.36	1,583.43	406.30	11,135.67	590.00	120.23

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

SUMMER 1980.

TYPE	SCIENTIFIC NAME	STATION						
		BCK	DCK	EP1	EP2	EP3	MCV	SCK
Amphipoda	Corophium lacustre	.	.	.	.	.	.	3.19
	Gammarus mucronatus	.	1.59	.	.	.	.32	1.28
	Monoculodes edwardsii	.	.32	.	.	.	.	.
Ascidiacea	Persephora punctata	.	.	.	.32	.32	.	.
Calanoida	Calanoid copepod	.	.	1.28	.	.	.	.
Caridean Shrimp	Ogyrides spp.	.	.	.	.	.	.	.32
	Alpheus heterochelis	.	.	.	.	.	.	.96
Cirripedia	Balanus balanus	2.23	3.51	.	13.08	12.44	3.51	.
Cnidaria	Actiniarian (cnidaria)	.96	.	15.95	.96	1.91	9.89	.
Cumacea	Diastylis polita	4.46	41.46	29.66	.32	.32	.64	13.39
Echinodermata	Ophiuroidea Sp. A.	.	.	69.52	8.61	.96	.	.
Isopoda	Cyathura spp.	.32	15.95	.96	.	.	1.28	.
	Edotera spp.	.	.32	2.23	.	.	.	.
Malacostraca	Squilla spp.	.32	.	.	.32	.	.32	.
Mollusca	Abra aequalis	.	4.15	15.31	8.29	.96	4.15	.
	Anadara ovalis	.	.	1.91	.	2.23	.	.
	Anadara transversa	.	.	.96	.	.	.	.
	Cryptopleura costata	.	.	.	.	.	.32	.
	Hiatella arctica	.	.	.	.	.	.	.32
	Macoma tenta	.	.	1.59	.	.	.	.
	Mercenaria mercenaria	.	.	.	.	.	1.59	.
	Modiolus demissus	.	.64	.32	.	.	3.51	.
	Mulinia lateralis	1.91	5.74	36.04	587.13	636.56	12.76	3.19
	Tellina spp.	.	.	.	.64	.	.64	1.28
	Anachis obesa	.	.	2.55	1.91	.32	.	.
	Epitomium multistriatum	.	.	.32	.	.	.	.
	Epitomium rupicola	.	.	.	.	.	.32	.
	Eupleura caudata	.	.	1.28	.	.	.	.
	Haminoes spp.	.32	.	.	.	.	.32	.32
	Illyanassa obsoleta	48.79	.	.32	.32	.	3.51	.32
	Nassarius vibax	.	.	.	.	.32	.	.
	Odostomia imprissa	.	.	.32	.	.	.	.
	Petricola spp.	.	.	.	.	.	.64	.
	Polinices duplicalus	.	.	1.91	.	1.28	.	.

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

SUMMER 1980 (Cont'd).

TYPE	SCIENTIFIC NAME	STATION BCK	DCK	EP1	EP2	EP3	MCV	SCK
Mysid Shrimp	Mysid spp.	.	.	.32	1.59	.	.	.
Penaeidae	Penaeus duorarum	.	.	.	.	.	.	.32
Pisces	Anguilla rostrata	.	.	.	.	.32	.32	.
	Symphurus plagiusa	.	.	.32	.	.	.	.32
	Larval fish	.	.	.	.	.	.32	.
	Gobiosoma spp.	.	.	.	.	.	.	1.59
	Tricnectes maculatus	.	.32	.	.	.	.	.
Polychaeta	Glycera dibranchiata	.	.	13.39	4.15	1.28	3.19	2.55
	Neresis succinus	.32	5.10	31.25	1.91	.64	5.74	12.76
	Pectinaria gouldii	.	.	.32	.32	.	.	.
	Polychaete (fragments) - not counted	.00	.00	.00	.00	.00	.00	.00
	Polychaete Sp. A.	.	.	4.15	.	.	.	.
	Polychaete Sp. B.	.	.	40.50	.	.	.	.
	Polychaete Sp. D.	.	.	.96	.	.	.	.
Pinnotherid	Pinnixa chaetopterana	.	.	.96	.	.	.	.
	Pinnixia spp.	.	.	.64	.	.	.	.
Portunid	Callinectes sapidus	.	.	.	.	.	.32	.
Xanthid	Eurypanopeus abbreviatus	.	.	.	.	.	.64	.
	Eurypanopeus spp.	.	.64	.32	.	.32	.	.
	Panopeus herbstii	.	.	.	.	.	.	.32
TOTAL		59.64	79.73	275.55	629.86	660.16	54.22	42.42

Location of stations BCK through SCK
shown in Figure 2.8-4

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

FULTON-DAME POINT CUTOFF: SPRING 1980.

TYPE	SCIENTIFIC NAME	STATION MCV	OP1	OP2	OP3
Amphipoda	Corophium lacustre	341.24	.64	4.46	26,079.86
	Gammarus mucronatus	39.23	.	10.84	6.70
	Haustoriddae spp.	.	.	.32	.
	Monoculodes edwardsii	3.19	.32	24.88	.
	Neohaustorius spp.	.64	4.78	1.91	.
Caridean Shrimp	Alpheus heterochelis	.64	.	.	.
Cirripedia	Balanus balanus	4.78	.	.	7.02
Cumacean	Diastylis polita	7.97	.	14.99	.32
Decapoda	Decapod zoea	.	.	.32	.
Isopoda	Cyathura spp.	9.89	.	.	.96
	Edotera spp.	2.55	1.59	.64	3.19
	Isopod spp.	.	.	.	.32
Mollusca	Cryptopleura costata	59.64	.	.32	72.71
	Modiolus demissus	.	.	.	.32
	Mulinia lateralis	85.15	22.96	4.78	18.18
	Tagelus divisus	.96	.	.	.
	Tellina spp.	.	.	4.78	.
	Petricola spp.	.	.	.	70.48
Nematoda	Nematode (Fragments) Not Counted	.	.00	.	.
Penaeidae	Penaeus spp.	.32	.	.32	.
Pisces	Larval fish	.	.	.	.64
	Gobiosoma spp.	.	.	.	1.59
Polychaeta	Capitella capitada	.	1.91	.96	.
	Capitella spp.	7.97	.	.	.
	Glycera dibranchiata	2.23	.	.	.

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

FULTON-DAME POINT CUTOFF: SPRING 1980 (Cont'd).

TYPE	SCIENTIFIC NAME	STATION MCV	OP1	OP	OP3
Polychaeta	Neresis succinus	20.41	122.46	35.40	128.84
	Polychaete (Fragments) Not Counted	.00	.	.00	.00
Portunid	Callinectes sapidus	1.28	.	.	5.42
Xanthid	Eurypanopeus spp.	.96	.	.	3.83
	Panopeus herbstii	.96	.	.	.
	Xanthaid (Fragments)	.	.	.32	.
	Rithropanopeus harrisii	.	.	.	.96
Total		590.00	154.68	105.24	26,401.33

Location of Stations MCV Through OP3
Shown in Figure 2.8-4

Table B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = PONAR DREDGE

FULTON-DAME POINT CUTOFF: SUMMER 1980.

TYPE	SCIENTIFIC NAME	STATION MCV	OP1	OP2	OP3
Amphipoda	Amphipoda (Fragments) Not counted	.	.00	.00	.
	Gammarus mucronatus	.32	.	.32	.64
Caridean Shrimp	Alpheus heterochelis	.	.	.	2.87
Cirripedia	Balanus balanus	3.51	.	.	107.79
Cnidaria	Actiniarian (Cnidaria)	9.89	.	.	52.94
Cumacean	Diastylis polita	.64	.96	3.51	.32
Isopoda	Cyathura spp.	1.28	.	.	.
	Edotera spp.	.	.	.32	.64
Malacostraca	Squilla spp.	.32	.	.	.
Mollusca	Abra aequalis	4.15	.	.	.
	Cryptopleura costata	.32	.	.	.
	Hiatella arctica	.	.	.	20.41
	Mercenaria mercenaria	1.59	.	.	.96
	Modiolus demissus	3.51	.	.	12.12
	Mulinia lateralis	12.76	2.55	.	1.59
	Tagelus divisus	.	22.32	.32	.
	Tellina spp.	.64	.	.	.
	Crassostrea virginia	.	.	.	5.74
	Epitonium rupicola	.32	.	.	.
	Haminoes spp.	.32	.	.	.
	Illyanassa obsoleta	3.51	.32	.	.
	Petricola spp.	.64	.	.	189.44
Penaeidae	Penaeus duorarum	.	.	.	.32
Pisces	Anguilla rostrata	.32	.	.	.
	Larval fish	.32	.	.	.
	Fish fragment	.	.	.	.00
	Gobiosoma spp.	.	.	.	.96

TABLE B-8 (Continued)

BENTHIC NEKTON AND INVERTEBRATE DENSITIES (ORGANISMS PER SQUARE METER)
FOR THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

FULTON-DAME POINT CUTOFF: SUMMER 1980 (Cont'd). SAMPLING METHOD - PONAR DREDGE

TYPE	SCIENTIFIC NAME	STATION MCV	OP1	OP2	OP3
Platyhelminthes	Turbellarian spp.	.	.	.	1.28
Polychaeta	Glycera dibranchiata	3.19	.	.32	.
	Neresis succinus	5.74	.	.	80.69
	Polychaete (Fragments) Not counted	.00	.00	.00	.00
Grapsid	Grapsidae (Juvenile)	.	.	.32	.
Portunid	Callinectes sapidus	.32	.	.	.96
Xanthid	Eurypanopeus abbreviatus	.64	.	.	1.28
	Eurypanopeus spp.	.	.	.	1.91
Total		54.22	26.15	7.65	482.84

Location of stations MCV through OP3
shown in Figure 2.8-4

Table B-9

SEASONAL OCCURRENCE OF BENTHIC MACROINVERTEBRATES
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON			
			FALL 1979	WINTER 1980	SPRING 1980	SUMMER 1980
Amphipoda	Scud	Amphipoda (fragments)	+	+	+	-
		Corophium lacustre	+	+	+	+
		Gammaridian sp. E	+	-	-	-
		Gammarus mucronatus	+	+	+	+
		Haustoriddae spp.	-	-	+	-
		Monoculodes edwardsii	-	+	+	+
		Neohaustorius spp.	+	-	+	-
Ascidiacea	Tunicate	Persephora punctata	-	-	-	+
Bryozoa	Moss Animal	Bryozoan colony	+	-	+	-
Calanoida	Copepod	Calanoid copepod	-	-	-	+
Caridea Shrimp	Caridean Shrimp	Natantia (fragments)	+	+	+	-
	Long-eyed Shrimp	Ogyrides spp.	+	+	+	+
	Shore Shrimp	Palaemonetes pugio	+	+	-	-
	Snapping Shrimp	Alpheus heterochelis	+	+	+	+
Cirripedia	Barnacle	Balanus balanus	+	+	+	+
		Balanus improvisus	+	-	-	-
Cnidaria	Jellyfish	Actiniarian (cnidaria)	-	-	-	+
Cumacea	Cumacean Shrimp	Diastylis polita	-	-	+	+
Decapoda	Larval Decapod	Decapod zoea	-	-	+	-
Diogenid Crab	Hermit Crab	Clibanarius vitlatus	-	+	-	-
Echonodermata	Brittle Star	Ophiuroidea (juvenille form)	-	+	-	-
		Ophiuroidea sp. A	-	+	+	+
Goneoplacid Crab	Crab	Speocarcinus carolinensis	-	-	+	-
Grapsid crab	Crab	Grapsidae (juvenille form)	+	+	-	-
		Grapsidae sp. A	+	+	-	-
Hirudinea	Leech	Calliobdella vivda	-	+	-	-
		Malmiana philotherma	-	+	-	-
Isopoda	Isopod	Cyathura spp.	+	+	+	+
		Edotera spp.	+	+	+	+
		Isopod spp.	-	-	+	-
Malcostraca	Mantis Shrimp	Squilla spp.	-	-	-	+

Table B-9

SEASONAL OCCURRENCE OF BENTHIC MACROINVERTEBRATES
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON			
			FALL 1979	WINTER 1980	SPRING 1980	SUMMER 1980
Mollusca	Clam	Abra aequalis	-	-	-	+
		Anadara ovalis	-	-	-	+
		Anadara transversa	-	-	-	+
		Cryptopleura costata	-	+	+	+
		Hiatella arctiia	-	-	-	+
		Macoma tenta	-	-	-	+
		Mercenaria mercenaria	-	+	-	+
		Modiolus americanus	-	+	+	-
		Modiolus demissus	+	+	+	+
		Mulinia lateralis	+	+	+	+
		Tagelus divisus	+	+	+	-
		Tellina spp.	+	+	+	+
	Oyster	Crassostrea virginia	-	+	-	+
	Snail	Anachis obesa	-	-	-	+
		Anachis translirata	-	+	-	-
		Dendronotus spp.	-	-	+	-
		Diodora spp.	+	-	-	-
		Elysis chlorotica	-	+	-	-
		Epitomium multistriatum	-	-	-	+
		Epitonium rupicola	-	+	-	+
		Eupleura caudata	-	-	-	+
		Haminoes spp.	-	-	-	+
		Illyanassa obsoleta	+	+	+	+
		Nassarius trivittatus	-	-	+	-
		Nassarius vibax	-	+	-	+
		Odostomia imprissa	-	-	-	+
		Ovetella myosotsis	-	+	-	-
		Petricola spp.	-	-	+	+
		Polinices duplicalus	-	+	+	+
Mysid Shrimp	Mysid Shrimp	Mysid (fragments)	-	-	+	-
		Mysid spp.	-	-	-	+
Nematoda	Roundworm	Nematode (fragments)	-	+	+	-
		Nematode sp. A	+	+	-	-
		Nematode sp. B	+	-	-	-
		Nematode sp. C	+	-	-	-
Nephropsidae	Mud Shrimp	Upogebia affinis	-	+	-	-
Oligochaeta	Aquatic Earthworm	Oligochaeta A	+	-	-	-

Table B-9
(Continued)

SEASONAL OCCURRENCE OF BENTHIC MACROINVERTEBRATES
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON			
			FALL 1979	WINTER 1980	SPRING 1980	SUMMER 1980
Oligochaeta	Aquatic Earthworm	Oligochaeta sp. B	-	+	-	-
		Oligochaeta sp. C	-	+	+	-
		Oligochaete sp. D	-	+	+	-
		Terebellida sp. A	-	+	-	-
		Terebellida sp. B	-	+	-	-
Pagurid Crab	Hermit Crab	Pagurus longicarpus	-	-	+	-
Penaeidae	Brown Shrimp	Penaeus aztecus	-	-	+	-
	Pink Shrimp	Penaeus duorarum	-	-	-	+
	Shrimp	Penaeus spp.	-	-	+	-
Pinnotherid Crab	Crab	Pinnixa chaetopterana	-	-	-	+
		Pinnixia spp.	-	-	-	+
Pisces	American Eel	Anguilla rostrata	-	-	-	+
	Blackcheek Tonguefish	Symphurus plagiusa	+	+	+	+
	Eel Larvae	Leptocephala (larval forms)	+	+	-	-
	Fish	Larval fish	-	-	+	+
	Fish Fragment	Fish fragment	-	-	-	+
	Goby	Gobiosoma spp.	+	-	+	+
	Hogchoker	Tricnectes maculatus	-	-	+	+
Platyhelminthes	Flatworm	Hoploplanidae spp.	-	+	-	-
		Platahelminthes sp. B	-	+	-	-
		Turbellaria spp.	-	-	-	+
Polychaeta	Bristle Worm	Aphrodita spp.	-	+	-	-
		Arbellidae sp. A	-	+	-	-
		Arbellidae sp. B	-	+	-	-
		Arbellidae sp. C	-	+	-	-
		Capitella capitada	+	+	+	-
		Capitella spp.	-	+	+	-
		Chaetopterus variopedatus	-	+	-	-
		Glycera dibranchiata	-	+	+	+
		Laenereis culveri	-	+	-	-
		Neresis succinus	+	+	+	+
		Odonotosyllis spp.	-	+	-	-
		Paranois spp.	-	+	-	-
		Pectinaria gouldii	-	+	+	+
		Polychaete sp. A	-	-	-	+
		Polychaete sp. B	-	-	-	+
		Polychaete sp. D	-	-	-	+

Table B-9
(Continued)

SEASONAL OCCURRENCE OF BENTHIC MACROINVERTEBRATES
IN THE ST. JOHNS RIVER AND CONTIGUOUS CREEKS
NEAR THE NORTHSIDE GENERATING STATION

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON			
			FALL 1979	WINTER 1980	SPRING 1980	SUMMER 1980
Polychaete	Bristle Worm	Polycirrus spp.	-	+	+	-
		Polydora spp.	-	+	-	-
		Sebellidae sp. A	-	+	-	-
		Sphaerodorida sp. A	+	-	-	-
		Websterineresis tridentata	-	+	+	-
	Bristle Worm Fragments	Polychaete (fragments)	+	+	+	+
Portunid Crab	Blue Crab	Callinectes ornatus	+	-	-	-
		Callinectes sapidus	+	+	+	+
		Portunas gibbesi	-	-	+	-
Rhynchocoela	Nemertean Worm	Cerebratulus spp.	-	+	+	-
	Proboscis Worm	Rhynchocela sp. A	+	+	-	-
		Rhynchocoela sp. B	+	+	+	-
		Rhynchocoela sp. C	-	+	-	-
	Proboscis Worm Fragments	Rhynchocoela (fragments)	-	-	+	-
Sipcunculida	Peanut Worm	Sipunculida sp. A	+	-	-	-
Xanthid Crab	Black-Fingered Mud Crab	Eurypanopeus abbreviatus	-	-	+	+
		Eurypanopeus spp.	-	-	+	+
		Panopeus herbstii	+	+	+	+
		Panopeus occidentalis	-	+	-	-
	Crab Fragments	Xanthid (fragments)	-	+	+	-
	White Shrimp	Penaeus setiferous	-	+	-	-
	White-Fingered Mud Crab	Rithropanopeus harrisii	-	+	+	-

Table B-10

MEAN DENSITIES FOR ICHTHYOPLANKTON AND NEKTON LARVAE
(ORGANISMS PER 1000 CUBIC METERS) IN THE ST. JOHNS RIVER
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON FALL 1979	SEASON WINTER 1980
Commercial Species	Banded Shrimp	Trachypenaeus constrictus	.93	.
	Blue Crab	Callinectes spp.	.	.23
	Croaker	Micropogonias undulatus	14.99	40.63
	Gulf Flounder	Paralichthys albigutta	.	.44
	Menhaden	Brevoortia spp.	.	4.23
	Shrimp	Penaeus spp.	7.98	2.29
	Spot	Leiostomus xanthurus	.	4.02
	Striped Mullet	Mugil cephalus	.	.40
	White Shrimp	Penaeus setiferus	.67	.31
Forage Species	Bay Anchovy	Anchoa mitchelli	14.03	5.43
	Blueback Herring	Alosa aestivalis	.	.05
	Rough Silverside	Membras martinica	.	.17
	Silverside	Antherinidae	.	2.93
	Star Drum	Stellifer lanceolatus	13.65	4.37
Other Species	Bay Whiff	Citharichthys spilopterus	.	.16
	Bighead Searobin	Prionotus tribulus	.28	.
	Chain Pipefish	Syngnathus louisianae	.	.06
	Darter Goby	Gobionellus boleosoma	.	.30
	Fat Sleeper	Dormitator maculatus	.28	.15
	Hogchoker	Trinectes maculatus	.	.39
	Ladyfish	Elops saurus	.	.05
	Mojarra	Eucinostomus spp.	.43	.
	Pinfish	Lagodon rhomboides	.	.87
	Planehead Filefish	Monocanthus hispidus	.69	.
	Sea Catfish	Arius felis	.	.29
	Sharptail Goby	Gobionellus hastatus	.33	.
	Shrimp Eel	Ophichthus gomesi	.	.05
	Skilletfish	Gobiesox strumosus	.	.12
	Southern Stargazer	Astroscopus y-graecum	.	.07
	Speckled Worm Eel	Myrophus punctatus	.33	2.63
	Blackcheek Tonguefish	Symphurus plagiusa	.	.22
	Total		54.59	70.86

Mean densities averaged from stations
EP1, EP2, and EP3 Figure 2.8-4

Table B-10 (Continued)

MEAN DENSITIES FOR ICHTHYOPLANKTON AND NEKTON LARVAE
(ORGANISMS PER 1000 CUBIC METERS) IN THE ST. JOHNS RIVER
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON	
			SPRING 1980	SUMMER 1980
Commercial Species	Banded Shrimp	Trachypenaeus constrictus	36.86	36.95
	Black Drum	Pogonias cromis	13.42	.
	Blue Crab	Callinectes spp.	12.25	28.89
	Brown Shrimp	Penaeus aztecus	.05	.00
	Centrarchid	Centrachidae	.	2.03
	Croaker	Michropogonias undulatus	43.50	.
	Gulf Flounder	Paralichthys albigutta	.32	.09
	Menhaden	Brevoortia spp.	5.38	.
	Northern Kingfish	Menticirrhus saxatilis	.	.22
	Red Drum	Sciaenops ocellata	.	.18
	Sciaenid	Sciaenidae	114.37	407.66
	Shrimp	Penaeus spp.	12.07	391.46
	Silver Perch	Bairdiella chrysura	22.23	6.67
	Southern Flounder	Paralichthys lethostigma	.09	.40
	Southern Kingfish	Menticirrhus americanus	1.16	.27
	Spot	Leiostomus xanthurus	3.21	.
	Spotted Seatrout	Cynoscion nebulosus	51.39	289.84
	Weakfish	Cynoscion regalis	352.95	649.37
Forage Species	Anchovy	Anchoa spp.	4,391.58	4,943.12
	Bay Anchovy	Anchoa mitchelli	56.43	42.26
	Clupied	Clupeidae	.64	4.45
	Silverside	Antherinidae	3.69	.
	Star Drum	Stellifer lanceolatus	9.04	25.24
	Striped Anchovy	Anchoa hepsetus	31.52	121.31
Other Species	Atlantic Bumper	Chloroscombrus chrysurus	.	1.03
	Atlantic Spadefish	Chaetodipterus faber	.12	.
	Atlantic Thread Herring	Opisthonema oglinum	.05	.
	Banded Drum	Larimus fasciatus	.06	.
	Bay Whiff	Citharichthys spilopterus	.99	.
	Blenny	Blenniidae	37.80	101.92
	Butterfish	Peprilus spp.	75.71	7.86
	Chain Pipefish	Syngnathus louisianae	1.63	.71
	Clown Goby	Microgobius gulosus	.	.11
	Code Goby	Gobiosoma robustum	.	.35
	Darter Goby	Gobionellus boleosoma	1.14	3.61
	Fat Sleeper	Dormitator maculatus	.12	.
	Freshwater Goby	Gobionellus shufeldti	2.27	.
	Gobionellus	Gobionellus spp.	27.38	540.67
	Gobiosoma	Gobiosoma spp.	785.16	1,175.73
	Gulf Pipefish	Syngnathus scovelli	.16	.
	Halfbeak	Hemirhamphus unifasciatus	.	.11
	Hogchoker	Trinectes maculatus	6.03	21.63

Table B-10 (Continued)

MEAN DENSITIES FOR ICHTHYOPLANKTON AND NEKTON LARVAE
(ORGANISMS PER 1000 CUBIC METERS) IN THE ST. JOHNS RIVER
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON	
			SPRING 1980	SUMMER 1980
OTHER SPECIES (Cont'd)	Hypsoblennius	Hypsoblennius spp.	.14	.30
	Irish Pompano	Diapterus olisthostomus	.	.23
	Lady Crab	Ovalipes ocellatus	.06	.
	Ladyfish	Elops saurus	1.31	.
	Leopard Searobin	Prionotus tribulus	.10	.
	Inshore Lizardfish	Synodus foetens	.63	.
	Microgobias	Microgobius spp.	16.98	91.98
	Mojarra	Eucinostomus spp.	.12	.62
	Naked Goby	Gobiosoma bosci	8.68	24.62
	Northern Pipefish	Syngnathus fuscus	.67	.11
	Northern Puffer	Sphoeroides maculatus	.26	.
	Oyster Toadfish	Opsanus tau	.19	.
	Pigfish	Orthopristus chrysoptera	.87	.13
	Planehead Filefish	Monocanthus hispidus	.	.25
	Searobin	Prionotus spp.	.05	.41
	Seaboard Goby	Gobiosoma ginsburgi	.11	1.35
	Sharptail Goby	Gobionellus hastatus	.06	.28
	Shrimp Eel	Ophichthus gomesi	.09	.
	Skilletfish	Gobiesox strumosus	4.83	3.80
	Southern Stargazer	Astroscopus y-graecum	.08	.
	Speckled Worm Eel	Myrophus punctatus	.16	.
	Striped Blenny	Chasmodes bosquianus	.07	.
	Striped Burrfish	Chilomycterus schoepfi	.29	.13
	Blackcheek Tonguefish	Symphurus plagiusa	.53	8.20
	Unidentified Goby	Gobiidae	2.08	59.68
	Unidentifiable Fish		7.42	3.71
	Total		6,146.57	8,999.94

Mean densities averaged
from stations EP1, EP2, and EP3
Figure 2.8-4

Table B-11

MEAN DENSITIES FOR ICHTHYOPLANKTON AND NEKTON LARVAE
(ORGANISMS PER 1000 CUBIC METERS) IN THE CONTIGUOUS TIDAL CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON FALL 1979	SEASON WINTER 1980
Commercial	American Eel	Anguilla rostrata	.	.12
	Blue Crab	Callinectes spp.	.	.44
	Croaker	Micropogonias undulatus	47.53	44.10
	Gulf Flounder	Paralichthys albigutta	.	.22
	Menhaden	Brevoortia spp.	.	8.67
	Pink Shrimp	Penaeus duorarum	.71	.
	Shrimp	Penaeus spp.	25.75	2.51
	Spot	Leiostomus xanthurus	.	10.67
	Striped Mullet	Mugil cephalus	.	.60
	White Shrimp	Penaeus setiferus	1.66	.14
Forage	Atlantic Silversides	Menidia menidia	.	.13
	Bay Anchovy	Anchoa mitchelli	25.70	18.17
	Blueback Herring	Alosa aestivalis	.	.50
	Silverside	Antherinidae	.	11.23
	Star Drum	Stellifer lanceolatus	.	.75
	Tidewater Silverside	Menidia beryllina	.	.09
Other	Bay Whiff	Citharichthys spilopterus	.	.23
	Blenny	Blenniidae	.71	.
	Crested Cusk-eel	Ophidion welshi	.	.22
	Darter Goby	Gobionellus boleosoma	1.49	.75
	Fat Sleeper	Dormitator maculatus	.	.15
	Irish Pompano	Diapterus olisthostomus	.	.13
	Ladyfish	Elops saurus	.	.58
	Naked Goby	Gobiosoma bosci	.	.38
	Pinfish	Lagodon rhomboides	.	1.74
	Sea Catfish	Arius felis	.	.10
	Speckled Worm Eel	Myrophus punctatus	3.26	3.57
	Blackcheek Tonguefish	Symphurus plagiusa	.	.33
TOTAL			106.82	106.53

Mean densities averaged from stations BCK and SCK
Figure 2.8-4

Table B-11
(Continued)
MEAN DENSITIES FOR ICHTHYOPLANKTON AND NEKTON LARVAE
(ORGANISMS PER 1000 CUBIC METERS) IN THE CONTIGUOUS TIDAL CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON	
			SPRING 1980	SUMMER 1980
Commercial	Banded Shrimp	Trachypenaeus constrictus	8.41	17.19
	Black Drum	Pogonias cromis	6.30	.
	Blue Crab	Callinectes spp.	4.66	15.31
	Bluefish	Pomatomus saltatrix	.09	.
	Brown Shrimp	Penaeus aztecus	.38	.
	Centrarchid	Centrarchidae	.	1.13
	Croaker	Micropogonias undulatus	25.47	.
	Gulf Flounder	Paralichthys albigutta	.23	.
	Menhaden	Brevoortia spp.	16.67	.
	Northern Kingfish	Menticirrhus saxatilis	.10	.
	Sciaenid	Sciaenidae	135.20	244.00
	Shrimp	Penaeus spp.	32.48	445.87
	Silver Perch	Bairdiella chrysura	23.26	4.97
	Snapper	Lutjanidae spp.	.	.20
	Southern Flounder	Paralichthys lethostigma	.	.15
	Southern Kingfish	Menticirrhus americanus	1.25	.
	Spot	Leiostomus xanthurus	7.38	.
	Spotted Seatrout	Cynoscion nebulosus	53.35	428.56
	Striped Mullet	Mugil cephalus	.09	.
	Weakfish	Cynoscion regalis	463.44	462.33
Forage	Anchovy	Anchoa spp.	3,461.30	5,336.84
	Atlantic Silversides	Menidia menidia	.09	.
	Bay Anchovy	Anchoa mitchelli	38.81	38.34
	Blueback Herring	Alosa aestivalis	2.46	.
	Clupied	Clupeidae	.09	.18
	Rough Silverside	Membras martinica	.	.17
	Silverside	Antherinidae	19.33	1.14
	Star Drum	Stellifer lanceolatus	.31	.66
	Striped Anchovy	Anchoa hepsetus	13.82	10.07
Other	Atlantic Bumper	Chloroscombrus chrysurus	.	.88
	Atlantic Needlefish	Strongylura marina	.10	.23
	Banded Drum	Larimus fasciatus	.	.34
	Bay Whiff	Citharichthys spilopterus	.66	.15
	Bighead Searobin	Prionotus tribulus	.08	.
	Blenny	Blenniidae	106.02	188.56
	Butterfish	Peprilus spp.	95.10	12.93
	Chain Pipefish	Syngnathus louisianae	.56	.54
	Code Goby	Gobiosoma robustum	.	.17
	Darter Goby	Gobionellus boleosoma	1.37	1.67
	Fat Sleeper Goby	Dormitator maculatus	.08	.
	Freshwater Goby	Gobionellus shufeldti	.56	.
	Frillfin Goby	Bathygobius sorporator	.	.25

Table B-11
(Continued)
MEAN DENSITIES FOR ICHTHYOPLANKTON AND NEKTON LARVAE
(ORGANISMS PER 1000 CUBIC METERS) IN THE CONTIGUOUS TIDAL CREEKS
NEAR THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON	
			SPRING 1980	SUMMER 1980
Other	Fringed Flounder	Etropus crossotus	.	.33
	Gobionellus	Gobionellus spp.	391.31	5,271.16
	Gobiosoma	Gobiosoma spp.	952.17	2,270.05
	Gulf Pipefish	Syngnathus scovelli	.08	.17
	Harvestfish	Peprilus alepidotus	.	.34
	Hogchoker	Trinectes maculatus	3.95	17.63
	Hypsoblennius	Hypsoblennius spp.	.35	.20
	Irish Pompano	Diapterus olisthostomus	.	.27
	Lady Crab	Ovalipes ocellatus	.	.17
	Ladyfish	Elops saurus	3.68	.
	Lined Sole	Achirus lineatus	.	3.08
	Inshore Lizardfish	Synodus foetens	.59	.17
	Microgobius	Microgobius spp.	5.06	103.66
	Mojarra	Eucinostomus spp.	.10	2.09
	Mosquitofish	Gambusia affinis	.	.22
	Mummichog	Fundulus heteroclitus	1.49	4.29
	Naked Goby	Gobiosoma bosci	13.02	59.63
	Northern Pipefish	Syngnathus fuscus	.56	.
	Ocellated Flounder	Ancyclopsetta quadrocellata	.10	.
	Oyster Toadfish	Opsanus tau	.08	.22
	Pigfish	Orthopristus chrysoptera	1.77	.
	Pinfish	Lagodon rhomboides	.98	.
	Searobin	Prionotus spp.	.46	.17
	Seaboard Goby	Gobiosoma ginsburgi	.10	.74
	Sharptail Goby	Gobionellus hastatus	.19	.
	Skilletfish	Gobiesox strumosus	3.10	.
	Southern Stargazer	Astroscopus y-graecum	.	1.14
	Speckled Worm Eel	Myrophus punctatus	.17	.
	Blackcheek Tonguefish	Symphurus plagiusa	.16	9.07
	Unidentified Goby	Gobiidae	4.80	76.18
	Unidentifiable Fish		.41	.
TOTAL			5,904.28	15,033.77

Mean densities averaged from stations BCK and SCK
Figure 2.8-4

Table B-12

MEAN DENSITIES FOR ICHTHYOPLANKTON AND NEKTON LARVAE
(ORGANISMS PER 1000 CUBIC METERS) ENTRAINED
AT THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON		
			WINTER 1980	SPRING 1980	SUMMER 1980
Commercial	Banded Shrimp	Trachypenaeus constrictus	.	22.90	72.49
	Black Drum	Pogonias cromis	.	4.07	.
	Blue Crab	Callinectes spp.	.	1.16	14.45
	Croaker	Micropogonias undulatus	15.03	304.89	.
	Menhaden	Brevoortia spp.	20.34	10.18	.
	Northern Kingfish	Menticirrhus saxatilis	.	.36	.
	Sciaenid	Sciaenidae	.	14.69	49.56
	Sheedshead	Archosargus probatocephalus	.	.20	.
	Shrimp	Penaeus spp.	1.26	15.23	1,105.32
	Silver Perch	Bairdiella chrysura	.	14.47	6.04
	Southern Kingfish	Menticirrhus americanus	.	.65	8.02
	Spot	Leiostomus xanthurus	19.44	13.16	.
	Spotted Seatrout	Cynoscion nebulosus	.	1.66	123.19
	Striped Mullet	Mugil cephalus	.	.27	.
	Weakfish	Cynsocion regalis	.	63.39	69.45
Forage	Anchovy	Anchoa spp.	.	113.98	1,210.69
	Bay Anchovy	Anchoa mitchelli	8.64	18.86	111.64
	Silverside	Antherinidae	3.69	14.28	.
	Star Drum	Stellifer lanceolatus	.	4.55	56.91
	Striped Anchovy	Anchoa hepsetus	.	10.93	52.17
Other	Atlantic Bumper	Chloroscombrus chrysurus	.	.	2.60
	Atlantic Thread Herring	Opisthonema oglinum	.	.	.76
	Bay Whiff	Citharichthys spilopterus	.	.80	.
	Blenny	Blenniidae	.	141.82	270.40
	Butterfish	Peprilus spp.	.	1.23	.
	Chain Pipefish	Syngnathus louisianae	.	.31	.55
	Code Goby	Gobiosoma robustum	.	.	3.48
	Darter Goby	Gobionellus bolesoma	1.26	2.89	13.94
	Fat Sleeper	Dormitator maculatus	.	1.70	.
	Freshwater Goby	Gobionellus shufeldti	.	.63	6.26
	Frillfin Goby	Bathygobius sorporator	.	.	4.17
	Gobionellus	Gobionellus spp.	.	2.86	297.63
	Gobiosoma	Gobiosoma spp.	.	205.79	1,015.41
	Gulf Pipefish	Syngnathus scovelli	.	.27	.
	Hickory Shad	Alosa medocris	.	.	.59
	Hogchoker	Trinectes maculatus	1.26	1.63	.
	Hypsoblennius	Hypsoblennius spp.	.	.36	.
	Ladyfish	Elops saurus	.	2.16	.
	Inshore Lizardfish	Synodus foetens	.	.31	.
	Microgobius	Microgobius spp.	.	3.70	74.45

Table B-12
(Continued)
MEAN DENSITIES FOR ICHTHYOPLANKTON AND NEKTON LARVAE
(ORGANISMS PER 1000 CUBIC METERS) ENTRAINED
AT THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = 363 MICRON MESH PLANKTON NET TOW

TYPE	COMMON NAME	SCIENTIFIC NAME	SEASON		
			WINTER 1980	SPRING 1980	SUMMER 1980
Other	Mojarra	Eucinostomus spp.	.	.25	2.27
	Mosquitofish	Gambusia affinis	.	.	1.22
	Naked Goby	Gobiosoma bosci	.	8.52	166.37
	Northern Pipefish	Syngnathus fuscus	.	.98	.
	Oyster Toadfish	Opsanus tau	.	1.20	.
	Pigfish	Orthopristus chrysoptera	.	.76	.
	Pinfish	Lagodon rhomboides	1.17	.52	.
	Planehead Filefish	Monocanthus hispidus	.	.	1.02
	Searobin	Prionotus spp.	.	.31	.
	Seaboard Goby	Gobiosoma ginsburgi	.	.96	3.98
	Sharptail Goby	Gobionellus hastatus	.	.25	.78
	Skilletfish	Gobiesox strumosus	4.95	13.34	.
	Speckled Worm Eel	Myrophus punctatus		.	.
	Blackcheek Tonguefish	Symphurus plagiusa	.	.	20.55
	Unidentified Goby	Gobiidae	.	2.14	9.43
	Unidentifiable Fish		.	.	4.10
TOTAL			77.04	1,025.51	4,779.91

Location of the cooling water discharge canal for the Northside Generating Station shown in Figure 2.8-4

Table B-13

NUMBERS OF ORGANISMS COLLECTED BY ELECTROFISHING
AT THE FRESHWATER CREEKS
ON THE PROPOSED ST. JOHNS POWER PARK SITE

SPRING 1980.

Type	Common Name	Scientific Name	Creek A				Creek B	
			North of Island Drive	South of Island Drive	Upstream of Weir	Downstream of Weir	Bayhead Brook U. Stream of Road	Bayhead Brook D. Stream of Road
Commercial	Americal Eel	Anguilla rostrata	.	.	.	1	.	.
	Black Crappie	Pomoxis nigromaculatus	.	1	5	.	.	.
	Blue Crab	Callinectes sapidus	.	.	1	3	.	.
	Bluegill Sunfish	Lepomis macrochirus	.	.	8	1	.	.
Other	Black Bullhead	Ictalurus melas	.	2	2	7	1	1
	Least Killifish	Heterandria formosa	.	.	.	.	10	18
	Mosquitofish	Gambusia affinis	26	141	.	.	41	141
	Redfin Pickerel	Esox americanus	1	.	26	11	4	24
	Yellow Bullhead	Ictalurus natalis	.	6	10	20	.	.
	Braun's Frog	Rana clamitans	.	.	.	.	.	1
	Leopard Frog	Rana pipiens	.	.	.	.	.	1
	Crayfish	Procambarus pictus	.	2	.	.	1	9
	Greater Siren	Siren lacertina	.	.	.	.	1	.
TOTAL			27	152	52	44	58	195

Location of Creeks A and B
shown in Appendix Figure B-15

Table B-13
(Continued)

NUMBERS OF ORGANISMS COLLECTED BY ELECTROFISHING
AT THE FRESHWATER CREEKS
ON THE PROPOSED ST. JOHNS POWER PARK SITE

SUMMER 1980.

Type	Common Name	Scientific Name	Creek A				Creek B	
			North of Island Drive	South of Island Drive	Upstream of Weir	Downstream of Weir	Bayhead Brook U. Stream of Road	Bayhead Brook D. Stream of Road
Commercial	American Eel	Anguilla rostrata	.	.	1	.	.	.
	Black Crappie	Pomoxis nigromaculatus	.	1	2	.	.	.
	Bluegill Sunfish	Lepomis macrochirus	.	.	6	2	.	.
	Spot	Leiostomus xanthurus	.	.	1	1	.	.
Other	Black Bullhead	Ictalurus mezas	4	3	4	2	.	.
	Crayfish	Procambarus pictus	1	.	.	1	.	.
	Least Killifish	Heterandria formosa	.	.	.	.	6	.
	Mosquitofish	Gambusia affinis	72	70	1	2	23	.
	Okefenokee Pigmy Sunfish	Elassoma okefenokee	1	.	.	.	1	.
	Redfin Pickerel	Esox americanus	3	.	9	15	.	.
	Yellow Bullhead	Ictalurus natalis	6	8	4	.	.	.
TOTAL			87	82	28	23	30	.

Location of Creeks A and B shown in Appendix Figure B-15

Table B-14

NEKTON FISHERIES IN THE CONTIGUOUS CREEKS NEAR
THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = EXPERIMENTAL GILL NETS--FISHED FROM SUNSET TO SUNRISE

FALL 1979.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	STATION SCK
Commercial Species	Red Drum	Sciaenops ocellata	2	Not Sampled
	Southern Flounder	Paralichthys lethostigma	1	
	Weakfish	Cynoscion regalis	1	
	Silver Perch	Bairdiella chrysura	1	
Other Species	Atlantic Stingray	Dasyatis sabina	1	
Total			6	

Location of station BCK
shown in Figure 2.8-4

Table B-14

(Continued)
NEKTON FISHERIES IN THE CONTIGUOUS CREEKS NEAR
THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = EXPERIMENTAL GILL NETS--FISHED FROM SUNSET TO SUNRISE

WINTER 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	STATION SCK
Commercial Species	Atlantic Croaker	Micropogonias undulatus	.	1
	Atlantic Menhaden	Brevoortia tyrannus	2	3
	Sheepshead	Archosargus probatocephalus	.	1
	Silver Perch	Bairdiella chrysura	3	2
	Southern Flounder	Paralichthys lethostigma	.	1
	Spot	Leiostomus xanthurus	1	17
	Spotted Seatrout	Cynoscion nebulosus	1	.
	Striped Mullet	Mugil cephalis	1	22
Forage Species	Threadfin Shad	Dorosoma pentense	1	.
Other Species	Ladyfish	Elops saurus	.	2
	Sea Catfish	Arius felis	.	24
	Violet Goby	Gobionellus broussonneti	.	1
TOTAL			9	74

Location of stations BCK and SCK
shown in Figure 2.8-4

Table B-14
(Continued)
NEKTON FISHERIES IN THE CONTIGUOUS CREEKS NEAR
THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = EXPERIMENTAL GILL NETS--FISHED FROM SUNSET TO SUNRISE

SPRING 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	STATION SCK
Commercial Species	Atlantic Menhaden	Brevoortia tyrannus	.	6
	Blue Crab	Callinectes sapidus	1	1
	Silver Perch	Bairdiella chrysura	.	2
	Southern Flounder	Paralichthys lethostigma	1	.
	Spot	Leiostomus xanthurus	1	1
	Spotted Seatrout	Cynoscion nebulosus	1	2
	Striped Mullet	Mugil cephalis	.	1
	White Shrimp	Penaeus setiferus	.	1
	Yellowfin Menhaden	Brevoortia smithii	1	.
Forage Species	Gizzard Shad	Dorosoma cepedianum	1	2
Other Species	Sea Catfish	Arius felis	2	8
TOTAL			8	26

Location of stations BCK and SCK
shown in Figure 2.8-4

Table B-14
(Continued)

NEKTON FISHERIES IN THE CONTIGUOUS CREEKS NEAR
THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = EXPERIMENTAL GILL NETS--FISHED FROM SUNSET TO SUNRISE

SUMMER 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	STATION SCK
Commercial	Blue Crab	Callinectes sapidus	5	4
	White Shrimp	Penaeus setiferus	1	1
	Bluefish	Pomatomus saltatrix	.	2
	Silver Seatrout	Cynoscion nothus	.	1
	Weakfish	Cynoscion regalis	1	.
	Atlantic Croaker	Micropogonias undulatus	1	5
	Spot	Leiostomus xanthurus	2	6
	Silver Perch	Bairdiella chrysura	5	15
	Striped Mullet	Mugil cephalus	1	5
	Southern Flounder	Paralichthys lethostigma	1	1
Forage	Atlantic Menhaden	Brevoortia tyrannus	48	78
	Gizzard Shad	Dorosoma cepedianum	2	18
	Threadfin Shad	Dorosoma petenense	1	8
Other	Ladyfish	Elops saurus	2	8
	Sea Catfish	Arius felis	10	17
	Gafftopsail Catfish	Bagre marinus	.	9
	Crevalle Jack	Caranx hippos	.	2
	Atlantic Bumper	Chloroscombrus chrysurus	1	.
	Spotfin Mojarra	Eucinostomus argenteus	.	.
TOTALS			81	180

Location of stations BCK and SCK
shown in Chapter 2, Figure 2.8-4

Table B-15

NEKTON FISHERIES IN THE CONTIGUOUS CREEKS NEAR
THE NORTHSIDE GENERATING STATION

FALL 1979.

SAMPLING METHOD = BEACH SEINES 1/4 INCH MESH NET

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	STATION SCK
Commercial Species	Pink Shrimp	Penaeus duorarum	1	.
	Red Drum	Sciaenops ocellata	5	.
	White Shrimp	Penaeus setiferus	9	.
Forage Species	Atlantic Silverside	Menidia menidia	2	12
	Tidewater Silverside	Menidia beryllina	34	6
Other Species	Crevalle Jack	Caranx hippos	.	1
	Marsh Killifish	Fundulus confluentus	6	1
	Sheepshead Killifish	Cyprinodon variegatus	.	1
	Shore Shrimp	Palaemonetes pugio	86	.
	Silver Jenny	Eucinostomus gula	1	.
	Spotfin Mojarra	Eucinosomus argenteus	24	27
	Striped Killifish	Fundulus majalis	.	1
	Total		168	39

Location of stations BCK and SCK shown in Figure 2.8-4

Table B-15
(Continued)
NEKTON FISHERIES IN THE CONTIGUOUS CREEKS NEAR
THE NORTHSIDE GENERATING STATION

WINTER 1980. SAMPLING METHOD = BEACH SEINES 1/4 INCH MESH NET

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	STATION SCK
Commercial Species	Atlantic Croaker	Micropogonias undulatus	1	15
	Blue Crab	Callinectes sapidus	5	4
	Gulf Flounder	Paralichthys albigutta	1	.
	Pink Shrimp	Penaeus duorarum	.	1
	Southern Flounder	Paralichthys lethostigma	.	1
	Striped Mullet	Mugil cephalis	1	10
Forage Species	White Mullet	Mugil curema	.	4
	Tidewater Silverside	Menidia beryllina	21	17
Other Species	Blackcheek Tonguefish	Symphurus plagiusa	1	1
	Marsh Killifish	Fundulus confluentus	131	1
	Naked Goby	Gobiosoma bosci	1	1
	Sheepshead Killifish	Cyprinodon variegatus	.	1
	Shore Shrimp	Palaemonetes pugio	2	78
	Spotfin Mojarra	Eucinostomus argenteus	.	2
	Striped Killifish	Fundulus majalis	2	12
		Unidentified Fish	.	1
	TOTAL		166	150

Location of Stations BCK and SCK shown in Figure 2.8-4

Table B-15
(Continued)
NEKTON FISHERIES IN THE CONTIGUOUS CREEKS NEAR
THE NORTHSIDE GENERATING STATION

SPRING 1980.

SAMPLING METHOD = BEACH SEINES 1/4 INCH MESH NET

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BCK	STATION SCK
Commercial Species	Atlantic Croaker	Micropogonias undulatus	3	10
	Atlantic Menhaden	Brevoortia tyrannus	.	23
	Blue Crab	Callinectes sapidus	7	5
	Brown Shrimp	Penaeus aztecus	31	9
	Red Drum	Sciaenops ocellata	1	2
	Silver Perch	Bairdiella chrysura	1	.
	Snook	Centropomus undecimalis	.	1
	Southern Flounder	Paralichthys lethostigma	3	1
	Spot	Leiostomus xanthurus	32	33
	Striped Mullet	Mugil cephalis	46	.
Forage Species	Atlantic Silverside	Menidia menidia	3	.
	Bay Anchovy	Anchoa mitchilli	81	2
Other Species	Atlantic Bumper	Chloroscombrus chrysurus	1	.
	Bay Whiff	Citharichtys spilopterus	2	4
	Blackcheek Tonguefish	Symphurus plagiusa	4	.
	Inshore Lizardfish	Synodus foetens	1	.
	Irish Pompano	Diapterus olisthostomus	.	1
	Lined Sole	Achirus lineatus	.	1
	Longnose Killifish	Fundulus similis	3	.
	Marsh Killifish	Fundulus confluentus	10	.
	Mosquitofish	Gambusia affinis	.	1
	Mummichog	Fundulus heteroclitus	1	.
	Naked Goby	Gobiosoma bosci	.	1
	Pinfish	Lagodon rhomboides	.	1
	Shore Shrimp	Palaemonetes intermedius	.	4
	Shore Shrimp	Palaemonetes pugio	70	9
	Southern Puffer	Sphoeroides nephelus	1	.
	Striped Killifish	Fundulus majalis	1	.
	Total		302	126

Location of Stations BCK through SCK shown in Chapter 2, Figure 2.8-4

Table B-15
(Continued)
NEKTON FISHERIES IN THE CONTIGUOUS CREEKS NEAR
THE NORTHSIDE GENERATING STATION

SUMMER 1980.

SAMPLING METHOD = BEACH SEINES 1/4 INCH MESH NET

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION SCK	STATION BCK
Commercial Species	Blue Crab	Callinectes sapidus	7	12
	White Shrimp	Penaeus setiferus	172	.
	Spotted Seatrout	Cynoscion nebulosus	4	.
	Spot	Leiostomus xanthurus	40	64
	Striped Mullet	Mugil cephalus	6	3
Forage Species	Bay Anchovy	Anchoa mitchilli	2	.
	Atlantic Menhaden	Brevoortia tyrannus	4	.
	Gizzard Shad	Dorosoma cepedianum	10	.
	Tidewater Silverside	Menidia beryllina	23	.
	Atlantic Silverside	Menidia menidia	144	67
	White Mullet	Mugil curema	.	1
Other Species	Stingray	Dasyatis sabina	.	1
	Inshore Lizardfish	Synodus foetens	1	.
	Sheepshead Minnow	Cyprinodon variegatus	2	.
	Mummichog	Fundulus heteroclitus	100	119
	Striped Killifish	Fundulus majalis	1	5
	Marsh Killifish	Fundulus confluentus	19	64
	Longnose Killifish	Fundulus similis	11	. .
	Mosquitofish	Gambusia affinis	2	.
	Irish Pompano	Diapterus olisthostomus	3	.
	Spotfin Mojarra	Eucinostomus argenteus	165	125
	Pigfish	Orthopristus chrysoptera	3	.
	Pinfish	Lagodon rhomboides	2	1
	Bighead Searobin	Prionotus tribulus	1	.
	Bay Whiff	Citharichthys spilopterus	2	19
	Fringed Flounder	Etropis crossotus	.	1
	Blackcheek Tonguefish	Symphurus plaqiusa	.	2
	Shore Shrimp	Palaemonetes pugio	49	3
	Banded Shrimp	Trachypenaeus constrictus	79	8
	Total		852	495

Location of Stations BCK and SCK shown in Figure 2.8-4

Table B-16

NEKTON FISHERIES IN THE ST. JOHNS RIVER NEAR
THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = EXPERIMENTAL GILL NETS--FISHED FROM SUNSET TO SUNRISE

FALL 1979.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION EP1	EP2	EP3
Commercial Species	Blue Crab	Callinectes sapidus	5	3	1
	Sheepshead	Archosargus probatocephalus	.	1	.
	Southern Kingfish	Menticirrhus americanus	.	1	.
	White Shrimp	Penaeus setiferus	.	1	1
Forage Species	Threadfin Shad	Dorosoma petenense	1	.	.
Other Species	Crevalle Jack	Caranx hippos	.	.	1
	Sea Catfish	Arius felis	.	4	.
TOTAL			6	10	3

Locations of stations EP1 through EP3
shown in Figure 2.8-4

Table B-16
(Continued)
NEKTON FISHERIES IN THE ST. JOHNS RIVER NEAR
THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = EXPERIMENTAL GILL NETS--FISHED FROM SUNSET TO SUNRISE

WINTER 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION EP1	EP2	EP3
Commercial Species	Atlantic Croaker	Micropogonias undulatus	.	.	1
	Atlantic Menhaden	Brevoortia tyrannus	1	1	9
	Blue Crab	Callinectes sapidus	5	12	6
	Sheepshead	Archosargus probatocephalus	1	.	.
	Silver Perch	Bairdiella chrysura	3	.	1
	Southern Flounder	Paralichthys lethostigma	.	.	1
	Spot	Leiostomus xanthurus	1	1	3
Forage Species	Atlantic Silverside	Menidia menidia	1	.	.
	Gizzard Shad	Dorosoma cepedianum	1	.	2
Other Species	Blackcheek Tonguefish	Symphurus plagiusa	.	.	1
	Oyster Toadfish	Opsanus tau	.	1	.
	Sea Catfish	Arius felis	.	1	1
TOTAL			13	16	25

Locations of stations EP1 through EP3
shown in Figure 2.8-4

Table B-16
(Continued)
NEKTON FISHERIES IN THE ST. JOHNS RIVER NEAR
THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = EXPERIMENTAL GILL NETS--FISHED FROM SUNSET TO SUNRISE

SPRING 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION EP1	EP2	EP3
Commercial Species	Atlantic Croaker	Micropogonias undulatus	.	2	6
	Atlantic Menhaden	Brevoortia tyrannus	.	.	1
	Blue Crab	Callinectes sapidus	4	14	3
	Bluefish	Pomatomus saltatrix	.	.	3
	Brown Shrimp	Penaeus aztecus	.	.	2
	Silver Perch	Bairdiella chrysura	1	.	.
	Southern Flounder	Paralichthys lethostigma	1	.	1
	Southern Kingfish	Menticirrhus americanus	.	.	2
	Spot	Leiostomus xanthurus	3	9	13
	Spotted Seatrout	Cynoscion nebulosus	.	1	1
Forage Species	Gizzard Shad	Dorosoma cepedianum	.	1	.
	Star Drum	Stellifer lanceolatus	1	.	.
Other Species	Atlantic Stingray	Dasyatis sabina	.	.	2
	Black-fingered Mud Crab	Panopeus occidentalis	1	.	.
	Sea Catfish	Arius felis	2	7	3
TOTAL			13	34	38

Locations of stations EP1 through EP3
shown in Figure 2.8-4

Table B-16
(Continued)
NEKTON FISHERIES IN THE ST. JOHNS RIVER NEAR
THE NORTHSIDE GENERATING STATION

SAMPLING METHOD = EXPERIMENTAL GILL NET--FISHED FROM SUNSET TO SUNRISE

SUMMER 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION EP1	EP2	EP3
Commercial	Blue Crab	Callinectes sapidus	7	6	7
	White Shrimp	Penaeus setiferus		1	2
	Silver Seatrout	Cynoscion nothus		2	3
	Spotted Seatrout	Cynoscion nebulosus	2	2	2
	Atlantic Croaker	Micropogonias undulatus	5	7	4
	Spot	Leiostomus xanthurus	2		12
	Silver Perch	Bairdiella chrysura		3	1
	Southern Flounder	Paralichthys lethostigma			1
Forage	Gizzard Shad	Dorosoma cepedianum		4	1
	Atlantic Bumper	Chloroscombrus chrysurus		2	
	Star Drum	Stellifer lanceolatus			1
Other	Ladyfish	Elops saurus			1
	Sea Catfish	Arius felis	8	12	7
	Gafftopsail Catfish	Bagre marinus		1	2
TOTAL			24	40	44

Locations of stations EP1 through EP3
shown in Figure 2.8-4

Table B-17

NEKTON FISHERIES IN THE ST. JOHNS RIVER NEAR
THE NORTHSIDE GENERATING STATION

FALL 1979.

SAMPLING METHOD = OTTER TRAWL - FISHED FOR 25 MINUTES

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION EP1	EP2	EP3
Commercial Species	Atlantic Croaker	Micropogonias undulatus	.	.	7
	Atlantic Menhaden	Brevoortia tyrannus	1	.	1
	Blue Crab	Callinectes sapidus	17	10	9
	Pink Shrimp	Penaeus duorarum	3	4	7
	Silver Perch	Bairdiella chrysura	2	1	1
	Silver Seatrout	Cynoscion nothus	.	.	1
	Southern Flounder	Paralichthys lethostigma	3	.	3
	Southern Kingfish	Menticirrhus americanus	.	3	1
	Weakfish	Cynoscion regalis	.	2	.
	White Shrimp	Penaeus setiferus	5	8	3
Forage Species	Bay Anchovy	Anchoa mitchilli	4	.	.
	Gizzard Shad	Dorosoma cepedianum	.	.	1
	Star Drum	Stellifer lanceolatus	335	407	307
Other Species	Blackcheek Tonguefish	Symphurus plagiusa	8	24	35
	Hogchoker	Trinectes maculatus	1	.	3
	Sea Catfish	Arius felis	3	11	1
	Striped Cusk-Eel	Rissola marginata	1	.	.
	Total		383	470	380

Locations of stations EP1 through EP3
shown in Figure 2.8-4

Table B-17
(Continued)
NEKTON FISHERIES IN THE ST. JOHNS RIVER NEAR
THE NORTHSIDE GENERATING STATION

WINTER 1980.

SAMPLING MEHTOD = OTTER TRAWL - FISHED FOR 25 MINUTES

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION EP1	EP2	EP3
Commercial Species	Atlantic Croaker	Micropogonias undulatus	.	8	2
	Atlantic Menhaden	Brevoortia tyrannus	1	1	5
	Blue Crab	Callinectes sapidus	37	18	25
	Pink Shrimp	Penaeus duorarum	15	7	1
	Silver Perch	Bairdiella chrysura	1	2	.
	Silver Seatrout	Cynoscion nothus	.	2	.
	Southern Flounder	Paralichthys lethostigma	.	1	.
	Spot	Leiostomus xanthurus	1	.	3
	Weakfish	Cynoscion regalis	1	.	.
	White Shrimp	Penaeus setiferus	5	17	3
Forage Species	Bay Anchovy	Anchoa mitchilli	.	1	1
	Star Drum	Stellifer lanceolatus	8	246	369
Other Species	Blackcheek Tonguefish	Symphurus plagiusa	25	92	323
	Cutlass Fish	Trichiurus lepturus	1	.	.
	Hogchoker	Trinectes maculatus	3	2	4
	Mantis Shrimp	Squilla empusa	.	.	.
	Oyster Toadfish	Opsanus tau	1	.	1
	Sea Catfish	Arius felis	.	.	1
	Shore Shrimp	Palaemonetes pugio	50	.	99
	Skilletfish	Gobiesox strumosus	1	.	.
	Striped Cusk-Eel	Rissola marginata	1	.	1
	Total		151	397	838

Location of stations EP1 through EP3
shown in Figure 2.8-4

Table B-17
(Continued)
NEKTON FISHERIES IN THE ST. JOHNS RIVER NEAR
THE NORTHSIDE GENERATING STATION

SPRING 1980.

SAMPLING METHOD = OTTER TRAWL - FISHED FOR 25 MINUTES

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION EP1	EP2	EP3
Commercial Species	Atlantic Croaker	Micropogonias undulatus	77	120	115
	Blue Crab	Callinectes sapidus	36	47	57
	Brown Shrimp	Penaeus aztecus	6	7	5
	Silver Perch	Bairdiella chrysura	7	1	5
	Silver Seatrout	Cynoscion nothus	3	.	2
	Southern Flounder	Paralichthys lethositigma	1	.	3
	Southern Kingfish	Menticirrhus americanus	1	.	1
	Spot	Leiostomus xanthurus	2	.	.
	Weakfish	Cynoscion regalis	5	.	2
	White Shrimp	Penaeus setiferus	.	4	1
Forage Species	Bay Anchovy	Anchoa mitchilli	1	3	6
	Star Drum	Stellifer lanceolatus	34	27	71
Other Species	Atlantic Spadefish	Chaetodipterus faber	.	1	.
	Atlantic stingray	Dasyatis sabina	1	.	.
	Bay Whiff	Citharichthys spilopterus	3	1	.
	Bighead Searobin	Prionotus tribulus	1	.	1
	Blackcheek Tonguefish	Symphurus plagiusa	1	3	1
	Brief Squid	Lolliguncula brevis	3	.	.
	Hogchoker	Trinectes maculatus	33	211	8
	Lined Sole	Achirus lineatus	1	.	.
	Naked Goby	Gobiosoma bosci	1	.	.
	Oyster Toadfish	Opsanus tau	1	1	.
	Penaeid Shrimp	Trachypenaeus constrictus	141	303	16
	Sea Catfish	Arius felis	6	15	75
	Shore Shrimp	Palaemonetes pugio	3	1	.
	Striped Cusk-Eel	Rissola marginata	3	1	1
		Unidentified Fish	9	1	3
	Total		380	725	373

Location of stations EP1 through EP3
shown in Figure 2.8-4

Table B-17
(Continued)
NEKTON FISHERIES IN THE ST. JOHNS RIVER NEAR
THE NORTHSIDE GENERATING STATION

SUMMER 1980.

SAMPLING METHOD = OTTER TRAWL -FISHED FOR 25 MINUTES

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION EP1	EP2	EP3
Commercial Species	Blue Crab	Callinectes sapidus	135	58	23
	White Shrimp	Penaeus setiferus	1	7	1
	Silver Seatrout	Cynoscion nothus	.	10	2
	Atlantic Croaker	Micropogonias undulatus	.	1,262	8
	Spot	Leiostomus xanthurus	.	1	.
	Silver Perch	Bairdiella chrysura	.	.	1
	Southern Kingfish	Menticirrhus americanus	4	13	2
Forage Species	Bay Anchovy	Anchoa mitchilli	144	1	138
	Star Drum	Stellifer lanceolatus	.	1,271	138
Other Species	Ladyfish	Elops saurus	.	.	1
	Sea Catfish	Arius felis	20	16	4
	Oyster Toadfish	Opsanus tau	3	8	.
	Striped Cusk-Eel	Rissola marginata	.	1	.
	Pigfish	Orthopristus chrysoptera	1	.	.
	Bighead Searobin	Prionotus tribulus	2	.	.
	Bay Whiff	Citharichthys spilopterus	.	7	1
	Hogchoker	Trinectes maculatus	.	178	3
	Blackcheek Tonguefish	Symphurus plagiusa	.	7	1
	Lookdown	Selene vomer	.	1	.
	Atlantic Bumper	Chloroscombrus chrysurus	10	4	12
	Atlantic Spadefish	Chaetodipterus faber	7	11	.
	Inshore Lizardfish	Synodus foetens	1	.	.
	Banded Shrimp	Trachypenaeus constrictus	7	26	27
	Grass Shrimp	Palaemonetes pugio	11	19	1
	Hermit Crab	Pagurus sp	1	1	.
	Mantis Shrimp	Squilla empusa	.	1	.
	Mud Crab	Panopeus herbstii	.	5	.
	Spider Crab	Liginia dubia	.	3	1
	Brief Squid	Lolliguncula brevis	.	1	.
	Total		347	2,912	499

Location of stations EP1 through EP3
shown in Chapter 2, Figure 2.8-4

Table B-18

NEKTON FISHERIES ON BLOUNT ISLAND
NEAR THE PROPOSED COAL OFFLOADING FACILITY

SAMPLING METHOD = EXPERIMENTAL GILL NETS--FISHED DURING THE DAY

SPRING 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BIP	
			SPRING 1980	SUMMER 1980
Commercial	Blue Crab	Callinectes sapidus	27	11
	Striped Mullet	Mugil cephalus	36	9
Other	White Mullet	Mugil curema	.	8
TOTAL			63	28

Location of station BIP
shown in Figure 2.8-4

Table B-19

NEKTON FISHERIES ON BLOUNT ISLAND
NEAR THE PROPOSED COAL OFFLOADING FACILITY

SPRING 1980.

SAMPLING METHOD = BEACH SEINE 1/4 INCH MESH

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION OPI	STATION BIP
Commercial Species	Atlantic Croaker	Micropogonias undulatus	3	1
	Blue Crab	Callinectes sapidus	3	6
	Brown Shrimp	Penaeus aztecus	.	5
	Spot	Leiostomus xanthurus	107	7
	Striped Mullet	Mugil cephalis	21	7
Forage Species	Bay Anchovy	Anchoa mitchilli	2	.
	Tidewater Silverside	Menidia beryllina	.	2
Other Species	Bay Whiff	Citharichtys spilopterus	2	1
	Longnose Killifish	Fundulus similis	4	.
	Marsh Killifish	Fundulus confluentus	5	3
	Mosquitofish	Gambusia affinis	.	1
	Mummichog	Fundulus heteroclitus	3	.
	Naked Goby	Gobiosoma bosci	2	.
	Pinfish	Lagodon rhomboides	2	.
	Rainwater Killifish	Lucania parva	.	17
	Sailfin Molly	Poecilia latipinna	2	412
	Sheepshead Killifish	Cyprinodon variegatus	16	177
	Shore Shrimp	Palaemonetes pugio	3	.
	Spotfin Mojarra	Eucinostomus argenteus	.	49
	Striped Killifish	Fundulus majalis	4	27
	Total		179	715

Location of Stations OPI and BIP shown in Chapter 2, Figure 2.8-4

Table B-19
(Continued)
NEKTON FISHERIES ON BLOUNT ISLAND
NEAR THE PROPOSED COAL OFFLOADING FACILITY

SAMPLING METHOD = BEACH SEINES 1/4 INCH MESH

SUMMER 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION BIP	STATION BID
Commercial	Blue Crab	Callinectes sapidus	.	9
	Spot	Leiostomus xanthurus	2	.
	Striped Mullet	Mugil cephalus	9	37
Forage	Threadfin Shad	Dorosoma petenense	.	3
Other	Sailfin Molly	Poecilia latipinna	.	5
	Spotfin Mojara	Eucinostomus argentus	.	1
	Mummichog	Fundulus heteroclitus	1	45
	Striped Killifish	Fundulus majalis	.	51
	Sheepshead Killifish	Cyprinodon variegatus	.	85
	Banded Shrimp	Trachypenaeus constrictus	.	1
	Grass Shrimp	Palaemonetes pugio	.	6
TOTAL			12	243

Locations of stations EP1 through EP3
shown in Figure 2.8-4

Table B-20

NEKTON FISHERIES IN THE FULTON DAME POINT CUTOFF
NEAR THE PROPOSED COAL OFFLOADING FACILITY

SPRING 1980.

SAMPLING METHOD = OTTER TRAWL - FISHED FOR 25 MINUTES

TYPE	COMMON NAME	SCIENTIFIC	STATION OP2	OP3	OP4
Commercial Species	Atlantic Croaker	Micropogonias undulatus	.	2	17
	Atlantic Menhaden	Brevoortia tyrannus	1	.	.
	Blue Crab	Callinectes spadius	.	4	.
	Brown Shrimp	Penaeus aztecus	1	.	2
	Sheepshead	Archosargus probatocephalus	4	.	.
	Southern Kingfish	Menticirrhus americanus	.	4	2
	Spot	Leiostomus xanthurus	.	.	1
	Summer Flounder	Paralichthys dentatus	.	1	.
Forage Species	Atlantic Silverside	Menidia menidia	3	.	.
	Bay Anchovy	Anchoa mitchilli	18	.	.
Other Species	Atlantic Spadefish	Chaetodipterus faber	1	1	.
	Banded Shrimp	Trachypenaeus constrictus	.	2	27
	Black-Fingered Mud Crab	Panopeus occidentalis	.	13	.
	Brief Squid	Lolliguncula brevis	.	4	.
	Fringed Flounder	Etropus crossotus	2	.	.
	Inshore Lizardfish	Synodus foetens	4	.	.
	Ladyfish	Elops saurus	.	3	1
	Oyster Toadfish	Opsanus tau	1	.	.
	Rock Sea Bass	Centropristis philadelphica	1	.	.
	Sea Catfish	Arius felis	.	1	.
	Shore Shrimp	Palaemonetes pugio	5	6	.
	Southern Stargazer	Astroscopus Y-Graecum	1	.	.
	Total		42	41	50

Location of stations OP2 through OP4 shown in Chapter 2, Figure 2.8-4

Table B-20
(Continued)
NEKTON FISHERIES IN THE FULTON DAME POINT CUTOFF
NEAR THE PROPOSED COAL OFFLOADING FACILITY

SAMPLING METHOD = OTTER TRAWL--FISHED FOR 25 MINUTES

SUMMER 1980.

TYPE	COMMON NAME	SCIENTIFIC NAME	STATION OP2	STATION OP3	STATION OP4
Commercial	Blue Crab	Callinectes sapidus	21	45	3
	White Shrimp	Penaeus setiferus		3	.
	Sheepshead	Archosaraus probatocephalus	1	.	.
Forage	Bay Anchovy	Anchoa mitchilli	.	.	4
	Star Drum	Stellifer lanceolatus	.	2	.
Other	Atlantic Bumper	Chloroscombrus chrysurus	.	.	4
	Striped Burrfish	Chilomycterus schoepfi	1	.	.
	Banded Shrimp	Trachypennaeus constrictus	1	31	.
	Grass Shrimp	Palaemonetes pugio	.	11	.
TOTAL			25	92	11

Location of stations OP2 through OP4
shown in Figure 2.8-4

Table B-21

MEAN DENSITIES FOR ICHTHYOPLANKTON AND NEKTON LARVAE
(ORGANISMS PER 1000 CUBIC METERS) IN THE BLOUNT ISLAND SPOIL DRAINAGE DITCH

Type	Common Name	Scientific Name	Season	
			Spring 1980	Summer 1980
Commercial Species	Blue Crab	Callinectes spp.	11.2	60.7
	Brown Shrimp	Penaeus aztecus	22.7	
	Menhaden	Brevoortia spp.	14.8	
	Shrimp	Penaeus spp.	5.9	957.0
	Silver Perch	Bairdiella chrysura	5.6	
	Southern Kingfish	Menticirrhus americanus	5.6	
	Spot	Leiostomus xanthurus	31.0	50.2
	Spotted Seatrout	Cynoscion nebulosus		72.6
	Weakfish	Cynoscion regalis	163.9	
	White Shrimp	Penaeus setiferus		20.3
Forage Species	Anchovy	Anchoa spp.	1325.1	161.0
	Atlantic Silversides	Menidia menidia	22.7	
	Bay Anchovy	Anchoa mitchelli	14.2	
Other Species	Bay Whiff	Citharichthys spilopterus	8.6	
	Darter Goby	Gobionellus boleosoma	3.0	
	Freshwater Goby	Gobionellus shufeldti	9.4	
	Gobionellus	Gobionellus spp.	158.3	
	Gobiosoma	Gobiosoma spp.	387.0	
	Gulf Pipefish	Syngnathus scovelli	22.4	
	Hypsoblennius	Hypsoblennius spp.	5.6	
	Mojarra	Eucinostomus spp.		99.1
	Mosquitofish	Gambusia affinus		15.0
	Mummichog	Fundulus heteroclitus	5.6	
	Naked Goby	Gobiosoma bosci	195.1	20.3
	Northern Pipefish	Syngnathus fuscus	5.6	
	Rainwater Killifish	Lucania parva	44.9	
	Searobin	Prionotus spp.	3.0	
	Unidentifiable			72.6
	Total		2501.5	1528.8

Table B-22 (Revision 1)

CYANIDE TOXICITY OF A SIGNIFICANT INDIGENOUS FISH SPECIES
TO THE BLOUNT ISLAND CHANNEL AND A SUBSTITUTE FISH SPECIES

Species	Community/Habitat	Cyanide Toxicity	Reference[a]
Pinfish (*Lagodon rhombiodes*)	Nekton/Blount Island Channel and tidal creeks	24 hr LC_{50} - 0.069 mg HCN/1 96 hr LC_{50} - 0.048-0.066 mg HCN/1 max dose no kill = 0.05 mg HCN/1 min dose all killed = 0.10 mg HCN/1	Daugherty and Garrett, 1951 as cited by Becker and Thatcher, 1973
Mosquitofish (*Gambusia affinis*)[b]	Nekton/tidal creeks	24 hrLC_{50} = 1.6 mg KCN/1 48 hrLC_{50} = 1.6 mg KCN/1 96 hrLC_{50} = 1.6 mg KCN/1 All normal at 1 mg KCN/1 loss of equilibrium at 1.8 mg KCN/1 all dead at 3.2 mg KCN/1	Wallen, *et al.* 1957

a References cited in Chapter 5, Section 5.1.
b Substitute species occurs in tidal creeks but not in river channel.

Table B-23

IRON TOXICITY OF SUBSTITUTE FISH SPECIES

Substitute Species[a]	Community/Habitat	Iron Toxicity	Reference
Mummichog (Fundulus heteroclitus)	Nekton/tidal creeks	ferric ammonium citrate found to be non-toxic up to 200 mg/l for 1 week	in Doudoroff and Katz, 1953
Mosquitofish (Gambusia affinis)	Nekton/tidal creeks	96 hrLC_{50} = 74 mg $FeCl_3$/l 96 hrLC_{50} = 133 mg $Fe_2(SO_4)_3$/l 96 hrLC_{50} = 350 mg $FeSO_3$/l 96 hrLC_{50} 10,000 mg FeO/l 96 hrLC_{50} 10,000 mg FeS/l	Wallen et al. 1957

a The mummichog and mosquitofish were not found in Blount Island Channel although they were collected in the tidal creeks during the preoperational monitoring program. Both the mummichog and the mosquitofish may reasonably be expected to produce effects equal to those of significant indigenous fish species of the aquatic communities which may occur in the mixing zones.

b References cited in Chapter 5, Section 5.1.

Table B-24

SILVER TOXICITY OF SIGNIFICANT INDIGENOUS MEROPLANKTON
TO THE BLOUNT ISLAND CHANNEL AND A SUBSTITUTE FISH SPECIES

Significant Indigenous Species[a]	Community/Habitat	Silver Toxicity	Reference[b]
Meroplankton			
American oyster larvae (*Crassostrea virginica*)	Plankton/Blount Island Channel and tidal creeks	12 dLC_{50} = 25 ug Ag/1	Calabrese *et al.* 1977
American oyster embryos (*Crassostrea virginica*)	Plankton/Blount Island Channel and tidal creeks	48 $hrLC_{50}$ = 5.8 ug Ag/1	Calabrese *et al.* 1973
Fish ("Substitute Species")			
Mummichog (*Fundulus heteroclitus*)	Nekton/tidal creeks	48 $hrLC_{50}$ = 0.04 mg Ag/1	Waldichuk, 1974
Mummichog (*Fundulus heteroclitus*)	Nekton/tidal creeks	Enzyme effect at 20 ug/1	Jackim *et al.* 1970

a The mummichog was not found in Blount Island Channel although it was found in the contiguous tidal creeks. Although the mummichog is not considered to be a significant indigenous species occurring in the river channel, it may reasonably be expected to produce effects equal to those of significant indigenous species of fish at similar concentrations of silver.

b References cited in Chapter 5, Section 5.1.

Table B-25 (Revision 1)

COPPER TOXICITY OF SIGNIFICANT FISH, MACROINVERTEBRATES AND MEROPLANKTON TO THE BLOUNT ISLAND CHANNEL SURFACE AND BOTTOM WATERS AND BENTHIC COMMUNITY

Significant Indigenous Species	Community/Habitat	Copper Toxicity	Reference[a]
Fish			
Pinfish (*Lagodon rhomboides*)	Nekton/Blount Island Channel and tidal creeks	14 dLC_{50} = 0.15 mg Cu/1	Engel *et al.* 1976
Spot (*Leiostomus xanthurus*)	Nekton/Blount Island Channel and tidal creeks	14 dLC_{50} = 0.16 mg Cu/1	
Croaker (*Micropogonias undulatus*)	Nekton/Blount Island Channel and tidal creeks	14 dLC_{50} = 0.21 mg Cu/1	
Macroinvertebrates			
Polychaete worm (*Capitella capitata*)	Benthic/Blount Island Channel and tidal creeks	96 $hrLC_{50}$ = 0.2 mg $CuSO_4$/1 28 dLC_{50} = 0.2 mg $CuSO_4$/1	Reish *et al.* 1976
Meroplankton			
Polychaete worm trochophore (*Capitella capitata*)	Plankton/Blount Island Channel and tidal creeks	96 $hrLC_{50}$ = 0.18 mg $CuSO_4$/1	Reish *et al.* 1976
American oyster embryos and larvae (*Crassostrea virginica*)	Plankton/Blount Island Channel and tidal creeks	48 $hrLC_{50}$ = 0.1 mg Cu/1 12 dLC_{50} = 0.03 mg Cu/1	Calabrese *et al.* 1977

a References cited in Chapter 5, Section 5.1.

Table B-26

ALUMINUM TOXICITY OF SIGNIFICANT FISH, MACROINVERTEBRATES AND MEROPLANKTON SPECIES OF THE BLOUNT ISLAND CHANNEL SURFACE AND BOTTOM WATERS AND BENTHIC COMMUNITY

Significant Indigenous Species	Community/Habitat	Aluminum Toxicity	Reference[a]
Fish			
Red drum (*Sciaenops ocellata*)	Nekton/Blount Island Channel and tidal creeks	11 dLC_0 44 mg $AlCl_3$/l 2 $hrLC_{100}$ = 88 mg $AlCl_3$/l	Pulley, 1950
Spotted seatrout (*Cynoscion nebulosus*)	Nekton/Blount Island Channel and tidal creeks	11 dLC_0 44 mg $AlCl_3$/l 7 dLC_{100} = 88 mg $AlCl_3$/l	
Striped mullet (*Mugil cephalus*)	Nekton/Blount Island Channel and tidal creeks	11 dLC_0 44 mg $AlCl_3$/l 24 $hrLC_{100}$ = 88 mg $AlCl_3$/l	
Macroinvertebrates			
White shrimp (*Penaeus setiferus*)	Nekton/Blount Island Channel and tidal creeks	11 dLC_0 44 mg $AlCl_3$/l 60 $hrLC_{50}$ = 88 mg $AlCl_3$/l	
Polychaete worm (*Capitella capitata*)	Benthic in fauna/Blount Island Channel and tidal creeks	7 dLC_0 2.0 mg $AlCl_3$/l	Petrich and Reish, 1979
Meroplankton			
American oyster embryos (*Crassostrea virginica*)	Plankton/Blount Island Channel and tidal creeks	48 $hrLC_{50}$ 7.5 mg/l	Calabrese *et al.* 1973

a References cited in Chapter 5, Section 5.1.

Table B-27 (Revision 1)

MERCURY TOXICITY OF SIGNIFICANT FISH, MACROINVERTEBRATES AND MEROPLANKTON TO THE BLOUNT ISLAND CHANNEL SURFACE AND BOTTOM WATERS AND BENTHIC COMMUNITY

Significant Indigenous Species	Community/Habitat	Mercury Toxicity	Reference[a]
Macroinvertebrates			
Polychaete worm (*Capitella capitata*)	Benthic in fauna/Blount Island Channel and tidal creeks	96 hrLC_{50} 0.1 mg$HgCl_2$/l	Reish et al. 1976
Hermit crab (*Pagurus longicarpus*)	Epibenthic/Blount Island Channel and tidal creeks	96 hrLC_{50} = 0.050 mg $HgCl_2$/l 168 hrLC_{50} = 0.050 mg $HgCl_2$/l	Eisler and Henneckey, 1977
Meroplankton			
American oyster embryos (*Crassostrea virginica*)	Plankton/Blount Island Channel and tidal creeks	48 hrLC_{50} = 5.6 ug Hg/l	Calabrese *et al.* 1973
American oyster larvae (*Crassostrea virginica*)	Plankton/Blount Island Channel and tidal creeks	12 dLC_{50} = 12.0 ug Hg/l	Calabrese *et al.* 1977
Polychaete worm trochophore (*Capitella capitata*)	Plankton/Blount Island Channel and tidal creeks	96 hrLC_{50} = 0.014 mg $HgCl_2$/l	Reish *et al.* 1976
Fiddler crab larvae (*Uca pugilator*)	Plankton/Blount Island Channel and tidal creeks	8 dLC_{50} = 0.180 mg Hg/l	Vernberg *et al.* 1974
Fish (substitute species)			
Mummichog (*Fundulus heteroclitus*)	Nekton/tidal creeks	96 hrLC_{50} = 0.80 mg$HgCl_2$/l 168 hrLC_{50} = 0.80 mg$HgCl_2$/l	Eisler and Henneckey, 1977

a References cited in Chapter 5, Section 5.1.

Table B-28 (Revision 1)

TOTAL RESIDUAL CHLORINE TOXICITY OF SIGNIFICANT INDIGENOUS SPECIES TO THE BLOUNT ISLAND CHANNEL

Species	Community/Habitat	Total Residual Chlorine Toxicity	Reference[a]
Naked Goby (Gobiosoma bosci)	Nekton and Meroplankton/ Blount Island Channel and tidal creeks	2 hr TL_{50} 0.64 mg/1 24 hr TL_{50} 0.08 mg/1 45 hr TL_{50} 0.08 mg/1 96 hr TL_{50} 0.08 mg/1	Roberts et al., 1975
Grass Shrimp (Palaemonetes pugio)	Nekton and Meroplankton/ Blount Island Channel and tidal creeks	24 hr TL_{50} 0.38 mg/1 96 hr TL_{50} 0.22 mg/1	Roberts et al., 1975
American oyster-larvae (Crassostrea virginica)	Meroplankton/Blount Island Channel and tidal creeks	2 hr TL_{50} 0.75 mg/1 24 hr TL_{50} 0.27 mg/1 48 hr TL_{50} 0.11 mg/1	Roberts et al., 1975
Atlantic Silverside - egg 2 hr. old (Menidia menidia)	Meroplankton/Blount Island Channel and tidal creeks	24 hr LC_{50} 0.38 mg/1 48 hr LC_{50} 0.30 mg/1	Morgan and Prince, 1977

a References cited in Chapter 5, Section 5.1.

Table B-29 (Revision 1)

CADMIUM TOXICITY OF SIGNIFICANT INDIGENOUS SPECIES
TO THE BLOUNT ISLAND CHANNEL

Species	Community/Habitat	Cadmium Toxicity	Reference[a]
Blue Crab-Juvenile (*Callinectes sapidus*)	Nekton/Blount Island and tidal creeks	24 hr LC_{50} 13.8 ppm[b] Cd ($CdCl_2$) 48 hr LC_{50} 9.8 ppm[b] Cd ($CdCl_2$) 72 hr LC_{50} 7.4 ppm[b] Cd ($CdCl_2$) 96 hr LC_{50} 4.7 ppm[b] Cd ($CdCl_2$)	Frank and Robertson, 1979
American Oyster Embryo (*Crassostrea virginica*)	Meroplankton/Blount Island Channel and tidal creeks	48 hr LC_{50} 3.80 ppm Cd ($CdCl_2$)	Calabrese, *et al.*, 1973

a References cited in Chapter 5, Section 5.1.
b Tests performed at salinity of 15 ppt.

Table B-30 (Revision 1)

ANTIMONY TOXICITY OF A SIGNIFICANT INDIGENOUS SPECIES
TO BLOUNT ISLAND CHANNEL

Species	Community/Habitat	Antimony Toxicity	Reference[a]
Alga (*Skelatonema costatum*)	Phytoplankton/Blount Island Channel and tidal creeks	96 hr EC_{50}[b] > 4200 ug/l $Sb(SbO_3)$	USEPA, 1978 as cited in USEPA 1980c

a References cited in Chapter 5, Section 5.1.
b EC_{50} for reduction in cell numbers.

Table B-31 (Revision 1)

LEAD TOXICITY OF SIGNIFICANT INDIGENOUS SPECIES TO BLOUNT ISLAND CHANNEL

Species	Community/Habitat	Lead Toxicity	Reference[a]
American oyster-embryo (*Crassostrea virginica*)	Meroplankton/Blount Island Channel and tidal creeks	48 hr LC_{50} 2.45 ppm Pb	Calabrese et al., 1973
Hard shell clam-embryo (*Mercenaria mercenaria*)	Meroplankton/Blount Island Channel and tidal creeks	42-48 hr LC_{50} 0.78 ppm Pb	Calabrese and Nelson, 1974

a References cited in Chapter 5, Section 5.1.

Figure B-1 Ichthyoplankton and Nekton Larvae - Total Ichthyoplankton Mean Densities by Sampling Episode

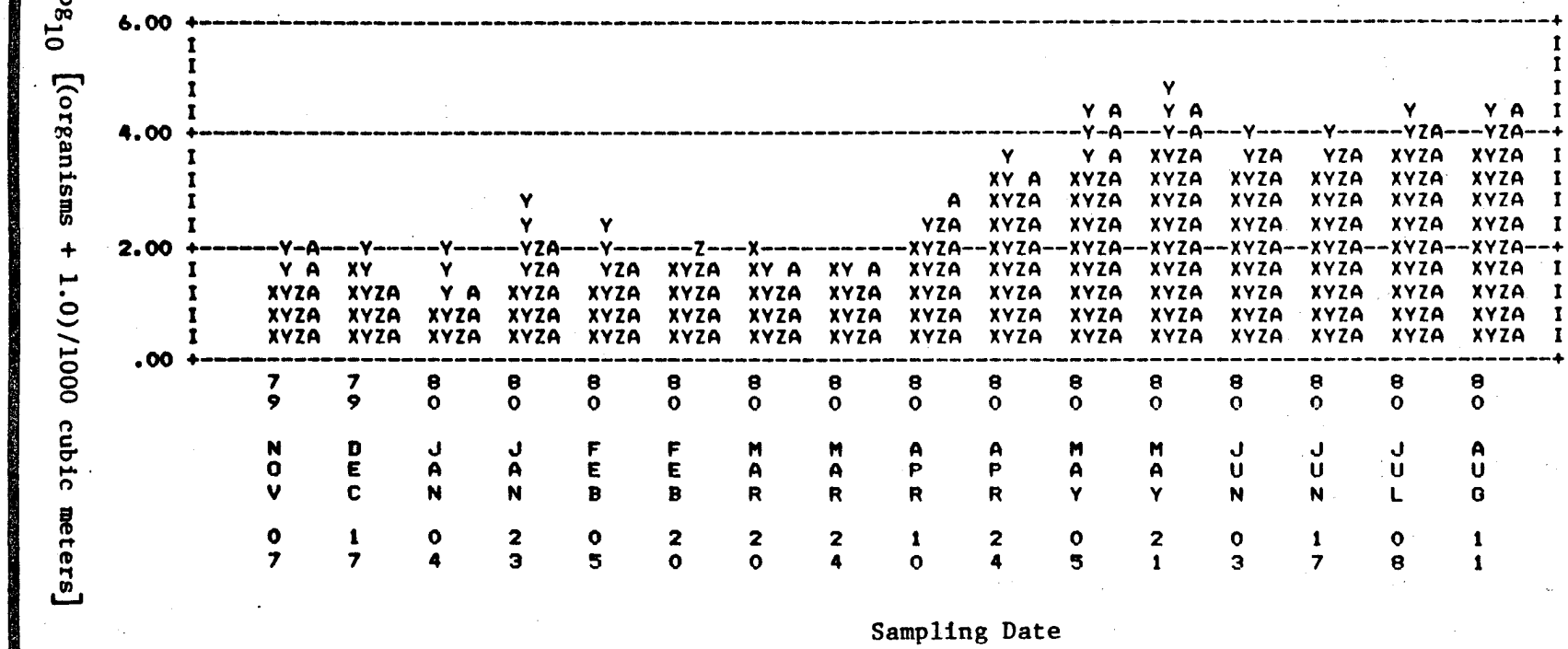

Figure B-1 Ichthyoplankton and Nekton Larvae - Total Ichthyoplankton Mean Densities by Sampling Episode

FIGURE B-1

FISH LARVAE AND NEKTONIC LARVAE IN THE ICHTHYOPLANKTON IN THE ST. JOHNS RIVER NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-1 Ichthyoplankton and Nekton Larvae - Total Ichthyoplankton Mean Densities by Sampling Episode

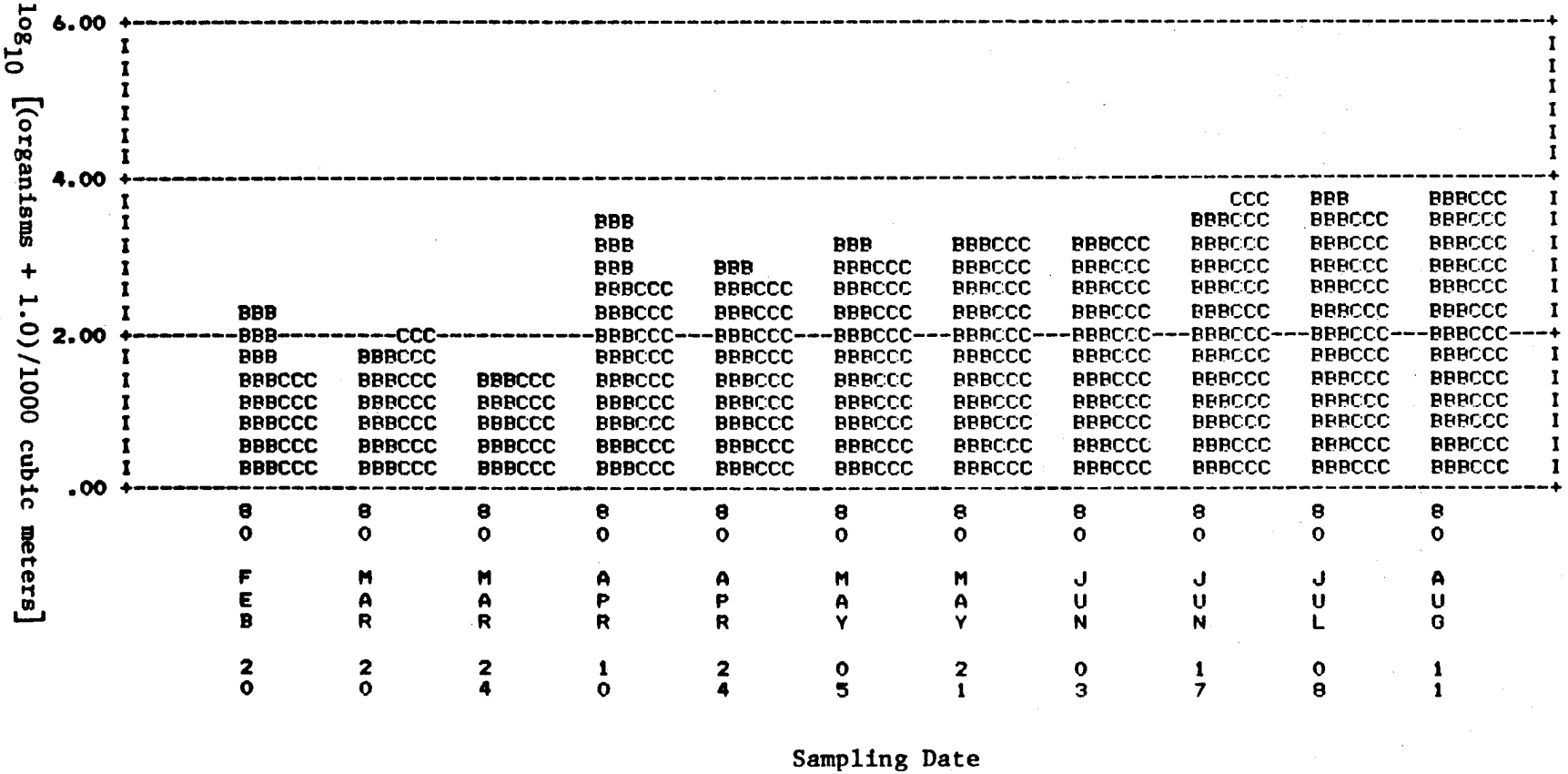

FIGURE B-1

FISH LARVAE AND NEKTONIC LARVAE IN ICHTHYOPLANKTON ENTRAINED BY THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES

C--- REPRESENTS OUTGOING TIDE SAMPLES

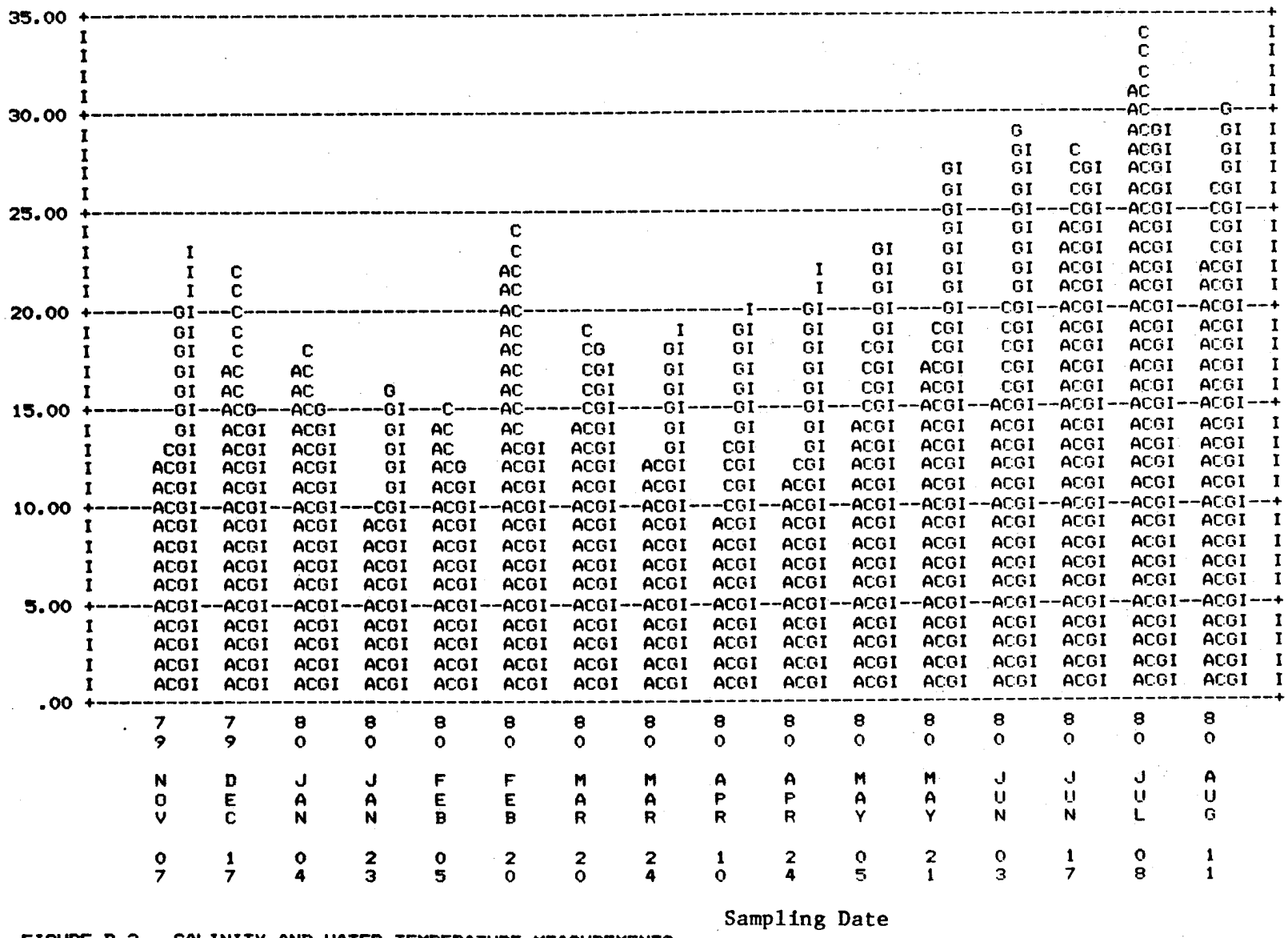

FIGURE B-2. SALINITY AND WATER TEMPERATURE MEASUREMENTS
IN THE ST. JOHNS RIVER
NEAR THE NORTHSIDE GENERATING STATION

A--- REPRESENTS SURFACE SALINITY VALUES ON AN INCOMING TIDE
C--- REPRESENTS SURFACE SALINITY VALUES ON AN OUTGOING TIDE
G--- REPRESENTS SURFACE WATER TEMPERATURE VALUES ON AN INCOMING TIDE
I--- REPRESENTS SURFACE WATER TEMPERATURE VALUES ON AN OUTGOING TIDE

Figure B-2 Ichthyoplankton and Nekton Larvae - Salinity and Temperature Values by Sampling Episode

Figure B-2 Ichthyoplankton and Nekton Larvae - Salinity and Temperature Values by Sampling Episode

FIGURE B-2. SALINITY AND WATER TEMPERATURE MEASUREMENTS IN THE COOLING WATER DISCHARGE CANAL AT THE NORTHSIDE GENERATING STATION

E--- REPRESENTS SALINITY VALUES ON AN INCOMING TIDE

F--- REPRESENTS SALINITY VALUES ON AN OUTGOING TIDE

K--- REPRESENTS WATER TEMPERATURE VALUES ON AN INCOMING TIDE

L--- REPRESENTS WATER TEMPERATURE VALUES ON AN OUTGOING TIDE

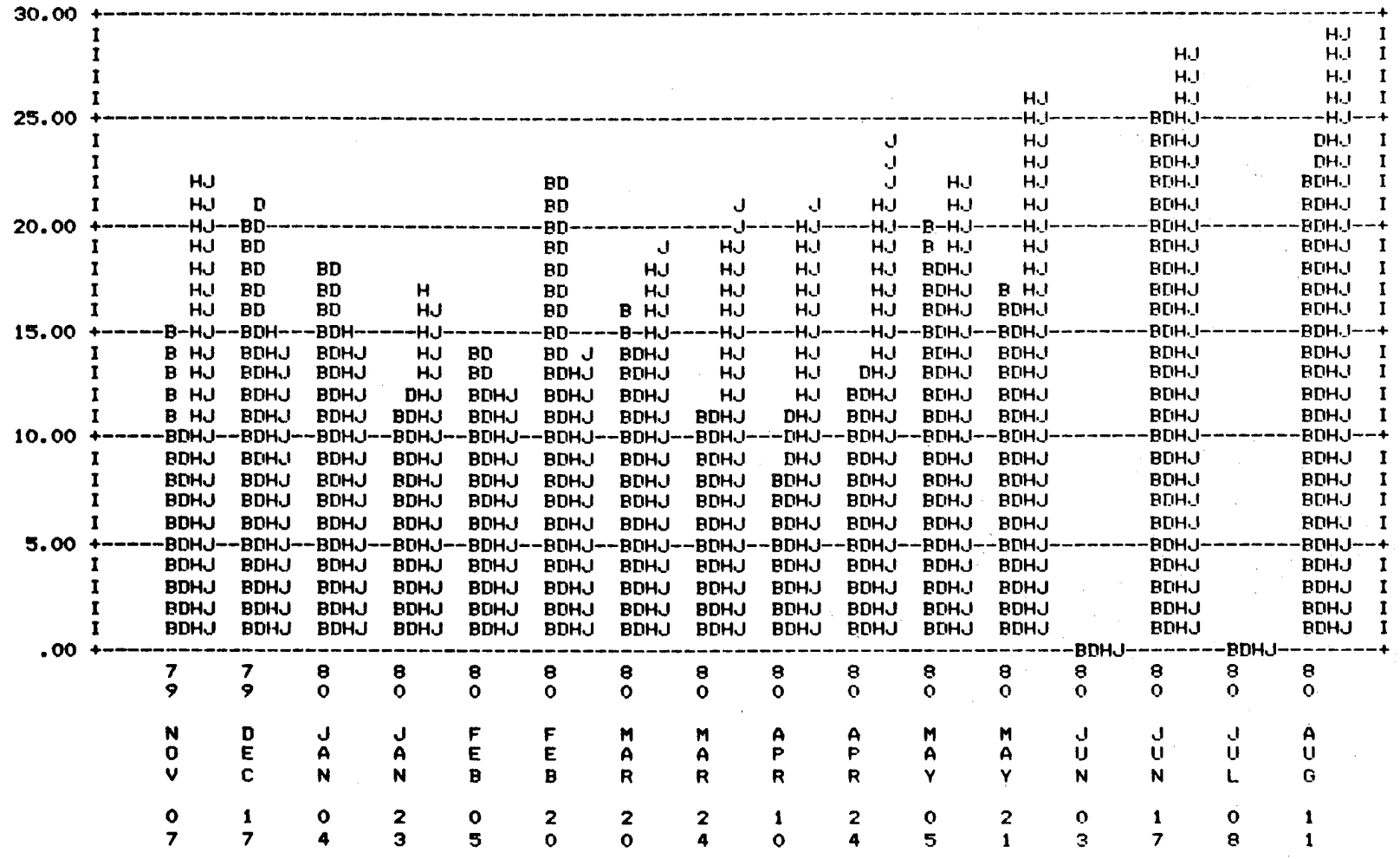

FIGURE B-2. SALINITY AND WATER TEMPERATURE MEASUREMENTS
IN THE CONTIGUOUS TIDAL CREEKS
NEAR THE NORTHSIDE GENERATING STATION

WATER TEMPERATURE VALUES IN DEGREES CENTIGRADE,
SALINITY VALUES IN PARTS PER THOUSAND

B--- REPRESENTS BOTTOM SALINITY VALUES ON AN INCOMING TIDE
D--- REPRESENTS BOTTOM SALINITY VALUES ON AN OUTGOING TIDE
H--- REPRESENTS BOTTOM WATER TEMPERATURE VALUES ON AN INCOMING TIDE
J--- REPRESENTS BOTTOM WATER TEMPERATURE VALUES ON AN OUTGOING TIDE

Figure B-2 Ichthyoplankton and Nekton Larvae - Salinity and Temperature Values by Sampling Episode

Figure B-3 Ichthyoplankton and Nekton Larvae - Occurrence of Weakfish

Figure B-3 Ichthyoplankton and Nekton Larvae - Occurrence of Weakfish

FIGURE B-3

WEAKFISH --CYNOSCION REGALIS-- ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE

Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE

Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE

A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

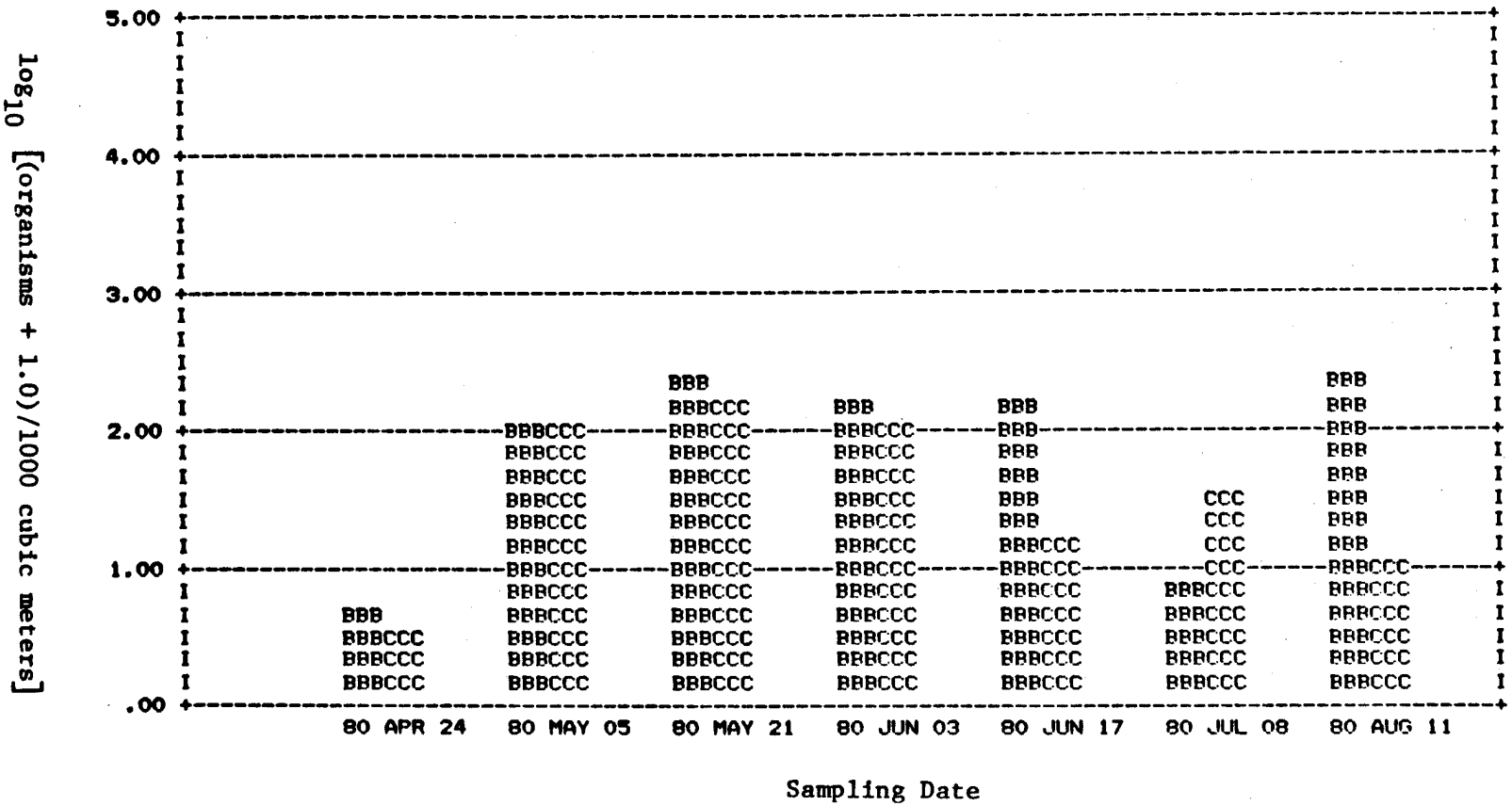

FIGURE B-3

WEAKFISH --CYNOSCION REGALIS-- ICHTHYOPLANKTON ENTRAINED BY THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES

C--- REPRESENTS OUTGOING TIDE SAMPLES

Figure B-3 Ichthyoplankton and Nekton Larvae - Occurrence of Weakfish

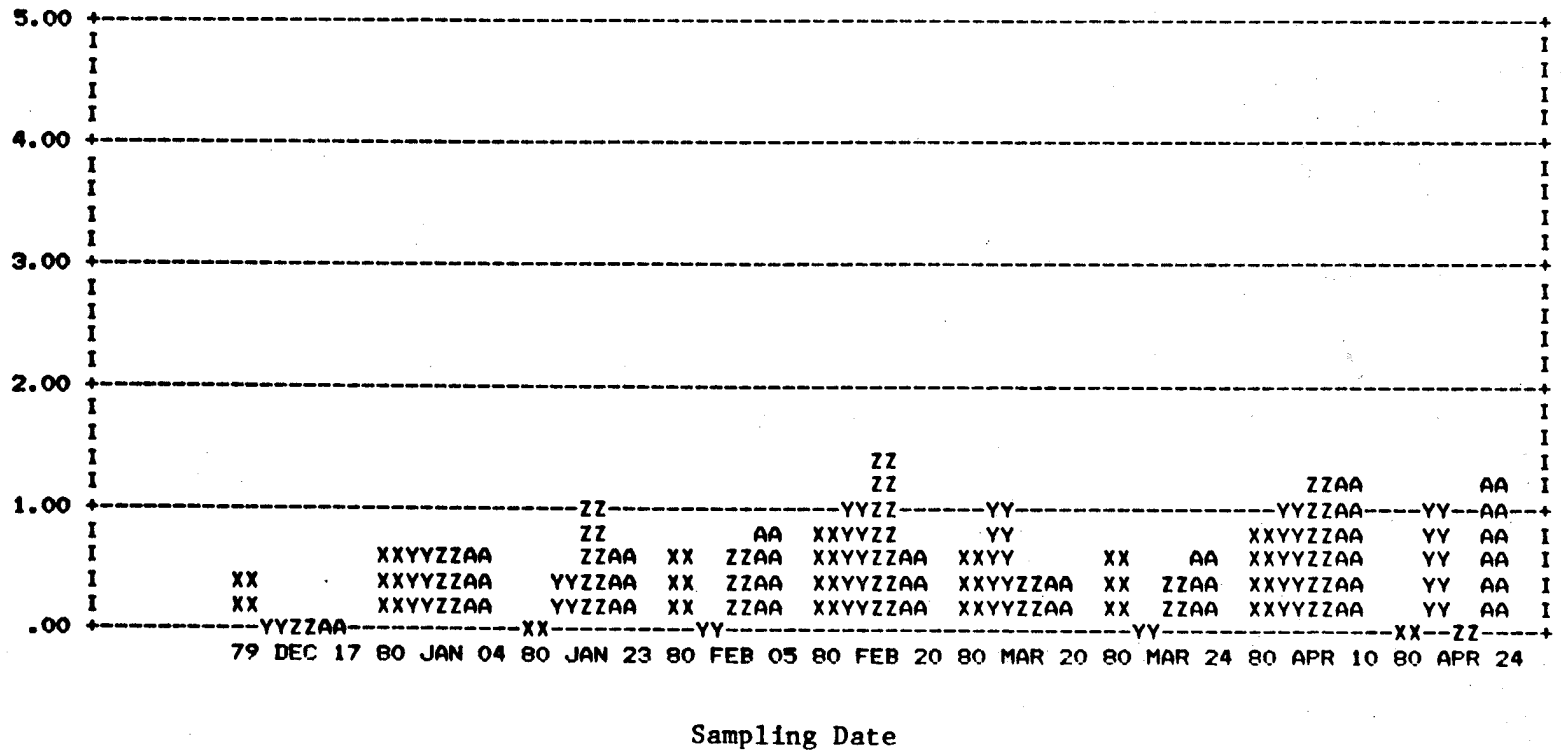

FIGURE B-4

SPOT --LEIOSTOMUS XANTHURUS-- ICHTHYOPLANKTON IN THE
ST. JOHNS RIVER
NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-4 Ichthyoplankton and Nekton Larvae - Occurrence of Spot

FIGURE B-4

SPOT --LEIOSTOMUS XANTHURUS-- ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-4 Ichthyoplankton and Nekton Larvae - Occurrence of Spot

FIGURE B-4

SPOT --LEIOSTOMUS XANTHURUS-- ICHTHYOPLANKTON ENTRAINED BY THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES

C--- REPRESENTS OUTGOING TIDE SAMPLES

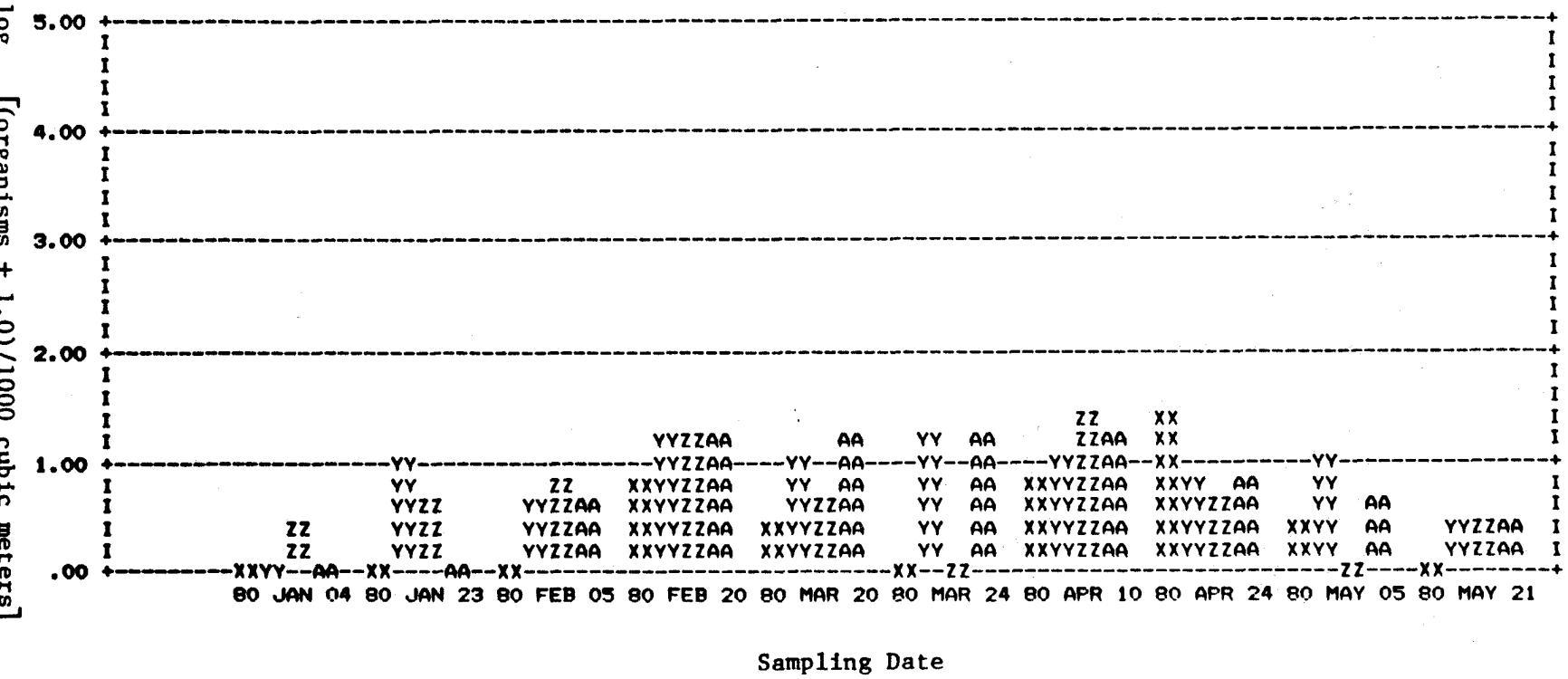

Figure B-5 Ichthyoplankton and Nekton Larvae - Occurrence of Menhaden

FIGURE B-5

MENHADEN --BREVOORTIA SPP.-- ICHTHYOPLANKTON IN THE ST. JOHNS RIVER NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

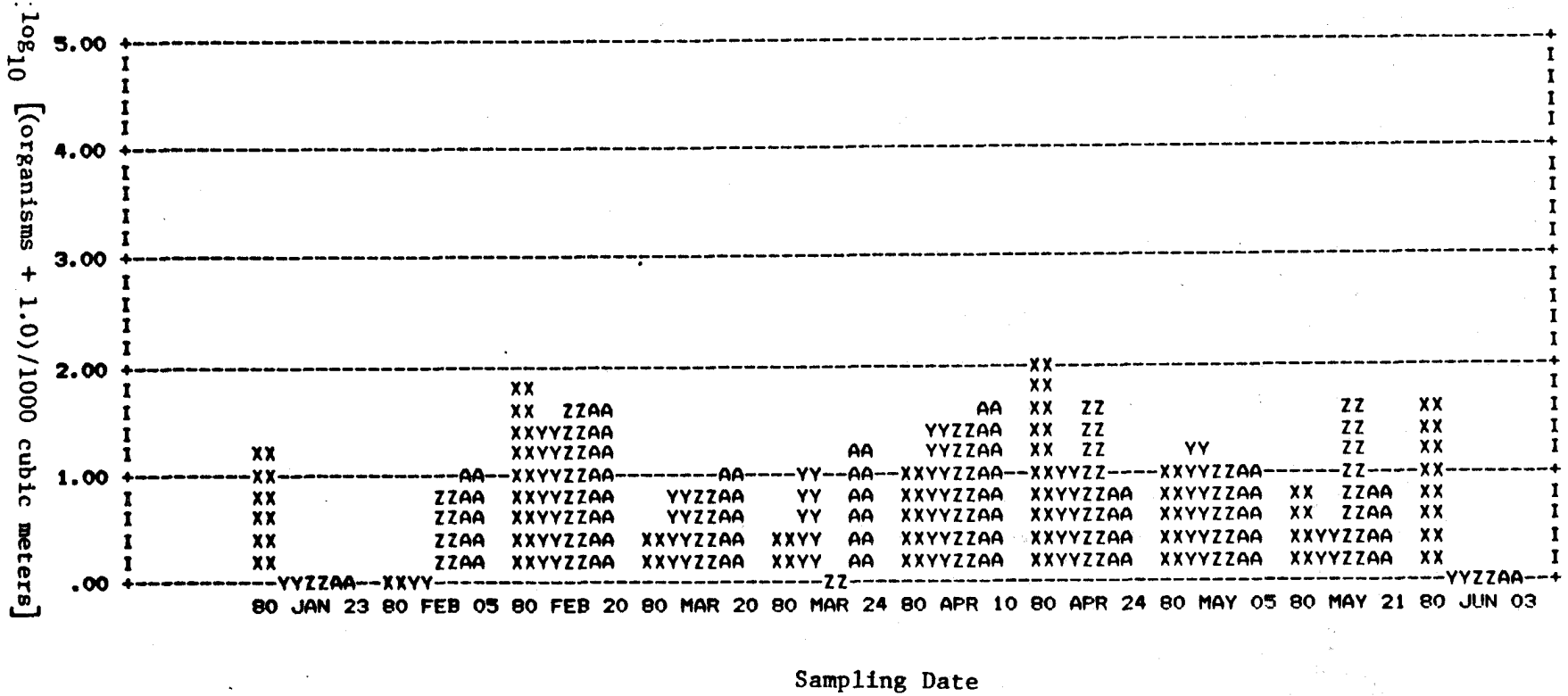

FIGURE B-5

MENHADEN --BREVOORTIAL SPP.-- ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-5 Ichthyoplankton and Nekton Larvae - Occurrence of Menhaden

FIGURE B-5

FIGURE B-6

SPOTTED SEATROUT --CYNOSCION NEBULOSUS-- ICHTHYOPLANKTON IN THE ST. JOHNS RIVER NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

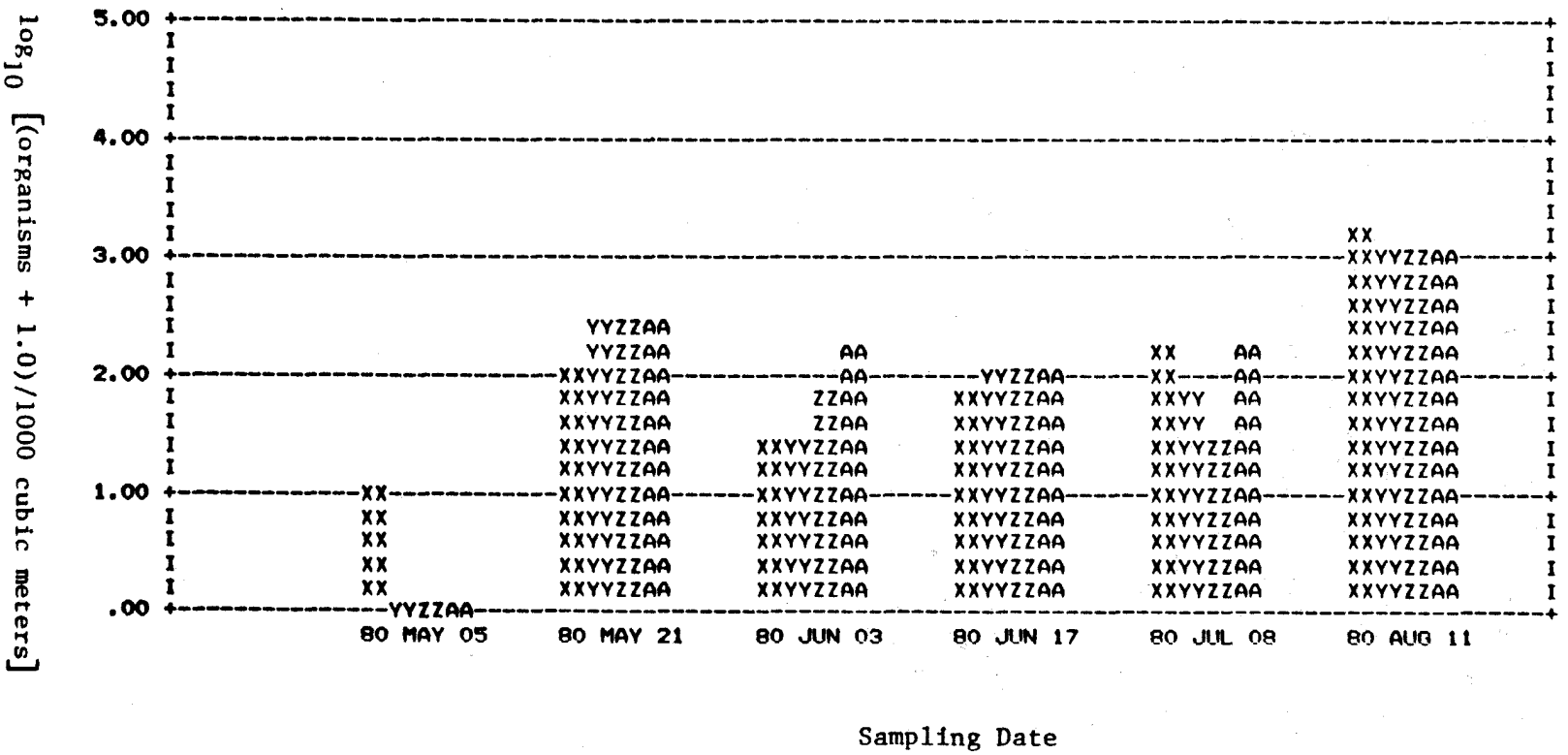

FIGURE B-6

SPOTTED SEATROUT --CYNOSCION NEBULOSUS-- ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS
NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-6 Ichthyoplankton and Nekton Larvae - Occurrence of Spotted **Seatrout**

FIGURE B-6

SPOTTED SEATROUT --CYNOSCION NEBULOSUS-- ICHTHYOPLANKTON ENTRAINED BY THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES

C--- REPRESENTS OUTGOING TIDE SAMPLES

6.00
4.00
2.00
.00
log10 [(organisms + 1.0)/1000 cubic meters]
Sampling Date
79 79 80 80 80

Figure B-7 Ichthyoplankton and Nekton Larvae - Occurrence of Croaker

FIGURE B-7

CROAKER --MICROPOGONIAS UNDULATUS-- ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-7 Ichthyoplankton and Nekton Larvae - Occurrence of Croaker

FIGURE B-7

CROAKER --MICROPOGONIAS UNDULATUS-- ICHTHYOPLANKTON ENTRAINED BY THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES

C--- REPRESENTS OUTGOING TIDE SAMPLES

FIGURE B-8

SILVER PERCH --BAIRDIELLA CHRYSURA-- ICHTHYOPLANKTON IN THE ST. JOHNS RIVER
NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

FIGURE B-8

SILVER PERCH --BAIRDIELLA CHRYSURA-- ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-8 Ichthyoplankton and Nekton Larvae - Occurrence of Silver Perch

Figure B-8 Ichthyoplankton and Nekton Larvae - Occurrence of Silver Perch

FIGURE B-8

SILVER PERCH --BAIRDIELLA CHRYSURA-- ICHTHYOPLANKTON ENTRAINED BY THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES

C--- REPRESENTS OUTGOING TIDE SAMPLES

FIGURE B-9

BLACK DRUM --POGONIAS CROMIS-- ICHTHYOPLANKTON IN THE ST. JOHNS RIVER NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

FIGURE B-9

BLACK DRUM --POGONIAS CROMIS-- ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

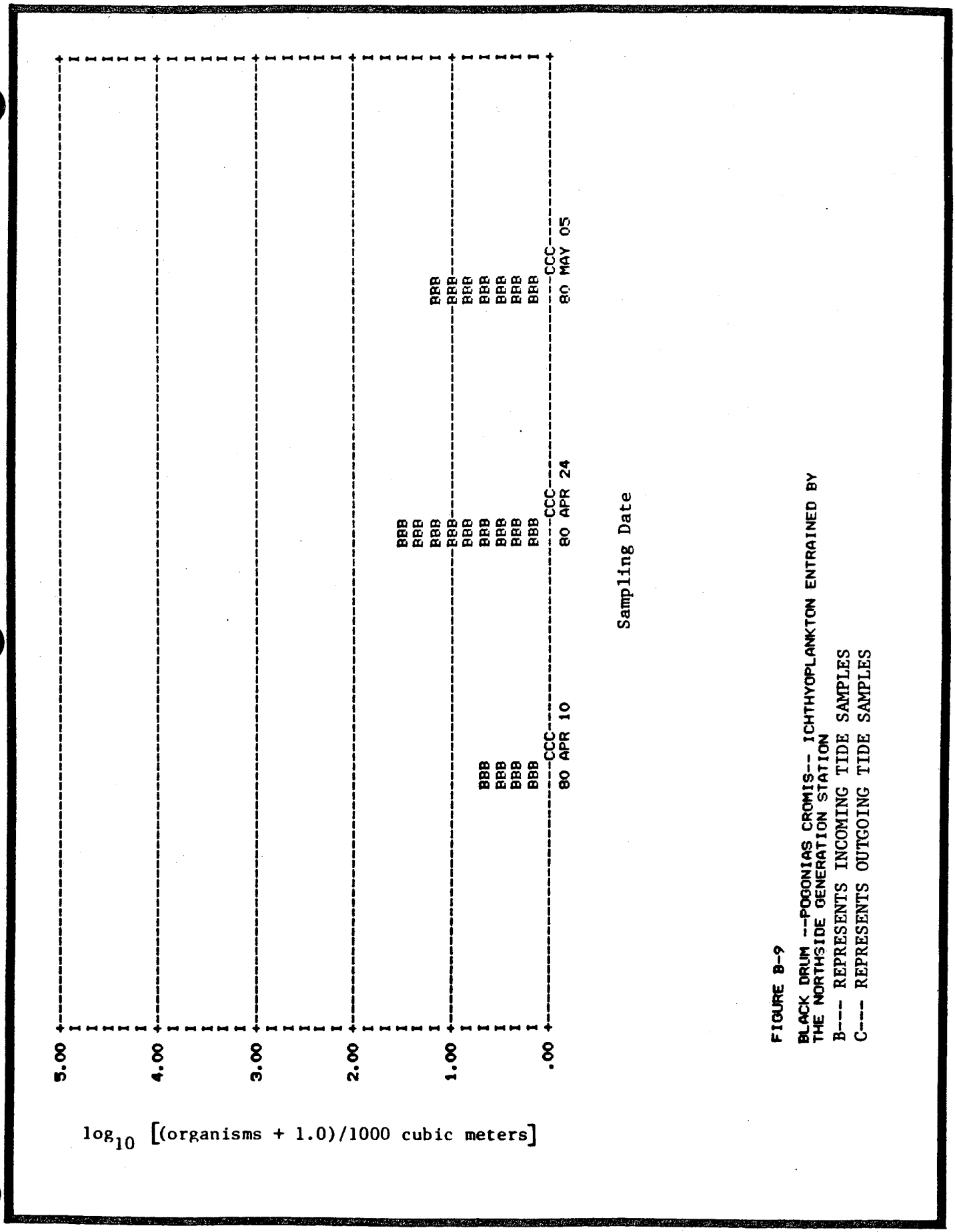

Figure B-9 Ichthyoplankton and Nekton Larvae - Occurrence of Black Drum

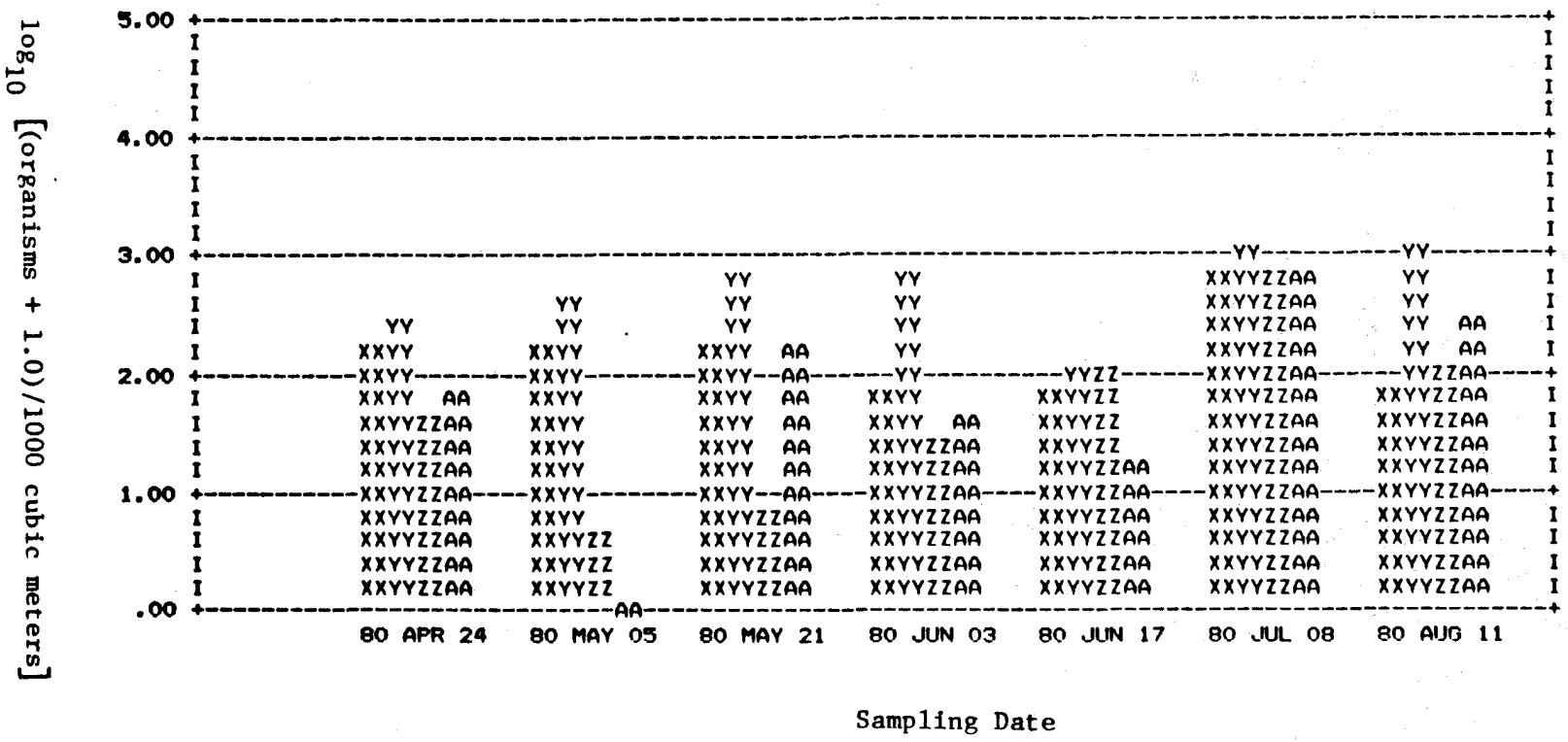

FIGURE B-10

UNIDENTIFIED SCIAENID SPP. ICHTHYOPLANKTON IN THE
ST. JOHNS RIVER
NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-10 Ichthyoplankton and Nekton Larvae - Occurrence of Sciaenid Species

FIGURE B-10

UNIDENTIFIED SCIAENID SPP. ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-10 Ichthyoplankton and Nekton Larvae - Occurrence of Sciaenid Species

FIGURE B-10

UNIDENTIFIED SCIAENID SPP. ICHTHYOPLANKTON ENTRAINED BY THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES

C--- REPRESENTS OUTGOING TIDE SAMPLES

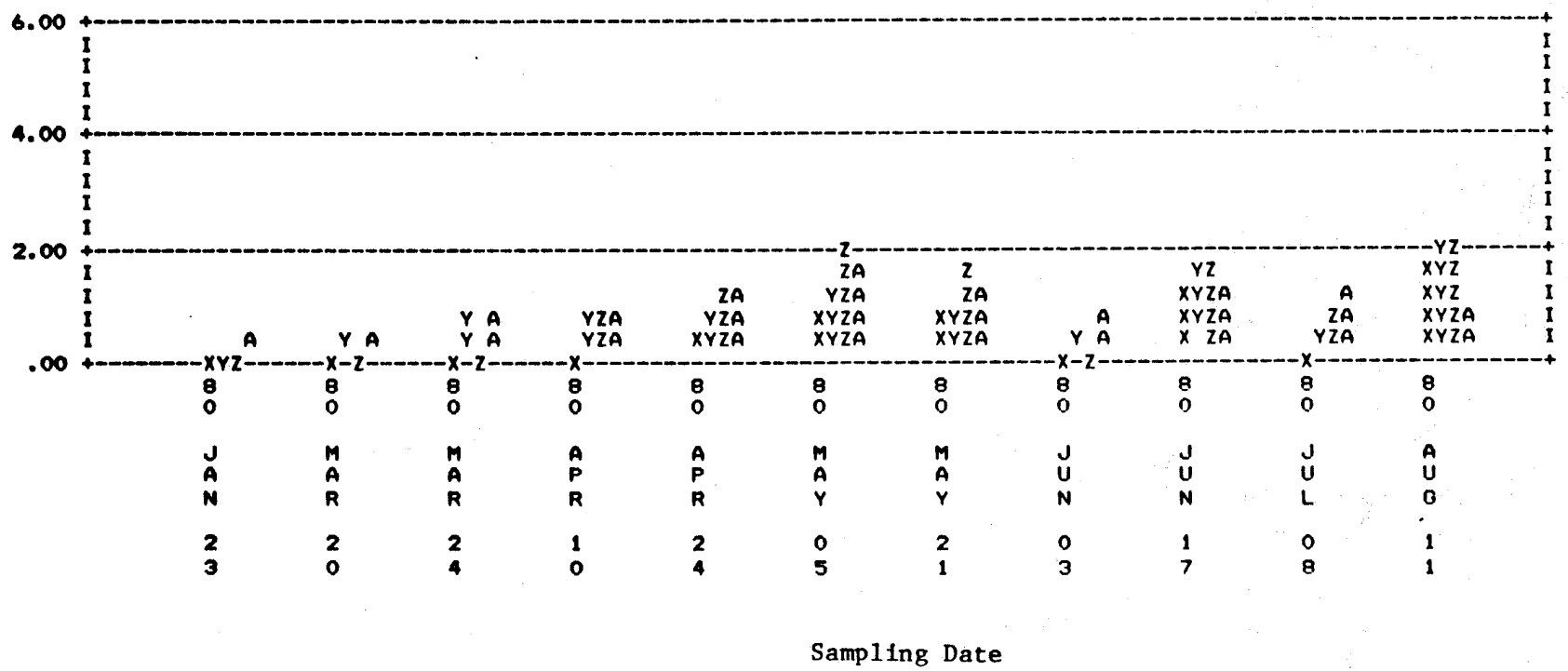

FIGURE B-11

BLUE CRAB --CALLINECTES SAPIDUS-- IN THE ICHTHYOPLANKTON IN THE ST. JOHNS RIVER NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

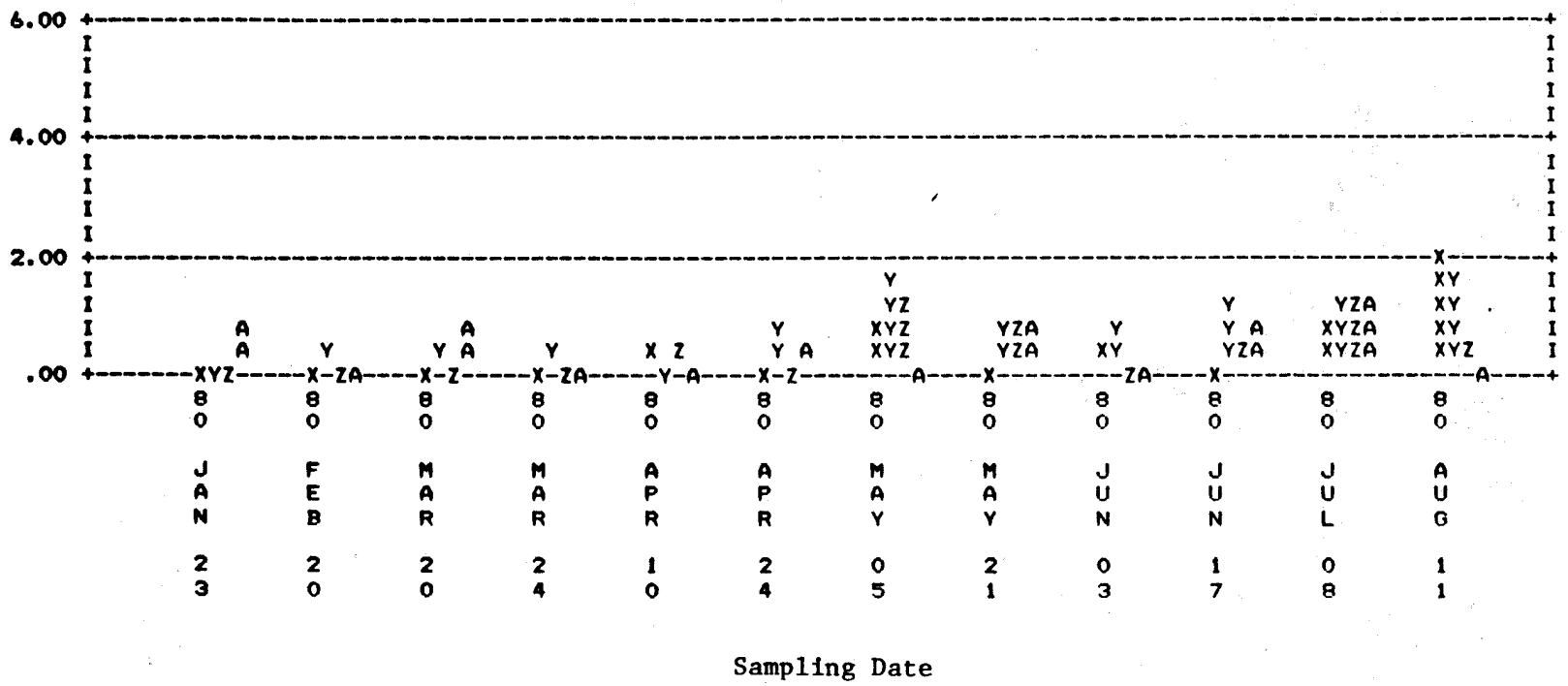

FIGURE B-11

BLUE CRAB --CALLINECTES SAPIDUS-- IN THE ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-11 Ichthyoplankton and Nekton Larvae - Occurrence of Blue Crab Post-Larvae

Figure B-11 Ichthyoplankton and Nekton Larvae - Occurrence of Blue Crab Post-Larvae

FIGURE B-11

BLUE CRAB --CALLINECTES SAPIDUS-- IN THE ICHTHYOPLANKTON ENTRAINED BY THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES

C--- REPRESENTS OUTGOING TIDE SAMPLES

FIGURE B-12

COMMERCIAL SHRIMP POSTLARVAE ICHTHYOPLANKTON IN THE ST. JOHNS RIVER NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

FIGURE B-12

COMMERCIAL SHRIMP POSTLARVAE IN THE ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS
NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-12 Ichthyoplankton and Nekton Larvae - Occurrence of Shrimp Post-Larvae

FIGURE B-12

COMMERCIAL SHRIMP POSTLARVAE IN THE ICHTHYOPLANKTON ENTRAINED BY THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES

C--- REPRESENTS OUTGOING TIDE SAMPLES

6.00
4.00
2.00
.00
log10 [(organisms + 1.0)/1000 cubic meters]
Sampling Date
7 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
9 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
N D J J F M M A M M J J J A
O E A A E A A P A A U U U U
V C N N B R R R Y Y N N L G
0 1 0 2 0 2 2 1 2 0 2 0 1 0 1
7 7 4 3 5 0 4 0 4 5 1 3 7 8 1
Y
Y
Y

FIGURE B-13

ANCHOVY ICHTHYOPLANKTON IN THE
CONTIGUOUS TIDAL CREEKS
NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

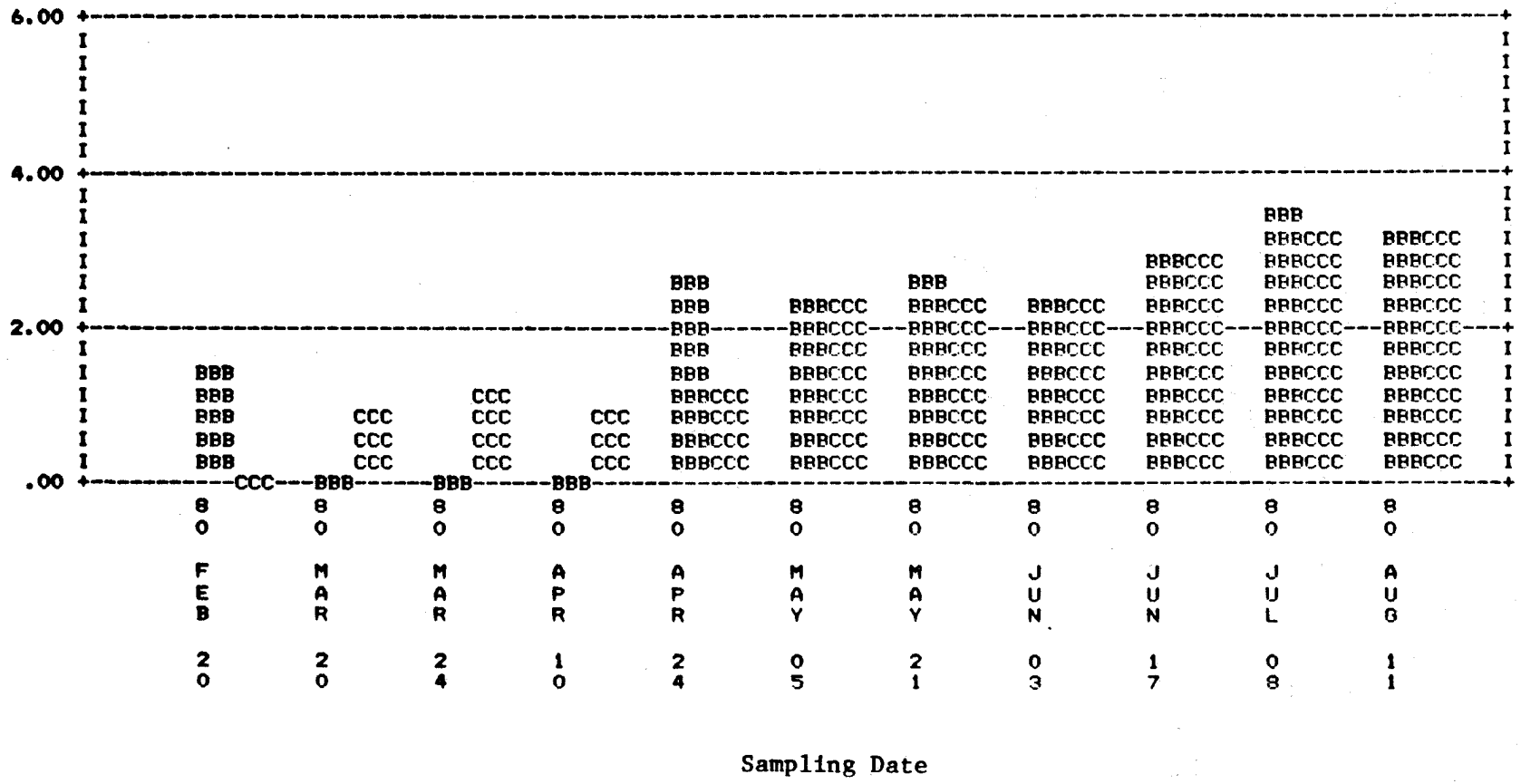

FIGURE B-13

ANCHOVY ICHTHYOPLANKTON ENTRAINED BY
THE NORTHSIDE GENERATION STATION
THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES
C--- REPRESENTS OUTGOING TIDE SAMPLES

FIGURE B-14

GOBY ICHTHYOPLANKTON IN THE CONTIGUOUS TIDAL CREEKS NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
Z--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

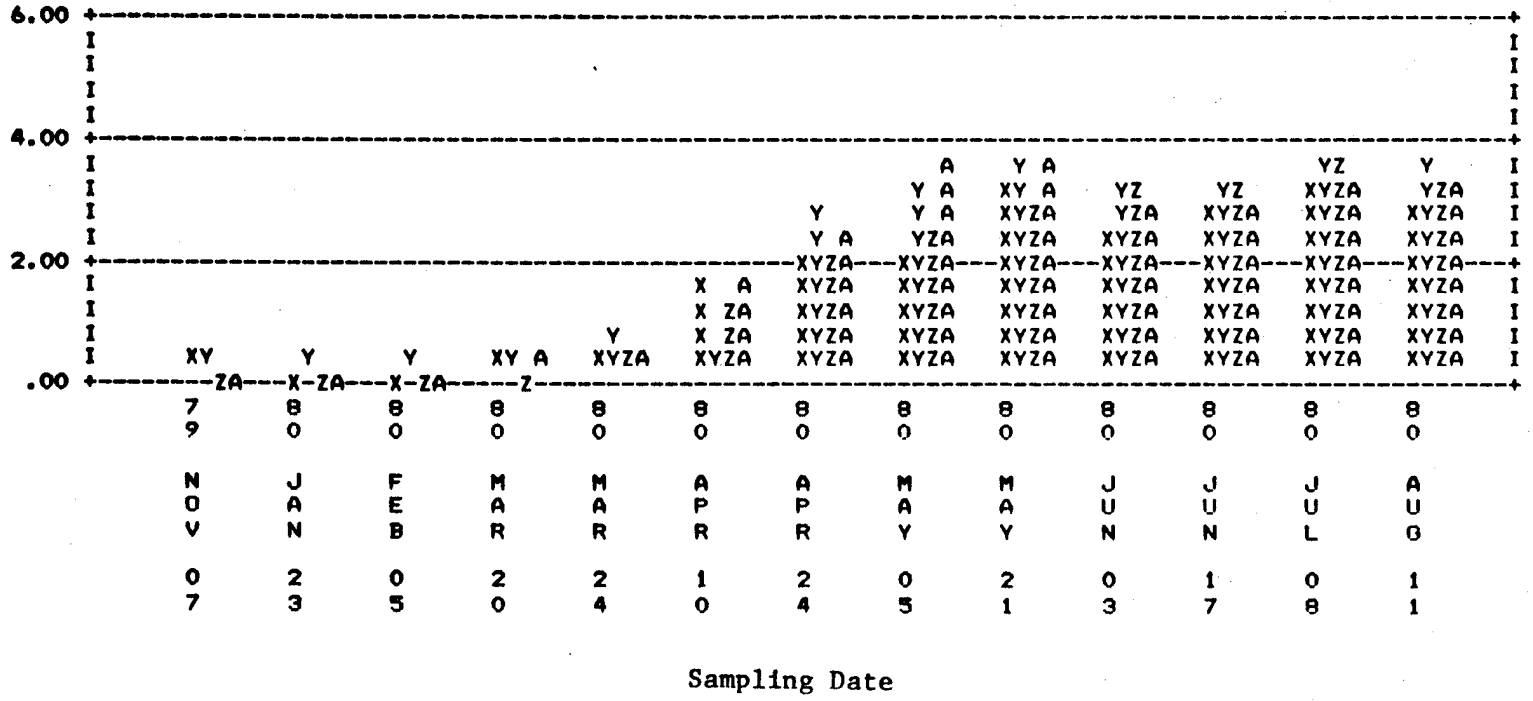

FIGURE B-14

GOBY ICHTHYOPLANKTON IN THE
ST. JOHNS RIVER
NEAR THE NORTHSIDE GENERATING STATION

X--- REPRESENTS SURFACE DENSITIES ON AN INCOMING TIDE
Y--- REPRESENTS BOTTOM DENSITIES ON AN INCOMING TIDE
Z--- REPRESENTS SURFACE DENSITIES ON AN OUTGOING TIDE
A--- REPRESENTS BOTTOM DENSITIES ON AN OUTGOING TIDE

Figure B-14 Ichthyoplankton and Nekton Larvae - Occurrence of Gobies

FIGURE B-14

GOBY ICHTHYOPLANKTON ENTRAINED BY
THE NORTHSIDE GENERATION STATION

B--- REPRESENTS INCOMING TIDE SAMPLES

C--- REPRESENTS OUTGOING TIDE SAMPLES

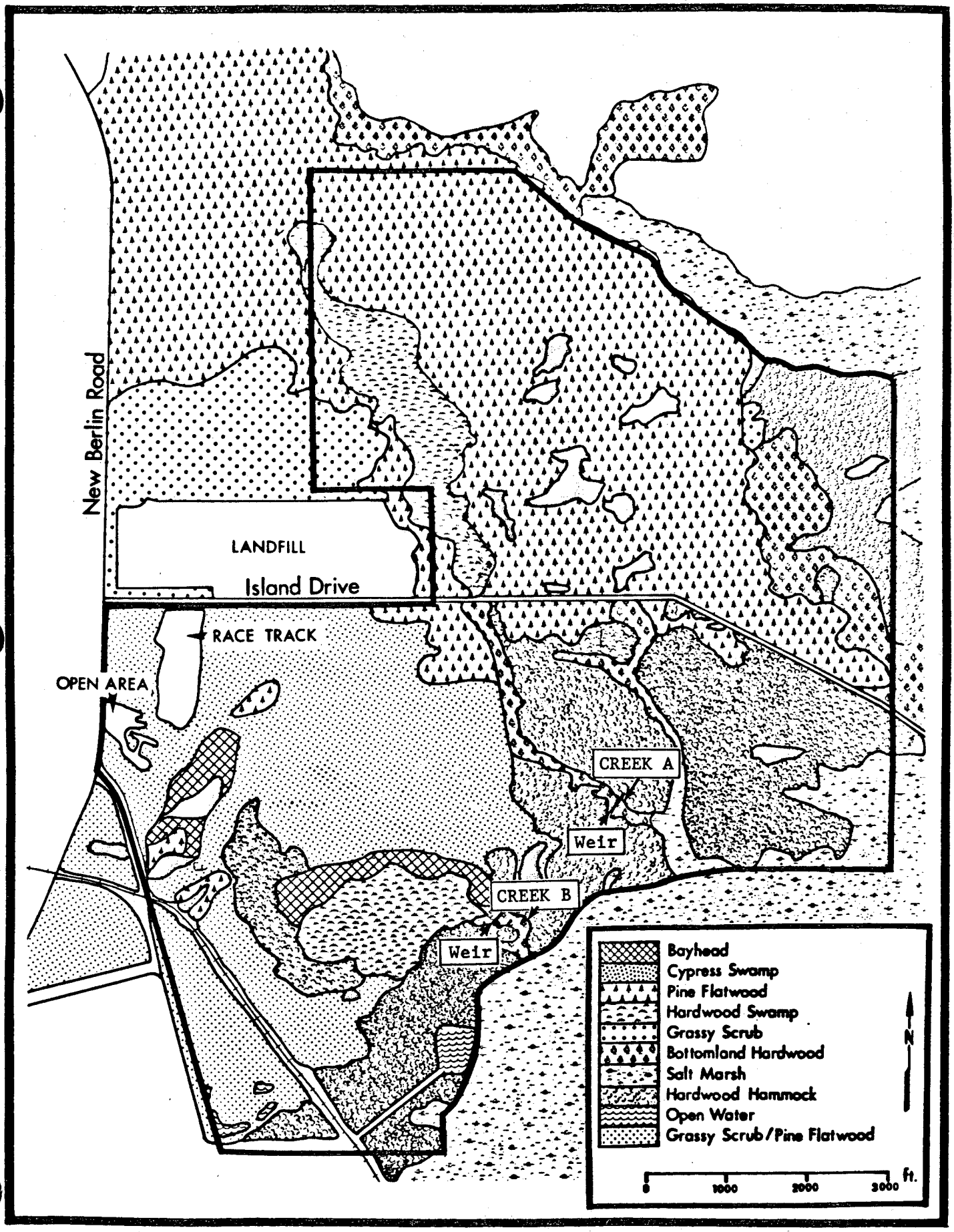

Figure B-15 Location of Fresh Water Creeks on the Proposed St. Johns Power Park Site

C

SURFACE WATER HYDROLOGY

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C-74 Temperature Data - 5/80

C-75 Temperature Data - 6/80

C-76 Temperature Data - 7/80

C-77 Temperature Data - 8/80

C-78 Temperature Data - 9/80

C-79 Bathymetry - Northside Station - 1973

APPENDIX C

SURFACE WATER HYDROLOGY

INTRODUCTION

This appendix contains detailed information pertinent to the surface water hydrology of the proposed plant and coal unloading facility sites. The information presented in this appendix provides supplementary data and discussion for several sections of Chapters 2, 4, 5, and 6. Historical water quality data available for the St. Johns River in the vicinity of the proposed plant are presented in Section C.4. Mathematical modelling utilized in the determination of thermal and chemical impacts on water quality are described in Sections C.1 and C.6. Quality assurance programs developed and implemented for all surface water programs associated with the SCA/EID for the proposed plant are discussed in Section C.2. Sections C.5, C.7, C.8, and C.9 contain examples and discussions of the pre-application monitoring program data obtained for assessing the existing water chemistry, hydrographic, and thermal characteristics of the St. Johns River. Section C.3 contains a copy of the existing Northside Generating Station's (NGS) NPDES permit, which is referenced throughout the body of this report. The final section, C.10, contains the references cited in the preceding sections.

C.1 MATHEMATICAL MODELLING OF THERMAL DISCHARGE

The proposed St. Johns River Power Park is designed to utilize the existing Northside Generating Station (NGS) circulating water system both as a source of cooling tower makeup and as a dilution discharge system for cooling tower blowdown. Description of the ambient receiving body of water (RBW) temperature distribution requires that the characteristics of the thermal discharge from the NGS be provided for all its expected modes of operation. This necessitates the use of a mathematical model to predict those characteristics for the NGS operating modes which cannot be measured directly.

The NGS discharge can be classified as a shallow water submerged discharge into a receiving water with periodically reversing currents (Wapora, Inc., 1978). There are no widely accepted models for this particular type of discharge. In 1976, acting on the recommendation of the USEPA, Reynolds, Smith and Hills (RS&H) used a mathematical model called SYMJET, developed by D.S. Trent and J.R. Welty (Reynolds, Smith and Hills, 1976), in conjunction with physical model studies. Based on their results, a mixing zone was defined and incorporated in the NGS NPDES Permit (Section C-3). RS&H noted certain drawbacks to the SYMJET model as listed below:

1. Only vertical discharges can be modelled. The actual installed system discharges at an angle 10 degrees above the horizontal.

2. Only one discharge can be handled. The actual installation consists of two discharges.

Since that effort, other models have been utilized to predict behavior for such shallow water submerged discharges. Two of these have been selected and compared against the actual data recorded during monitoring surveys. Table C-1 summarizes the measured and allowed dimensions of the 2 and 4 degree F isotherms during three thermal surveys, and Figures C-1, C-2 and C-3 provide plan views of the isotherms measured during the same surveys, at the 1 meter depth.

The first model investigated (V. Balasubramanian and S. Jain, 1978) was developed for the specific case of a horizontal submerged discharge in stagnant shallow water. It is a phenomenological model which correlates plume characteristics such as surface impingement, temperature rise, centerline temperature decay, and corresponding plume area with the dimensionless variables of densimetric Froude number (F_d) and outfall aspect ratio (H/D, water depth divided by outlet diameter). This model was derived from data taken in a physical model, for F_d ranging between 5.05 and 20.80, and H/D ranging from 2.63 to 7.05. The following relationship was derived:

$$(1) \quad T_s = T_o C \, (F_d)^m \, (H/D)^n$$

where T_s = surface impingement temperature rise
T_o = initial temperature rise
H = depth
D = outlet diameter
C, m, and n = experimentally derived constants

Balasubramanian found that for H/D less than 0.36 F_d, C= 1.27, m = 0.03, and n = -1.35. These are the conditions which occur at the NGS discharge. For the relationship between centerline temperature and distance, the following relationship was derived:

$$(2) \quad T = T_o K \, (X/H)^S$$

where T = centerline temperature rise
X = centerline distance
K = a function of H/D
S = -0.4 to -0.5

A value of -0.45 was used for S in these studies. K was found to be best fitted by a second degree equation as follows:

(3) $K = 2.75 - 0.93\ (H/D) + 0.092\ (H/D)^2$

For the area enclosed by an isotherm, the following expression was derived:

(4) $A(T) = 0.13\ (X(T))^2$

where A(T) = area enclosed by isotherm at T degrees above ambient, acres

X(T) = centerline distance to isotherm at T degrees above ambient, calculated from equation 2, feet

This model was run for the conditions which existed during the three thermal surveys previously described (Figures C-1, C-2, and C-3). Plots of the predicted centerline distances to each isotherm, as well as the measured distances from the surveys, are shown in Figures C-4, C-5, and C-6. Similarly, plots of predicted and measured areas contained within each isotherm are presented as Figures C-7, C-8 and C-9. These figures indicate that the model is somewhat conservative down to the temperature rise of about 2 degrees F above ambient, and very conservative at temperature rises less than that.

The second model investigated is a composite model previously utilized for a two port submerged discharge at Florida Power & Light Company's St. Lucie Plant, Unit 1 (Nagel, et al.). This model consists of a near-field model and a far-field model. The near-field model is a well-known (Koh and Fan, 1970) submerged jet model consisting of a set of seven simultaneous differential equations. They include equations of conservation of mass, horizontal momentum flux, vertical momentum flux, density deficiency flux, and thermal energy flux, and two equations of horizontal and vertical distance. This near-field model was used to estimate the initial jet impingement temperature and width. These results were then used as input to the far-field model.

A semi-empirical (Pritchard, 1970) far-field model is used to predict centerline temperature distribution and areas enclosed by isotherms. It considers plume dispersion to be governed solely by jet entrainment and turbulent diffusion. The centerline distance from the boil area to a given excess temperature is given as:

$$(5) \quad X(T) = (T_s/T)^2 \, nb_o$$

where b_o = initial plume width
n = an empirical constant equal to 6

The corresponding area enclosed within an isotherm of temperature rise T is given as:

$$A(T) = 0.215 \, (X(T))^2$$

Examination of the data from the thermal surveys indicated that, for temperatures at the one meter depth, the initial jet impingement temperature (T_s) and width (b_o) are well approximated by the predictions of the near-field model at a distance 5/6 of the height of the water above the centerline of the outfall. Plots of the predicted distance to each isotherm, as well as measured distances, for the three thermal surveys previously described, are presented in Figures C-10, C-11 and C-12. In order to correlate the areas enclosed by isotherms with centerline distances at the one meter depth, a second degree curve was fitted to the measured field data. The expression is of the form:

$$A(T) = 1.86 \, (X(T)/1000)^2 - 0.28$$

Plots of predicted areas enclosed by isotherms, and measured areas, for the conditions of the three previously described thermal surveys, are presented in Figures C-13, C-14, and C-15.

As was the case with the Balasubramanian model, the Nagel model is seen to be slightly conservative for temperature rises down to about 2 degrees F, and very conservative for smaller temperature rises.

Examination of the thermal survey isotherms (Figures C-1, C-2, and C-3) in sequence gives a good indication of how the plume migrates with tidal flow. Figure C-1 shows the plume at maximum downstream extent, on an ebb tide. Figure C-2 shows the plume as it is migrating upstream on the following flood tide. Figure C-3 shows the plume's maximum upstream extent on a flood tide. This indicates that the plume oscillates upstream and downstream with the tidal flow. The plume's maximum extent occurs near slack current, when it has been fully extended by the tide. The plume then migrates on the following tide, to again reach its maximum extent, at about the following slack current. It is these maximum extents which both models are calibrated to predict.

In order to predict the extent of the thermal plume for the various pumping modes of NGS (Figure C-16) for which no field data is available, the second model (Nagel, 1977) has been selected, for the following reasons:

1. It is sensitive to non-temperature density differences.

2. It provides an estimate of the plume width in the initial jet impingement (boil) region.

3. It is more sensitive to changes in plant load because it includes conservation of thermal energy flux.

4. Densimetric Froude numbers at the NGS discharge can be below the range investigated by Balasubramanian.

NGS has four operating modes, on which Figure C-16 was based. These modes, and the corresponding flow rates, for the two cases of no throttling of NGS circulating water pumps and maximum expected throttling (70 percent flow) of these pumps, are tabulated in Table C-2.

The selected model has been run to predict the centerline distances to each isotherm for each of the eight flows shown in Table C-2. The results are presented in Figures C-17 and C-18 for the unthrottled and throttled pump cases, respectively. These runs were made assuming full load on each operating Northside unit for each case, and tidal stage at mean sea level. Similarly, the selected model was run for each of the eight flows to predict the area enclosed by each isotherm. The results are shown in Figures C-19 and C-20, for the unthrottled and throttled pump cases, respectively. The model predicts the largest thermal plume for mode 3, in the unthrottled pump case, and mode 2 for the throttled pump case. This indicates that the maximum extent of the thermal plume occurs at a flow rate of about 280,000 gpm. At greater flow rates, the increased velocity of the discharge promotes more rapid mixing. At lower flow rates, the decrease in heat load results in a smaller plume.

Average and extreme cases have been modelled for both Northside Station alone and the combined discharge of Northside Station and the proposed plant. The results are described in Section 5.1.2. The input parameters were developed from quantities presented in Section 3.4 and 5.1.2, and are tabulated herein as Tables C-3 through C-12. The results of the modelling are presented herein as Figures C-21 through C-24, with respect to predicted plume centerline distance to the 2 degree F isotherm, average case; Figures C-25 through C-28, with respect to plume area of the 2 degree F isotherm, average case; Figures C-29 thrugh C-32, with respect to plume centerline distance to the 2 degree F isotherm, extreme case; and Figures C-33 through C-36, with respect to plume area of the 2 degree F isotherm, extreme case. Because the mode 5 plume is much smaller than the mode 4 plume, it has not been shown.

C.2 QUALITY ASSURANCE - SURFACE WATER PROGRAMS

C.2.1 Hydrographic/Hydrothermal

C.2.1.1 General

A complete set of sample checkout sheets, deployment/retrieval forms, film service sheets, and equipment instruction and service manuals is maintained within the project files in the Envirosphere Company, Atlanta office.

C.2.1.2 In-situ Current Data

Instrumentation used in in-situ current measurements are subjected to detailed check-out procedures prior to use. This type of check-out assures operational status of the instrument before its installation. Deployment and retrieval information are logged in a master logbook in New York with copies to Atlanta. Upon retrieval, the unit is post-tested. Any abnormalities in the records are then logged so as to be included with the film service sheet which is filled out utilizing the information from the logs. Copies of these service sheets, with the film packs, go to the vendor where the data is sent for reduction. The film packs are sent via the U.S. Postal Service, registered, return receipt requested, and these registry forms are on file in New York. After completion of the data reduction, the vendor sends two copies of the printout to the Atlanta office and the magnetic tape containing this same data to the New York office. The tape is converted to disc file and entered into permanent storage in the Ebasco computer facilities. One copy of the printout is sent to New York for storage and verification. The vendor maintains copies of all data sent and the original films in case of further reduction needs.

C.2.1.3 In-situ Temperature Data

In-situ temperature instrumentation is handled in a manner similar to in-situ current instrumentation, with pre- and post-deployment testing done on the units. The data reduction and storage is exactly the same as the current meter data since it is reduced (and the equipment manufactured) by the same vendor.

C.2.2 In-situ Tide and Water Level Measurements

In-situ tide measurements are made with the Leupold and Stevens Digital Tide recorder. Its installation and setup are performed in accordance with USGS Standards and the vendor's instructions. After installation, weekly checks are performed on the unit to verify operation and data continuity. Data is retrieved from the unit during regular instrument turn-arounds and shipped to the Atlanta office for reduction in a vendor produced optical reader. Cards are keypunched and read into the computer and made into a disk file. Spot checks of the keypunching and verification of reader against tapes are made during the data reduction process.

In-situ stream gage measurements utilizing the data-tide gauges in combination with weirs or sills follow the same data reduction and verification process. In addition, stream height above the weirs or sills is recorded for later flow calculation measurements.

C.2.3 Profiles

Utilizing ENDECO 110 Profiling Current Meters, profile measurements were made of river current velocity, current direction, and coincident temperature at various tidal stages.

Calibration is internal and described in the vendor literature. Data reduction consists of tabulated values in standard log format, with copies sent to New York and Atlanta.

C.2.4 Hewlett-Packard On-Board Data Acquisition System

The Hewlett-Packard On-Board Data Acquisition System is a self-contained data processing system. Power must be supplied in the field from a generator of at least 2.5 kW capability. System start-up begins with all circuit breakers and equipment power switches in the off position. The generator is then started and the circuit breakers turned on. The generator throttle is then adjusted until the frequency meter reads approximately 60 cycles. The Mini-Ranger, Multiprogrammer, HP9835, Epson printer, and HP-9872A plotter are then energized. The frequency is rechecked and readjusted carefully, if necessary.

Upon receiving power, with a tape cartridge loaded, the HP-9835 automatically loads and runs the program AUTOST. Normally, this data is preset before going out to survey. Upon completion of AUTOST, the main program is loaded and executed. In the output, the following values are printed: Range and code for first transponder, range and code for second transponder, the hexadecimal thumbwheel, 6 temperatures (probes 3 through 8), line number, fix number, and date/time. Line numbers are input via the thumbwheels, fix numbers are calculated. The second line of output gives the coordinates of the point. The hexadecimal thumbwheel sets the data collection trigger either to manual or to a constant time interval.

A complete set of instruction manuals accompanies the system, and is required for copying tapes. Only the programs AUTOST and Sandy need be copied to create a new tape; these programs automatically generate the required data files.

Data up to 3100 points can be stored on each tape. Each survey produces a printed copy of all recorded data, and a plot of boat positions, as well as the tape data.

C.2.5 Bathymetry

Measurements will be made as described by Jackson (Jackson and Verma, 1978).

C.2.6 Thermal Plume

Will be made as described by Jackson (Jackson and Verma, 1978).

C.2.7 Water Chemistry Quality Assurance

Both the in-situ measurements and water quality analyses were obtained by observing standard quality control procedures from sample collection through disposition. The instruments measuring in-situ parameters were checked out and calibrated prior to use in accordance with the procedures listed in Section C.2.7.1. Results of these measurements were immediately recorded on data sheets, a copy and an explanation of which are included in Section C.2.7.2. Completed data forms are copied then transmitted to the project files in Atlanta.

The samples for chemical analysis are collected in clean bottles supplied by the laboratory. Some bottles contain preservatives as necessary for certain analyses, as shown in Table C-13. Each bottle is labeled with a "file code" before sampling begins and these codes are recorded on an inventory record which accompanies delivery of the bottles to the lab. Receipt of water samples by the laboratory is documented on these inventory records. In addition to listing the field codes, the record is completed by the lab which assigns sequential date codes to each sample. These codes are also written on the appropriate bottles. The inventory record is signed by the delivering and receiving parties and copied for each party's files. Subsequent handling procedures by the lab include:

1. All samples are maintained at proper temperatures until time of analysis.

2. The date code, date sampled, company name, purchase order number, company code and/or description, and analysis to be run is entered into a log book. At this time, lab report sheets are prepared for each sample, listing all tests to be run and providing space after each test for the result and initials of the technician who performed the test.

3. After testing, those samples whose quality will not deteriorate over time are stored in a warehouse for about a month, in the event reanalysis is required. Those samples which will not keep or which have been chemically altered during analysis are discarded.

The USEPA supports maintenance of laboratory quality control by furnishing quality control (QC) samples to interested parties. These samples are intended as independent measures of technique and performance and are used as secondary checks on within-laboratory quality control programs. As a part of this project's quality assurance program, a set of selected QC samples was delivered to Branchemco, Inc. for analysis.

Instructions for preparing the samples for analysis and data sheets for recording the analytical results were supplied to the laboratory. The true values of concentration for each parameter to be analyzed were retained by Envirosphere to ensure the validity of the analytical results. Table C-14 lists the parameters analyzed, the expected concentrations, and the concentrations determined by the laboratory.

The samples submitted to Branchemco were selected based on available concentrations as similar as possible to those observed in the St. Johns River during the pre-application monitoring program. The EPA "Methods for Chemical Anlaysis of Water and Wastes" was consulted to determine the appropriate margin of error (as standard of deviation) for each analysis. These values were used, in turn, to assess the laboratory's performance and

1. All samples are refrigerated until time of analysis.

2. The date code, date sampled, company name, purchase order number, company code and/or description, and analysis to be run is entered into a log book. At this time, lab report sheets are prepared for each sample, listing all tests to be run and providing space after each test for the result and initials of the technician who performed the test.

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The samples submitted to Branchemco were selected based on available concentrations as similar as possible to those observed in the St. Johns River during the pre-application monitoring program. The EPA "Methods for Chemical Anlaysis of Water and Wastes" was consulted to determine the appropriate margin of error (as standard of deviation) for each analysis. These values were used, in turn, to assess the laboratory's performance and

accuracy. Except for cyanide, nitrate, ammonia, orthophosphate, and chloride, the results obtained were within an acceptable range of the expected results. The chloride concentration reported was only slightly outside the estimated range. The concentrations of nutrients analyzed (1.33 mg/l, 1.64 mg/l and 0.181 mg/l for ammonia, nitrate, and orthophosphate, respectively) do not correspond with the expected concentrations for the sample submitted to the laboratory but they are very close to the true values of a second EPA sample for nutrient analysis which was not submitted to the laboratory (1.3, 1.59, and 0.154 mg/l). Conversations with EPA indicate that it is entirely possible that the ampules in the quality control set received by Envirosphere were labelled incorrectly (Miller, 1981). At this time, there is no way to verify that this error occurred. However, the other data indicate that the laboratory's analytical technique is acceptable and produces reasonable results.

C.2.7.1 Instrument Calibration Checklist

Date _____ Performed by: _____

Remarks _____

_____

Initials

1. Salinity-Conductivity-Temperature (S-C-T) Meter
   S/N _____

   a) Adjust meter zero (if necessary) by turning the bakelite screw on the meter face so that meter needle coincides with zero on the conductivity scale. _____

   b) Calibrate meter by turning MODE control to REDLINE and adjusting RED LINE control so meter needle lines up with redline on meter face. Replace batteries if this is not possible _____

   c) Plug probe into probe jack. Proceed with measurements. When measuring salinity or conductance on X100 or X10 scales, depress CELL TEST button. If meter reading is greater than 2 percent, clean probe and remeasure. _____

2. Dissolved Oxygen (D.O.) Meter. S/N _____

   a) With switch in OFF position, adjust the meter pointer to zero with screw in center of panel. _____

   b) Switch to REDLINE and adjust red line knob until meter needle aligns with red mark. _____

   c) Switch to ZERO and adjust to zero with zero control knob. _____

   d) Attach the D.O. probe to PROBE connector and adjust the retaining ring finger tight. Allow about 15 minutes for probe stabilization before continuing. _____

   e) Air calibrate the probe by placing it in fresh water for a moment, then removing to air. Wait about 5 minutes for temperature stabilization. _____

   f) Switch to TEMPERATURE and read. Determine calibration value by referring to Table on reverse of instrument. _____

g) Switch to the appropriate ppm range, set the SALINITY knob to zero and adjust the CALIBRATE knob until the meter heads the correct calibration value. Wait two minutes to verify calibration stability. Readjust if necessary. _____

3. pH Meter S/N _____

a) Check zero adjustment: Turn function switch to OFF position. If needle is not exactly center scale, turn zero adjust screw with screwdriver until needle is exactly center scale. _____

b) Check batteries: Turn function switch to BATT position. Needle should stop in or be at right of green BATT OK arc on meter. If not, recharge batteries by connecting to live power. _____

c) Connect electrode and standardize using two-buffer technique. Turn function switch to pH position. Measure temperature of second buffer solution. _____

d) Place pH electrode in pH 7 buffer solution. Turn calibration control until needle indicates pH of the buffer. Remove electrode from solution. Rinse and place in pH 10 solution. _____

e) Turn temperature compensator knob until meter needle points to the pH of second buffer solution. _____

f) Turn slope indicator until arrow of temperaure compensator points to temperature of solution. The theoretical slope reading on slope scale should be greater than 90 percent. If less than 90 percent, pH electrode may be defective or buffer solution may be contaminated. If so, repeat calibration. _____

g) Remove electrode from pH 10 buffer and rinse. Instrument is now ready for use. _____

4. Turbidimeter S/N _____

a) Check meter zero with turbidimeter off. Adjust if necessary by means of black screw on meter face.

b) Turn rotary switch to "battery check" position. Meter pointer should register within green BATTERY area. If not, battery recharge is required. _____

c) Turn rotary switch to 100 range and allow approximately 2 to 3 minutes for detectors to equilibrate to light. _____

d) Switch to 1 range and place Reference Standard (0.12 FTU) in sample well. With light shield in place, adjust reference adjust knob to read 0.12 on the scale. Unit is now ready for use. _____

5. Maintain instrument calibration list with field data sheets while in field and file with QA file upon return to office. _____

C.2.7.2 Water Quality: Field Data Sheet

PROJECT SITE: _____ PROJECT OFS NO: _____ INVESTIGATOR: _____

WEATHER: _____ HYDROLOGIC COND: _____ SHEET ____ OF ____

TIME - HW: _____ LW: _____ RECORDER: _____

DATE YRMODA	TIME HRMN	TNST # STA	DEPTH FT SAMWATER	PH STDU	COND UMHOS	SALINITY (°/oo)	DISS O2 (MG/L)	TEMP (°C)	TURB (TU)

C.2.7.2 Water Quality: Field Data Sheet

Sign-Off	Explanation
Investigator	First, middle, and last initials (or full last name) of investigator.
Sheet ____ of ____	Page number identifying that sheet as part of a set.
Recorder	First, middle and last initials of recorder. Recorder must be someone other than investigator.

Data Input - General

Project Site	Designated name of site for which samples are collected.
Weather	Description of weather conditions during collection.
Project OFS No.	Project charge number for sample collection activity.
Hydrologic Cond.	Description of surface water conditions during collection.
Time - HW _____ LW _____	Approximate time of high tide or low tide at sample location.

Data Input - Specific

Date	Date of collection as year, month, day (e.g., 23 October 1980 - 801023)
Time	Time of collection according to 24-hour clock (e.g., 4 pm = 1600)
Inst., # Sta.	Identification of transect, station number of sample
Depth - Sam., Water	Depth in feet of water at sample location and total water depth at that station

Data Input - Specific	Explanation
pH - Std. U	pH of sample measured in standard units
Cond. - umhos	Conductivity of sample measured in micro mhos
Salinity (o/oo)	Salinity of sample, measured is parts per thousand
Diss. O_2 (mg/l)	Dissolved oxygen in sample, measured in mg/l
Temp. (^oC)	Sample temperature (^oC)
Turb. (TU)	Turbidity of sample, measured in standard turbidity units (e.g., NTU)

C.3 NORTHSIDE GENERATING STATION (NGS) NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT

The following section contains a reproduction of the NPDES Permit granted to the Jacksonville Electric Authority for the NGS.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION
2562 EXECUTIVE CENTER CIRCLE, EAST
MONTGOMERY BUILDING
TALLAHASSEE, FLORIDA 32301

REUBIN O'D. ASKEW
GOVERNOR

JOSEPH W. LANDERS, JR.
SECRETARY

December 10, 1976

Paul J. Traina
Director, Enforcement Division
U.S. Environmental Protection Agency
345 Courtland Street N.E.
Atlanta, Georgia 30308

Dear Mr. Traina:

Pursuant to Section 401 of the Federal Water Pollution Control Act (33 USC 1251, 1341), the State of Florida hereby revises its previous certification for:

Jacksonville Electric Authority
Northside Generating Station FL0001031

an applicant for a National Pollutant Discharge Elimination System Permit, subject to the following additional state requirements:

1. The permittee must comply with Chapter 253 and 403, Florida Statutes, and all applicable Sections of Chapter 17, Florida Administrative Code, including but not limited to the water quality and waste treatment requirements of Chapter 17-3 and the permit requirements of Chapter 17-4.

2. The thermal zone of mixing encompassed by the $2^{o}F$ isotherm shall not exceed a size of 102.27 acres, nor shall it be more than 5,400 feet in length from the point of discharge.

3. The temperature at the point of discharge shall not exceed $19^{o}F$ above ambient nor $105^{o}F$, whichever is less.

4. The applicant will continuously monitor the temperature of the water entering the plant and the temperature of the water discharged from the plant.

5. The applicant shall continuously monitor the temperature of the water at the mouth of San Carlos Creek. The department, upon application, will review this requirement after two years of operation to determine the necessity for continuance.

6. The applicant shall monitor the aquatic biological communities in the St. Johns River, San Carlos Creek and Nichols Creek for a minimum of a two-year period after commencement of operation to verify that the thermal discharge will not cause substantial damage to aquatic life. The field sampling should be performed at at least six stations in the St. Johns River and the San Carlos-Nichols Creek system. Suggestion station locations are marked on the attached sheet. The following illustrates communities and frequencies for sampling:

Community	Sampling Frequency
Phytoplankton	Every four months
Zooplankton	Every four months
Ichthyoplankton	Every four months
Benthos (including Periphyton)	Every two months
Fish	Every two months

7. The discharge of Ferrous Sulfate should not exceed 0.8 mg/1. The State of Florida certifies that if the applicant meets these conditions, its discharge will comply with the provisions of Section 301 and 302 of the act.

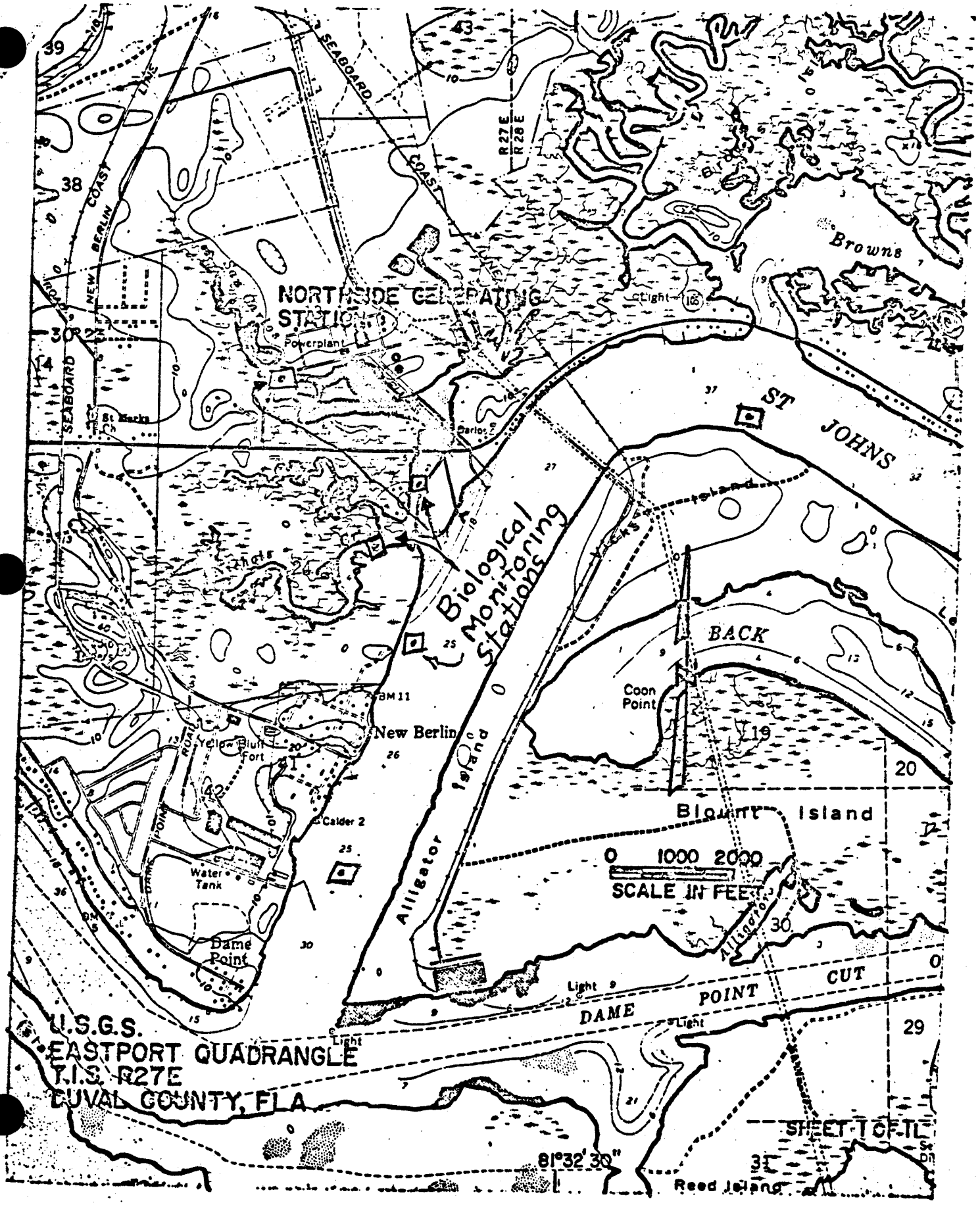
Sincerely yours,

Joseph W. Landers, Jr.
Secretary

JWL:hop
cc: John Jackson
W. R. Opp
R. Breitmoser

Attachment

Fil. # 3854



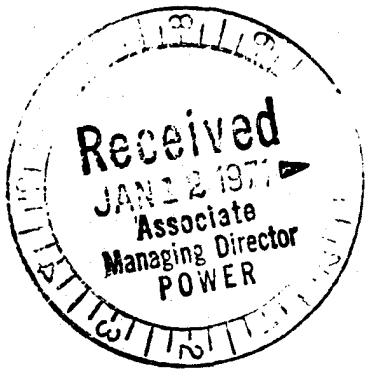
ATTACHMENT
C-22

1437.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET
ATLANTA, GEORGIA 30308



January 3, 1977

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Jacksonville Electric Authority
233 West Bay Street
Jacksonville, Florida 32202

Dear Sir:

Enclosed is the National Pollutant Discharge Elimination System permit for the facility referenced above. This NPDES permit constitutes my determination under Title 40, Code of Federal Regulations, Section 125.35, as amended (39 FR 27080, July 24, 1974).

The construction of facilities required by this permit for diversion of condenser cooling water from San Carlos Creek to the St. Johns River is interpreted by me to come under the provisions of Section 316(c) of Public Law 92-500 which states:

> Notwithstanding any other provision of this Act, any point source of a discharge having a thermal component, the modification of which point source is commenced after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 and which, as modified, meets effluent limitations established under section 301 or, if more stringent, effluent limitations established under section 303 and which effluent limitations will assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in or on the water into which the discharge is made, shall not be subject to any more stringent effluent limitation with respect to the thermal component of its discharge during a ten year period beginning on the date of completion of such modification or during the period of depreciation or amortization of such facility for the purpose of section 167 or 169 (or both) of the Internal Revenue Code of 1954, whichever period ends first.

In accordance with 40 CFR 125.35, this permit will become issued and effective on the effective date specified in the permit, provided that no request for an adjudicatory hearing and/or legal decision is subsequently filed with the Agency. In the event that such a request is filed, the contested provisions of the permit will be stayed and will not become effective until the administrative review process is completed. All uncontested provisions of the permit will be considered issued and effective on the effective date set out in the permit and must be complied with by the facility.

If you wish to request an adjudicatory hearing and/or legal decision, you must submit such request (an original and two copies) to the Regional Hearing Clerk within ten (10) days from the receipt of this letter. The request will be timely if mailed by Certified Mail within the ten (10) day time period. For the request to be valid, it must conform to the requirements of 40 CFR 125.36(b). Such requirements are specified in the attachment hereto.

If you have any questions about the permit, please contact the coordinator for your state at 404/881-3971. Information on the request procedures and legal matters may be obtained by contacting Ms. Sara Turnipseed at 404/881-3506.

Sincerely yours,

for John A. Little, Deputy
Jack E. Ravan
Regional Administrator

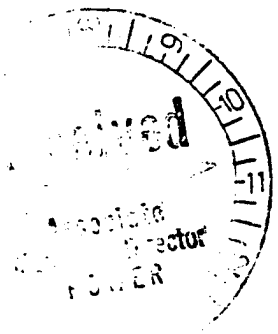
Enclosures

Image Quality
As you review the next group of images, Please note that the original documents
were of poor quality.

Permit No. FL0001031
Application No. FL-074-0YL-2-0001

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251 et. seq; the "Act").



Jacksonville Electric Authority
233 West Bay Street
Jacksonville, Florida 32202

is authorized to discharge from a facility located at

Northside Generating Station (Units 1, 2 and 3)
4377 Hecksher Drive
Jacksonville, Florida 32202

to receiving waters named San Carlos Creek and St. Johns River

from discharge points enumerated herein, as serial numbers 001, 002, 003, 004, 005, 006, 007, 008 and 009

during the effective period of this period of this permit.

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective on February 17, 1977.

This permit and the authorization to discharge shall expire at midnight, February 17, 1982. Permittee shall not discharge after the above date of expiration without prior authorization. In order to receive authorization to discharge beyond the above date of expiration, the permittee shall submit such information, forms, and fees as are required by the Agency authorized to issue NPDES permits no later than 180 days prior to the above date of expiration.

Signed this 3rd day of January, 1977.

for Jack E. Ravan, Regional Administrator
John A. Little, Deputy

A. **EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS**

During the period beginning on effective date and lasting through December 31, 1978
the permittee is authorized to discharge from outfall(s) serial number(s)001, 002 & 008 - Once-through cooling water discharged to San Carlos Creek and/or St. Johns River
Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirements	
	Chlorination Period Average	Instantaneous Maximum	Measurement Frequency	Sample Type
Flow-m^3/Day (MGD per unit) —	N/A	N/A	Hourly	Pump logs and/or calculation
Discharge Temperature, C(°F) per unit	N/A	N/A	Hourly	Pump logs and/or calculation
Free available chlorine (mg/l)	See Below		1/week	Multiple grabs
Total residual chlorine (mg/l)	See Below		1/week	Multiple grabs

After July 1, 1977, free available chlorine shall not exceed an average concentration of 0.2 mg/l and a maximum instantaneous concentration of 0.5 mg/l at the outlet corresponding to an individual unit. Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit may discharge free available or total residual chlorine at any one time unless the permittee can demonstrate to the Regional Administrator that the unit(s) cannot operate at or below this level of chlorination. However, a study shall be instituted to evaluate all practicable methods to reduce total residual chlorine levels, including, but not necessarily limited to (1) minimization of chlorine addition commensurate with control requirements and (2) reduction of flow during chlorination. Results of this study including facilities and/or methods proposed to reduce total chlorine residuals shall be submitted no later than 180 days prior to expiration of this permit.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Outlet corresponding to an individual unit prior to mixing with other waste streams.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning January 1, 197[illegible] and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 001, 002 & 008* - Once-through cooling water discharged to St. Johns River
Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations Chlorination Period Average		Monitoring Requirements Measurement Frequency	Sample Type
Flow-m^3/Day (MGD)	N/A	N/A	Hourly	Pump logs and/or calculation
24 hour Maximum Average Temperature °C(°F)**	N/A	40 (104)	Hourly	Pump logs and/or calculation
Free available chlorine (mg/l)	See Below		1/week	Multiple grabs
Total residual chlorine (mg/l)	See Below		1/week	Multiple grabs

After July 1, 1977, free available chlorine shall not exceed an average concentration of 0.2 mg/l and a maximum instantaneous concentration of 0.5 mg/l at the outlet corresponding to an individual unit. Neither free available chlorine or total residual chlorine may be discharged form any unit for more than two hours in any one day and not more than one unit may discharge free available or total residual chlorine at any one time unless the permittee can demonstrate to the Regional Administrator that the unit(s) cannot operate at or below this level of chlorination. In addition, a study shall be instituted to evaluate all practicable methods to reduce total residual chlorine levels, including, but not necessarily limited to (1) minimization of chlorine addition commensurate with control requirement and (2) reduction of flow during chlorination. Results of this study including facilities and/or methods proposed to reduce total chlorine residuals shall be submitted no later than 180 days prior to expiration of this permit.

** The thermal discharge may not cause the temperature of the receiving body of water as measured 1 meter below the surface to exceed 1.1°C(2°F) above the natural water temperature outside a 250 meter (275 yard) wide mixing zone extending no more than 1650 meters (1800 yards) from the point of discharge and 2.2°C(4°F) outside a 125 meter (133 yard) wide mixing zone extending 1190 meters (1300 yards) from the point of discharge. Sampling to assure conformance with mixing zone requirements shall be conducted each year as close to the time of equinoxial tides as practicable and shall reflect the activity of the thermal plume over a 24 hour period.

Results of the monitoring program shall be reported to the State and the Regional Administrator.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Chlorine at the outlet corresponding to an individual unit prior to mixing with other waste streams. Temperature in the common discharge structure for units 1, 2 and 3.

* Serial number 008 assigned for purposes of monitoring and identification.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning July 1, 1977 and lasting through expiration
the permittee is authorized to discharge from outfall(s) serial number(s) 003, 004, 005, 006 & 009* - Low Volume Waste Sources from Generating Units 1, 2 and 3
Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirements	
	Daily Average	Daily Maximum	Measurement Frequency	Sample Type

On or before July 1, 1977, low volume wastes shall be routed to an evaporation/percolation pond from which there is no discharge to navigable waters.

*Serial number assigned for purposes of monitoring and identification.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning July 1, 1977 and lasting through expiration the permittee is authorized to discharge from outfall(s) serial number(s) 006 - Boiler Blowdown from Generating Units 1, 2 and 3

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirements	
	Daily Average	Daily Maximum	Measurement Frequency	Sample Type

On or before July 1, 1977, boiler blowdown shall be routed to an evaporation/percolation pond from which there is no discharge to navigable waters.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning July 1, 1977 and lasting through expiration
the permittee is authorized to discharge from outfall(s) serial number(s) 007 * - Point source(s) runoff from construction

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations	Monitoring Requirements	
	Instantaneous Maximum	Measurement Frequency	Sample Type
Flow—m^3/Day (MGD)	N/A	1/	1/
Total Suspended Solids (mg/l)	50 2/	1/	1/

Construction runoff shall include rainfall runoff discharged to navigable waters through any discernable, confined and discrete conveyance from any construction activity and any earth surface disturbed by such activity from the inception of any construction until any construction is complete and any disturbed earth is returned to a vegetative or other cover commensurate with the intended land use.

These limitations and monitoring requirements shall not apply to any runoff caused by construction of the cooling water discharge structure to the St. Johns River.

1/ Frequency and sample type to be commensurate with the waste treatment system instituted

2/ Applicable to any flow up to and including the flow resulting from a 24-hour rainfall event with a probable recurrance interval of once in ten years. If an impoundment is utilized, it shall be capable of containing the 10 year-24 hour rainfall event.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored continuously or at a lesser frequency commensurate with the waste treatment instituted 2/.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): point(s) of discharge from treatment system prior to mixing with any other waste stream.

* Serial number 007 assigned to all site construction point source runoff for monitoring and identification purposes.

B. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

a. Construction of St. Johns River Discharge

(1) Progress report - 6/31/77
(2) Progress report - 3/31/78
(3) Achieve operational level - 12/31/78

b. Achieve chlorine levels - 6/30/77 (Discharge of cooling water)
c. Chlorine reduction report - 180 days prior to expiration of permit
d. Cease discharge of thermal and chemical effluent to San Carlos Creek - 12/31/78

2. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

Note: Any construction of new waste treatment facilities or alterations to existing waste treatment facilities will require a permit or authorization for construction in accordance with applicable state law and regulations.

C. MONITORING AND REPORTING

1. *Representative Sampling*

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. *Reporting*

Monitoring results obtained during the previous 3 months shall be summarized for each month and reported on a Discharge Monitoring Report Form (EPA No. 3320-1), postmarked no later than the 28th day of the month following the completed reporting period. The first report is due on July 28, 1977 . Duplicate signed copies of these, and all other reports required herein, shall be submitted to the Regional Administrator and the State at the following addresses:

Regional Administrator
Environmental Protection Agency
345 Courtland St., N.E.
Atlanta, GA 30308

AND

Florida Department of Environmental Regulation
Commodore Building, Suite 101
3444 McCrory Place
Orlando, Florida 32803

3. *Definitions*

a. The "daily average" concentration means the arithmetic average (weighted by flow) of all the daily determinations of concentration made during a calendar month. Daily determinations of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the daily determination of concentration shall be the arithmetic average (weighted by flow) of all the samples collected during that calendar day.

b. The "daily maximum" concentration means the daily determination of concentration for any calendar day.

c. "Weighted by flow" means the summation of each sample concentration times its respective flow in convenient units divided by the summation of the flow values.

d. "Nekton" means free swimming aquatic animals whether of freshwater or marine origin.

e. For the purpose of this permit, a calendar day is defined as any 24-hour period.

4. *Test Procedures*

Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(g) of the Act, under which such procedures may be required.

5. *Recording of Results*

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The exact place, date, and time of sampling;

b. The dates the analyses were performed;

c. The person(s) who performed the analyses;

d. The analytical techniques or methods used; and

e. The results of all required analyses.

6. *Additional Monitoring by Permittee*

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form (EPA No. 3320-1). Such increased frequency shall also be indicated.

7. *Records Retention*

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator or the State water pollution control agency.

A. MANAGEMENT REQUIREMENTS

1. *Change in Discharge*

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the permit issuing authority of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. *Noncompliance Notification*

If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum effluent limitation specified in this permit, the permittee shall provide the Regional Administrator and the State with the following information, in writing, within five (5) days of becoming aware of such condition:

a. A description of the discharge and cause of noncompliance; and

b. The period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

3. *Facilities Operation*

The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

4. *Adverse Impact*

The permittee shall take all reasonable steps to minimize any adverse impact to navigable waters resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

5. *Bypassing*

Any diversion from or bypass of facilities necessary to maintain compliance with the terms and conditions of this permit is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall promptly notify the Regional Administrator and the State in writing of each such diversion or bypass.

6. *Removed Substances*

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

7. *Power Failures*

In order to maintain compliance with the effluent limitations and prohibitions of this permit, the permittee shall either:

a. In accordance with the Schedule of Compliance contained in Part I, provide an alternative power source sufficient to operate the wastewater control facilities;

or, if such alternative power source is not in existence, and no date for its implementation appears in Part I,

b. Halt, reduce or otherwise control production and/or all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

B. RESPONSIBILITIES

1. *Right of Entry*

The permittee shall allow the head of the State water pollution control agency, the Regional Administrator, and/or their authorized representatives, upon the presentation of credentials:

a. To enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

b. At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in this permit; and to sample any discharge of pollutants.

2. *Transfer of Ownership or Control*

In the event of any change in control or ownership of facilities from which the authorized discharges emanate, the permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Regional Administrator and the State water pollution control agency.

3. *Availability of Reports*

Except for data determined to be confidential under Section 308 of the Act, all reports prepared in accordance with the terms of this permit shall be available for public

inspection at the offices of the State water pollution control agency and the Regional Administrator. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Act.

4. *Permit Modification*

After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

5. *Toxic Pollutants*

Notwithstanding Part II, B-4 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

6. *Civil and Criminal Liability*

Except as provided in permit conditions on "Bypassing" (Part II, A-5) and "Power Failures" (Part II, A-7), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. *Oil and Hazardous Substance Liability*

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

8. *State Laws*

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. *Property Rights*

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

10. *Severability*

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

PART III

OTHER REQUIREMENTS

A. In the event that waste streams from various sources are combined for treatment or discharge, the quantity of each pollutant or pollutant property attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

B. If the permittee, after monitoring for at least six months, determines that he is consistently meeting the effluent limits contained herein, the permittee may request of the Regional Administrator that the monitoring requirements be reduced to a lesser frequency or be eliminated. Upon written notification by the Regional Administrator, the permittee will monitor as directed.

C. There shall be no discharge of polychlorinated biphenol compounds such as those commonly used for transformer fluid.

D. The company shall notify the Regional Administrator in writing not later than sixty (60) days prior to instituting use of any additional biocide or chemical other than chlorine, which may be toxic to aquatic life other than those previously reported to EPA. Such notification shall include:

1. Name and general composition of biocide or chemical.
2. Frequency of use.
3. Quantities used.
4. Proposed effluent limitations.
5. EPA registration number.

E P.O 1974 - 740-000 / 00 REGION NO 4

E. Intake screen wash water and fish return water shall be returned to San Carlos Creek without limitation or monitoring requirement, except that provisions shall be made to return impinged fish and shellfish to San Carlos Creek in a viable manner.

F. Permittee shall cease all discharges to navigable waters except once-through cooling water, storm water runoff, construction runoff, intake screen wash water treated sanitary waste, fish return water, and mix-cellaneous drains which discharge water meeting both guideline requirements and State water quality standards by June 30, 1977.

G. No later than July 1, 1980, permittee shall submit to the Regional Administrator and the State a report evaluating the effectiveness of the fish return system in minimizing the adverse environmental impact of the intake.

C.4 HISTORICAL WATER QUALITY

Tables C-15 through C-28 contain historical water quality monitoring data which have been collected in the vicinity of the project site. Locations of these sampling sites are shown in Chapter 2, Figures 2.5-13 and 2.5-14. Those STORET stations in the immediate vicinity of the project site are shown in Chapter 2, Figure 2.5-13.

Tables C-15 through C-19 present data collected on the St. Johns River by the U.S. Army Corps of Engineers (COE), the U.S. Environmental Protection Agency (USEPA), and two private engineering companies from 1972 through 1979. Tables C-20 through C-27 present data collected in Browns Creek, Blount Island Channel, Nichols Creek, and San Carlos Creek. These data were collected by the COE and two private engineering companies from 1972 through 1974. Table C-28 presents data obtained from the USEPA STORET water quality data storage and retrieval system. These data were collected at a number of stations in the St. Johns River and the Blount Island Channel.

These data indicate a wide variation in both the types of parameters measured and the range of values for these parameters. These data also indicate several parameters which have had values reported in excess of the Florida Water Quality Criteria for Class III (predominantly marine) Waters. Four parameters, cadmium, mercury, iron, and copper, were measured in excess of their water quality criteria at a number of locations. Three other parameters, lead, total chromium, and arsenic, were found in excess of their water quality criteria at a lesser number of locations, while pH and nickel were reported in excess of their criteria at one location each. Table C-29 lists these nine parameters and the locations at which they have been reported in excess of their water quality criteria.

C.5 ANALYSIS OF MONITORING PROGRAM DATA

Data collected during the pre-application water quality monitoring program are summarized in Tables C-30 through C-34. These data were collected at monitoring sites shown in Chapter 2, Figures 2.5-12 and 2.5-21, and represent two phases of the monitoring program, monitoring of the open waters adjacent to the site, and monitoring of water bodies located on the proposed site.

Two types of samples were collected in the open water monitoring phase, discrete and tide composite. Discrete samples are defined as those collected at any specific time during the day, while tide composite samples are a composite of two samples, one collected at a high tide and the other collected at a low tide on the same day. Tide composite samples are representative of average daily conditions and are useful, therefore, when comparing sampling sites for trends.

Not all samples contained a detectable concentration of each parameter measured during the analysis. For statistical analyses when a sample contained an undetectable concentration of a chemical parameter, the mean value was conservatively estimated by substituting a real number for the undetectable value. This real number was determined by subtracting 0.01 from those detection limits expressed in terms of tenths of a part (0.1, etc.) or by subtracting 0.001 from those detection limits expressed in terms of hundredths of a part (0.01, etc.). Thus, a parameter which had no detectable measurement and which had a detection limit of 0.2 mg/l was represented by the number 0.19 mg/l, etc.

A discussion of those parameters observed in excess of their water quality criteria can be found in Chapter 2, Section 2.5.1.5. Chapter 2, Table 2.5-3 compares the mean and maximum values of these parameters to their water quality standards as defined in Chapter 2, Table 2.5-1.

Another observation which can be made from the water quality monitoring data is the presence of a salt "front" in the Blount Island Channel. By comparing the mean tide composite values for conductivity, salinity, and chlorides at Station F-2, Transect G, and Station H-2, it can be seen that each of these parameters has the highest mean value at Station H-2 (most downstream station) and the lowest mean value at Station F-2 (most upstream station). Furthermore, at each of these stations the mean bottom values are higher than the mean top values for each of the three parameters. This would be expected in an estuarine environment characterized by freshwater flowing into (and on top of) salt water.

Two statistical analyses were performed to determine the reliability of data collected in the open water. Using all salinity data collected at Transect G, a histogram plot and a normal probability plot were calculated. The histogram plot (Figure C-37), which plots salinity in parts per thousand versus the percent relative frequency, illustrates the central tendency of the salinity data. The mean value for all salinity data collected at Transect G, as computed by the computer program which developed the histogram plot, is equal to 23 ppt. The normal probability plot (Figure C-38) represents another measure of the distribution of the salinity data. In general, if a straight line can be drawn through the plotted points on a normal probability plot, then the data suggests a normal distribution.

Water quality data collected at the on-site water bodies and PCB data, as presented in Tables C-33 and C-34, are discussed in Chapter 2, Section 2.5.1.7, On-Site Water Bodies.

Elutriate tests were performed on four core soil samples taken in the proposed dredge area for the ocean vessel unloading facility. The surface water in this area was analyzed to determine background concentrations of selected parameters, then was used to produce the elutriate from the core samples. The procedure employed for these tests is described in Chapter 6, Section 6.2.4. Table C-35 presents the results of the chemical analyses

for the core samples taken at locations BI-4 and BI-6 as indicated in Appendix E, Figure E-19. In addition, those parameters whose concentrations exceed water quality standards (Chapter 2, Table 2.5-1) are identified in Table C-35. The impacts of these results on surface water quality are discussed in Chapter 4, Section 4.4.

C.6 IMPACTS ON SURFACE WATER QUALITY

Impacts on surface water quality of the St. Johns River associated with operation of the proposed plant will occur within a given area of mixing, or mixing zone, containing the existing submerged point of discharge (POD) of the NGS. The methodology used to calculate chemical concentrations at the POD, the areal extent of mixing, the impacts on the surface water quality of the St. Johns River, and the conditions in conjunction with the assessment are discussed below.

To assess the impact on chemical water quality of the St. Johns River resulting from operation of the proposed plant, it was necessary to calculate POD chemical concentrations. As noted in Chapter 3, Section 3.5, and shown schematically in Chapter 3, Figure 3.3-1, the proposed plant is integrated with the NGS circulating water system. The defined POD of the proposed plant is, therefore, through the existing submerged diffuser. As a result, POD flows and chemical concentrations calculated below and in Chapter 5, Section 5.1.3 represent combined discharges from both NGS and the proposed plant. The mathematical models described below, termed AVGPOD and MAXPOD, were used to estimate average and maximum POD chemical concentrations, respectively.

Figure C-39 is a diagramatic representation of the proposed plant. The major plant water and wastewater loops considered in the AVGPOD and MAXPOD modelling are identified and are assigned appropriate subscript identifiers (i.e., Q_m is volumetric makeup water flow to the cooling towers and C_m is the concentration of a given chemical parameter in the cooling tower makeup water). The surface water makeup to the proposed plant is withdrawn from the NGS discharge channel. Therefore, the chemical characteristics of the surface water makeup are essentially equal to those of the NGS discharge, or stated mathematically:

$$C_m = C_n \qquad \text{(C.6-1)}$$

where C_n = Concentration of a given parameter in NGS discharge

C_m = Concentration of a given parameter in surface water makeup to proposed plant

For the purpose of this modelling, it has been assumed that there are no changes in chemical concentrations as the water passes through NGS. Thus the following is true:

$$C_n = C_i \qquad \text{(C.6-2)}$$

where C_i = Concentration of a given parameter in ambient surface water from St. Johns River at Transect G

Therefore, the concentration for any conservative chemical parameter at the POD can be obtained by use of a straight-forward mixing equation. In terms of mass balance, Eqs. C.6-1 and C.6-2 can be restated with volumetric flows to yield:

$$(Q_n - Q_m)C_n + Q_{bc}C_{bc} = (Q_m - Q_m + Q_{bc})C_d \qquad \text{(C.6-3)}$$

where Q_d = Volumetric flow of discharge at POD

Q_m = Volumetric flow of makeup to proposed plant

Q_n = Volumetric flow from NGS circulating water system

Q_{bc} = Volumetric flow of total wastewater streams from the proposed plant

C_d = Concentration of a given parameter at POD to St. Johns River

C_{bc} = Concentration of a given parameter within the total wastewater stream from the proposed plant before mixing with the NGS discharge

Values of C_d for any conservative chemical parameter in any given NGS operating mode were calculated using the following relationship:

$$C_d = \frac{(Q_n Q_m)C_n + Q_{bc}C_{bc}}{Q_n - Q_m + Q_{bc}} \qquad (C.6\text{-}4)$$

The value of Q_n is set by selecting a given mode for NGS operation (e.g. mode 1 through 5) and by selecting a given set of proposed plant operating conditions. The wastewater streams contributing to the combined flow from the plant are the cooling tower blowdown, the chemical wastewater treatment facility effluent, the treated sanitary effluent and the discharge from the oily wastewater collection basin. Stated mathematically this relationship is:

$$Q_{bc}C_{bc} = Q_bC_b + Q_{ow}C_{ow} + Q_wC_w + Q_sC_s \qquad (C.6\text{-}5)$$

where C_b = Concentration of a given parameter in the proposed plant cooling tower blowdown

C_{ow} = Concentration of a given parameter from the oily wastewater collection basin

C_w = Concentration of a given parameter in chemical wastewater treatment facility effluent

C_s = Concentration of a given parameter in the treated sanitary effluent

Q_b = Volumetric flow of cooling tower blowdown

Q_{ow} = Volumetric flow from oily wastewater collection basin

Q_w = Volumetric flow from chemical wastewater treatment facility

Q_s = Volumetric flow of treated sanitary effluent

The value for C_b was calculated using:

$$C_b = \frac{Q_m C_m - Q_e C_e - Q_{dr} C_{dr}}{Q_b} \qquad \text{(C.6-6)}$$

where C_{dr} = Concentration of a given parameter in cooling tower drift

C_e = Concentration of a given parameter in evaporation from cooling tower

C_m = Concentration of a given parameter in surface water makeup to cooling tower

Q_{dr} = Volumetric flow of drift from cooling tower

Q_e = Volumetric flow of evaporation from cooling tower

Q_m = Volumetric flow of makeup to cooling towers

The design drift rate from the cooling towers is estimated at 0.002 percent of the total proposed plant circulating water flow of 212,400 gpm (Chapter 3, Section 3.4.1), or about 4 gpm of drift from each tower. The total 8 gpm is not significant compared to the evaporation (10,519 gpm average, see Chapter 3, Table 3.4-1), or the makeup (34,400 gpm average, Chapter 3, Section 3.3). Therefore, Q_{dr} is set equal to zero in Eq. C.6-6. Also, by definition, conservative chemical parameters are not present in the evaporation and C_e is equivalent to zero. Eq. C.6-6 then becomes:

$$C_b = \frac{Q_m C_m}{Q_b} \qquad (C.6\text{-}7)$$

The value of C_w is calculated using the following relationship:

$$C_w = \frac{(Q_{eq} C_{eq} + Q_{cp} C_{cp})\ (f)}{Q_w} \qquad (C.6\text{-}8)$$

where C_{cp} = Concentration of a given parameter in effluent from coal pile runoff sediment control pond

C_{eq} = Concentration of a given parameter in effluent from equalization basin

Q_{cp} = Volumetric flow for effluent from coal pile runoff sediment control pond

Q_{eq} = Volumetric flow for effluent fron equalization basin

f = Percent removal efficiency estimated for a given parameter in the chemical wastewater treatment facility (see Table C-36b)

$Q_w = Q_{cp} + Q_{eq}$

By substitution of Eq. C.6-7 and C.6-8 into Eq. C.6-5, a value for C_{bc} was determined with:

$$C_{bc} = \frac{(Q_b C_b + K_1 + K_2)}{Q_{bc}} \qquad (C.6\text{-}9)$$

where $K_1 = Q_{ow} C_{ow} + Q_s C_s$

$K_2 = Q_{eq} C_{eq} + Q_{cp} C_{cp}$

Substituting C_{bc} in Eq. C.6-9 for C_{bc} in Eq. C.6-4, and recognizing C_m is equal to C_n, yields:

$$C_d = \frac{(Q_n Q_m)\ C_n + Q_b\ C_b + K_1 + K_2}{Q_d} \qquad \text{(C.6-10)}$$

Where:

$$Q_d = Q_n - Q_m + Q_{bc}$$

Solving Equation C.6-10 provides the concentration for a given chemical parameter at the POD to the St. Johns River.

Table C-36 is a listing, according to major plant stream, of chemical data input to AVGPOD and MAXPOD, and intermediate values calculated (e.g., concentrations in cooling tower blowdown and FGD system blowdown). Volumetric flows as well as other plant operating conditions used to calculate C_d are presented in Table C-37. Results from analyses of POD concentrations, C_d, for average and maximum plant operating conditions are presented in Table C-38. These data are used to construct Tables 5.1-8 and 5.1-9, in Chapter 5, Section 5.1.3, which serve to demonstrate Class III water quality compliance at the POD.

An assessment was made of each chemical parameter exceeding Class III water quality standards to determine its impact on water quality within a specific mixing zone. The Nagel model as discussed in Appendix C.1 was used to predict the areal extent of the chemical plume. Minor modifications in the model, renamed MZ%, were made to accommodate the presentation of chemical data. The modifications introduced required the calculation of a dimensionless number referred to as the dilution factor. For all MZ% model runs an area enclosed by each isotherm was calculated and a corresponding dilution factor was determined using the following relationship:

$$D = (T_d - T_p)/(T_p - T_i) \qquad \text{(C.6-12)}$$

where D = Dilution Factor

T_d = Temperature at POD to St. Johns River

T_i = Ambient temperature in St. Johns River

T_p = Temperature in plume

By translating the dilution factor obtained in the thermal model into one incorporating chemical parameters, it was possible to predict chemical concentration within a given area. For each dilution factor the concentration of a chemical parameter enclosed by a specific area was found by using:

$$C_p = \frac{C_d + (D)(C_i)}{(1 + D)} \qquad \text{(C.6-13)}$$

where C_d = Concentration of a given parameter at the POD to the St. Johns River

C_i = Ambient concentration of a given parameter in the St. Johns River

C_p = Concentration of a given parameter within the mixing zone

As seen in Figures C-1, C-2 and C-3, NGS thermal plumes in the river take on irregular shapes and occur in varying locations within the channel. Because of this dynamic situation, it is more useful to describe a zone within which a plume is predicted to occur, rather than to draw a regular shape to describe a specific predicted plume. For purposes of further discussion, the zone within which a plume can occur will be referred to as the predicted mixing zone, and the plume will be referred to as the predicted mixing area. The areal extent of each predicted mixing

zone was calculated through the use of the model MZ%. Because these mixing zones represent areas within which the predited mixing areas can occur, they therefore are conservative and represent larger surface areas than the predicted mixing areas. The same procedure was utilized by USEPA and FDER to delineate the permitted thermal mixing zone for the NGS NPDES Permit (Section C.3).

Figures C-40 and C-41 illustrate the estimated boundaries of the predicted mixing zones in the St. Johns River for maximum and average combined proposed plant and NGS operating conditions. The dimensions and areas of these predicted mixing zones and predicted mixing areas, as well as the associated dilution factors and concentrations for those chemical parameters exceeding their respective water quality standards, are listed in Tables C-39 and C-40. Table C-41 describes the seasonal influence of the St. Johns River mixing zone on various chemical parameters in the vicinity of the POD for the average case, while Figures C-42 through C-49 are graphical presentations of the mixing zone for the maximum case (i.e., minimum dilution).

The analyses of average case conditions, as presented in Table C-41, show copper, total residual chlorine, cyanide, iron, mercury and silver exceed Class III water quality standards at the POD. Cyanide is predicted to be at ambient mean river concentrations at the POD; therefore, no influence from mixing is possible. Ambient mean river water concentrations for copper, total residual chlorine, iron, mercury, and silver are found to exceed Class III standards. In every instance, the influence of mixing in the St. Johns River is such that plume concentrations are nearly equal to ambient levels in less than three acres. This rapid approach of plume concentrations to ambient concentrations is predicted to occur during each of the four seasons. This approach to ambient holds even though changes in the areal extent of the plume are predicted due to seasonal temperature differentials at the POD (Chapter 5, Section 5.1.2 and Appendix C.1).

For maximum case analyses in the mixing zone, several factors were evaluated to best represent minimum dilution and consequently, maximum concentrations in the plume. NGS operation in mode 4 (98,000 gpm) was selected to provided minimum dilution in the discharge channel. Also, plume conditions for February with combined plant flow were found to give the maximum areal extent for the plume (see Appendix C.1). Furthermore, both the operating case of discharge and zero discharge from areas producing rainfall runoff were assessed to determine which would yield higher concentrations.

The results of analyses for maximum case conditions are presented in Figures C-42 through C-49. Aluminum, total residual chlorine, chloride, copper, cyanide, iron, mercury, oil and grease, selenium, and silver are the ten chemical parameters found to exceed Class III standards at the POD under maximum conditions. In every case, except chloride and selenium, the ambient levels of these parameters are also in excess of Class III standards. Chlorine and selenium will meet Class III standards with a mixing zone of approximately 80 square meters. The other parameters exhibit a rapid approach to ambient levels within a 31 acre, 125,600 square meter, mixing zone. However, with ambient river water above Class III standards, these eight parameters cannot meet the standards at the mixing zone boundary.

C.7 EXAMPLE OF RESULTS OF CURRENT DATA ANALYSIS

This section presents monthly time series plots of current data for each station in two-hour intervals as Figures C-50 through C-62. Each figure represents a month. The "blanks" in these figures depict unrecovered data. In these figures, the abscissa is the day of the month under consideration. The vertical axis refers to true north direction. The current speed can be estimated from the scale marked along the ordinate. The data recovery rate is shown in the following table:

Current Data Recovery Rate (%)

Station:	PKL	PKU	SCC	NBU	NBL	BIS	INT
Month							
9/79	18	18	15	*	*	*	*
10/79	100	100	4	*	*	*	*
11/79	100	100	79	41	85	*	*
12/79	100	98	86	65	100	*	*
1/80	100	100	87	98	100	*	*
2/80	100	100	90	99	99	*	*
3/80	100	100	88	100	100	*	*
4/80	97	96	82	100	97	71	68
5/80	90	90	26	90	89	90	86
6/80	94	94	72	29	58	84	19
7/80	83	83	66	72	88	80	83
8/80	98	98	89	100	100	95	*
9/80	93	93	88	14	94	90	81

* Unrecovered data

C.7 EXAMPLE OF RESULTS OF CURRENT DATA ANALYSIS

This section presents monthly time series plots of current data for each station in two-hour intervals as Figures C-50 through C-62. Each figure represents a month. The "blanks" in these figures depict unrecovered data. In these figures, the abscissa is the day of the month under consideration. The vertical axis refers to true north direction. The current speed can be estimated from the scale marked along the ordinate. The data recovery rate is shown in the following table:

Current Data Recovery Rate (%)

Station:	PKL	PKU	SCC	NBU	NBL	BIS	INT
Month							
9/79	18	18	15	*	*	*	*
10/79	100	100	4	*	*	*	*
11/79	100	100	79	41	85	*	*
12/79	100	98	86	65	100	*	*
1/80	100	100	87	98	100	*	*
2/80	100	100	90	99	99	*	*
3/80	100	100	88	100	100	*	*
4/80	97	96	82	100	97	71	68
5/80	90	90	26	90	89	90	86
6/80	94	94	72	29	58	84	19
7/80	83	83	66	72	88	80	83
8/80	98	98	89	100	100	95	*
9/80	93	93	88	14	94	90	81

* Unrecovered data

C.8 EXAMPLES OF RESULTS OF TEMPERATURE DATA ANALYSIS

Continuous water temperature data was recorded from September, 1979 to October, 1980 at the station locations shown in Figure 6.2-1. Monthly time series plots of temperature data for each station are presented in Figures C-66 through C-78. Each figure represents a month of data. The "blanks" in these figures depict unrecovered data. Data are plotted in three hour intervals. The data recovery rate (i.e., actually recorded hours/total hour of month) at each observing station is as follows:

Temperature Data Recovery Rate (%)

Station:	BCB	SCT	DIS	INT	NBU	PKU	PKL	BIS	NBL
Month									
9/79	*	21	*	18	*	18	18	*	*
10/79	*	100	*	57	*	100	100	*	*
11/79	85	93	85	*	85	100	100	*	*
12/79	99	100	34	66	100	100	85	*	*
1/80	98	100	*	100	100	100	100	*	*
2/80	97	97	50	95	100	100	100	*	*
3/80	100	100	100	100	100	100	100	*	*
4/80	97	97	97	97	97	97	97	72	*
5/80	90	91	91	92	90	60	90	90	*
6/80	98	98	98	98	64	*	98	98	*
7/80	86	*	87	86	64	86	*	86	64
8/80	99	99	99	99	99	100	*	99	100
9/80	93	12	93	93	96	93	*	93	96

* Unrecovered data

The following two sections are a sample of the temperature statistical and persistence analyses which was performed. There are two such tables, for each station, for each month, on file in the Atlanta Envirosphere office.

C.8.1 Temperature Statistical Analysis - Example

** MONTH/YEAR = 10 / 79 REQUIRED ID = PRIM SAMPLING INTERVAL = 1 HR **

MONTHLY STATISTICS

TEMPERATURE (F)	PERSISTENCE (HRS)	PERSISTENCE (%)	CUMULATIVE (HRS)	CUMULATIVE (%)
> 81	[illegible]	1.3	[illegible]	5.3
> 79	[illegible]	16.7	[illegible]	16.3
> 77	[illegible]	33.9	[illegible]	44.4
> 75	[illegible]	66.7	[illegible]	72.5
> 73	744.0	100.0	744.0	100.0

TEMPERATURE MAX = [illegible] MIN = 72.5 MEAN = 77.0 STDV = 2.8

DAILY STATISTICS

DAY	HOURS	MAX	MIN (DEG. F)	MEAN	STDV
1	24	81.9	76.6	81.2	0.4
2	24	81.7	76.3	81.0	0.3
3	24	81.3	76.3	81.1	0.4
4	24	81.4	75.9	81.5	0.4
5	24	81.2	75.9	81.0	0.4
6	24	81.0	75.4	78.0	0.4
7	24	79.9	77.8	78.5	0.5
8	24	79.9	76.9	77.5	0.5
9	24	79.5	76.7	77.5	0.5
10	24	78.1	76.4	77.3	0.4
11	24	78.6	76.3	77.4	0.4
12	24	78.9	75.7	77.4	0.5
13	24	79.0	75.4	77.4	0.5
14	24	78.8	75.3	77.3	0.5
15	24	77.9	74.2	75.5	0.9
16	24	77.1	74.2	75.5	0.8
17	24	76.4	74.2	75.5	0.6
18	24	76.5	74.2	75.5	0.6
19	24	75.9	74.2	75.3	0.5
20	24	75.5	75.0	75.3	0.3
21	24	77.7	75.0	75.5	0.4
22	24	78.3	75.0	76.4	0.5
23	24	79.0	75.5	77.5	0.5
24	24	77.8	74.0	75.7	0.6
25	24	75.6	74.0	74.6	0.4
26	24	74.9	73.5	74.2	0.3
27	24	74.7	73.5	74.1	0.3
28	24	75.1	73.7	74.2	0.4
29	24	75.3	73.7	74.2	0.4
30	24	75.3	73.7	74.2	0.4
31	24	75.3	73.7	74.2	0.4

C.8.2 Temperature Persistence Analysis - Example

** MONTH/YEAR = 10 / 79 RECORDER ID = PRI SAMPLING INTERVAL = 1 HR **

SEQUENCE OF PERSISTENCE IN HOUR AND STARTING DATE(DAY-HOUR)

> 81.
6. (1- 1) 6. (1- 7) 4. (1-22) 1. (2- 4) 1. (5-18)
4. (2-23) 7. (7-10) 4. (3-23) 1. (4-14) 1. (5-19)

> 79.
124. (1- 1) 6. (5-14) 1. (7- 3) 2. (7-15) 1. (7-21)
2. (11-22)

> 77.
178. (1- 1) 20. (8-23) 17. (9-15) 1. (10-11) 17. (10-16)
12. (11-15) 6. (12- 4) 5. (12-17) 7. (12-18) 2. (13- 2)
17. (13- 9) 1. (14- 4) 1. (14-10) 1. (14-14) 1. (14-22)
1. (16-16) 8. (22-15) 4. (23- 3) 4. (23- 9) 18. (23-16)
1. (24-10) 8. (24-18) 1. (25- 5) 1. (25-17) 1. (25-22)

> 75.
340. (1- 1) 8. (15- 9) 9. (15-22) 2. (16-11) 4. (16-24)
2. (17- 5) 20. (17-12) 11. (17-24) 21. (18-12) 148. (19-17)
6. (26-19) 2. (27- 4) 1. (27-10) 1. (30-24) 1. (31-23)

> 73.
744. (1- 1)

C.9 BATHYMETRY AND TIDAL STAGES

Figure C-79 portrays the results of a bathymetric survey performed in 1973 for the vicinity of the Northside Station thermal plume. Comparison of Figures 2.5-4 and C.79 indicates there has been little change in bathymetry in the Northside thermal plume area over the past seven years.

Table C-42 is a sample comparison for tidal heights and times as predicted at Mayport and heights and times as measured at the site. The table shows that time of occurrence of low tide at the site follows that at Mayport by an average of 1 hour 18 minutes, with a range between 52 minutes and 2 hours 13 minutes. Similarly, high tide at the site follows that at Mayport by an average of 45 minutes, with a range between 24 minutes and 1 hour 13 minutes. These results are representative for the rest of the data.

Table C-43 is a comparison of the tidal ranges corresponding to the times and heights of Table C-42. The ratio of range at the site to range at Mayport is more uniform than the difference between the ranges. The average ratio of the ranges is 0.834, with a maximum of 0.96 and a minimum of 0.72. These results are also representative for the rest of the data.

Reasonable predictions for the tidal stage at the site, based on the Department of Commerce predictions for Mayport, can be made from the corrections shown in Table C-44.

C.10 REFERENCES

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Table C-1

MEASURED[a] AND ALLOWED EXTENT[b] OF NORTHSIDE STATION THERMAL DISCHARGE

Isotherm	1	2	3
2°F Area (Acres) - Allowed	102.27	102.27	102.27
2°F Area (Acres) - Measured	1.9 acres	6.9 acres	5.4 acres
2°F Width (feet) - Allowed	825	825	825
2°F Width (feet) - Measured	400	300	240
2°F Length (feet) - Allowed	5400	5400	5400
2°F Length (feet) - Measured	640	2250	2300
4°F Width (feet) - Allowed	399	399	399
4°F Width (feet) - Measured	50	24	190
4°F Length (feet) - Allowed	3900	3900	3900
4°F Length (feet) - Measured	300	440	530

a Measured during thermal surveys of September 3-4, 1980
b Allowed by existing Northside Station NPDES permit

Table C-2

NORTHSIDE OPERATING CIRCULATING WATER FLOW RATES[a]

Case Mode	Throttled	Unthrottled
1	392,000	560,000
2	294,000	420,000
3	196,000	280,000
4	98,000	140,000

a Flows in gpm

Table C-3 (Revision 1)

PREDICTED AVERAGE THERMAL DISCHARGE CHARACTERISTICS BY MONTH - NGS MODE 5[a]

	Northside Discharge			Combined Discharge		
Month	Delta T (°F)	Flow[b] (gpm)	Heat Load (MBtu/hr)	Delta T (°F)	Combined[b] Flow (gpm)	Heat Load (MBtu/hr)
Jan	0.0	98000	0	4.4	86455	217
Feb	0.0	98000	0	4.1	87071	201
Mar	0.0	98000	0	4.2	86414	208
Apr	0.0	98000	0	2.6	86140	127
May	0.0	98000	0	1.8	86098	88
Jun	0.0	98000	0	1.8	85910	89
Jul	0.0	98000	0	1.1	85830	54
Aug	0.0	98000	0	1.1	85874	54
Sep	0.0	98000	0	1.3	85914	63
Oct	0.0	98000	0	1.6	86198	79
Nov	0.0	98000	0	1.8	86369	89
Dec	0.0	98000	0	2.7	86496	130

a Based on Tables 3.4-2 and 5.1-2
b Assumed a minimum of 98000 gpm will be provided by Northside Station circulating water pumps at all times

Table C-4 (Revision 1)

PREDICTED AVERAGE THERMAL DISCHARGE CHARACTERISTICS BY MONTH - NGS MODE 4[a]

	Northside Discharge			Combined Discharge		
Month	Delta T (°F)	Flow (gpm)	Heat Load (MBtu/hr)	Delta T (°F)	Combined Flow (gpm)	Heat Load (MBtu/hr)
Jan	10.8	98000	531	12.7	86455	549
Feb	10.3	98000	506	11.8	87071	517
Mar	8.5	98000	418	10.8	86414	469
Apr	10.0	98000	491	10.1	86140	434
May	11.0	98000	540	9.9	86098	426
Jun	11.1	98000	545	10.0	85910	430
Jul	12.9	98000	634	10.5	85830	450
Aug	13.7	98000	673	11.0	85874	475
Sep	16.4	98000	806	13.2	85914	567
Oct	147	98000	722	12.3	86198	530
Nov	7.9	98000	388	7.7	86369	332
Dec	9.1	98000	447	9.5	86496	410

a Derived from Tables 3.4-2 and 5.1-2

Table C-5 (Revision 1)

PREDICTED AVERAGE THERMAL DISCHARGE CHARACTERISTICS BY MONTH - NGS MODE 3[a]

	Northside Discharge			Combined Discharge		
Month	Delta T (°F)	Flow (gpm)	Heat Load (MBtu/hr)	Delta T (°F)	Combined Flow (gpm)	Heat Load (MBtu/hr)
Jan	10.8	196000	1060	11.7	184455	1080
Feb	10.3	196000	1010	11.0	185071	1020
Mar	8.5	196000	835	9.6	184414	887
Apr	10.0	196000	983	10.0	184140	926
May	11.0	196000	1080	10.5	184098	967
Jun	11.1	196000	1090	10.6	183910	975
Jul	12.9	196000	1270	11.8	183830	1080
Aug	13.7	196000	1350	12.5	183874	1150
Sep	16.4	196000	1610	14.9	183914	1370
Oct	14.7	196000	1440	13.6	184198	1250
Nov	7.9	196000	776	7.8	184369	720
Dec	9.1	196000	894	9.3	184496	857

a Derived from Tables 3.4-4 and 5.1-2

Table C-6 (Revision 1)

PREDICTED AVERAGE THERMAL DISCHARGE CHARACTERISTICS BY MONTH - NGS MODE 2[a]

	Northside Discharge			Combined Discharge		
Month	Delta T (°F)	Flow (gpm)	Heat Load (MBtu/hr)	Delta T (°F)	Combined Flow (gpm)	Heat Load (MBtu/hr)
Jan	10.8	294000	1590	11.4	282455	1610
Feb	10.3	294000	1520	10.8	283071	1530
Mar	8.5	294000	1250	9.2	282414	1300
Apr	10.0	294000	1470	10.0	282140	1420
May	11.0	294000	1620	10.7	282098	1510
Jun	11.1	294000	1640	10.8	281910	1520
Jul	12.9	294000	1900	12.2	281830	1720
Aug	13.7	294000	2020	12.9	281874	1820
Sep	16.4	294000	2420	15.4	281914	2180
Oct	14.7	294000	2170	14.0	282198	1970
Nov	7.9	294000	1160	7.8	282369	1110
Dec	6.3	294000	1340	9.2	282496	1300

a Derived from Tables 3.4-2 and 5.1-2

Table C-7 (Revision 1)

PREDICTED AVERAGE THERMAL DISCHARGE CHARACTERISTICS BY MONTH - NGS MODE 1[a]

	Northside Discharge			Combined Discharge		
Month	Delta T (°F)	Flow (gpm)	Heat Load (MBtu/hr)	Delta T (°F)	Combined Flow (gpm)	Heat Load (MBtu/hr)
Jan	10.8	392000	2120	11.2	380455	2140
Feb	10.3	392000	2020	10.7	381071	2040
Mar	8.5	392000	1670	9.0	380414	1720
Apr	10.0	392000	1970	10.0	380140	1910
May	11.0	392000	2160	10.7	380098	2050
Jun	11.1	392000	2180	10.8	379910	2070
Jul	12.9	392000	2540	12.3	379830	2350
Aug	13.7	392000	2690	13.1	379874	2490
Sep	16.4	392000	3220	15.7	379914	2980
Oct	14.7	392000	2890	14.1	380198	2700
Nov	7.9	392000	1550	7.8	380369	1500
Dec	9.1	392000	1790	9.2	380496	1750

a Derived from Tables 3.4-2 and 5.1-2

Table C-8 (Revision 1)

PREDICTED MAXIMUM THERMAL DISCHARGE CHARACTERISTICS BY MONTH - NGS MODE 5[a]

	Northside Discharge			Combined Discharge		
Month	Delta T (°F)	Flow[b] (gpm)	Heat Load (MBtu/hr)	Delta T (°F)	Combined[b] Flow (gpm)	Heat Load (MBtu/hr)
Jan	0.0	98000	0	9.9	86765	432
Feb	0.0	98000	0	11.6	86201	500
Mar	0.0	98000	0	11.0	85967	476
Apr	0.0	98000	0	8.1	85829	350
May	0.0	98000	0	7.6	85806	327
Jun	0.0	98000	0	7.5	85443	320
Jul	0.0	98000	0	8.7	85805	373
Aug	0.0	98000	0	8.5	85566	365
Sep	0.0	98000	0	9.5	85699	407
Oct	0.0	98000	0	8.0	85850	344
Nov	0.0	98000	0	5.8	86387	251
Dec	0.0	98000	0	7.6	86496	328

a Derived from Tables 3.4-4 and 5.1-2

b Assumed a minimum of 98000 gpm will be provided by Northside Station circulating water pumps at all times

Table C-9 (Revision 1)

PREDICTED MAXIMUM THERMAL DISCHARGE CHARACTERISTICS BY MONTH - NGS MODE 4[a]

	Northside Discharge			Combined Discharge		
Month	Delta T (°F)	Flow (gpm)	Heat Load (MBtu/hr)	Delta T (°F)	Combined Flow (gpm)	Heat Load (MBtu/hr)
Jan	8.8	98000	432	9.9	86765	432
Feb	9.8	98000	481	11.6	86201	500
Mar	10.3	98000	506	11.0	85967	476
Apr	8.5	98000	418	8.1	85829	350
May	9.0	98000	442	7.6	85806	327
Jun	9.1	98000	447	7.5	85443	320
Jul	12.8	98000	629	8.7	85805	373
Aug	12.8	98000	629	8.5	85566	365
Sep	14.5	98000	712	9.5	85699	407
Oct	10.7	98000	526	8.0	85850	344
Nov	5.1	98000	251	5.8	86387	251
Dec	6.3	98000	310	7.6	86496	328

a Derived from Tables 3.4-1 and 5.1-2

Table C-10 (Revision 1)

PREDICTED MAXIMUM THERMAL DISCHARGE CHARACTERISTICS BY MONTH - NGS MODE 3[a]

	Northside Discharge			Combined Discharge		
Month	Delta T (°F)	Flow (gpm)	Heat Load (MBtu/hr)	Delta T (°F)	Combined Flow (gpm)	Heat Load (MBtu/hr)
Jan	8.8	196000	865	9.4	184765	873
Feb	9.8	196000	963	10.8	184201	996
Mar	10.3	196000	1010	10.7	183967	988
Apr	8.5	196000	835	8.3	183829	765
May	9.0	196000	884	8.2	183806	758
Jun	9.1	196000	894	8.2	183443	754
Jul	12.8	196000	1260	10.5	183805	968
Aug	12.8	196000	1260	10.4	183566	959
Sep	14.5	196000	1420	11.7	183699	1080
Oct	10.7	196000	1050	9.2	183850	848
Nov	5.1	196000	501	5.5	184387	508
Dec	6.3	196000	619	7.0	184496	647

a Derived from Tables 3.4-4 and 5.1-2

Table C-11 (Revision 1)

PREDICTED MAXIMUM THERMAL DISCHARGE CHARACTERISTICS BY MONTH - NGS MODE 2[a]

	Northside Discharge			Combined Discharge		
Month	Delta T (°F)	Flow (gpm)	Heat Load (MBtu/hr)	Delta T (°F)	Combined Flow (gpm)	Heat Load (MBtu/hr)
Jan	8.8	294000	1300	9.2	282765	1310
Feb	9.8	294000	1440	10.5	282201	1480
Mar	10.3	294000	1520	10.6	281967	1500
Apr	8.5	294000	1250	8.4	281829	1180
May	9.0	294000	1330	8.5	281806	1200
Jun	9.1	294000	1340	8.5	281443	1200
Jul	12.8	294000	1890	11.2	281805	1580
Aug	12.8	294000	1890	11.2	281566	1570
Sep	14.5	294000	2140	12.6	281699	1770
Oct	10.7	294000	1580	9.7	281850	1360
Nov	5.1	294000	752	5.4	282387	760
Dec	6.3	294000	929	6.8	282496	961

a Derived from Tables 3.4-4 and 5.1-2

Table C-12 (Revision 1)

PREDICTED MAXIMUM THERMAL DISCHARGE CHARACTERISTICS BY MONTH - NGS MODE 1[a]

	Northside Discharge			Combined Discharge		
Month	Delta T (°F)	Flow (gpm)	Heat Load (MBtu/hr)	Delta T (°F)	Combined Flow (gpm)	Heat Load (MBtu/hr)
Jan	8.8	392000	1730	9.1	380765	1740
Feb	9.8	392000	1930	10.3	380201	1970
Mar	10.3	392000	2020	10.5	379967	2000
Apr	8.5	392000	1670	8.4	379829	1600
May	9.0	392000	1770	8.6	379806	1640
Jun	9.1	392000	1790	8.6	379443	1640
Jul	12.8	392000	2520	11.6	379805	2210
Aug	12.8	392000	2520	11.5	379566	2200
Sep	14.5	392000	2850	13.0	379699	2480
Oct	10.7	392000	2100	9.9	379850	1890
Nov	5.1	392000	1000	5.3	380387	1010
Dec	6.3	392000	1240	6.7	380496	1270

a Derived from Tables 3.4-4 and 5.1-2

Table C-13

WATER QUALITY CHEMICAL ANALYSES SAMPLES
CONTAINERS AND PRESERVATION TECHNIQUES

Parameters	Container and Preservation
Total Dissolved Solids Total Suspended Solids Total Hardness Alkalinity BOD_5 Total Residual Chlorine Nitrate Nitrite Sulfate Chloride Bicarbonate Silica (dissolved) Calcium Magnesium	1 gallon polyethylene jug. Cool in ice chest.
Sulfide	Remove 4 ounces of sample. Add 0.5 ml of 2N zinc acetate
Oil and Grease Total Phosphorus Kjeldahl Nitrogen Ammonia Nitrogen Copper (total) Iron (total)	5 pint glass jug. Cool in ice chest. 6 ml (1+1) H_2SO_4 included in jug as preservative.
Fecal Coliform Total Coliform	8 ounce sterile bottle. Cool in ice chest.
Bromide Fluoride	1 quart polyethylene bottle. Cool in ice chest.
Phenols	1 quart glass bottle. 1 ml (1+1) H_2SO_4 and 1 g $CuSO_4$ included as preservative. Cool in ice chest.
Cyanide	1 quart polyethylene bottle. 2 ml 10N NaOH included. Cool in ice chest.

Table C-13 (Continued)

WATER QUALITY CHEMICAL ANALYSES SAMPLES
CONTAINERS AND PRESERVATION TECHNIQUES

Parameters	Container and Preservation
Antimony Arsenic Beryllium Boron Cadmium Chromium (total) Chromium (hexavalent) Lead Manganese Mercury Nickel Potassium Selenium Silver Sodium Zinc	1 gallon polyethylene jug. 12 ml (1+1) HNO_3 included as preservative. Cool in ice chest.

Table C-13 (Continued)

WATER QUALITY CHEMICAL ANALYSES SAMPLES
CONTAINERS AND PRESERVATION TECHNIQUES

Parameters	Container and Preservation
Antimony Arsenic Beryllium Boron Cadmium Chromium (total) Chromium (hexavalent) Lead Manganese Mercury Nickel Potassium Selenium Silver Sodium Zinc	1 gallon polyethylene jug. 12 ml (1+1) HNO_3 included as preservative. Cool in ice chest.

Table C-14

LABORATORY QUALITY CONTROL ANALYTICAL RESULTS
(Concentration in mg/l)

Parameter	EPA Control	Laboratory Analysis
Ammonia, N	0.19	1.33
Calcium	40.6	38.2
Chloride	87.9	80.8
Cyanides, iron	0.185	0.40
Cyanide complexes, metal	0.642	0.98
Fluoride	1.30	1.25
Nitrate, N	0.31	1.64
Orthophosphate, P	0.031	0.181
Residue, non-filterable (I)[a]	29.7 ± 3.6	30.8
Residue, non-filterable (II)[a]	572 ± 81	540
Sulfate	93.6	94
Aluminum	0.061	0.080
Antimony	0.0082	0.008
Arsenic	0.024	0.020
Beryllium	0.024	0.026
Cadmium	0.0065	0.0107
Chromium	0.0044	0.0063
Copper	0.0087	0.0102
Iron	0.016	0.0134
Mercury	0.0004	0.0007
Nickel	0.0087	0.009
Lead	0.030	0.031
Selenium	0.0087	0.008
Silver	0.0012	0.0020
Zinc	0.0061	0.0058

a Two samples were submitted for both non-filterable and filterable residue anlayses. Results were reported only for non-filterable residue, due to loss of the filtrate prior to the analysis for filterable residue.

Table C-15

HISTORICAL WATER QUALITY MONITORING DATA - ST. JOHNS RIVER

Parameter (mg/l unless noted)	Transect and Station: Rm 7.8[a] - Sta. #7 compos. spl. (8/16/73)	RM 10.8[a] - Sta. #11 compos. spl. (8/16/73)	RM 8[b] - Sta. BI-3 (6/7/72)	RM 9.3[b] - Sta. BI-16 (6/7/72)	RM 10.8[b] - Sta. BI-14 (6/7/72)
Tide	Falling	Falling	-	-	-
Alkalinity ($CaCO_3$)	102.6	86.8	74	52	61
Bicarbonate ($CaCO_3$)	-	-	90	63	74
Chloride	-	-	6130	4010	4610
Color (TCU)	6	6	-	-	-
Conductivity (umhos)	35,000 (mhos/cm)	23,000 (mhos/cm)	18,200	12,350	14,000
Hardness, Total ($CaCO_3$)	-	-	2110	1382	1591
pH (st'd units)	7.62	7.61	7.5	6.9	7.0
Turbidity (NTU)	13.5	21.9	-	-	-
Ammonia (N)	0.2	0.08	-	-	-
Nitrate (N)	0.079	0.1	0.14	0.22	0.16
Nitrite (N)	0.059	0.061	-	-	-
Nitrogen, Total Kjeldahl (N)	0.75	0.6	-	-	-
COD	-	-	67.4	38.9	37.2
Carbon, Dissolved Organic	11	12	-	-	-
TOC	13	13	-	-	-
Carbon, Total Inorganic	18	18	-	-	-
Hydrocarbons	0.025	0.024	-	-	-
Phenols	0.31	0.12	-	-	-
Phosphate, Ortho (P)	-	-	0.09	0.08	0.11
Phosphate, Organic (P)	0.091	0.09	-	-	-
Phosphorus, Total (P)	0.136	0.111	0.17	0.16	0.19
Arsenic	-	-	0.1	< 0.1	< 0.1
Calcium	-	-	155.1	107.9	117.2
Chromium, Total	< 0.01	< 0.01	-	-	-
Copper	-	-	0.07	0.06	0.08
Iron	-	-	0.7	0.7	0.7
Lead	< 0.5	< 0.5	0.04	< 0.04	< 0.04
Magnesium	-	-	418.2	270.1	315.1
Manganese	-	-	0.05	0.03	0.04
Mercury	-	-	< 0.005	< 0.005	< 0.005
Nickel	-	-	0.04	< 0.04	< 0.04
Potassium	-	-	171	106	128
Sodium	-	-	2750	2200	2300
Solids, Total Dissolved	-	-	12,332	8073	9123
Solids, Total Suspended	-	-	18	16	18
Silica (SiO_2)	-	-	10.4	19.6	22.8
Sulfate (SO_4)	-	-	998	828	1010
Sulfide (S)	< 0.01	< 0.01	-	-	-
Zinc	-	-	0.6	0.6	0.6

a Environmental Science and Engineering, Inc.; Preliminary Environmental Impact Assessment of the Florida Gas Clean Fuels Facility; Dec., 1973.
b U.S. Army Corps of Engineers, Jacksonville, Florida; Final Environmental Statement - Blount Island Development Permit; Jan., 1973.

Table C-16

HISTORICAL WATER QUALITY MONITORING DATA - ST. JOHNS RIVER

Parameters (mg/l unless noted)	Transect and Station (Surface/Bottom)[a] RM7.3 - Sta. K				RM10.7 - Sta. H			
	1/8/74	4/23/74	1/8/74	4/23/74	1/8/74	4/23/74	1/8/74	4/23/74
Time	0920		0920		1025		1025	
Tide	High	High	Low	Low	High	High	Low	Low
Salinity (ppt)	26.2/27.9	13.4/14.1	19.6/26.8	13.75/13.3	19.2/25	11.75/12.9	14.9/23.2	11.2/10.9
BOD_5		1.0/0.45		0.75/2.0		1.8/1.6		1.1/2.0
Solids, Total Suspended		47/84		59/46		30/50		34/46
Ammonia	0.28/0.28	0/0	0.28/0.28	0/0	0.28/0.28	0/0	0.28/0	0/0
Nitrate (N)	0.01/0.002	0.06/0.03	0.03/0.002	0.04/0.04	0.07/0.03	0.07/0.07	0.16/0.06	0.08/0.07
Nitrogen, Kjeldahl (N)	0.56/0.56	0.56/0.42	0.56/0.56	0.28/0.56	1.12/1.4	0.56/0.42	1.4/0.84	0.42/0.56
Phosphorus, Total	1.35/0.43	1.1/2.07	0.36/0.14	5.0/0.37	0.16/0.4	1.88/2.92	1.0/0.11	0.71/1.1
Carbon, Total Organic		13/12		6/8		11/13		5/19
COD		38/35		18/24		32/38		15/27
Chromium, Total		0.06/0.05		0.06/0.05		0.05/0.05		0.05/0.05
Copper	0.04/0.04	0.046/0.051	0.04/0.04	0.058/0.046	0.04/0.03	0.044/0.044	0.04/0.04	0.039/0.044
Iron		0.471/1.011		0.822/0.506		0.312/0.094		0.506/0.388
Manganese		0.074/0.091		0.055/0.055		0.068/0.047		0.066/0.064
Zinc		0.02/0.05		0.03/0.02		0.03/0.01		0.02/0.03
Phosphate, Ortho (P)	0.02/0.03	0.08/0.08	0.02/0.03	0.08/0.08	0.07/0.05	0.09/0.09	0.06/0.09	0.1/0.1
Mercury		0.0014/0.0014		0.0023/0.0038		0.0033/0.0027		0.0031/0.0028

[a] Reynolds, Smith and Hills, Inc.; Thermal Energy Release Studies - Interim Reports No. 1 and 2; Nov., 1973 and February, 1974

Table C-17

HISTORICAL WATER QUALITY MONITORING DATA - ST. JOHNS RIVER

Parameter (mg/l unless noted, high/mean/low value)	Transect and Station[a] RM 4.0 Sta. 20030056 (7/18-20/72)	RM 7.1 Sta. 20030012 (5/5/72-1/11/79)	RM 10.6 Sta. 20030046 (7/7-11/73)	RM 13 Sta. 20030008 (7/18-20/72)	RM 13.3 Sta. 20030032 (8/14/72)
Turbidity, NTU	12/10.7/10	17/4.3/0	8/8/8	15/10.3/8	22/15.5/9
Transparency, in. (Secchi)	-	33/33/33	-	-	-
Conductivity, umhos	-	38,200/23,325/5,700	-	-	-
Oxygen, Dissolved	6.5/5.7/4.9	12.5/6.5/4	5/5/5	5.8/4.7/4.0	6.3/5.8/5.3
BOD-5	0/0/0	1.6/0.8/0	0.3/0.3/0.3	1.3/0.8/0.3	0.9
pH, St'd Units	7.8/7.3/6.5	8/7.4/5.5	7.5/7.5/7.5	7.5/7.4/7.1	7.0/7.0/7.0
Alkalinity, $CaCO_3$	-	127/85.4/0	-	-	-
Acidity, $CaCO_3$	-	135/12.3/0	-	-	-
Residue, Tot.	-	16,130/10,770/5,410	-	-	-
Residue, Tot. Vol.	-	3,780/3,780/3,780	-	-	-
Residue, Tot. Fix.	-	12,350/12,350/12,350	-	-	-
Residue, Total NFLT	89/59/36	650/62.2/8	-	-	-
Residue, Vol. NFLT	20/13.3/6	23/11.6/5	-	-	-
Residue, Fix. NFLT	70/45.6/23	32/15.4/9	-	-	-
Nitrogen, Total (N)	-	6.4/6.4/6.4	-	-	-
Nitrogen, Organic (N)	-	3.43/0.708/0.016	-	-	-
Ammonia, N	-	5/0.261/0	-	-	-
Nitrate, N	-	0.99/0.31/0.014	-	-	-
TOC	-	34/17.3/2	-	-	-
Phosphorus, Total (PO_4)	-	2.94/0.599/0.01	-	-	-
Ortho Phosphate (PO_4)	-	2.93/0.27/0.02	-	-	-
Phosphorus, Total (P)	-	0.56/0.33/0.08	-	-	-
Ortho-Phosphate (P)	-	1.5/0.44/0.08	-	-	-
Calcium	-	95/91.3/87	-	-	-
Magnesium ($CaCO_3$)	-	525.1/478.6/432	-	-	-
Potassium	-	268/268/268			
Chloride	18,200/13,678/10,100	21,000/9,961/4,000	9,000/9,000/9,000	6,000/5,114/4,600	11,200/10,700/10,200
Sulfate, SO_4	-	230/200/170	-	-	-
Cadmium, ug/l	-	90/46.5/4	-	-	-
Chromium (Total) ug/l	-	350/77.8/0	-	-	-
Copper (ug/l)	-	100/48.1/0.33	-	-	-
Iron (ug/l)	-	5,900/648.5/101	-	-	-
Lead (ug/l)	-	620/177.5/0	-	-	-
Manganese, ug/l	-	0/0/0	-	-	-
Nickel, ug/l	-	0/0/0	-	-	-
Zinc, ug/l	-	700/72.4/10	-	-	-
Coliform, Total (MPN)	80/26.8/0.24	13,000/1,761/0.24	-	49,000/18,666/0.24	2,300/1,605/910
Coliform, Fecal (MPN)	-	4,900/868/50	-	-	-

[a] USEPA; Storage and Retrieval - Water Quality Control Information System (STORET); July, 1972 to January, 1979

Table C-18

HISTORICAL WATER QUALITY DATA - ST. JOHNS RIVER

Parameter (mg/l unless noted)	Transect and Station[a] RM10.8 - Sta. #5 (composite)		RM10.9 - Sta. #4 (epilimnion/hypolimnion)	
Date	3/22/73	3/21/73	3/22/73	3/21/73
Tide	Low	High	Low	High
NO_3 (N)	0.075	0.165	0.110/0.085	0.175/0.06
NH_3 (N)	0.05	0.07	0.05/0.06	0.11/0.12
Organic Nitrogen	0.5	0.55	0.35/0.3	0.7/0.6
Orthophosphate (P)	0.031	0.045	0.044/0.109	0.029/0.033
Total Phosphate (P)	0.272	0.220	0.152/0.368	0.216/0.38
Aluminum	0.46	0.48	0.65/.8	0.75/0.7
Chromium	< 0.05	< 0.05	< 0.05/<0.05	< 0.05/<0.05
Lead	< 0.01	< 0.01	< 0.01/<0.01	< 0.01/<0.01
Iron	0.5	0.74	0.24/0.31	0.42/0.48
Turbidity (JTU)	16	19	23/28	33/33
Total Suspended Solids	38	41	40/95	38/72
Volatile Suspended Solids	19	23	23/60	20/46
Total Organic Carbon	9	11	10/14	14/14

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a Reynolds, Smith & Hills, Inc.; and Environmental Science and Engineering, Inc.; Draft Environmental Statement, Administrative Action for Southside Boulevard Extension; November, 1973; pp. 124-132.

Table C-19

HISTORICAL WATER QUALITY DATA - ST. JOHNS RIVER

Transect and Station[a] (3/21-22/73)	Water Layer	Tide	pH	pH eg	DO (mg/1)	Temp (°C)	Salinity (ppt)
RM10.8 (Sta. 5)	Epilimnion	high	8.0	8.1	7.9	18.0	12.1
	Hypolimnion	high	NM	NM	7.5	18.0	12.1
	Epilimnion	low	7.8	8.0	7.9	19.9	10.3
	Hypolimnion	low	NM	NM	8.1	19.9	10.3
RM10.9 (Sta. 4)	Epilimnion	high	9.9	8.05	9.0	16.3	22.8
	Hypolimnion	high	7.75	8.05	9.0	16.0	23.8
	Epilimnion	low	7.7	8.0	8.0	18.1	15.8
	Hypolimnion	low	7.9	8.0	8.0	16.4	21.0

NM Not measured

a Reynolds, Smith and Hills, Inc. and Environmental Science and Engineering, Inc.; Draft Environmental Statement, Administrative Action for Southside Boulevard Extension; November, 1973; pp. 124-132.

Table C-20

HISTORICAL WATER QUALITY DATA
BROWNS CREEK - JULY 24, 1973

Parameter (mg/l unless noted)	Station Location and Identification[a] Sta. 3	Sta. 4	Sta. 5	Sta. 6
Tide	high slack	falling	falling	falling
Alkalinity ($CaCO_3$)	85.4	84.6	92.6	92.8
Conductivity (mhos/cm)	22,000	20,000	21,000	20,000
True Color Units	5	6	8	8
Turbidity Units	10	9.5	25	9.5
pH	7.78	7.74	7.75	7.77
Biological Oxygen Demand	3.3	2.1	2.5	1.4
Phenols	0.18	1.0	0.1	-
Hydrocarbons	0.01	0.005	0.019	0.011
Total Organic Carbon	12.5	12.5	16	15
Total Inorganic Carbon	17	17.5	20	17
Dissolved Organic Carbon	11	10.5	12	13.5
Total PO_4 (P)	0.152	0.156	0.148	0.156
Organic PO_4 (P)	0.098	0.096	0.084	0.100
Total Organic Nitrogen	0.35	0.35	0.4	0.4
NH_3 (N)	0.105	0.175	0.07	0.145
NO_3 (N)	0.085	0.08	0.06	0.09
NO_2 (N)	0.06	0.055	0.04	0.065
Lead	0.5	0.5	0.5	0.5
Chromium	0.1	0.1	0.1	0.1
Sulfides	0.1	0.1	0.1	0.1

a Environmental Science and Engineering, Inc.; Preliminary Environmental Impact Assessment of the Florida Gas Clean Fuels Facility; 1974; pp. 174-176

Table C-21

HISTORICAL WATER QUALITY DATA
BLOUNT ISLAND CHANNEL

Parameter (mg/l unless noted)	Station Location and Identification[a] Sta. 1 (7/24/73)	Sta. 2 (7/24/73)	Sta. 8 (8/16/73)	Sta. 9 (8/16/73)	Sta. 10 (8/16/73)
Tide	rising	rising	falling	falling	falling
Alkalinity ($CaCO_3$)	88.8	92.8	89.6	92	89
Conductivity (mhos/cm)	20,000	24,000	26,000	23,000	24,000
True Color Units	5	5	7	7	7
Turbidity Units	11.7	7.3	12.5	12.5	19.9
pH	7.63	7.72	7.65	7.87	7.86
Biological Oxygen Demand	1.4	1.4	-	-	-
Phenols	0.24	0.18	0.1	0.1	0.1
Hydrocarbons	0.018	0.006	0.017	0.019	0.044
Total Organic Carbon	13.5	13	12	12	15
Total Inorganic Carbon	16	16	19	19	19
Dissolved Organic Carbon	11	12	12	10	14
Total PO_4 (P)	0.162	0.148	0.134	0.132	0.127
Organic PO_4 (P)	0.106	0.102	0.091	0.088	0.084
Total Organic Nitrogen	0.35	0.3	0.23	0.23	0.37
NH_3 (N)	0.105	0.07	0.12	0.11	0.17
NO_3 (N)	0.115	0.1	0.093	0.08	0.084
NO_2 (N)	0.07	0.065	0.058	0.054	0.053
Lead	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chromium	< 0.1	< 0.1	< 0.01	< 0.01	< 0.01
Sulfides	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

a Environmental Science and Engineering, Inc.; Preliminary Environmental Impact Assessment of the Florida Gas Clean Fuels Facility; 1974; pp. 174-176.

HISTORICAL WATER QUALITY DATA
BLOUNT ISLAND CHANNEL AND BROWNS CREEK
(7/23-24/73)

Station[a]	Water Layer	Tide	Water Depth (m)	Salinity (ppt)	D.O. (mg/l)	Temp. (°C)	Secchi (m)
1	Epilimnion	high	2	20.4	6.4	31.5	0.87
1	Hypolimnion	high	2	20.5	6.6	30.4	
1	Epilimnion	low	1	12.1	6.4	31.5	0.83
1	Hypolimnion	low	1	12.3	6.4	31.5	
2	Epilimnion	high	8	20.5	6.6	31.7	0.80
2	Hypolimnion	high	8	21.3	6.8	29.4	
2	Epilimnion	low	5	NM	6.9	31.5	0.83
2	Hypolimnion	low	5	13.9	6.8	30.0	
3	Epilimnion	high	5.3	20.2	7.1	31.4	1.03
3	Hypolimnion	high	5.3	20.1	6.8	31.3	
3	Epilimnion	low	2.1	10.3	5.8	30.1	1.10
3	Hypolimnion	low	2.1	12.8	5.8	30.1	
4	Epilimnion	high	2.2	19.9	6.9	31.8	0.96
4	Hypolimnion	high	2.2	20.1	6.8	31.8	
4	Epilimnion	low	1	10.4	5.9	30.3	0.93
4	Hypolimnion	low	1	10.5	5.9	30.3	
5	Epilimnion	high	1	19.9	6.8	32.4	0.8
5	Hypolimnion	high	1	19.9	6.8	32.4	
5*	Epilimnion	low	0.5	NM	NM	NM	NM
5*	Hypolimnion	low	0.5	NM	NM	NM	
6	Epilimnion	high	1.5	19.9	6.8	32	0.89
6	Hypolimnion	high	1.5	19.9	6.7	32	
6	Epilimnion	low	1	10.5	6.1	30.5	0.85
6	Hypolimnion	low	1	10.5	6.1	30.5	

* Not accessible at low tide
NM Not measured

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[a] Environmental Science and Enginering, Inc.; Preliminary Environmental Impact Assessment of the Florida Gas Clean Fuels Facility; 1974; pp. 174-176.

Table C-23

HISTORICAL WATER QUALITY DATA
BLOUNT ISLAND CHANNEL AND BROWNS CREEK

Parameter (mg/l)	Blount Island Channel[a]				Browns Creek[a]		
	Sta. 2 S/B (Surface/Bottom)	Sta. 9	Sta. 10	Sta. 11	Sta. 1 S/B (Surface/Bottom)	Sta. 1 S/B (Surface/Bottom)	Sta. 12
Date	8/30/73	9/19/73	9/19/73	9/19/73	8/30/73	9/19/73	9/19/73
BOD	1/1	1	1	1	1/2	1/1	1
COD	16/16.8	36.7	32.6	41.8	29.4/36.6	45.3/44.7	36.7
Salinity (ppt)	19.2/22.1	11.8	12.5	13.5	16.9/17.2	5.8/7.5	11.8
Suspended Solids	25/65	30	40	35	40/62	31/23	30
pH	8/7.8	7.65	7.45	7.5	8/7.8	7.55/7.6	7.5
Total Phosphorus (P)	0.13/0.17	0.18	0.16	0.18	0.18/0.22	0.44/0.38	0.16
Ortho Phosphorus (P)	0.11/0.14	0.14	0.13	0.16	0.11/0.18	0.13/0.16	0.14
Nitrates (N)	0.08/0.1	0.44	0.42	0.37	0.13/0.07	0.57/0.38	0.43
Ammonia (N)	0.0/0.56	0	0	0	0/1.12	0/0	0
Total Org. Nitrogen	1.12/0.84	1.12	0.84	1.12	1.68/0.28	1.12/2.24	1.4
TOC	6/6.3	12.4	11	14.1	11/13.7	15.3/15.1	12.4
Mercury	0.0006/0.0005	0.0003	0.0003	0.0004	0.0005/0.0006	0.0005/0.0004	0.0004
Copper	0.03/0.02	0.18	0.22	0.2	0.02/0.02	0.11/0.16	0.18
Manganese	0.05/0.06	0.03	0.04	0.03	0.05/0.05	0.03/0.03	0.03
Iron	0.1/0.3	0.22	0.47	0.25	0.1/0.3	0.32/0.42	0.26
Chromium	< 0.01/< 0.01	0.02	0.01	0.01	< 0.01/< 0.01	< 0.01/< 0.01	< 0.01
Zinc	0.01/0.02	0.03	0.04	0.03	0.02/0.03	0.01/0.05	0.02

[a] Reynolds, Smith and Hills, Inc.; JEA Thermal Energy Release Studies; Interim Report No. 1; November, 1973; pp. 15-18.

Table C-24

HISTORICAL WATER QUALITY DATA
NICHOLS CREEK AND SAN CARLOS CREEK

Parameter (mg/l unless noted)	Nichols Creek[a]			San Carlos Creek[a]					
	Sta. 3N	Sta. 7	Sta. 8	Sta. 2	Sta. 3	Sta. 4	Sta. 4S	Sta. 5	Sta. 6
Date	8/30/73	9/19/73	9/19/73	9/19/73	9/19/73	9/19/73	8/30/73	9/19/73	9/19/73
BOD	2	1	1	1	1	1	1	1	1
COD	18.7	42.7	39.1	44.4	42	44.4	28.3	80.5	50.4
Salinity (ppt)	17	5	9	5.5	6	5.25	20.9	5.7	5.6
Suspended Solids	57	22	18	20	33	25	58	28	63
pH	7.8	7.4	7.45	7.5	7.6	7.4	7.9	7.45	7.5
Total Phosphorus (P)	0.2	0.18	0.14	0.18	0.22	0.22	0.16	0.2	0.31
Ortho Phosphorus (P)	0.16	0.16	0.14	0.13	0.16	0.16	0.13	0.16	0.27
Nitrates (N)	0.07	0.45	0.47	0.43	0.44	0.45	0.08	0.48	0.45
Ammonia (N)	0	0	0	0	0	0	0	0	0
Total Org. Nitrogen	1.68	0.84	1.12	0.84	1.12	0.84	1.4	1.12	1.4
TOC	7	14.4	13.2	15	14.2	15	10.6	27.2	17
Mercury	0.0007	0.0009	0.0003	0.0009	0.0007	0.0008	0.0007	0.0005	0.0008
Copper	0.02	0.01	0.14	0.07	0.1	0.08	0.02	0.01	0.02
Manganese	0.06	0.01	0.03	0.02	0.02	0.02	0.07	0.02	0.04
Iron	0.3	0.11	0.26	0.26	0.38	0.42	0.3	0.3	1.09
Chromium	<0.01	<0.01	0.01	0.01	0.01	0.02	0.01	0.02	<0.01
Zinc	0.01	0.01	0.01	0.03	0.01	0.02	0.02	0.01	0.02

[a] Reynolds, Smith and Hills, Inc.; JEA Thermal Energy Release Studies; Interim Report No. 1; November, 1973; pp. 15-18.

Table C-25

HISTORICAL WATER QUALITY DATA - BLOUNT ISLAND CHANNEL

Parameter (mg/l unless noted)	Sta. I[a] (surface/bottom)			
Date	1/8/74	4/23/74	1/8/74	4/23/74
Tide Stage	High	High	Low	Low
Time (hrs)	1010	-	1535	-
BOD	-	1.8/1.6	-	0.9/1.2
Suspended Solids	-	38/155	-	137/43
Total Phosphorus (P)	0.21/0.13	2.13/0.18	0.79/0.21	1.46/2.96
Orthophosphate (P)	0.06/0.07	0.1/0.18	0.05/0.05	0.19/0.08
Nitrates (N)	0.05/0.1	0.07/0.16	0.12/0.13	0.13/0.05
Ammonia (N)	0.28/0	0/0	0.56/0.56	0/0
Total Organic Nitrogen	0.84/0.56	0.84/0.7	0.84/0.84	0.7/0.42
Total Organic Carbon	-	15/16	-	10/4
Mercury	-	0.0017/0.003	-	0.003/0.003
Copper	0.04/0.04	0.46/0.44	0.04/0.04	0.051/0.054
Manganese	-	0.077/0.115	-	0.119/0.066
Iron	-	0.455/2.0	-	1.8/0.8
Chromium	-	0.06/0.06	-	0.06/0.06
Zinc	-	0.03/0.03	-	0.03/0.03
COD	-	44/47	-	30/12
pH (units)	-	-	-	-
Salinity (ppt)	21.3/21.8	12.6/13.6	21.7/26	13.8/13.3

[a] Reynolds, Smith and Hills, Inc.; JEA Thermal Energy Release Studies, Interim Reports No. 2 and 3, February 15, 1974 and July 22, 1974.

Table C-26

HISTORICAL WATER QUALITY DATA - BLOUNT ISLAND CHANNEL

Parameter (mg/l unless noted)	Sta. J[a] (surface/bottom)			
Date	1/8/74	4/23/74	1/8/74	4/23/74
Tide Stage	High	High	Low	Low
Time (hrs)	1000	-	1530	-
BOD	-	1.6/1	-	1.1/1.55
Suspended Solids	-	31/57	-	83/56
Total Phosphorus (P)	0.83/0.11	0.56/1.5	0.14/0.31	3.38/3.68
Orthophosphate (P)	0.05/0.09	0.09/0.08	0.05/0.05	0.12/0.1
Nitrates (N)	0.03/0.004	0.09/004	0.05/0.004	0.07/0.06
Ammonia (N)	0.28/0.56	0	0.28/0.28	0
Total Organic Nitrogen	1.12/1.12	0.07/0.7	0.56/0.84	0.56/0.7
Total Organic Carbon	-	14/15	-	7/7
Mercury	-	0.0037/0.0017	-	0.0033/0.0026
Copper	0.04/0.04	0.045/0.044	0.04/0.04	0.054/0.051
Manganese	-	0.07/0.079	-	0.072/0.077
Iron	-	0.438/0.7	-	1.393/0.77
Chromium	-	0.06/0.05	-	0.06/0.06
Zinc	-	0.03/0.02	-	0.03/0.04
COD	-	41/44	-	21/21
pH (units)	-	-	-	-
Salinity (ppt)	21.9/24.6	12.2/13.2	22/26	13.4/13.1

[a] Reynolds, Smith and Hills, Inc.; JEA Thermal Energy Release Studies, Interim Reports No. 2 and 3, February 15, 1974 and July 22, 1974.

Table C-27

HISTORICAL WATER QUALITY DATA - BLOUNT ISLAND CHANNEL

Parameter (mg/l unless noted)	Station[a] BI-5	BI-8	BI-11
pH (units)	7.3	7.0	7.1
Specific Conductance (umhos at 25°C)	20,400	16,550	15,050
Total Solids	14,679	11,514	10,194
Hardness, Total ($CaCO_3$)	2,262	1,759	1,684
Dissolved Solids	4,671	11,499	10,170
Suspended Solids	8	15	24
Total Phosphorus	0.14	0.14	0.16
Calcium	174.4	125.8	124.4
Ortho Phosphate (P)	0.1	0.08	0.08
Magnesium	443.6	350.7	333.2
Nickel, Total	< 0.04	< 0.04	< 0.04
Sodium	3,800	2,500	2,750
Lead, Total	< 0.04	< 0.04	< 0.04
Potassium	194	142	132
Sulfates (SO_4)	1,266	1,124	988
Chlorides	7,160	5,460	5,000
Arsenic, Total	< 0.1	< 0.1	< 0.1
Bicarbonates (HCO_3)	83	66	68
Alkalinity ($CaCO_3$)	68	54	56
Copper, Total	0.07	0.06	0.07
Silica (SiO_2)	10.4	19.6	24
Iron, Total	0.5	0.6	1.1
Manganese, Total	0.05	0.03	0.05
Mercury, Total	< 0.005	< 0.005	< 0.005
COD	70.8	35.4	38.9
Nitrates (N)	0.17	0.08	0.19
Zinc, Total	0.6	0.6	0.7

a U.S. Army Engineer District, Jacksonville; Final Environmental Statement - Blount Island Development Permit; January, 1973; pp. 24-25.

Table C-28

USEPA STORET DATA

STORET DATE 80/07/08

/TYPA/AMBNT/ESTURY

20030053
30 23 54.3 081 23 42.2 1
ST JOHNS R BUOY 11
12031 FLORIDA
SOUTH-EAST
ST JOHNS
21FLA
0000 CLASS 00

PARAMETER				NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER TEMP		CENT	15	26.8666	17.5176	4.18540	.155784	1.08067	30.0000	16.0000	72/07/18	78/11/20
00027	COLLECT AGENCY		CODE	7	8056.71	384.000	19.5959	.002432	7.40656	8067.00	8031.00	77/03/16	78/11/20
00070	TURB	JKSN	JTU	4	8.20000	15.6267	3.95306	.482081	1.97653	12.0000	2.80000	72/07/18	77/12/19
00076	TURB	TRBIDMTR	HACH FTU	1	1.60000					1.60000	1.60000	78/11/20	78/11/20
00078	TRANSP	SECCHI	METERS	2	1.70000	5.12000	2.26274	1.33102	1.60000	3.30000	.100000	77/03/16	78/11/20
00094	CNDUCTVY	FIELD	MICROMHO	1	160.000					160.000	160.000	77/03/16	77/03/16
00095	CNDUCTVY	AT 25C	MICROMHO	5	34900.0	.498E+08	7056.92	.202204	3155.95	45000.0	28000.0	77/12/19	78/06/26
00299	DO	PROBE	MG/L	1	4.70000					4.70000	4.70000	77/03/16	77/03/16
00300	DO		MG/L	13	6.06153	.519246	.720588	.118879	.199855	7.10000	5.00000	72/07/18	78/11/20
00310	BOD	5 DAY	MG/L	6	1.05000	1.19100	1.09133	1.03936	.445534	3.00000	.000000	72/07/18	78/11/20
00315	BOD	7 DAY	MG/L	2	3.35000	3.12498	1.76776	.527690	1.25000	4.60000	2.10000	78/06/26	78/06/26
00324	BOD	20 DAY	MG/L	2	5.55000	6.84499	2.61629	.471404	1.85000	7.40000	3.70000	78/06/26	78/06/26
00400	PH		SU	4	7.15000	.456696	.675793	.094516	.337896	7.90000	6.40000	72/07/18	78/11/20
00403	LAB	PH	SU	6	7.68333	.418750	.647109	.084222	.264181	8.15000	6.40000	77/03/16	78/06/26
00410	T ALK	CACO3	MG/L	1	91.0000					91.0000	91.0000	77/12/19	77/12/19
00435	T ACDITY	CACO3	MG/L	1	6.70000					6.70000	6.70000	77/12/19	77/12/19
00530	RESIDUE	TOT NFLT	MG/L	9	54.3111	1359.78	36.8751	.678962	12.2917	97.0000	.000000	72/07/18	78/11/20
00535	RESIDUE	VOL NFLT	MG/L	8	15.2500	83.0714	9.11435	.597662	3.22241	28.0000	.000000	72/07/18	78/11/20
00540	RESIDUE	FIX NFLT	MG/L	8	43.6250	945.982	30.7568	.705027	10.8742	79.0000	.000000	72/07/18	78/11/20
00605	ORG N	N	MG/L	1	.518000					.518000	.518000	77/12/19	77/12/19
00610	NH3+NH4-	N TOTAL	MG/L	2	.142500	.035112	.187383	1.31497	.132500	.275000	.010000	77/12/19	78/11/20
00615	NO2-N	TOTAL	MG/L	4	.004250	.000028	.005252	1.23576	.002626	.012000	.001000	78/06/26	78/06/26
00620	NO3-N	TOTAL	MG/L	6	.299000	.491705	.701217	2.34521	.286271	1.73000	.005000	77/12/19	78/11/20
00625	TOT KJEL	N	MG/L	3	2.18533	1.26810	1.12610	.515299	.650154	3.32000	1.06800	78/06/26	78/11/20
00650	T PO4	PO4	MG/L	5	.321800	.015388	.124048	.385481	.055476	.500000	.150000	77/12/19	78/06/26
00660	ORTHOPO4	PO4	MG/L	5	.053200	.000354	.018807	.353515	.008411	.080000	.035000	77/12/19	78/06/26
00665	PHOS-TOT		MG/L P	1	2.50000					2.50000	2.50000	78/11/20	78/11/20
00940	CHLORIDE	CL	MG/L	12	15858.3	.183E+08	4279.02	.269828	1235.25	21300.0	10400.0	72/07/18	78/06/26
01027	CADMIUM	CD,TOT	UG/L	1	46.0000					46.0000	46.0000	77/12/19	77/12/19
01042	COPPER	CU,TOT	UG/L	1	116.000					116.000	116.000	77/12/19	77/12/19
01045	IRON	FE,TOT	UG/L	1	389.000					389.000	389.000	77/12/19	77/12/19
01051	LEAD	PB,TOT	UG/L	1	363.000					363.000	363.000	77/12/19	77/12/19
01092	ZINC	ZN,TOT	UG/L	1	11.0000					11.0000	11.0000	77/12/19	77/12/19
31501	TOT COLI	MFIMENDO	/100ML	1	50.0000					50.0000	50.0000	77/12/19	77/12/19
31505	TOT COLI	MPN CONF	/100ML	5	352.096	298986	546.796	1.55297	244.534	1300.00	.240000	72/07/18	78/11/20
31615	FEC COLI	MPNECMED	/100ML	1	110.000					110.000	110.000	78/11/20	78/11/20
31616	FEC COLI	MFM-FCBR	/100ML	3	73.3333	4633.33	68.0686	.928208	39.2994	150.000	20.0000	77/12/19	78/06/26
32210	CHLRPHYL	A	UG/L	1	.180000					.180000	.180000	78/11/20	78/11/20
32230	CHLRPHYL	A	MG/L	2	.056000	.000242	.015556	.277791	.011000	.067000	.045000	78/06/26	78/06/26

Table C-28 (Continued)

USEPA STORET DATA

STORET DATE 80/07/08

/TYPA/AMBNT/ESTURY

20030043
30 24 17.8 081 36 18.6 1
ST JOHNS R BUOY 59 NAVY DEPT
12031 FLORIDA
SOUTH-EAST
ST JOHNS
21FLA
0000 CLASS 00

PARAMETER				NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER TEMP	TEMP	CENT	65	22.3369	33.8234	5.81579	.260366	.721359	31.0000	12.0000	68/10/14	77/12/19
00027	COLLECT AGENCY	AGENCY	CODE	1	8067.00					8067.00	8067.00	77/12/19	77/12/19
00070	TURB JKSN	JKSN	JTU	69	16.7869	309.473	17.5919	1.04795	2.11781	142.000	1.00000	68/10/14	77/12/19
00080	COLOR PT-CO	PT-CO	UNITS	59	77.9661	4270.80	65.3513	.838202	8.50802	450.000	25.0000	68/10/14	73/06/11
00095	CNDUCTVY AT 25C	AT 25C	MICROMHO	1	17000.0					17000.0	17000.0	77/12/19	77/12/19
00300	DO		MG/L	70	5.50568	2.18577	1.47843	.268529	.176707	8.10000	2.20000	68/10/14	73/08/13
00301	DO SATUR	SATUR	PERCENT	16	75.3061	126.262	11.2367	.149213	2.80916	92.2000	51.4000	72/06/12	73/06/13
00310	BOD 5 DAY	5 DAY	MG/L	68	2.31323	52.4029	7.23899	3.12938	.877856	60.0000	.000000	68/10/14	77/12/19
00400	PH		SU	54	7.39255	.074108	.272228	.036825	.037046	7.90000	6.60000	68/10/14	72/07/20
00403	LAB PH	PH	SU	15	7.40666	.084961	.291481	.039354	.075260	8.00000	7.00000	72/08/14	77/12/19
00410	T ALK CACO3	CACO3	MG/L	1	80.0000					80.0000	80.0000	77/12/19	77/12/19
00435	T ACDITY CACO3	CACO3	MG/L	1	1.20000					1.20000	1.20000	77/12/19	77/12/19
00530	RESIDUE TOT NFLT	TOT NFLT	MG/L	6	20.4000	90.8803	9.53311	.467310	3.37046	42.0000	12.0000	72/07/18	77/12/19
00535	RESIDUE VOL NFLT	VOL NFLT	MG/L	7	8.42857	24.6191	4.96176	.588684	1.87537	18.0000	2.00000	72/07/18	72/07/20
00540	RESIDUE FIX NFLT	FIX NFLT	MG/L	7	11.8571	45.1429	6.71885	.566650	2.53948	24.0000	4.00000	72/07/18	72/07/20
00605	ORG N N	N	MG/L	1	1.36900					1.36900	1.36900	77/12/19	77/12/19
00610	NH3+NH4- N TOTAL	N TOTAL	MG/L	1	.059000					.059000	.059000	77/12/19	77/12/19
00620	NO3-N TOTAL	TOTAL	MG/L	1	.522000					.522000	.522000	77/12/19	77/12/19
00650	T PO4 PO4	PO4	MG/L	1	.130000					.130000	.130000	77/12/19	77/12/19
00660	ORTHOPO4 PO4	PO4	MG/L	1	.130000					.130000	.130000	77/12/19	77/12/19
00940	CHLORIDE CL	CL	MG/L	70	4575.21	.175E+08	4185.61	.914846	500.276	15000.0	4.50000	68/10/14	73/08/13
01027	CADMIUM CD,TOT	CD,TOT	UG/L	1	25.0000					25.0000	25.0000	77/12/19	77/12/19
01042	COPPER CU,TOT	CU,TOT	UG/L	1	65.0000					65.0000	65.0000	77/12/19	77/12/19
01045	IRON FE,TOT	FE,TOT	UG/L	1	220.000					220.000	220.000	77/12/19	77/12/19
01051	LEAD PB,TOT	PB,TOT	UG/L	1	126.000					126.000	126.000	77/12/19	77/12/19
01092	ZINC ZN,TOT	ZN,TOT	UG/L	1	21.0000					21.0000	21.0000	77/12/19	77/12/19
31501	TOT COLI MFIMENDO	MFIMENDO	/100ML	1	600.000					600.000	600.000	77/12/19	77/12/19
31505	TOT COLI MPN CONF	MPN CONF	/100ML	67	7135.33	.411E+09	20288.8	2.84343	2478.68	130000	.240000	68/10/14	73/08/13
31616	FEC COLI MFM-FCBR	MFM-FCBR	/100ML	1	170.000					170.000	170.000	77/12/19	77/12/19

Table C-28 (Continued)

USEPA STORET DATA

STORET DATE 80/07/08

/TYPA/AMBNT/ESTURY

20030035
30 22 22.5 081 37 45.7 1
ST JOHNS R LONG BRANCH CR
12031 FLORIDA
SOUTH-EAST
ST JOHNS
21FLA
0000 CLASS 00

PARAMETER				NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	3	20.3333	86.0837	9.27813	.456302	5.35673	30.0000	11.5000	78/02/27	78/11/28
00027	COLLECT	AGENCY	CODE	3	8067.00	-.800E+01	.000000		.000000	8067.00	8067.00	78/02/27	78/11/28
00076	TURB	TRBIDMTR	HACH FTU	3	5.73333	40.4134	6.35715	1.10881	3.67030	13.0000	1.20000	78/02/27	78/11/28
00095	CNDUCTVY	AT 25C	MICROMHO	3	7980.00	.115E+09	10737.3	1.34553	6199.21	20240.0	250.000	78/02/27	78/11/28
00300	DO		MG/L	3	6.43333	3.90345	1.97571	.307106	1.14068	8.20000	4.30000	78/02/27	78/11/28
00310	BOD	5 DAY	MG/L	2	1.30000	.980004	.989952	.761502	.700002	2.00000	.600000	78/02/27	78/11/28
00315	BOD	7 DAY	MG/L	1	3.00000					3.00000	3.00000	78/07/10	78/07/10
00340	COD	HI LEVEL	MG/L	3	118.767	3176.37	56.3592	.474538	32.5390	183.000	77.6000	78/02/27	78/11/28
00403	LAB	PH	SU	3	6.50666	.768249	.876498	.134708	.506047	7.10000	5.50000	78/02/27	78/11/28
00525	RESIDUE	FIX FLT	MG/L	1	211.000					211.000	211.000	78/02/27	78/02/27
00530	RESIDUE	TOT NFLT	MG/L	3	21.0000	127.000	11.2694	.536639	6.50641	34.0000	14.0000	78/02/27	78/11/28
00552	OIL-GRSE	TOT-HEXN	MG/L	1	.600000					.600000	.600000	78/02/27	78/02/27
00610	NH3+NH4-	N TOTAL	MG/L	3	.029667	.000542	.023288	.784993	.013445	.046000	.003000	78/02/27	78/11/28
00620	NO3-N	TOTAL	MG/L	3	.035667	.000534	.023116	.648103	.013346	.050000	.009000	78/02/27	78/11/28
00625	TOT KJEL	N	MG/L	3	.574666	.129153	.359378	.625369	.207487	.810000	.161000	78/02/27	78/11/28
00650	T PO4	PO4	MG/L	2	.121500	.000220	.014849	.122216	.010500	.132000	.111000	78/02/27	78/07/10
00660	ORTHOPO4	PO4	MG/L	2	.085500	.001301	.036062	.421784	.025500	.111000	.060000	78/02/27	78/07/10
00665	PHOS-TOT		MG/L P	1	.110000					.110000	.110000	78/11/28	78/11/28
00680	T ORG C	C	MG/L	2	40.5000	40.5000	6.36396	.157135	4.50000	45.0000	36.0000	78/02/27	78/07/10
00745	SULFIDE	TOTAL	MG/L	1	.600000					.600000	.600000	78/02/27	78/02/27
00937	PTSSIUM	K,TOT	MG/L	1	4.09000					4.09000	4.09000	78/02/27	78/02/27
00940	CHLORIDE	CL	MG/L	3	4223.00	.331E+08	5761.23	1.36425	3326.25	10800.0	69.0000	78/02/27	78/11/28
00945	SULFATE	SO4-TOT	MG/L	1	15.8400					15.8400	15.8400	78/02/27	78/02/27
01002	ARSENIC	AS,TOT	UG/L	1	10.0000					10.0000	10.0000	78/02/27	78/02/27
01027	CADMIUM	CD,TOT	UG/L	1	15.0000					15.0000	15.0000	78/11/28	78/11/28
01034	CHROMIUM	CR,TOT	UG/L	2	31.5000	480.500	21.9203	.695883	15.5000	47.0000	16.0000	78/02/27	78/11/28
01042	COPPER	CU,TOT	UG/L	1	44.0000					44.0000	44.0000	78/11/28	78/11/28
01045	IRON	FE,TOT	UG/L	1	380.000					380.000	380.000	78/11/28	78/11/28
01051	LEAD	PB,TOT	UG/L	1	292.000					292.000	292.000	78/11/28	78/11/28
01067	NICKEL	NI,TOTAL	UG/L	1	163.000					163.000	163.000	78/11/28	78/11/28
01092	ZINC	ZN,TOT	UG/L	1	114.000					114.000	114.000	78/11/28	78/11/28
31501	TOT COLI	MFIMENDO	/100ML	1	340.000					340.000	340.000	78/11/28	78/11/28
31505	TOT COLI	MPN CONF	/100ML	2	1650.00	605000	777.817	.471404	550.000	2200.00	1100.00	78/02/27	78/07/10
31615	FEC COLI	MPNECMED	/100ML	2	261.500	104425	323.148	1.23575	228.500	490.000	33.0000	78/02/27	78/07/10
31616	FEC COLI	MFM-FCHR	/100ML	1	160.000					160.000	160.000	78/11/28	78/11/28
31677	FECSTREP	MPNADEVA	/100ML	1	21.0000					21.0000	21.0000	78/07/10	78/07/10
32730	PHENOLS	TOTAL	UG/L	1	13.2700					13.2700	13.2700	78/02/27	78/02/27
39360	DDD	WHL SMPL	UG/L	1	.050000					.050000	.050000	78/07/10	78/07/10
39365	DDE	WHL SMPL	UG/L	1	.050000					.050000	.050000	78/07/10	78/07/10

Table C-28 (Continued)

USEPA STORET DATA

STORET DATE 80/07/08

/TYPA/AMBNT/ESTURY

20030034
30 17 46.0 081 40 32.8 1
ST JOHNS R MIDCHAN NEAR EDGEWOOD
12031 FLORIDA
SOUTH-EAST
ST JOHNS
21FLA
0000 CLASS 00

PARAMETER				NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	9	25.5555	45.7163	6.76138	.264576	2.25379	32.0000	11.5000	72/07/18	78/11/28
00027	COLLECT	AGENCY	CODE	4	8067.00	-.106E+02	.000000		.000000	8067.00	8067.00	77/05/04	78/11/28
00067	TIDE	STAGE	CODE	1	5210.00					5210.00	5210.00	77/05/04	77/05/04
00076	TURB	TRBIDMTR	HACH FTU	3	1.63333	.223336	.472585	.289338	.272847	2.00000	1.10000	78/02/27	78/11/28
00095	CNDUCTVY	AT 25C	MICROMHO	9	2623.44	4756542	2180.95	.831331	726.983	5300.00	43.0000	72/07/18	78/11/28
00300	DO		MG/L	9	5.54444	1.57529	1.25510	.226372	.418368	7.50000	3.80000	72/07/18	78/11/28
00310	BOD	5 DAY	MG/L	3	1.13333	.723335	.850491	.750434	.491031	2.10000	.500000	72/07/20	78/11/28
00315	BOD	7 DAY	MG/L	1	2.50000					2.50000	2.50000	78/07/10	78/07/10
00340	COD	HI LEVEL	MG/L	2	16.7000	273.780	16.5463	.990796	11.7000	28.4000	5.00000	78/07/10	78/11/28
00403	LAB	PH	SU	3	6.44333	.447708	.669110	.103845	.386311	7.20000	5.93000	78/02/27	78/11/28
00530	RESIDUE	TOT NFLT	MG/L	3	5.66667	9.33339	3.05506	.539128	1.76384	9.00000	3.00000	78/02/27	78/11/28
00610	NH3+NH4-	N TOTAL	MG/L	3	.021667	.000661	.025716	1.18691	.014847	.051000	.003000	78/02/27	78/11/28
00620	NO3-N	TOTAL	MG/L	3	.017000	.000337	.018358	1.07986	.010599	.038000	.004000	78/02/27	78/11/28
00625	TOT KJEL	N	MG/L	3	.467667	.005329	.073002	.156099	.042148	.551000	.415000	78/02/27	78/11/28
00650	T PO4	PO4	MG/L	4	.111500	.011101	.105359	.944924	.074500	.186000	.037000	78/02/27	78/07/10
00660	ORTHOPO4	PO4	MG/L	2	.036000	.000512	.022627	.628541	.016000	.052000	.020000	78/02/27	78/07/10
00665	PHOS-TOT		MG/L P	1	.087000					.087000	.087000	78/11/28	78/11/28
00680	T ORG C	C	MG/L	2	33.0000	32.0000	5.65685	.171420	4.00000	37.0000	29.0000	78/02/27	78/07/10
00937	PTSSIUM	K,TOT	MG/L	1	.849000					.849000	.849000	78/02/27	78/02/27
00940	CHLORIDE	CL	MG/L	9	732.555	387959	622.863	.850261	207.621	1520.00	11.0000	72/07/18	78/11/28
01027	CADMIUM	CD,TOT	UG/L	1	11.0000					11.0000	11.0000	78/11/28	78/11/28
01034	CHROMIUM	CR,TOT	UG/L	1	47.0000					47.0000	47.0000	78/11/28	78/11/28
01042	COPPER	CU,TOT	UG/L	1	13.0000					13.0000	13.0000	78/11/28	78/11/28
01045	IRON	FE,TOT	UG/L	1	168.000					168.000	168.000	78/11/28	78/11/28
01051	LEAD	PB,TOT	UG/L	1	11.0000					11.0000	11.0000	78/11/28	78/11/28
01067	NICKEL	NI,TOTAL	UG/L	1	36.0000					36.0000	36.0000	78/11/28	78/11/28
01092	ZINC	ZN,TOT	UG/L	1	10.0000					10.0000	10.0000	78/11/28	78/11/28
31501	TOT COLI	MFIMENDO	/100ML	2	405.000	61250.0	247.487	.611080	175.000	580.000	230.000	77/05/04	78/11/28
31505	TOT COLI	MPN CONF	/100ML	5	164.144	58821.0	242.530	1.47755	108.463	540.000	.240000	72/07/18	78/07/10
31614	FEC COLI	MPN	TUBECODE	4	42.6800	7204.61	84.8800	1.98875	42.4400	170.000	.240000	72/07/18	72/07/19
31615	FEC COLI	MPNECMED	/100ML	5	40.7440	5422.20	73.6356	1.80727	32.9308	170.000	.240000	72/07/18	78/07/10
31616	FEC COLI	MFM-FCBR	/100ML	2	60.0000	3200.00	56.5685	.942809	40.0000	100.000	20.0000	77/05/04	78/11/28
39360	DDD	WHL SMPL	UG/L	1	.050000					.050000	.050000	78/07/10	78/07/10
39365	DDE	WHL SMPL	UG/L	1	.050000					.050000	.050000	78/07/10	78/07/10
39370	DDT	WHL SMPL	UG/L	1	.050000					.050000	.050000	78/07/10	78/07/10
70507	PHOS-T	ORTHO	MG/L P	1	.005000					.005000	.005000	78/11/28	78/11/28

Table C-28 (Continued)

USEPA STORET DATA

STORET DATE 80/07/08

/TYPA/AMBNT/ESTURY

20030023
30 14 42.6 081 39 57.1 1
ST JOHNS R MIDSTR JAX NAS SAN JO
12031 FLORIDA
SOUTH-EAST
ST JOHNS
21FLA
0000 CLASS 00

PARAMETER				NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	8	28.5000	3.42857	1.85164	.064970	.654653	30.0000	24.0000	72/07/18	75/10/20
00027	COLLECT	AGENCY	CODE	4	8067.00	-.106E+02	.000000		.000000	8067.00	8067.00	75/10/20	77/05/16
00067	TIDE	STAGE	CODE	2	1160.00	5000.00	70.7107	.060957	50.0000	1210.00	1110.00	77/05/04	77/05/16
00070	TURB	JKSN	JTU	4	10.6750	11.2892	3.35994	.314749	1.67997	14.0000	7.00000	72/07/18	73/07/11
00095	CNDUCTVY	AT 25C	MICROMHO	6	1575.00	64030.0	253.041	.160661	103.304	1830.00	1140.00	72/07/18	72/07/20
00300	DO		MG/L	7	5.41428	.254829	.504806	.093236	.190799	6.10000	4.80000	72/07/18	73/07/11
00310	BOD	5 DAY	MG/L	2	.800000	.020000	.141423	.176779	.100001	.900000	.700000	72/07/20	73/07/11
00403	LAB	PH	SU	1	7.20000					7.20000	7.20000	73/07/11	73/07/11
00530	RESIDUE	TOT NFLT	MG/L	3	25.0000	175.000	13.2288	.529150	7.63763	35.0000	10.0000	72/07/18	72/07/20
00535	RESIDUE	VOL NFLT	MG/L	3	10.6667	24.3335	4.93290	.462459	2.84801	14.0000	5.00000	72/07/18	72/07/20
00540	RESIDUE	FIX NFLT	MG/L	3	14.3333	69.3335	8.32667	.580931	4.80741	21.0000	5.00000	72/07/18	72/07/20
00660	ORTHOPO4	PO4	MG/L	1	.240000					.240000	.240000	75/10/20	75/10/20
00940	CHLORIDE	CL	MG/L	7	373.571	8322.75	91.2291	.244208	34.4813	475.000	240.000	72/07/18	73/07/11
01025	CADMIUM	CD,DISS	UG/L	1	10.0000					10.0000	10.0000	75/11/20	75/11/20
01026	CADMIUM	CD,SUSP	UG/L	1	10.0000					10.0000	10.0000	75/10/20	75/10/20
01040	COPPER	CU,DISS	UG/L	2	25.0250	1247.50	35.3200	1.41139	24.9750	50.0000	.050000	75/10/20	75/11/20
01045	IRON	FE,TOT	UG/L	2	700.000	.000000	.000000		.000000	700.000	700.000	75/10/20	75/11/20
01051	LEAD	PB,TOT	UG/L	2	100.000	.000000	.000000		.000000	100.000	100.000	75/10/20	75/11/20
01092	ZINC	ZN,TOT	UG/L	2	60.0000	.000000	.000000		.000000	60.0000	60.0000	75/10/20	75/11/20
31501	TOT COLI	MFIMENDO	/100ML	1	80.0000					80.0000	80.0000	77/05/04	77/05/04
31505	TOT COLI	MPN CONF	/100ML	6	183.667	19953.9	141.258	.769101	57.6684	350.000	23.0000	72/07/18	77/05/16
31614	FEC COLI	MPN	TUBECODE	5	61.1200	3992.78	63.1885	1.03384	28.2587	130.000	5.60000	72/07/18	75/10/20
31615	FEC COLI	MPNECMED	/100ML	6	54.2666	3476.03	58.9579	1.08645	24.0695	130.000	5.60000	72/07/18	77/05/16
31616	FEC COLI	MFM-FCBR	/100ML	1	100.000					100.000	100.000	77/05/04	77/05/04

Table C-28 (Continued)

USEPA STORET DATA

STORET DATE 80/07/08

/TYPA/AMBNT/ESTURY

20030016
30 21 00.7 081 37 01.5 1
ST JOHNS R OFF MUNICIPAL DOCKS
12031 FLORIDA
SOUTH-EAST
ST JOHNS
21FLA
0000 CLASS 00

PARAMETER			
00010	WATER TEMP		CENT
00027	COLLECT AGENCY		CODE
00067	TIDE STAGE		CODE
00070	TURB JKSN		JTU
00076	TURB TRBIDMTR		HACH FTU
00077	TRANSP SECCHI		INCHES
00080	COLOR PT-CO		UNITS
00094	CNDUCTVY FIELD		MICROMHO
00095	CNDUCTVY AT 25C		MICROMHO
00299	DO PROBE		MG/L
00300	DO		MG/L
00301	DO SATUR		PERCENT
00310	BOD 5 DAY		MG/L
00400	PH		SU
00403	LAB PH		SU
00410	T ALK CACO3		MG/L
00435	T ACDITY CACO3		MG/L
00500	RESIDUE TOTAL		MG/L
00530	RESIDUE TOT NFLT		MG/L
00535	RESIDUE VOL NFLT		MG/L
00540	RESIDUE FIX NFLT		MG/L
00605	ORG N N		MG/L
00610	NH3+NH4- N TOTAL		MG/L
00620	NO3-N TOTAL		MG/L
00650	T PO4 PO4		MG/L
00660	ORTHOPO4 PO4		MG/L P
00665	PHOS-TOT		MG/L
00680	T ORG C C		MG/L
00915	CALCIUM CA,DISS		MG/L
00920	MGNSIUM CACO3		MG/L
00937	PTSSIUM K,TOT		MG/L
00940	CHLORIDE CL		MG/L
01025	CADMIUM CD,DISS		UG/L
01026	CADMIUM CD,SUSP		UG/L
01027	CADMIUM CD,TOT		UG/L
01034	CHROMIUM CR,TOT		UG/L
01040	COPPER CU,DISS		UG/L
01042	COPPER CU,TOT		UG/L
01045	IRON FE,TOT		UG/L
01051	LEAD PB,TOT		UG/L
01092	ZINC ZN,TOT		UG/L
31501	TOT COLI MFIMENDO		/100ML
31505	TOT COLI MPN CONF		/100ML
31614	FEC COLI MPN		TUBECODE
31615	FEC COLI MPNECMED		/100ML
31616	FEC COLI MFM-FCBR		/100ML
70507	PHOS-T ORTHO		MG/L P

NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
96	75.6208	133396	365.235	4.82982	37.2766	2807.00	9.00000	68/10/14	79/01/11
37	8065.05	113.778	10.6667	.001323	1.75359	8067.00	8031.00	74/03/18	78/11/14
8	3485.00	493568	702.544	.201591	248.387	5210.00	3110.00	76/11/01	77/07/13
84	11.2107	85.5647	9.25012	.825115	1.00927	67.0000	.000000	68/10/14	78/11/14
4	4.05000	.616664	.785279	.193896	.392640	4.60000	2.90000	78/08/08	79/01/11
2	29.5000	112.500	10.6066	.359546	7.50000	37.0000	22.0000	77/03/14	77/05/02
53	112.736	71933.1	268.204	2.37904	36.8406	2000.00	40.0000	68/10/14	73/06/11
8	14283.7	.137E+09	11729.4	.821168	4146.95	33000.0	1100.00	76/09/20	78/11/14
32	12565.0	.534E+08	7311.63	.581904	1292.53	25000.0	680.000	74/03/18	79/01/11
3	5.23333	.003334	.057741	.011033	.033337	5.30000	5.20000	77/03/14	77/07/13
97	6.01335	2.50548	1.58287	.263226	.160716	9.50000	2.80000	68/10/14	79/01/11
14	72.6213	53.4615	7.31174	.100683	1.95414	85.4000	57.7000	72/06/12	73/08/13
89	.984053	.730188	.854510	.868358	.102871	5.20000	.000000	68/10/14	79/01/11
52	7.39035	.066023	.256950	.034768	.035633	8.10000	6.70000	68/10/14	78/11/14
51	7.54016	.085879	.293051	.038865	.041035	8.10000	6.80000	72/08/14	79/01/11
38	67.4395	494.382	22.2347	.329698	3.60694	96.0000	.000000	74/03/18	79/01/11
39	9.05640	243.606	15.6079	1.72341	2.49926	99.0000	.400000	73/12/04	79/01/11
1	525.000					525.000	525.000	78/08/08	78/08/08
39	47.4538	13263.9	115.169	2.42697	18.4418	735.000	3.70000	72/07/18	79/01/11
3	10.3333	5.33350	2.30944	.223494	1.33335	13.0000	9.00000	72/07/18	72/07/19
3	12.3333	60.3335	7.76746	.629794	4.48455	21.0000	6.00000	72/07/18	72/07/19
40	.800420	.327119	.571943	.714554	.090432	2.95600	.016000	74/03/18	79/01/11
42	.127714	.023566	.153511	1.20199	.023687	.900000	.000000	73/12/04	79/01/11
38	.267026	.037173	.192804	.722043	.031277	.920000	.030000	73/12/04	79/01/11
30	.362666	.128313	.358208	.987707	.065399	1.70000	.030000	74/05/13	78/10/18
38	.172736	.025542	.159820	.925222	.025926	.950000	.010000	74/03/18	78/11/14
3	.400000	.067900	.260577	.651443	.150444	.650000	.130000	75/08/04	79/01/11
10	21.6600	50.8008	7.12747	.329061	2.25390	32.6000	8.00000	73/12/04	78/09/19
1	70.0000					70.0000	70.0000	73/12/04	73/12/04
1	259.700					259.700	259.700	73/12/04	73/12/04
1	181.000					181.000	181.000	78/10/18	78/10/18
66	4012.11	.133E+08	3658.78	.911934	450.364	15500.0	6.20000	68/10/14	79/01/11
5	12.8000	147.200	12.1326	.947860	5.42586	30.0000	2.00000	75/05/05	75/09/08
12	38.6667	1242.43	35.2481	.911588	10.1752	100.000	.000000	73/12/04	75/10/13
21	30.1428	470.029	21.6802	.719247	4.73100	85.0000	5.00000	75/10/13	79/01/11
4	128.000	41912.7	204.726	1.59942	102.363	433.000	8.00000	75/07/21	79/01/11
14	2393.59	.776E+08	8809.56	3.68048	2354.45	33000.0	.000000	73/12/04	75/10/31
20	56.7500	2147.04	46.3361	.816496	10.3611	217.000	20.0000	75/10/13	79/01/11
25	390.680	28561.6	169.002	.432584	33.8003	900.000	50.0000	74/03/18	79/01/11
31	145.194	18417.1	135.710	.934681	24.3742	620.000	.000000	73/12/04	79/01/11
35	56.4722	5950.54	77.1398	1.36598	12.8566	400.000	3.00000	73/12/04	79/01/11
22	6086.00	.163E+09	12774.1	2.09894	2723.45	61000.0	140.000	74/03/18	79/01/11
77	6581.38	.156E+09	12506.4	1.90027	1425.24	93000.0	2.30000	68/10/14	77/06/13
12	7249.16	.117E+09	10857.1	1.49770	3134.17	35000.0	200.000	74/06/12	75/09/08
19	7468.94	.182E+09	13495.9	1.80693	3096.17	49000.0	110.000	74/06/12	77/06/13
22	662.409	1344450	1159.50	1.75043	247.207	4600.00	20.0000	74/03/18	79/01/11
5	.230600	.014077	.118646	.514512	.053060	.383000	.110000	75/10/13	79/01/11

Table C-28 (Continued)

USEPA STORET DATA

STORET DATE 80/07/08

20030015
30 22 52.4 081 27 41.6 1
ST JOHNS R BUOY NO 2
12031 FLORIDA
SOUTH-EAST
ST JOHNS
21FLA
0000 CLASS 00

/TYPA/AMBNT/ESTURY

PARAMETER				NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	1	23.5000					23.5000	23.5000	76/05/12	76/05/12
00027	COLLECT	AGENCY	CODE	1	8031.00					8031.00	8031.00	76/05/12	76/05/12
00028	ANALYZE	AGENCY	CODE	1	8066.00					8066.00	8066.00	76/05/12	76/05/12
00076	TURB	TRBIDMTR	HACH FTU	1	2.00000					2.00000	2.00000	76/05/12	76/05/12
00078	TRANSP	SECCHI	METERS	1	1.60000					1.60000	1.60000	76/05/12	76/05/12
00081	AP COLOR	PT-CO	UNITS	1	40.0000					40.0000	40.0000	76/05/12	76/05/12
00095	CNDUCTVY	AT 25C	MICROMHO	1	42000.0					42000.0	42000.0	76/05/12	76/05/12
00400	PH		SU	1	7.80000					7.80000	7.80000	76/05/12	76/05/12
00403	LAB	PH	SU	1	7.85000					7.85000	7.85000	76/05/12	76/05/12
00410	T ALK	CACO3	MG/L	1	105.000					105.000	105.000	76/05/12	76/05/12
00435	T ACDITY	CACO3	MG/L	1	6.00000					6.00000	6.00000	76/05/12	76/05/12
00530	RESIDUE	TOT NFLT	MG/L	1	124.000					124.000	124.000	76/05/12	76/05/12
00535	RESIDUE	VOL NFLT	MG/L	1	18.0000					18.0000	18.0000	76/05/12	76/05/12
00540	RESIDUE	FIX NFLT	MG/L	1	106.000					106.000	106.000	76/05/12	76/05/12
00620	NO3-N	TOTAL	MG/L	1	.010000					.010000	.010000	76/05/12	76/05/12
00625	TOT KJEL	N	MG/L	1	.330000					.330000	.330000	76/05/12	76/05/12
00665	PHOS-TOT		MG/L P	1	.080000					.080000	.080000	76/05/12	76/05/12
00680	T ORG C	C	MG/L	1	5.00000					5.00000	5.00000	76/05/12	76/05/12
00916	CALCIUM	CA-TOT	MG/L	1	184.000					184.000	184.000	76/05/12	76/05/12
00927	MGNSIUM	MG,TOT	MG/L	1	1720.00					1720.00	1720.00	76/05/12	76/05/12
00929	SODIUM	NA,TOT	MG/L	1	5500.00					5500.00	5500.00	76/05/12	76/05/12
00937	PTSSIUM	K,TOT	MG/L	1	260.000					260.000	260.000	76/05/12	76/05/12
00951	FLUORIDE	F,TOTAL	MG/L	1	1.00000					1.00000	1.00000	76/05/12	76/05/12
01027	CADMIUM	CD,TOT	UG/L	1	.500000					.500000	.500000	76/05/12	76/05/12
01042	COPPER	CU,TOT	UG/L	1	4.00000					4.00000	4.00000	76/05/12	76/05/12
01045	IRON	FE,TOT	UG/L	1	400.000					400.000	400.000	76/05/12	76/05/12
01051	LEAD	PB,TOT	UG/L	1	.000000					.000000	.000000	76/05/12	76/05/12
01092	ZINC	ZN,TOT	UG/L	1	230.000					230.000	230.000	76/05/12	76/05/12
70507	PHOS-T	ORTHO	MG/L P	1	.020000					.020000	.020000	76/05/12	76/05/12

Table C-28 (Continued)

USEPA STORET DATA

STORET DATE 80/07/08

/TYPA/AMBNT/ESTURY

20030012
30 23 22.5 081 29 49.5 1
ST JOHNS R AT JCT OF BACK R
12031 FLORIDA
SOUTH-EAST
ST JOHNS
21FLA
0000 CLASS 00

PARAMETER				NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010 WATER	TEMP	CENT		44	23.3863	29.4230	5.42430	.231943	.817744	31.5000	11.0000	72/07/19	79/01/11
00027 COLLECT	AGENCY	CODE		32	8067.00	-.825E+01	.000000		.000000	8067.00	8067.00	73/10/09	78/11/14
00067 TIDE	STAGE	CODE		4	3410.00	26661.3	163.283	.047884	81.6415	3610.00	3210.00	76/11/01	77/06/13
00070 TURB	JKSN	JTU		35	4.30857	26.5479	5.15246	1.19586	.870925	17.0000	.000000	72/05/05	78/11/14
00076 TURB	TRBIDMTR	HACH FTU		4	3.85000	1.95000	1.39642	.362707	.698212	5.20000	1.90000	78/08/08	79/01/11
00077 TRANSP	SECCHI	INCHES		1	33.0000					33.0000	33.0000	77/03/14	77/03/14
00094 CNDUCTVY	FIELD	MICROMHO		7	20857.1	.291E+08	5398.44	.258829	2040.42	25000.0	10000.0	76/09/20	78/11/14
00095 CNDUCTVY	AT 25C	MICROMHO		32	23325.0	.722E+08	8500.32	.364429	1502.66	38200.0	5700.00	73/10/09	79/01/11
00299 DO	PROBE	MG/L		2	5.35000	.124985	.353532	.066081	.249985	5.60000	5.10000	77/03/14	77/07/13
00300 DO		MG/L		47	6.46594	2.63725	1.62396	.251156	.236879	12.5000	4.00000	72/07/18	79/01/11
00310 BOD	5 DAY	MG/L		12	.833333	.416969	.645732	.774878	.186407	1.60000	.000000	72/07/18	79/01/11
00400 PH		SU		8	7.44999	.648612	.805364	.108103	.284739	8.00000	5.50000	72/07/18	78/11/14
00403 LAB	PH	SU		41	7.57924	.188434	.434090	.057273	.067793	8.30000	6.50000	73/10/09	79/01/11
00410 T ALK	CACO3	MG/L		39	85.4384	759.970	27.5675	.322660	4.41434	127.000	.000000	73/10/09	79/01/11
00435 T ACDITY	CACO3	MG/L		38	12.2552	462.430	21.5042	1.75469	3.48844	135.000	.000000	73/10/09	79/01/11
00500 RESIDUE	TOTAL	MG/L		2	10770.0	.574E+08	7580.17	.703823	5359.99	16130.0	5410.00	72/05/05	78/08/08
00505 RESIDUE	TOT VOL	MG/L		1	3780.00					3780.00	3780.00	72/05/05	72/05/05
00510 RESIDUE	TOT FIX	MG/L		1	12350.0					12350.0	12350.0	72/05/05	72/05/05
00515 RESIDUE	DISS-105	C MG/L		1	16080.0					16080.0	16080.0	72/05/05	72/05/05
00530 RESIDUE	TOT NFLT	MG/L		42	62.2309	12832.6	113.281	1.82033	17.4796	650.000	8.00000	72/05/05	79/01/11
00535 RESIDUE	VOL NFLT	MG/L		7	11.5714	33.9524	5.82687	.503557	2.20235	23.0000	5.00000	72/05/05	72/07/20
00540 RESIDUE	FIX NFLT	MG/L		7	15.4286	58.2858	7.63451	.494829	2.88557	32.0000	9.00000	72/05/05	72/07/20
00600 TOTAL N	N	MG/L		1	6.40000					6.40000	6.40000	75/11/03	75/11/03
00605 ORG N	N	MG/L		35	.708139	.578664	.760700	1.07422	.128582	3.42700	.016000	73/10/09	79/01/11
00610 NH3+NH4-	N TOTAL	MG/L		36	.260916	.695812	.834154	3.19702	.139026	5.00000	.000000	73/10/09	78/08/08
00620 NO3-N	TOTAL	MG/L		35	.310485	.062446	.249892	.804844	.042239	.990000	.014000	73/11/07	79/01/11
00650 T PO4	PO4	MG/L		27	.599406	.619627	.787164	1.31324	.151490	2.94000	.010000	74/03/18	78/10/18
00660 ORTHOPO4	PO4	MG/L		38	.270000	.258213	.508147	1.88203	.082432	2.93000	.020000	74/01/07	78/11/14
00665 PHOS-TOT		MG/L P		3	.330000	.057900	.240624	.729164	.138924	.560000	.080000	75/08/04	79/01/11
00680 T ORG C	C	MG/L		11	17.3273	91.2181	9.55081	.551201	2.87968	34.0000	2.00000	73/10/09	78/09/19
00915 CALCIUM	CA,DISS	MG/L		3	91.3333	16.3457	4.04298	.044266	2.33422	95.0000	87.0000	73/10/09	73/12/04
00920 MGNSIUM	CACO3	MG/L		2	478.550	4334.00	65.8331	.137568	46.5511	525.100	432.000	73/10/09	73/12/04
00937 PTSSIUM	K,TOT	MG/L		1	268.000					268.000	268.000	78/10/18	78/10/18
00940 CHLORIDE	CL	MG/L		19	9960.52	.177E+08	4210.12	.422681	965.869	21000.0	4000.00	72/07/18	79/01/11
00945 SULFATE	SO4-TOT	MG/L		2	200.000	1800.00	42.4264	.212132	30.0000	230.000	170.000	73/10/09	73/11/07
01025 CADMIUM	CD,DISS	UG/L		5	50.0000	300.000	17.3205	.346410	7.74597	80.0000	40.0000	75/06/02	75/10/13
01026 CADMIUM	CD,SUSP	UG/L		13	52.6923	3916.57	62.5825	1.18770	17.3572	200.000	.000000	73/10/09	75/10/13
01027 CADMIUM	CD,TOT	UG/L		19	46.5263	654.375	25.5808	.549813	5.86863	90.0000	4.00000	75/10/13	79/01/11
01034 CHROMIUM	CR,TOT	UG/L		5	77.8000	23205.2	152.333	1.95800	68.1252	350.000	.000000	73/11/07	79/01/11
01040 COPPER	CU,DISS	UG/L		16	31.5186	3851.68	62.0619	1.96905	15.5155	200.000	.000000	73/10/09	75/10/13
01042 COPPER	CU,TOT	UG/L		19	48.1226	626.898	25.0379	.520294	5.74409	100.000	.330000	75/10/13	79/01/11
01045 IRON	FE,TOT	UG/L		29	648.483	1099860	1048.74	1.61722	194.746	5900.00	101.000	73/11/07	79/01/11
01051 LEAD	PB,TOT	UG/L		32	177.500	29082.4	170.536	.960764	30.1467	620.000	.000000	73/10/09	79/01/11
01055 MANGNESE	MN	UG/L		1	.000000					.000000	.000000	73/11/07	73/11/07
01067 NICKEL	NI,TOTAL	UG/L		1	.000000					.000000	.000000	73/11/07	73/11/07
01092 ZINC	ZN,TOT	UG/L		39	72.3846	12172.0	110.327	1.52418	17.6664	700.000	10.0000	73/10/09	79/01/11
31501 TOT COLI	MFIMENDO	/100ML		23	869.565	1572757	1254.10	1.44221	261.497	4900.00	20.0000	73/12/04	79/01/11
31505 TOT COLI	MPN CONF	/100ML		24	1761.10	8804251	2967.20	1.68485	605.676	13000.0	.240000	72/07/18	77/06/13
31614 FEC COLI	MPN	THRECODE		14	868.571	2133398	1460.62	1.68163	390.366	4900.00	50.0000	73/10/09	75/09/08
31615 FEC COLI	MPNECMED	/100ML		20	667.050	1562128	1249.85	1.81916	279.475	4900.00	11.0000	73/10/09	77/06/13
31616 FEC COLI	MFM-FCBR	/100ML		23	310.000	500217	707.260	2.28148	147.474	3300.00	3.00000	73/12/04	79/01/11
70507 PHOS-T	ORTHO	MG/L P		7	.438428	.237124	.486954	1.11068	.184051	1.50000	.080000	73/10/09	79/01/11
71900 MERCURY	HG,TOTAL	UG/L		2	2.40000	11.5200	3.39411	1.41421	2.40000	4.80000	.000000	73/10/09	73/11/07

Table C-28 (Continued)

USEPA STORET DATA

STORET DATE 80/07/08

20030007
30 24 37.6 081 35 45.7 1
ST JOHNS R BROWARD R DUNNS CR
12031 FLORIDA
SOUTH-EAST
ST JOHNS
21FLA
0000 CLASS 00

/TYPA/AMBNT/ESTURY

PARAMETER				NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00010	WATER	TEMP	CENT	44	143.386	307486	554.515	3.86728	83.5962	2802.00	10.0000	73/09/16	79/01/11
00027	COLLECT	AGENCY	CODE	43	8065.32	73.1428	8.55236	.001060	1.30422	8067.00	8031.00	73/09/16	78/11/14
00067	TIDE	STAGE	CODE	8	3485.00	499282	706.599	.202754	249.820	5210.00	3110.00	76/11/01	77/07/13
00070	TURB	JKSN	JTU	26	4.06538	38.6295	6.21527	1.52883	1.21891	25.0000	.000000	73/09/16	78/11/14
00076	TURB	TRBIDMTR	HACH FTU	4	6.30000	1.40007	1.18325	.187817	.591623	7.20000	4.60000	78/08/08	79/01/11
00077	TRANSP	SECCHI	INCHES	2	34.5000	112.500	10.6066	.307438	7.50000	42.0000	27.0000	77/03/14	77/05/02
00094	CNDUCTVY	FIELD	MICROMHO	8	17425.0	.758E+08	8711.36	.499934	3079.93	25000.0	2400.00	76/09/20	78/11/14
00095	CNDUCTVY	AT 25C	MICROMHO	36	17903.3	.673E+08	8206.13	.458358	1367.69	32000.0	1000.00	73/10/09	79/01/11
00299	DO	PROBE	MG/L	3	5.13333	.013336	.115482	.022497	.066674	5.20000	5.00000	77/03/14	77/07/13
00300	DO		MG/L	45	6.34888	3.71037	1.92623	.303397	.287145	12.4000	2.00000	73/09/16	79/01/11
00310	BOD	5 DAY	MG/L	9	3.61111	13.9737	3.73814	1.03518	1.24604	10.0000	.800000	75/07/21	79/01/11
00315	BOD	7 DAY	MG/L	2	2.80000	.180005	.424270	.151525	.300004	3.10000	2.50000	78/06/26	78/06/26
00324	BOD	20 DAY	MG/L	2	6.05000	.245010	.494985	.081816	.350007	6.40000	5.70000	78/06/26	78/06/26
00400	PH		SU	8	7.43333	.550732	.742113	.099836	.302967	8.00000	6.00000	76/09/20	78/11/14
00403	LAB	PH	SU	43	7.60114	.107585	.328001	.043152	.050020	8.10000	6.85000	73/09/16	79/01/11
00410	T ALK	CACO3	MG/L	40	74.0600	928.957	30.4788	.411542	4.81912	173.000	.000000	73/09/16	79/01/11
00435	T ACDITY	CACO3	MG/L	40	11.2275	322.252	17.9514	1.59888	2.83836	110.000	.200000	73/09/16	79/01/11
00500	RESIDUE	TOTAL	MG/L	1	788.000					788.000	788.000	78/08/08	78/08/08
00530	RESIDUE	TOT NFLT	MG/L	37	43.2676	2220.27	47.1197	1.08903	7.74643	230.000	10.0000	73/09/16	79/01/11
00605	ORG N	N	MG/L	40	.819822	1.01459	1.00727	1.22864	.159263	5.81200	.015000	73/09/16	79/01/11
00610	NH3+NH4-	N TOTAL	MG/L	39	.299230	1.05356	1.02643	3.43024	.164361	6.49400	.000000	73/09/16	78/12/19
00615	NO2-N	TOTAL	MG/L	4	.008750	.000108	.010372	1.18540	.005186	.024000	.001000	78/06/26	78/06/26
00620	NO3-N	TOTAL	MG/L	42	.225595	.028443	.168650	.747580	.026023	.690000	.005000	73/09/16	79/01/11
00625	TOT KJEL	N	MG/L	2	.970499	.002112	.045961	.047358	.032499	1.00300	.938000	78/06/26	78/06/26
00650	T PO4	PO4	MG/L	29	.366103	.237516	.487356	1.33120	.090500	2.67000	.010000	74/03/18	78/10/18
00660	ORTHOPO4	PO4	MG/L	42	.156023	.010809	.103965	.666346	.016042	.460000	.042000	73/09/16	78/11/14
00665	PHOS-TOT		MG/L P	3	.466666	.002234	.047262	.101275	.027287	.520000	.430000	75/04/21	79/01/11
00680	T ORG C	C	MG/L	12	19.6166	97.5820	9.87836	.503570	2.85164	32.0000	1.00000	73/10/09	78/09/19
00915	CALCIUM	CA,DISS	MG/L	3	78.0000	31.0000	5.56776	.071382	3.21455	84.0000	73.0000	73/10/09	73/12/04
00920	MGNSIUM	CACO3	MG/L	2	352.750	1940.81	44.0547	.124889	31.1513	383.900	321.600	73/10/09	73/12/04
00937	PTSSIUM	K,TOT	MG/L	1	232.000					232.000	232.000	78/10/18	78/10/18
00940	CHLORIDE	CL	MG/L	17	7979.41	.162E+08	4036.75	.505896	979.055	15600.0	2300.00	73/09/16	79/01/11
00945	SULFATE	SO4-TOT	MG/L	2	171.000	722.000	26.8701	.157135	19.0000	190.000	152.000	73/10/09	73/11/07
01025	CADMIUM	CD,DISS	UG/L	5	27.4000	68.8005	8.29461	.302723	3.70946	40.0000	20.0000	75/04/21	75/09/08
01026	CADMIUM	CD,SUSP	UG/L	17	41.7059	1991.47	44.6259	1.07001	10.8234	160.000	.000000	73/09/16	75/10/13
01027	CADMIUM	CD,TOT	UG/L	20	35.4000	406.674	20.1662	.569666	4.50929	70.0000	4.00000	75/10/13	79/01/11
01034	CHROMIUM	CR,TOT	UG/L	5	169.200	44050.7	209.883	1.24044	93.8624	475.000	.000000	73/11/07	79/01/11
01040	COPPER	CU,DISS	UG/L	19	13.7086	887.748	29.7951	2.17346	6.83546	100.000	.000000	73/09/16	75/10/13
01042	COPPER	CU,TOT	UG/L	29	50.4737	2948.71	54.3020	1.07585	12.4577	267.000	18.0000	75/10/13	79/01/11
01045	IRON	FE,TOT	UG/L	34	400.483	55704.4	236.018	.589333	43.8274	1110.00	.000000	73/11/07	79/01/11
01051	LEAD	PB,TOT	UG/L	34	150.588	22494.9	149.983	.995980	25.7218	580.000	.000000	73/10/09	79/01/11
01055	MANGNESE	MN	UG/L	1	.000000					.000000	.000000	73/11/07	73/11/07
01067	NICKEL	NI,TOTAL	UG/L	1	.000000					.000000	.000000	73/11/07	73/11/07
01092	ZINC	ZN,TOT	UG/L	39	69.4872	5749.99	75.8287	1.09126	12.1423	400.000	3.00000	73/09/16	79/01/11
31501	TOT COLI	MFIMENDO	/100ML	22	2937.27	.320E+08	5662.39	1.92777	1207.23	27000.0	110.000	73/12/04	79/01/11
31505	TOT COLI	MPN CONF	/100ML	21	8034.90	.560E+09	23669.2	2.94579	5165.03	110000	13.0000	73/09/16	77/06/13
31614	FEC COLI	MPN	TUHECODE	14	7726.42	.592E+09	24338.9	3.15008	6504.83	92000.0	170.000	73/09/16	75/09/08
31615	FEC COLI	MPNECMED	/100ML	21	5318.71	.397E+09	19931.3	3.74740	4349.37	92000.0	23.0000	73/09/16	77/06/13
31616	FEC COLI	MFM-FCHR	/100ML	23	363.087	774692	880.166	2.42412	183.527	4350.00	20.0000	74/01/07	79/01/11
32230	CHLRPHYL	A	MG/L	2	.058000	.000072	.008485	.146297	.006000	.064000	.052000	78/06/26	78/06/26
70507	PHOS-T	ORTHO	MG/L P	7	.557000	.443306	.665813	1.19536	.251653	2.05000	.220000	73/10/09	79/01/11
71900	MERCURY	HG,TOTAL	UG/L	2	3.20000	20.4800	4.52548	1.41421	3.20000	6.40000	.000000	73/10/09	73/11/07

Table C-28 (Continued)

USEPA STORET DATA

STORET DATE 80/07/08

/TYPA/AMBNT/ESTURY

20030002
30 19 20.4 081 39 31.5 1
ST JOHNS RIVER MAIN STREET BRIDG
12031 FLORIDA
SOUTH-EAST 031992
ST JOHNS
21FLA
0000 CLASS 00

PARAMETER				NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00618	NO3-N	DISS	MG/L	5	.030000	.186E-08	.000043	.001439	.000019	.030000	.030000	74/06/03	74/06/30
00620	NO3-N	TOTAL	MG/L	72	.247555	.103075	.321054	1.29690	.037837	2.60000	.005000	72/07/18	80/02/27
00625	TOT KJEL	N	MG/L	35	1.37959	.369331	.607726	.440510	.102724	2.61000	.260000	72/07/18	80/03/19
00650	T PO4	PO4	MG/L	31	.387193	.115974	.340550	.879534	.061165	1.60000	.040000	74/03/19	78/10/18
00660	ORTHOPO4	PO4	MG/L	43	.192000	.023213	.152358	.793531	.023234	.840000	.024000	74/01/07	78/11/14
00665	PHOS-TOT		MG/L P	37	.238648	.018178	.134828	.564964	.022166	.670000	.090000	72/07/18	80/03/19
00680	T ORG C	C	MG/L	31	43.8451	15054.3	122.696	2.79839	22.0368	700.000	.000000	69/08/11	79/09/16
00915	CALCIUM	CA,DISS	MG/L	3	50.6667	34.3359	5.85969	.115652	3.38309	55.0000	44.0000	73/10/09	73/12/04
00916	CALCIUM	CA-TOT	MG/L	9	23.0167	753.388	27.4479	1.19252	9.14930	55.0000	.030000	73/10/09	78/03/06
00920	MGNSIUM	CACO3	MG/L	2	130.250	88.5039	9.40765	.072228	6.65222	136.900	123.600	73/10/09	73/12/04
00927	MGNSIUM	MG,TOT	MG/L	3	101.167	2581.78	50.8112	.502253	29.3359	136.900	43.0000	73/10/09	78/03/06
00929	SODIUM	NA,TOT	MG/L	1	350.000					350.000	350.000	78/03/06	78/03/06
00937	PTSSIUM	K,TOT	MG/L	2	67.6000	4685.12	68.4479	1.01254	48.4000	116.000	19.2000	78/03/06	78/10/18
00940	CHLORIDE	CL	MG/L	2719	3286.04	.104E+08	3239.95	.985973	62.1346	27000.0	2.40000	59/06/08	80/02/27
00945	SULFATE	SO4-TOT	MG/L	10	238.800	61593.7	248.181	1.03928	78.4817	840.000	10.0000	73/10/09	80/02/27
00951	FLUORIDE	F,TOTAL	MG/L	12	.218333	.016161	.127125	.582253	.036698	.550000	.100000	78/01/31	80/03/19
01025	CADMIUM	CD,DISS	UG/L	6	9.33333	77.8667	8.82421	.945451	3.60247	20.0000	2.00000	75/04/21	75/09/08
01026	CADMIUM	CD,SUSP	UG/L	12	32.0000	1520.00	38.9872	1.21835	11.2546	120.000	.000000	73/10/09	75/10/13
01027	CADMIUM	CD,TOT	UG/L	29	28.6379	681.017	26.0963	.911250	4.84596	120.000	.500000	74/02/25	79/01/11
01034	CHROMIUM	CR,TOT	UG/L	8	75.1667	6564.17	81.0196	1.07787	33.0761	200.000	.000000	73/11/07	79/01/11
01037	COBALT	CO,TOTAL	UG/L	5	.030000	.186E-08	.000043	.001439	.000019	.030000	.030000	74/06/03	74/06/30
01040	COPPER	CU,DISS	UG/L	18	10.7403	312.509	17.6779	1.64595	4.16672	50.0000	.000000	73/10/09	75/10/13
01042	COPPER	CU,TOT	UG/L	25	47.8000	1013.58	31.8368	.666043	6.36737	141.000	4.00000	73/10/09	79/01/11
01045	IRON	FE,TOT	UG/L	40	451.154	156903	396.110	.877994	62.6305	1800.00	.000000	73/11/07	79/01/11
01051	LEAD	PB,TOT	UG/L	30	117.722	20371.5	142.729	1.21242	23.7881	700.000	.000000	73/10/09	79/01/11
01055	MANGNESE	MN	UG/L	1	.000000					.000000	.000000	73/11/07	73/11/07
01067	NICKEL	NI,TOTAL	UG/L	1	.000000					.000000	.000000	73/11/07	73/11/07
01092	ZINC	ZN,TOT	UG/L	41	46.7805	2525.83	50.2576	1.07433	7.84892	270.000	3.00000	73/10/09	79/01/11
31501	TOT COLI	MFIMENDO	/100ML	28	7148.57	.442E+08	6648.44	.930038	1256.44	17000.0	30.0000	73/12/04	78/12/19
31505	TOT COLI	MPN CONF	/100ML	2719	30313.8	.245E+10	49554.1	1.63470	950.332	930000	.240000	59/06/08	80/03/19
31614	FEC COLI	MPN	TUBECODE	15	64466.7	.560E+11	236684	3.67141	61111.5	920000	1000.00	73/10/09	75/09/08
31615	FEC COLI	MPNECMED	/100ML	33	18940.7	.159E+11	126168	6.66121	17330.5	920000	9.30000	73/10/09	80/03/19
31616	FEC COLI	MFM-FCHR	/100ML	23	880.880	1483481	1217.98	1.38269	243.596	5000.00	20.0000	73/12/04	78/12/19
32230	CHLRPHYL	A	MG/L	2	.052000	.000018	.004243	.081591	.003000	.055000	.049000	78/06/26	78/06/26
50050	CONDUIT	FLOW	MGD	1	3.30000					3.30000	3.30000	77/04/06	77/04/06
70507	PHOS-T	ORTHO	MG/L P	23	.159782	.012351	.111136	.695548	.023173	.445000	.050000	73/10/09	79/01/11
71900	MERCURY	HG,TOTAL	UG/L	28	.318750	.581669	.762672	2.39270	.269645	2.20000	.000000	73/10/09	78/03/06
72016	BOT DPTH	OF SMPLE	FT	9	45.1666	550.197	23.4563	.519328	9.57599	78.7000	12.2000	77/11/02	79/07/11
80109	SUGAR	REDUC	MG/L	5	3.00000	.000000	.000000		.000000	3.00000	3.00000	74/06/03	74/06/30

Table C-28 (Continued)

USEPA STORET DATA

STORET DATE 80/07/08

02246500
30 19 16.0 081 39 54.0 2
ST. JOHNS RIVER AT JACKSONVILLE,
12031 FLORIDA
032091

/TYPA/AMBNT/STREAM

112WRD
0000 CLASS 00

PARAMETER				NUMBER	MEAN	VARIANCE	STAN DEV	COEF VAR	STAND ER	MAXIMUM	MINIMUM	BEG DATE	END DATE
00935 POTASSIUM	K,DISS	MG/L		57	81.7156	5254.64	72.4889	.887087	9.60139	250.000	2.10000	62/06/08	77/05/05
00940 CHLORIDE	CL	MG/L		109	3546.07	9775630	3126.60	.881709	299.474	11000.0	69.0000	62/06/08	77/05/05
00945 SULFATE	SO4-TOT	MG/L		56	560.392	192837	439.132	.783617	58.6815	1340.00	25.0000	62/06/08	77/05/05
00950 FLUORIDE	F,DISS	MG/L		57	.524558	.050460	.224633	.428234	.029753	1.00000	.200000	62/06/08	77/05/05
00955 SILICA	DISOLVED	MG/L		93	3.25481	20.8599	4.56726	1.40323	.473603	43.9999	.300000	62/06/08	77/05/05
01000 ARSENIC	AS,DISS	UG/L		4	5.00000	33.3333	5.77350	1.15470	2.88675	10.00000	.000000	70/05/15	71/10/01
01002 ARSENIC	AS,TOT	UG/L		10	5.19999	40.6221	6.37355	1.22568	2.01549	20.0000	.000000	72/05/12	77/05/05
01025 CADMIUM	CD,DISS	UG/L		3	.000000	.000000	.000000		.000000	.000000	.000000	70/10/02	71/10/01
01027 CADMIUM	CD,TOT	UG/L		10	.499999	1.61111	1.26929	2.53859	.401386	4.00000	.000000	72/05/12	77/05/05
01032 CHROMIUM	HEX-VAL	UG/L		3	.000000	.000000	.000000		.000000	.000000	.000000	70/10/02	71/10/01
01034 CHROMIUM	CR,TOT	UG/L		3	16.6667	433.333	20.8166	1.24900	12.0185	40.0000	.000000	70/05/15	72/10/10
01035 COBALT	CO,DISS	UG/L		3	.333333	.333333	.577350	1.73205	.333333	1.000000	.000000	70/10/02	71/10/01
01037 COBALT	CO,TOTAL	UG/L		2	.000000	.000000	.000000		.000000	.000000	.000000	72/05/12	72/10/10
01040 COPPER	CU,DISS	UG/L		12	9.41666	129.720	11.3894	1.20950	3.28785	30.0000	.000000	70/05/15	77/05/05
01042 COPPER	CU,TOT	UG/L		2	5.00000	50.0000	7.07107	1.41421	5.00000	10.00000	.000000	72/05/12	72/10/10
01045 IRON	FE,TOT	UG/L		10	400.000	24866.7	157.692	.394229	49.8665	620.000	100.000	72/05/12	77/05/05
01046 IRON	FE,DISS	UG/L		38	101.588	24649.5	157.002	1.54548	25.4690	940.000	.000000	62/06/08	77/05/05
01049 LEAD	PB,DISS	UG/L		14	4.07142	16.9945	4.12244	1.01253	1.10177	12.0000	.000000	70/05/15	77/05/05
01050 LEAD	PB,SUSP	UG/L		7	4.71428	41.5714	6.44759	1.36767	2.43696	15.0000	.000000	74/06/06	77/05/05
01051 LEAD	PB,TOT	UG/L		10	8.79999	32.1777	5.67254	.644608	1.79382	18.0000	.000000	72/05/12	77/05/05
01054 MANGNESE	MN,SUSP	UG/L		7	15.7143	128.571	11.3389	.721569	4.28571	30.0000	.000000	74/06/06	77/05/05
01055 MANGNESE	MN	UG/L		10	37.3000	261.791	16.1800	.433780	5.11656	63.0000	20.0000	66/05/25	77/05/05
01056 MANGNESE	MN,DISS	UG/L		14	19.5000	181.963	13.4894	.691763	3.60518	40.0000	.000000	67/05/10	77/05/05
01067 NICKEL	NI,TOTAL	UG/L		8	4.12500	14.1250	3.75832	.911109	1.32877	11.0000	.000000	73/09/19	77/05/05
01080 STRONTUM	SR,DISS	UG/L		38	2417.24	2408087	1551.80	.641972	251.735	5800.00	1.60000	66/10/05	77/05/05
01090 ZINC	ZN,DISS	UG/L		12	25.6666	341.698	18.4851	.720199	5.33618	60.0000	.000000	70/05/15	77/05/05
01092 ZINC	ZN,TOT	UG/L		2	15.0000	49.9998	7.07105	.471404	4.99999	20.0000	9.99999	72/05/12	72/10/10
01105 ALUMINUM	AL,TOT	UG/L		8	138.750	12469.6	111.668	.804812	39.4804	320.000	.000000	73/09/19	77/05/05
32730 PHENOLS	TOTAL	UG/L		5	1.00160	4.99601	2.23517	2.23160	.999601	5.00000	.499E-06	68/10/14	68/10/14
39730 2,4-D	WHL SMPL	UG/L		5	.032000	.001320	.036332	1.13537	.016248	.080000	.000000	75/07/22	76/01/27
39740 2,4,5-T	WHL SMPL	UG/L		5	.010000	.000500	.022361	2.23607	.010000	.050000	.000000	75/07/22	76/01/27
39760 SILVEX	WHL SMPL	UG/L		5	.004000	.000030	.005477	1.36931	.002449	.010000	.000000	75/07/22	76/01/27
70299 RES-SUSP	AT 180 C	MG/L		7	19.0000	83.6665	9.14694	.481419	3.45722	33.0000	6.99999	73/09/19	76/10/08
70300 RESIDUE	DISS-180	C MG/L		34	7400.01	.536E+08	7327.44	.990193	1256.65	18700.0	278.000	62/06/08	77/05/05
70301 DISS SOL	SUM	MG/L		48	7511.90	.359E+08	5998.71	.798562	865.840	17900.0	179.000	66/04/26	77/05/05
70302 DISS SOL	TONS/DAY			11	1065868	.444E+13	2108244	1.97796	635660	6680000	306.001	66/05/25	77/05/05
70303 DISS SOL	TONS PER	ACRE-FT		51	10.5472	69.0477	8.30950	.787838	1.16356	25.4000	.380000	62/06/08	77/05/05
70507 PHOS-T	ORTHO	MG/L P		41	.113877	.001102	.033201	.291554	.005185	.230000	.045000	71/10/01	77/05/05
71845 AMMONIA	TOT-NH4	MG/L		3	.026667	.000033	.005774	.216513	.003333	.030000	.020000	68/10/14	68/10/14
71846 AMMONIA	DISS-NH4	MG/L		21	.130476	.014785	.121592	.931915	.026534	.390000	.000000	68/10/14	72/01/31
71850 NITRATE	TOT-NO3	MG/L		3	1.40000	.120000	.346411	.247437	.200000	1.60000	.999999	68/10/14	68/10/14
71851 NITRATE	DISS-NO3	MG/L		61	1.32950	2.92976	1.71165	1.28744	.219155	11.0000	.000000	62/06/08	72/08/14
71855 NITRITE	TOT-NO2	MG/L		3	.026667	.000133	.011547	.433017	.006667	.040000	.020000	68/10/14	68/10/14
71856 NITRITE	DISS-NO2	MG/L		32	.072812	.017872	.133688	1.83605	.023633	.619999	.499E-06	68/10/14	72/01/31
71885 IRON	FE	UG/L		7	198.572	107848	328.402	1.65382	124.124	-940.000	40.0001	66/05/25	66/12/22
71886 TOTAL P	AS PO4	MG/L		9	.434444	.018178	.134825	.310340	.044942	.700000	.280000	71/05/06	72/01/31
71887 TOTAL N	AS NO3	MG/L		19	4.83684	.875773	.935827	.193479	.214693	7.20000	3.10000	74/07/31	77/05/05
71900 MERCURY	HG,TOTAL	UG/L		12	-.116667	.037879	.194625	1.66821	.056183	-.600000	.000000	71/05/06	77/05/05

Table C-29

HISTORICAL WATER QUALITY DATA SHOWING PARAMETERS
IN EXCESS OF WATER QUALITY CRITERIA

Parameters	Location[a]
Arsenic	Blount Island Channel - Sta. BI-5, BI-8 and BI-11
Cadmium	St. Johns River - RM 7.1 STORET Sta. #20030002, 20030007, 20030012, 20030016, 20030034, 20030035, and 20030043
Copper	St. Johns River - RM 7.1, 7.3, 8, 9.3, 10.7 and 10.8 Blount Island Channel - Sta. # 10, I, J, BI-5, BI-8, and BI-11 Browns Creek - Sta. #1 S/B and 12 Nichols Creek - Sta. #3N and 8 San Carlos Creek - Sta. #2, 3, 4, 4S, and 6 STORET Sta. #20030002, 20030007, 20030012, 20030016, 20030035, and 20030043
Iron	St. Johns River - RM 7.1, 7.3, 8, 9.3, 10.7, 10.8, 10.9 Blount Island Channel - Sta. #10, I, J, BI-5, BI-8, and BI-11 Browns Creek - Sta. #1 S/B San Carlos Creek - Sta. #3, 4 and 6 STORET Sta. #02246500, 20030002, 200300007, 20030012, 20030015, 20030016, 20030023, and 20030035
Lead	St. Johns River - RM 7.1, 7.8 and 10.8 STORET Sta. #20030002, 20030007, 20030012, 20030016, 20030023, 20030035, and 20030043
Mercury	St. Johns River - RM 7.3, 8, 9.3, 10.7, 10.8 Blount Island Channel - Sta. #2 S/B, 9, 10, 11, I, J, BI-5, BI-8 and BI-11 Browns Creek - Sta. #1 S/B and 12 Nichols Creek - Sta. #3N, 7 and 8 San Carlos Creek - Sta. #2, 3, 4, 4S, 5 and 6 STORET Sta. #02246500, 20030002, 20030007, and 20030012
Nickel	STORET Sta. #20030035
pH	St. Johns River - RM 7.1 (low pH = 5.5)
Total Chromium	St. Johns River - RM 7.1, 7.3 Blount Island Channel - Sta. #I, J STORET Sta. #20030002, 20030007, 20030012, 20030016, and 20030035

a See Chapter 2, Figures 2.5-13 and 2.5-14

Table C-30 (Revision 1)

TIDE COMPOSITE VALUES AT SURFACE AND BOTTOM - ST JOHNS RIVER AT THE PROPOSED SITE
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2 Mean	F-2 Max	G Mean	G Max	H-2 Mean	H-2 Max
Alkalinity, $CaCO_3$	88 (91)	104 (104)	91 (95)	106 (106)	92 (96)	106 (108)
Aluminum, ug/l	448.6 (796.1)	1900 (3340)	351.6 (625)	2760 (3630)	439.1 (496.1)	2400 (4130)
Ammonia, N	0.1 (0.1)	0.29 (0.25)	0.11 (0.09)	0.38 (0.23)	0.12 (0.11)	0.27 (0.27)
Antimony, ug/l	< 0.2 (< 0.2)	0.9 (0.9)	< 0.2 (< 0.2)	0.95 (0.9)	< 0.2 (< 0.2)	0.9 (1.0)
Arsenic, ug/l	0.75 (0.75)	1.0 (1.0)	0.66 (0.72)	1.0 (1.0)	0.66 (0.66)	1.0 (1.0)
Beryllium, ug/l	< 0.1 (< 0.1)	0.19 (0.19)	< 0.1 (< 0.1)	0.19 (0.19)	< 0.1 (< 0.1)	0.19 (0.19)
Bicarbonate, $CaCO_3$	88 (91)	104 (104)	91 (95)	106 (106)	92 (96)	106 (108)
BOD-5	< 2 (< 2)	4.0 (4.5)	2.2 (2.0)	6.7 (4.0)	< 2 (2.1)	2.7 (5.4)
Boron	2.77 (2.99)	4.3 (4.3)	3.08 (3.14)	4.6 (4.7)	3.06 (3.25)	4.6 (4.7)
Bromide	36.4 (36.4)	57 (53)	35.8 (38.3)	50 (63)	34.5 (40.1)	45.0 (53)
Cadmium, ug/l	0.22 (0.28)	0.4 (0.7)	0.33 (0.26)	2.2 (1.1)	0.26 (0.23)	0.6 (0.55)

Table C-30 (Revision 1) (Continued)

TIDE COMPOSITE VALUES AT SURFACE AND BOTTOM - ST JOHNS RIVER AT THE PROPOSED SITE
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2 Mean	F-2 Max	G Mean	G Max	H-2 Mean	H-2 Max
Calcium	240 (257)	390 (390)	264 (279)	390 (395)	272 (292)	385 (395)
Carbonate, $CaCO_3$	0 (0)		0 (0)		0 (0)	
Chloride	11478 (12283)	19300 (19200)	12677 (13345)	20400 (20300)	13075 (14140)	19500 (20300)
Chlorine, Total Residual	0.04 (0.03)	0.09 (0.09)	0.04 (0.04)	0.09 (0.2)	0.04 (0.04)	0.09 (0.1)
Chromium (Hex) ug/l	<1.0 (<1.0)	< 1.0 (<1.0)	< 1.0 (<1.0)	< 1.0 (<1.0)	< 1.0 (<1.0)	< 1.0 (<1.0)
Chromium (Total) ug/l	1.6 (1.45)	3.0 (3.0)	1.5 (1.68)	5.0 (4.0)	1.43 (1.62)	3.0 (4.0)
Coliform, Fecal (MPN)	29 (22)	150 (144)	22 (26)	200 (164)	31 (15)	200 (40)
Coliform, Total (MPN)	478 (678)	2500 (3500)	755 (369)	10000 (3500)	698 (201)	5000 (550)
Conductivity, umhos	27500 (31286)	42500 (48000)	28977 (29905)	49000 (47000)	30938 (32143)	47500 (46000)
Copper, ug/l	61 (88.9)	119 (185)	65.6 (73.3)	137 (275)	68.7 (78.6)	108 (245)

Table C-30 (Revision 1) (Continued)

TIDE COMPOSITE VALUES AT SURFACE AND BOTTOM - ST JOHNS RIVER AT THE PROPOSED SITE
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2 Mean	F-2 Max	G Mean	G Max	H-2 Mean	H-2 Max
Cyanide	0.008 (0.006)	0.031 (0.02)	0.009 (0.013)	0.034 (0.09)	0.008 (0.007)	0.026 (0.023)
Fluorides	0.44 (0.48)	0.52 (0.55)	0.47 (0.48)	0.56 (0.55)	0.48 (0.51)	0.53 (0.55)
Hardness (Total) $CaCO_3$	3595 (3877)	5450 (5400)	3974 (4203)	5900 (5850)	4164 (4454)	5650 (5800)
Iron, ug/l	550 (1008)	930 (2200)	572 (1031)	1280 (2700)	434 (717)	840 (1610)
Lead	0.004 (0.005)	0.007 (0.009)	0.004 (0.004)	0.007 (0.01)	0.003 (0.003)	0.006 (0.005)
Magnesium	739 (794)	1170 (1150)	816 (870)	1185 (1200)	855 (914)	1195 (1150)
Manganese, ug/l	21 (40)	63.5 (94)	20.8 (33.8)	59 (90)	16.7 (29.7)	27 (65)
Mercury, ug/l	<0.22 (<0.22)	0.4 (0.4)	0.24 (0.234)	0.6 (0.6)	0.25 (<0.22)	0.4 (0.29)
Nickel, ug/l	2.7 (2.5)	6.0 (4.0)	3.9 (2.74)	16.5 (8.0)	2.3 (3.3)	6.0 (9.0)
Nitrate, N	0.19 (0.2)	0.33 (0.34)	0.17 (0.18)	0.43 (0.50)	0.15 (0.15)	0.76 (0.54)
Nitrite, N	0.01 (0.01)	0.06 (0.05)	0.01 (0.008)	0.08 (0.09)	0.02 (0.009)	0.08 (0.04)

Table C-30 (Revision 1) (Continued)

TIDE COMPOSITE VALUES AT SURFACE AND BOTTOM - ST JOHNS RIVER AT THE PROPOSED SITE
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2 Mean	F-2 Max	G Mean	G Max	H-2 Mean	H-2 Max
Nitrogen, Kjeldahl (N)	0.7 (0.86)	1.41 (1.35)	0.67 (0.78)	1.92 (2.1)	0.6 (0.64)	1.48 (1.74)
Oil and Grease	1.81 (1.5)	3.1 (3.2)	2.2 (1.8)	9.0 (6.8)	2.6 (2.6)	11.3 (6.1)
Oxygen, Dissolved	7.1 (6.3)	9.8 (8.8)	7.1 (6.8)	9.8 (9.6)	6.8 (6.8)	9.8 (9.6)
pH, St'd Units	7.9 (7.8)	8.2 (8.2)	7.9 (7.9)	8.2 (8.2)	7.9 (7.9)	8.1 (8.1)
Phenols, ug/l	6.3 (4.8)	13.0 (12.0)	8.4 (7.8)	53.0 (25.0)	6.9 (4.8)	18.0 (10.0)
Phosphorus, Total	0.14 (0.2)	0.2 (0.42)	0.16 (0.18)	0.9 (0.39)	0.11 (0.13)	0.19 (0.2)
Potassium	240 (258)	340 (340)	260 (274)	355 (365)	268 (290)	340 (370)
Salinity, ppt	17.7 (19.7)	25 (27.5)	19.8 (21.2)	33 (34)	20.6 (23)	28 (30)
Selenium, ug/l	<0.5 (<0.5)	<0.5 (<0.5)	<0.5 (<0.5)	0.75 (0.75)	<0.5 (<0.5)	0.5 (<0.5)
Silica, Dissolved	3.6 (3.5)	8.4 (9.7)	3.2 (3.3)	7.2 (7.8)	3 (2.6)	7.4 (6.4)

Table C-30 (Revision 1) (Continued)

TIDE COMPOSITE VALUES AT SURFACE AND BOTTOM - ST JOHNS RIVER AT THE PROPOSED SITE
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2 Mean	F-2 Max	G Mean	G Max	H-2 Mean	H-2 Max
Silver, ug/l	<0.16 (<0.16)	0.25 (0.2)	<0.16 (<0.16)	0.35 (0.3)	<0.16 (<0.16)	0.3 (0.6)
Sodium	6370 (6940)	8750 (8950)	6954 (7348)	9050 (9150)	7223 (7743)	8850 (9400)
Solids, Total Dissolved	19500 (21422)	25800 (30200)	22410 (23647)	34300 (34000)	23210 (25740)	31400 (34800)
Solids, Total Suspended	45 (71)	90 (135)	44 (66)	133 (175)	38 (46)	89 (87)
Sulfate, SO_4	1542 (1719)	2530 (2590)	1686 (1786)	2560 (2600)	1777 (1928)	2490 (2670)
Sulfide, S	<0.034 (<0.034)	0.049 (0.049)	<0.034 (<0.034)	0.049 (0.05)	<0.034 (<0.034)	0.05 (0.049)
Temperature, ^oC	22.8 (24.1)	30 (30)	22.5 (21.9)	31 (30)	22.6 (30)	30 (29)
Turbidity, NTU	12.8 (24.3)	26 (58)	11.6 (22.6)	24 (61)	19.8 (14.1)	18 (24)
Zinc, ug/l	44 (59)	186 (115)	47 (46)	149 (130)	51 (53)	134 (180)

a See Figure 2.5-12

Notes: ( ) = Value at bottom location
Source: 1979-80 Pre-operational Monitoring Program

Table C-31 (Revision 1)

SURFACE WATER QUALITY MONITORING PROGRAM
DISCRETE HIGH TIDE MEAN VALUE AT SURFACE AND BOTTOM
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2	G-2	H-2
Alkalinity, $CaCO_3$	83 (91.5)	87.3 (90.3)	87.5 (89)
Aluminum, ug/l	535.3 (531.8)	403.5 (1273.3)	1128.8 (829.3)
Ammonia, N	0.14 (0.16)	0.1 (0.11)	0.11 (0.14)
Antimony, ug/l	0.37 (0.38)	0.37 (0.37)	0.37 (0.39)
Arsenic, ug/l	0.88 (1.0)	0.75 (0.88)	0.63 (0.63)
Beryllium, ug/l	0.1 (<0.1)	0.1 (<0.1)	0.1 (<0.1)
Bicarbonate, $CaCO_3$	83 (91.5)	87.3 (90.3)	87.5 (89)
BOD-5	2.3 (2.3)	1.4 (1.3)	2.7 (1.9)
Boron	2.06 (3.0)	2.51 (3000)	2.46 (2.91)
Bromide	41.3 (36.8)	36.5 (39.5)	34.7 (40.0)
Cadmium, ug/l	0.4 (0.37)	0.32 (0.39)	0.34 (0.29)
Calcium	241 (252.8)	260 (285.3)	268.3 (297.5)
Carbonate, $CaCO_3$	0 (0)	0 (0)	0 (0)

Table C-31 (Revision 1) (Continued)

SURFACE WATER QUALITY MONITORING PROGRAM
DISCRETE HIGH TIDE MEAN VALUE AT SURFACE AND BOTTOM
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2	G-2	H-2
Chloride	10230 (11858)	11655 (12530)	11563 (13238)
Chlorine, Total Residual	<0.039 (<0.039)	<0.039 (<0.039)	<0.039 (<0.039)
Chromium (Hex), ug/l	<1.0 (<1.0)	<1.0 (<1.0)	<1.0 (<1.0)
Chromium (Total), ug/l	1.5 (2)	2 (1.7)	1.7 (2.2)
Coliform, Fecal(MPN)	27 (33)	15 (14)	21.8 (11)
Coliform, Total(MPN)	415 (388)	323 (333)	365 (162)
Conductivity, umhos	27750 (32375)	29000 (31500)	29125 (32250)
Copper, mg/l	45.3 (108)	41.3 (69.3)	57.3 (133.3)
Cyanide	0.005 (0.004)	0.009 (0.01)	0.009 (0.007)
Fluorides	0.45 (0.47)	0.47 (0.49)	0.48 (0.51)
Hardness (Total) $CaCO_3$	3315 (3720)	3552.5 (3965)	3647.5 (4127.5)
Iron, ug/l	490 (825)	400 (607.5)	360 (400)
Lead	0.0005 (0.003)	0.0005 (0.0005)	0.0005 (0.0003)

Table C-31 (Revision 1) (Continued)

SURFACE WATER QUALITY MONITORING PROGRAM
DISCRETE HIGH TIDE MEAN VALUE AT SURFACE AND BOTTOM
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2	G-2	H-2
Magnesium	688.8 (727.5)	753.8 (823.8)	773.8 (868.8)
Manganese, ug/l	34.3 (32.3)	21.0 (29.7)	23.7 (10.7)
Mercury, ug/l	0.17 (0.14)	0.11 (0.12)	0.12 (0.13)
Nickel, ug/l	2.2 (2.2)	2.2 (2.5)	3.7 (1.9)
Nitrate, N	0.19 (0.21)	0.12 (0.22)	0.46 (0.28)
Nitrite, N	0.004 (0.004)	0.04 (0.004)	0.004 (0.023)
Nitrogen, Kjeldahl (N)	0.68 (0.63)	0.53 (0.42)	0.3 (0.37)
Oil and Grease	1.6 (1.3)	2.3 (2.2)	1.9 (1.4)
Oxygen, Dissolved	7.1 (6.5)	7.0 (6.4)	6.7 (6.7)
pH, St'd units	7.9 (7.9)	7.9 (7.9)	7.9 (7.9)
Phenols, ug/l	7.2 (7)	8.6 (8)	5.7 (5.7)
Phosphorus, Total	0.13 (0.17)	0.12 (0.12)	0.14 (0.15)
Potassium	198.8 (229.0)	217.3 (242.3)	223.3 (251.5)

Table C-31 (Revision 1) (Continued)

SURFACE WATER QUALITY MONITORING PROGRAM
DISCRETE HIGH TIDE MEAN VALUE AT SURFACE AND BOTTOM
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2	G-2	H-2
Salinity, ppt	17.6 (20.9)	18.6 (20.8)	19.3 (21.3)
Selenium, ug/l	<0.5 (<0.5)	0.62 (<0.5)	<0.5 (<0.5)
Silica, Dissolved	4 (4.2)	4.1 (4.4)	3.9 (3.6)
Silver, ug/l	0.2 (0.15)	0.17 (0.17)	0.2 (0.22)
Sodium	5350 (6092.5)	5887.5 (6550)	6012.5 (6825)
Solids, Total Dissolved	17725 (21375)	19250 (21750)	20850 (24525)
Solids, Total Suspended	42 (90)	64 (51)	5.1 (32)
Sulfate, SO_4	1388.8 (1615.0)	1532.5 (1712.5)	1577.5 (1648.8)
Sulfide, S	<0.034 (<0.034)	<0.034 (< 0.034)	<0.034 (<0.034)
Temperature, °C	23.1 (22.8)	22.8 (22.0)	22.3 (22.4)
Turbidity, NTU	8.2 (16)	8.0 (13.1)	8.5 (10.4)
Zinc, ug/l	82.8 (80.8)	58.3 (93.8)	145 (97.8)

a See Figure 2.5-12
Notes: ( ) = Value at bottom location

Table C-32 (Revision 1)

SURFACE WATER QUALITY MONITORING PROGRAM
DISCRETE LOW TIDE MEAN VALUE AT SURFACE AND BOTTOM
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2	G-2	H-2
Alkalinity, $CaCO_3$	84.3 (87.3)	87.8 (94.0)	87.3 (95.3)
Aluminum, ug/l	748 (1659.3)	1003.8 (1046.5)	458.8 (1470.5)
Ammonia, N	0.19 (0.17)	0.11 (0.21)	0.11 (0.16)
Antimony, ug/l	0.38 (0.43)	0.37 (0.37)	0.37 (0.37)
Arsenic, ug/l	0.5 (0.83)	0.75 (0.75)	0.63 (0.75)
Beryllium, ug/l	0.1 (<0.1)	0.1 (<0.1)	0.1 (<0.1)
Bicarbonate, $CaCO_3$	84.3 (87.3)	87.8 (94.0)	87.3 (95.3)
BOD-5	1.8 (1.8)	1.4 (1.5)	1.5 (1.4)
Boron	2.69 (2.70)	2.79 (3.21)	2.87 (3.19)
Bromide	31.5 (35.8)	37.5 (42.6)	34.3 (40.2)
Cadmium, ug/l	0.32 (0.39)	0.34 (0.55)	0.32 (0.37)
Calcium	237.5 (238)	255.5 (291.8)	262 (294.8)
Carbonate, $CaCO_3$	0 (0)	0 (0)	0 (0)

Table C-32 (Revision 1) (Continued)

SURFACE WATER QUALITY MONITORING PROGRAM
DISCRETE LOW TIDE MEAN VALUE AT SURFACE AND BOTTOM
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2	G-2	H-2
Chloride	10768 (11413)	11830 (13303)	11793 (13638)
Chlorine, Total Residual	0.039 (<0.039)	0.039 (<0.039)	0.039 (<0.039)
Chromium (Hex), ug/l	1.0 (<1.0)	1.0 (<1.0)	1.0 (<1.0)
Chromium (Total), ug/l	1.95 (2.3)	2.7 (2)	1.5 (1.95)
Coliform, Fecal (MPN)	11 (128)	104 (24)	32 (24.5)
Coliform, Total (MPN)	491 (297)	562 (149)	308 (170)
Conductivity, umhos	27250 (29833)	32250 (29333)	32750 (32000)
Copper, ug/l	61.5 (44.3)	45.5 (132.5)	51.8 (55.5)
Cyanide	0.01 (0.008)	0.01 (0.007)	0.008 (0.008)
Fluorides	0.44 (0.46)	0.47 (0.5)	0.48 (0.51)
Hardness (Total) $CaCO_3$	3172.5 (3360)	3552.5 (4100)	3680 (4325)
Iron, ug/l	555 (650)	412.5 (885)	277.8 (565)
Lead	0.0005 (0)	0.0005 (0.0003)	0.0003 (0.0003)

Table C-32 (Revision 1) (Continued)

SURFACE WATER QUALITY MONITORING PROGRAM
DISCRETE LOW TIDE MEAN VALUE AT SURFACE AND BOTTOM
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2	G-2	H-2
Magnesium	682.5 (718.3)	752.5 (853.8)	791.3 (891.3)
Manganese, ug/l	36.7 (47.5)	21.0 (43.0)	15.7 (26.0)
Mercury, ug/l	0.17 (0.1)	0.12 (0.19)	0.16 (0.15)
Nickel, ug/l	2 (2.3)	8.9 (1.9)	1.9 (1.9)
Nitrate, N	0.21 (0.27)	0.26 (0.29)	0.3 (0.22)
Nitrite, N	0.006 (0.003)	0.004 (0.006)	0.004 (0.004)
Nitrogen, Kjeldahl(N)	0.77 (0.74)	0.65 (0.74)	0.47 (1.4)
Oil and Grease	1.2 (1.1)	1.8 (2)	1.9 (2.0)
Oxygen, Dissolved	7.2 (5.8)	7.1 (7.0)	6.9 (7.0)
pH, St'd units	7.8 (7.7)	7.9 (7.9)	7.9 (7.8)
Phenols, ug/l	5.5 (1.9)	5.7 (3.7)	7.8 (4.2)
Phosphorus, Total	0.14 (0.17)	0.14 (0.2)	0.13 (0.11)
Potassium	194.5 (211.7)	221.3 (250.8)	229.5 (266.3)

Table C-32 (Revision 1) (Continued)

SURFACE WATER QUALITY MONITORING PROGRAM
DISCRETE LOW TIDE MEAN VALUE AT SURFACE AND BOTTOM
(Values in mg/l, except as noted)

Parameter	Transect and Station[a] F-2	G-2	H-2
Salinity, ppt	17.8 (18.2)	22.0 (23.5)	21.9 (24.8)
Selenium, ug/l	0.5 (<0.5)	0.5 (<0.5)	0.5 (<0.5)
Silica, Dissolved	4.7 (3.9)	3.8 (4.5)	4.0 (3.4)
Silver, ug/l	0.22 (0.23)	0.12 (0.2)	0.25 (0.32)
Sodium	5150 (5660)	5912.5 (6800)	6050 (7127.5)
Solids, Total Dissolved	17275 (17967)	19650 (22725)	21200 (25100)
Solids, Total Suspended	43.8 (53.3)	43.0 (57.5)	24.5 (45.8)
Sulfate, SO_4	1286.3 (1416.7)	1553.8 (1753.8)	1577.5 (1793.8)
Sulfide, S	0.034 (0.036)	0.034 (<0.034)	0.034 (<0.034)
Temperature, °C	22.5 (26.0)	21.6 (21.8)	22.9 (22.6)
Turbidity, NTU	17.5 (35.3)	10.4 (28.5)	9.8 (17.8)
Zinc, ug/l	79.3 (54.7)	87.0 (41.3)	44.8 (68.3)

a See Chapter 2, Figure 2.5-12
Notes: ( ) = Value at bottom location

Table C-33 (Revision 1)

SURFACE WATER QUALITY MONITORING PROGRAM
ON-SITE STREAM SAMPLING RESULTS
(Values in mg/l, except as noted)

Parameter	Station[a] B-1	E-2	F-3	4	C-5	D-6
Alkalinity, $CaCO_3$	<0.5	18	23	20	2	26
Aluminum	0.24	0.06	0.48	0.73	0.32	0.93
Ammonia, N	0.03	0.03	1.45	1.58	0.03	2.3
Antimony, ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic, ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Beryllium, ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bicarbonate, $CaCO_3$	<0.5	18	23	20	2	26
BOD-5	20	2.3	5.3	10	1.5	20
Boron, ug/l	0.08	0.08	0.11	0.11	0.08	0.12
Bromide	0.3	0.3	0.3	0.3	0.6	0.6
Cadmium, ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Calcium	0.72	2.9	3.5	3.1	2.0	3.3
Carbonate, $CaCO_3$	0.5	0.5	0.5	0.5	0.5	0.5
Chloride	11	14	19	21	19	21
Chlorine, Total Residual	0.1	0.1	0.1	0.1	0.1	0.1
Chromium (Hex) ug/l	<1	<1	<1	<1	<1	<1
Chromium (Total) ug/l	<1	<1	<1	<1	<1	<1
Coliform, Fecal (MPN)	2,810	340	490	760	3,110	1,660
Coliform Total (MPN)	21,300	3,100	20,000	17,000	7,500	16,000
Conductivity (umhos)	70	80	110	700	285	280
Copper, ug/l	1.5	0.9	0.9	0.7	0.4	0.8

Table C-33 (Revision 1) (Continued)

SURFACE WATER QUALITY MONITORING PROGRAM
ON-SITE STREAM SAMPLING RESULTS
(Values in mg/l, except as noted)

Parameter	Station[a] B-1	E-2	F-3	4	C-5	D-6
Cyanide, ug/l	0.5	0.5	0.5	4.0	4.0	5.0
Fluorides	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Hardness (Total) $CaCO_3$	13	23	28	34	14	30
Iron, ug/l	400	170	600	650	550	720
Lead, ug/l	5	2	<2	<2	<2	<2
Magnesium, ug/l	2,100	4,200	3,600	3,800	2,200	4,200
Manganese, ug/l	3.5	7.0	5.5	6.8	3.1	6.3
Mercury, ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Nickel, ug/l	<2	<2	<2	<2	<2	<2
Nitrate, N	0.06	0.05	0.6	0.06	0.05	0.07
Nitrite, N	0.003	0.003	0.003	0.003	0.003	0.003
Nitrogen, Kjeldahl(N)	0.29	0.94	4.3	5.8	0.6	2.3
Oil and Grease	0.3	0.4	0.3	0.8	0.7	1.1
Phenols, ug/l	2	2	2	4	2	2
Phosphorus, Total	0.02	0.04	0.07	0.07	0.08	0.04
Potassium, ug/l	100	100	2,700	3,100	350	4,000
Selenium, ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silica, Dissolved	3.6	11.2	9.8	7.5	13.2	5.5
Silver, ug/l	<0.1	0.2	<0.1	0.2	0.1	<0.1
Sodium, ug/l	5,800	7,200	11,600	11,900	8,700	13,800

Table C-33 (Revision 1) (Continued)

SURFACE WATER QUALITY MONITORING PROGRAM
ON-SITE STREAM SAMPLING RESULTS
(Values in mg/l, except as noted)

Parameter	Station[a] B-1	E-2	F-3	4	C-5	D-6
Solids, Total Dissolved	75	105	125	110	120	165
Solids, Total Suspended	3	3	7	8	4	45
Sulfate, SO_4	6	1	8	9	1	13
Sulfide, S	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc, ug/l	9	9	7	6	5	14

a See Figure 2.5-21

Table C-34

POLYCHLORINATED BIPHENYLS ANALYSES RESULTS
FROM WATER, SOIL, AND SEDIMENT SAMPLES
TAKEN ON PROPOSED SITE
(Concentration in ppm)

Sample Location[a]	PCB Concentration as Aroclor 1016		
	Water	Sediment	Soil
A	< 0.001	< 0.01	
B-1	< 0.001	< 0.01	
C-5	< 0.001	< 0.01	
D-6	< 0.001	< 0.01	
E-2	< 0.001	< 0.01	
F-3	< 0.001	< 0.01	
G1[b]	< 0.001	< 0.01	
10			< 0.01
20			< 0.01
30			< 0.01
40			< 0.01
50			< 0.01
60			< 0.01
F2[b]	< 0.001		
H2[b]	< 0.001		

a See Figure 2.5-21
b Samples collected in Blount Island Channel

Table C-35 (Revision 1)(Continued)

ELUTRIATE TEST DATA - PROPOSED COAL UNLOADING FACILITY DREDGE AREA
(Concentration in mg/l)

Parameter	Receiving Water	Boring Locations BI-6[a]	BI-6[b]	BI-4[c]	BI-4[d]
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.052	0.072	0.070	0.076	0.063
Oil and Grease	3.6	5.0	4.7	6.0[e]	9.3[e]
pH, st'd units	7.85	7.80	7.83	7.77	7.84
Phosphorus, elemental	NR	NR	NR	NR	NR
Silver	0.0061[e]	0.0084[e]	0.0079[e]	0.0079[e]	0.0064[e]
Total Residual Chlorine	<0.1	NA	NA	NA	NA
Total Suspended Solids	23	NA	NA	NA	NA
Turbidity, NTU	7.0	NA	NA	NA	NA
Zinc	0.080	0.2	0.19	0.19	0.10

---

a Depth from -10.5 to -11.5 feet
b Duplicate sample of depth from -10.5 to -11.5 feet MSL
c Depth from -25.0 to -27.0 feet
d Duplicate sample of depth from -25.0 to -27.0 feet MSL
e Concentration exceeds water quality standard for that parameter. See Chapter 2, Table 2.5-1

Notes: NR = Results not received
NA = No analysis performed
MSL = Mean sea level
Approximate location of boring sites is shown in Figure E-19

Table C-35 (Revision 1)

ELUTRIATE TEST DATA - PROPOSED COAL UNLOADING FACILITY DREDGE AREA
(Concentration in mg/l)

Parameter	Receiving Water	Boring Locations BI-6[a]	BI-6[b]	BI-4[c]	BI-4[d]
Aluminum	0.033	0.066	0.055	0.033	0.044
Ammoniacal N	0.34	0.48	0.45	0.21	0.22
Antimony	0.18	0.23[e]	0.18	0.23[e]	0.20
Arsenic	<0.002	<0.002	<0.002	<0.002	<0.002
Beryllium	<0.0006	0.003	0.003	0.005	0.003
Cadmium	0.0082[e]	0.010[e]	0.0095[e]	0.011[e]	0.0089[e]
Chromium, hexavalent	<0.005	<0.005	< 0.005	<0.005	<0.005
Chromium, total	0.016	0.021	0.016	0.020	0.017
Copper	0.015	0.017[e]	0.015	0.017[e]	0.015
Cyanide	<0.002	<0.010	<0.010	<0.010	<0.010
Fluoride	0.74	0.76	0.76	0.76	0.74
Iron	0.12	0.13	0.12	0.16	0.13
Lead	0.062[e]	0.072[e]	0.069[e]	0.072[e]	0.062[e]
Manganese	0.016	0.020	0.019	0.019	0.020

Table C-36 (Revision 1)

ESTIMATED CHEMICAL CHARACTERISTICS OF MAJOR PLANT EFFLUENT STREAMS

Parameter	Landfill Area Runoff[a]	Cooling Tower Blowdown[b]	Demineralizer Regeneration[c]	Coal Pile Runoff[d]	FGD System[e]
Alkalinity, $CaCO_3$, mg/l	ND	134/158	1108	0	ND
Bromide, mg/l	ND	53.4/93.8	ND	ND	ND
Chloride, mg/l	59	18,742/30,388	149	20	6905
Cyanide, mg/l	0	0.014/0.134	ND	ND	ND
Fluoride, mg/l	ND	0.69/0.83	4.12	ND	10
Total Kjeldahl Nitrogen, mg/l	ND	1.0/3.1	ND	ND	0.002
Oil and Grease, mg/l	ND	2.9/13.4	ND	ND	ND
Phenols, mg/l	ND	11.7/78.9	256	ND	ND
Total Phosphorus, mg/l		0.25/1.34	0.43	ND	0.41
Silica, Dissolved, mg/l	ND	4.6/11.6	ND	180.0	3.3
Solids, Total Dissolved, mg/l	1334	33,172/51,243	2471	7500	15,000
Sulfate,mg/l	766	2,501/3,873	8,000	5000	10,000
Sulfide, mg/l	ND	0.04/0.07	ND	ND	ND
Aluminum, mg/l	0.9	0.7/5.41	0.13	0.25	0.3
Antimony, ug/l	ND	0.27/1.42	ND	500	2300

Table C-36 (Revision 1) (Continued)

ESTIMATED CHEMICAL CHARACTERISTICS OF MAJOR PLANT EFFLUENT STREAMS

Parameter	Landfill Area Runoff[a]	Cooling Tower Blowdown[b]	Demineralizer Regeneration[c]	Coal Pile Runoff[d]	FGD System[e]
Arsenic, ug/l	15	0.99/1.49	7.1	150	300
Beryllium, ug/l	6	0.13/0.28	ND	5.00	140
Boron, mg/l	ND	4.5/7.0	2.9	ND	46
Cadmium, ug/l	1.8	0.42/3.28	5.7	ND	110
Calcium, mg/l	130	391/588	394	300	3,000
Chromium (total), ug/l	9	2.3/7.4	ND	5	500
Copper, ug/l	23	100/410	28	900	200
Iron, mg/l	1.2	1.2/4.0	.18	200	8.1
Lead, ug/l	12	0.53/14.9	149	ND	400
Magnesium, mg/l	ND	1,215/1,788	162	250	2,750
Manganese, ug/l	ND	39.3/134	14.2	30	2,500
Mercury, ug/l	0.46	0.35/0.89	.71	.5	70
Nickel, ug/l	64	4.8/24.6	24.9	2500	1,500
Potassium, mg/l	ND	385/544	8.2	ND	32

Table C-36 (Revision 1) (Continued)

ESTIMATED CHEMICAL CHARACTERISTICS OF MAJOR PLANT EFFLUENT STREAMS

Parameter	Landfill Area Runoff[a]	Cooling Tower Blowdown[b]	Demineralizer Regeneration[c]	Coal Pile Runoff[d]	FGD System[e]
Selenium, ug/l*	10	0.72/1.12	35.5	5.0	2,200
Silver, ug/l	9	0.23/0.52	2.84	ND	600
Sodium, mg/l	ND	10,300/13,630	2,200	ND	2,400
Zinc, ug/l*	50	66.6/222	49.7	6500	350

a Values developed as volume-weighted average concentrations (see Table C-36a).
b Cooling tower blowdown concentrations calculated from Eq. C.6-9.
c Demineralizer regeneration concentrations calculated from groundwater quality data from August, 1980 (see Appendix D, Table D-10) and demineralizer train operation as noted in Chapter 3, Section 3.5.1.1.
d Coal pile and limestone runoff from approximate coal pile drainage data (EPA, 1979).
e FGD system blowdown concentrations estimated from FGD scrubber pond liquor on wet limestone systems using eastern coal (EPRI, 1980).

Notes: ND Data not available in referenced material
N/A Cannot be assumed as a conservative constituent; however, effluent limit of 15 mg/l was used (Chapter 2, Table 2.5-1)
/ Data reported as average/maximum

Table C-36a (Revision 1)

QUALITY OF RUNOFF FROM SOLID WASTE LANDFILL DISPOSAL AREA
(Concentrations in mg/l)

Variable	FGD Solids[a]	Fly Ash[b]	Bottom Ash[b]	Volumed Weighted Average
Arsenic	0.004	0.03	0.018	0.015
Beryllium	<0.004	<0.01	<0.01	<0.007
Cadmium	0.002	0.0012	0.003	0.0018
Chromium	<0.003	0.02	0.01	0.01
Copper		0.02	0.41	0.023
Lead	0.010	0.014	0.017	0.012
Mercury	<0.00005	0.001	0.001	0.00046
Selenium	0.006	0.015	0.011	0.01
Zinc	0.04	0.06	0.14	0.05
Chloride	100	6.13	7.38	59.42
Fluoride	0.08			0.8
Sulfite	30			30
Sulfate	1200	208.75	139.25	765.9
Total Dissolved Solids	2200	142	524	1334
Iron	0.2[c]	1.93	5.98	1.22
Barium		0.11	0.125	0.112
Silver		<0.01	< 0.01	< 0.01
Cyanide		<0.01	< 0.01	< 0.01
Aluminum	0.1[c]	1.8	2.8	0.9
Nickel		0.054	0.12	0.064
Calcium		142	62.5	129.6
Magnesium		3.86	6.94	4.34

a USEPA, 1978
b Chu, et al., 1976
c USEPA, 1980
d Volume weighted average developed by multiplying reported concentrations of substances in each type of waste to be landfilled by that waste's expected maximum disposal quantity, adding these numbers together, then dividing by the total quantity of waste.

Table C-36b (Revision 1)

APPROXIMATE REMOVAL EFFICIENCY FOR CERTAIN CHEMICAL PARAMETERS IN THE CENTRAL WASTEWATER TREATMENT FACILITY[a]

Parameter	Percent Removal Range	Percent Removal Assumed
Aluminum	-	140 ug/l[b]
Antimony	8 - 30	20
Arsenic	>69 - >99	85
Beryllium	>82 - >89	85
Cadmium	25 - >50	40
Chromium (total)	>55 - >95	75
Copper	-	1.0 mg/l[c]
Iron	-	1.0 mg/l[c]
Lead	>40 - >96	70
Mercury	>30 - >60	45
Nickel	>35 - >95	65
Selenium	>18 - >24	20
Silver	>79 - >97	90
Zinc	>79 - >97	90

a Assumed percent removal based on chemical addition of iron followed by sedimentation, EPA, 1980a.

b Approximate solubility of aluminum at pH 9 to 9.5, Stumm and Morgan, 1970.

c Approximate solubility reported for coal pile drainage, EPA, 1979 and effluent limitation (see Chapter 5, Table 5.1-1).

Table C-37 (Revision 1)

OPERATING CONDITIONS USED TO ESTIMATE COMBINED CHEMICAL CONCENTRATIONS AT THE POD TO THE ST. JOHNS RIVER

Process	Average[a]	Maximum[b]
Northside Station, Operating Mode[c]	2	4
Northside Station, Circulating Water Flow, gpm[c]	294,000	98,000
Proposed Plant Makeup, Surface Water, gpm	34,400	34,400
Proposed Plant Makeup, Groundwater, gpm	2,644	5,400
FGD System Makeup, gpm	2,150	3,150
Cooling Tower Makeup, Surface Water, gpm	34,400	34,400
Cooling Tower Evaporation, gpm[d]	10,519	11,307
Cooling Tower Blowdown, gpm	23,881	23,093
FGD System Blowdown, gpm	1,000	2,000
Oily Wastewater Collection Basin Dicharge, gpm[d]	500	500
Demineralizer Regeneration, gpm[f]	15	350
Sanitary Treatment Effluent, gpm[g]	11	240
Chemical Wastewater Treatment Facility Effluent, gpm[h]	3,600	3,600

Table C-37 (Revision 1) (Continued)

OPERATING CONDITIONS USED TO ESTIMATE COMBINED CHEMICAL CONCENTRATIONS AT THE POD TO THE ST. JOHNS RIVER

Process	Average[a]	Maximum[b]
Coal Pile Runoff Sediment Control Pond Discharge[i]	1,000	1,000
Total Combined Plant Effluent at POD, gpm	287,592	91,033

a Average case chemical conditions are ambient mean tide composites from Transect G (Section 2.5.1.5 and Table C-30).
b Maximum case chemical conditions are ambient maximum tide composites at surface or bottom from Transect G (Section 2.5.1.5 and Table C-30).
c Northside mode description is in Section 2.5.1.6.
d Assumes a 100 percent heat load for two unit operation.
e A flow of 500 gpm was used since the effluent is controlled by pump operation.
f A flow of 15 gpm was used since flow equalization will take place in the sedimentation pond.
g A flow of 240 gpm was used for average case conditions since flow is controlled by pump operation.
h Chemical Wastewater Treatment Facility effluent flow is controlled by pump operation.
i A flow of 1,000 gpm was used for average case since flow is controlled by pumps.

Table C-38 (Revision 1)

ESTIMATED CHEMICAL CONCENTRATIONS AT THE POD TO THE ST. JOHNS RIVER FOR COMBINED PLANT FLOW

Parameter	Concentration			
	Ambient[a]		Estimated POD[b]	
	Average	Max	Average	Max
Alkalinity, $CaCO_3$, mg/l	92.8	106	96.9	121
Bromide, mg/l	37.1	63	38.2	69.0
Chloride, mg/l	13011	20400	13436	22617
Cyanide, mg/l	0.01	0.09	0.01	0.099
Fluoride, mg/l	0.477	0.56	0.57	0.88
Total Kjeldahl Nitrogen, mg/l	0.72	2.1	0.74	2.3
Oil and Grease, mg/l	2	9	2.1	9.9
Total Phosphorus, mg/l	0.17	0.9	0.18	1.0
Silica, Dissolved, mg/l	3.2	7.8	3.9	10.4
Solids, Total Dissolved, mg/l	23028	34400	23804	38229
Sulfate,mg/l	1736	2600	1867	3123
Sulfide, mg/l	0.03	0.05	0.031	0.055
Aluminum, ug/l	488	3630	503	3996
Antimony, ug/l	< 0.2	0.95	15.3	49.4
Arsenic, ug/l	0.69	1	1.08	2.28
Beryllium, ug/l	< 0.1	0.19	0.26	0.76
Boron, mg/l	3.1	4.7	3.58	6.4
Cadmium, ug/l	0.29	2.2	0.84	4.2

Table C-38 (Revision 1) (Continued)

ESTIMATED CHEMICAL CONCENTRATIONS AT THE POD TO THE ST. JOHNS RIVER FOR COMBINED PLANT FLOW

Parameter	Concentration			
	Ambient[a]		Estimated POD[b]	
	Average	Max	Average	Max
Calcium, mg/l	271.7	395	304	513
Chromium (total), ug/l	1.59	5	2.66	8.78
Copper, ug/l	69.5	275	72	304
Iron, mg/l	.801	2.7	0.83	3.0
Lead, ug/l	0.37	10	1.4	14.2
Magnesium, mg/l	843.3	1200	890	1392
Manganese, ug/l	27.3	90	48.5	165
Mercury, ug/l	0.24	0.6	0.56	1.67
Nickel, ug/l	3.34	16.5	9.9	38.4
Potassium, mg/l	267.5	365	275.4	402
Selenium, ug/l	<0.5	0.75	15	47
Silver, ug/l	0.16	0.35	0.21	0.54
Sodium, mg/l	7151	9150	7373	10126
Zinc, ug/l	46.2	149	50	169

a Ambient conditions are mean tide composites from Transect G for average case and maximum tide composites at surface or bottom from Transect G for maximum case (Section 2.5.1.5 and Table C-30).

b POD is point of discharge into St. Johns River through existing submerged diffuser. Average case used mode 2 flow conditions and zero material handling, storage and disposal area discharge. Maximum case used mode 4 flow conditions and 1,000 gpm material handling, storage and disposal area discharge unless zero flow yields higher POD concentrations.

Table C-39 (Revision 1)

ESTIMATED MIXING ZONE CHARACTERISTICS FOR MAXIMUM OPERATING CONDITIONS[a]

Characteristics[b]	Mixing Zone[c] A_x	B_x	C_x
Mixing Zone Length, ft	714	1607	2857
Mixing Zone Width, ft	179	402	714
Predicted Boundary of Mixing Zone, acres	2.9	14.8	46.8
Predicted Mixing Plume Area, acres	0.67	4.5	14.9
Dilution Factor[d]	3.84	6.25	8.67
Parameter Exceeding Class III Standard at POD		Concentration	
Aluminum	3.707	3.681	3.668
Chloride	20858.4	20705.6	20629.2
Copper	.285	.283	.282
Cyanide	91.861	91.241	90.931
Iron	2.762	2.741	2.731
Mercury	.821	.748	.711
Oil and Grease	9.19	9.12	9.09
Selenium	10.3	7.1	5.5
Silver	.389	.376	.37

a See Figure C-40.

b Characteristics are presented for a specific tide phase (e.g., ebb slack or flood slack). Boundary conditions are equivalent for both tide phases.

c A_x, B_x, and C_x are zones enclosing predicted areas of equal minimum dilution. Subscript "e" is for ebb slack and "f" for flood slack, respectively.

d Defined in Eq. C.6-12, Appendix C.6.

Table C-40 (Revision 1)

ESTIMATED MIXING ZONE CHARACTERISTICS FOR
AVERAGE OPERATING CONDITIONS[a]

Characteristics[b]	Mixing Zone[c] A_x	B_x	C_x	D_x
Mixing Zone Length, ft	470	734	1304	2935
Mixing Zone Width, ft	117	183	326	734
Predicted Boundary of Mixing Zone, acres	1.3	3.1	9.8	49.4
Predicted Mixing Plume Area, acres	0.13	0.7	2.9	15.8
Dilution Factor[d]	3.0	4.0	5.7	9.0
Parameter Exceeding Class III Standard at POD		Concentration		
Copper (mg/l)	0.070	0.0699	0.0699	0.698
Cyanide[e]	-	-	-	-
Iron (mg/l)	0.808	0.806	0.805	0.803
Mercury (ug/l)	0.32	0.30	0.29	0.27
Silver (ug/l)	1.173	0.171	0.168	0.165

a See Figure C-41.

b Characteristics are presented for a specific tide phase (e.g., ebb slack or flood slack). Boundary conditions are equivalent for both tide phases.

c A_x, B_x, C_x, and D_x are zones enclosing predicted areas of average dilution. Subscript "e" is for ebb slack and "f" for flood slack, respectively.

d Defined in Eq. C.6-12 Appendix C.6.

e Cyanide at ambient River concentration at POD; therefore, no further decrease through mixing is possible.

Table C-41 (Revision 1)

INFLUENCE OF ST. JOHNS RIVER MIXING ZONE ON CHEMICAL PARAMETERS ESTIMATED TO EXCEED CLASS III STANDARDS AT POINT OF DISCHARGE UNDER AVERAGE CONDITIONS BY SEASON

Parameter	Class III Standard[a]	Season (Month)	Concentration[b]		Mixing Zone Influence	
			Ambient[c]	POD[d]	Area,[e] Acres	Concentration at M.Z. Boundary
Copper, mg/l	0.015	Winter (January)	0.07	0.072	0	0.070
					.018	0.070
					4.5	0.069
					23.9	0.069
		Spring (April)	0.07	0.072	0	0.070
					0.129	0.070
					2.9	0.069
					15.8	0.069
		Summer (July)	0.07	0.072	0	0.070
					0.2	0.070
					7.4	0.069
					38.67	0.069
		Fall (October)	0.07	0.072	0	0.070
					0.17	0.070
					13.1	0.069
					67.3	0.069

Table C-41 (Revision 1) (Continued)

INFLUENCE OF ST. JOHNS RIVER MIXING ZONE ON CHEMICAL PARAMETERS
ESTIMATED TO EXCEED CLASS III STANDARDS AT POINT OF DISCHARGE
UNDER AVERAGE CONDITIONS BY SEASON

Parameter	Class III Standard[a]	Season (Month)	Concentration[b]		Mixing Zone Influence	
			Ambient[c]	POD[d]	Area,[e] Acres	Concentration at M.Z. Boundary
Iron, mg/l	0.3	Winter (January)	0.80	0.83	0	0.811
					0.018	0.808
					4.5	0.804
					23.9	0.803
		Spring (April)	0.80	0.83	0	0.813
					0.129	0.808
					2.9	0.805
					15.8	0.803
		Summer (July)	0.80	0.83	0	0.81
					0.2	0.808
					7.4	0.804
					38.67	0.803
		Fall (October)	0.80	0.83	0	0.809
					0.17	0.808
					13.1	0.803
					67.3	0.802

Table C-41 (Revision 1) (Continued)

INFLUENCE OF ST. JOHNS RIVER MIXING ZONE ON CHEMICAL PARAMETERS
ESTIMATED TO EXCEED CLASS III STANDARDS AT POINT OF DISCHARGE
UNDER AVERAGE CONDITIONS BY SEASON

Parameter	Class III Standard[a]	Season (Month)	Concentration[b]		Mixing Zone Influence	
			Ambient[c]	POD[d]	Area,[e] Acres	Concentration at M.Z. Boundary
Mercury, ug/l	0.1	Winter (January)	0.24	0.56	0	0.35
					0.018	0.33
					4.5	0.28
					23.9	0.27
		Spring (April)	0.24	0.56	0	0.37
					0.129	0.32
					2.9	0.29
					15.8	0.27
		Summer (July)	0.24	0.56	0	0.35
					0.2	0.32
					7.4	0.28
					38.67	0.27
		Fall (October)	0.24	0.56	0	0.33
					0.17	0.32
					13.1	0.27
					67.3	0.26

Table C-41 (Revision 1) (Continued)

INFLUENCE OF ST. JOHNS RIVER MIXING ZONE ON CHEMICAL PARAMETERS
ESTIMATED TO EXCEED CLASS III STANDARDS AT POINT OF DISCHARGE
UNDER AVERAGE CONDITIONS BY SEASON

Parameter	Class III Standard[a]	Season (Month)	Concentration[b] Ambient[c]	Concentration[b] POD[d]	Mixing Zone Influence Area,[e] Acres	Mixing Zone Influence Concentration at M.Z. Boundary
Silver, ug/l	0.05	Winter (January)	0.16	0.17	0	0.18
					0.018	0.17
					4.5	0.17
					23.9	0.16
		Spring (April)	0.16	0.17	0	0.18
					0.129	0.17
					2.9	0.17
					15.8	0.17
		Summer (July)	0.16	0.17	0	0.18
					0.2	0.17
					7.4	0.17
					38.67	0.16
		Fall (October)	0.16	0.17	0	0.18
					0.17	0.17
					13.1	0.17
					67.3	0.16

a See Chapter 2, Table 2.5-1
b Average case used mode 2 flow conditions and either zero or maximum material handling, storage and disposal area discharge, whichever is more conservative.
c Ambient conditions are mean tide composites from Transect G (Chapter 2, Section 2.5.1.5)
d POD is point of discharge into St. Johns River via existing submerged diffuser.
e Approximate mixing zone area required to achieve stated concentration at mixing zone boundary.

Table C-42

SAMPLE TIDAL HEIGHTS AND TIMES

Low/High Tide	Mayport Time	Mayport Height (ft. MSL)	Day	Site Time	Site Height (ft. MSL)	Difference (hr. and min.)
L	0434	-1.9	11/8	0647	- .84	0213
H	1114	3.1		1247	2.75	0113
L	1721	-1.7		1847	- .69	0126
H	2338	2.2	11/9	0017	2.41	0039
L	0525	-1.6		0617	- .64	0052
H	1204	2.8		1257	2.72	0043
L	1815	-1.4		1947	- .62	0132
H	0030	2.0	11/10	0117	2.13	0047
L	0620	-1.4		0732	- .79	0112
H	1255	2.5		1347	2.32	0052
L	1911	-1.3		2017	-1.01	0106
H	0125	1.9	11/11	0217	1.79	0052
L	0721	-1.2		0817	-1.05	0056
H	1349	2.3		1417	2.02	0028
L	2008	-1.2		2117	-1.23	0109
H	0223	1.9	11/12	0247	1.75	0024

Average Difference Low	1 hr 18 min
Average Difference High	0 hr 45 min

Table C-43

SAMPLE TIDAL RANGES AND TIMES

Mayport Height (ft. MSL)	Range (ft.)	Site Height (ft. MSL)	Range (ft.)	Range Ratio	Range Difference (ft.)
-1.9	5.0	- .84			
3.1	5.0	2.75	3.59	.72	1.41
-1.7	4.8	- .69	3.44	.72	1.36
2.2	3.9	2.41	3.10	.79	.80
-1.6	3.8	- .64	3.05	.80	.75
2.8	4.4	2.72	3.36	.76	1.04
-1.4	4.2	- .62	3.34	.80	.86
2.0	3.4	2.13	2.75	.81	.65
-1.4	3.4	- .79	2.92	.86	.48
2.5	3.9	2.32	3.11	.80	.79
-1.3	3.8	-1.01	3.33	.88	.47
1.9	3.2	1.79	2.80	.88	.40
-1.2	3.1	-1.05	2.84	.92	.26
2.3	3.5	2.02	3.07	.88	.43
-1.2	3.5	-1.23	3.25	.93	.25
1.9	3.1	1.75	2.98	.96	.12
			Average =	.834	.67

Table C-44

TIDAL CORRECTIONS FOR THE SITE AREA

Time		Height (ft. MSL)	
High Water	Low Water	High Water	Low Water
0 hr 45 min	1 hr 18 min	Later	Later

Times EDT

Table C-45

CURRENT FREQUENCY OF OCCURRENCE[a] AND MODAL DIRECTION[b]

Date		Sampling Station[c] PKL[d] %	deg.	PKU[d] %	deg.	SCC %	deg.	NBL[d] %	deg.	NBU[d] %	deg.	BIS %	deg.	INC %	deg.
10/79															
	F	33.8	230.	26.6	215.										
	E	30.6	36.	40.3	33.										
11/79															
	F	34.1	218.	47.1	238.	35.0	335.	36.6	203.						
	E	40.6	34.	34.4	33.	21.7	150.	46.3	21.						
12/79															
	F	31.5	231.	34.9	234.	23.6	333.	33.6	209.	38.9	203.				
	E	43.7	31.	38.9	33.	19.0	149.	48.0	24.	34.3	20.				
1/80															
	F	30.1	232.	30.3	231.	25.5	331.	37.4	209.	29.7	203.				
	E	39.5	33.	44.3	32.	16.2	149.	47.2	28.	35.2	22.				
2/80															
	F	46.6	212.	27.6	232.	20.3	328.	40.4	205.	25.6	207.				
	E	36.4	35.	29.6	32.	19.2	149.	36.4	22.	43.8	22.				
3/80															
	F	44.0	217.	23.3	230.	25.6	328.	39.1	203.	35.5	207.				
	E	37.0	34.	39.9	34.	24.0	147.	32.5	21.	50.1	22.				
4/80															
	F	49.4	213.	35.0	212.	40.0	330.	34.8	204.	41.6	205.	43.0	206.	95.1	326.
	E	40.8	32.	39.3	28.	18.3	148.	40.1	23.	44.0	23.	44.5	22.	-	-

a Monthly frequency of occurrence in percentage
b Modal direction in degree, measured clockwise from true north
c See Figure 6.2-1
d U indicates upper instrument, L indicates lower instrument (see Figure 6.2-5)
F: Flood period
E: Ebb period

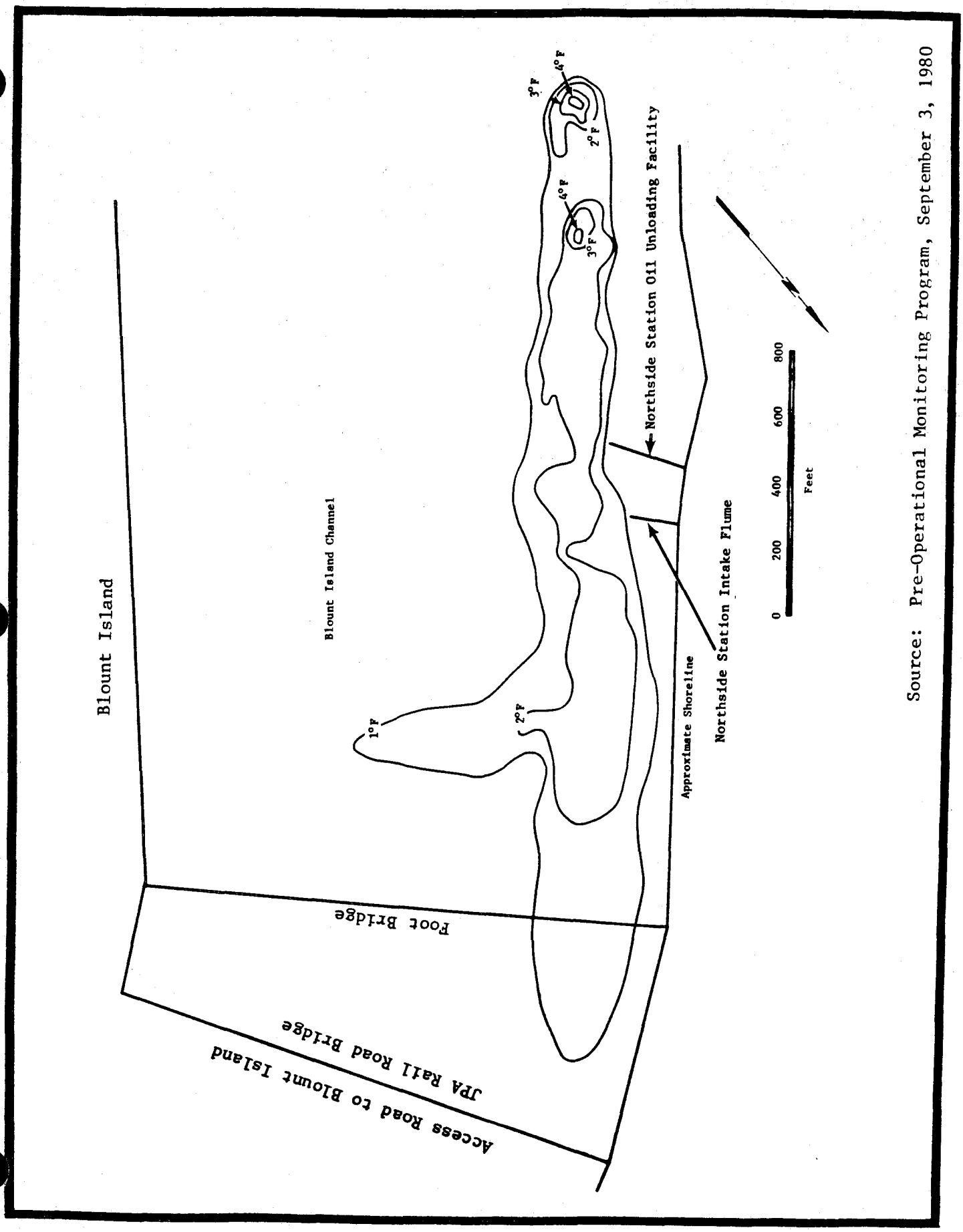
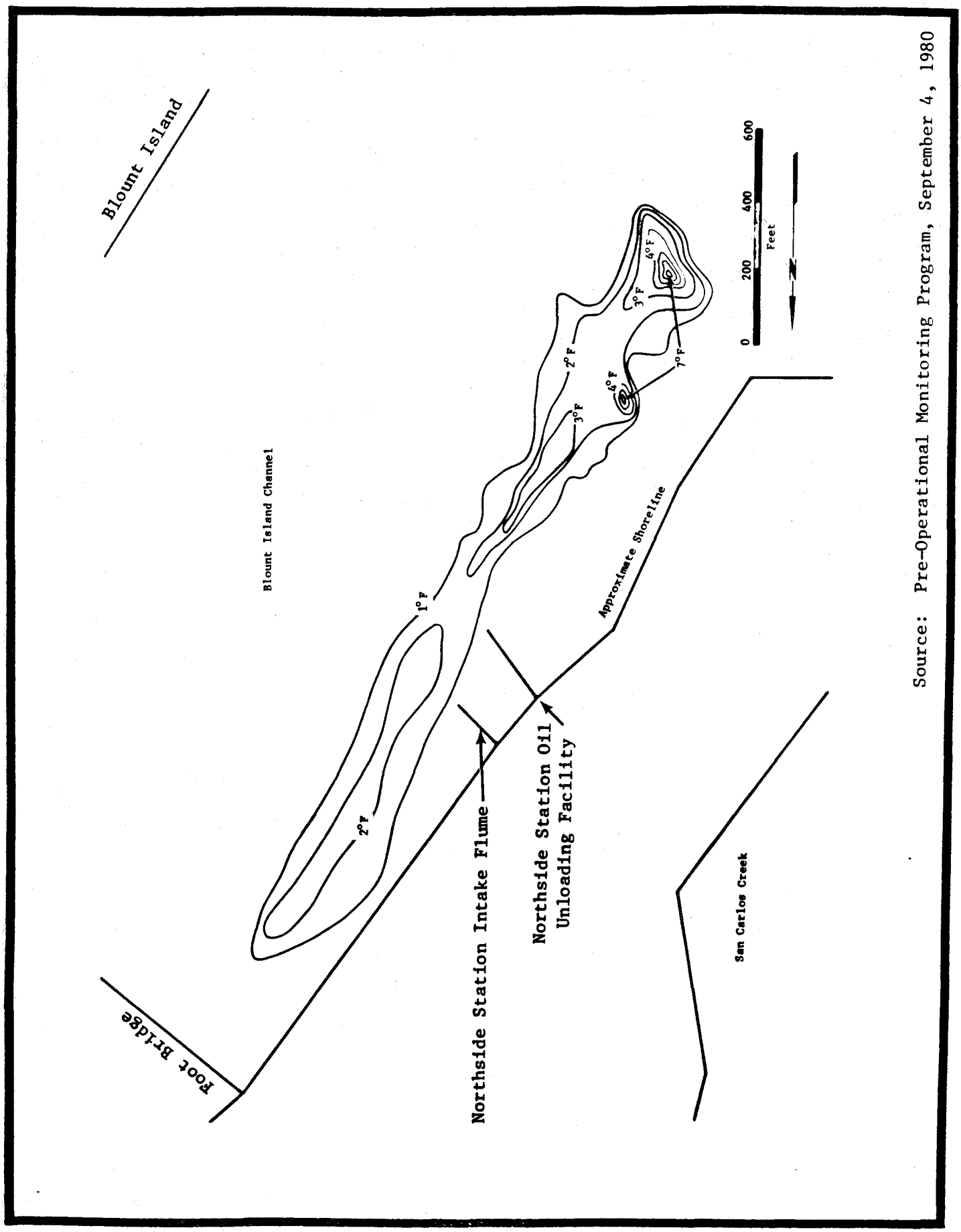


Figure C-1 **Extent of Northside Station Thermal Discharge, Plan View at One Meter Depth, Survey 2 (Ebb Tide)**



Source: Pre-Operational Monitoring Program, September 4, 1980

Figure C-2 Extent of Northside Station Thermal Discharge, Plan View at One Meter Depth, Survey 3 (Start of Flood Tide)

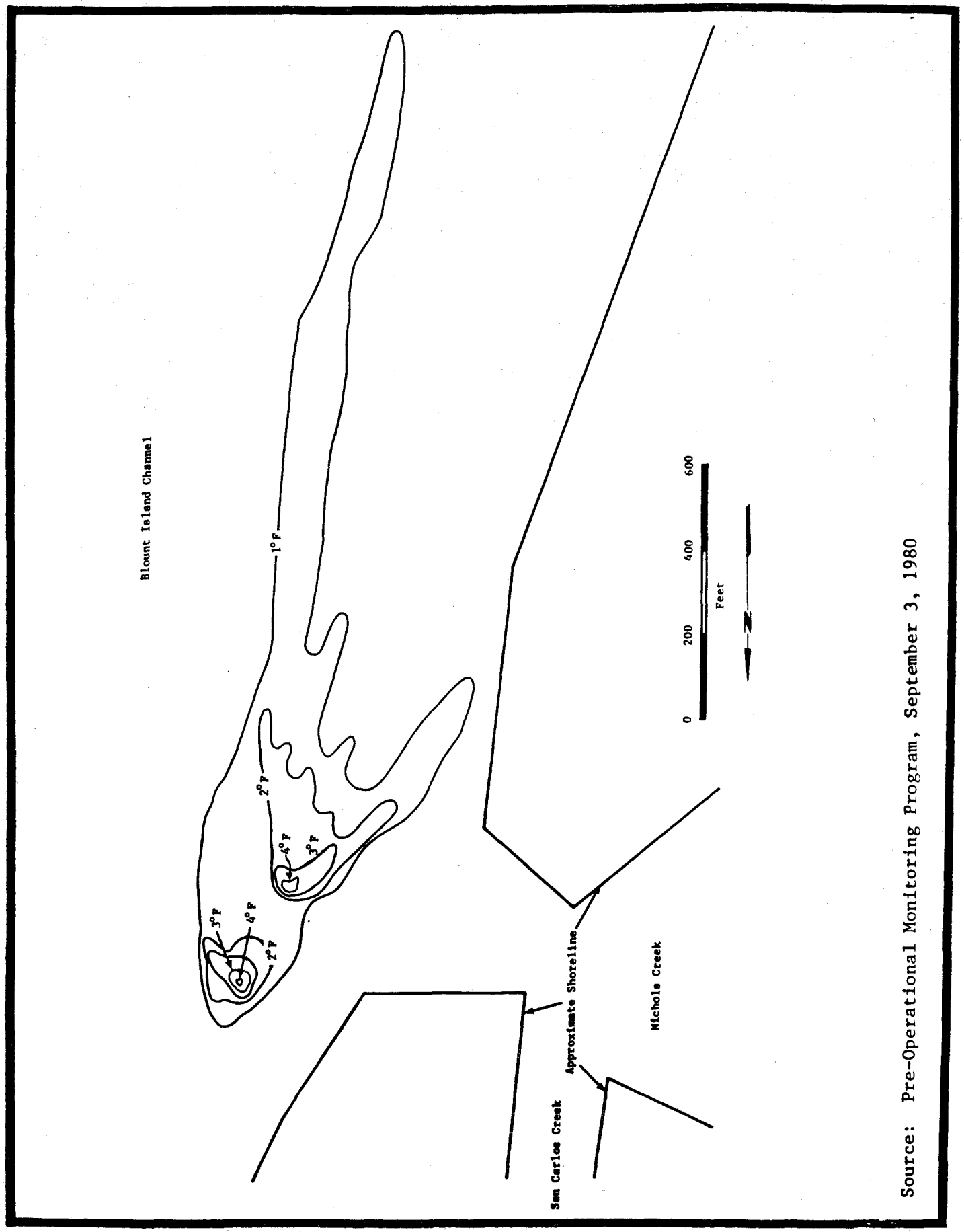


Figure C-3 Extent of Northside Station Thermal Discharge, Plan View at One Meter Depth, Survey 1 (Flood Tide)

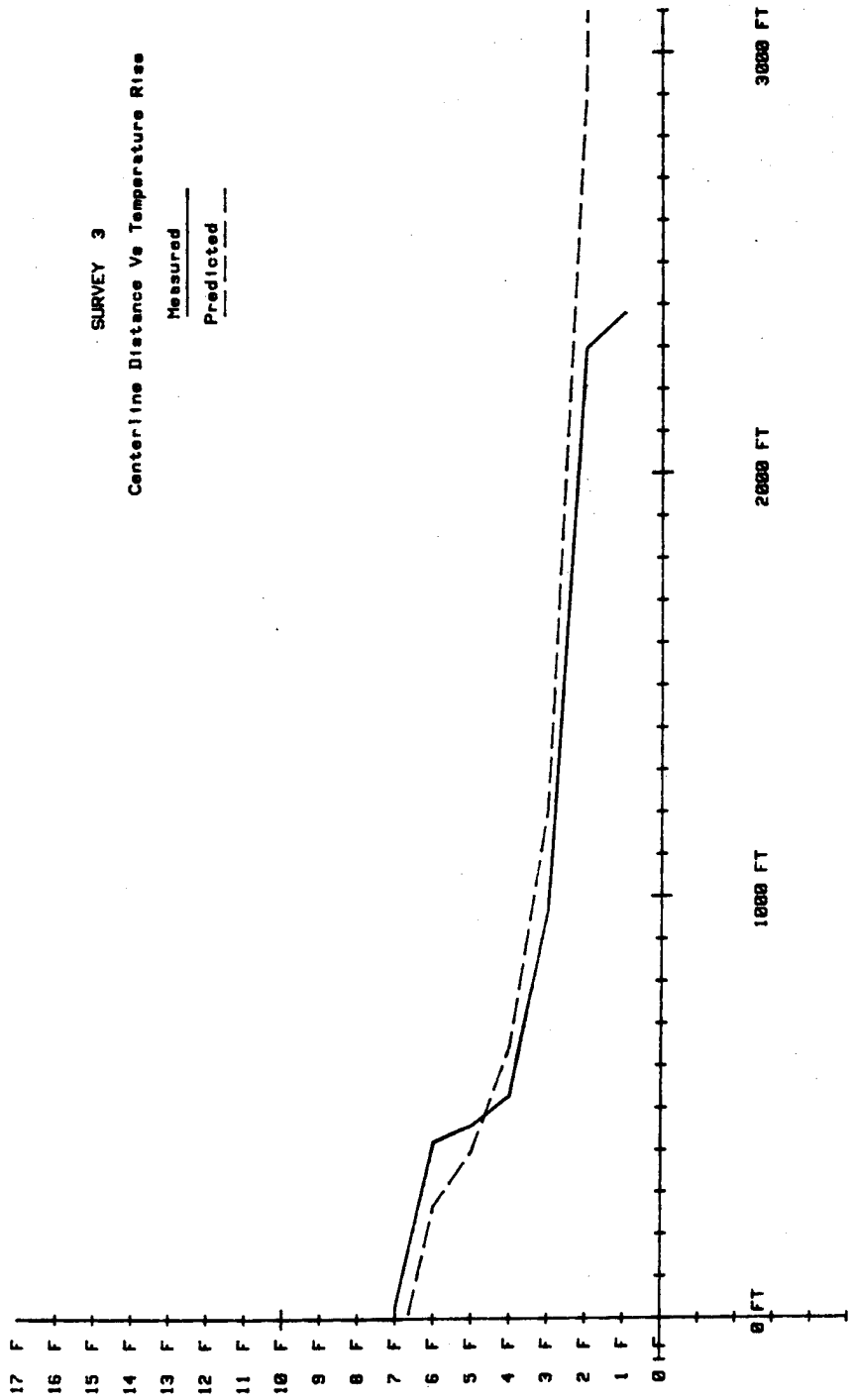


Figure C-4 Measured and Predicted Centerline Distance vs. Temperature Balasubramanian Model

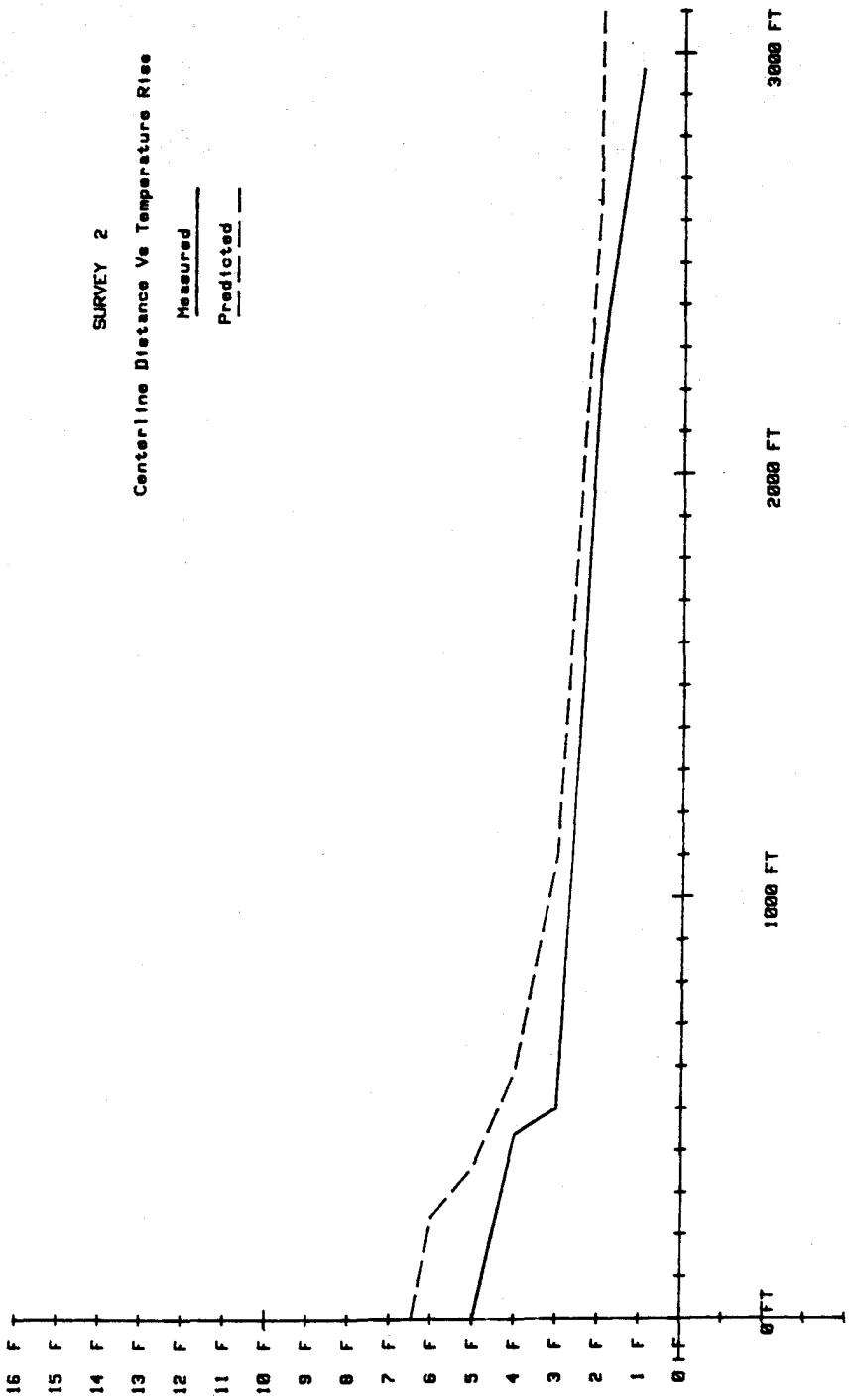


Figure C-5 Measured and Predicted Centerline Distance vs. Temperature Balasubramanian Model

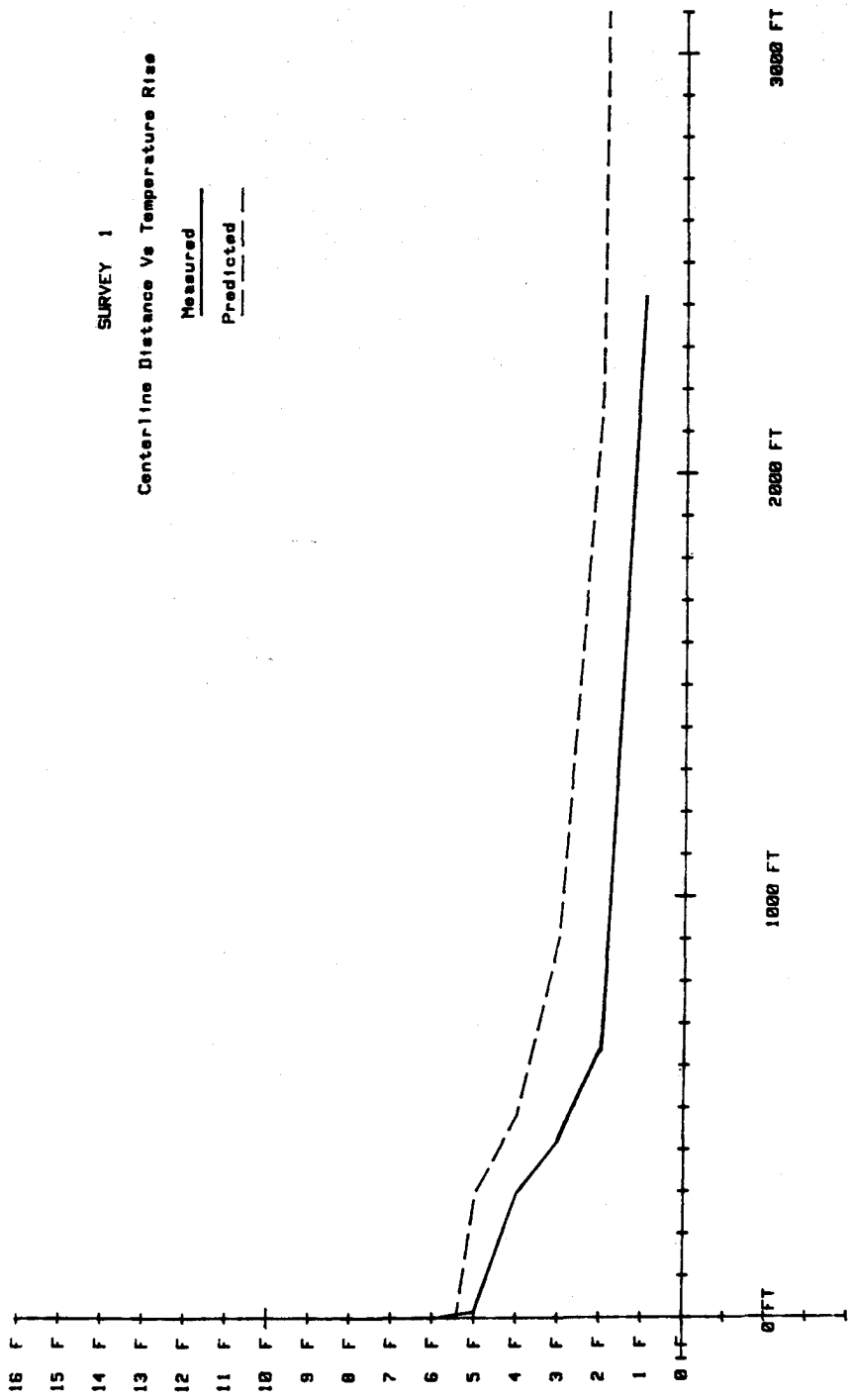


Figure C-6 Measured and Predicted Centerline Distance vs. Temperature Balasubramanian Model

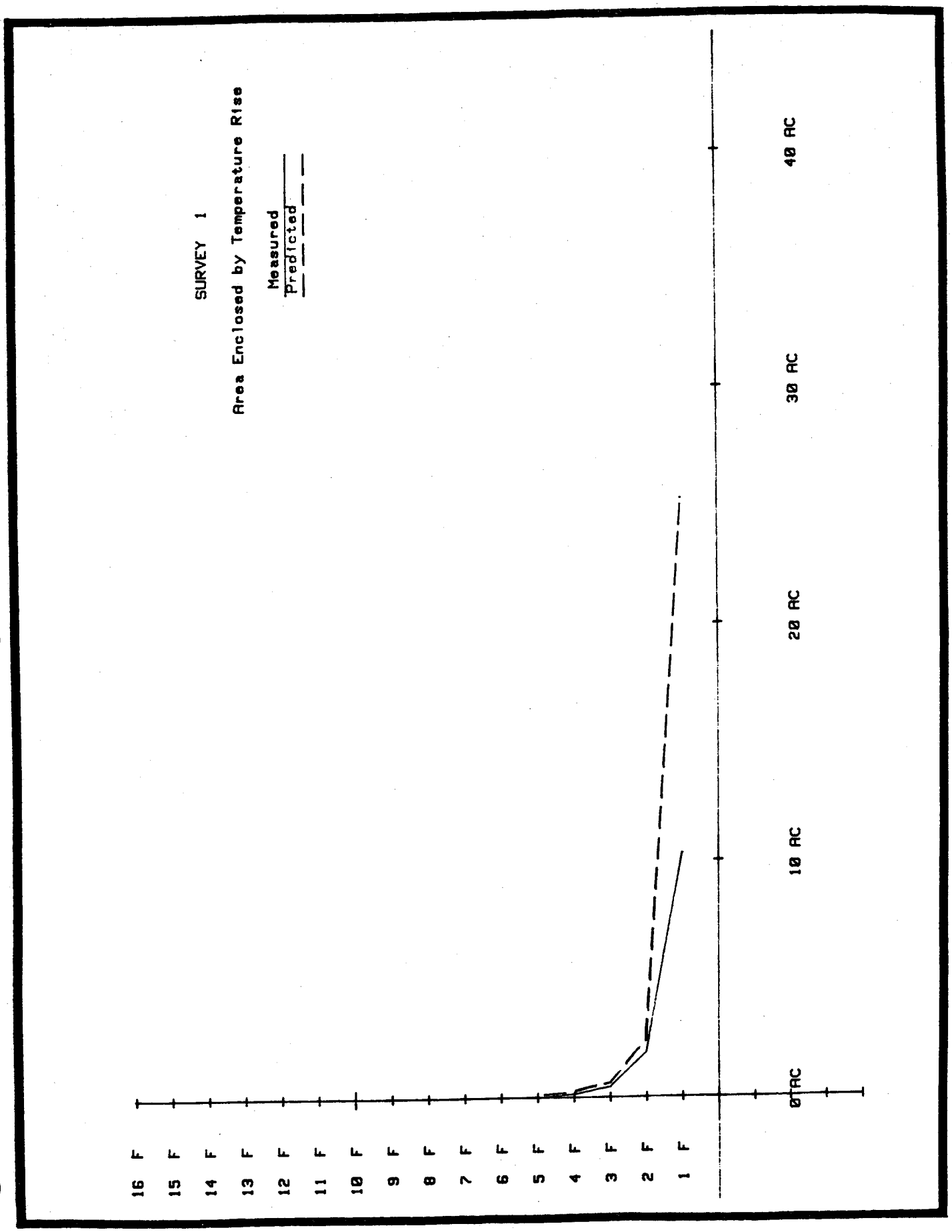


Figure C-7 Measured and Predicted Areas vs. Temperatures Balasubramanian Model

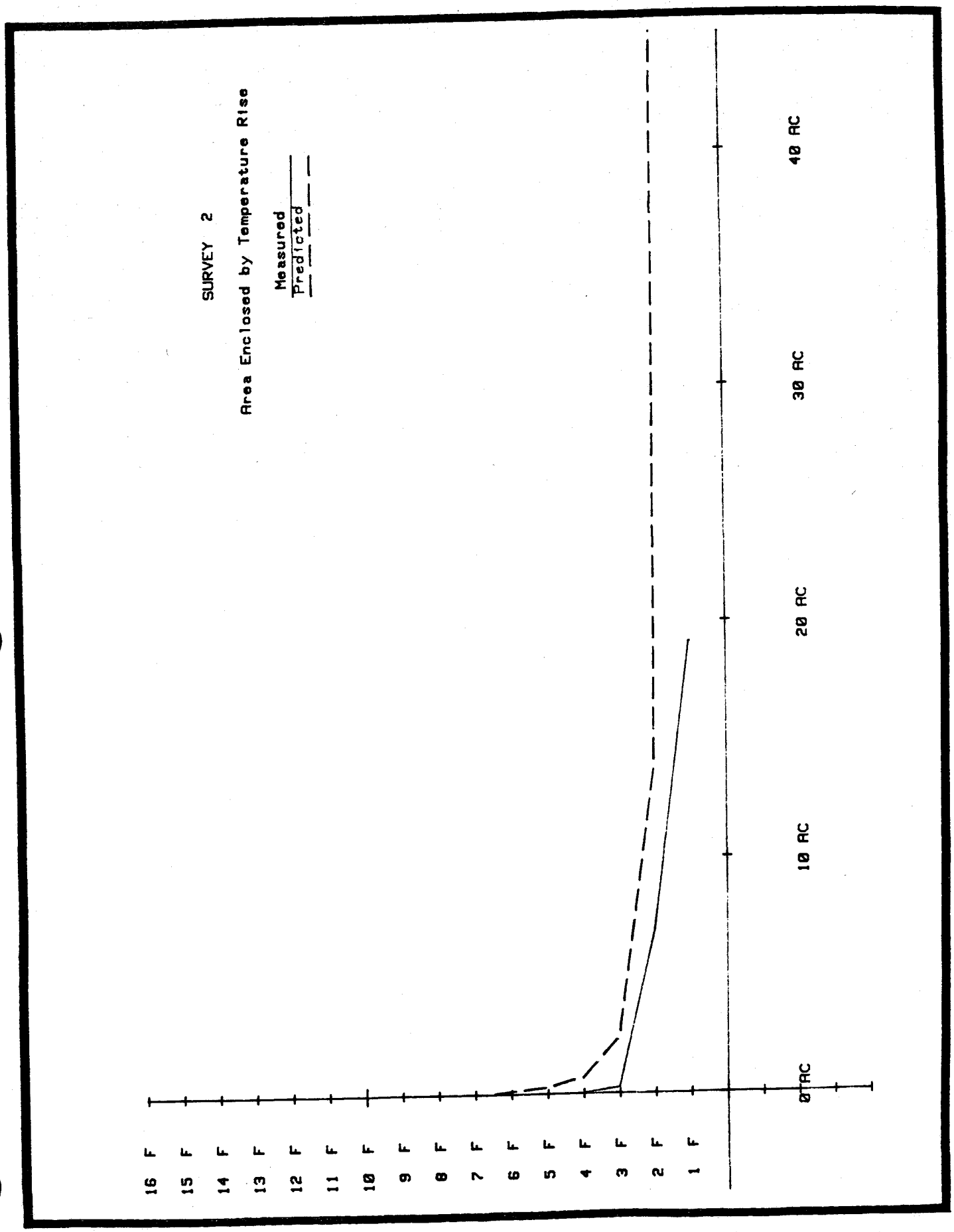


Figure C-8 Measured and Predicted Areas vs. Temperatures Balasubramanian Model

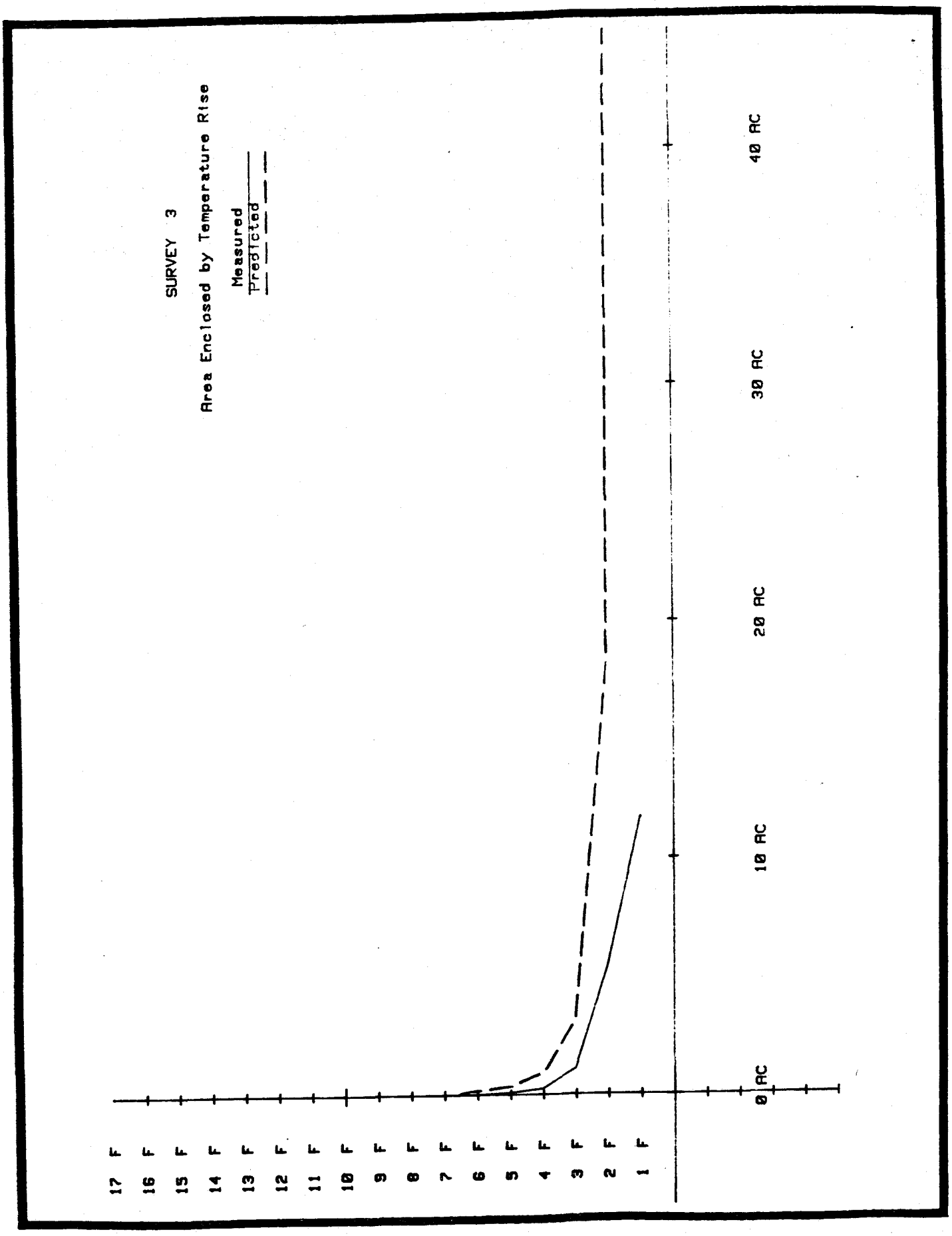


Figure C-9 Measured and Predicted Areas vs. Temperatures Balasubramanian Model

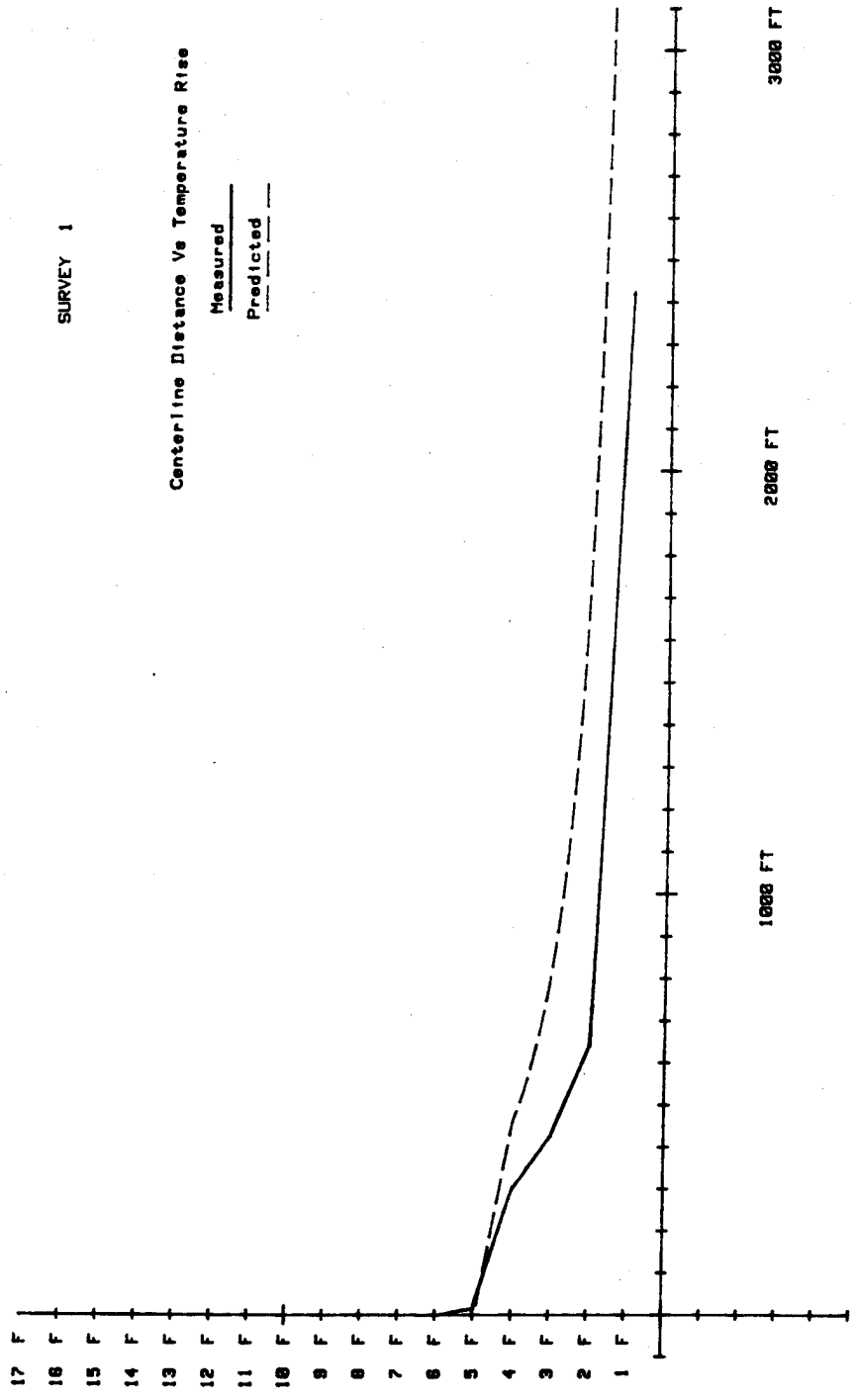


Figure C-10 Measured and Predicted Centerline Distance vs. Temperature Rise Nagel Model

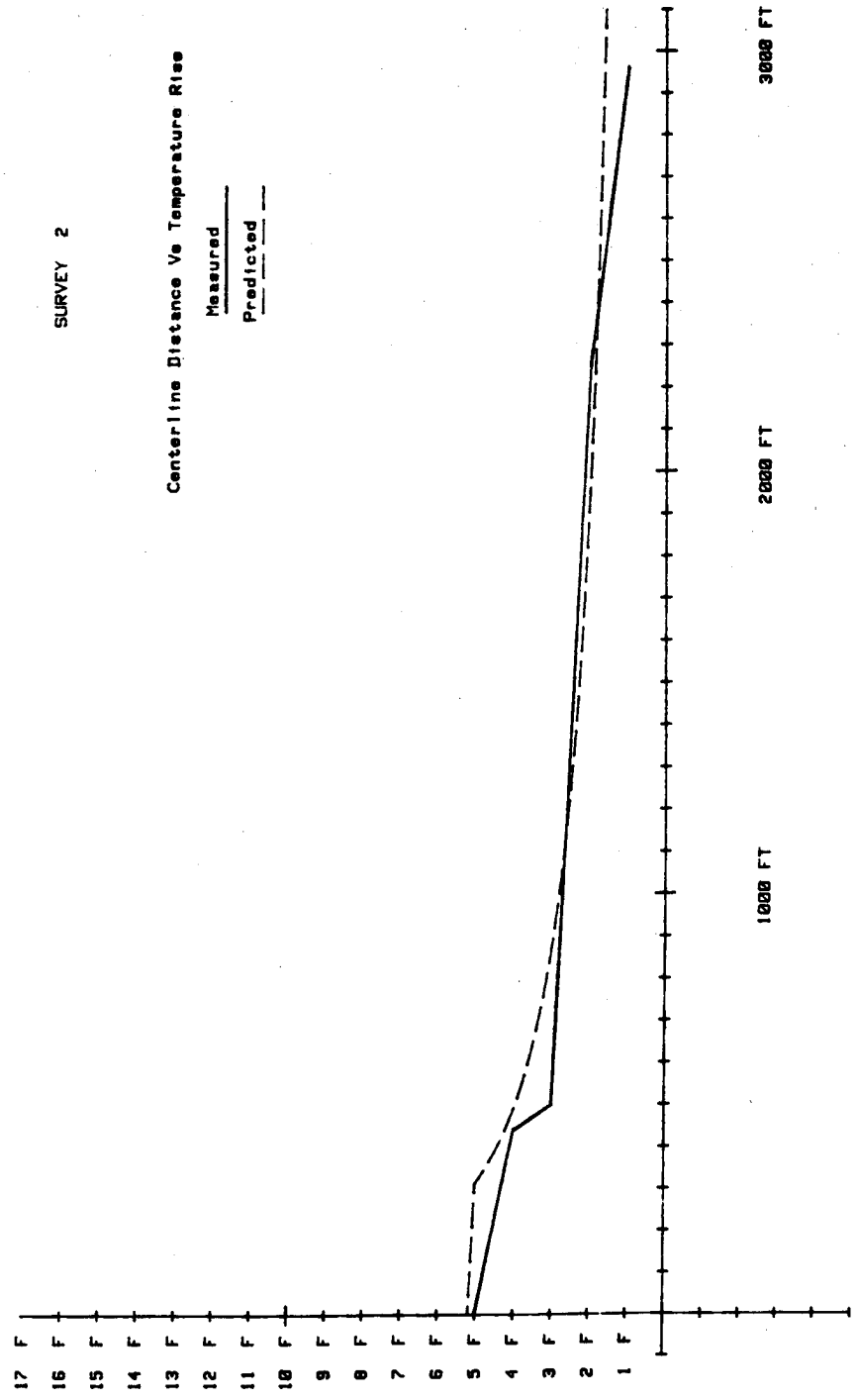


Figure C-11 Measured and Predicted Centerline Distance vs. Temperature Rise Nagel Model

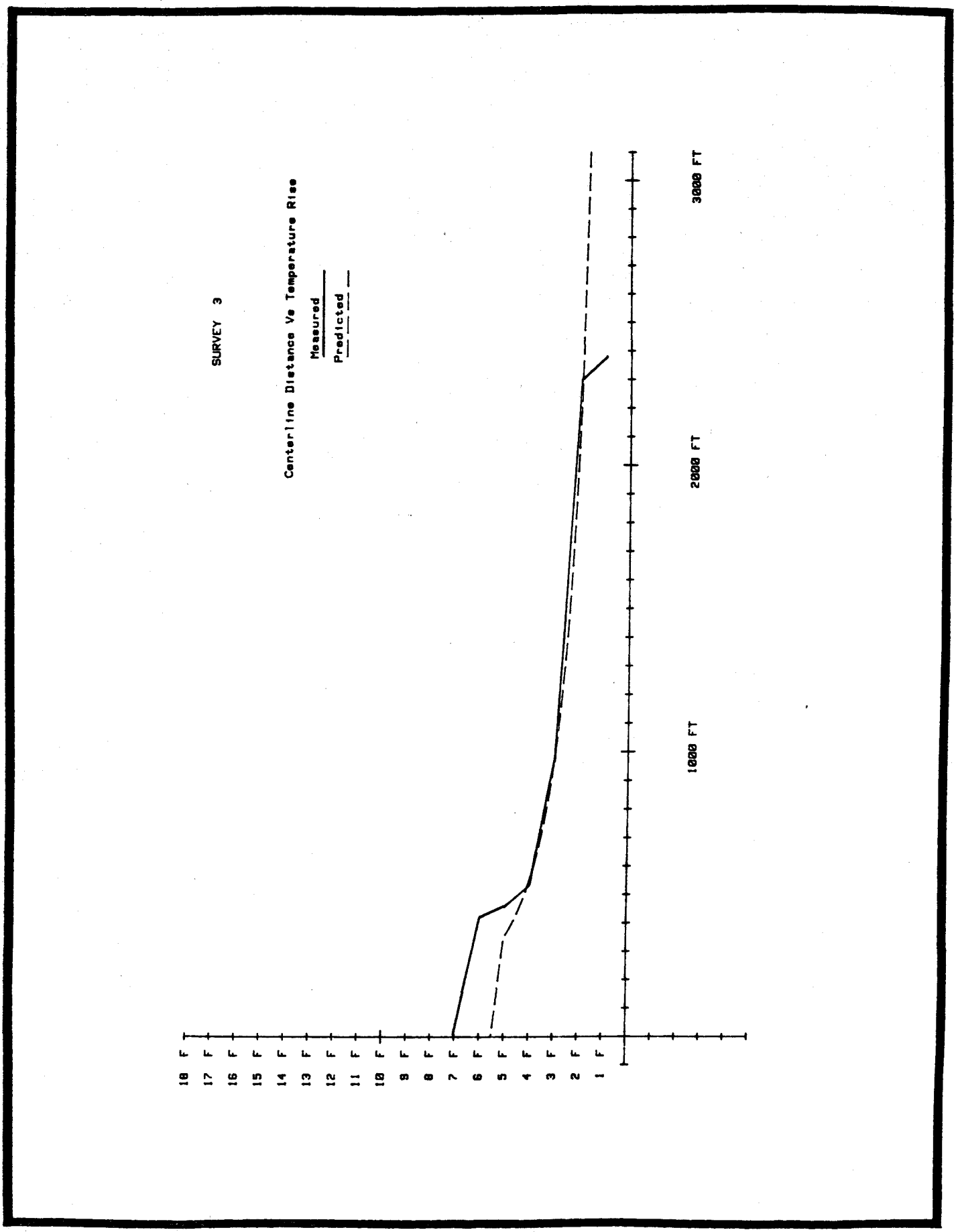


Figure C-12 Measured and Predicted Centerline Distance vs. Temperature Rise Nagel Model

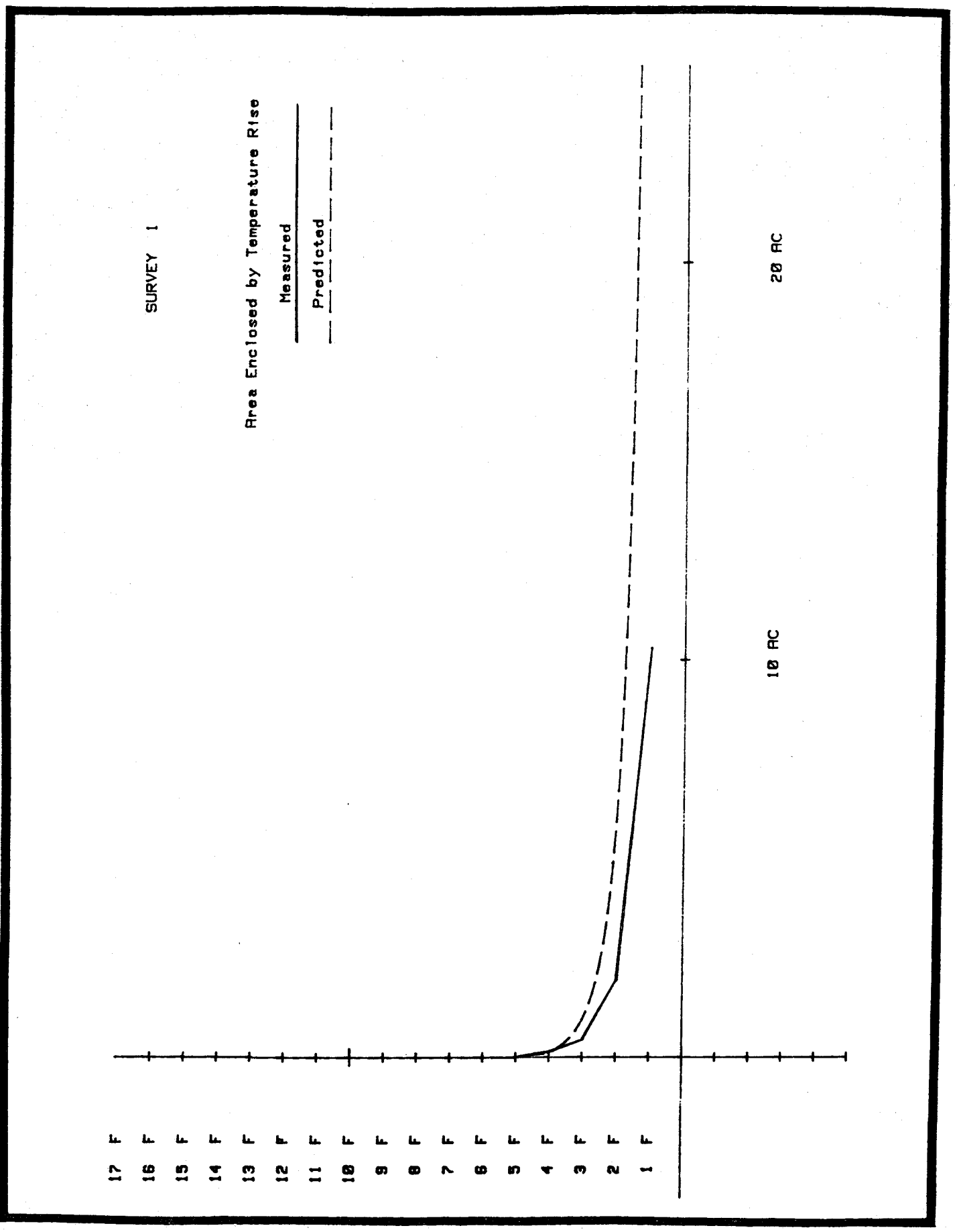


Figure C-13 Measured and Predicted Areas vs. Temperature Rise Nagel Model

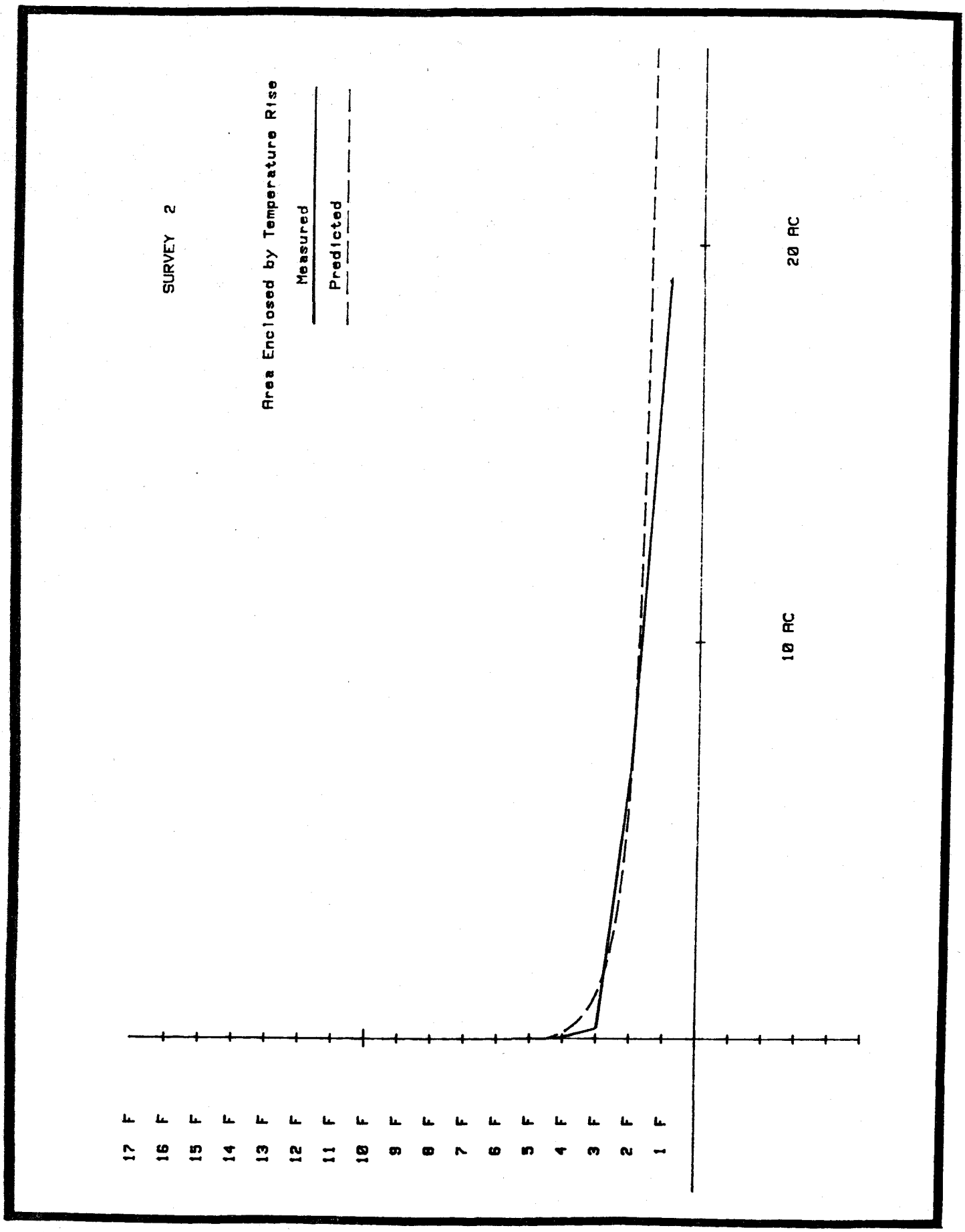


Figure C-14 Measured and Predicted Areas vs. Temperature Rise Nagel Model

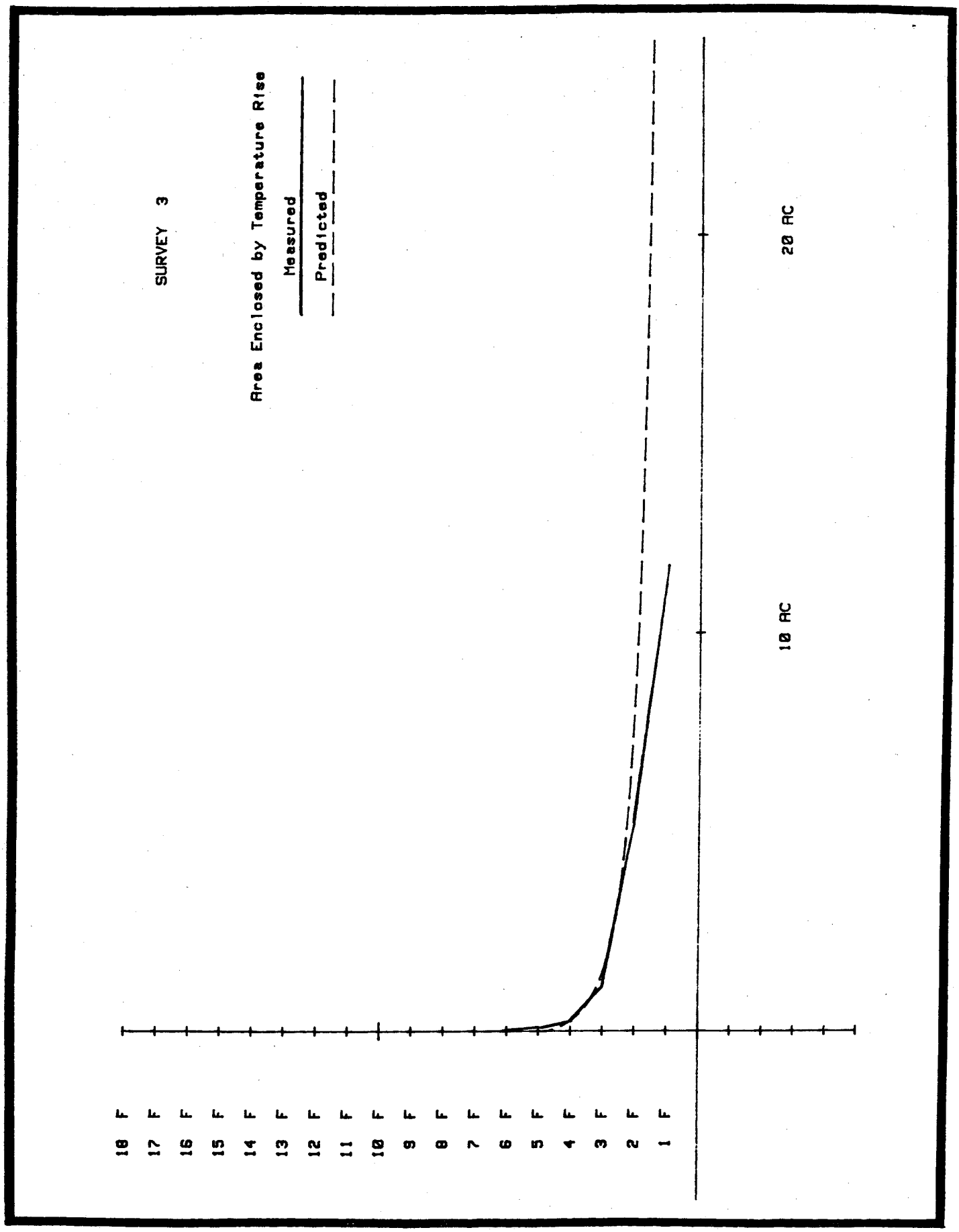


Figure C-15 Measured and Predicted Areas vs. Temperature Rise Nagel Model

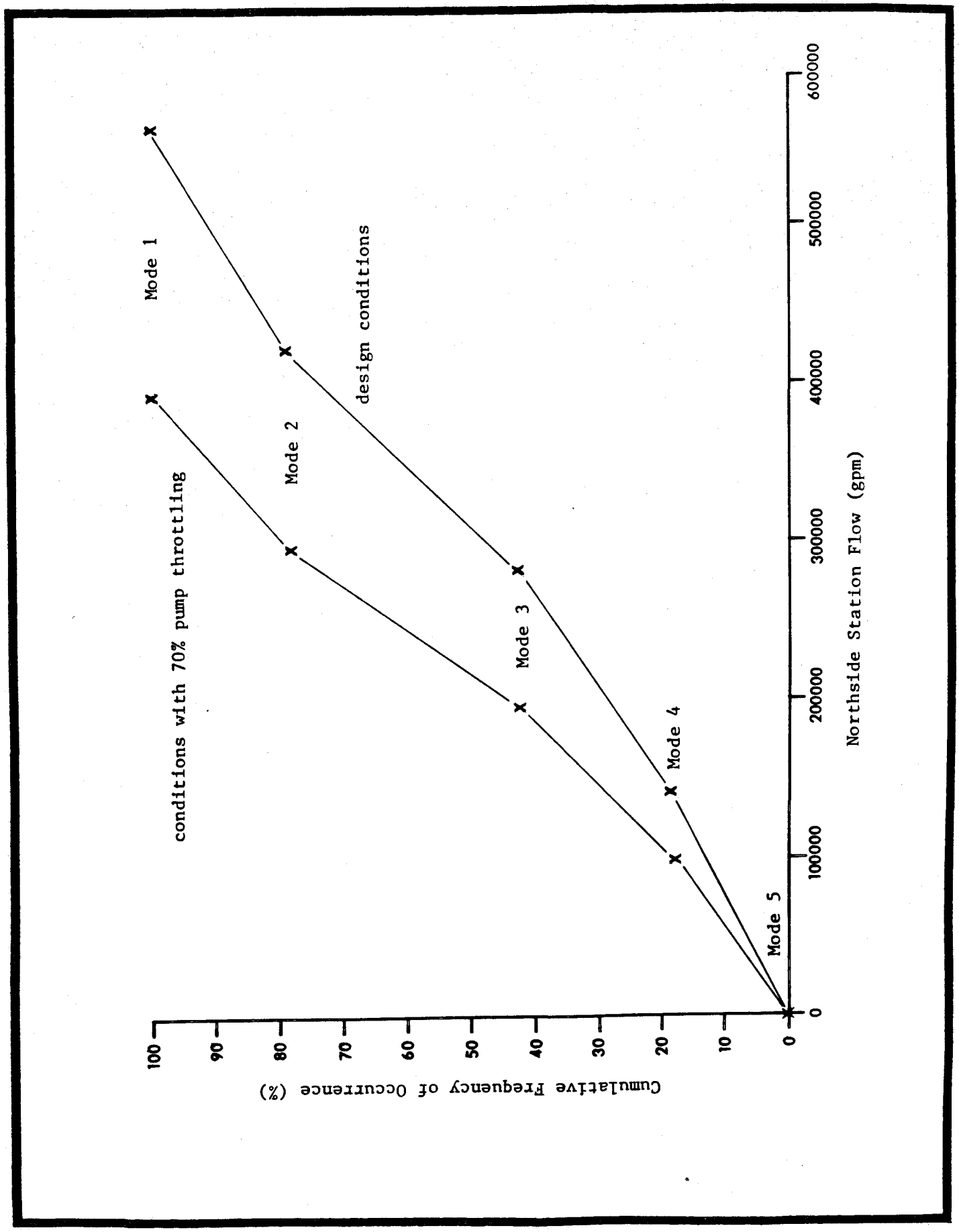


Figure C-16 Cumulative Frequency of Occurrence of Northside Station Flows

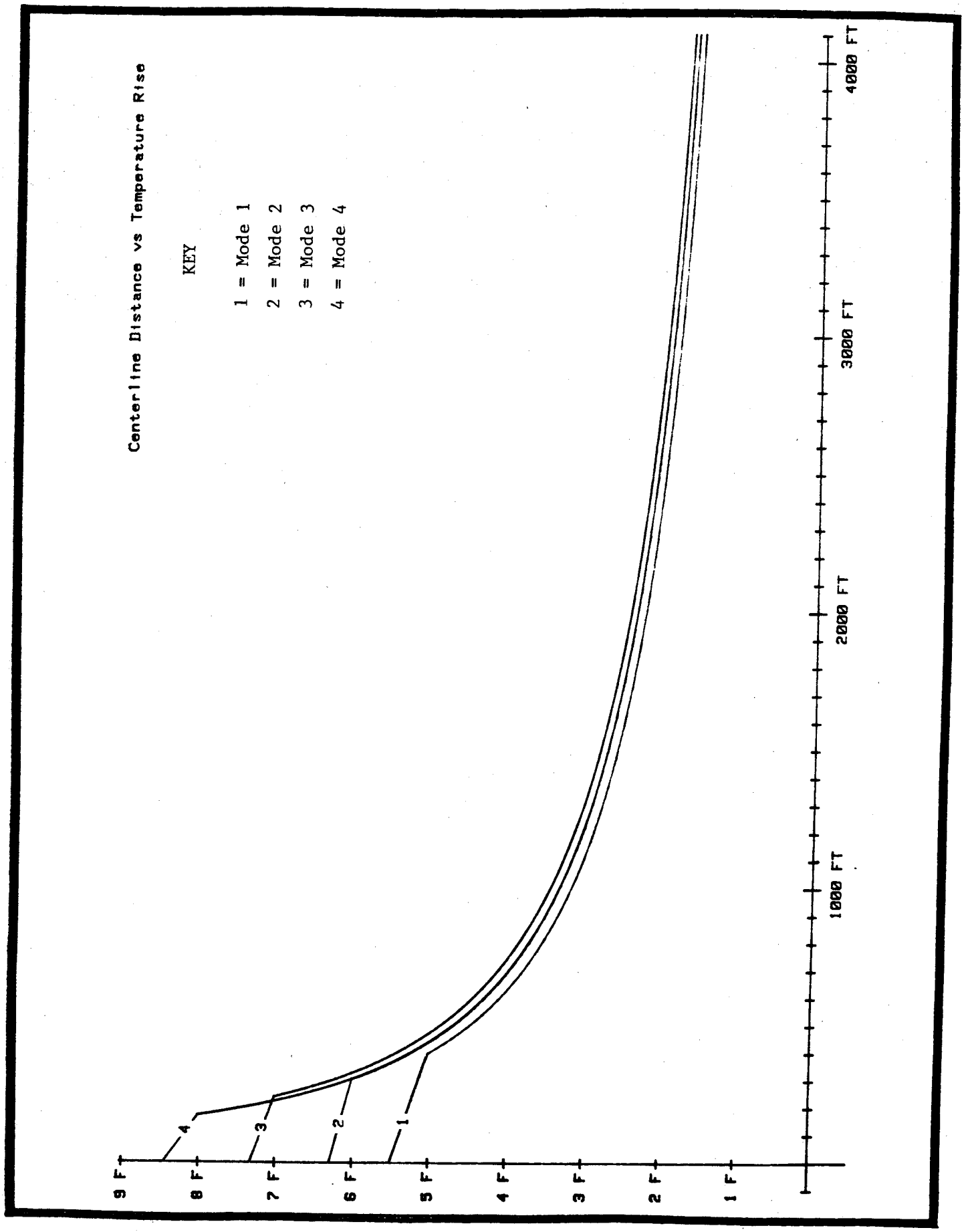


Figure C-17 Predicted Centerline Distance vs. Temperature Rise Northside Station at Full Load with no Pump Throttling

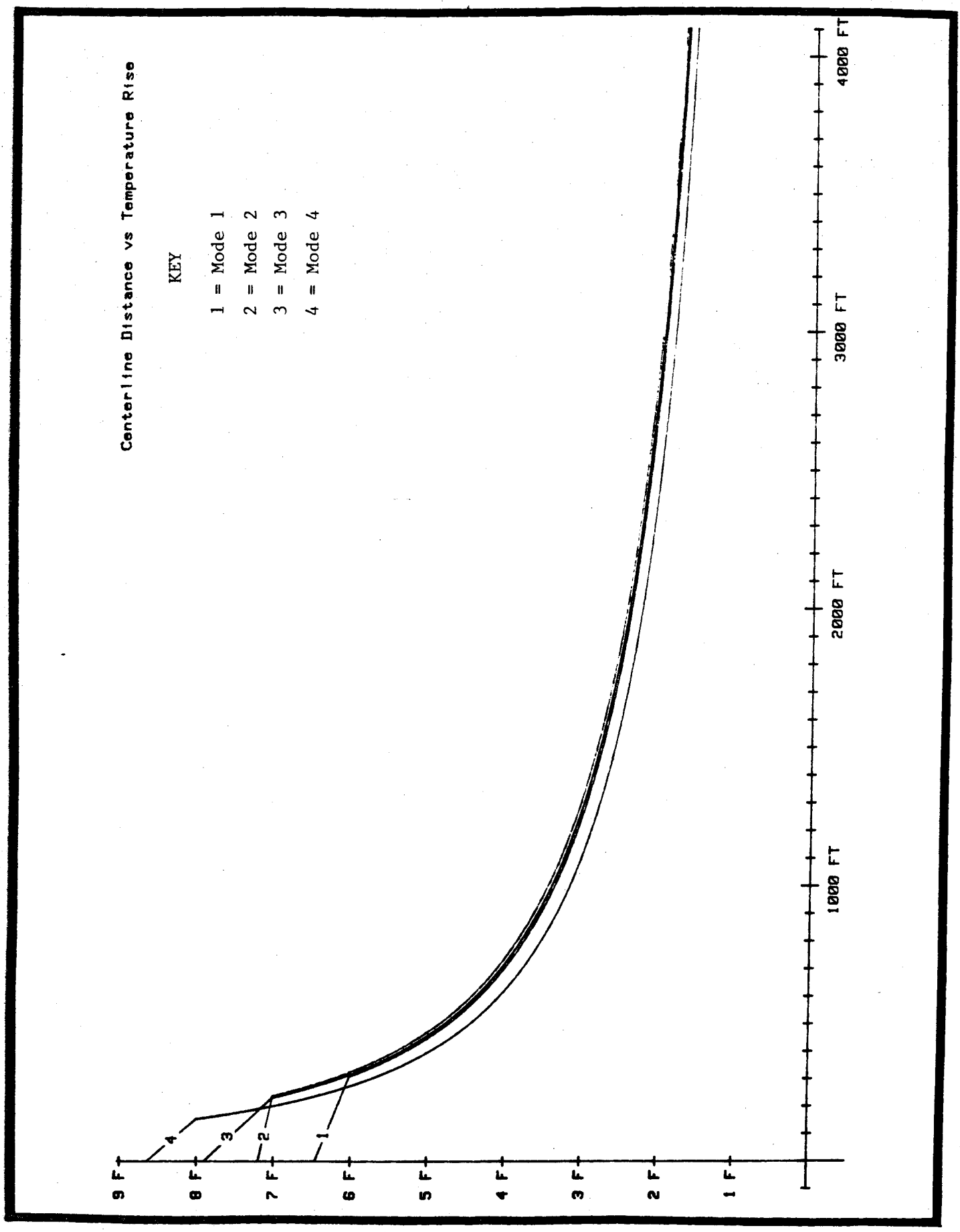


Figure C-18 Predicted Centerline Distance vs. Temperature Rise Northside Station at Full Load with Maximum Pump Throttling

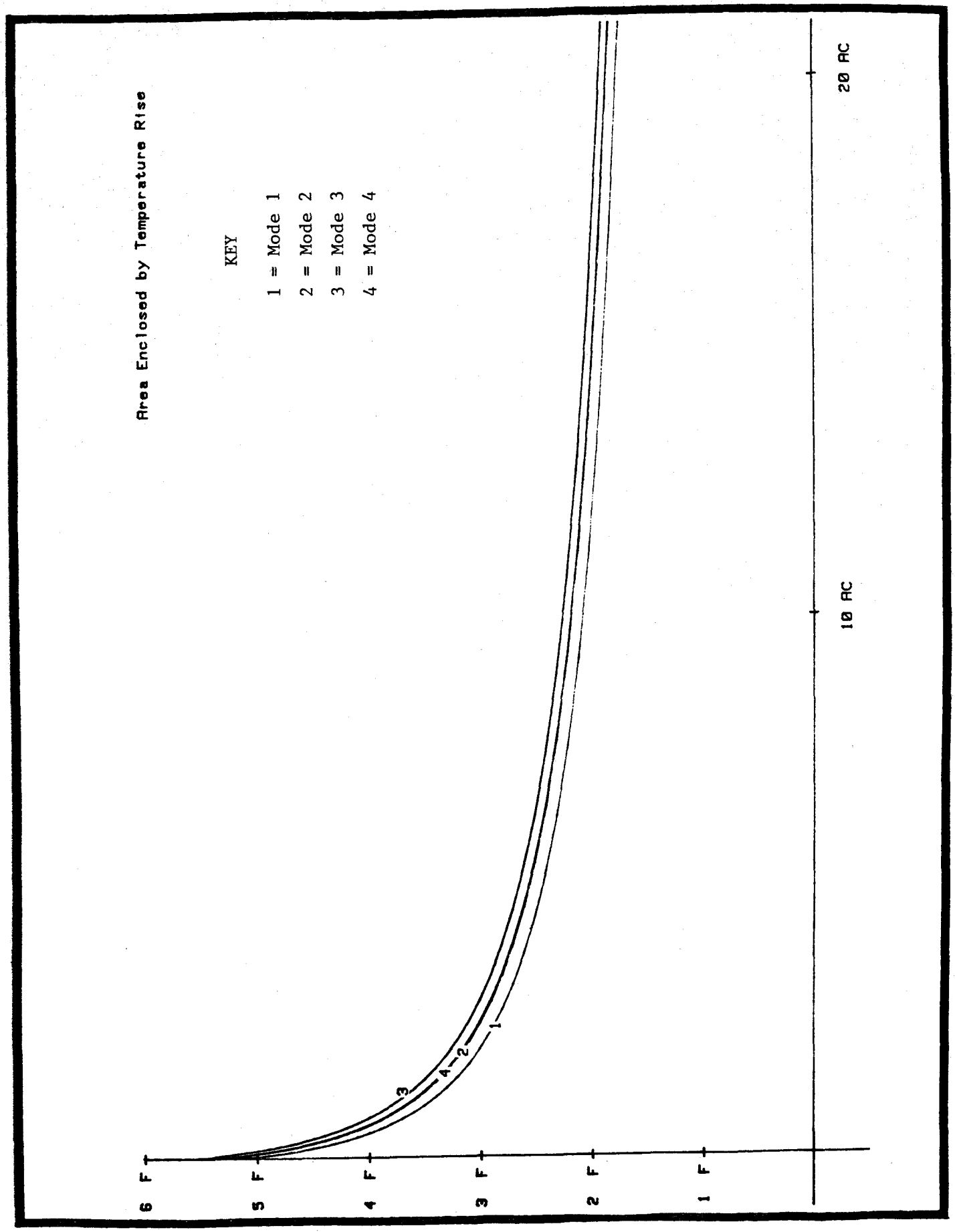


Figure C-19 Predicted Enclosed Area vs. Temperature Rise
Northside Station at Full Load with no Pump Throttling

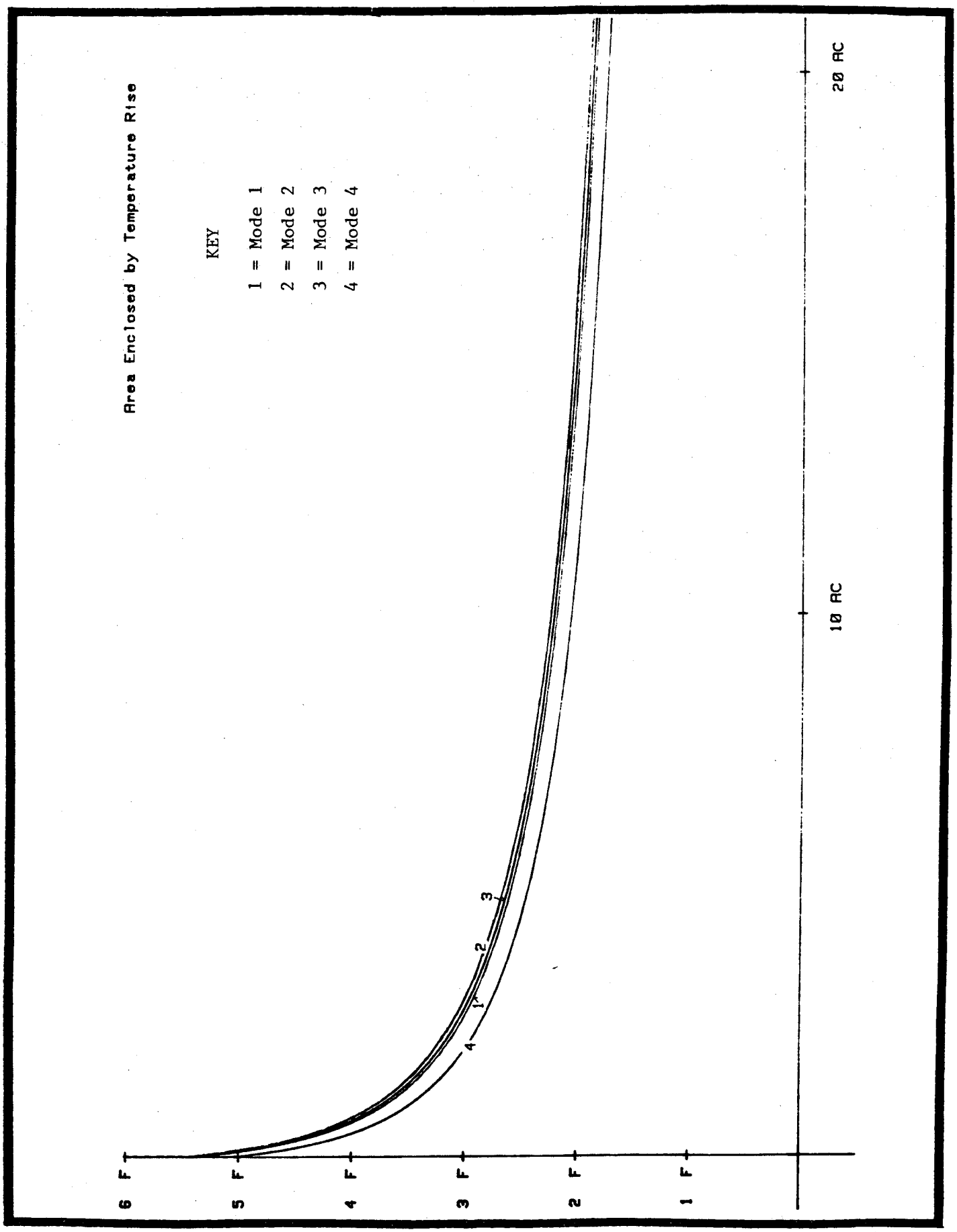


Figure C-20 Predicted Enclosed Area vs. Temperature Rise
Northside Station at Full Load with Maximum Pump Throttling

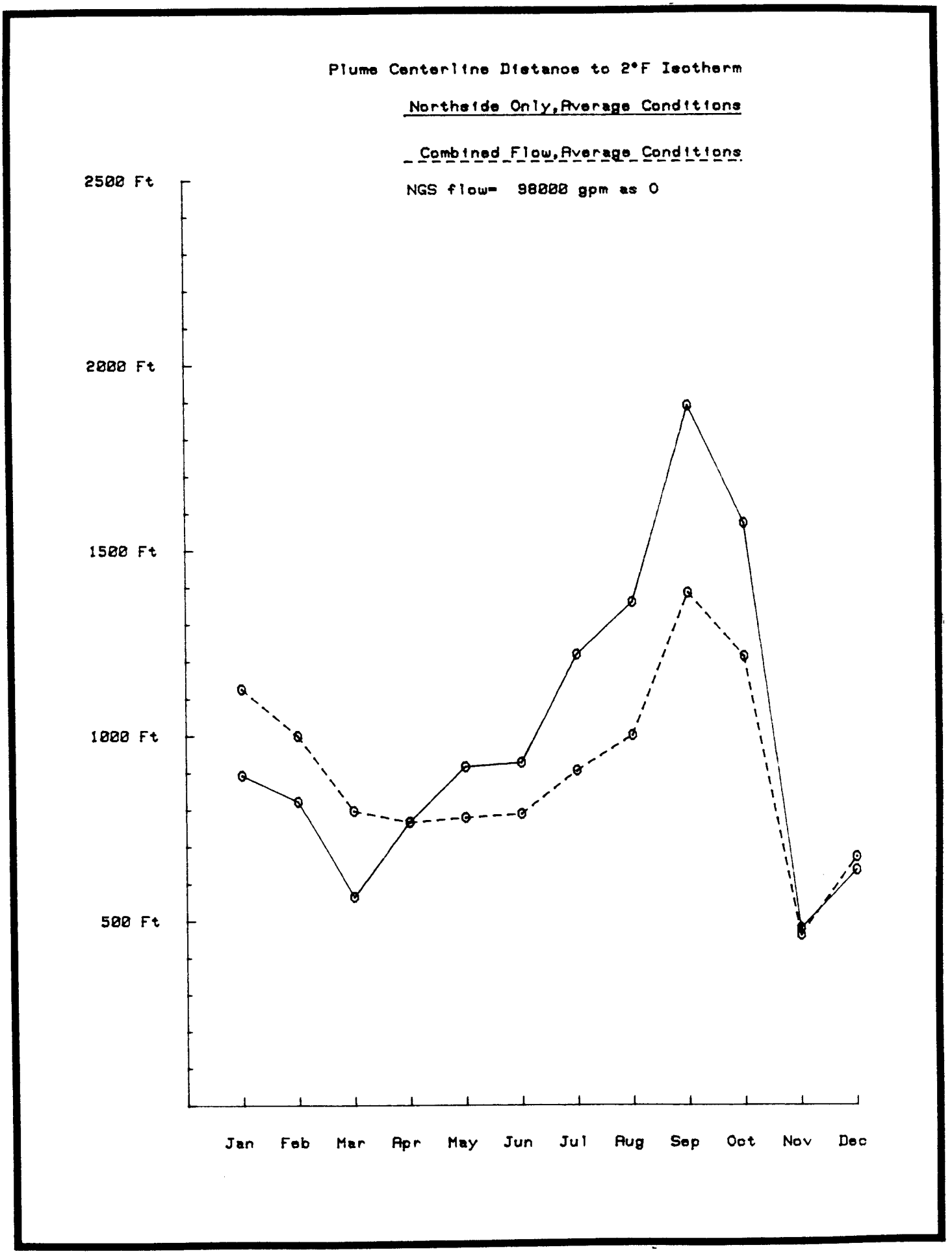


Figure C-21 Predicted Plume Centerline Distance to 2 Degree F Isotherm One Meter Depth-Average Case-Mode 4

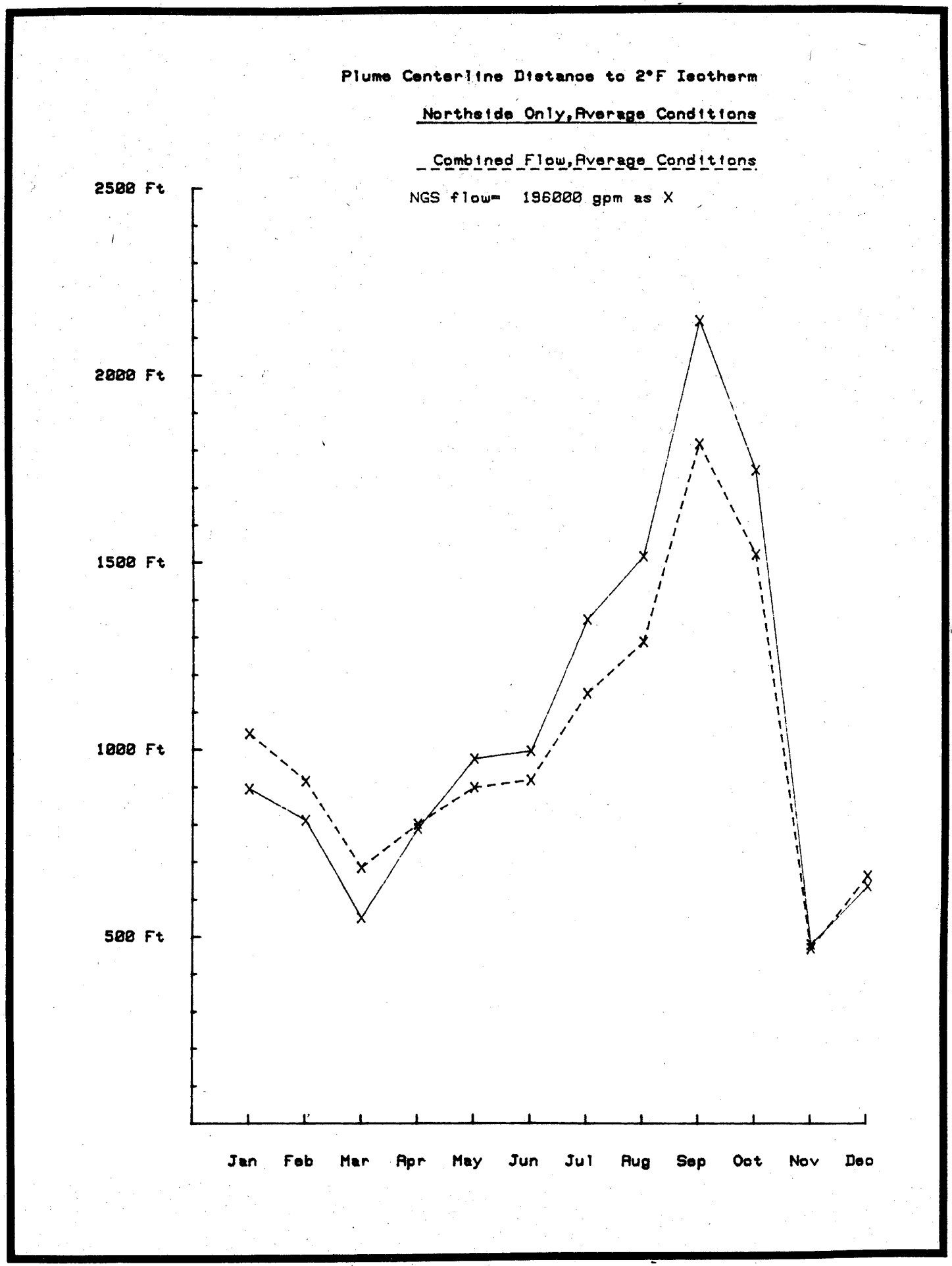


Figure C-22 Predicted Plume Centerline Distance to 2 Degree F Isotherm One Meter Depth-Average Case-Mode 3

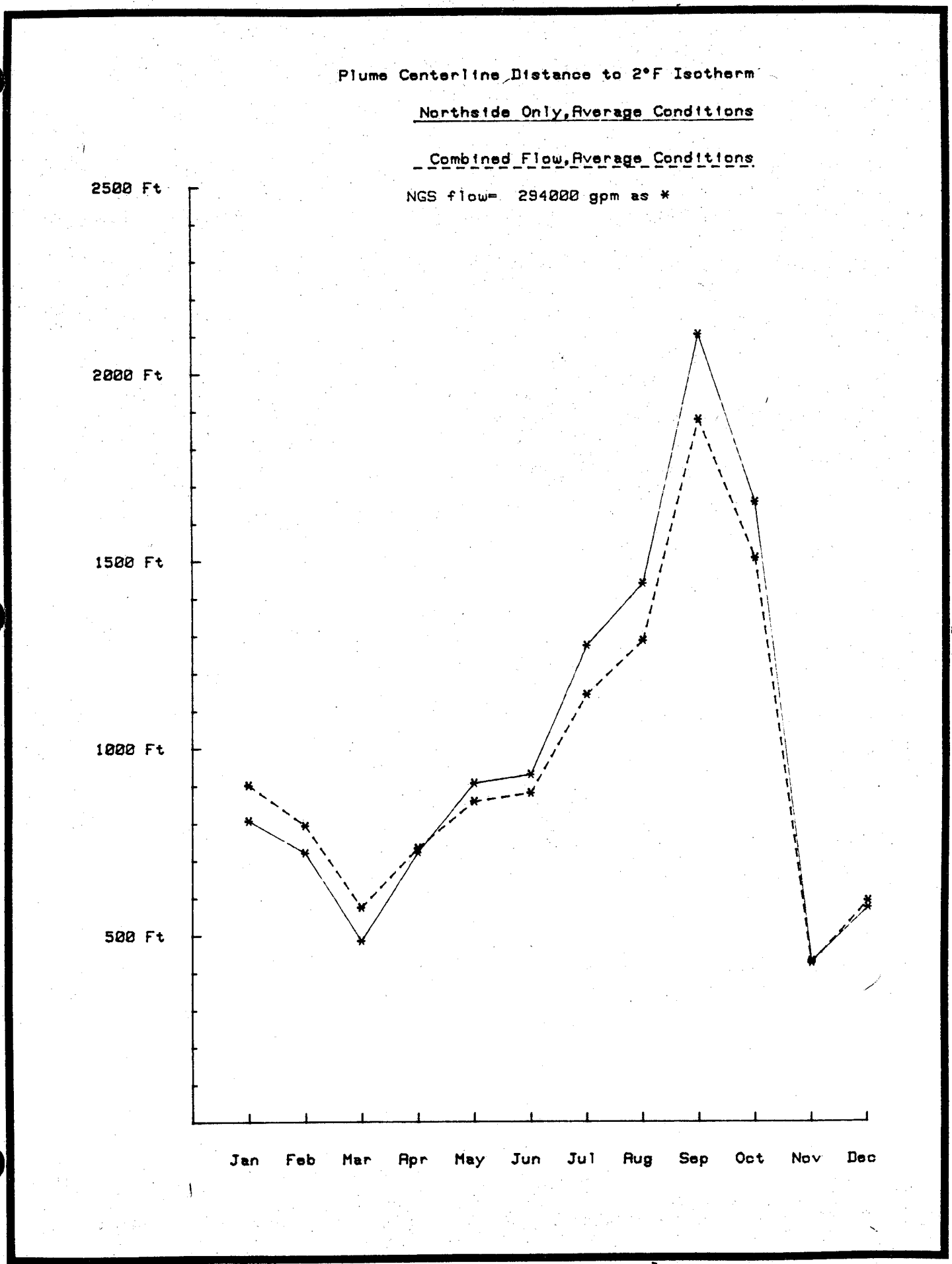


Figure C-23 Predicted Plume Centerline Distance to 2 Degree F Isotherm One Meter Depth-Average Case-Mode 2

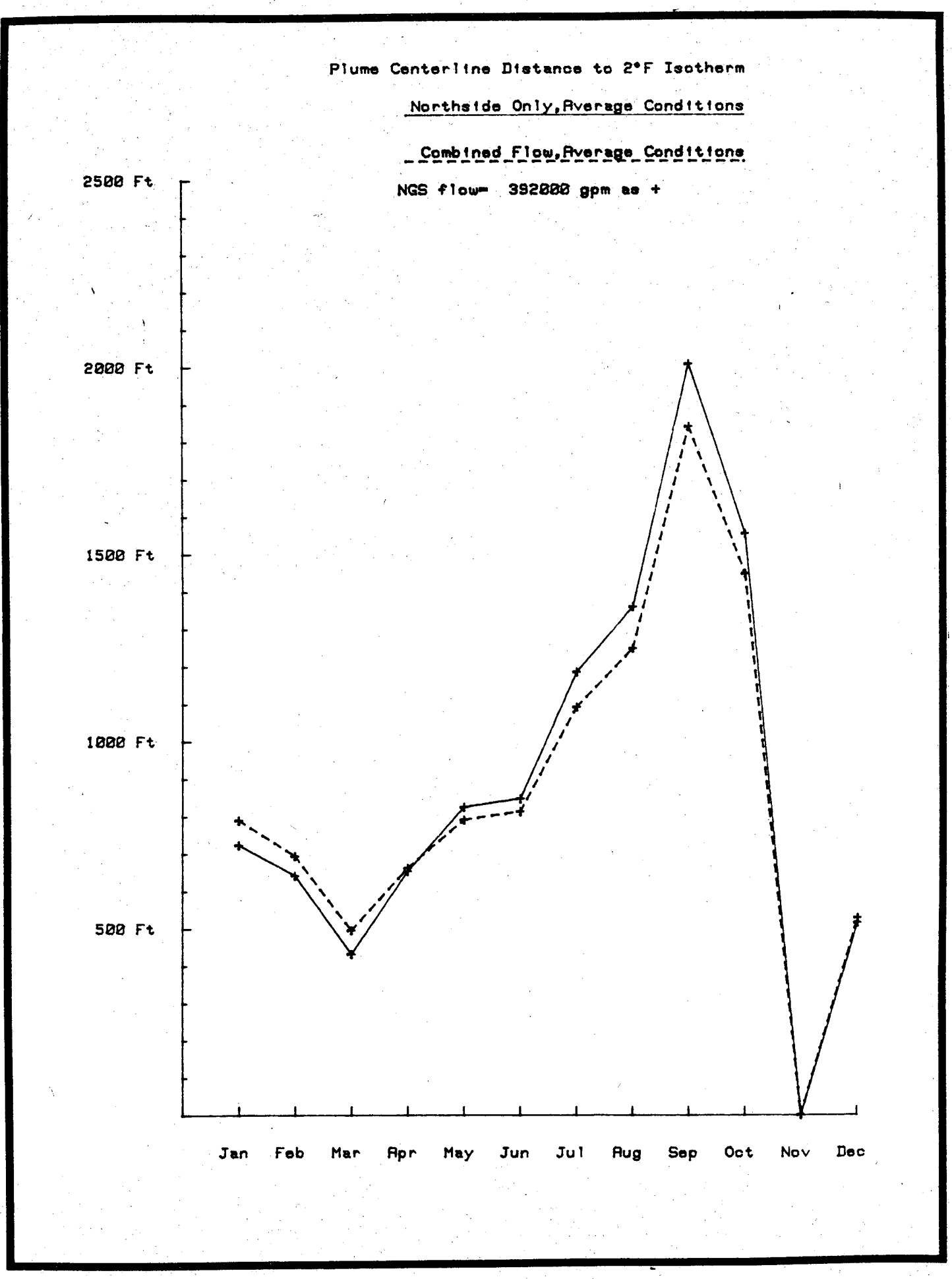


Figure C-24 Predicted Plume Centerline Distance to 2 Degree F Isotherm One Meter Depth-Average Case-Mode 1

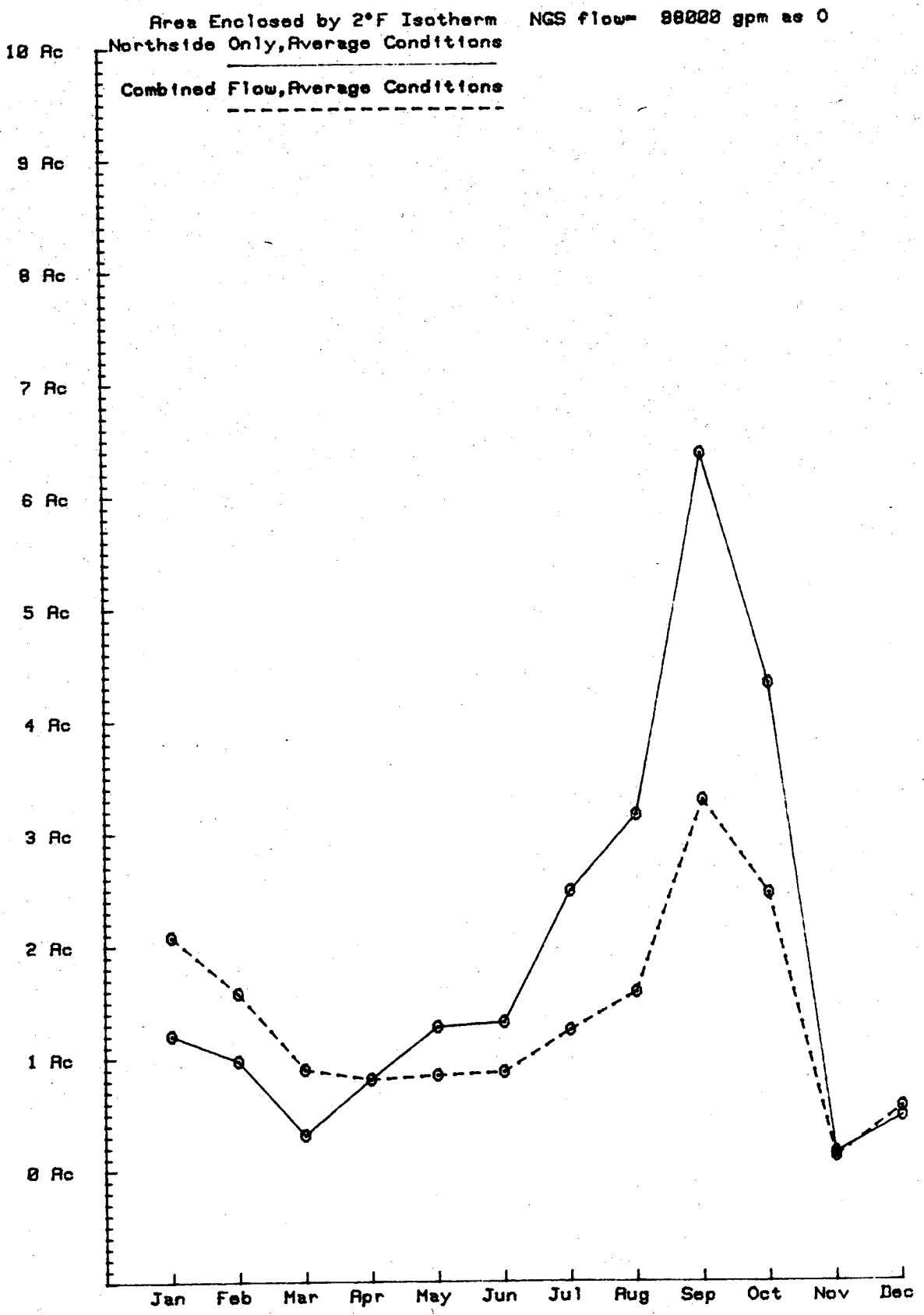


Figure C-25 Predicted Plume Area of 2 Degree F Isotherm One Meter Depth-Average Case-Mode 4

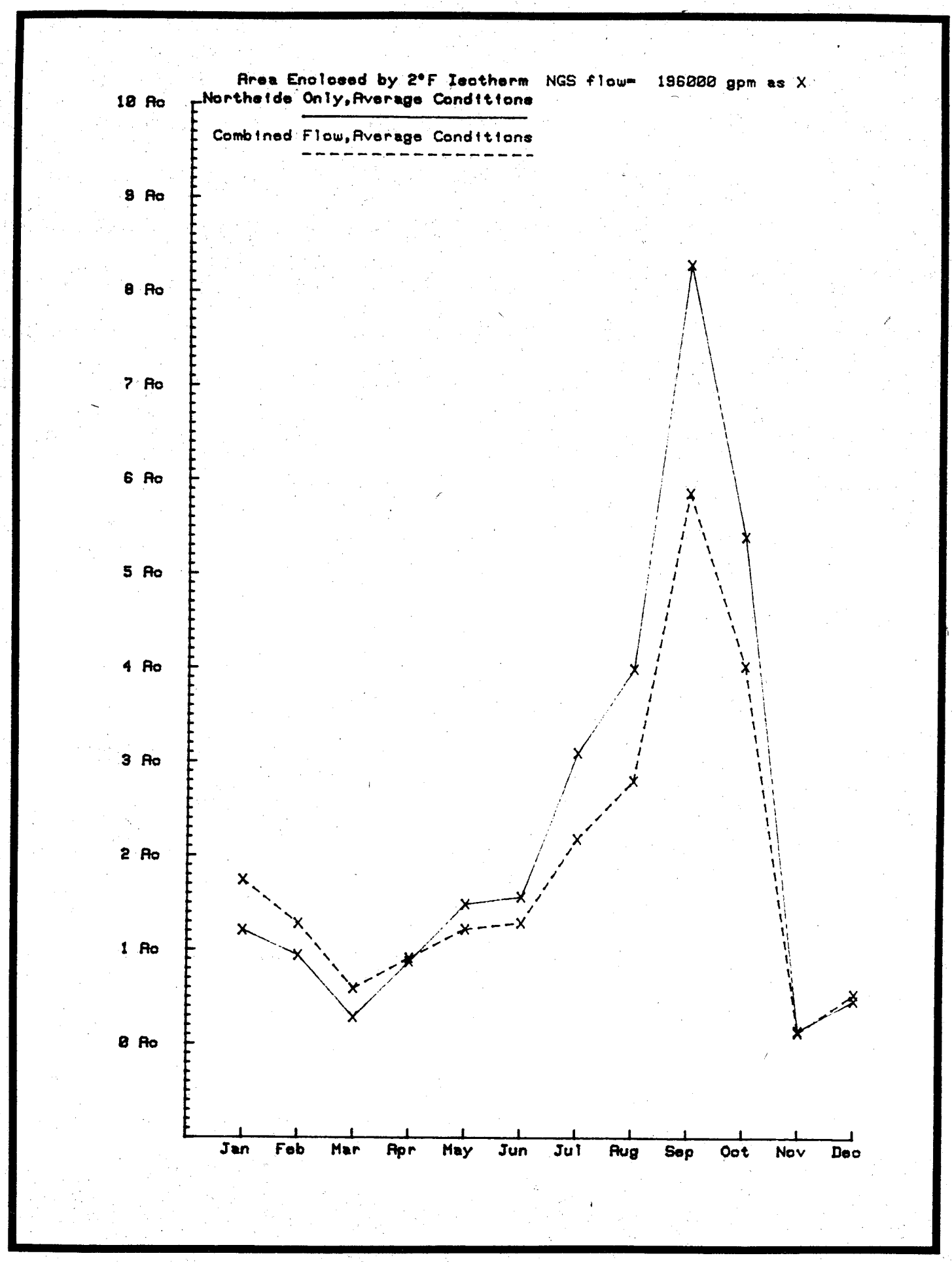


Figure C-26 Predicted Plume Area of 2 Degree F Isotherm One Meter Depth-Average Case-Mode 3

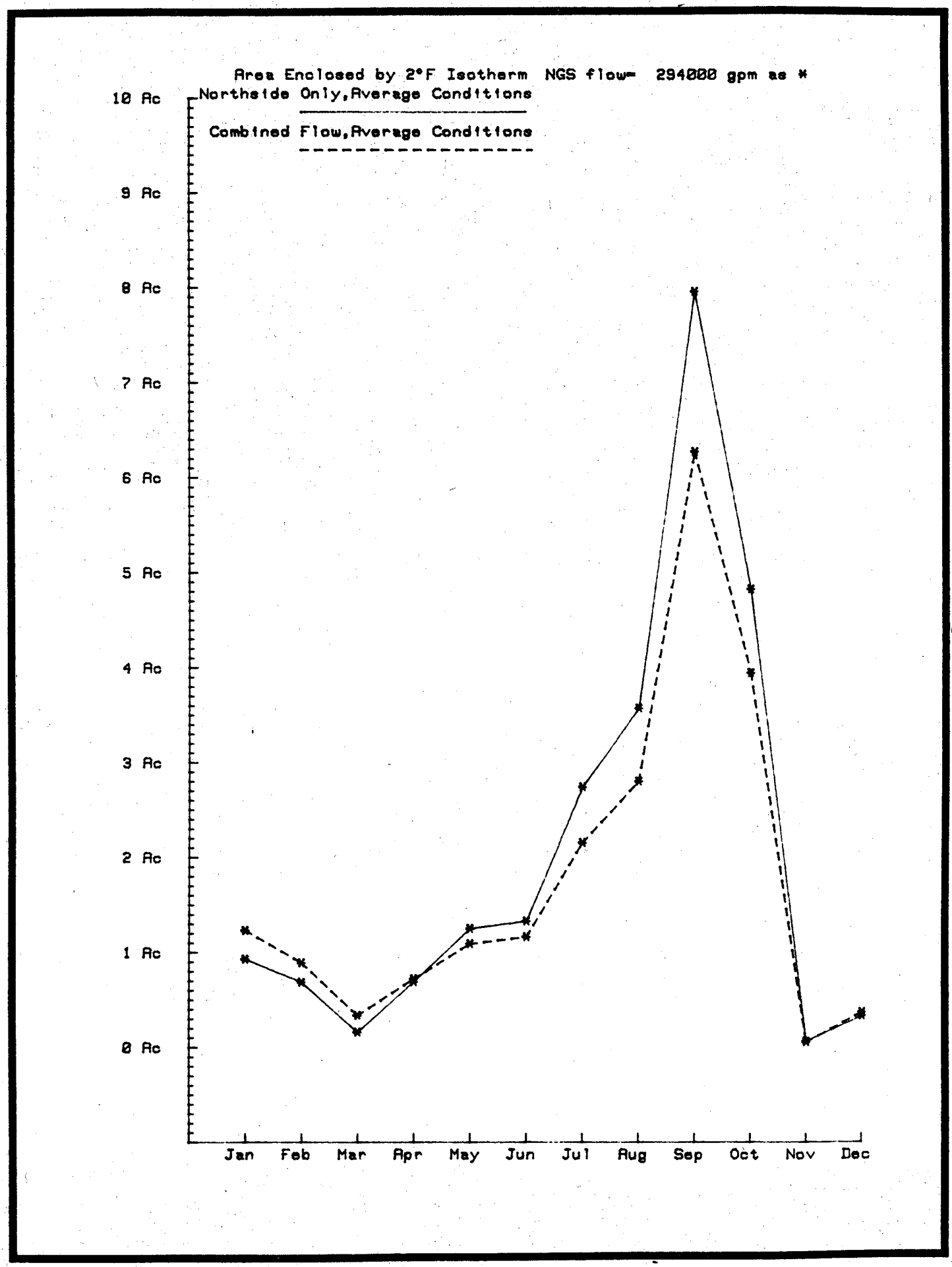


Figure C-27 Predicted Plume Area of 2 Degree F Isotherm One Meter Depth-Average Case-Mode 2

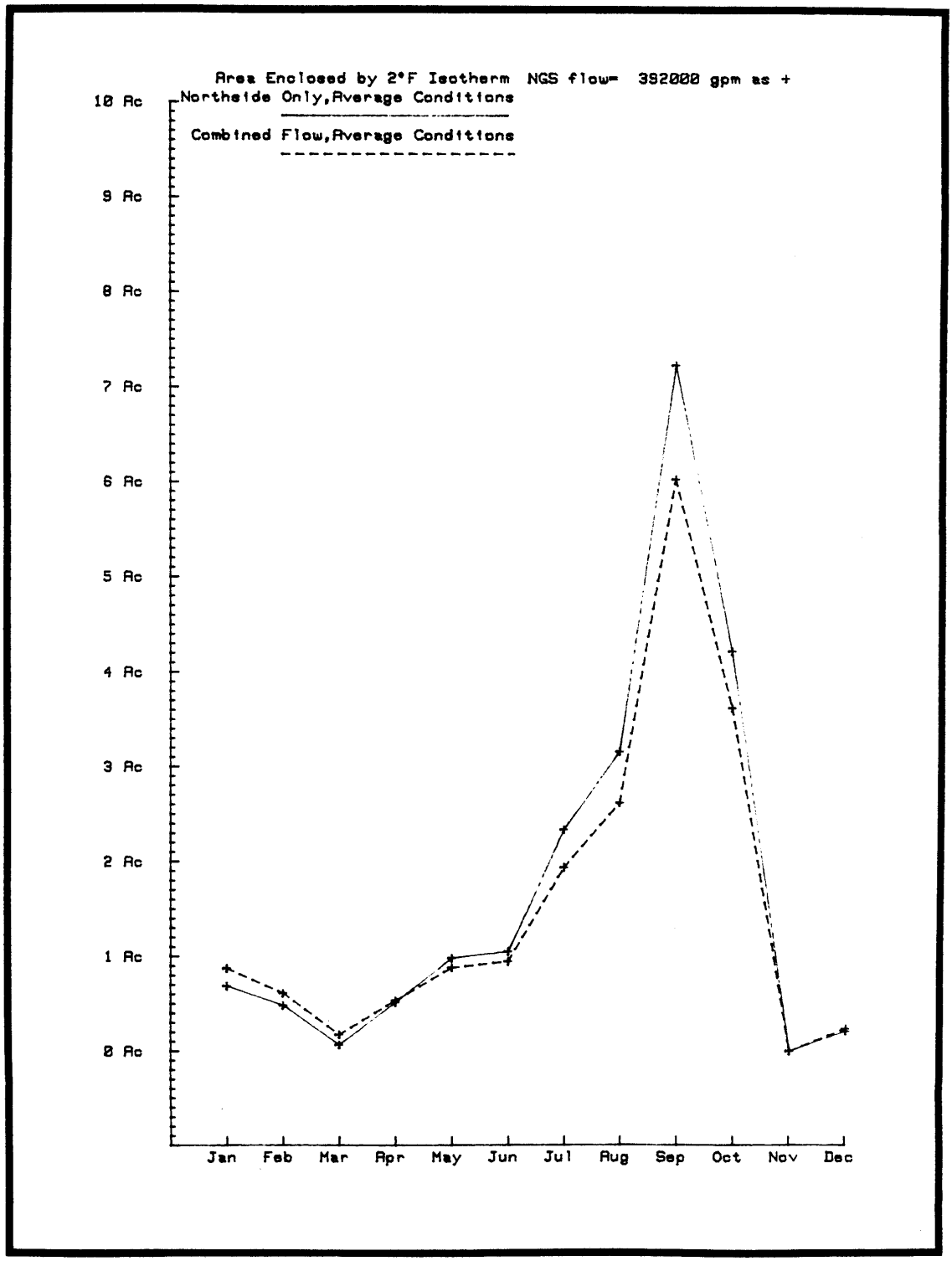


Figure C-28 Predicted Plume Area of 2 Degree F Isotherm One Meter Depth-Average Case-Mode 1

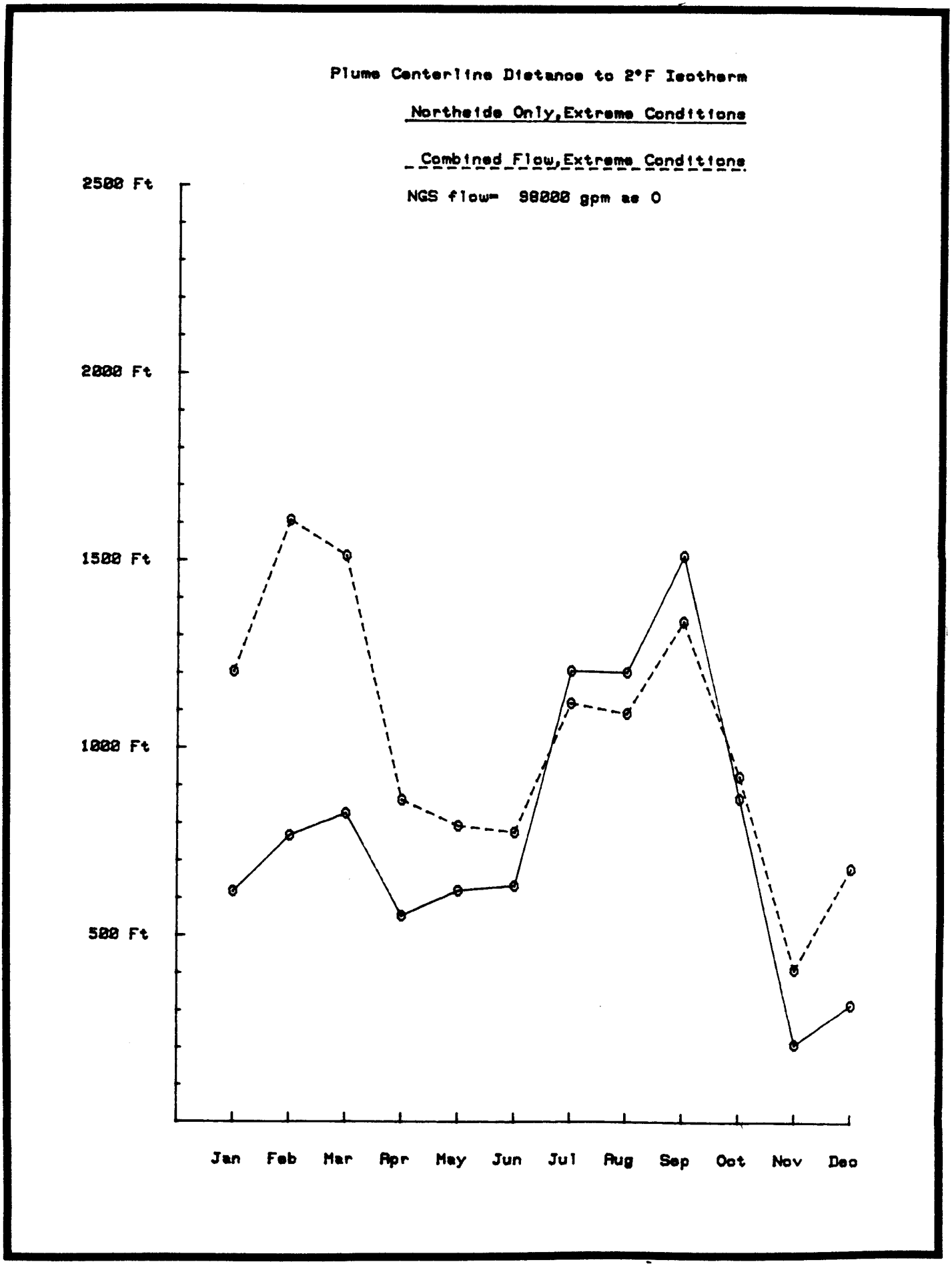


Figure C-29 Predicted Plume Centerline Distance to 2 Degree F Isotherm One Meter Depth-Extreme Case-Mode 4

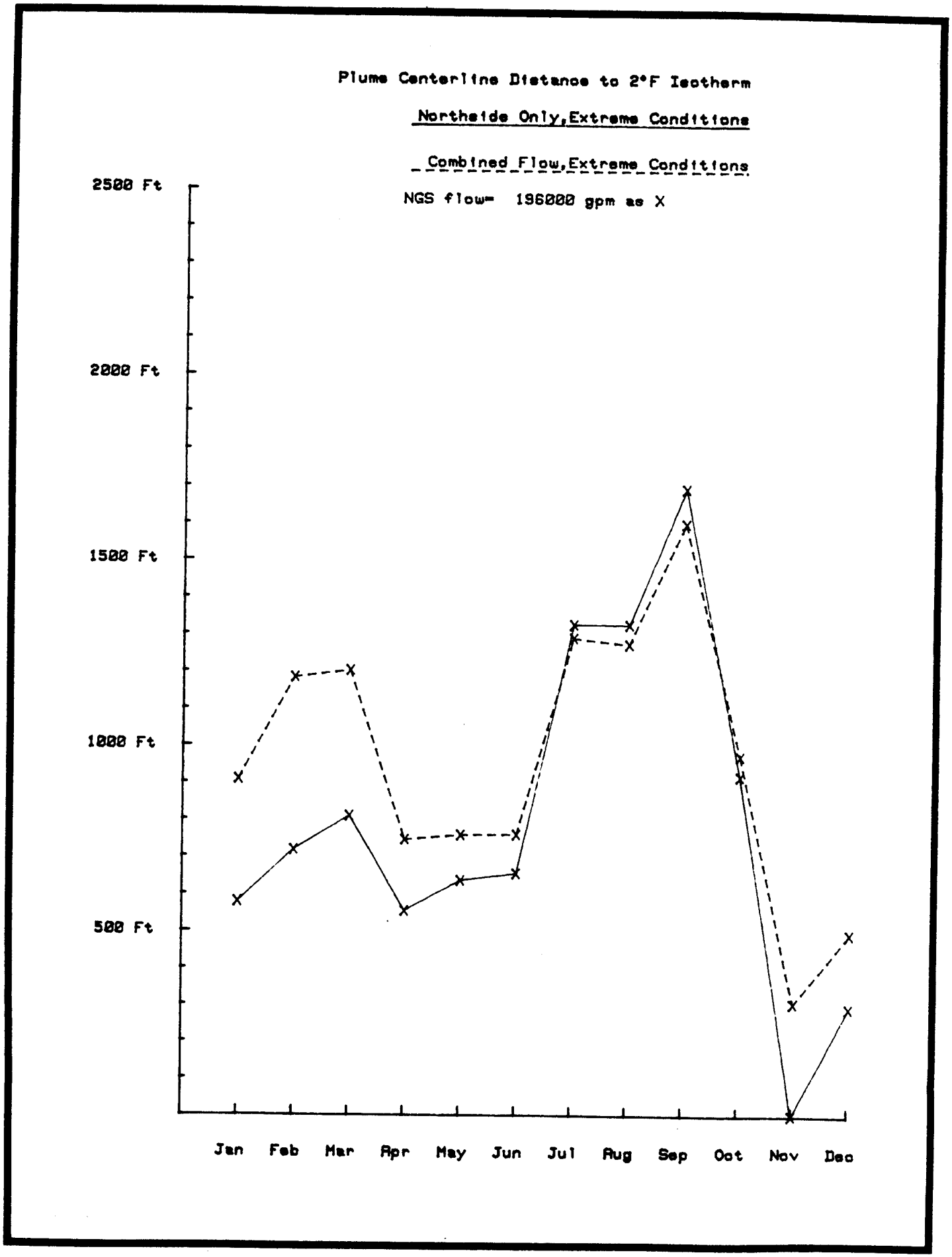


Figure C-30 Predicted Plume Centerline Distance to 2 Degree F Isotherm

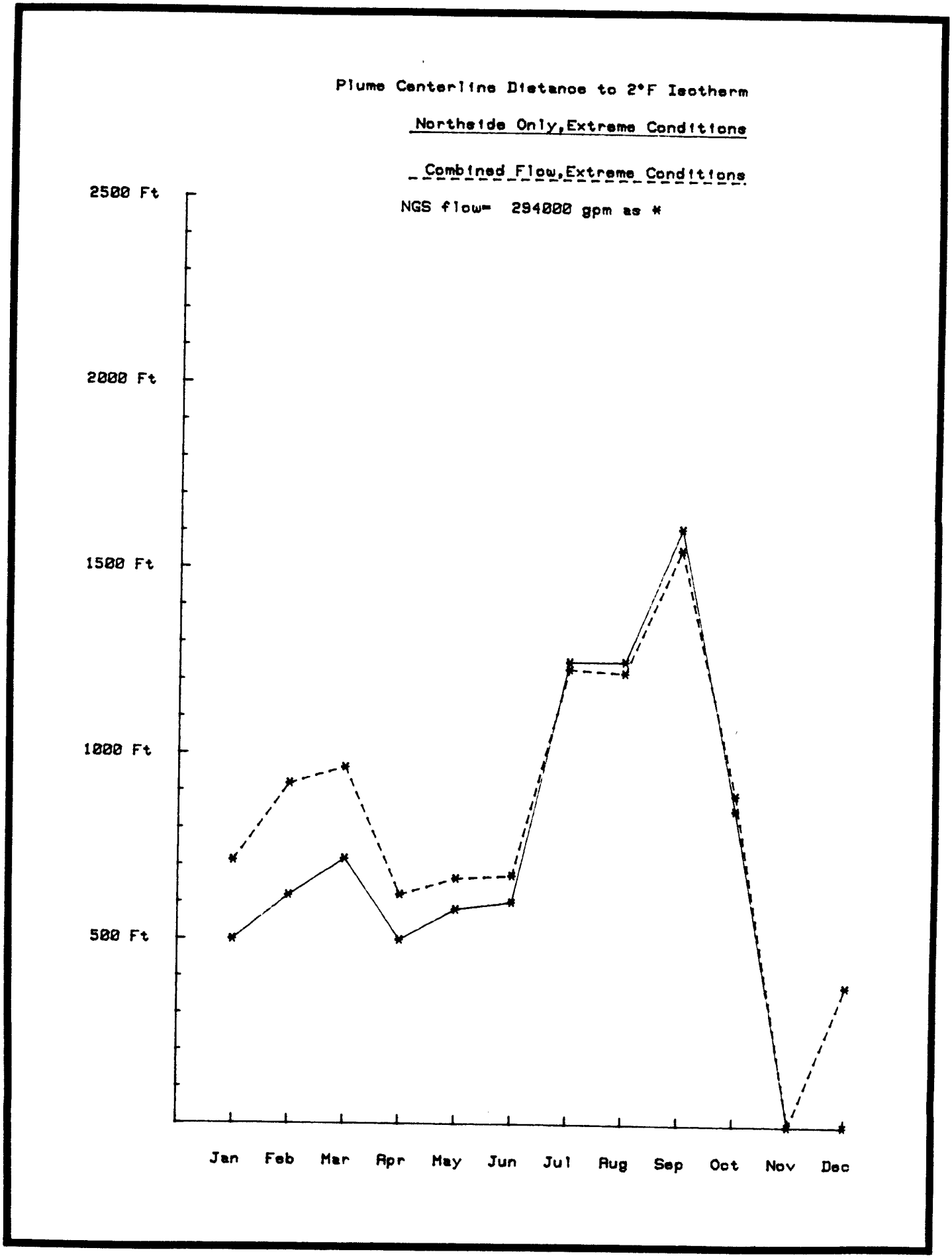


Figure C-31 Predicted Plume Centerline Distance to 2 Degree F Isotherm One Meter Depth-Extreme Case Mode 2

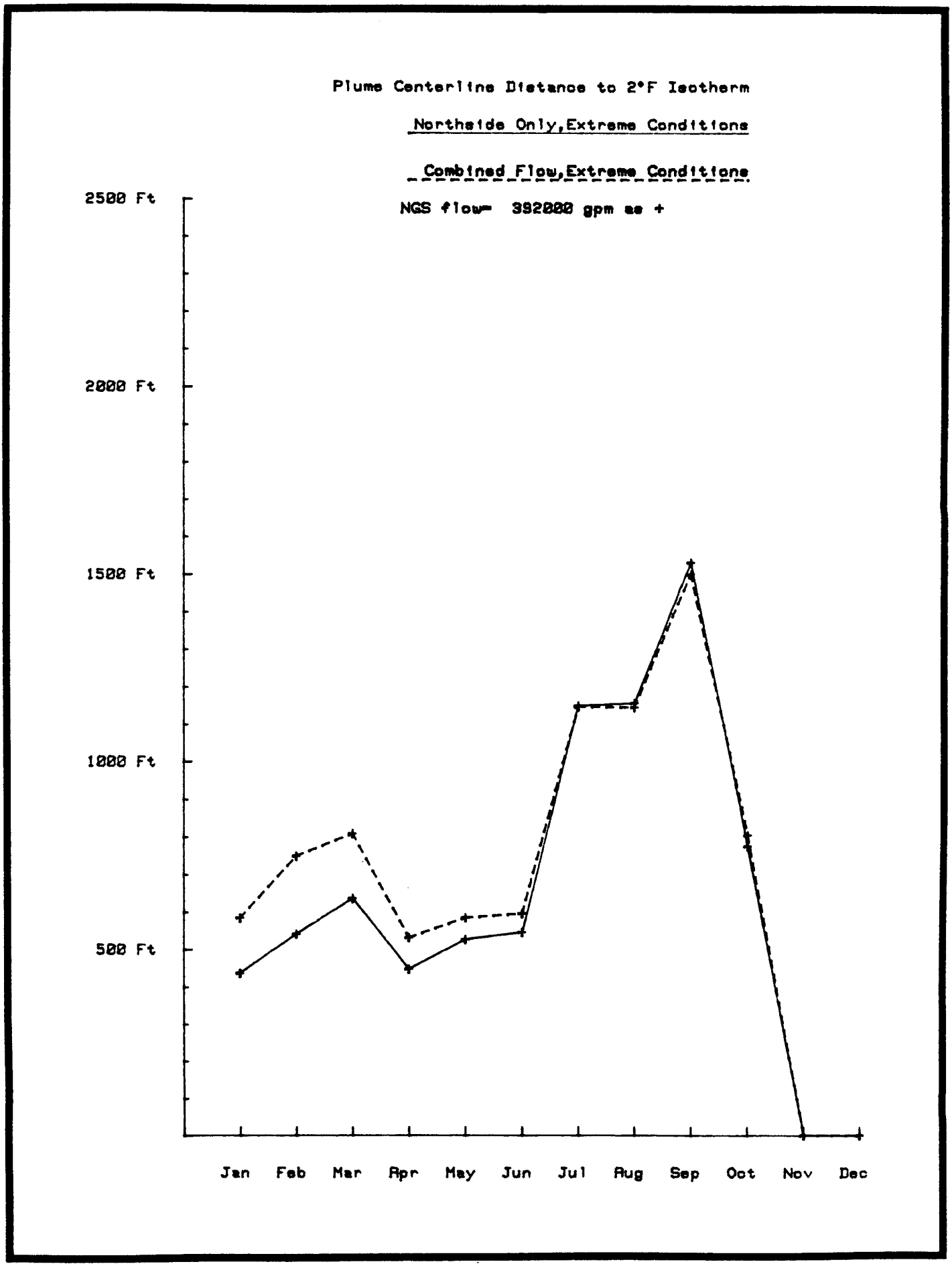


Figure C-32 Predicted Plume Centerline Distance to 2 Degree F Isotherm One Meter Depth-Extreme Case -Mode 1

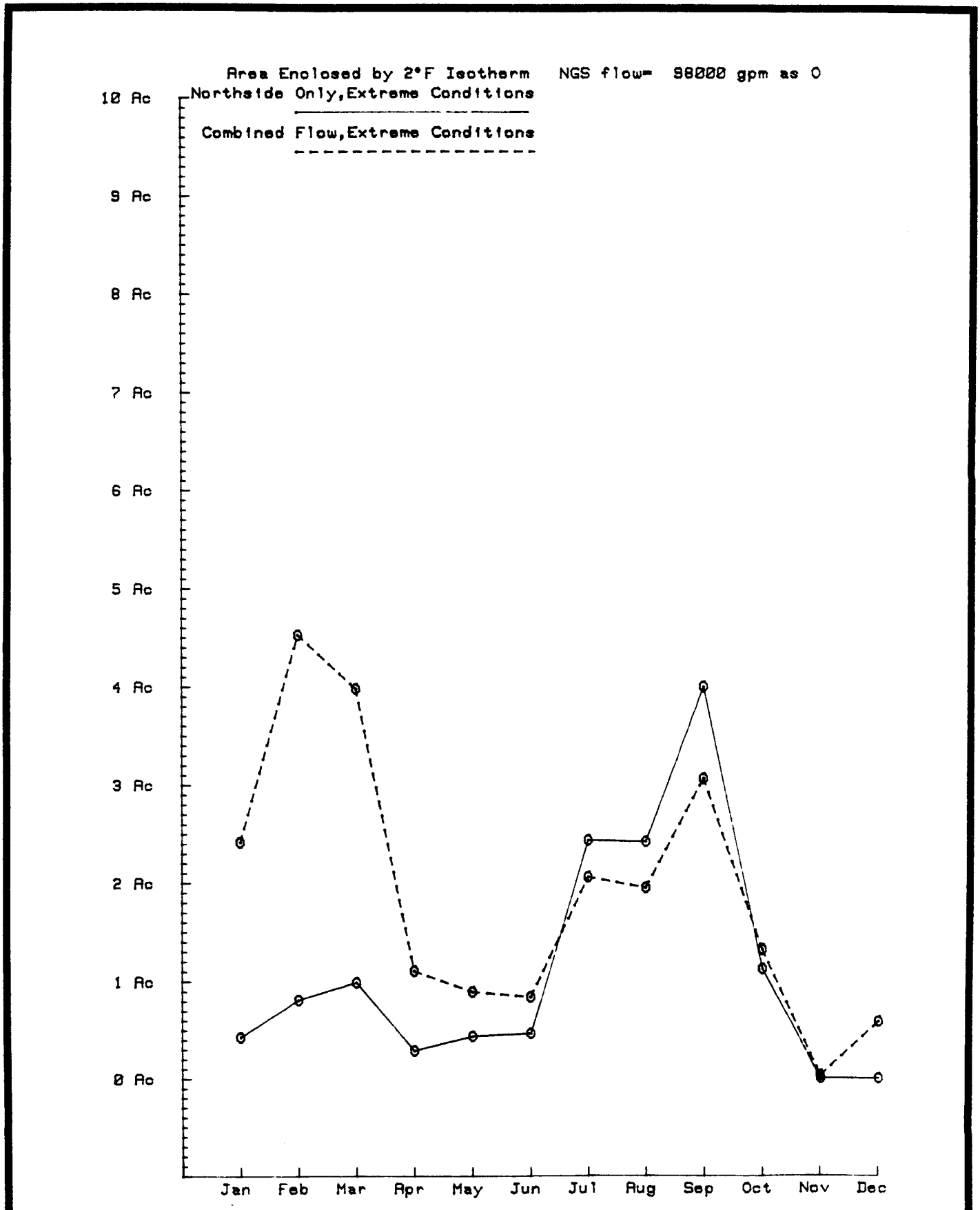


Figure C-33 Predicted Plume Area of 2 Degree F Isotherm One Meter Depth-
Extreme Case-Mode 4

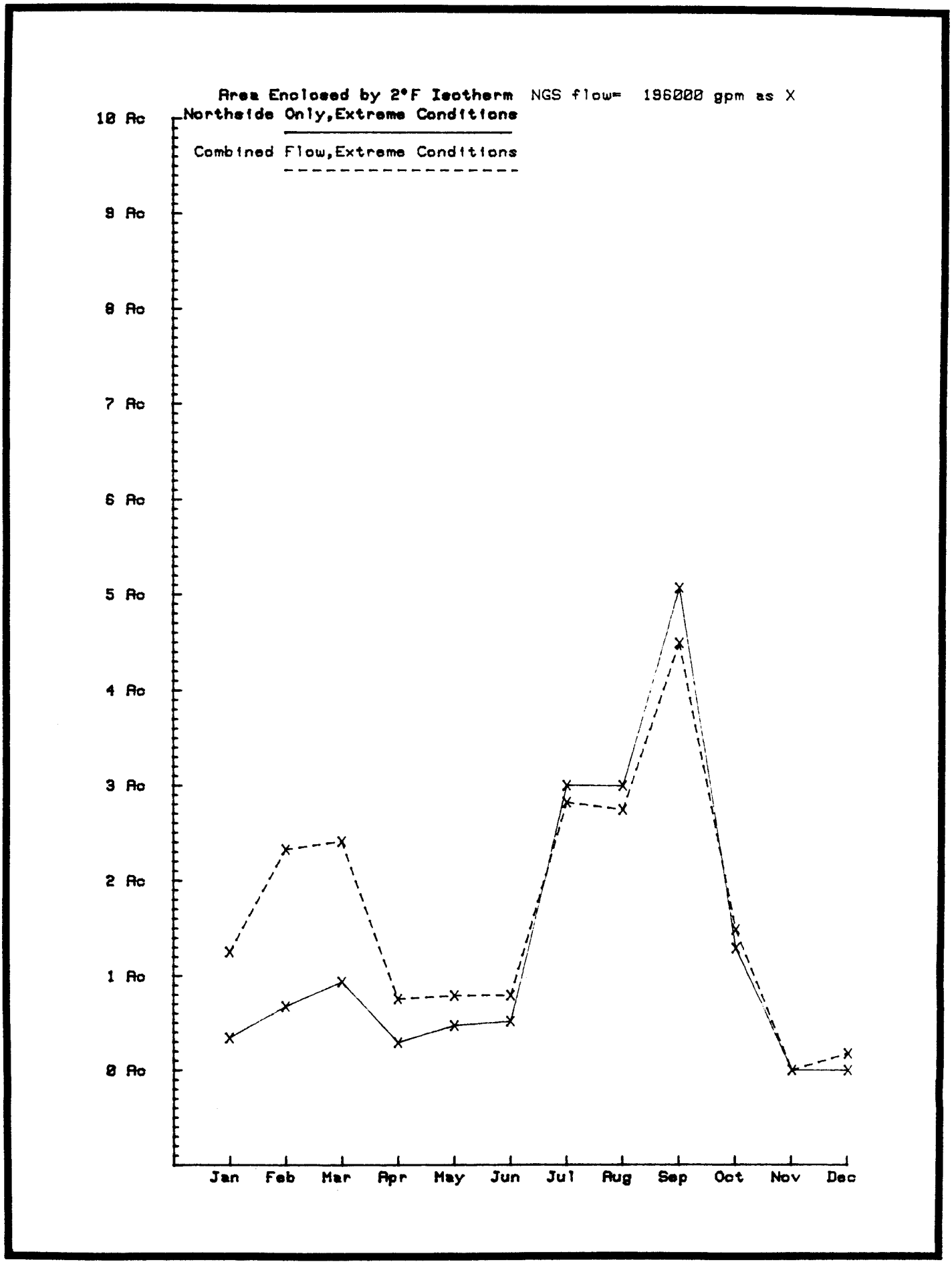


Figure C-34 Predicted Plume Area of 2 Degree F Isotherm One Meter Depth-

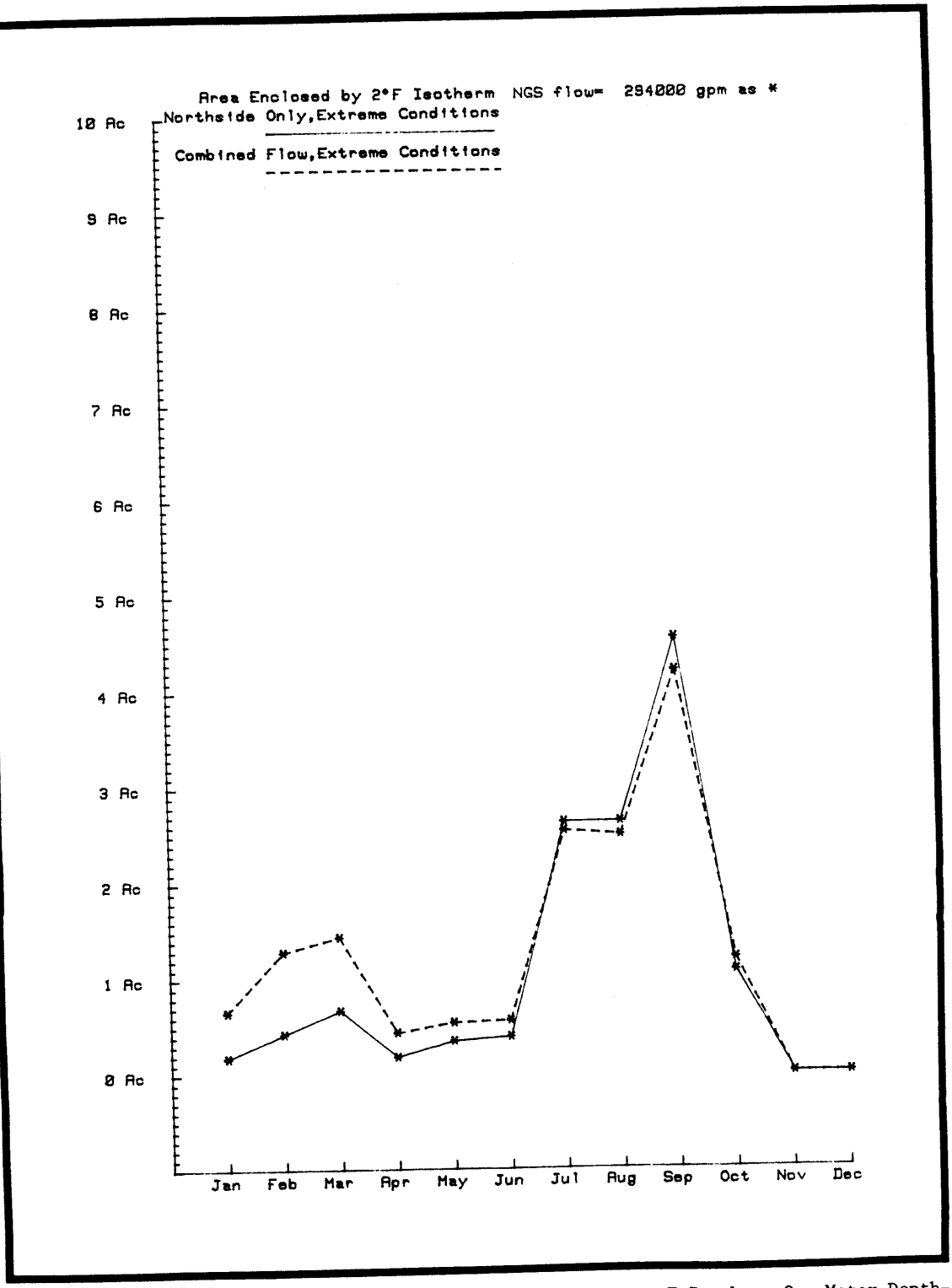


Figure C-35 Predicted Plume Area of 2 Degree F Isotherm One Meter Depth-Extreme Case-Mode 2

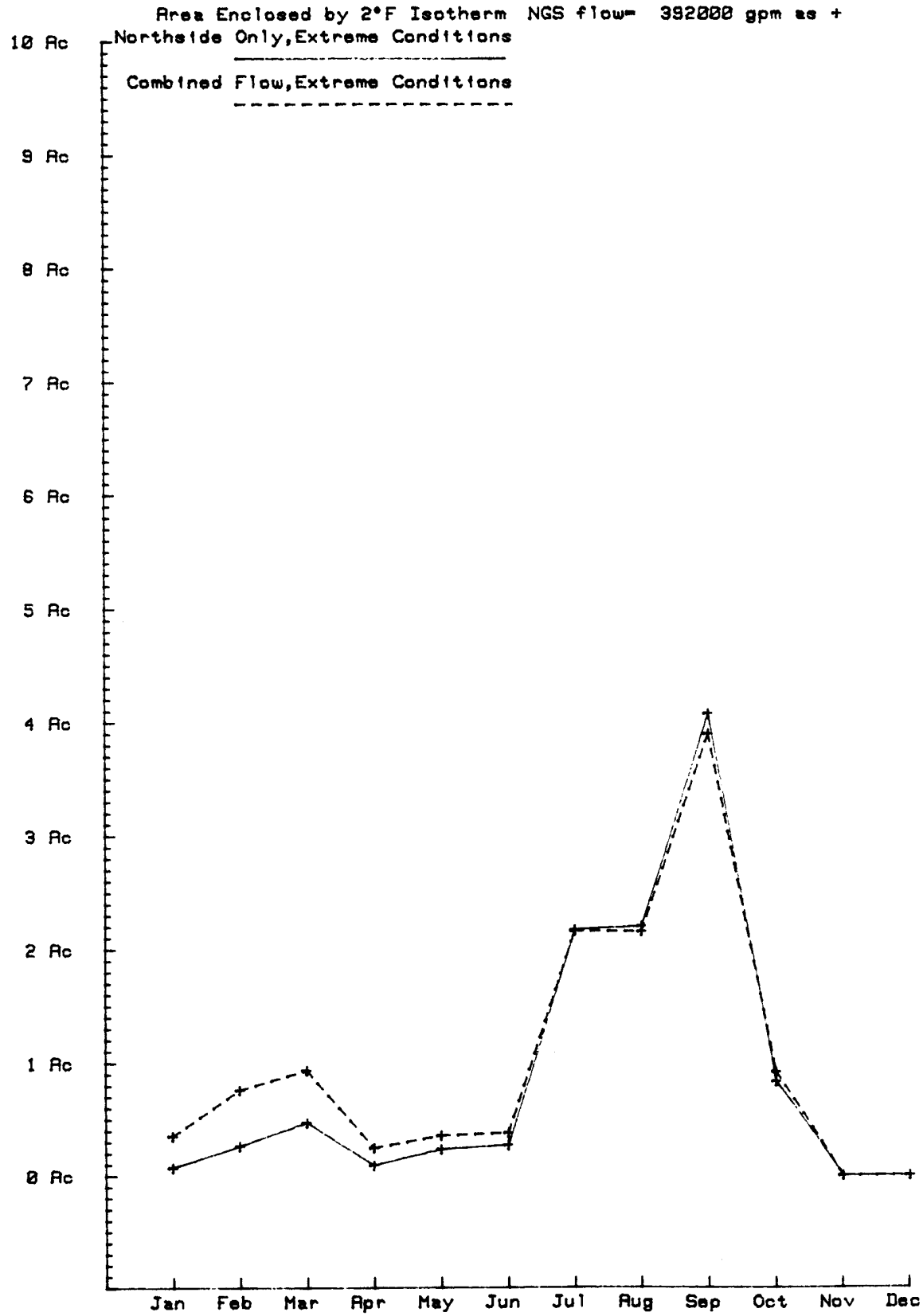


Figure C-36 Predicted Plume Area of 2 Degree F Isotherm One Meter Depth-Extreme Case-Mode 1

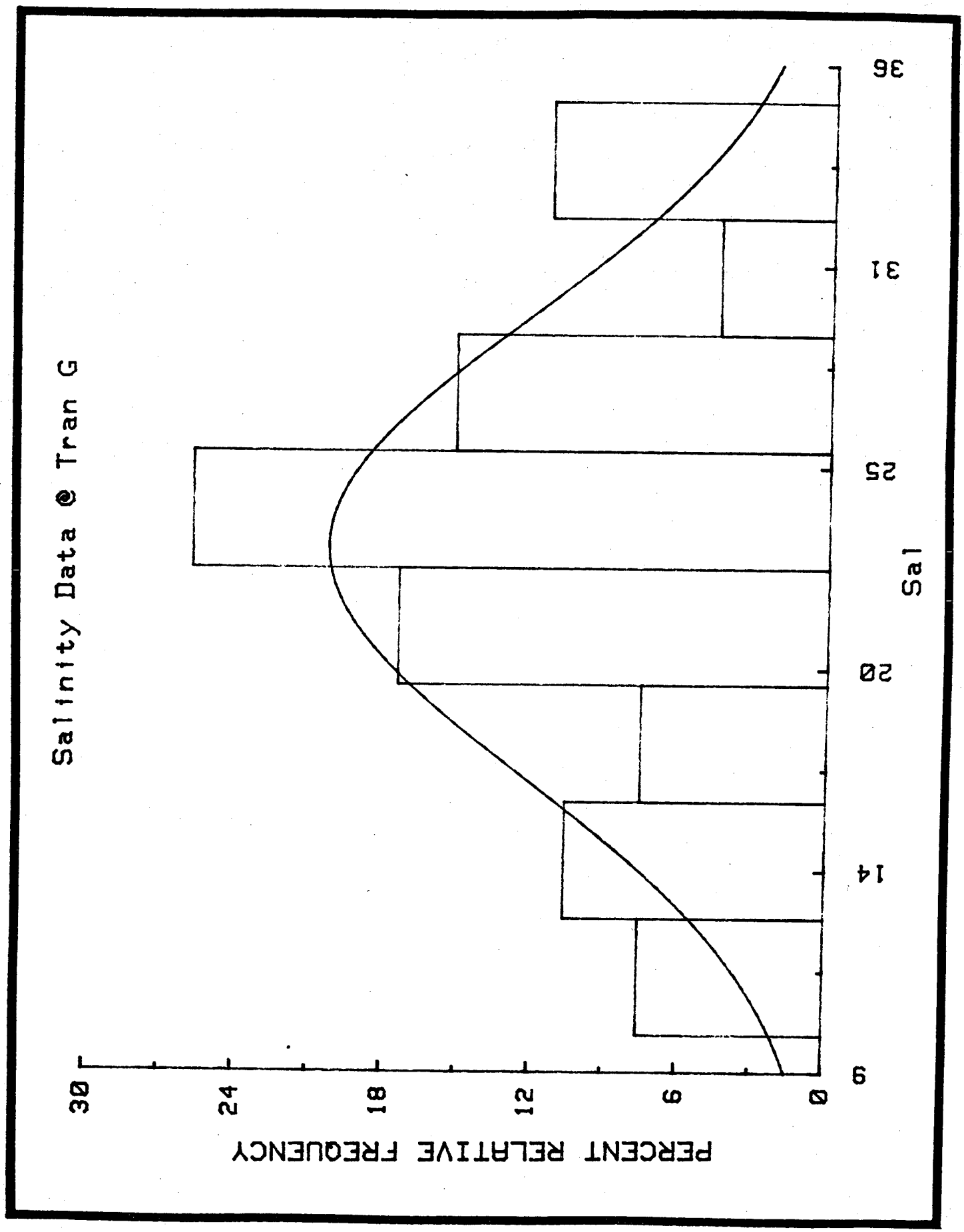


Figure C-37 Percent Relative Frequency of Salinity at Transect G

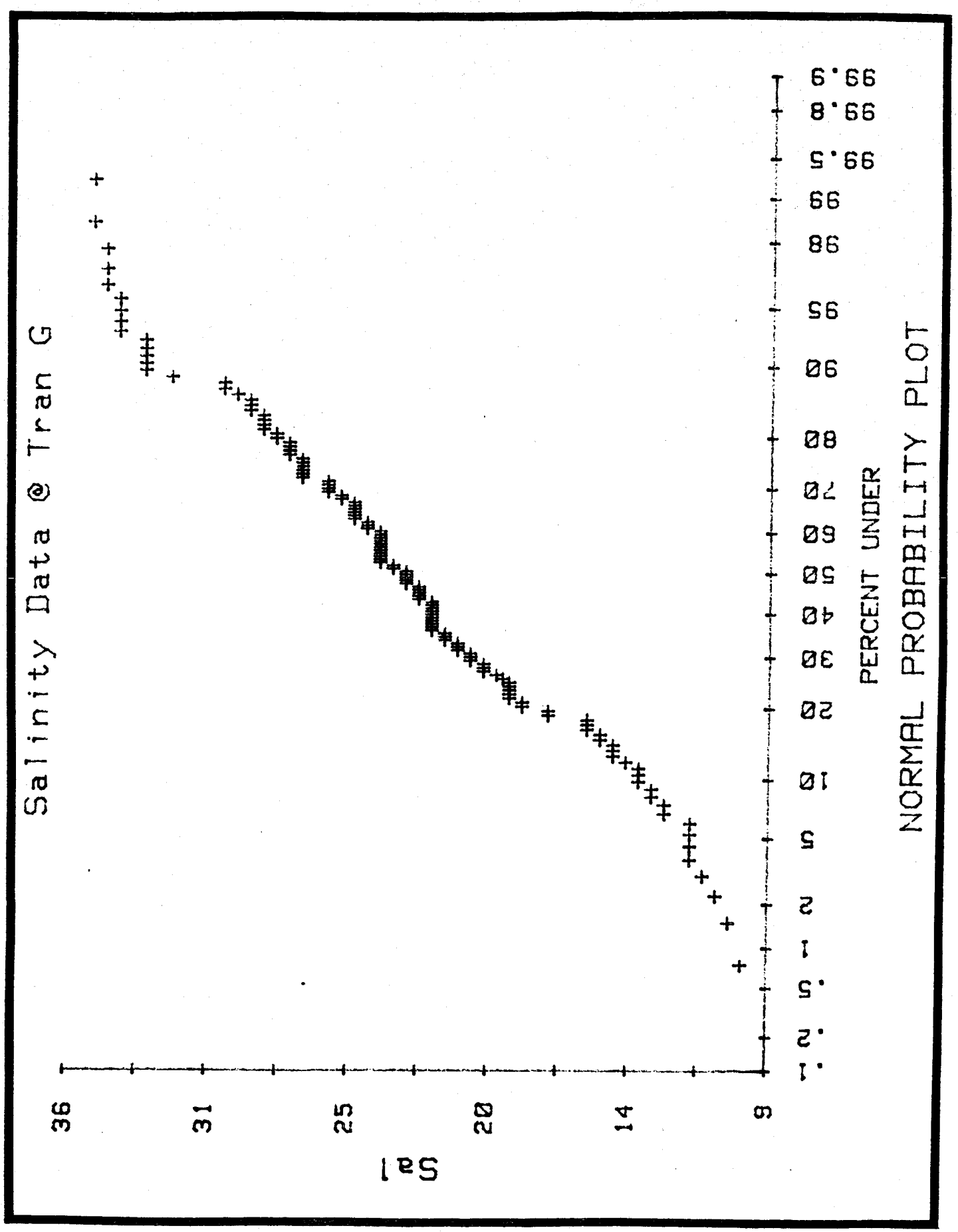


Figure C-38 Normal Probability Plot of Salinity at Transect G

Figure C-39 Schematic of Proposed Plant as Used in CHEMG Model

NOTES:

A. Ax, Bx, and Cx are zones enclosing predicted maximum areas of equal dilution (see Table C-39). The method used to estimate each zone is presented in Appendix C-6

B. Subscript "e" is estimated zone during ebb tide; while, subscript "f" is estimated zone during flood tide.

C. POD is existing point of discharge to St. Johns River.

Figure C-40 Estimated Boundaries of Mixing Zones in St. Johns River Under Maximum Operating Conditions

NOTES:

A. Ax, Bx, and Cx are zones enclosing predicted maximum areas of equal dilution (see Table C-40). The method used to estimate each zone is presented in Appendix C-6

B. Subscript "e" is estimated zone during ebb tide; while, subscript "f" is estimated zone during flood tide.

C. POD is existing point of discharge to St. Johns River.

Figure C-41 Estimated Boundaries of Mixing Zones in St. Johns River Under Average Operating Conditions

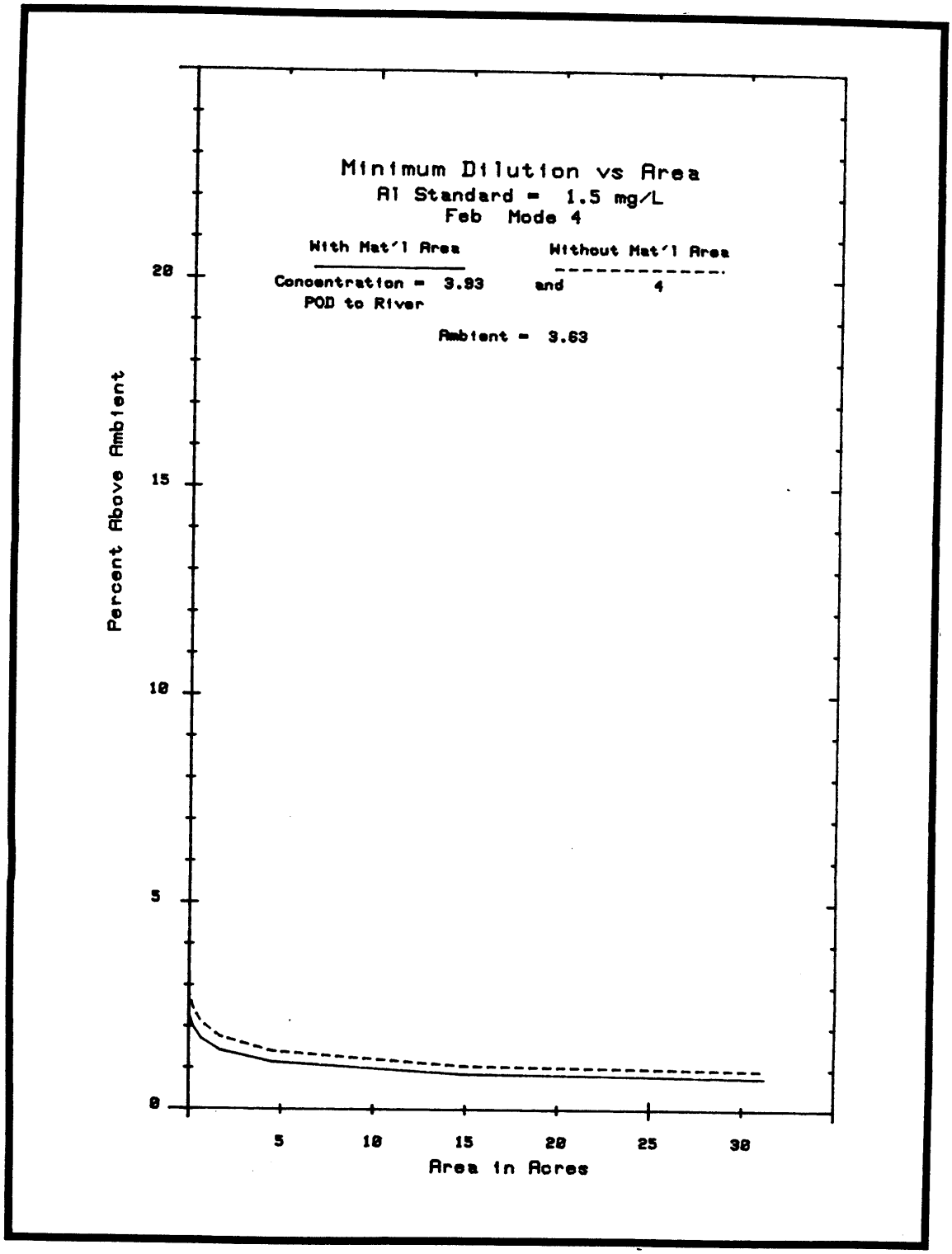


Figure C-42 Predicted Influence of St. Johns River Mixing Zone on Aluminum in Plant Discharge

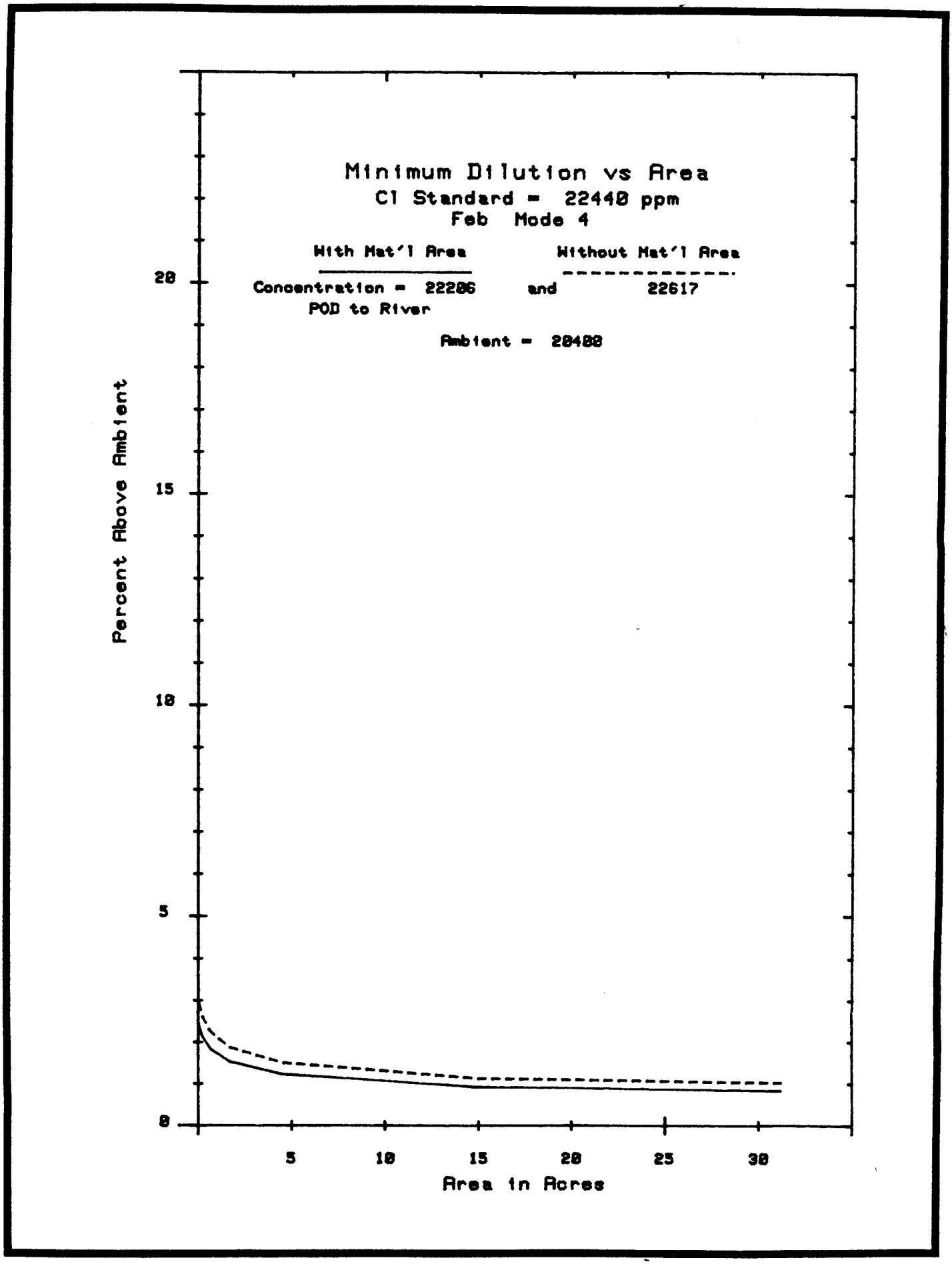


Figure C-43 Predicted Influence of St. Johns River Mixing Zone on Chloride in Plant Discharge

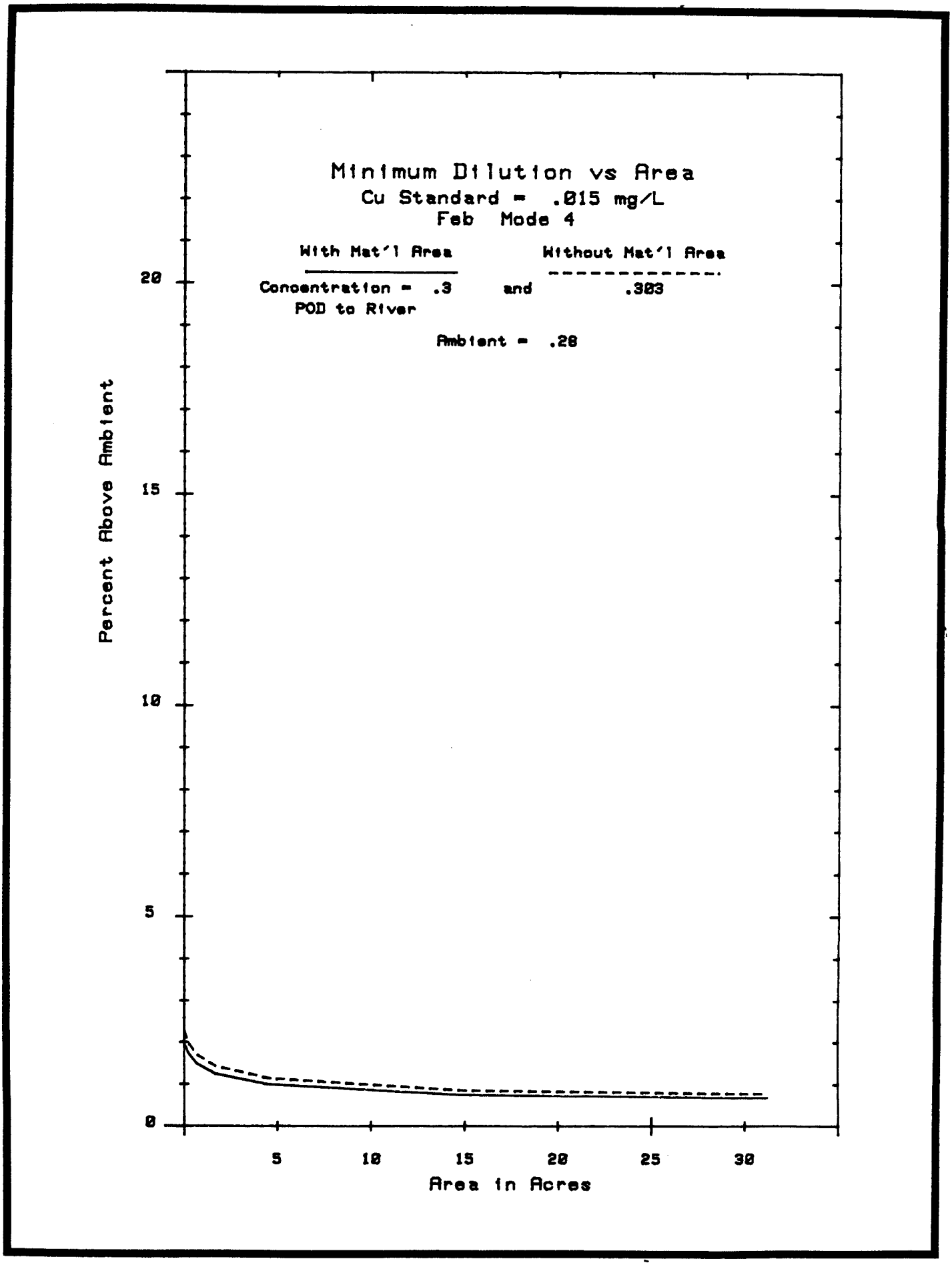


Figure C-44 Predicted Influence of St. Johns River Mixing Zone on Copper in Plant Discharge

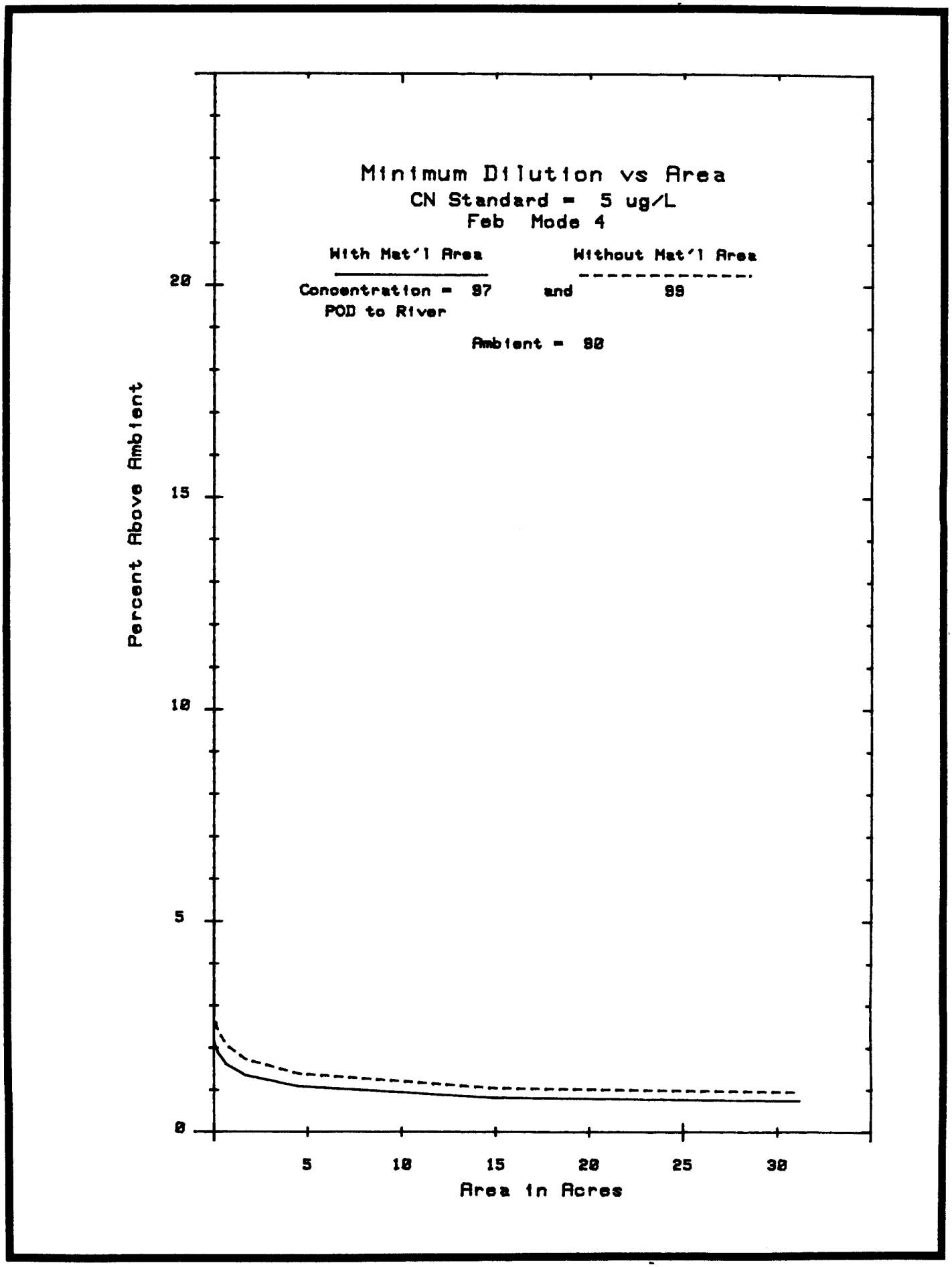


Figure C-45 Predicted Influence of St. Johns River Mixing Zone on Cyanide in Plant Discharge

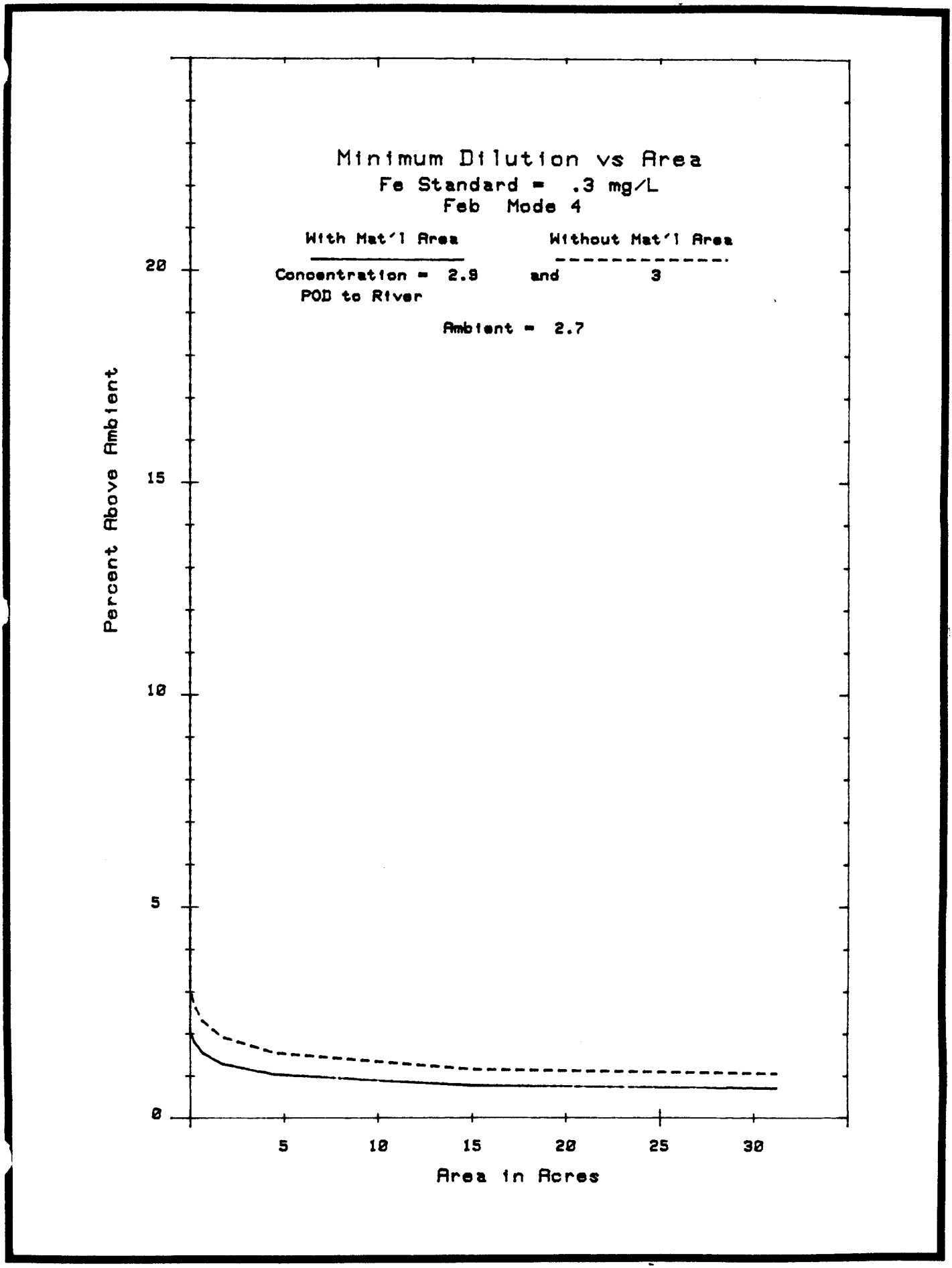


Figure C-46 Predicted Influence of St. Johns River Mixing Zone on Iron in Plant Discharge

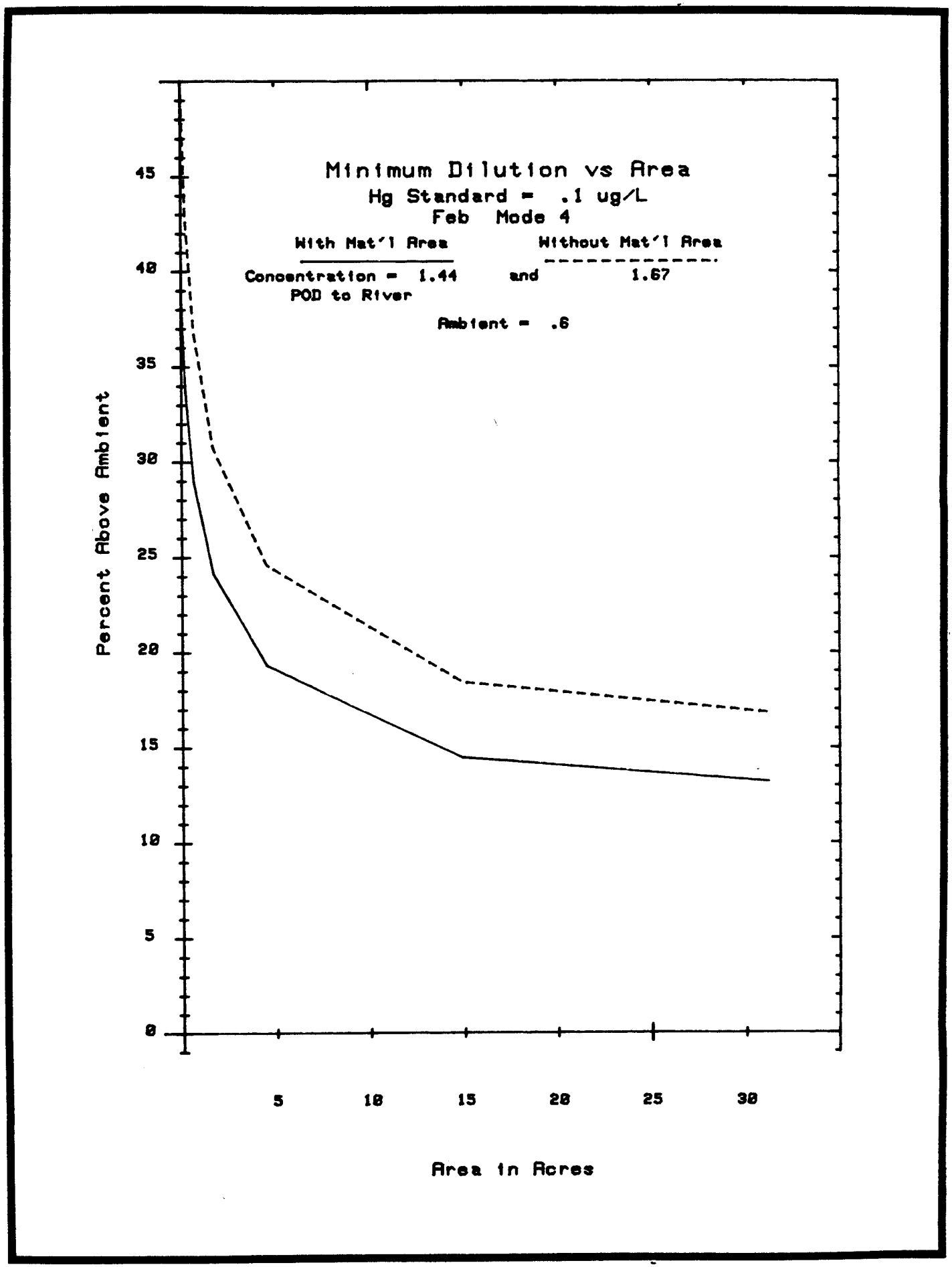


Figure C-47 Predicted Influence of St. Johns River Mixing Zone on Mercury in Plant Discharge

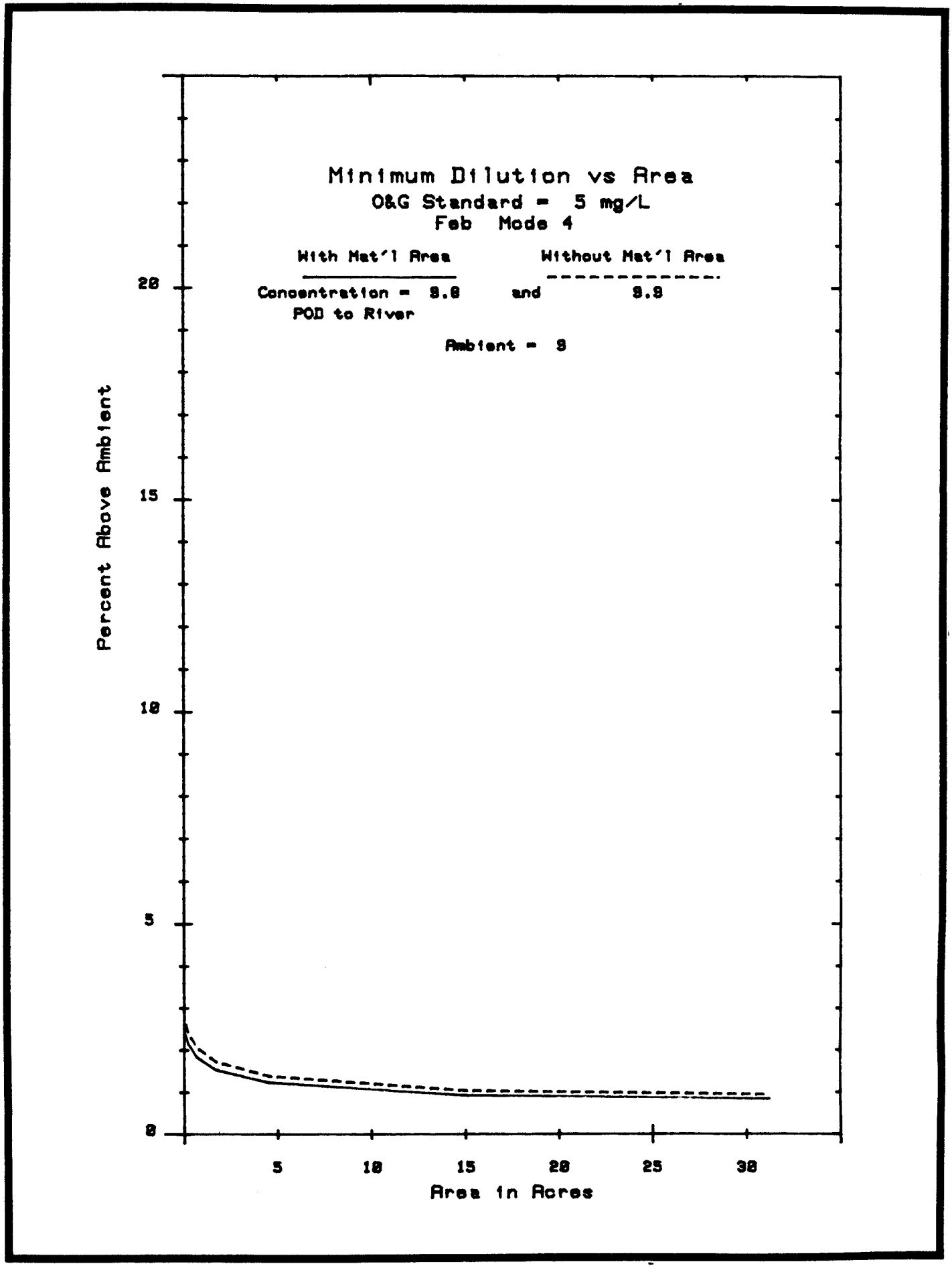


Figure C-48 Predicted Influence of St. Johns River Mixing Zone on Oil and Grease in Plant Discharge

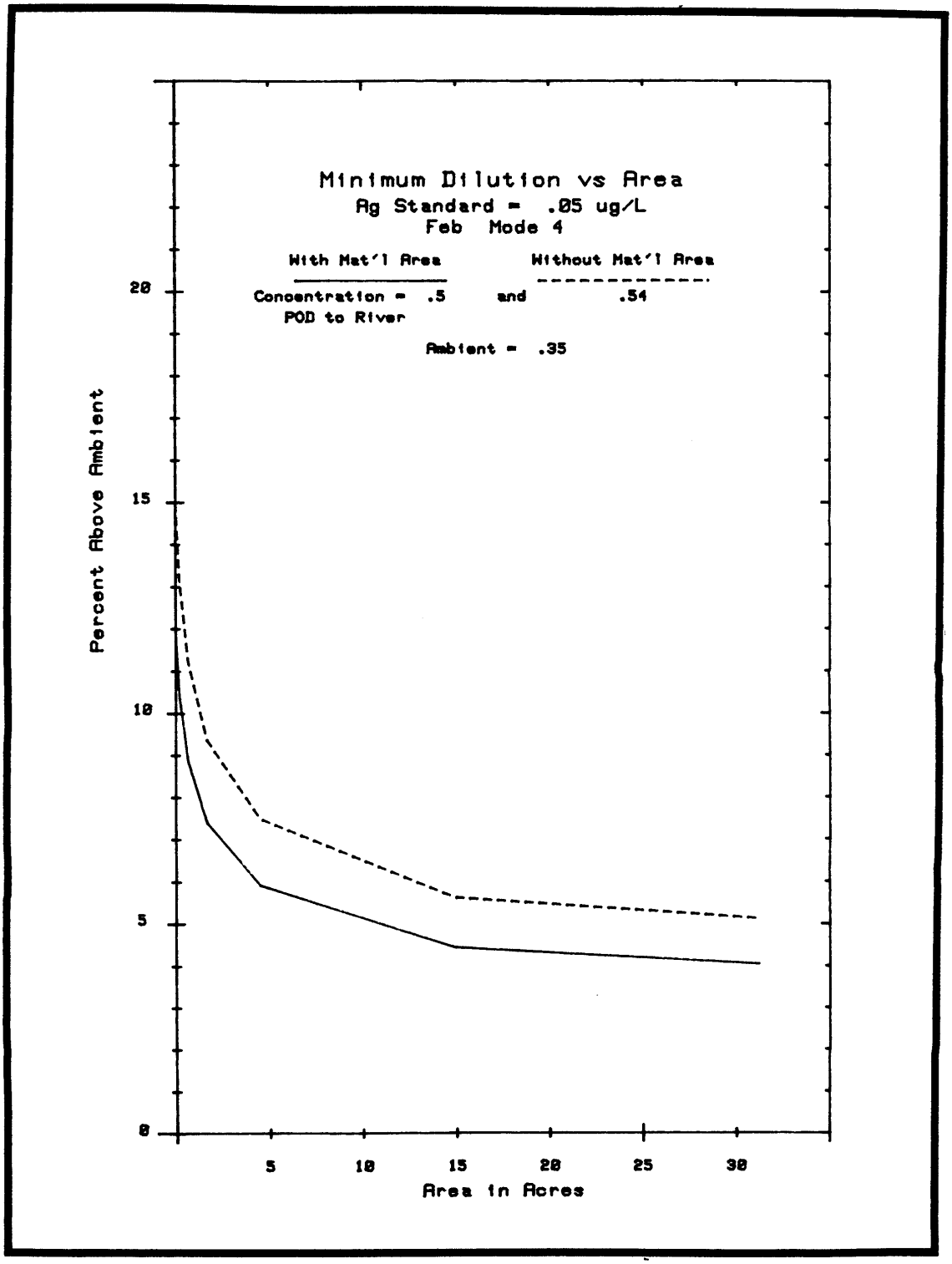


Figure C-49 Predicted Influence of St. Johns River Mixing Zone on Silver in Plant Discharge

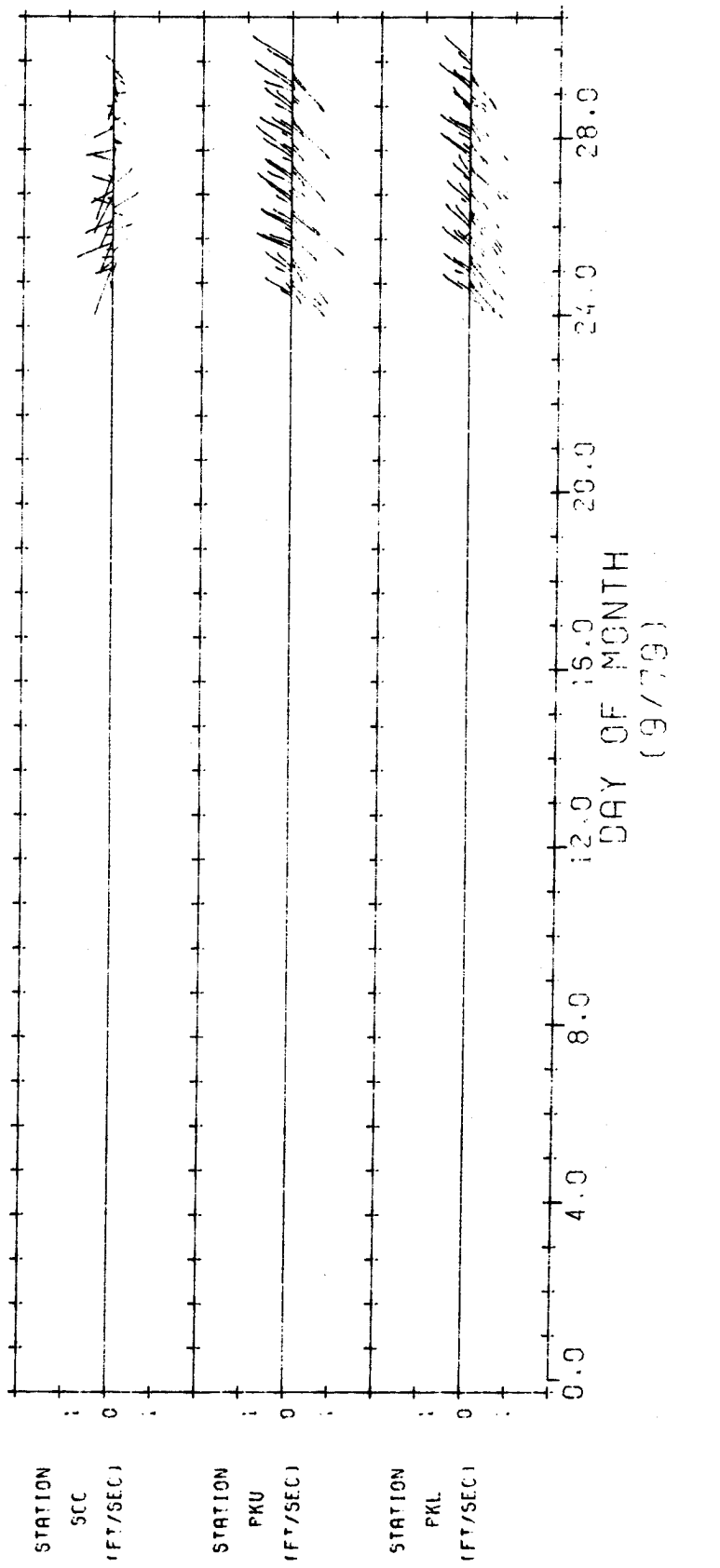
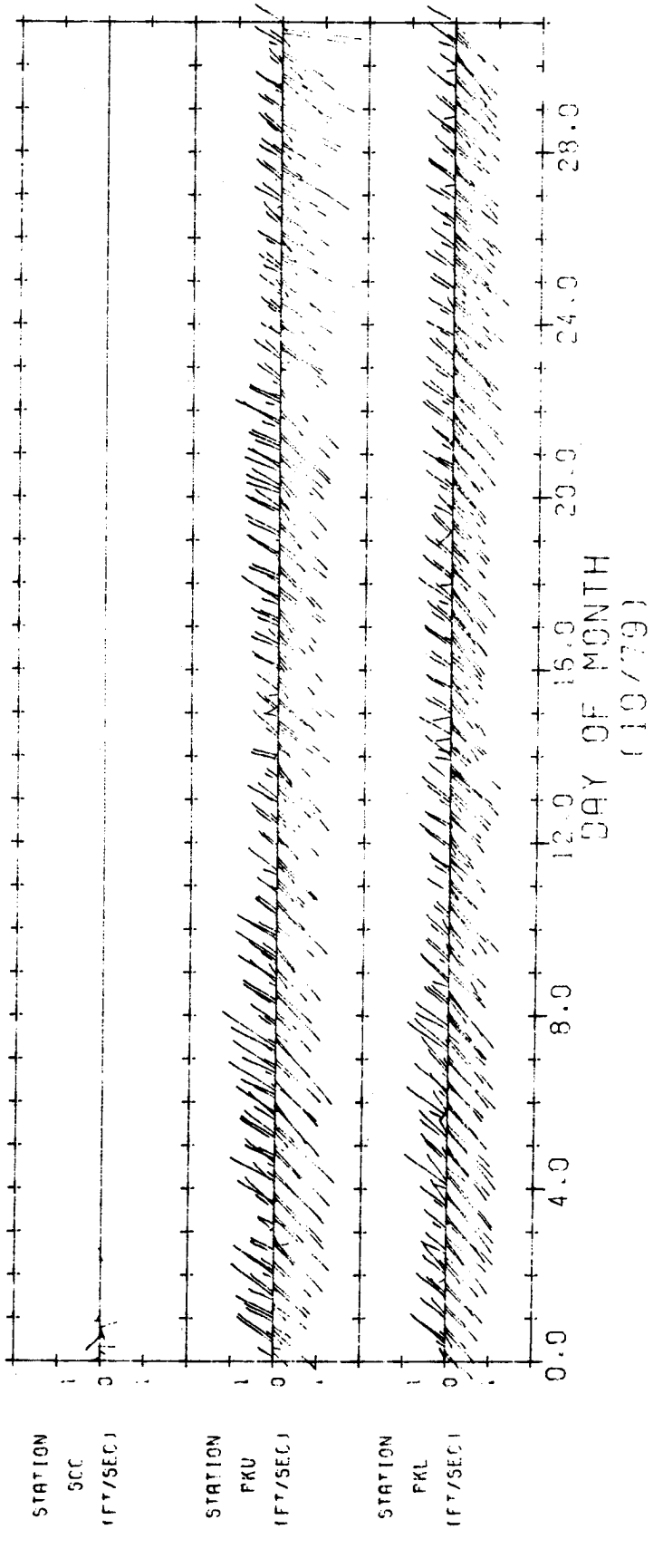


Figure C-50 Current Data - 9/79



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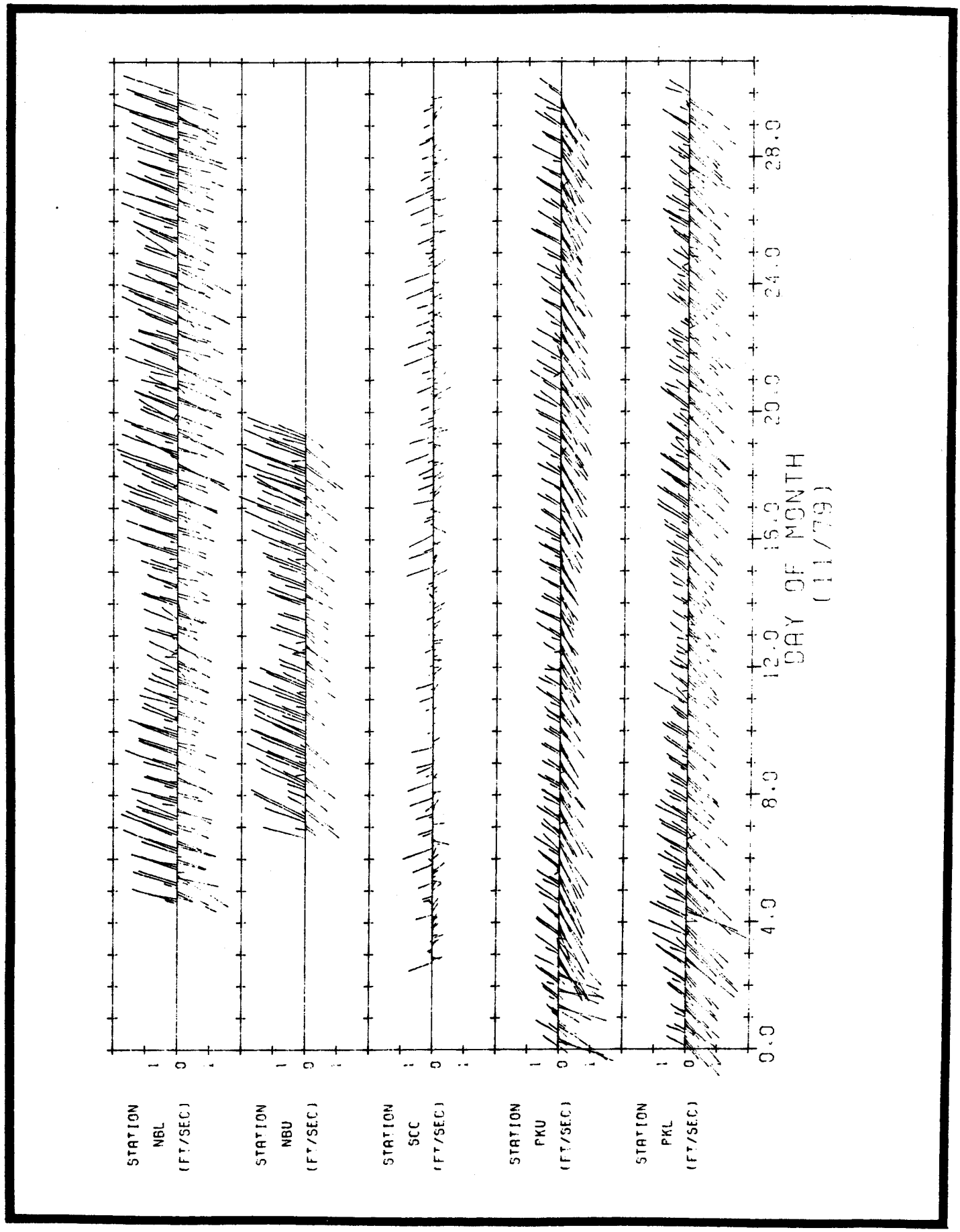

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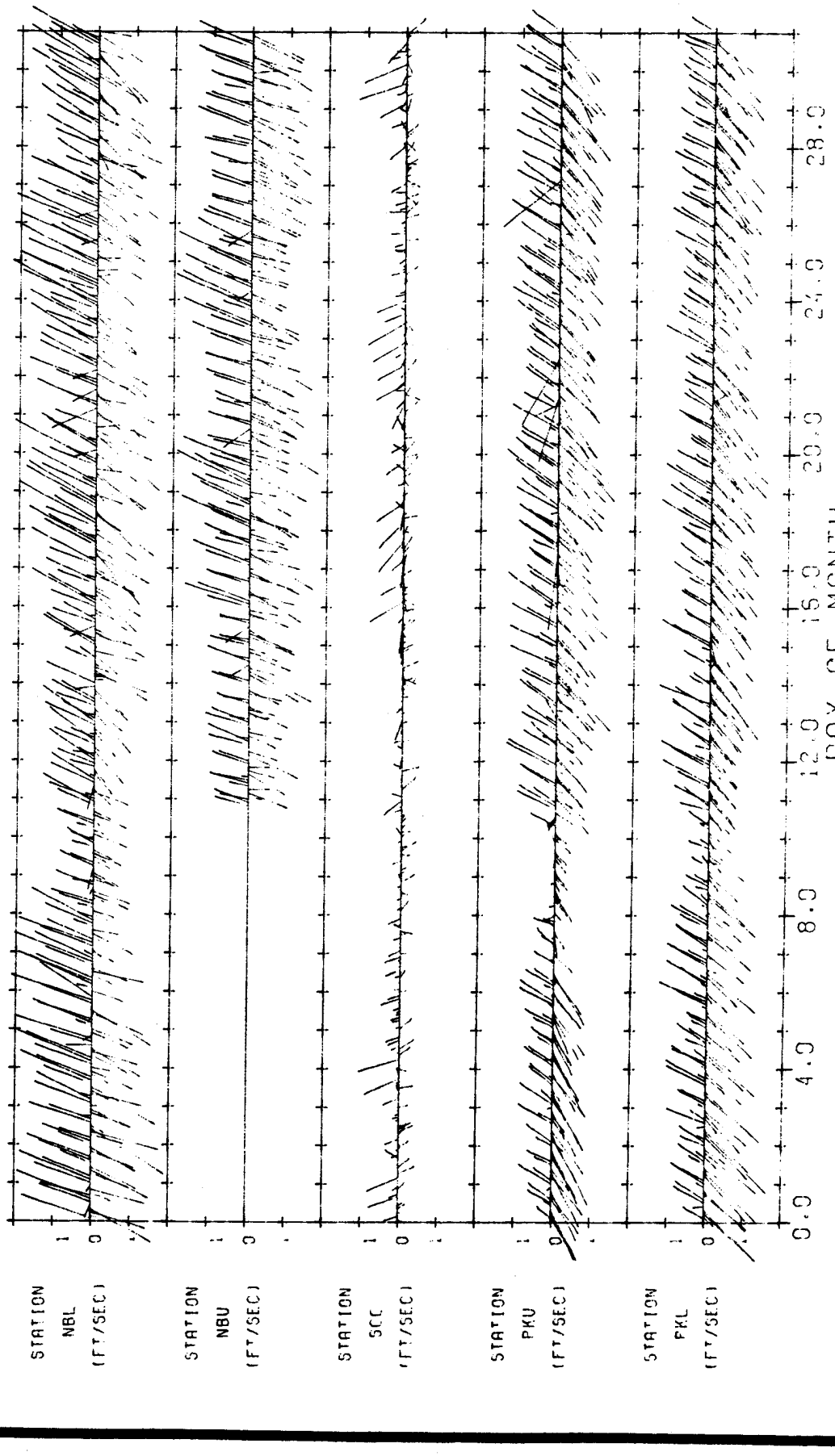


Figure C-53 Current Data - 12/79

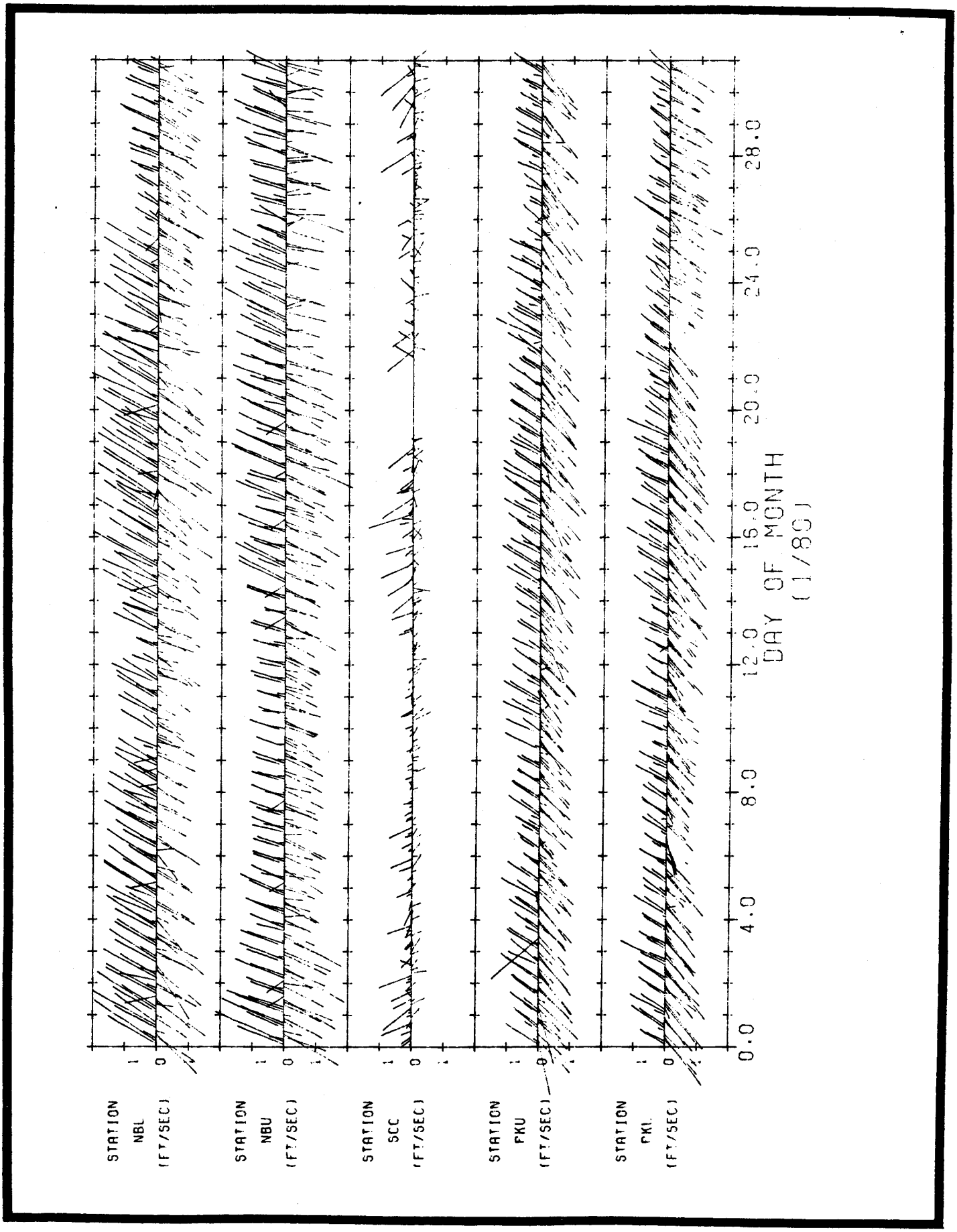
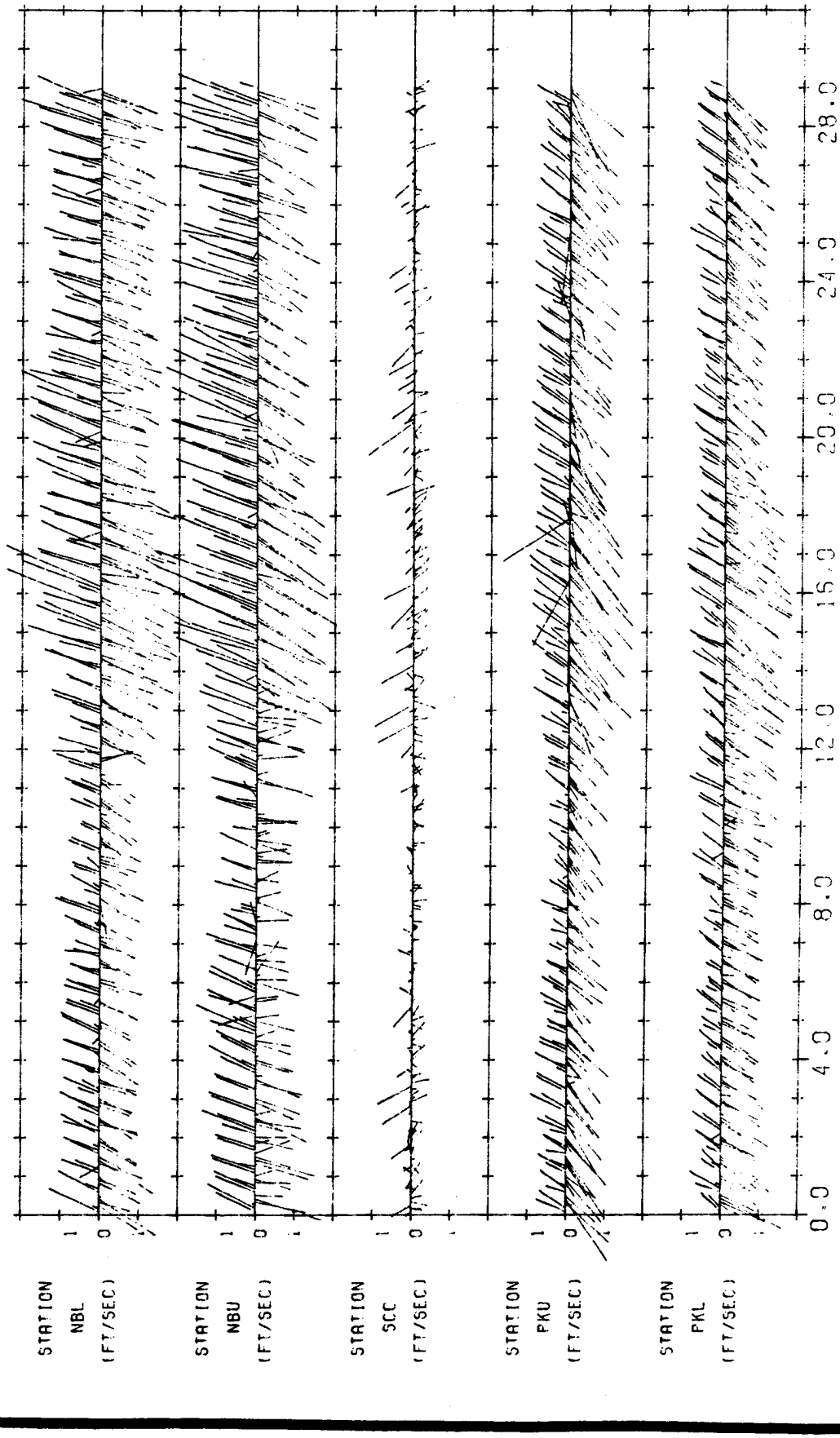


Figure C-54 Current Data - 1/80



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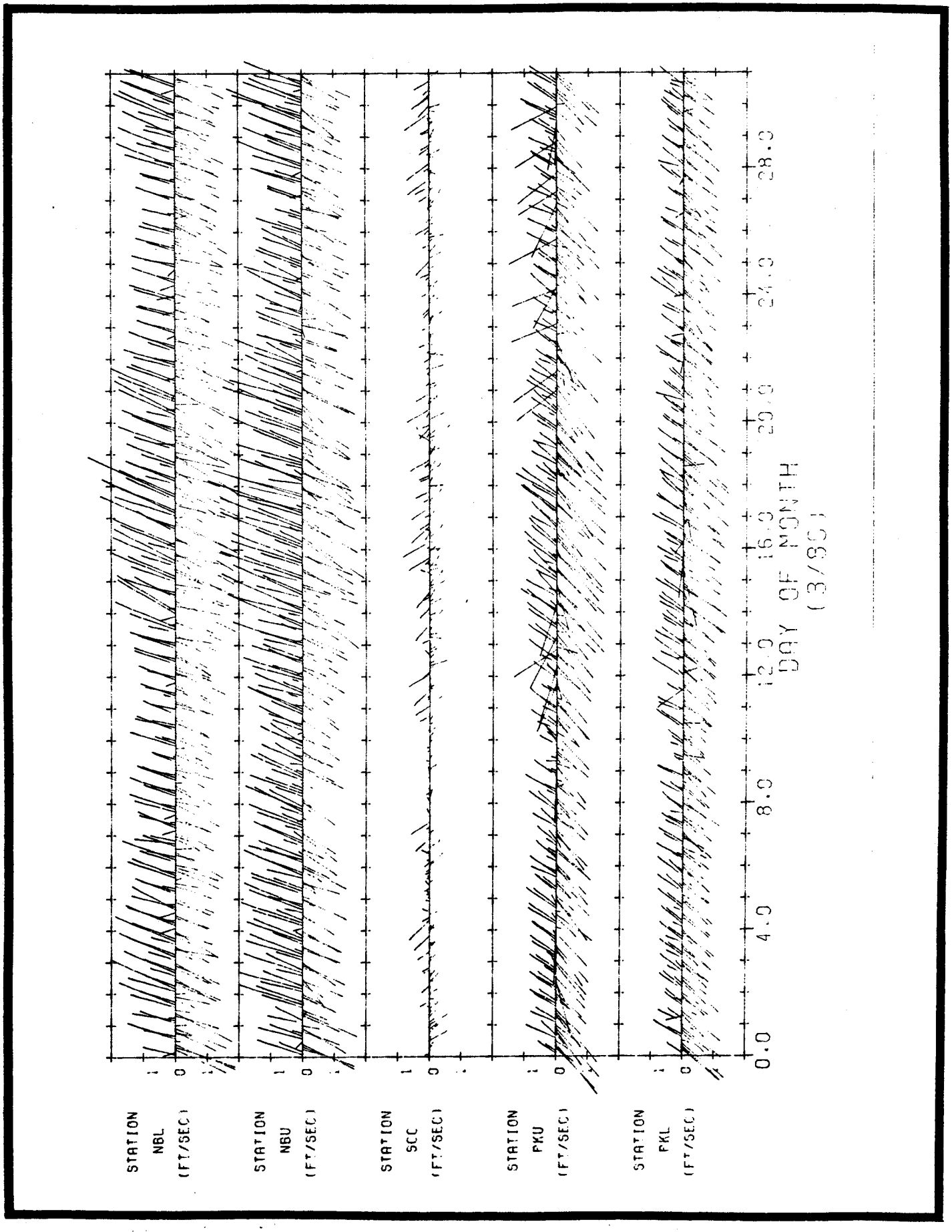

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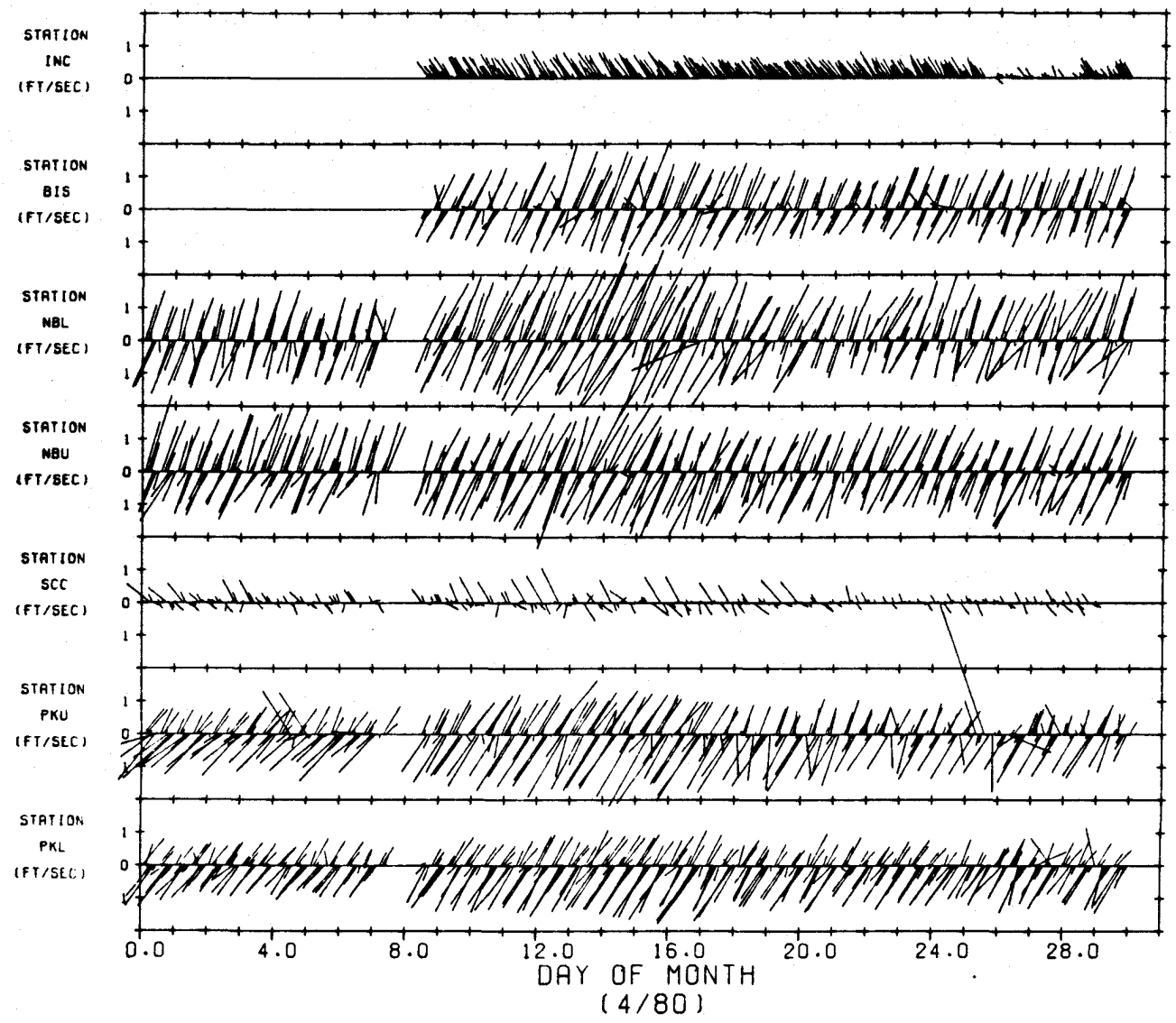

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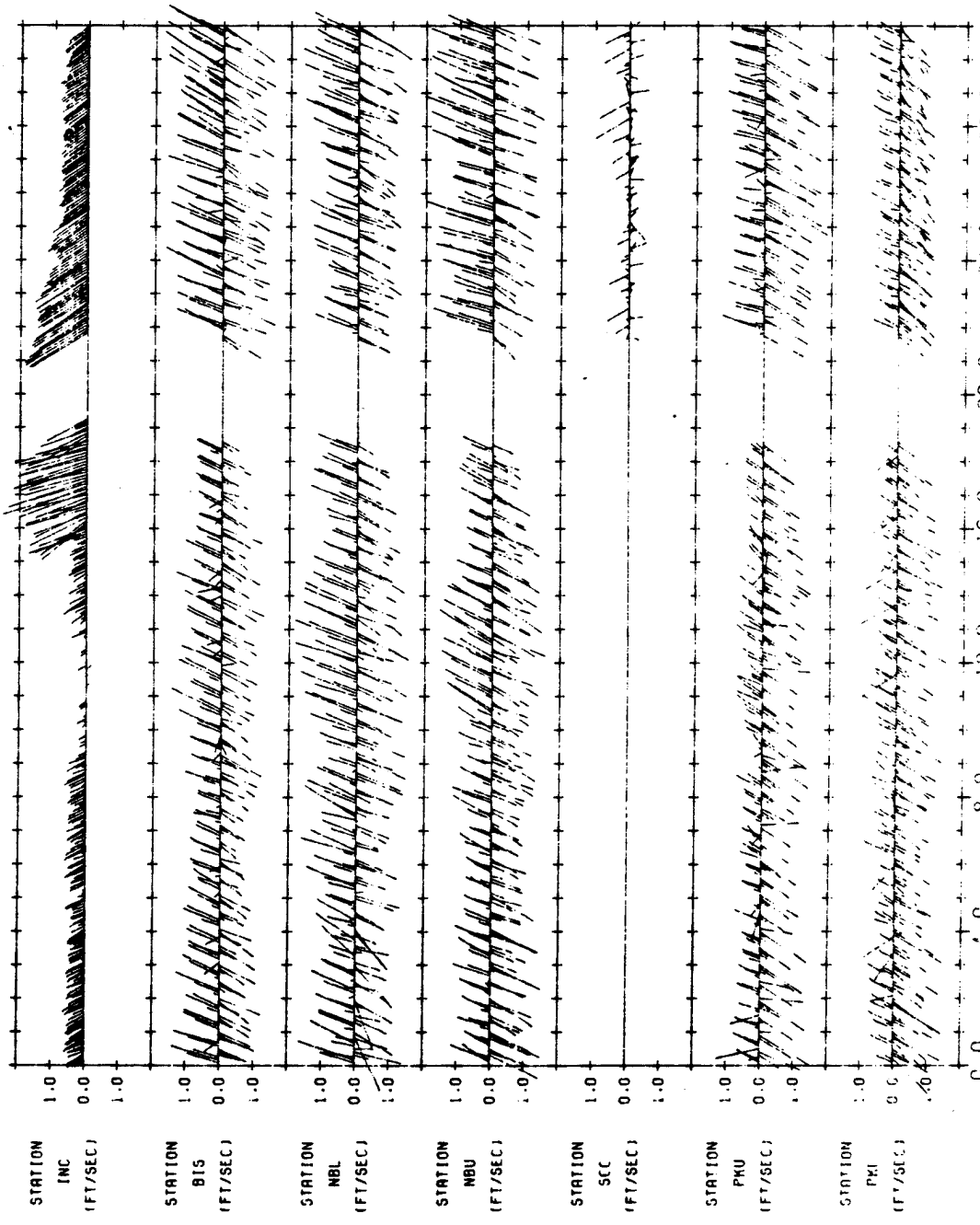

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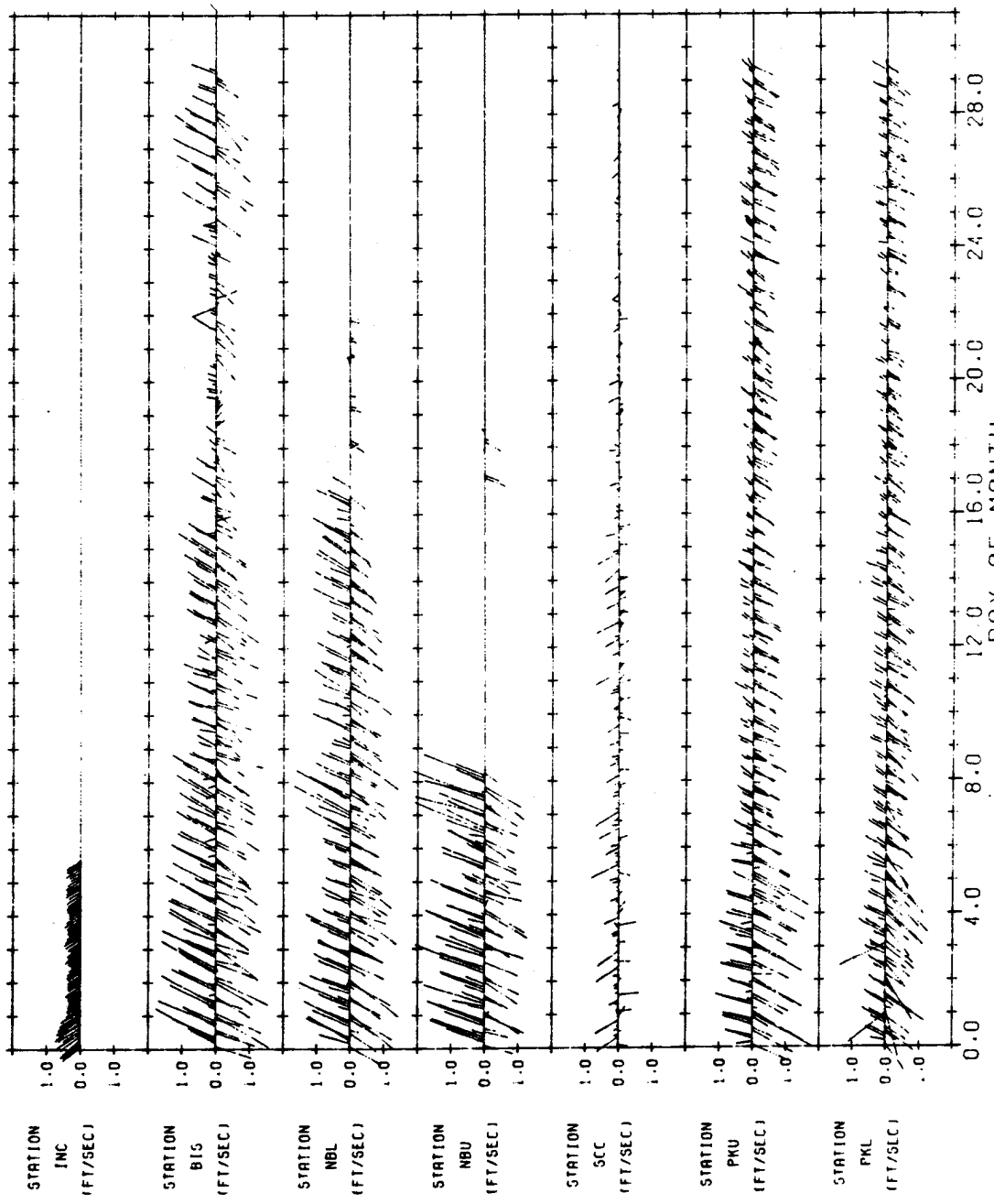

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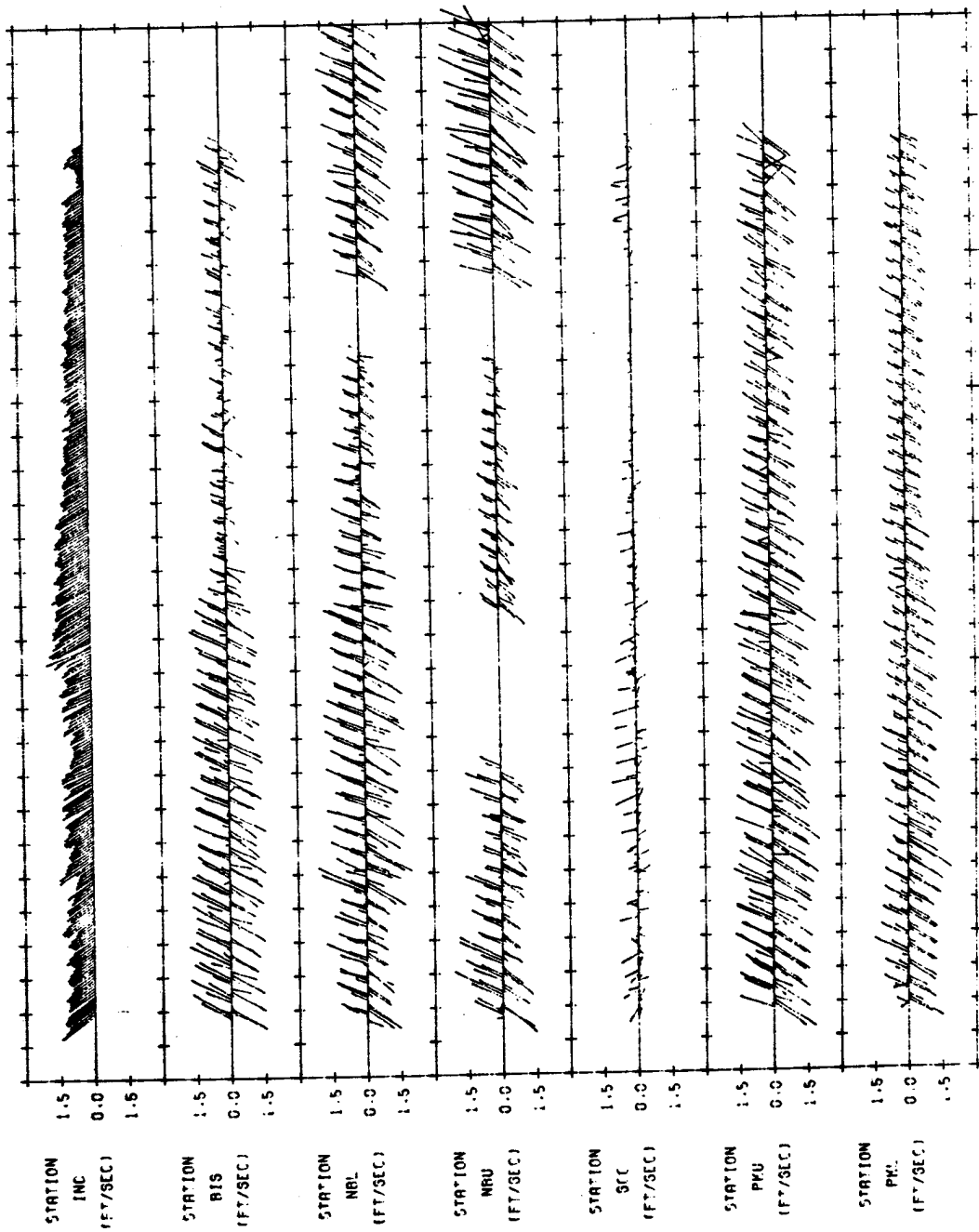
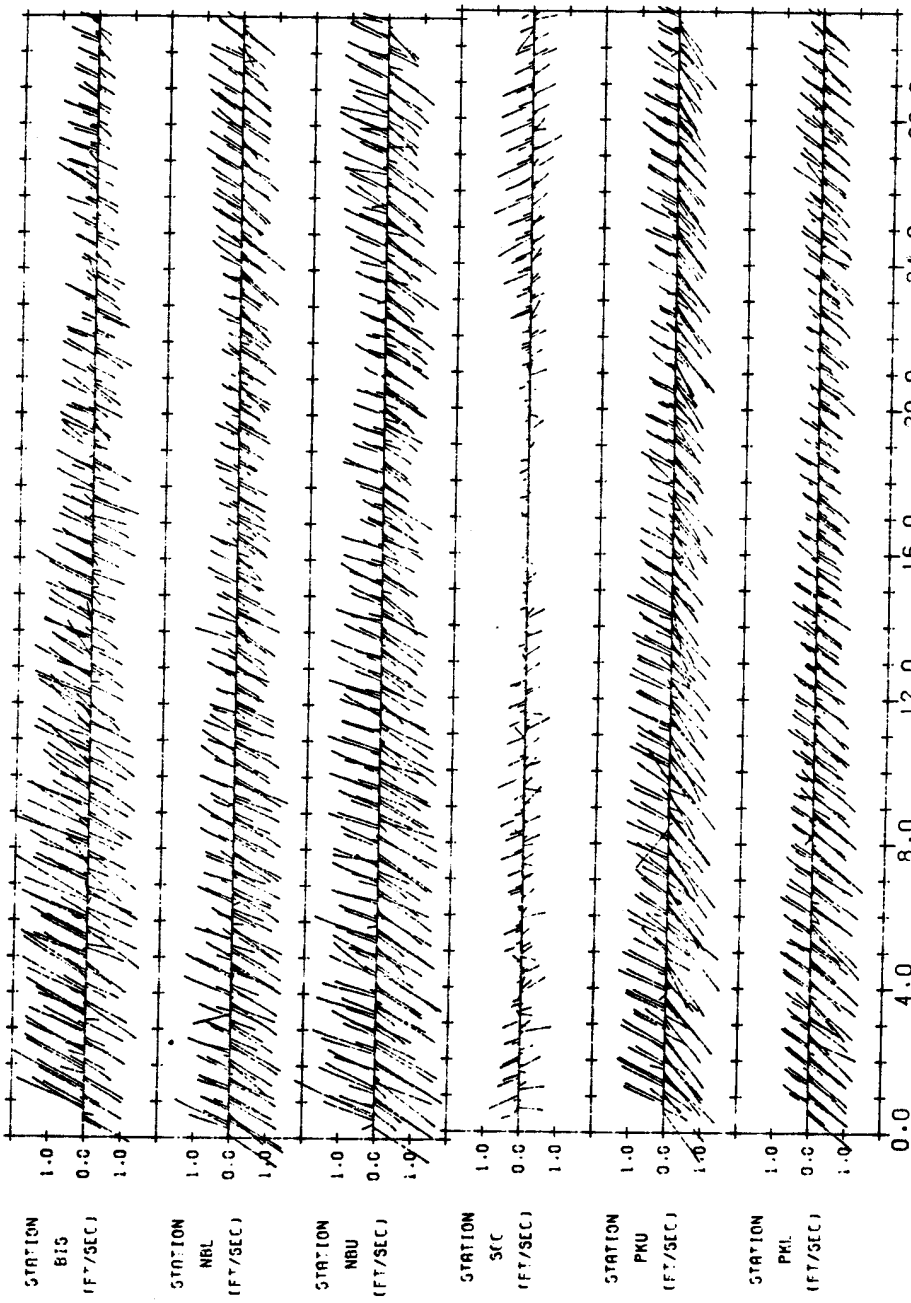


Figure C-60 **Current Data - 7/80**



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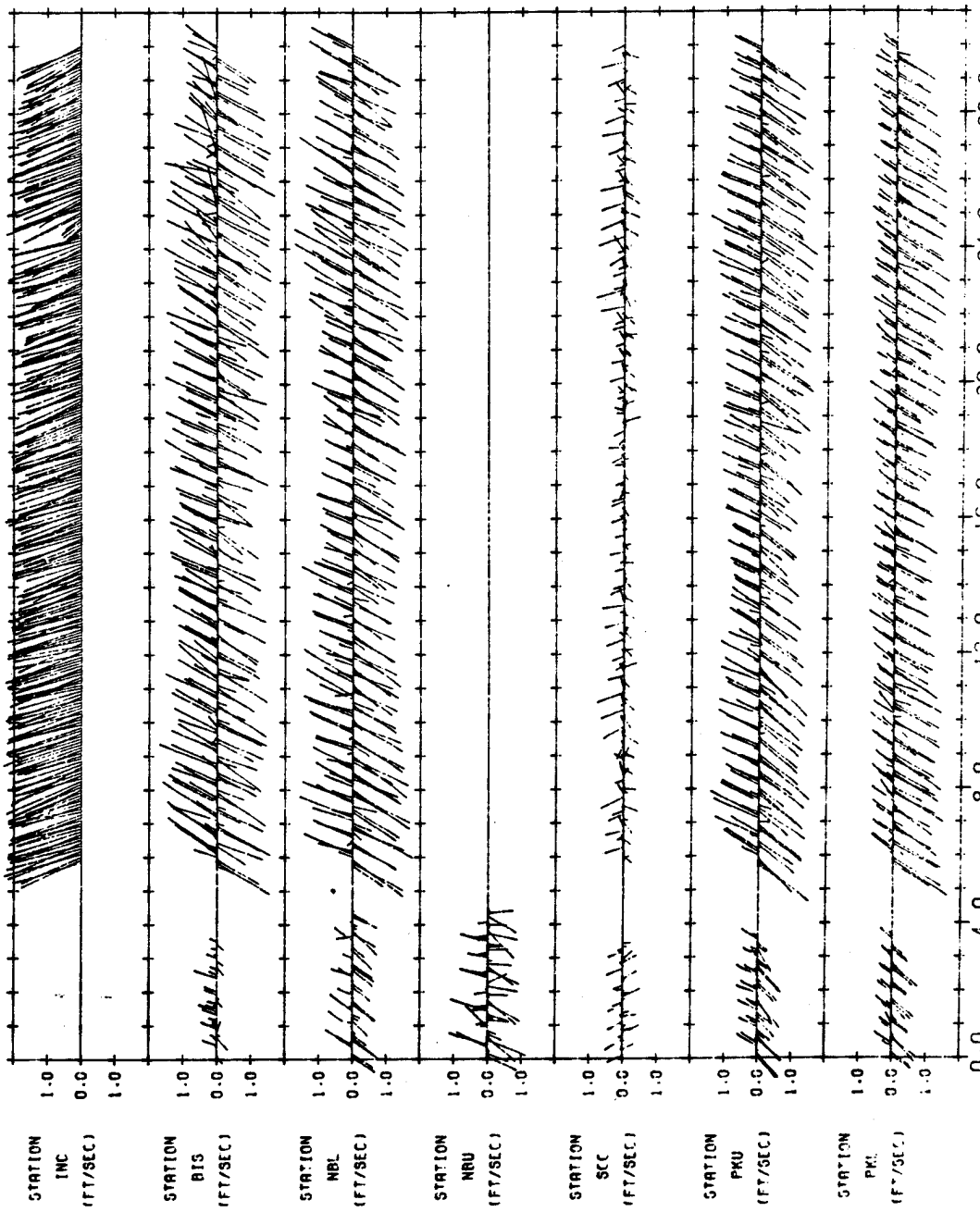

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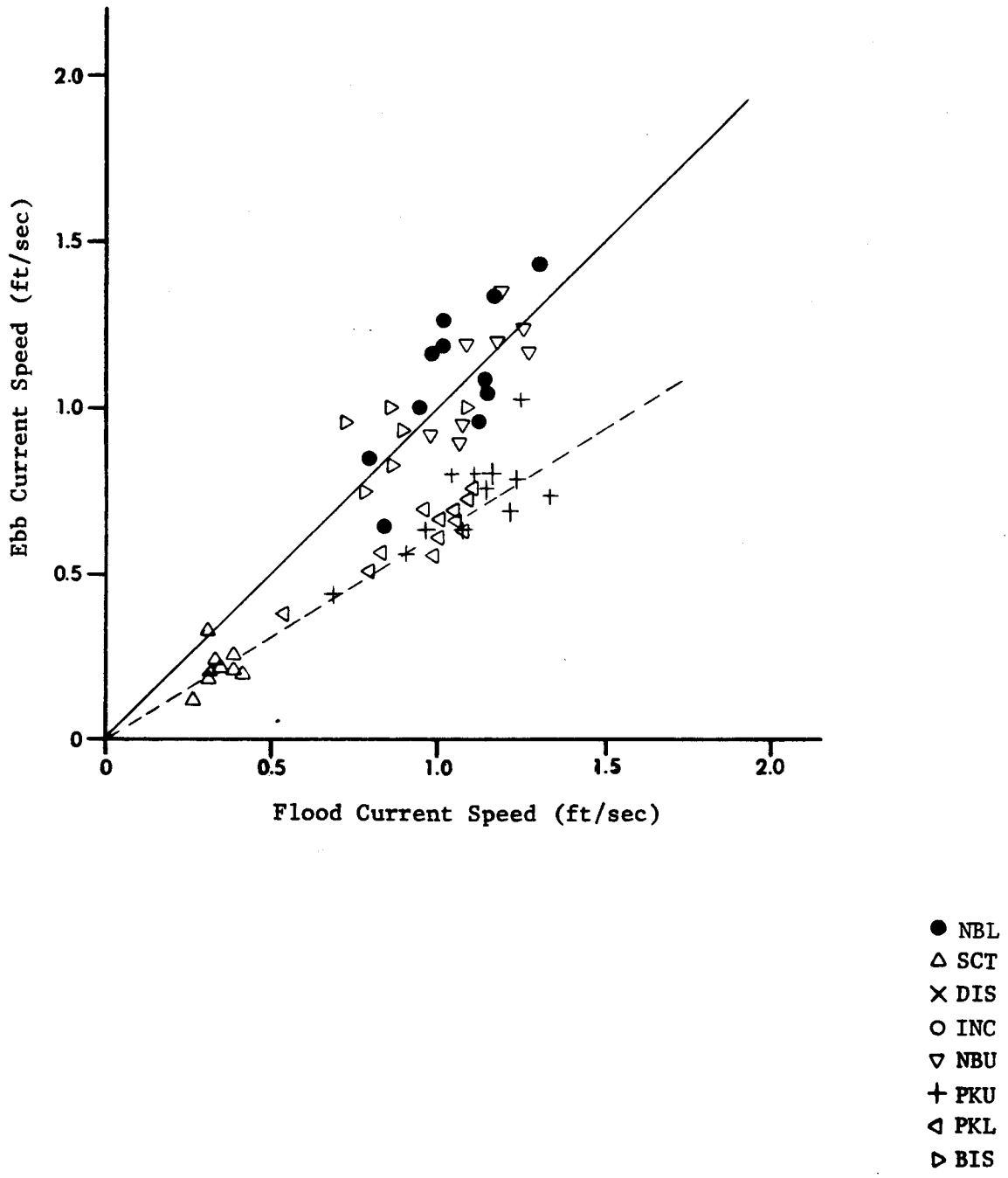


Figure C-63 Difference in Monthly Mean Current During Flood and Ebb Period

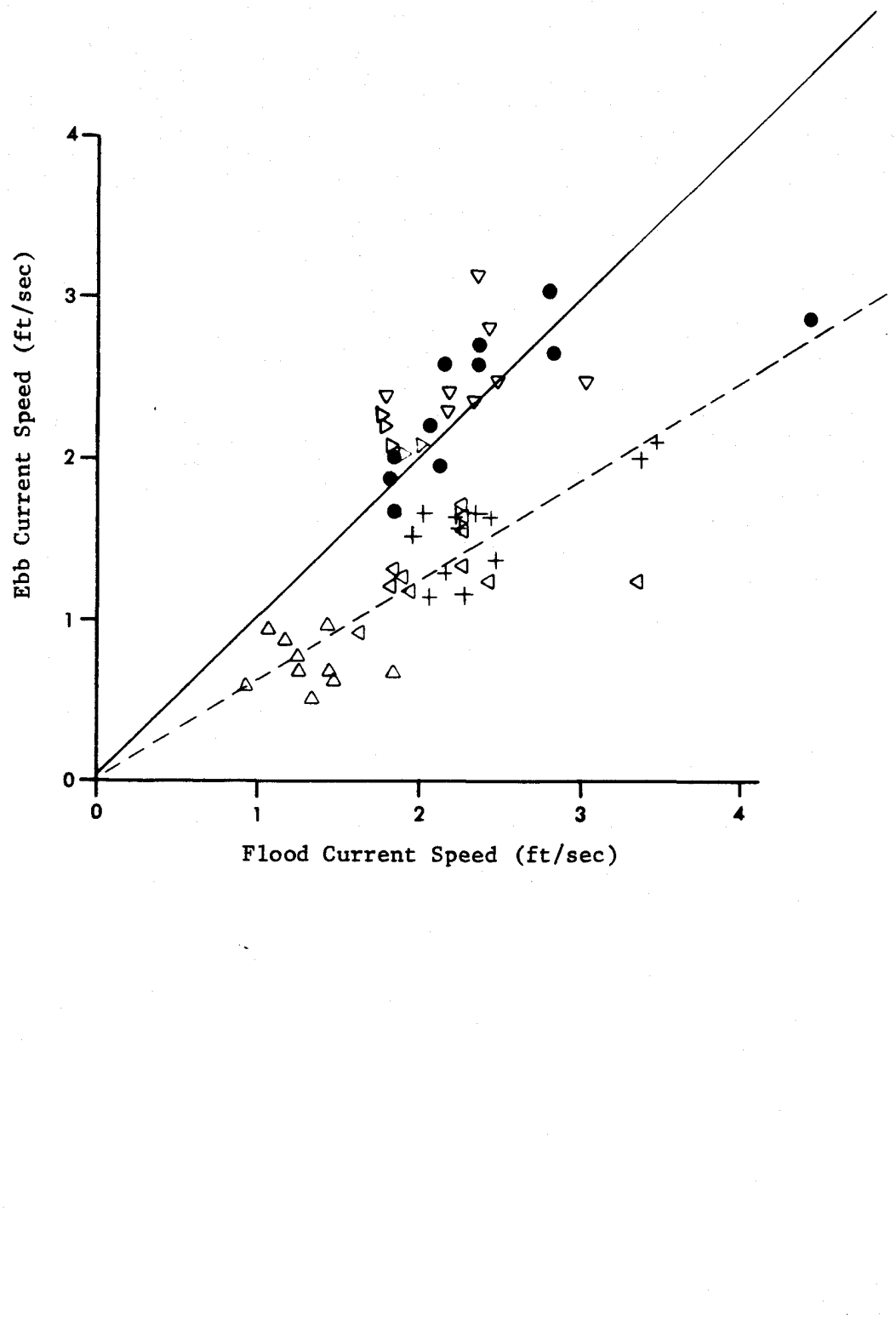


Figure C-64 Difference in Monthly Maximum Current During the Flood and Ebb Period

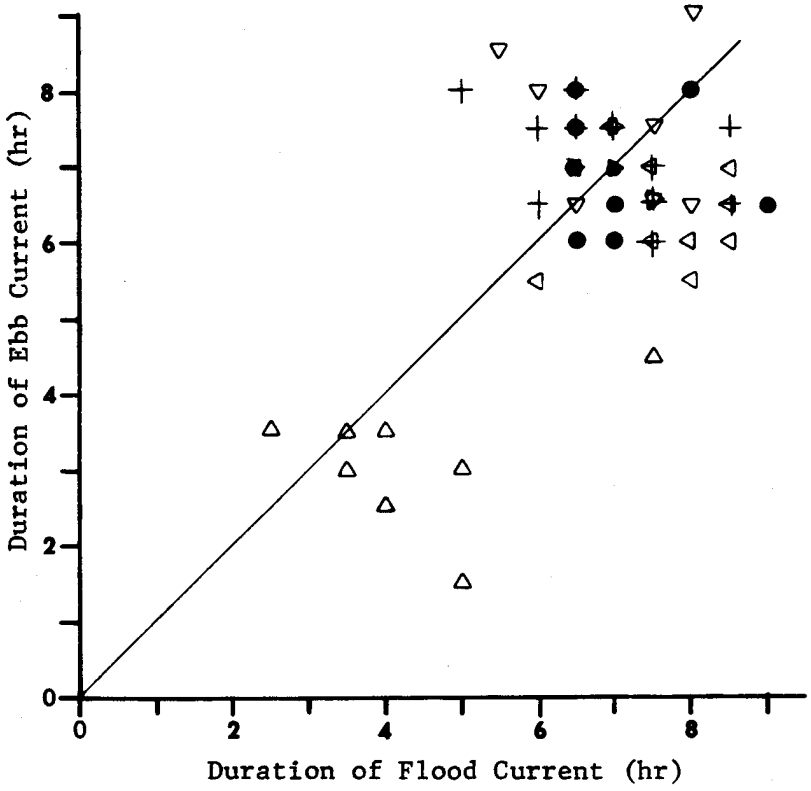


Figure C-65 Difference in Duration for Flood and Ebb Period

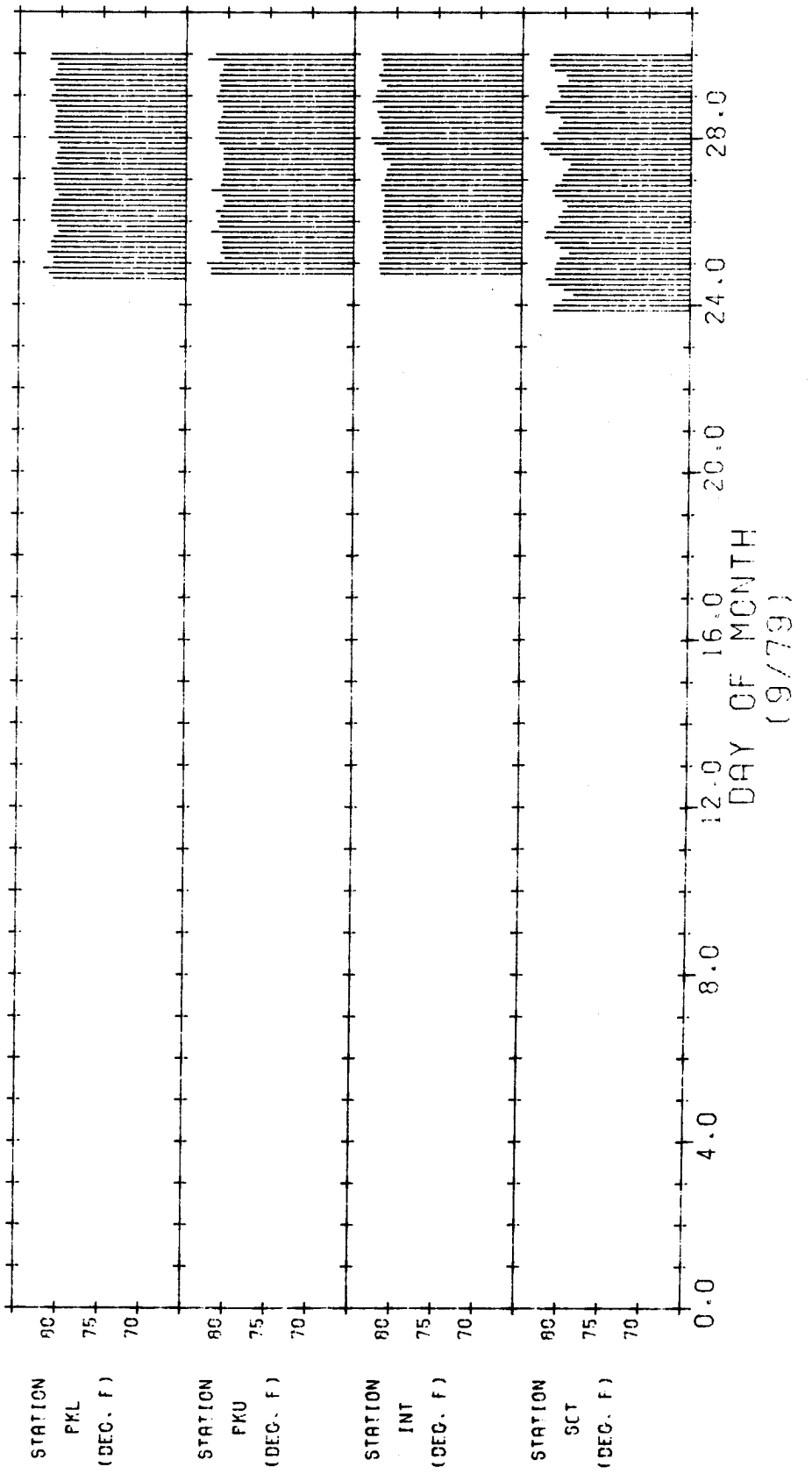
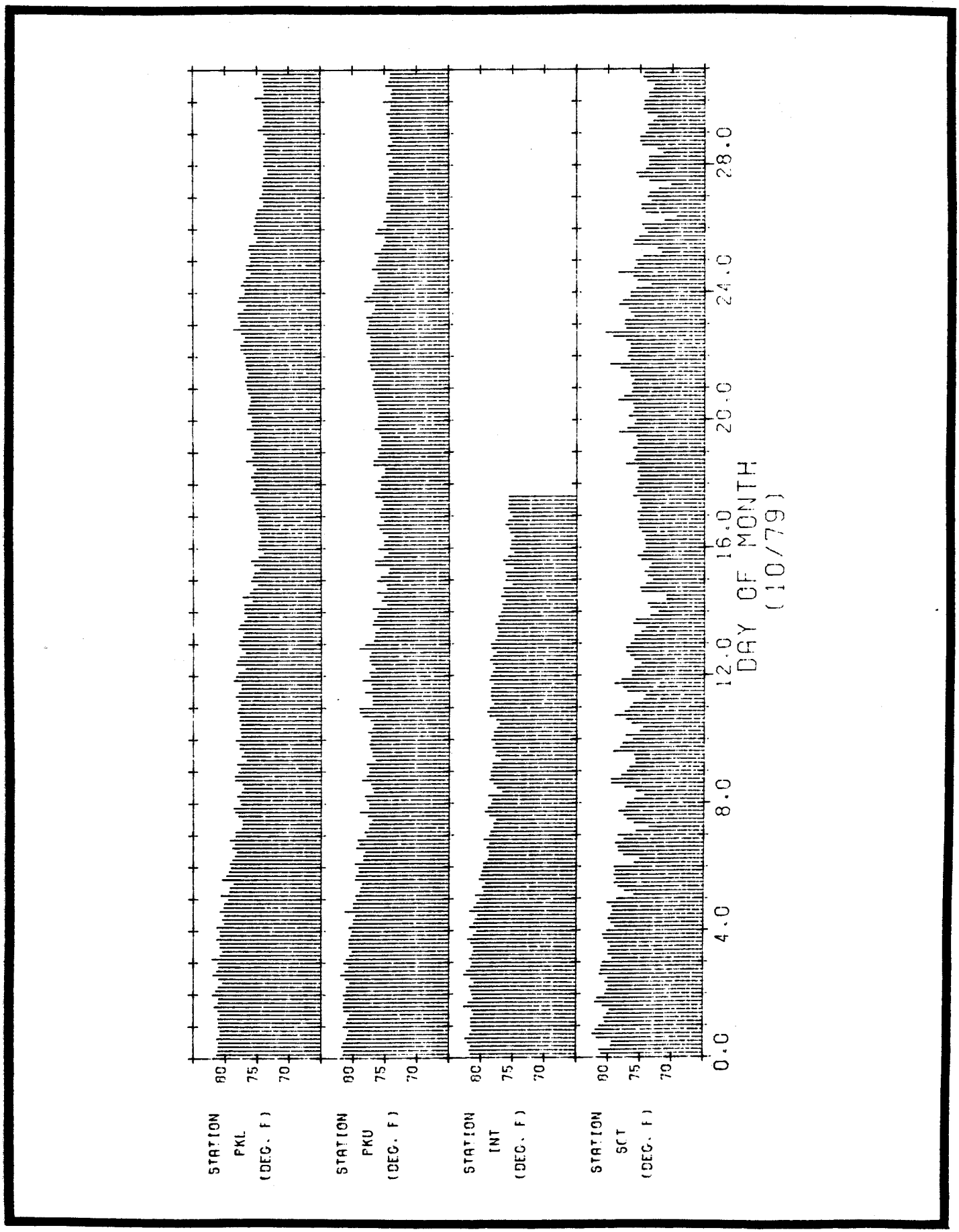


Figure C-66 Temperature Data - 9/79



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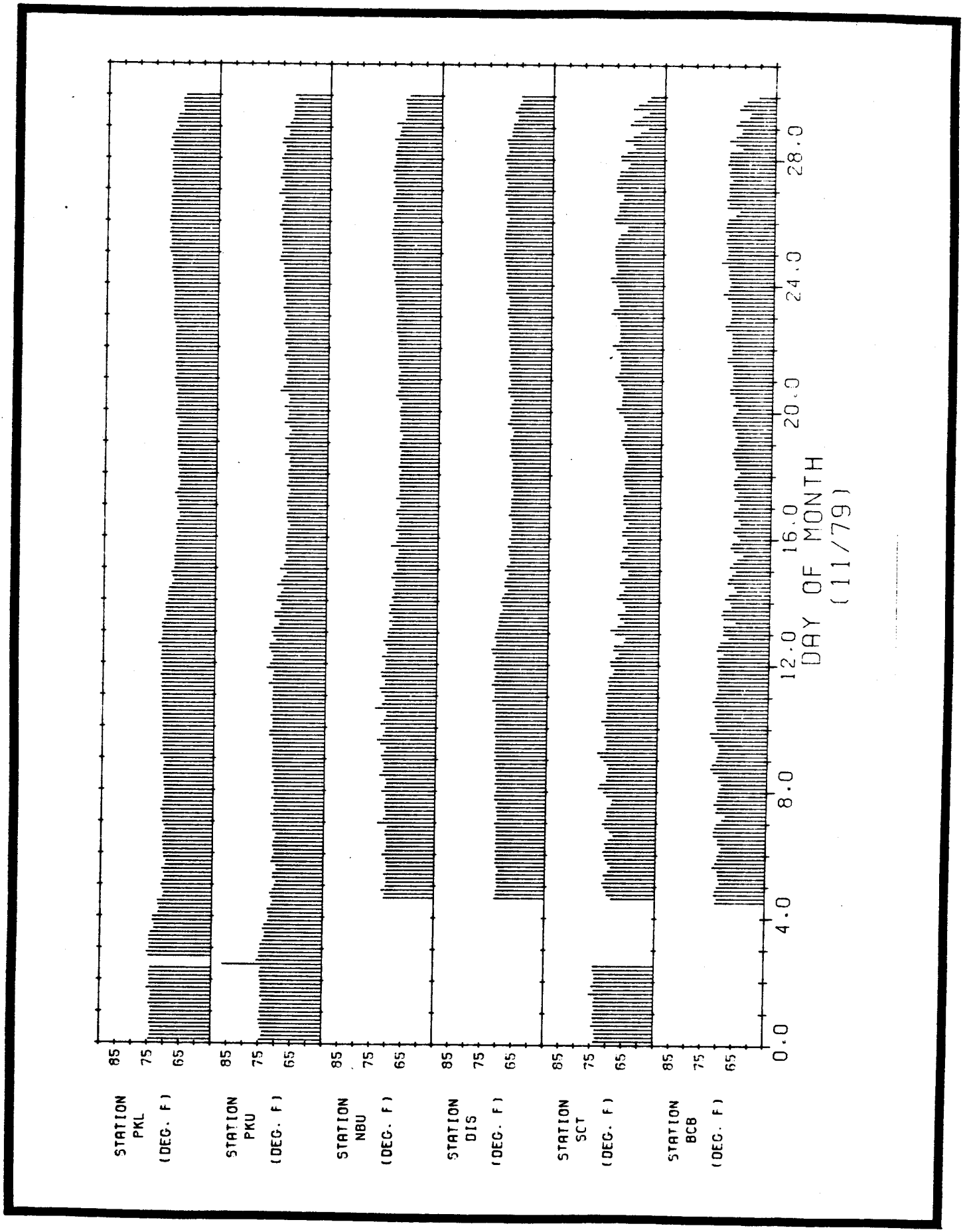

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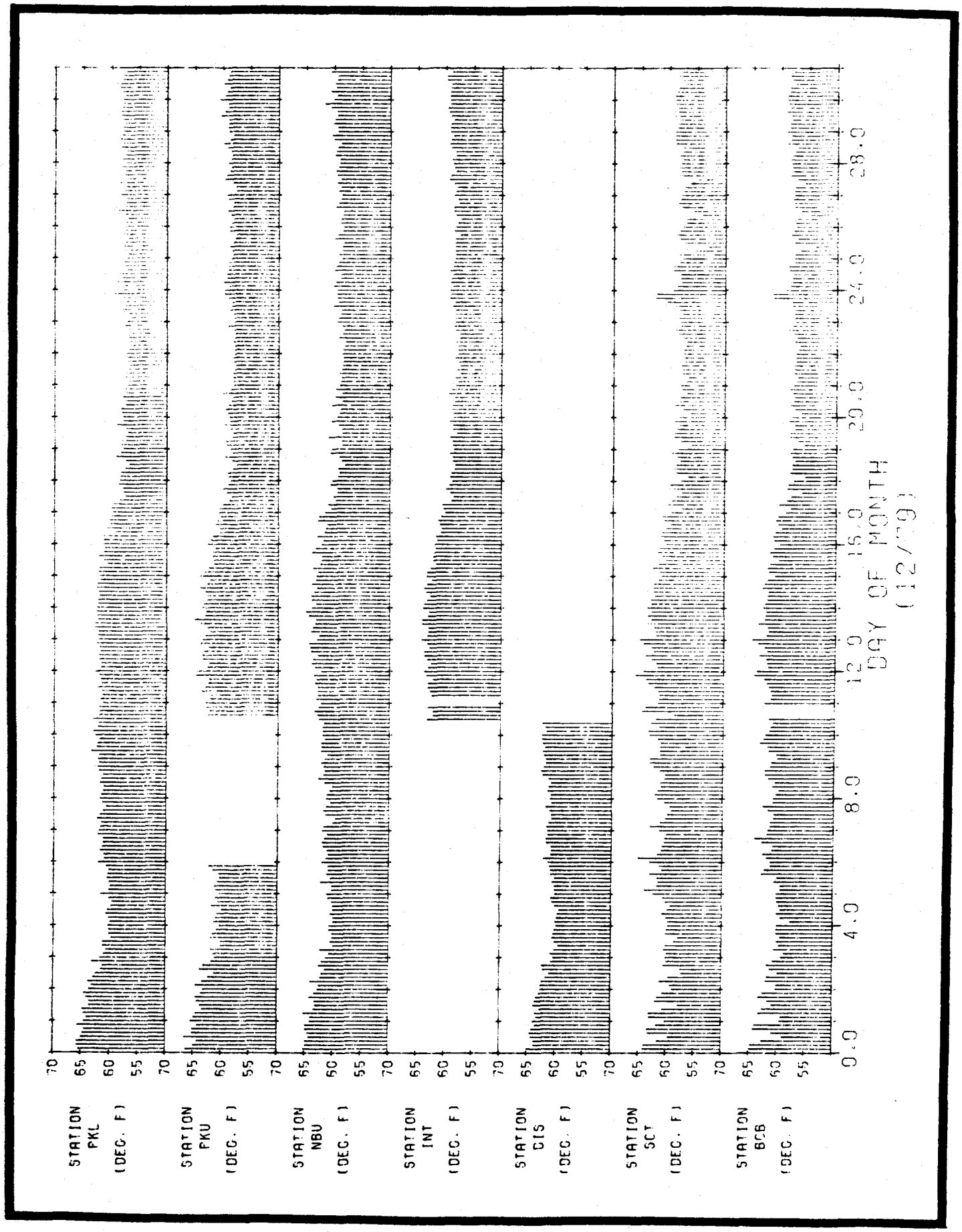

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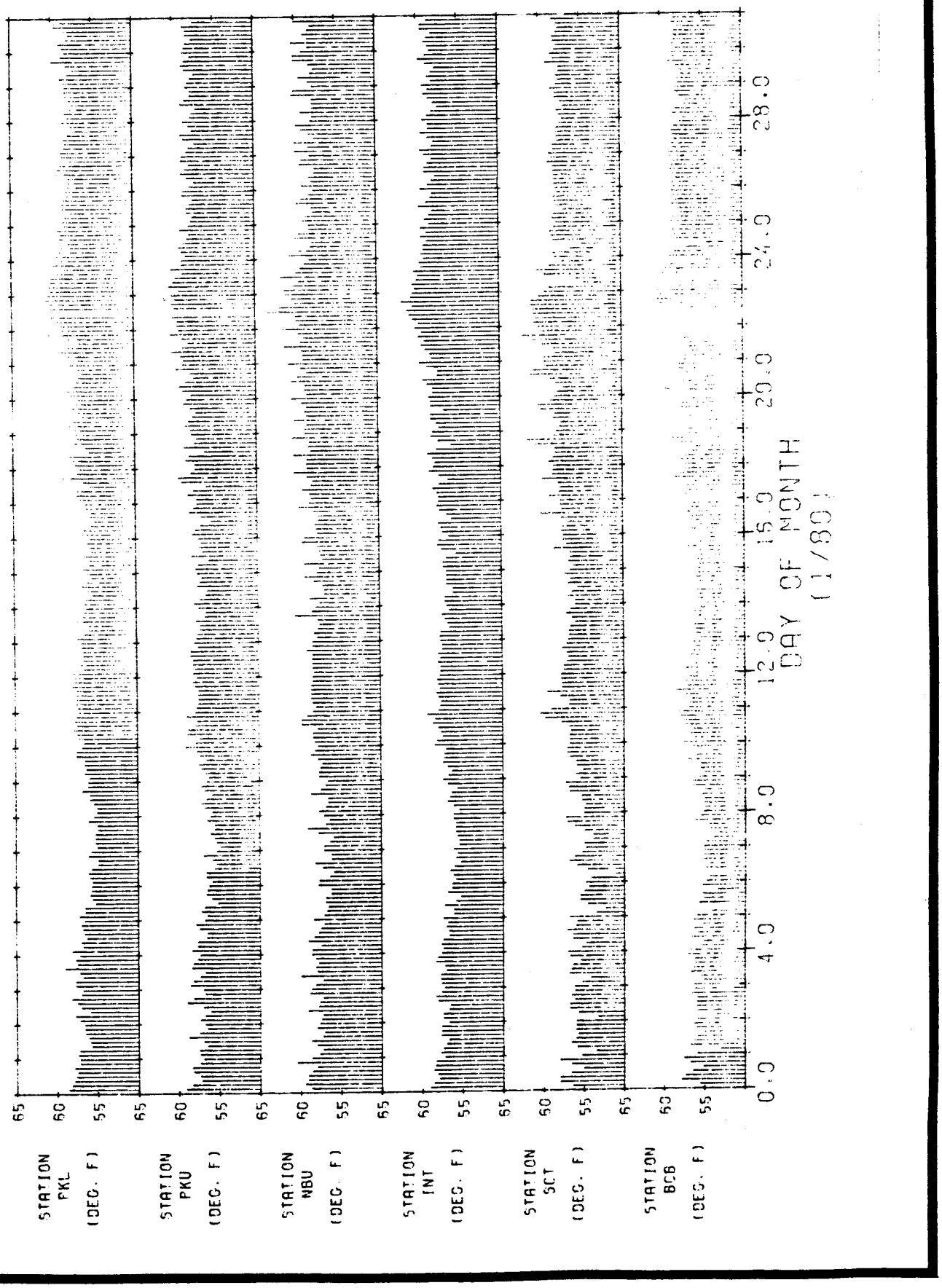

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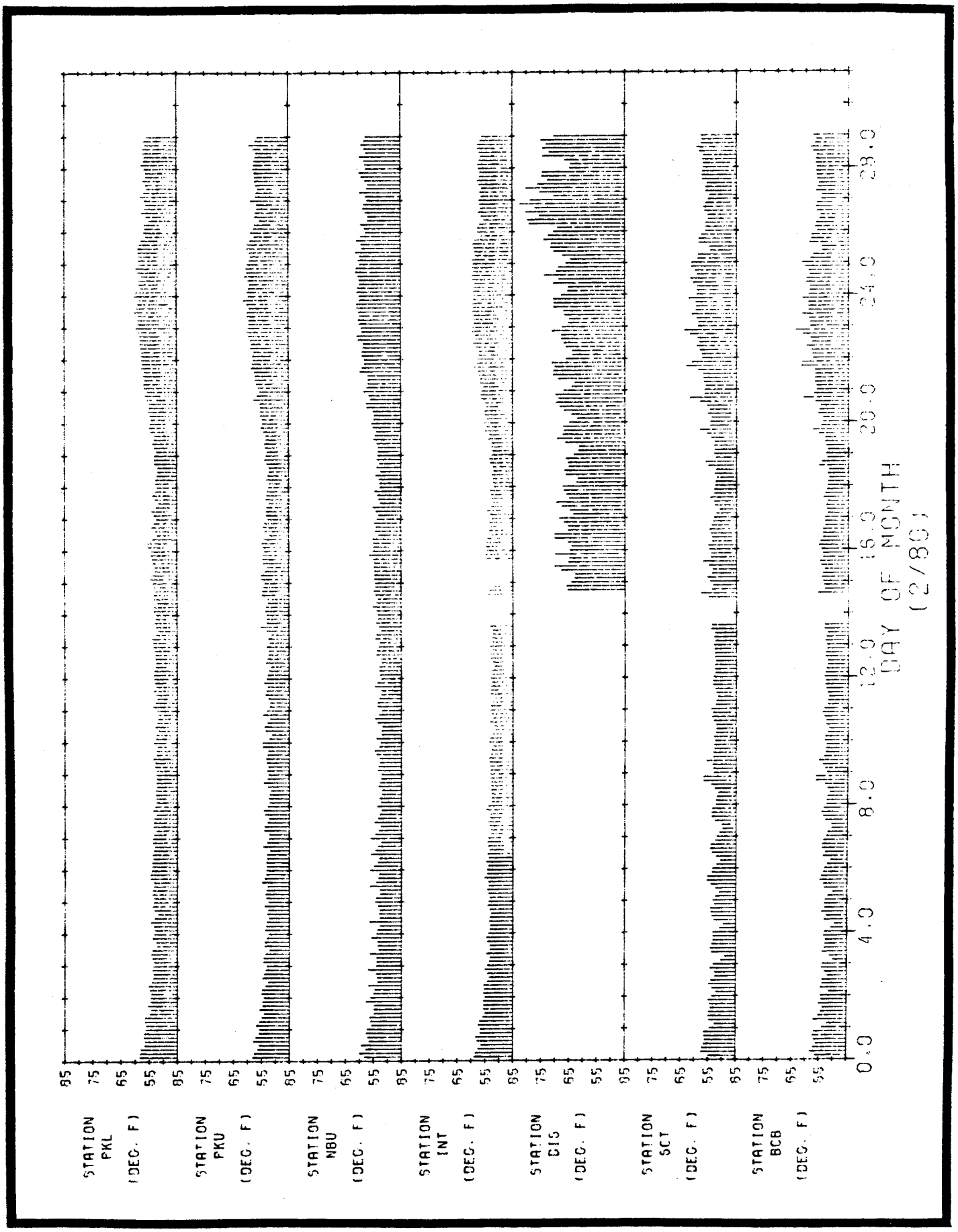

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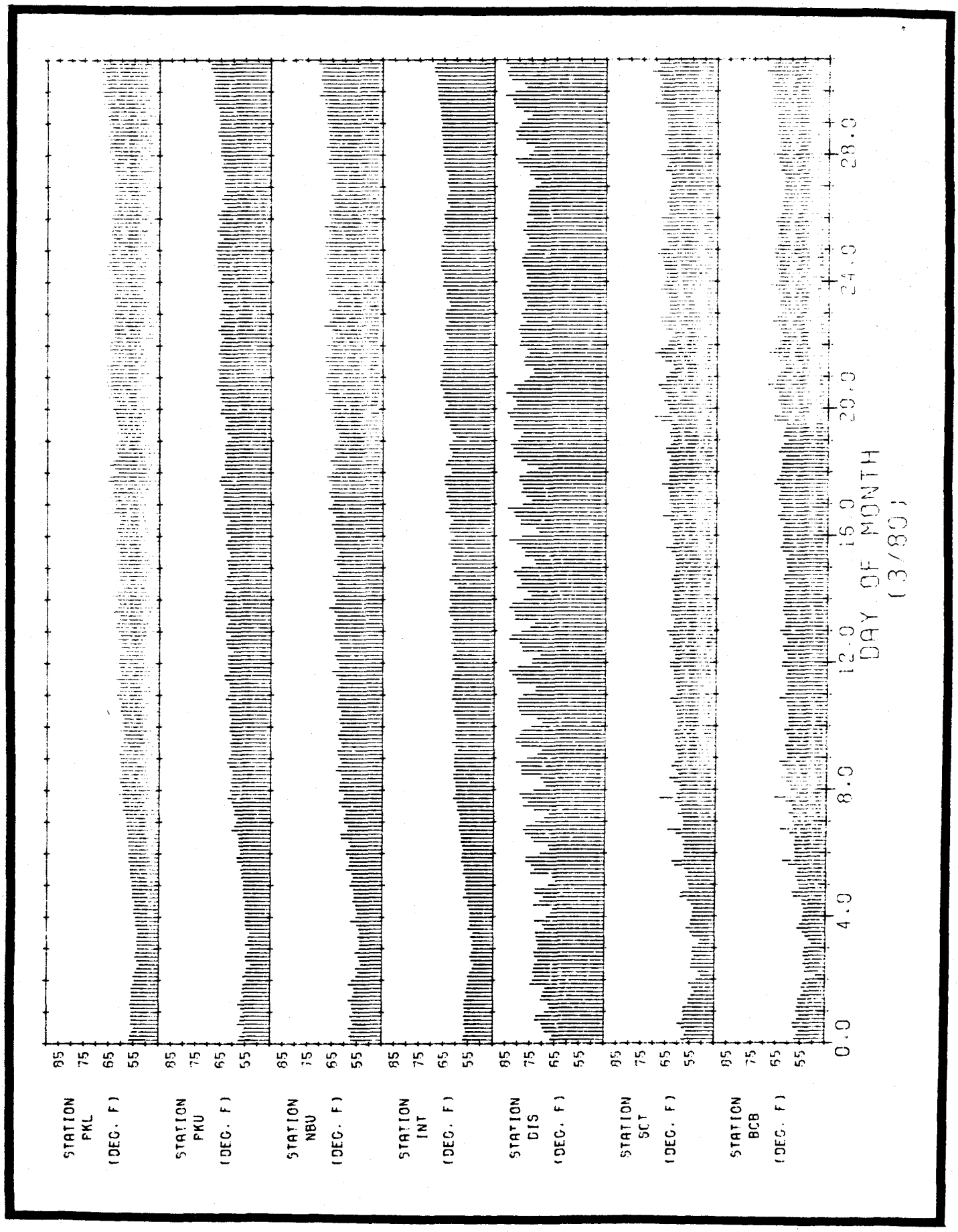

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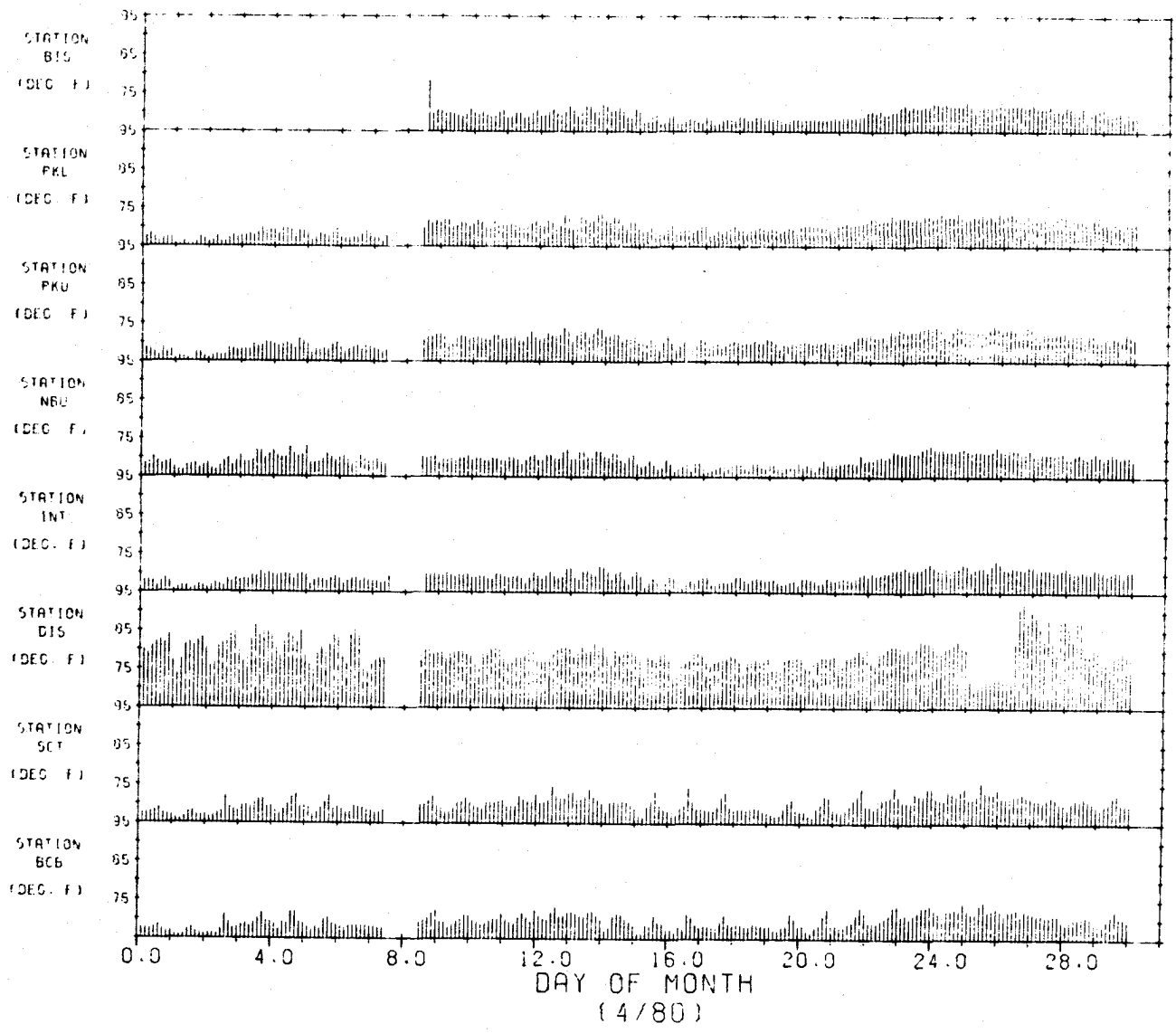

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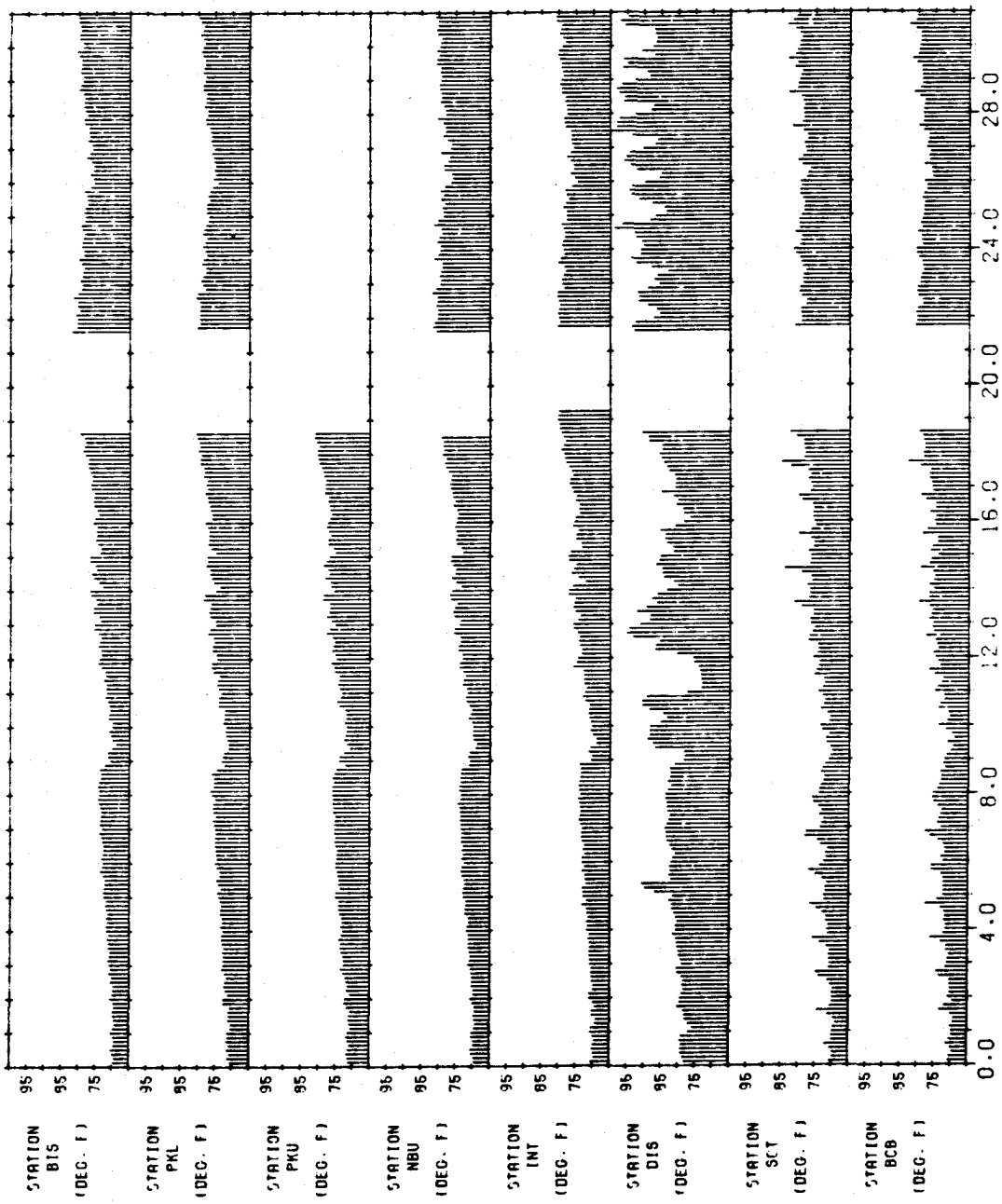

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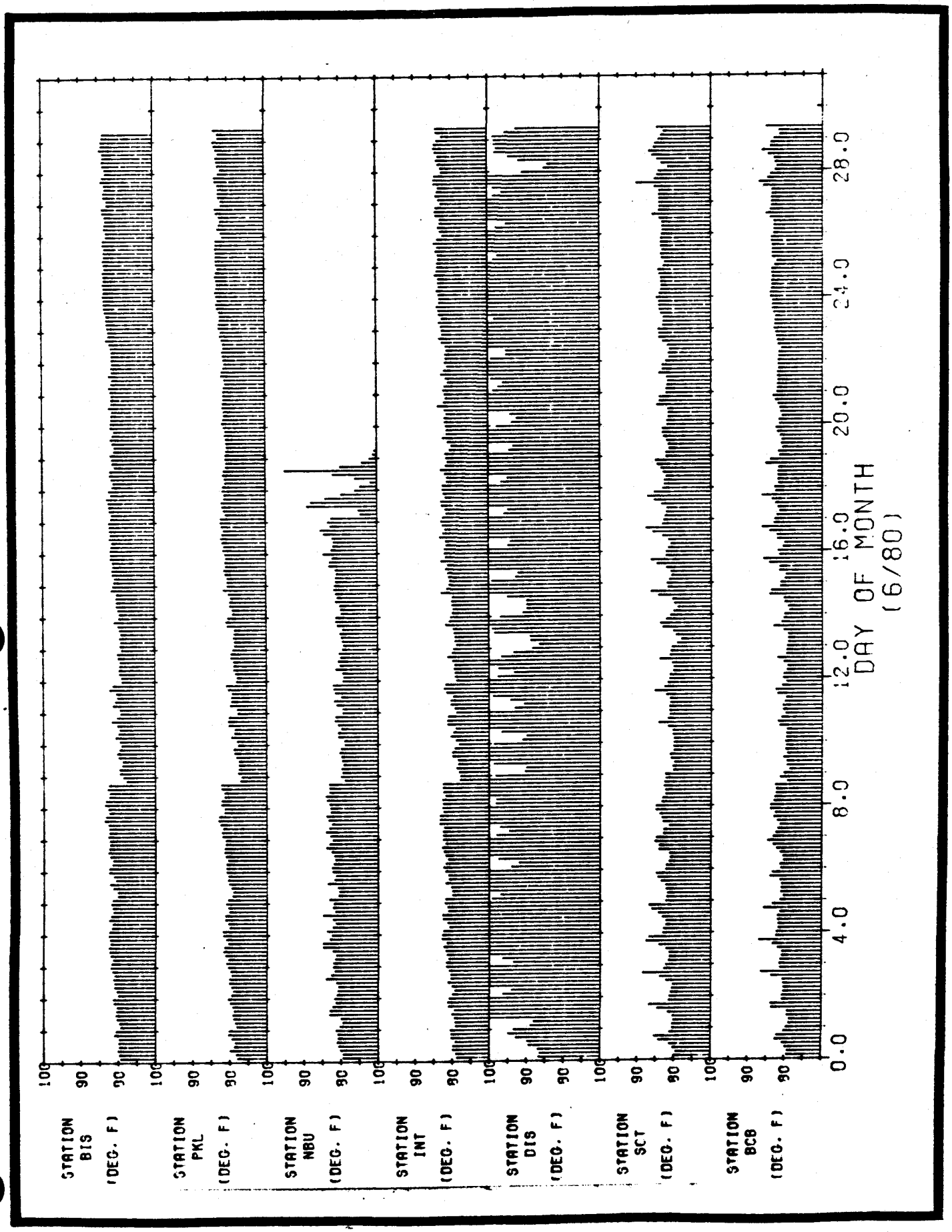

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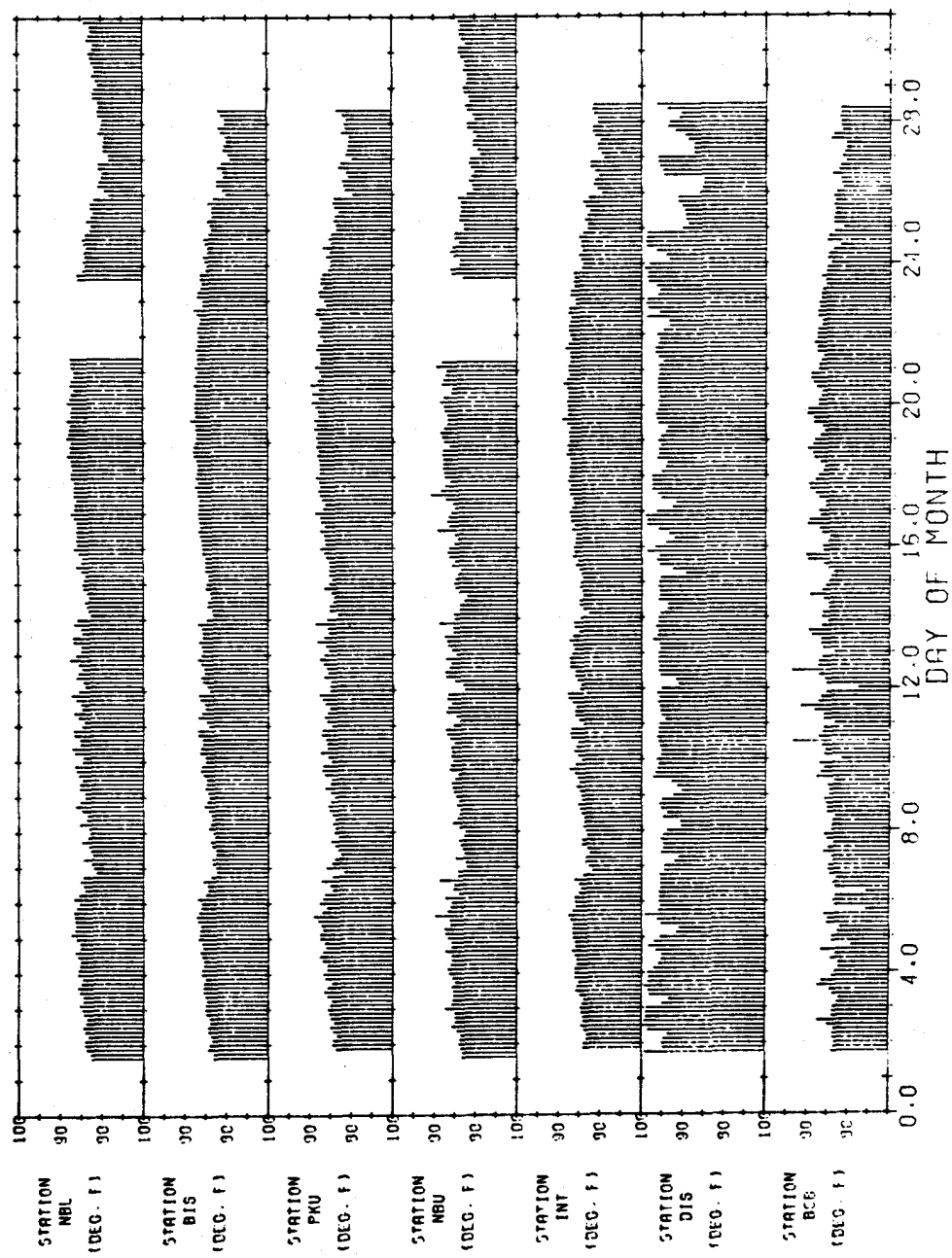
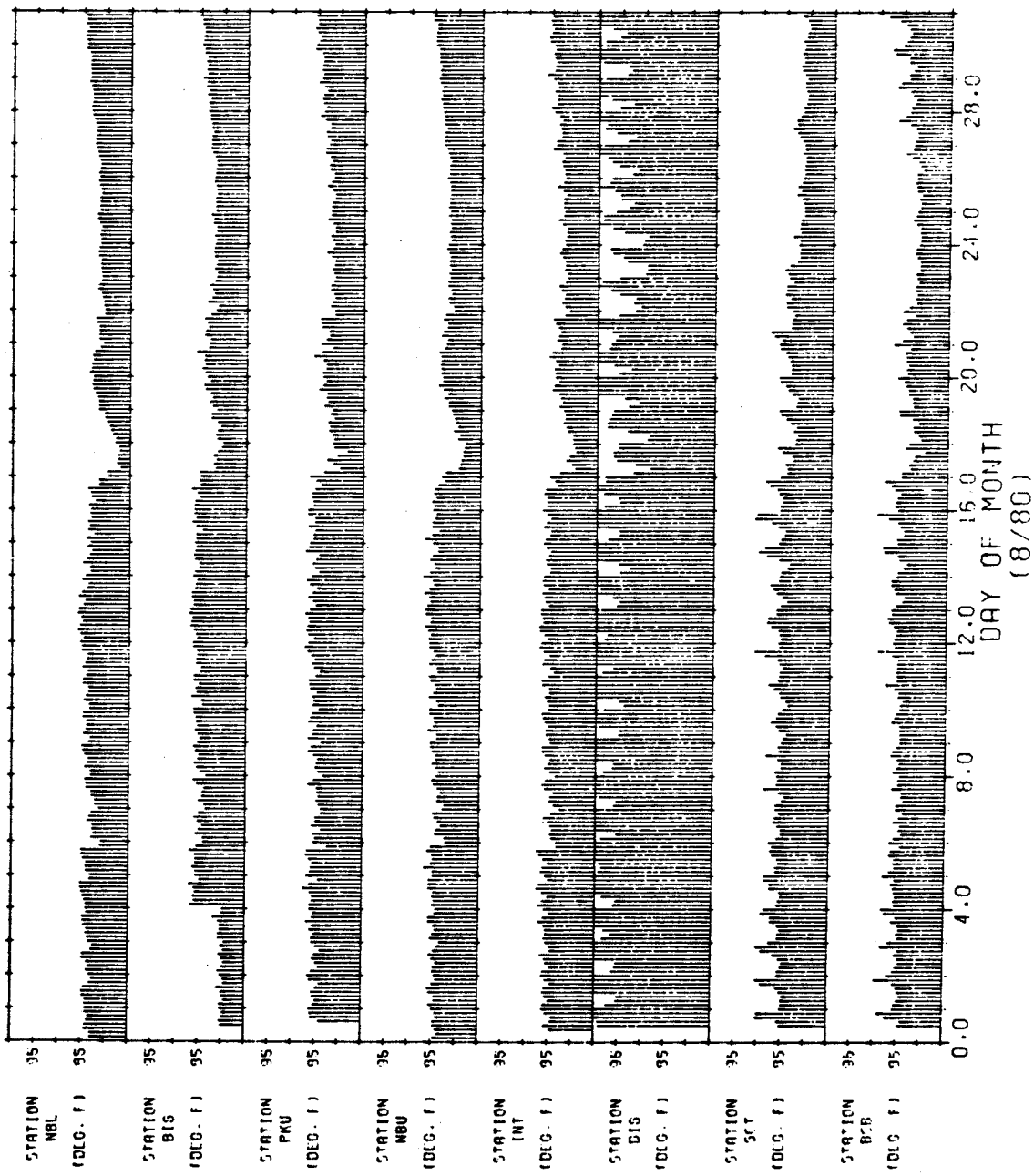


Figure C-76 **Temperature Data - 7/80**



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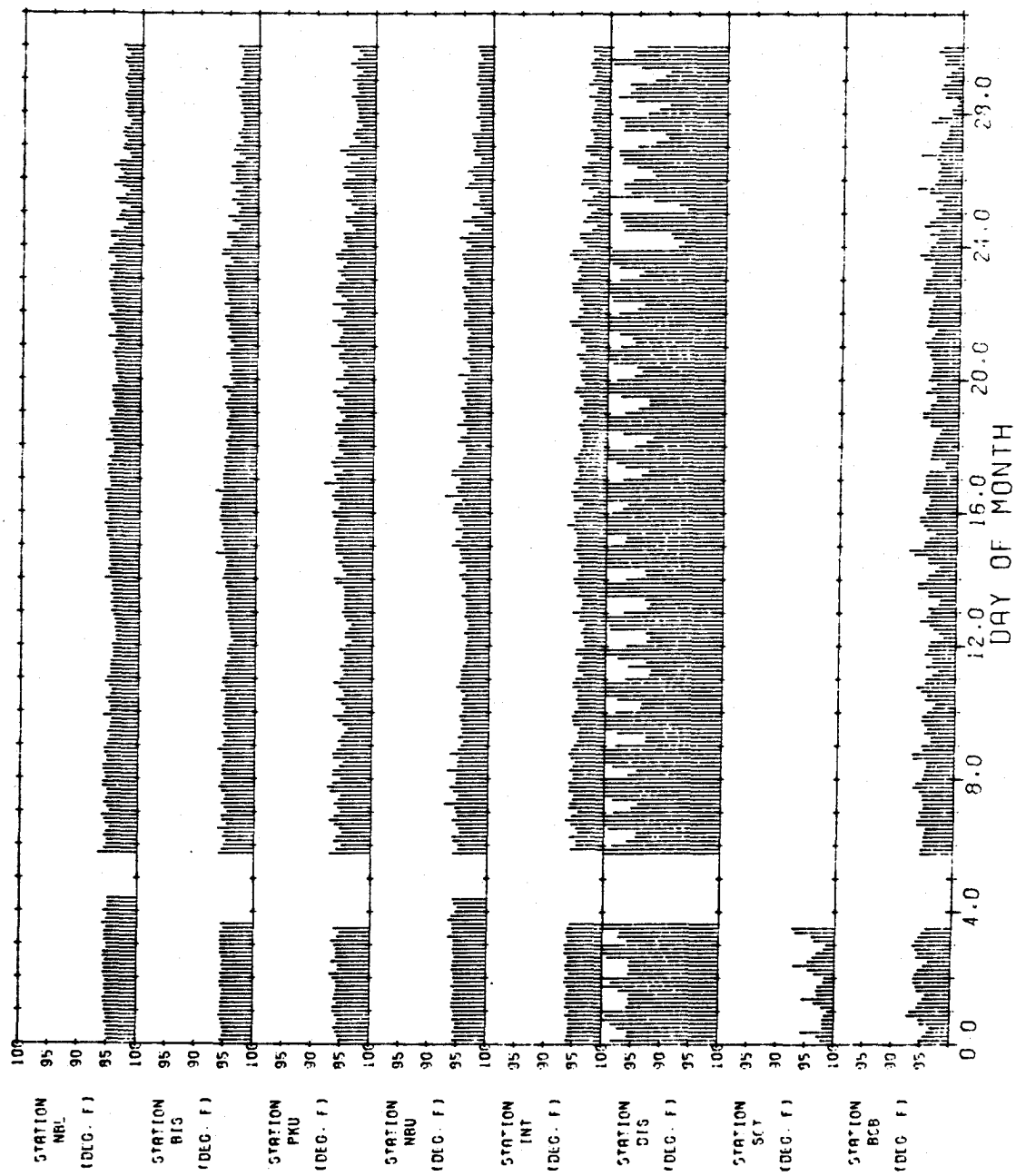

Figure C-78 Temperature Data - 9/80

BATHYMETRY
NORTHSIDE STATION

Figure C-79 Bathymetry Northside Station-1973

D

GROUND WATER HYDROLOGY

APPENDIX D

APPENDIX D

GROUNDWATER HYDROLOGY

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GROUNDWATER HYDROLOGY

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D.1 INTRODUCTION AND BACKGROUND

The objective of this report is to describe hydrologic conditions at the site for the purpose of predicting potential impacts to the prevailing groundwater system likely to occur as the result of plant construction and operation. The results of this investigation will guide the design of facilities, both in optimizing the use of natural resources and minimizing impacts to the groundwater regime.

This appendix begins with a discussion of the methods of investigation (Section D.2). The hydrogeologic framework is discussed on a regional scale (Section D.3) and a site-specific scale (Section D.4). Water quality impacts are discussed in Section D.5. References, figures, and tables appear at the conclusion of the text.

D.2 METHODS OF INVESTIGATION

The objective of the groundwater investigation was to describe the hydrogeologic framework of the proposed plant site as a basis for (1) plant design and (2) predicting potential impacts to the prevailing groundwater system likely to occur as the result of plant construction and operation. The investigation involved the collection of basic data and the performance of controlled testing for the purpose of characterizing the existing hydrologic regime. Where appropriate, selected analytical tools, including models, were used to describe existing groundwater conditions and to predict groundwater impacts. A description of the analytical methods, including use of models, is provided in Section D.2.4.

D.2.1 Background Investigations

A review of published, open-file, and unpublished reports and maps provided the basic framework for the groundwater study. Field and office interviews were conducted with representatives of the U.S. Geological Survey (USGS), Florida Department of Environmental Resources (FDER), St. Johns River Water Management District (SJRWMD), Duval County Department of Health, City of Jacksonville Division of Health, Welfare and Bio-Environmental Services (BESD), and local drilling contractors for additional information on the regional and local hydrogeologic conditions. Records of wells and groundwater quality data contained in the U.S. Geological Survey national WATSTORE system were accessed through the USGS district office in Jacksonville and through the western region office in Denver, Colorado. This information, along with information compiled in field interviews with the USGS and private well owners, formed the basis for a detailed well and groundwater quality inventory for the proposed site and vicinity (see Section D.4).

D.2.2 Site Investigations

D.2.2.1 Subsurface Investigations

Preliminary subsurface investigations were completed in January, 1980, and provided information on the physical, stratigraphic, and hydrologic conditions at the site. Eighty-three soil borings were made, to depths up to 150 feet. The subsurface investigations included collection of pertinent lithologic data, hydrologic data, information on rock and soil engineering properties, acquisition of disturbed and undisturbed samples, and testing of constant-head permeability in selected boreholes. Nine of the boreholes (DP-1A, DP-1B, DP-10A, DP-10B, DP-115, DP-138, DA-5, DA-9, DA-22) were completed as piezometers by installing 2-inch slotted pipe, or screen, and a gravel envelope adjacent to water-bearing intervals (Figure D-1). Short-duration constant discharge aquifer tests were conducted using these piezometers. Further information regarding the preliminary subsurface investigations can be found in Chapter 2, Section 2.4.

In July, 1980, 14 additional soils borings were completed in the vicinity of the proposed solid waste disposal area north of Island Drive. These borings were all 25 feet deep. Piezometers were installed in seven of the borings (DA-33, DA-34, DA-37, DA-39, DA-41, DA-42, DA-43), at locations indicated on Figure D-1. Two additional piezometers (DA-15, DA-24) were also installed in the area south of Island Drive at this time (see Figure D-1).

In November, 1980, nine additional piezometers (DP-6, DP-101, DP-103, DP-113, DP-122, DP-126, DP-129, DA-1, DA-44) were installed in the vicinity of the plant island. All were completed at a depth of 25 feet. Locations of these piezometers are also included on Figure D-1.

D.2.2.2 Groundwater Field Investigations

Based on the results of the background investigations and preliminary subsurface investigations, seven test wells, including one well completed in the Floridan aquifer, were drilled and tested for detailed assessment of site hydrogeologic conditions.

A single deep well (Well F-1) was drilled to a depth of 752 feet and completed in the uppermost water-bearing interval of the Floridan aquifer, since this is the interval most likely to be developed for the groundwater supply requirements of the proposed plant. The well was designed to accommodate a test pump large enough to produce 1000-1200 gallons per minute from the Floridan aquifer during hydrologic testing. The well was permitted and completed for use as a public water supply well. The location of the well is shown on Figure D-1. A geologic log was kept during drilling, and geophysical logs (gamma, resistivity, and caliper) were obtained on the completed well (See Figures D-7 through D-9).

Six shallow test wells were drilled to depths ranging from 21 feet to 90 feet at locations shown in Figure D-1. The wells were drilled by conventional, forward rotary methods using bentonite mud or water as a drilling fluid. Two wells (GW-1 and GW-6 drilled to 90 feet) were completed as open-hole in the limestone/shell/ cemented sand aquifer (shallow-rock aquifer). Wells GW-3 and GW-4 were screened and gravel-packed in water-bearing sand between 11 and 21 feet, locally referred to as the "water table" aquifer. Wells GW-2 and GW-5 were screened and gravel-packed in water-bearing sands occurring between the water table sands and the shallow-rock aquifer (38 to 60 feet). For each pair of wells, one was completed as a pumping well, and one as an observation well. All wells were developed with compressed air until the produced water was essentially free of turbidity.

Geologic logs and well construction logs were kept for wells GW-1 through GW-6. A gamma log and caliper log were obtained in Well GW-6 (See Figures D-14 through D-16).

Constant rate aquifer tests were performed on shallow Wells GW-1, GW-2 and GW-3 and Well F-1. A line-shaft turbine pump was installed and operated for a period of 22 hours in Well F-1. A 3-inch centrifugal pump was used for testing the shallow wells for periods ranging from one to six hours. Discharge was measured by means of an appropriately sized circular orifice, and was regulated and maintained with a gate valve located on the pump discharge. Water levels were measured with electric water level probes, a pressure recording instrument and/or water level (float) recorders for the duration of each test.

D.2.2.3 Preconstruction Monitoring

Preconstruction groundwater monitoring has consisted of a program of monitoring groundwater levels and groundwater quality in the general site vicinity. Preconstruction monitoring was oriented toward ascertaining time variations in shallow water levels, piezometric pressure in the Floridan aquifer, and groundwater quality. The preconstruction monitoring program has essentially a continuation of preapplication monitoring tasks and continued through the summer of 1981. Twelve months of groundwater level and quality data have been acquired for the purpose of documenting baseline hydrogeologic conditions and ascertaining seasonal variations in these conditions.

Groundwater monitoring points included the Floridan water supply well, F-1, plus an appropriate selection of shallow wells drawn from the preapplication monitoring wells and piezometers shown on Figure D-1. Piezometric pressure at Well F-1 has been measured on a quarterly basis. Water levels in shallow monitoring wells have been measured on a monthly basis. Samples for water quality analyses will be collected from the shallow monitoring locations on a quarterly basis. The samples have been analyzed for the parameters listed on Table D-1 in order to characterize the baseline groundwater quality.

D.2.3 Sampling Methodology

D.2.3.1 Well Drilling

All test wells and piezometers were drilled by auger and/or rotary methods using forward circulation. Where possible, air and/or clear water was used as a drilling fluid to minimize formation damage. Unstable hole conditions occasionally required the use of a bentonite based drilling fluid. Well F-1 was drilled by forward rotary methods using bentonite mud to the top of the Ocala Formation. Drilling through the Ocala (Floridan aquifer) was accomplished with reverse-air circulation to minimize formation damage, assist in the development of the aquifer, and provide indication of well production with increasing penetration into the aquifer.

Formation samples were collected during the drilling process. Sampling during preliminary subsurface investigations included recovery of undisturbed samples. These samples were placed in appropriate containers and delivered to the soil laboratories of Law Engineering and Testing Company, Jacksonville, Florida for further analysis. Formation samples were collected from the drilling fluid returns during drilling of Well F-1 and test Wells GW-1 through GW-6. These samples were placed in appropriate containers and shipped to the Bureau of Geology in Tallahassee for cataloging and storage.

Pertinent drilling and well performance data were recorded during construction of all wells. Drilling performance data included penetration rate, fluid circulation rate (qualitative), and water production (quantitative), where the wells were drilled by air rotary methods. Where practicable, static water levels were measured at the start of each drilling period.

D.2.3.2 Water Level Measurement

Instrumentation for water level measurement included electric probes, wetted tapes, float recorders, pressure recorders, and piezometer tubes.

Monitoring of shallow groundwater levels in the nine piezometers south of Island Drive drilled during preliminary site investigations has been conducted on an approximate monthly basis since January, 1980. Monitoring of shallow groundwater levels in the seven piezometers north of Island Drive, the two additional piezometers south of Island Drive and three test wells (GW-2, GW-3 and GW-6) commenced with their construction in August 1980, and is continuing on an approximate monthly basis. Monitoring of shallow groundwater levels in the nine additional piezometers, constructed within the proposed rail loop in November, 1980, will also be conducted on an approximate monthly basis. Monitoring of static pressures of the Floridan well, F-1, commenced with the completion of the well in August, 1980, and will continue on a quarterly basis.

D.2.3.3 Water Quality Sampling and Analysis

Selected piezometers and wells were sampled for analysis of baseline groundwater quality. Groundwater samples were obtained by pumping the equivalent of two casing volumes of water from the well/piezometer before sample collection.

Water samples were collected in bottles furnished by the testing laboratory (Technical Services, Inc., Jacksonville, Florida), to which appropriate preservatives had been added. Samples were delivered to the laboratory for analysis within 24 hours of the time of collection. Table D-2 lists sample handling and preservation methods used during the investigation. All methods were in accordance with procedures specified by Standard Methods (1975) or the U.S. Environmental Protection Agency (1974). Table D-1 lists the physical and chemical parameters constituting the groundwater quality analysis. A second sample was collected at each sampling location for field water quality measurements. Field temperature, pH, and conductivity were measured at the time of collection. A field log was maintained for all samples collected, including date, time, and location of sample collected and all field measurements.

Groundwater quality data obtained during the course of field investigations were supplemented by water quality records maintained by the North Landfill of the City of Jacksonville, and by the Northside Generating Station (NGS) of JEA.

D.2.3.4 Other Field Measurements

Other information obtained during aquifer testing included data on tidal stages in the St. Johns River and barometric records obtained from the National Weather Service at the Jacksonville International Airport.

D.2.4 Methods of Analysis

D.2.4.1 Aquifer Test Data

The groundwater field investigations included aquifer tests using test Wells F-1 and GW-1 through GW-6. The data from those aquifer tests were analyzed using a variety of standard techniques, depending on specific aquifer and test conditions.

Floridan Aquifer Test Well

Data from the Floridan Aquifer test Well F-1, and observation Well D-1255 (Capitol Concrete well), were analyzed by applying the Jacob modified non-equilibrium method (Walton, 1962) to water level drawdown and recovery data from Wells F-1 and D-1255, and by applying the Hantush leaky artesian type curves (Walton, 1962) to water level drawdown and recovery data from the observation Well D-1255.

The Jacob modified non-equilibrium method of analysis involves plotting water-level drawdown data versus the logarithm of elapsed time since start of pumping on semi-logarithmic graph paper, and fitting a straight line to the test data. The aquifer transmissivity can then be calculated from the slope

of the straight line, and the storativity can be calculated from the time at which the straight line crosses the zero-drawdown axis. Storativity values are only calculated in this manner using data from observation wells .

The modified non-equilibrium method can also be applied to water-level recovery data following cessation of pumping. One approach to such analysis is to plot the observed depth to water during the recovery period versus the logarithm of t/t', where t is the elapsed time since pumping started and t' is the elapsed time since pumping stopped. The transmissivity can then be calculated from the slope of a straight line fit to data from the pumping well or observation well, but storativity cannot be calculated by this approach.

A second approach to using recovery data is to first extrapolate the observed drawdown trend at the end of the pumping period through the duration of the recovery period, and then subtract the observed recovery water level from the corresponding value of the extrapolated drawdown. The resultant value, which can be called corrected recovery, can then be plotted versus t' in the same manner as the original drawdown data were plotted versus time, t, during the pumping period.

The Hantush leaky-artesian type curve method involves plotting drawdown versus time (or corrected recovery versus t') on double-logarithmic graph paper, and matching the observed data to one of a family of type curves plotted on graph paper of the same scale. The aquifer transmissivity and storativity can then be calculated from the coordinates of a convenient match point on both the field data plot and the type curve plot. The various curves on the family of type curves are distinguished by a parameter. The value of this parameter for the type curve which best matches the field data can be used to calculate the ratio of the hydraulic conductivity to thickness of a semi-permeable "leaky" stratum separating the aquifer being tested from an adjacent aquifer in which the potentiometric head remains constant. This approach does not account for water which may be derived from storage in the leaky stratum, nor does it distinguish between the effects of leaky strata overlying or underlying the tested aquifer.

The Hantush leaky-artesian type curve method can be applied to both drawdown and corrected recovery data. However, data from the pumping well cannot be used to calculate reliable values of aquifer storativity or properties of the leaky stratum, because of difficulties in estimating the effective radius of the pumping well.

Shallow-Aquifer Test Wells

Three aquifer tests were conducted using shallow test Wells GW-1 through GW-6. Preliminary geologic and drilling data suggested the presence of three distinct aquifer zones at the test-well site: a shallow-rock zone with its base at a depth of about 90 feet, consisting of limestone, shell, and cemented sand; an overlying intermediate sand unit; and a shallow water table sand unit, separated from the intermediate sand unit by an interval of finer-grained material of variable thickness and consistency. The shallow-rock and intermediate sand units appeared to be under confined (artesian) conditions, while the water table sand appeared to be unconfined. Consequently, different approaches were required in analyzing the data from these different aquifer units.

When possible, all of the data were analyzed using the Jacob modified non-equilibrium and Hantush leaky-artesian type curve techniques discussed above. Those approaches were not applied for the following cases: (1) when pumping from the shallow rock or intermediate sand zones, no drawdown was observed in the water table wells, so data from the water table wells were not analyzed; (2) when pumping from the water table zone, no drawdown was observed in the shallow rock or intermediate sand wells, so data from the shallow rock and intermediate sand wells were not analyzed; and (3) data from the pumping well in the water table aquifer were not analyzed because of the relatively large drawdown in that well (in general, the Jacob and Hantush approaches are valid only for artesian aquifers, although the techniques can be reasonably applied to observation well data in a water table aquifer if, as in the present case, the total drawdown is a very small fraction of the initial saturated thickness of the aquifer).

During pumping from the water table aquifer (well GW-3), drawdown and corrected recovery data from the water table observation well (GW-4) were also analyzed by applying the Boulton type-curve method (Walton, 1970). This approach, like the Hantush leaky-artesian type curve approach, involves plotting field data on full-logarithmic graph paper and matching the data to type curves drawn on graph paper of the same scale. Again, the aquifer transmissivity and storativity can be calculated from the coordinates of a convenient match point, while the type curve parameter can be used to calculate the specific yield of the aquifer.

In addition to the Jacob and Hantush methods noted above, the data from the shallow rock (GW-1 and GW-6) and intermediate sand (GW-2 and GW-5) wells, obtained during pumping from either of those units, were analyzed by applying the anisotropic, partial-penetration approach outlined by Weeks (1969). These analyses were conducted because the shallow-rock and intermediate sand units appeared to be in direct hydraulic communication, and it was thought that they might behave as a single aquifer exhibiting horizontal-vertical anisotropy, in which case any of Wells GW-1, 2, 5, or 6 would only partially penetrate the anisotropic aquifer.

The anisotropic partial-penetration approach is again a type-curve technique. However, for each pumping test, a family of type curves must be prepared for each observation well. In the present case there were two pumping tests (GW-1 and GW-2) and three observation wells for each test, so a total of six families of type curves were prepared. Each family of curves consisted of several curves drawn for different values of the ratio of horizontal to vertical hydraulic conductivity. The analysis proceeds by matching field data plots on full-logarithmic graph paper with type curves drawn on graph paper of the same scale.

D.2.4.2 Groundwater Quality Data

Analyses of groundwater quality data consist of four sets of quarterly water quality samples.

The water quality data were reviewed for evidence of time and spatial variations in water quality. For each sample collected in August, 1980, the reported analyses were used to construct graphical representations as proposed by Stiff and Piper (Hem, 1970). The graphical representations were then compared to discern any obvious spatial differences in water quality.

For each reported analysis, a check on ionic balance was conducted by comparing total milligram-equivalents per liter (meq/l) of major cations with total meq/l of major anions. Reported concentrations of total and dissolved chemical species were also compared with appropriate groundwater quality standards.

D.2.4.3 Impact Analyses

Groundwater Supply Impacts

The potential impacts of developing the required groundwater supply from the Floridan Aquifer were analyzed by predicting the long-term cone of depression of the Floridan Aquifer piezometric surface in the vicinity of planned withdrawal wells. Projections were made for two cases: long-term average production of 3,600 gallons per minute (gpm), and short-term (24-hour) maximum production of 5,400 gpm.

Drawdown resulting from long-term average production at a constant rate from a leaky artesian aquifer was calculated using the following formula (Walton, 1970):

$$s_1 = (Q_1/2\ T)\ K_o\ (r/B), \qquad \text{(D.2-1)}$$

where s_1 = drawdown

r = distance from pumped well to point of calculation

Q_1 = constant long-term rate of production

T = aquifer transmissivity

B = $[T/(K'/b')]^{1/2}$

K' = hydraulic conductivity of leaky layer

b' = thickness of leaky layer

The function $K_o(r/B)$ is the modified Bessel function of the second kind of order zero, and can be evaluated by techniques given by Abramowitz and Stegun (1964). Drawdown resulting from short-term maximum groundwater production was calculated by superimposing on the long-term average drawdown (Eq. D.2-1) an additional amount of drawdown calculated using the following formula (Walton, 1970):

$$s_2 = (Q_2/4\ T)\ W\ (u, r/B) \qquad \text{(D.2-2)}$$

where s_2 = additional drawdown

Q_2 = short-term (24-hour) production rate for second well

u = $r^2\ S/4Tt$

S = storativity of aquifer

t = duration of production from second well (24 hours),

and other symbols have been defined above. The function $W(u, r/B)$ is given by the following integral, values of which are available in tabular and infinite series form (Walton, 1970):

$$W\ (u, r/B) = \int_u^{\infty} (1/y)\ \exp\ (-y - r^2/4B^2y)\ dy \qquad \text{(D.2-3)}$$

Solid Waste Disposal Impacts

The potential impacts on the groundwater regime will be primarily limited to the effects of leachate from raw material storage and solid waste disposal areas. Although various potential sources may produce different quantities of

leachate of different quality, the general approach to analyzing their impacts is the same for each source:

1. estimate the rate of leachate infiltration to the groundwater;
2. estimate the dilution of leachate once it reaches the water table;
3. estimate the rate of transport of leachate through the groundwater regime; and
4. estimate the resultant groundwater quality at locations such as the solid waste boundary, site boundary, or areas of groundwater discharge to surface water bodies or sensitive wetlands.

In order to investigate the sensitivity of potential groundwater quality impacts to various relevant parameters, extremely conservative calculations have been carried out, as described below and in Section D.5.

Leachate Infiltration

In areas where solid waste or raw materials are stored at the surface, the rate of infiltration will depend on the relative values of infiltration of precipitation and vertical hydraulic conductivity of natural surface materials, waste pile materials, and the clay liner (if any).

For cases in which the source of potential leachate includes ponded water, the ultimate rate of steady-state seepage can be calculated using the following formula (Polubarinova-Kochina, 1962):

$$q = \bar{K}\,(H+L)/L, \qquad \text{(D.2-4)}$$

where q = seepage rate per unit area of waste disposal pond

$\bar{K}$ = effective hydraulic conductivity of materials lying between ponded water and natural water table

$$q = \bar{K}\,(H+L)/L, \qquad \text{(D.2-4)}$$

where q = seepage rate per unit area of waste disposal pond

$\bar{K}$ = effective hydraulic conductivity of materials lying between ponded water and natural water table

L = total thickness of materials lying between ponded water and natural water table (= length of seepage path for vertical seepage and horizontal stratification)

H = depth of ponded water

For a system consisting of three horizontal layers of material of thicknesses (L_1, L_2, and L_3) and hydraulic conductivities (K_1, K_2, and K_3) respectively,

$$L = L_1 + L_2 + L_3 \qquad \text{(D.2-5)}$$

and

$$L/\bar{K} = L_1/K_1 + L_2/K_2 + L_3/K_3 \qquad \text{(D.2-6)}$$

(Polubarinova - Kochina, 1962). Such a system could represent a pond with a clay liner of thickness L_2 and hydraulic conductivity K_2, overlain by a layer of solid waste of thickness L_1 and hydraulic conductivity K_1, and with a thickness L_3 of natural aquifer material with hydraulic conductivity K_3 lying between the bottom of the clay liner and the water table.

For cases which do not involve ponded water, estimates of seepage can be obtained by calculating an effective permeability for a multi-layered system using Eq. D.2-6, and then conservatively assuming that the system is fully saturated with a unit head applied (i.e., no ponded water). If the effective permeability of the multi-layered system exceeds the average rate of infiltration of precipitation, then the rate of leachate production is assumed

Dilution of Leachate

Leachate which percolated downward to the water table will be diluted by mixing with groundwater flowing through the aquifer beneath the leachate source. For a given dissolved chemical constituent, the dilution can be represented by the following formula:

$$C_o = (C_L Q_L + C_G Q_G)/(Q_L + Q_G), \quad \text{(D.2-7)}$$

where C_L = concentration of dissolved constituent in leachate,
Q_L = volumetric rate of introduction of leachate,
C_G = concentration of constituent in groundwater,
Q_G = volumetric rate of groundwater flow beneath leachate source, and
C_o = resultant concentration of constituent downgradient from leachate source.

Dilution can then be represented by C_o/C_L.

For a given leachate source, Q_L is given by the product of the rate of leachate infiltration discussed above and the surface area A of the leachate source. If it is assumed that the leachate source is a square of area A, and that the groundwater underflow beneath the source is normal to one side of the square, then

$$Q_L = q\ A \quad \text{(D.2-8)}$$

and

$$Q_G = KIb\ A^{1/2}, \quad \text{(D.2-9)}$$

where K = hydraulic conductivity of aquifer
b = saturated thickness of aquifer
I = hydraulic gradient, and
q = the rate of leachate infiltration.

Leachate Transport and Dispersion

Once leachate has been introduced to the water table aquifer, it will be transported downgradient, and concentrations of dissolved constituents will be further reduced by the process of hydrodynamic dispersion (Bear, 1972). For

the leachate sources discussed above, theories of the continuous introduction of leachate to the aquifer must be applied. Practical solutions to problems involving two-dimensional dispersion of contaminants from a continuous point source have been presented by Hunt (1978) and Wilson and Miller (1978). In the present context, those solutions are generally not applicable because the areal dimensions of the leachate source are of the same order of magnitude as the length of the downgradient travel path. Closed-form solutions to the problems of continuous injection of leachate from a two-dimensional source area do not appear to be available in the literature. Although more sophisticated modelling techniques are available, it was ultimately decided not to carry out detailed calculations of dispersion downgradient from solid waste sources in order to maintain conservatism in estimating groundwater quality impact. Rates of leachate transport have been estimated by applying the formula

$$v = KI/m, \qquad \text{(D.2-10)}$$

where v = rate of transport of dissolved species
K = hydraulic conductivity of aquifer
I = hydraulic gradient, and
m = effective porosity of aquifer

Resultant Groundwater Quality

For purposes of conservatively estimating potential impacts on the groundwater of solid waste disposal, Eq. D.2-7 has been applied using the groundwater quality data obtained from the field investigations program and appropriate estimates of leachate quality from literature sources. Since no detailed dispersion analysis has been conducted, it has been assumed that relative concentrations of dissolved constituents at site boundaries or discharge points are given by the leachate dilution formula (Eq. D.2-7). Note that for a continuous source of leachate, the form of existing analytical solutions of dispersion problems indicates that once the concentration of a dissolved constituent has attained its maximum value at the site boundary or wetlands area, the concentration of that constituent in the groundwater will

remain at that maximum value so long as leachate continues to be introduced at the assumed rate and concentrations. Even the retardation of ionic motion as a result of sorptive phenomena does not change the steady state distribution of dissolved species, but only the rate of development of that distribution (Wilson and Miller, 1978).

D.3 REGIONAL HYDROGEOLOGIC FRAMEWORK

The site is situated in the Atlantic Coastal Plain physiographic province, and is underlain to depths of 2100+ feet by rocks and sediments ranging in age from Eocene to Recent. General stratigraphic and hydrologic conditions in Duval County are shown in Table D-3.

D.3.1 Regional Geology

The sedimentary stratigraphy of penninsular Florida consists of about 8,000 feet of marine, littoral, and terrestrial deposits. Paleozoic and Mesozoic sequences comprise approximately 5,000 feet of these sediments. Their depth of burial makes them of little consequence to this study. Cenozoic strata, extending to over 3000 feet below the ground surface, include all of the geologic and hydrologic formations pertinent to this project.

The Cedar Keys limestone constitutes the lowest or oldest strata in the Cenozoic series. The limestone was deposited in an open Paleocene sea. Little is known of the lithology of the Cedar Keys, as only one well in the Jacksonville area has penetrated the formation. Generally, the Cedar Keys is believed to consist of evaporites and hard bioclastic limestones, some of which likely have been dolomitized. Most importantly, it serves as the regional aquiclude or lower confining unit for the overlying Floridan Aquifer.

The Floridan Aquifer comprises all of the Eocene deposits in the region. The aquifer consists of 4 or 5 formations, depending on the specific locale. In ascending order they are: the Oldsmar limestone of Wilcox stage; the Lake City, Tallahasee, and Avon Park limestones of Claiborne stage; and the Ocala Group of Jackson stage.

The Oldsmar limestone has been divided into two units in the region (Franks and Phelps, 1979). An upper, low permeability zone of hard limestone and dolomite, approximately 400 to 500 feet thick, serves as a semi-confining zone within the Floridan aquifer. The lower zone consists of porous limestone

and dolomite with thin gypsiferous lenses. The zone is approximately 150 feet thick (Leve and Goolsby, 1967) and is potentially a high water producing zone. Few wells currently are completed in this zone, however.

The Lake City limestone lies uncomformably on top of the Oldsmar. The Lake City consists of alternating layers of chalky and dark brown glauconitic limestone. The rock tends to increase in clastic content to the west. The formation is rather dense, with dolomitization having reduced the permeability in some areas. Thickness of the Lake City limestone in the region varies from 250 to 500 feet (Leve, 1966).

The contact between the Lake City and the overlying Tallahassee is believed to be conformable (Applin and Applin, 1944). The Tallahassee, however, does not underlie much of the Duval County area. Erosion during Eocene time removed the formation in eastern coastal areas. Where present the Tallahassee and penecontemporaneous limestones are non-fossiliferous and light colored with lenses of clay, chert, and gypsum.

The Avon Park limestone rests unconformably on the Lake City where the Tallahassee is absent, and conformably on the Tallahassee where it is present. The Avon Park is a chalky, light colored limestone, with increasing hard limestone and dolomite beds to the northeast. Thickness of the formation varies from 260 feet to as thin as 40 feet where erosion has left only the lowermost section.

The top of the Avon Park is an erosional surface upon which the Ocala Group was deposited, the last deposition of the Eocene epoch. In some areas the Ocala is undifferentiated, in others it has been divided into three formations (Leve, 1966): the Inglis, Williston and Crystal River formations. The subdivisions are largely time-stratigraphic as the formations have similar lithology. The group consists of white to tan, soft limestone. Solution caverns are common. Texture of the rock is commonly granular, but calcite deposition has filled many interspaces (Cooke, 1945). The Ocala group is quite pervious and is a primary source of groundwater through northeast

Florida. The Ocala is also the oldest deposit to outcrop in Florida. Exposures of the group are visible along a structural feature known as the Ocala Arch, located some 60 to 70 miles west and southwest of the Jacksonville area.

During Oligocene time the area was uplifted and eroded. For this reason no Oligocene sediments remain in the vicinity of the study site. To the west, the Suwannee Limestone was deposited. This formation is yellowish green to cream colored, with alternating hard and soft layers. The formation is less than 100 feet in thickness, decreasing in an easterly direction. In the Jacksonville area, denudation continued into Miocene time. With the slow transgression of the seas in early middle Miocene, the Hawthorn formation was deposited unconformably on top of the Ocala.

The Hawthorn formation serves as the upper confining unit for the Floridan aquifer. The formation consists of deltaic and shallow marine gray phosphatic sands, with layers of greenish clay. Fossiliferous limestone and shell beds are also common, particularly in the upper half of the formation. Sand and porous limestone in this upper section have been tapped by artesian wells in the Duval County area. The Hawthorn underlies all of Peninsular Florida, except in the Ocala uplift located in the north-central portion of the peninsula (Cooke, 1945), where late Miocene and Pliocene erosion removed the formation.

The Hawthorn formation is overlain by a sandy limestone often called the Choctawhatchee formation (Clark et al, 1963). The contact is conformable, and thus in many areas it is difficult to distinguish. The Choctawhatchee contains numerous thin shell beds and traces of phosphatic sand. The upper sands of this late Miocene formation were likely eroded or reworked during Pliocene or Pleistocene time.

The post-Miocene deposition in peninsular Florida is characterized by a complex series of unconsolidated sands, clays, and shells. Pliocene deposits are scarce as a dynamic depositional environment during this time precluded

appreciable sediment accumulation. Where present, undifferentiated upper Miocene and Pliocene deposits consist of poorly sorted sands, gray sandy clays, and shell beds with abundant mollusks. Hydrologically these sediments exhibit low permeability, but local water bearing zones exist.

Pleistocene and Holocene deposits comprise the upper 20 to 90 feet of sediments in northern peninsular Florida. They are largely yellow to tan colored sands, with scattered thin clay layers.

D.3.2 Regional Aquifers

Two aquifer systems of regional significance underlie the site. The top of the deeper, Floridan aquifer lies at depths of between 460 and 600 feet in the Duval County area, and is the principal source of fresh water in Northeast Florida. Shallower aquifers, collectively referred to as the shallow-aquifer system (Fairchild, 1972), generally extend from the surface to depths of 100 feet in the Duval County area, providing water to shallow wells for primarily domestic and some industrial uses.

D.3.2.1 Floridan Aquifer

Groundwater in the Floridan aquifer occurs under artesian conditions. The aquifer comprises a 1600 foot sequence of alternating layers of soft, highly permeable limestones, and hard crystalline limestones and dolomites of Eocene age (Franks and Phelps, 1979). Franks and Phelps subdivide the aquifer into an upper and lower permeable zone. The upper permeable zone includes limestones of the Ocala Group, the Avon Park Limestone, and the Lake City Limestone, and averages approximately 1000 feet in thickness. Within the upper permeable zone, at least two water bearing intervals can be recognized. Limestones of the Ocala group constitute the first water-bearing interval and generally comprise the upper 200-400 feet of the Floridan aquifer. These are separated from a second, deeper water bearing interval by dense, relatively impermeable dolomites of the Avon Park Limestone. The second water-bearing

interval occurs primarily in a 400-500 foot thick interval of the Lake City Limestone, but may also include permeable limestones of the overlying Avon Park Limestone and underlying Oldsmar Limestone.

In the Jacksonville area, the top of the first water bearing interval generally occurs at depths of 400 to 600 feet below mean sea level (Leve, 1978). The second water-bearing interval of the upper permeable zone generally occurs at depths of between 950 and 1,200 feet below land surface (Leve, 1966).

Transmissivity of the upper permeable zone ranges from 1.5×10^5 to 1.5×10^6 gallons per day per foot (gpd/ft), based on an analysis of 20 aquifer tests in Duval County (Franks and Phelps, 1979). An average transmissivity of 6.0×10^5 gpd/ft was estimated for the Duval County area. A specific storage of $10^{-6}ft^{-1}$ was calculated from test data for the upper permeable zone and is considered to be fairly uniform in the Duval County area (Franks and Phelps, 1979).

The upper permeable zone is confined by the overlying Hawthorn Formation ("Upper confining unit" of Franks and Phelps, 1979). The Hawthorn Formation, averaging 400 feet in thickness, consists of silt, sand, shell and limestone beds of low to moderate permeability, and thin, nearly impermeable clay beds. Vertical hydraulic conductivity was estimated to be 1.0×10^{-3} ft/d. Specific storage was estimated to be $1.0 \times 10^{-5}ft^{-1}$ (Franks and Phelps, 1979).

The upper permeable zone is partially confined below by dense limestones and dolomites of the Lake City Limestone and the upper portions of the Oldsmar Limestone. Franks and Phelps (1979) report values of 1.5×10^{-1} gpd/ft and $10^{-6}ft^{-1}$ for vertical hydraulic conductivity and specific storage, respectively, for this semi-confining zone.

The upper permeable zone is the principal source of groundwater for municipal, industrial and domestic supplies in Duval County. Yields of wells completed in the upper permeable zone vary as a function of well construction,

depth of penetration, water transmitting properties of the rock penetrated by the well bore, and piezometric head. Wells penetrating the full thickness of the upper permeable zone typically yield in excess of 1000-2000 gallons per minute (gpm) by natural flow (Leve, 1966).

The lower permeable zone of the Floridan aquifer includes porous limestones and dolomites in the lower portion of the Oldsmar Limestone (Franks and Phelps, 1979). Very little hydrologic data is available for the lower permeable zone. Since adequate well yields are usually obtained by wells penetrating the upper permeable zone, development of the lower permeable zone for water supply in the Duval County area has been limited. A water-exploration well drilled in the Jacksonville area in 1966 penetrated the full thickness of the lower permeable zone (Leve and Goolsby, 1967). Fluid velocity logging indicated a highly permeable zone between depths of 1,900 and 2,050 feet below land surface. This interval was estimated to be contributing in excess of 400 gpm to the well's free-flow discharge of 1000 gpm. Well-head pressures were measured during the construction of the well and increased abruptly when the lower permeable zone was penetrated (Leve and Goolsby, 1967).

The lower permeable zone is underlain by the Cedar Keys limestone, a sequence of dense limestone, dolomite and evaporite beds ("Lower confining unit" of Franks and Phelps, 1979). Although there appear to be no quantitative hydrologic data for the lower confining unit, the unit is reported to have a very low permeability (Franks and Phelps, 1979).

The potentiometric surface for the Floridan aquifer in the Jacksonville area is illustrated in Figure D-2. Increasing water use from the Floridan aquifer has resulted in declines in the potentiometric surface averaging 0.5 to 2.0 feet per year over a period of 20-25 years ending in 1962 (Leve, 1966). In addition, high volume pumping in areas such as Eastport and Jacksonville has resulted in local depressions in the potentiometric surface.

Recharge to the Floridan aquifer in Northeast Florida occurs to the west and southwest of Duval County in areas of Putnam, Clay, Alachua, and Bradford Counties. Recharge enters the aquifer as direct infiltration of rainfall

where the aquifer is exposed at the surface, by downward percolation of water where confining beds are breached (by e.g., sinkholes and fractures), and by leakage through underlying and overlying confining beds where the potentiometric surface of the Floridan aquifer is lower than that of adjacent, water-bearing zones. Recharge may also be induced in areas where the potentiometric surface has been lowered artificially, e.g., by excessive pumping, to a level below that of adjacent water-bearing zones (Leve, 1966).

Water entering the aquifer generally moves laterally to the northeast, from areas of higher potentiometric head to discharge areas of lower potentiometric head (Figure D-2). Discharge from the Floridan aquifer occurs naturally as spring discharge, leakage through overlying beds, and probably as natural discharge to the Atlantic Ocean. In the Duval County area, the primary discharge from the aquifer is to municipal, industrial and domestic wells (Leve, 1966).

Water from the Floridan Aquifer in the Duval County area is suitable for domestic and most industrial uses (Leve, 1966). The quality of water varies primarily as a function of sampling location, sampling depth, and date of sampling. Results of water analyses of 43 wells penetrating the Floridan Aquifer in Duval County (Leve, 1966) yielded an average total dissolved solids content of 355 milligrams per liter (mg/l), and an average conductivity of 446 micromhos per centimeter. Carbonate hardness averaged 242 mg/l, indicating very hard water. Dissolved iron averaged 0.21 mg/l.

Hydrogen sulfide gas is frequently reported in wells in the Floridan aquifer, and ranged from 1.0 to 3.0 mg/l in analyses of samples from 60 wells in Duval County (Leve and Goolsby, 1969).

Chloride content of water from the Floridan aquifer is generally less than 30 mg/l (Leve, 1966). Increases in salinity have been documented in a number of wells in the Duval County area, including test Well D-425 in the Jacksonville area, and at least one production well operated by the City of Jacksonville-Lovegrove Pumping Station (Franks and Phelps, 1979). The general

increase in chloride content in water from the Floridan aquifer can been seen by comparing Figure D-3, which shows the distribution of chloride concentration in 1940, with Figure D-4, which shows the distribution of chloride concentration in 1962. Increases in chloride content have been correlated with a decline in artesian pressure. The correlation is most apparent in areas of excessively high water use, e.g., Jacksonville and Eastport (see Figure D-4), where high rates of pumping from the aquifer have caused the formation of distinct cones of depression. In these areas, chloride content has increased from between 10 and 20 mg/l in 1940 to between 30 and 40 mg/l in 1962 (Leve, 1966). At Fort George Island, chloride concentrations in water from one well reportedly have increased from above 60 mg/l in 1940 to 170 mg/l at present (Franks and Phelps, 1979). In general, the incidence of high chlorides appears greatest for wells penetrating permeable zones deeper than the Ocala, where there is less hydrologic separation from the inferior quality water within the Cedar Keys limestone and underlying formations (Leve, 1966). The rate of increase in chloride concentration is also greater for wells completed in deeper permeable zones of the Floridan aquifer. Based on data presented by Leve (1966), the rate of increase of chloride concentrations was about 0.25 mg/l per year between 1940 and 1962 for wells completed in the Ocala, while the rate ranged up to about 7.5 mg/l per year for wells completed in deeper formations.

Leve and Goolsby (1967) investigated the relationship between water quality and depth within and below the Floridan Aquifer in a water exploration well drilled in the Jacksonville area. The well was drilled to a depth of 2486 feet, penetrating the full thickness of the Floridan aquifer and terminating in the Cedar Keys limestone. Water in the lower permeable zone (well depth 1900-2050 feet) was found to be less mineralized than water sampled from upper permeable zones, indicating a degree of hydraulic separation of the upper and lower permeable zones at this location. Highly mineralized water was detected at a depth of around 2,100 feet in non-productive, low permebility rocks of the Cedar Keys limestone.

The progressive increase in salinity in several wells in the area appears to be the result of an excessive lowering of potentiometric levels in fresh water zones, allowing invasion of saline water from deeper sources. Lateral intrusion of saline waters is apparently not significant in the Jacksonville area. Confining beds separating the lower permeable zone from the deeper, saline sources, and the semi-confining bed separating the lower and upper permeable zones, appear to have retarded the upward migration of inferior quality water in many areas. Increased production from the Floridan aquifer, particularly in those areas where production has already caused a significant lowering of the potentiometric surface, is likely to be accompanied by further increases in salinity (Franks and Phelps, 1979).

Structural anomalies, such as faulting and solution phenomena (sinkholes), may provide a natural mechanism for upward migration of saline waters by allowing hydraulic communication between permeable zones within the Floridan aquifer or between permeable zones of the Floridan and underlying zones containing mineralized water. At present, however, there is no known evidence establishing this as a significant factor in the increase of chlorides observed in Duval County.

The Floridan aquifer serves as the principal supply of fresh water in the Jacksonville/Northeast Duval County area. In 1966, an estimated total of 162 million gallons per day (mgd) was being withdrawn from the aquifer (Leve and Goolsby, 1969). Table D-4 summarizes withdrawals from the Floridan aquifer by use for 1966.

D.3.2.2 Shallow Aquifers

Several shallow aquifers underlie the Duval County area to depths of 150 to 200 feet, and are an important source of water for domestic supply, heat exchange, and industrial and agricultural uses (Fairchild, 1972).

The shallow aquifer system consists of limestone and sand aquifers in the upper part of the Hawthorn Formation; shell, limestone, and sand aquifers in Pliocene or upper Miocene deposits; and sand and shell aquifers in the

Pleistocene and Holocene deposits. In many areas, the shallow aquifer system may consist of a single, relatively thick aquifer extending downward from the water table to the Hawthorn Formation. In central and eastern Duval County, the system consists of a series of relatively thin permeable zones separated locally by a number of thin confining beds (Leve, 1966).

General stratigraphic and hydrologic relationships of the shallow aquifer system are indicated in Table D-5.

Most wells in the Jacksonville area producing water from the shallow aquifer system have been completed in an interval referred to as the "shallow-rock zone", consisting of porous, sandy limestone in the Upper Miocene or Pliocene deposits, lying at depths of between 40 and 100 feet below land surface (Fairchild, 1972).

Several wells have been drilled to penetrate deeper sands and limestones within the Hawthorn. The Hawthorn is not considered to be a good source of water due to an abundance of clay and silt, and the restricted geometry of the water bearing sands and limestone.

A second, although less important aquifer, referred to as the shallow water table aquifer, is formed by the loose, unconsolidated sands and shell beds of Pleistocene and Holocene age, overlying the shallow-rock zone. These surface sediments form an aquifer ranging up to 90 feet in thickness and are typically developed with shallow, sand point type wells. Where saturated, the shallow sediments frequently require dewatering in cases where they are to be exposed by excavations.

Transmissivity of the shallow rock aquifer ranges from 2000 to 10,000 gpd/ft. The average thickness of the aquifer was approximately 17 feet in 13 test wells drilled in Duval County for the purpose of evaluating the aquifer's hydrologic properties (Causey and Phelps, 1978).

The aquifer occurs in conditions ranging from full artesian to water table, and the storage coefficient is expected to range from 10^{-1} to about 10^{-5}. Well yields in the shallow aquifer are generally less than about 100 gpm, although higher yields (up to 200 gpm) have been reported (Causey and Phelps, 1978).

Water in the shallow, surficial sands occurs under water table (phreatic) conditions. Wells drilled for an evaluation of the water table sands generally yielded less than 10 gallons per minute. One well yielded in excess of 40 gpm, having encountered a shell bed in the surficial sands (Causey and Phelps, 1978).

D.4 SITE HYDROGEOLOGIC FRAMEWORK

D.4.1 Site Geology

The deepest and oldest geologic formation pertinent to this study is the Cedar Keys Limestone. The Cedar Keys represents the aquiclude or lower confining unit for the Floridan Aquifer. The formation is generally a dense clastic limestone, with occasional evaporite layers.

The Floridan Aquifer overlying the Cedar Keys formation is comprised of four lithologic units. In ascending order they are: the Oldsmar, Lake City, Avon Park and Ocala formations.

Information on the Oldsmar Limestone was obtained from a USGS test hole drilled in Jacksonville in 1966 (Leve and Goolsby, 1967). Based on this well and subsequent investigations, the Oldsmar has been divided into an upper and a lower unit. The upper unit was encountered at a depth of 1300 feet and extended down to 1890 feet. This section consists of gypsiferous and dolomitic limestone. The rock is quite hard and relatively impervious, and apparently is laterally extensive (Leve and Goolsby, 1967). The lower unit of the Oldsmar extends from a depth of 1,890 feet to the contact with the underlying Cedar Keys formation at approximately 2,000 feet. The test well encountered a water bearing zone in this section and continuing into the Cedar Keys to a depth of 2050 feet. Lithologically, this section is comprised of soft, porous limestone and dolomite beds.

The Lake City limestone lies uncomformably on the Oldsmar. In the vicinity of the site, the formation extends from about 800 to 1,100 feet in depth. It is moderately permeable, consisting of chalky limestone, gray to grayish brown in color. Occasional denser dark brown limestone lenses are present as well.

The contact between the Lake City and the overlying Avon Park is also unconformable. Much of the Avon Park has been eroded away in the Jacksonville area. The formation here is only about 60 feet thick, extending from 738 to approximately 800 feet in depth (Leve, 1966). It is cream colored to light brown in color, hard, and generally consists of chalky limestone and dolomite.

The Ocala group of late Eocene age was deposited on the erosional surface of the remnant Avon Park. Three time-stratigraphic units have been used to divide the Ocala: the Inglis, Williston, and Crystal River formations. The formations are lithologically similar in the site area, and can be treated as one unit. The Ocala, an important regional aquifer, is approximately 270 feet thick, extending from 470 to 738 feet in depth in test well F-1. The rock is a fossiliferous limestone with occasional dolomitized lenses. Much of the strata is susceptible to solutioning, and the resultant voids have increased the permeability. Color ranges from chalk white in the upper portions to light brown or yellowish brown with depth.

Oligocene sediments are absent at the site. It is postulated that the Jacksonville area was an island during the Oligocene Sea (Applin and Applin, 1944; Clark et al., 1964). Transgression of the sea began again in late Oligocene and early Miocene time, resulting in the deposition of the Hawthorn formation.

The Hawthorn formation was deposited in shallow marine and near-shore terrestrial environments. It consists of thick layers of bluish gray clays, with lenses of moderately cemented limestone and loose sand. The interlayered sands are commonly phosphatic, giving them a characteristic green to greenish gray color. The formation is approximately 340 feet thick at the site, likely extending from about 90 to 470 feet below ground.

The late Miocene Choctawhatchee formation has not been identified at the site. A 10 to 30 foot thick section of interbedded limestone, clayey sands, and shell beds have been encountered overlying the Hawthorn east of Jacksonville. The sands contain only traces of phosphate which differentiates

them from the underlying Hawthorn. This stratum is probably contemporaneous with the Choctawhatchee and is similar in lithology. Its contact with the Hawthorn is apparently conformable, and thus these upper beds may represent a transition into Pliocene deposits.

The uppermost 40 to 60 feet of sediments at the site are comprised of unconsolidated deposits of upper Miocene to Holocene age.

Late Miocene or Pliocene deposits make up the lower 10 to 50 feet of this sequence. The sediments contain numerous sand lenses, with interlayered shell and clay beds. Mollusk shells are common. The sand layers appear fairly continuous across the site, but are not continuous regionally, due to gradual and abrupt facies changes to more argillaceous sediments.

Pleistocene and Holocene (Recent) deposits at the site are 40 to 50 feet thick. The upper 20 to 30 feet consists of relatively clean sands. The sands are tan to yellowish gray in color and generally well sorted. The lower 20 to 30 feet of this Pleistocene/Holocene sequence is characterized by increasing clay and shell content. Thin, clean sand lenses, however, are also interspersed in this lower section. The clays are gray to bluish gray in color and moderately plastic, and the shells are largely fragments. The sands are commonly fine grained; thicker lenses exhibit a fining upward sequence with some coarse-grained lenses at the bottom of each sequence. In general, the coarse sands tend to have less clays mixed in than the finer sands. This type of sedimentation is typical of the deltaic deposition that characterizes the eastern Jacksonville area.

The site is capped by a thin but well defined organic soil horizon. The Kershaw-Ortega soils predominate, consisting of brown organic, well drained sands grading rapidly downward into the Holocene deposits discussed above. The shallow water table and abundant rainfall allow for rapid decomposition of native grasses and forbs which comprise the understory.

The geologic structure of the study site is dominated by two sets of features: (1) the erosional unconformities between depositional sequences, and (2) an erratic upper surface to the Ocala Group and underlying Avon Park limestone, theorized to be a fault set with associated horst and graben movement (Leve, 1978).

The erosional unconformities lend complexity to the site geology, particularly in correlation of the shallow sediments. The depositional surfaces have been shown to be quite undulatory in this region (Clark, et.al., 1964; Fairchild, 1972). The lateral continuity of both water bearing sands and impermeable clays will thus be affected by the unconformable contacts. Facies changes within the shallow sediments preclude lateral correlation of the lithologic units. Analysis of well and drill hole data for the area indicate that depositional surface undulations may have amplitudes on the order of 10 to 20 feet. This exceeds the thickness of many of the lithofacies.

Leve (1966 and 1978) has postulated the existence of a pre-Hawthorn fault across the site. He originally proposed the location of a single fault trace, with upthrown and downthrown sides on the west and east respectively. His revised theory in 1978 indicates two fault traces with a downthrown graben in between (see Section 2.4, Geology and Soils). The eastern trace crosses the site in a northeast-southwest trend, whereas the western margin of this inferred graben is placed approximately three miles west of the site. The faulting is postulated to have occurred after deposition of the Ocala, but prior to Miocene sedimentation.

Evidence for the existence of the fault is a pronounced anomaly in the upper surface of the Ocala group and in the position of the underlying Avon Park. An offset of about 100 feet is indicated (Leve, 1978). The faults do not extend to the surface and are not considered capable.

D.4.2 Site Hydrogeology

D.4.2.1 Floridan Aquifer

An inventory of wells was made in the vicinity of the site (Figure D-5) for detailed information on local hydrogeologic conditions. The inventory consisted of a search of all wells lying within the area bounded by latitudes 30°22'00" to 30°28'00" and longitudes 81°30'30" to 81°36'00" contained in the U.S. Geological Survey's WATSTORE system (Water Data Storage and Retrieval System).

The inventory was supplemented by the results of an inspection of well records maintained by the U.S. Geological Survey's Jacksonville Office.

The well inventory resulted in the identification of approximately 90 Floridan wells in the search area, including information on well ownership, well construction, well performance, water levels, and water quality. Results of the inventory are summarized in Table D-6.

Historical water level records for selected wells in the vicinity of the site are summarized on Figure D-6. A comparison of water levels in selected wells versus time, as shown on Figure D-6, suggests an average decline of approximately 0.4 -0.5 feet per year in potentiometric levels of the Floridan aquifer in the vicinity of the site.

Water quality data for selected wells in the vicinity of the site are reproduced in Table D-7. The data indicate the water is generally of the calcium-bicarbonate type. Average concentrations of major cations and anions are shown in Table D-8. With the exception of anomalous chloride concentrations (approximately 210 mg/l) reported for well D-360 (Table D-7), there is no indication of chloride contamination in the Floridan aquifer in the area of investigation. Well D-1908 on Blount Island had a chloride concentration of 71 mg/l in 1978. While this chloride concentration is about

2.5 times the average for all wells in the study area, the water from this well appears to be generally of the same quality as that from most other wells in the area.

A test well (Well F-1) was drilled in July-August of 1980 to investigate the physical and hydrologic properties of the Floridan aquifer at the site (for location, see Figure D-1). The test well was drilled to a depth of 752 feet, penetrating approximately 290 feet of the Floridan aquifer, including approximately 20 feet of limestone from 450 feet to approximately 470 feet (basal limestone of the Hawthorn Formation?) and approximately 270 feet of limestone from 470 feet to 738 feet, collectively referred to here as the Ocala aquifer. This water-bearing interval comprises the Ocala or upper portion of the "Upper Permeable Zone" (Franks and Phelps, 1979). Details of well construction and copies of the geologic and geophysical logs are included as Figure D-7 (Well Drilling Log), D-8 (Well Construction Log) and D-9 (Geophysical Logs).

On the basis of test drilling results, the top of the Floridan aquifer lies at a depth of 450 feet at the site. The top of the Ocala limestone, identified by a sudden abundance of the microfossil lepidocyclina ocalana, was placed at a depth of 470 feet by U.S. Geological Survey personnel.

The test well penetrated friable, white to gray colored limestone and shell in the interval 450 to 738 feet. Alternating layers of limestone and hard, light to dark brown dolomite were encountered at 738 feet, and dense, dark brown colored dolomite was penetrated at approximately 750 feet. The top of the Avon Park Formation is placed at 738 feet.

A 22-hour pumping test was conducted at well F-1 to investigate the hydrologic properties of the aquifer. A vertical turbine pump was installed at a depth of 80 feet in well F-1 for testing purposes. A well seal was installed on the well-head, and all discharge was confined to a 10-inch discharge pipe. Well discharge was regulated with a 10-inch gate valve installed in the discharge piping, and was measured with an 8-inch by 10-inch orifice plate.

Water levels in the pumping well (F-1) were measured with a piezometer tube extending 20 feet above the well flange. Access to pumping water levels was through a removable plug installed in the well seal.

Water levels were also monitored in well D-1255, located approximately 2000 feet from the pumping well (Figure D-1). Well D-1255 is owned by Capitol Concrete, Division of Florida Rock Industries, and serves as a supply well for their plant located on New Berlin Road. The plant and the well were not in use at the time of the aquifer testing. Well D-1255 is completed as an open hole in the depth interval 568 to 753 feet, coinciding with the permeable zone penetrated in well F-1. Details of construction for well D-1255 are included in the well inventory (Table D-6). Water levels in D-1255 were monitored for the duration of the aquifer test with a pressure recording instrument having a range of 0-20 feet of water and an accuracy of $\pm$ 0.5 percent of full scale.

Well F-1 was pumped for 22 hours at a constant discharge rate of 1330 gallons per minute (gpm). Water level recovery was observed for a total of approximately 22 hours in both wells. Results of analyses of the pumping test are summarized in Table D-9.

Pumping test results indicate a transmissivity of approximately 1.0×10^5 gallons per day per foot and a storage coefficient of 2.8×10^{-4}. Applying non-steady state, leaky artesian type curves to time-drawdown and time recovery data from the observation well yielded a value of 4×10^{-4} day $^{-1}$ for leakance, where leakance is expressed as the ratio of vertical hydraulic conductivity to vertical thickness of the confining bed. Franks and Phelps (1979) estimate a leakance value of 2.5×10^{-6} per day for the "Upper Confining Unit" or Hawthorn formation, approximately 100 times lower than that determined in testing of F-1. It is likely that the major component of leakage to the Ocala aquifer during the test was derived from permeable zones within and underlying the Avon Park Dolomite, rather than leakage through the Hawthorn Formation.

Static water levels measured in well F-1 and D-1255 were 19.7 and 20.1 feet above land surface, respectively. The water level elevation (36 feet above mean sea level) is consistent with those reported by the USGS for this area in 1979 (see Figure D-2).

Water quality samples were collected from well F-1 in August and November of 1980, and April and July of 1981. Results of the analyses are reported in Table D-10. In general, the water is suitable for most uses with minimum treatment. Chloride concentrations for the four samples ranged from 10.8 to 21 mg/1, and averaged 15 mg/1. These concentrations are generally consistent with, and perhaps slightly lower than chloride concentrations in surrounding Floridan wells.

Water quality of the Floridan aquifer at the site compares favorably with state of Florida water quality criteria for Class I-B waters and U.S. Environmental Protection Agency Primary and Secondary Drinking Water Standards (Table D-11).

D.4.2.2 Shallow Aquifers

An inventory of wells in the vicinity of the site included listings of approximately 15 wells completed in the shallow aquifers. Results of the inventory are included as Table D-6.

Recharge to the shallow aquifers is principally by infiltration of rainfall and percolation from surface water bodies (Snell and Anderson, 1970). Accordingly, water levels in the shallow aquifers can be expected to respond measureably to local rainfall events. Snell and Anderson (1970) report annual water level fluctuations ranging from 5 to 20 feet in topographically high regions. Water level extremes over longer periods of record may be considerably greater (Snell and Anderson, 1970).

Limited groundwater quality data are available in the vicinity of the site and are summarized in Table D-12.

Groundwater quality data are also available as the result of sampling of shallow monitoring wells installed at the North Landfill (Wells NLF-1,2,3, Figure D-1). Analyses of samples from these wells are reproduced in Tables D-13, D-14, and D-15. A brief description of site conditions at the landfill is provided in Section D.4.2.3.

Hydrologic testing by the USGS of the shallow aquifers in Duval County included tests of the shallow-rock aquifer. The USGS reports transmissivities in the range of 2000 to 10,000 gallons per day per foot for the shallow-rock aquifer (Causey and Phelps, 1978).

Inland Area of Site

Site investigations of the shallow aquifers included drilling of 97 soil borings, and construction of 27 piezometers and 6 test wells. Table D-16 summarizes the construction details for the wells and piezometers. Results of soils borings investigations are described in Section 2.4, Site Geology. The locations of the wells and piezometers are shown in Figure D-10.

The site is underlain to a depth of approximately 100 feet by unconsolidated to partially consolidated sands, silts, clays, and limestones. These sediments are saturated to within a few feet of land surface. Phosphatic silts and clays with occasional lenses of sand and limestone belonging to the Hawthorn Formation extend from a depth of approximately 100 feet to about 470 feet, the top of the Ocala Formation.

Two aquifers are recognized in the sediments extending to a depth of approximately 100 feet. The sands, shell, and limestone deposits lying between depths of about 60 feet and 90 feet constitute an aquifer referred to locally as the "shallow-rock" aquifer. Water in this aquifer occurs under confined conditions. Permeability is afforded by a combination of interconnected pore spaces within the unconsolidated sands (primary permeability) and solutioning of the more calcareous zones in the limestones, shell beds and cemented sands (secondary permeability).

Unconsolidated sands, extending from the surface to a depth of 20 to 30 feet, form a second aquifer, locally referred to as the "water table" aquifer. Water in these sands occurs under water table conditions.

The shallow-rock aquifer is confined below by phosphatic silts and clays tentatively assigned to the Hawthorn Formation. The water table aquifer appears to have a lower boundary in the interval of 20-30 feet. Increasing proportions of clay, silt, and silty sand in this interval may restrict hydrologic communication with underlying sands, although there is little evidence for lateral continuity of these lower-permeability deposits. Sediments in the interval separating the water table aquifer from the shallow-rock aquifer include permeable sands and occasional silts and clays. Hydrologic testing indicates that these"intermediate sands" are in direct hydrologic communication with the shallow rock aquifer.

General hydrostratigraphic relationships in the shallow aquifer system on the site are depicted in cross-section in Figures D-11 and D-12. Cross section locations are shown in Figure D-13.

Results of shallow aquifer testing in borings and piezometers including constant-head permeability tests, and short term constant discharge tests are summarized in Table D-17.

Test wells GW-1 through GW-6 were drilled to investigate in detail the hydrologic properties of the shallow aquifer system (including possible interrelationships between the aquifers). Results of drilling investigations are included as Figures D-14 (Drilling Summaries), D-15 (Completion Summaries) and D-16 (Geophysical Logs for GW-6).

During the period August 2-4, 1980, three pumping tests were conducted at the shallow well test site (Figure D-10). On August 2, well GS-2 was pumped for 4.5 hours at 12.5 gallons per minute; on August 3, Well GS-1 was pumped for 5 hours at 79 gpm; on August 4, Well GS-3 was pumped at 12 gpm for 1 hour,

and at 20 gpm for 1.25 hours. During each test, water levels were monitored in the pumped well and in each of the 5 other wells during the pumping period and during a period of recovery following cessation of pumping.

Results of the pumping tests were analyzed using standard techniques of analyzing semi-logarithmic and full-logarithmic plots of time-drawdown and time-recovery data (Walton, 1970) and are summarized on Table D-18. Details of the analyses results are summarized on Table D-19.

During pumping of well GW-2, completed in an intermediate zone between the water table aquifer and the shallow-rock aquifer, water level declines were observed in well GW-5, completed in the intermediate zone, and in wells GW-1 and GW-6, completed in the shallow-rock zone. However, no response was observed in wells GW-3 and GW-4, completed in the shallow, water table aquifer.

During pumping of well GW-1, water level declines were observed in wells GW-2, GW-5 and GW-6. No response was observed in wells GW-3 and GW-4 early in the test, while water levels in these shallow wells gradually rose during the latter half of the test and during the recovery period. This was probably a result of infiltration of the water discharged during the course of the test.

During pumping of well GW-3, completed in the shallow, water table aquifer, water level declines were observed only in well GW-4. No response was observed in wells GW-1, GW-5, and GW-6. In well GW-2, completed in the intermediate zone, the water level rose abruptly when pumping was begun, and then gradually declined; when the pumping rate in well GW-3 was increased from 12 to 20 gpm, the water level in GW-2 again rose abruptly, and then gradually declined; when pumping from well GW-3 was terminated, the water level in GW-2 dropped abruptly, and then gradually rose during the remainder of the recovery period. This anomalous response of the intermediate zone is believed to be a pressure effect due to unloading and loading of the overlying water table aquifer.

The results of the aquifer testing indicate that the shallow water - table aquifer is unconfined, behaves as a phreatic aquifer, and readily responds to infiltration of water discharged at the surface. The shallow-rock aquifer and overlying intermediate-zone sands are both artesian, and are in direct hydraulic communication with each other. The intermediate-zone sands appear to be hydraulically separated from the water table aquifer, probably by finer-grained sediments which may be limited in areal extent and only locally effective as a confining unit for the intermediate-zone sands.

The hydrologic properties of the three tested aquifer zones are summarized on Table D-18. Note that all three zones have essentially the same hydraulic conductivity. The water table and intermediate zones have essentially the same storage coefficient, while the storage coefficient of the shallow-rock aquifer is an order of magnitude smaller. The apparent specific yield of the water table aquifer is low, but consistent with specific yield values generally determined for water table aquifers. The hydraulic conductivities determined from these aquifer tests (Table D-18) are one or two orders of magnitude greater than those determined from testing during the soil boring program (Table D-17). In general, the aquifer tests were of longer duration and screened intervals in the wells were greater than those for the soil boring tests. Consequently, the soil boring tests are more likely to have measured vertical hydraulic conductivities, and the aquifer tests are more likely to have measured horizontal conductivities. In stratified aquifers such as the shallow materials at the site, a ten- or hundred-fold difference in horizontal and vertical hydraulic conductivities is not uncommon.

A potentiometric surface map has been constructed for the shallow aquifers from water levels measured in November, 1980 (Figure D-17). Water levels in wells and piezometers completed in the intermediate sands and the shallow-rock aquifer were included on Figure D-17 to indicate the minor differences in potentiometric levels observed between the water table aquifer and the intermediate and shallow rock zones. Gradients prevailing in the deeper aquifer appear to be lower than those within the water table aquifer.

As shown in Figure D-17, prevailing groundwater gradients in both the shallow-rock aquifer and the water table aquifer are to the southeast, toward the inland tidal areas of the St. John's River.

Selected wells/piezometers were sampled for water quality analyses. The results of these analyses are summarized in Table D-20. In general, water quality compares favorably with both state criteria for Class I-B waters and with U.S. Environmental Protection Agency Primary Drinking Water Standards (Table D-11). The State of Florida Class I-B standard for lead of 0.05 mg/l was exceeded in one instance: a concentration of 0.196 mg/l of lead was detected in well DA-41 in August of 1980. Environmental Protection Agency secondary standards for iron, manganese, pH, and color are exceeded in several wells, including wells GW-2, GW-3, GW-6, DA-41, DP-1A, and DP-1B (see Tables D-11 and D-20).

Stiff diagrams were constructed for the shallow aquifer analyses for the August, 1980 sampling period, as shown in Figure D-18. These diagrams suggest that water in the shallow aquifers is differentiable on the basis of chemical quality. Water in the shallow-rock aquifer is of the calcium bicarbonate type. Water in the intermediate sands also tends to be of the calcium bicarbonate type (e.g., DP-1A, DP-10A, Figure D-18) although sodium and chloride ions are present as a higher percentage of the total ionic weight. The quality of water in the water table sands differs principally in the fact that the total dissolved solids are generally lower than the dissolved solids in either the shallow-rock aquifer or the intermediate sands. The principal ions in solution tend to be sodium and chloride, although calcium, sulfate, and to a lesser degree magnesium also contribute significantly to the total of dissolved solids.

Blount Island (Coal Unloading Facilities)

Blount Island is essentially a point bar deposit extending northward towards the present course of the St. Johns River. As such, the near surface stratigraphy is complex due to the northerly progradation of fluvial

sediments. The deposits can be considered reworked Holocene alluvium and thus differ from those found inland at the proposed plant site. The former consist largely of interbedded silts, clays, and fine sands, whereas clean to silty sands predominate at the plant site. Additionally, the construction of the Dame Point Cut Off has resulted in substantial fill placement, particularly along the southern portion of the island. The fill is largely saturated silts and sandy clays, essentially similar to natural island materials. As river bottom sediments, they are quite high in salt content.

An intensive field investigation of subsurface conditions in an area adjacent to the proposed coal off-loading facility was undertaken by Law Engineering in 1979. Logs of their test borings show that the water table was commonly encountered within two to three feet of the ground surface and was closely tied to the level of the St. Johns River. The water is expected to be brackish in quality due to this relationship. Silts and clays were encountered in these borings more often than in borings inland at the plant site. This predominance of fine grained sediments tends to restrict the vertical movement of any infiltrating waters. Horizontal movement will be similarly affected, although to a lesser degree, as the mode of deposition dictates seams of clayey silts overlapping coarser layers. In general, the hydraulic conductivity (and thus transmissivity) of the Blount Island sediments should be appreciably lower than those at similar depths inland. Percolating waters should tend to move laterally towards the river rather than downward.

The shallow rock aquifer, identified and tested at test wells GW-1, 2, 5, and 6 at the plant site, was encountered in the Blount Island borings at depths ranging from 40 to 70 feet below the surface. The lithology is apparently similar, with weakly cemented calcareous sands interbedded with sandy fossiliferous limestones. No wells utilize this aquifer on Blount Island.

In April, 1981, five piezometers were installed at depths of 10 to 12.5 feet below land surface at the proposed coal offloading facility. Water levels in these piezometers indicated a gradient of about one foot per hundred

feet toward the river and the tributary drainage on the south of Blount Island, with static water levels about 4 to 8 feet below land surface. A short-term aquifer test conducted on one piezometer indicated an aquifer transmissivity of about 1,600 gallons per day per foot. Water samples taken from two of these piezometers had total dissolved solids (TDS) concentrations of 1,814 and 7,535 mg/l, and met the Florida Class I-B water quality standards, although concentrations of arsenic, lead, and fluoride in one sample approached the Class I-B standards. Because of the high TDS concentrations observed at the top of the water table, at very shallow depths, it is expected that TDS concentrations at greater depths, and along the margin of the island, will exceed 10,000 mg/l.

D.4.2.3 Facilities Adjacent to the Proposed Site

North Landfill

The North Landfill, located to the north of Island Drive and to the east of New Berlin Road (Figure D-19), was permitted for operation in April of 1977. The landfill receives an estimated 500-600 tons per day of municipal solid waste; no industrial wastes are stored at the landfill at the present time. The landfill has a life expectancy of approximately 20 years, given present site boundaries and methods of landfilling (Sheffield, 1980).

The landfill is surrounded by a perimeter ditch, which appears to have penetrated the local water table in places. The perimeter ditch is designed to intercept seepage from the landfill and convey it to a series of six polishing (oxidation) ponds before discharging to a tributary to Browns Creek.

Groundwater quality at the landfill is monitored in three observation wells (Figure D-19). Results of water quality analyses are presented in Tables D-13, 14 and 15. These analyses suggest little or no deterioration of groundwater quality to date, as a result of the landfill operation. Maximum contaminant levels for Class I-B waters are listed in Table D-11. These

levels are exceeded in occasional groundwater samples from the North Landfill; however, there is no indication of progressive increases in concentrations of dissolved constituents for the period of record.

Northside Generating Station

The NGS adjoins the sourthern and western boundaries of the site (Figure D-19).

Groundwater use at the NGS is expected to average approximately 1.1 million gallons per day by the year 1982 (JEA, 1980). Groundwater is obtained from 4 wells completed in the Floridan aquifer to depths of approximately 1100 feet. A fifth well, also completed in the Floridan aquifer, is not in use and has been capped.

A series of percolation/evaporation ponds to the north of the powerplant receives liquid waste streams from the boiler cleaning process and water treatment systems (principally demineralizer regeneration wastes). Prevailing gradients in the shallow aquifers at the site (Figure D-17) are generally to the south and east. Treated waters entering the shallow groundwater system in the region of the percolation/evaporation ponds at the Northside Station will migrate down gradient, generally in the direction of the St. Johns River.

Offshore Power Systems

Facilities belonging to Offshore Power Systems (OPS) occupy the eastern portion of Blount Island. These facilities, including a large crane, administration and manufacturing buildings, and laydown areas were designed to support construction of floating nuclear generating units. Several large diameter wells were drilled to provide a groundwater supply for OPS (Wells D-1290, D-1908, D-2088, D-1289, D-1288, D-1902, Figure D-5 and Table D-6). OPS facilities are in limited operation and groundwater is being used at less than 0.1 MGD (BESD, City of Jacksonville, temporary water use permits).

Jacksonville Port Authority

The Jacksonville Port Authority (JPA) operates port facilities located on the southwestern portion of Blount Island. Enclosed warehouses and unenclosed automobile storage areas comprise the major portion of the actively used areas. Present water use at the JPA facility is estimated at less than 0.1 million gallons per day (BESD, City of Jacksonville, temporary water use permits) developed from several Floridan wells (D-488, D-489, D-74, Figure D-5 and Table D-6). Water requirements for the Blount Island coal unloading facility will be obtained from the existing JPA potable water system.

D.5 WATER QUALITY IMPACT ANALYSES

The potential impacts of plant operation on the shallow aquifer system will be primarily limited to the effects of leachate from raw material storage and waste disposal areas. The principal sources of potential leachate are coal storage areas, sedimentation ponds, and liquid waste retention basin, at the south end of the plant rail loop and on Blount Island, and disposal areas for fly ash and gypsum in the northern and eastern areas of the site (See Figure D-20). Although each of these potential sources may produce different quantities of leachate of different quality, the general approach to analyzing their impacts is the same for each source:

1. estimate the rate of leachate infiltration to the groundwater;

2. estimate the dilution of leachate once it reaches the water table; and

3. estimate the rate of transport of leachate through the groundwater regime.

Because of a variety of uncertainties in the quantity and quality of waste leachate which might be generated, and in particular because the chemical quality of coal pile and fly ash leachate cannot be reliably estimated until the coal source is selected, parametric sensitivity analyses have been carried out by applying the conservative approach outlined in Section D.2.4.3, particularly Eqs. D.2-4 through D.2-9.

D.5.1 Leachate Infiltration and Dilution

The initial dilution of leachate beneath a waste disposal area is governed by Eqs. D.2-7 through D.2-9. The volumetric rate of leachate introduction to the water table (Q_L) is given by Eq. D.2-8:

$$Q_L = qA,$$

where q is the seepage rate per unit area of waste disposal pond and A is the area of the pond.

D.5.1.1 Disposal Areas with Ponded Water

For a waste disposal area containing ponded water, such as a sedimentation pond, the seepage rate q is given by equation (D.2-4):

$$q = K(H+L)/L,$$

where H is the depth of ponded water, L is the total thickness of materials lying between the ponded water and the water table, and K is the effective hydraulic conductivity of those materials. The parameters L and K are defined by equations (D.2-5) and (D.2-6). The rate of seepage q is thus a function of the depth of ponded water H, the thickness and hydraulic conductivity of bottom ash or sludge at the bottom of a pond, and the thickness and hydraulic conductivity of any low-permeability pond liner, assuming that the water table remains a fixed distance below the base of the pond liner (in this case, five feet) and that the natural aquifer materials have a uniform vertical hydraulic conductivity (10^{-4} cm/sec). Assuming a clay pond liner of permeability (i.e., hydraulic conductivity) 10^{-7} cm/sec, the sensitivity of q to variations in the thickness, L_1, and hydraulic conductivity, K_1, of stored solids, and to variations in thickness, L_2, of the pond liner, are illustrated in Figure D-21.

The seepage rate is relatively insensitive to the thickness of stored waste materials (Figure D-21(a)). For a depth of ponded water of 10 feet, an increase of waste thickness from 4 feet to 10 feet would produce about a 33 percent increase in the rate of seepage.

The rate of seepage is somewhat more sensitive to variations in the hydraulic conductivity of the waste material (Figure D-21 (b)). A decrease in hydraulic conductivity from 10^{-4} to 10^{-5} cm/sec would have little effect on the seepage rate, while a decrease to 10^{-6} cm/sec could reduce seepage by about 33 percent for H = 10 feet. A reduction of K_1 to 10^{-7} cm/sec from 10^{-4} cm/sec could reduce seepage by about 80 percent for H = 10 feet. The hydraulic conductivity of bottom ash is expected to be of the order of about 10^{-4} cm/sec. Some reduction in hydraulic conductivity may result from natural settling and compaction of waste material, and further compaction might be attained artificially. However, it is believed that the resultant waste material is unlikely to have a hydraulic conductivity much lower than 10^{-5} cm/sec without extensive engineering to reduce its permeability.

The rate of seepage is quite sensitive to variations in the thickness of a pond liner of conductivity 10^{-7} cm/sec (e.g. a natural clay liner). Increasing the liner thickness from 1 foot to 2 feet could decrease the seepage rate by almost 50 percent for H = 10 feet (Figure D-21 (c)). Increasing the thickness from 1 foot to 5 feet could result in a 75 percent reduction in seepage, while a further increase to 10 feet would produce relatively little additional reduction in seepage.

The dilution of leachate beneath a waste disposal area is given by Eqs. D.2-7 through D.2-9, which can be combined to get:

$$C_o = FC_L + (1 - F)\, C_G, \qquad \text{(D.5-1)}$$

$$F = Q_L/(Q_L + Q_G), \qquad \text{(D.5-2)}$$

where C_L = concentration of dissolved constituent in leachate

C_G = concentration of dissolved constituent in natural groundwater

Q_L = rate of leachate infiltration to the water table

Q_G = rate of groundwater underflow beneath waste disposal area

C_o = concentration of dissolved constituent in groundwater downgradient from disposal area

Eq. D.5-2 defines a dilution factor F which characterizes the initial dilution of leachate beneath a disposal area. In general, the lower the value of F, the less the potential groundwater degradation from solid waste leachate. From Eqs. D.2-8 and D.2-9, the dilution factor F can be written as:

$$F = qA^{1/2}/(qA^{1/2} + KIb) \qquad (D.5\text{-}3)$$

Thus, the dilution factor can be expressed in terms of the rate of leachate seepage, q, the area of disposal pond, A, and the rate of groundwater underflow, KIb. Utilizing the aquifer properties noted in Section D.4.2.2 for the shallow water table aquifer, the approximate rate of groundwater underflow is 2.8 ft^2/day, so F can be expressed in terms of q and A.

Figure D-22 shows the variation of the dilution factor F with disposal area A and seepage rate q. The results shown on Figure D-21 suggest that for practical ranges of the parameters considered, the seepage rate is expected to be in the range of 500 to 2500 gpd/acre. Thus, for disposal pond areas in the range of 10 to 100 acres, Figure D-22 indicates that the dilution factor should be between 0.25 and 0.85. Thus, for a waste area containing ponded water, any leachate which contains a dissolved constituent in excess of four times the appropriate standard may result in a concentration of the constituent in excess of the standard in groundwater downgradient from the waste disposal area; in this context, four times the standard would only be acceptable where dilution factors do not exceed 0.25.

Some waste disposal areas are likely to contain ponded water which could degrade the underlying groundwater, based on the conservative approach outlined above. Water contained in the sedimentation pond and liquid waste retention basin are likely to be high in some trace metals,

particularly iron, lead, and mercury. Even with a four-fold dilution, leachate from such sources may exceed drinking water standards for some constituents.

Because of the potential for contamination of groundwater by leachate from waste disposal areas containing ponded liquids, resulting from the poor quality of those liquids, such waste disposal areas will be designed and constructed so as to preclude or minimize seepage from them. As noted in Chapter 3, the pond designs will include the use of artificial membrane liners of extremely low permeability.

D.5.1.2 Coal Pile Storage Areas and Disposal Areas for Dry Solid Waste

For coal pile storage areas and dry solid-waste disposal areas, such as those for fly ash disposal or storage of excess gypsum, the rate of leachate will be limited by the rate of infiltration of precipitation on the waste area, or the saturated permeability of materials overlying the water table. That is, a conservative estimate of seepage in the absence of ponded water is given by assuming full saturation with a unit hydraulic gradient, so that the seepage rate is equal to the effective hydraulic conductivity. However, if that rate exceeds the actual natural rate of infiltration of precipitation, then the seepage rate will equal the natural infiltration rate. With appropriate engineering practices such as grading, sloping, and revegetating, it is possible to reduce the infiltration rate below the natural rate of infiltration for the local area. Thus, in general, the seepage rate from a dry waste disposal area will be the lesser of the effective permeability of materials overlying the water table and the rate of infiltration of precipitation.

The effective hydraulic conductivity K is defined by Eqs. D.2-5 and D.2-6. The maximum rate of seepage is thus a function of the thickness and hydraulic conductivity of the solid waste pile, and the thickness and hydraulic conductivity of any low-permeability liner, assuming that the water table remains a fixed distance below the base of the pond (in this

case, five feet) and that the natural aquifer materials have a uniform vertical hydraulic conductivity (10^{-4} cm/sec). Assuming a clay liner of hydraulic conductivity 10^{-7} cm/sec and a waste pile thickness conservatively assumed to be of 30 feet, the rate of leachate seepage will be a function of the hydraulic conductivity of the waste, K_1, the thickness of the clay liner, L_2, and the rate of infiltration of precipitation, n.

The natural rate of infiltration has been conservatively assumed to equal the rate of recharge of rainfall to the shallow aquifer system in Duval County, 10 to 16 inches/year (Fairchild, 1972). In the sensitivity analyses discussed below, it has been assumed that seepage rates are limited by these values, as well as by 50 percent of these values (5 to 8 inches/year) which is assumed as an approximation of the effects of engineering waste pile construction to minimize infiltration.

Figure D-23 shows the rate of leachate seepage as a function of hydraulic conductivity of the waste and infiltration rate. The figure illustrates that, for a one foot thick clay liner and for waste with a hydraulic conductivity greater than about 10^{-6} cm/sec, the rate of leachate seepage will be controlled by the rate of infiltration. However, if the waste hydraulic conductivity can be reduced to less than 10^{-7} cm/sec, the seepage rate can be reduced by over 90 percent.

The hydraulic conductivity of fly ash or stored gypsum is expected to be of the order of 10^{-4} cm/sec. With compaction during emplacement, this value could be reduced substantially, but it is not expected to be reduced to much less than 10^{-5} cm/sec. Thus, the rate of leachate seepage is expected to equal the infiltration rate. For a one-foot thick clay liner, this rate could be in excess of 1000 gpd/acre if the infiltration rate approaches 16 in/yr, or less than 500 gpd/acre if the infiltration rate is as low as 5 in/yr as a result of grading, sloping and revegetating the waste pile to maximize runoff and minimize infiltration.

Figure D-24 shows the rate of leachate seepage as a function of liner thickness and infiltration rate. For liner thicknesses less than 3 feet, the rate of seepage is controlled by the infiltration rate. Furthermore, the figure indicates that use of a clay liner of hydraulic conductivity 10^{-7} cm/sec will have no effect in reducing seepage unless the liner is more than about 3 feet thick.

The results of these analyses suggest that for the probable properties of dry solid waste (fly ash and gypsum), the rate of leachate seepage will be controlled by the infiltration rate. The dilution factor for such seepage can again be defined by Eq. D.5-3. Figure D-25 shows the dilution factor as a function of disposal area and infiltration rate. For the assumed natural infiltration rates (10 to 16 in/yr) and disposal areas of 10 to 100 acres, the dilution factor could range from 0.35 to 0.75; if the infiltration rate could be halved, to 5 to 8 in/yr, the dilution factor would be reduced to the range 0.2 to 0.6.

Groundwater quality downgradient from a solid waste disposal area will depend largely on the quality of the actual leachate. Since a coal source has not yet been selected, the quality of coal pile or solid waste leachate cannot be anticipated. Table D-21 gives ranges of values of leachate constituents taken from the literature. If solid waste leachate at the site contains concentrations of constituents approaching the upper ends of ranges of reported values, resultant groundwater quality may exceed Florida Class I-B water quality standards for several parameters. However, because of the conservatism inherent in this analysis, such extreme results are not expected to be observed for the following reasons:

- The actual concentrations of dissolved constituents in the leachate will probably be less than the maxima reported.

- The assumption that the waste will be saturated, although necessary in order to obtain quantitative estimates of leachate volume, is very conservative. In reality, the waste will remain only partially

saturated except possibly in the event of an extreme rainfall event, and the amount of leachate generated as a result of percolation through the waste will be substantially less than the amount generated under saturated conditions.

- The assumed rate of infiltration of precipitation, estimated by the reported rate of recharge of precipitation to groundwater in Duval County, is also conservative. Engineering of the waste pile to maximize runoff and minimize infiltration can substantially reduce the infiltration rates utilized in the analysis.

The potential for groundwater contamination as a result of leachate from dry solid waste disposal areas will depend primarily on the quantity and chemical quality of the leachate generated. The leachate quality will depend on the properties of the actual waste materials generated, which in turn will depend on the actual coal to be utilized. As noted above, the quantity of leachate generated will depend on the sizes of waste disposal areas and rate of infiltration of precipitation into the waste piles. Since many of these factors cannot be predicted in advance, the concept of an on-site solid waste test program is proposed (see Chapter 3, Section 3.5.2.2).

D.5.2 Leachate Transport and Dispersion

Once leachate has been introduced to the water-table aquifer, it will be transported downgradient, and concentrations of dissolved constituents will be further reduced by the process of hydrodynamic dispersion (Bear, 1972). For the leachate sources discussed above, theories of the continuous introduction of leachate to the aquifer must be applied. Practical solutions to problems involving two-dimensional dispersion of contaminants from a continuous point source have been presented by Hunt (1978) and Wilson and Miller (1978). In the present context, the areal dimensions of the leachate source are of the same order of magnitude as the length of downgradient travel path (See Fig. D-20). Consequently, the

assumption of a point source of leachate injection is not applicable. Closed-form solutions to the problems of continuous injection of leachate from a two-dimensional source area do not appear to be available in the literature. It was ultimately decided not to carry out detailed dispersion calculations in order to maintain conservatism in these parametric analysis.

The rate of leachate transport downgradient from a waste disposal area can be estimated by applying Eq. D.2-10:

$$v = KI/m,$$

where v is the rate of transport of dissolved species, K is the horizontal hydraulic conductivity of the aquifer materials, I is the hydraulic gradient (or water table slope), and m is the effective porosity of the aquifer materials. From Table D-18, K is approximately 300 gpd/ft^2. From Figure D-17, I is approximately 0.0035. The effective porosity m is estimated to be 0.2. The transport velocity, v, is then approximately 0.7 feet per day. Once leachate entered the shallow aquifer system, it would then take approximately 2900 days, or 8 years, to travel 2000 feet from, for example, a solid-waste disposal area to the site boundary.

D.5.3 Retardation of Ionic Motion

Many dissolved constituents in groundwater exhibit a retardation of their rate of transport as a result of sorption/desorption phenomena. Dissolved ions are sorbed onto the surfaces of fine-grained, principally clayey, aquifer materials, and may later go back into solution as concentration gradients within the groundwater vary. The net effect of these phenomena is to retard the effective rate of transport of the ion (Bear, 1972; Grove, 1970; Dames and Moore, 1977). In some cases, particularly the transport of dissolved metals through unsaturated clays, the ions may be permanently bound onto the clay particles and thus totally removed from the groundwater.

Quantification of ionic retardation is difficult. Many of the values of retardation coefficients reported in the literature deal with radioactive ions and specific soils (e.g. Dames and Moore, 1977), and thus are not applicable in the present case. Some ions are not retarded in their motion at all. Consequently, ionic retardation has not been explicitly considered in the analyses discussed above.

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Table D-1

LIST OF PHYSICAL AND CHEMICAL PARAMETERS
FOR GROUNDWATER QUALITY ANALYSIS

Inorganic Constituents

- Ammonia (as NH_4)
- Calcium
- Chloride
- Fluoride
- Hardness (as $CaCO_3$)
- Hydrogen Sulfide
- Magnesium
- Nitrate (NO_3-)
- Nitrite (NO_2-)
- Phosphate
- Potassium
- Silica (colloidal and dissolved)
- Sodium
- Strontium
- Sulfate

Organic Constituents

- PCB
- Phenols
- Total Organic Carbon

Metals (total)

- Aluminum
- Arsenic
- Barium
- Boron
- Cadmium
- Chromium (Hexavalent)
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Molybdenum
- Nickel
- Selenium
- Silver
- Vanadium
- Zinc

Miscellaneous

- Alkalinity (as $CaCO_3$)[a]
- Alkalinity (as HCO_3)[a]
- Color
- Conductivity[a]
- Gross Alpha
- pH[a]
- Temperature[a]
- Total Dissolved Solids
- Total Suspended Solids
- Turbidity

[a] Field and laboratory measurements

Table D-2

SAMPLE COLLECTION AND PRESERVATION METHODS

Container	Volume	Preservation	Measurements
Plastic	0.5 Gal.	none	Gross Alpha Radiation
Plastic	1.0 Gal.	none	pH, Alkalinity, Chloride, Fluoride, Conductivity, Total Dissolved Solids, Total Suspended Solids, Chromium (hexavalent), Silica, Sulfate, Color, Turbidity
Plastic	0.25 Gal.	Nitric Acid to pH less than 2	Hardness, Mercury, Arsenic, Calcium, Potassium, Sodium, Strontium, Aluminum, Barium, Selenium, Vanadium, Cadmium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Silver, Zinc
Plastic	0.25 Gal.	Sulfuric Acid to pH less than 2	Ammonia, Nitrate, Nitrite, Phosphate, Boron, Total Organic Carbon
Glass	0.25 Gal.	Phosphoric Acid to pH less than 4. 1 gram copper sulfate per liter of sample added after collection	Phenol
Glass (Amber) with Teflon Cap	1.0 Gal.	none	PCB
Plastic	250 ml.	1 ml. of 1 Molar Zinc Acetate, plus 1 ml. of 1 Normal Sodium Hydroxide	Hydrogen Sulfide

Table D-3
GENERALIZED GEOLOGIC UNITS IN DUVAL COUNTY AND THEIR HYDROLOGIC PROPERTIES.

Geologic Age	Stratigraphy	Approximate Thickness (ft)	Lithology	Hydrogeologic Unit	Hydrologic Properties
Holocene to Pliocene	Surficial deposits	100	Discontinuous sand, clay, and shell beds	Surficial aquifer	Sand and shell deposits provide local limited water supplies
Miocene	Hawthorn Formation	400	Interbedded phosphatic sand, clay, marl, and limestone	Upper confining unit	Sand, shell, and limestone deposits provide local limited water supplies, both artesian and non-artesian. Low permeability clays serve as the principal confining beds for the Floridan aquifer below
Eocene	Ocala Limestone	500	Massive fossiliferous chalky to granular marine limestone sequence	Upper permeable zone of Floridan Aquifer (pumping zone)	Principal source of groundwater in Duval County. High permeability overall
	Avon Park Limestone				Water bearing layers separated by low permeability limestone and dolomite
	Lake City Limestone	500	Alternating beds of massive granular and chalky limestones, and dense dolomites		
	Upper Unit of Oldsmar Limestone	450		Semiconfining zone of Floridan Aquifer	Low permeability limestone and dolomite
	Lower Unit of Oldsmar Limestone	150		Lower permeable zone of Floridan Aquifer	Highly permeable, increases in salinity noted
Paleocene	Cedar Keys Limestone	?	Uppermost appearance of evaporites; dense limestones	Lower confining unit	Highly mineralized water, very low permeability

Source: Franks and Phelps, 1979

Table D-4
SUMMARY OF WATER WITHDRAWAL FROM THE FLORIDAN AQUIFER
IN THE JACKSONVILLE AREA IN 1966

USE	WITHDRAWAL million gallons per day (mgd)
Jacksonville municipal water utility	36
Other municipal utilities	3
Non-municipal utilities	22
Private domestic systems	5
Military water systems	6
Industrial and commercial water systems	72
Supplemental supplies for surface lakes and ponds	8
Wild wells (uncontrolled discharge)	10
Total	162 mgd

Source: Leve and Goolsby, 1969

Table D-5
STRATIGRAPHIC AND HYDROLOGIC RELATIONSHIPS
OF THE SHALLOW AQUIFER SYSTEM IN DUVAL COUNTY

Series	Formation	Lithologic Description
Holocene Pleistocene	Holocene and Pleistocene Deposits	Sand, tan to yellow, loose, medium to fine quartz, sometimes with shells and/or minor clay content -- often has hardpan layer of iron oxide-cemented, rusty red to dark brown medium to fine sand in upper part of section --source of water to shallow sandpoint wells.
Pliocene or Miocene	Pliocene or Upper Miocene Deposits	Upper part-tan to buff, fine to coarse sand and gray to light gray sandy clay, clayey sand, and shell beds; clay often contains abundant mollusk shell. Lower part-limestone, tan to yellow, often highly sandy, porous, and cavernous--also few thin beds of brown crystalline, dolomitic limestone--section is major source of water to shallow wells.
Miocene	Hawthorn Formation	Gray to blue-green and olive-green clay, and sandy limestone--usually phosphatic with abundant, well-rounded, polished granules and pebbles of phosphate. Formation not usually considered a good source of water; some wells tap lenses of sand and limestone in the upper part.

Source: Causey and Phelps, 1978

Table D-6 (Revision 1) (Continued)
INVENTORY OF WELLS IN THE PROJECT AREA

Well ID	Owner	Altitude (ft.above MSL)	Depth (ft.)	Smallest Casing Diameter (in.)	Casing Depth (ft.)	Water Quality Analysis	Remarks
D1150	Jacksonville Elec. Author.	12	1104	10	-	X[a]	JEA Well #3
D1149	Jacksonville Elec. Author.	13	1104	10	520	X	JEA Well #4
D270	Ponce, O.C.	5	-	-	-	X	-
DS186	Gregory, Roy	10	65	2	-	X	-
D228	Jacksonville Elec. Author.	10	840	10	530	X	JEA Well #5
D2273	James Mathey	10	560	2	435	-	-
DS39	Nickles	8	57	2	-	-	-
D1158	Hayman	10	560	2	460	X	-
D1306	Copeland	3	580	2	462	-	-
D1667	Pats	8	580	2	462	-	-
D2064	Parks Dept.	10	-	-	-	-	-
D2066	Weaver	8	500	2	459	-	-
D968	Deloach	5	580	2	456	-	-
D1973	Kirkland	3	-	-	-	-	-
DS292	Dunn Creek Fish Camp	5	-	-	-	-	-
D2014	Garnett Umberger	10	-	-	-	-	-
D2298	James Barrett	10	580	-	-	-	-
D942	Smith	5	560	2	462	-	-
DS120	Wise	8	235	-	-	-	-
D1050	Davis	5	580	2	469	-	-
D1148	Jacksonville Elec. Auth.	10	-	-	-	X	-
D1087	Degrove	8	580	2	462	-	-
D1904	Boatyard	5	-	-	-	-	-
D734	Jacksonville Elec. Auth.	5	588	2	490	X	-
D1906	-	10	700	-	-	-	-
D2210	Alvin Jenkins	5	-	-	-	-	-
D1290	Offshore Power Systems	10	550	2	450	-	OPS #2
D1908	Offshore Power Systems	10	1051	18	460	X	-
D2088	Offshore Power Systems	10	-	-	-	-	-
D2013	John Kern	8	-	2	459	-	-
D1052	Jarrell	3	-	-	-	-	-
D995	Riles	5	560	2	462	X	-
D2012	Construct Pats	8	580	-	-	-	-
D1051	Woods	5	-	-	-	X	-
D1287	Offshore Power Systems	10	550	2	450	-	OPS #1
D2128	Jacksonville Elec. Auth.	10	-	-	-	-	OPS #3
D1289	Offshore Power Systems	5	550	2	450	-	-
D1375	Eugene Lankford	10	-	-	-	-	-
D1736	-	-	-	-	-	-	-
D1374	North Shore Corp.	20	-	-	-	-	-
D1370	Russell Shotter	10	790	2	680	-	-
D1288	Offshore Power Systems	5	550	2	450	-	-
D1369	Clayton Brown	19	620	2	520	X	-
D1902	Offshore Power Systems	0	1209	10	515	-	-
D1365	Simmons	10	700	2	590	-	JPA

Table D-6 (Revision 1) (Continued)
INVENTORY OF WELLS IN THE PROJECT AREA

Well ID	Owner	Altitude (ft.above MSL)	Depth (ft.)	Smallest Casing Diameter (in.)	Casing Depth (ft.)	Water Quality Analysis	Remarks
D488	Jax Port Author.	9	755	6	-	X[a]	JPA
D489	Jax Port Author.	5	1274	-	-	X	JPA
D74	Jax Port Author.	5	1328	10	-	X	JPA
D278	Workman Goodman	39	1000	10	-	X	-
D485	Fr Caroline SHo	18	-	-	-	X	-
D1553	Leon Felhandler	35	770	2	670	-	-
D1250	Richard Hendrickson	10	672	2	460	-	-
D1268	J.B. Frangisis	25	720	2	504	-	-
D938	Peter J. Holliday	30	605	2	605	X	-
DS306	Whorton Atwood	20	-	-	-	-	-
DS337	-	-	-	-	-	-	-
D444	Duval School Bd.	-	745	-	-	-	-
DS307	Zane Turley	10	-	-	-	-	-
D1083	Mormon Church	40	740	2	630	-	-
D875	YMCA, Arlington	40	650	-	-	X	-
D559	Henry Bodi	30	645	4	-	-	-

[a] X indicates water quality data is reported in Tables D-7 and D-12

Source: U.S. Geological Survey, Water Data Storage and Retrieval System (WATSTORE)

Table D-7 (Revision 1)
WATER QUALITY DATA FOR THE
FLORIDAN AQUIFER IN THE STUDY AREA

Well	Date	Temp. (°C)	Conductivity (umhos/cm)	pH (Units)	CO_2 (diss. mg/l)	Alkalinity (mg/l as $CaCO_3$)	HCO_3 (mg/l)	CO_3 (mg/l)	Hardness (mg/l as $CaCO_3$)	Non-carb. Hardness (mg/l as $CaCO_3$)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)
D74	74-01-03		580						256					
D152	60-03-08													
	60-09-19													
	75-05-09		454						228					
	76-05-18		510						292					
	77-01-25													
	77-05-03	23.0	540						260					
	72-05-01								276					
	73-05-09								234					
	74-05-06								232					
D228	74-05-08								232					
	76-09-13		450						236					
D262	51-06-04			7.2					240					
	51-06-13			7.7		280								
	51-07-18			8.2					164					
	51-10-17			7.7	5.5	141	172	0	258	120	62	25		
	55-10-10			7.7	5.1	131	160	0	254	120	46	34		
	55-10-12			7.7	5.2	133	162	0	252	120	61	24		
	55-10-20			7.7	5.2	133	162	0	252	120	60	25		
	60-01-07													
	60-08-18													
	60-09-19													
	60-12-09													
	61-04-04													
	61-02-24													
	61-04-11													
	61-05-23													
	61-11-15													
	62-01-08													
	62-02-15													
	62-03-30													
	62-05-06													
	62-05-09													
	62-06-13		385	8.0	4.5	230	140	69	166	51	30	22	17	2.0

Table D-7 (Revision 1) (Continued)
WATER QUALITY DATA FOR THE
FLORIDAN AQUIFER IN THE STUDY AREA

Well	Date	Cl (mg/l)	SO_4 (mg/l)	F (mg/l)	SiO_2 (mg/l)	Fe Total (mg/l)	Fe Diss. (mg/l)	Sr (ug/l)	Solids Resid.@ 180° (mg/l)	NO_3 Total (mg/l)	I (mg/l)	Br (mg/l)	Hg (ug/l)
D74	74-01-03	29											
D152	60-03-08	24											
	60-09-19	25											
	75-05-09	22											
	76-05-18	22											
	77-01-25												
	77-05-03	24											
	72-05-01	20											
	73-05-09	23											
	74-05-06	23											
D228	74-05-08	20											
	76-09-13	20											
D262	51-06-04	23	75		31								
	51-06-13	28											
	51-07-18	25	75		23								
	51-10-17	21	107		16				366				
	55-10-10	21	81						381				
	55-10-12	23	72						409				
	55-10-20	23	68		26				322				
	60-01-07	24											
	60-08-18	25											
	60-09-19	26											
	60-12-09	26											
	61-01-04	26											
	61-02-24	25											
	61-04-11	24											
	61-05-23	24											
	61-11-15	27											
	62-01-03	24											
	62-02-15	25											
	62-03-30	26											
	62-05-06	27											
	62-05-09	27											
	62-06-13	22	48	0.6	20		250		254/300	.00			

Table D-7 (Revision 1) (Continued)
WATER QUALITY DATA FOR THE
FLORIDAN AQUIFER IN THE STUDY AREA

Well	Date	Temp. (°C)	Conductivity (umhos/cm)	pH (Units)	CO_2 (diss. mg/l)	Alkalinity (mg/l as $CaCO_3$)	HCO_3 (mg/l)	CO_3 (mg/l)	Hardness (mg/l as $CaCO_3$)	Non-carb. Hardness (mg/l as $CaCO_3$)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)
D262	62-06-21													
	62-07-25													
	65-03-24		512	7.4	12	157	192	0	243	90	59	25	15	1.8
	65-05-25		528	7.7	6.3	162	198	0	250	88	65	21	16	1.2
	72-05-11													
	73-05-09								226					
	74-05-06								144					
	75-05-09		250						144					
	75-07-09		570						266					
	75-07-10		517						258					
	77-05-02	23.5	550						270					
	78-05-08	24.5	560						260					
	78-09-01	24.5				160	200		260	100	61	27	17	1.8
	79-04-30	26.0	580						270					
D263	51-06-20			7.4					240					
	55-10-10			7.9	3.3	133	162	0	250	120	35	39		
	55-10-12					133	162	0	252	120	57	26		
	55-10-17			7.7	5.2	133	162	0	250	120	66	20		
	55-10-20			7.9	5.3	136	162	0	258	120	66	22		
	60-12-09													
	62-06-13		165	8.0	1.7	89	54	27	45	0	11	4.3	16	0.8
	65-03-24	23.0	210	8.0	1.5	77	94	0	79	2	12		14	1.6
	65-05-26	26.0	512	7.6	7.8	159	194	0	234	75	59		14	1.4
	72-05-01								180					
	73-05-09								92					
	74-05-06								204					
	75-05-09		370											
	78-09-01	23.5				100	120		110	12	21	14	14	1.5

Table D-7 (Revision 1) (Continued)
WATER QUALITY DATA FOR THE
FLORIDAN AQUIFER IN THE STUDY AREA

Well	Date	Cl (mg/l)	SO_4 (mg/l)	F (mg/l)	SiO_2 (mg/l)	Fe Total (mg/l)	Fe Diss. (mg/l)	Sr (ug/l)	Solids Resid.@ 180° (mg/l)	NO_3 Total (mg/l)	I (mg/l)	Br (mg/l)	Hg (ug/l)
D262	62-06-21	26											
	62-07-25	29											
	65-03-24	25	92	0.5	29		150		341/342		.10		
	65-05-25	22	84	0.6	29		20		360/336	.00			
	72-05-11	25											
	73-05-09	28											
	74-05-06	31											
	75-05-09	30											
	75-07-09	32											
	75-07-10	30											
	77-05-02	32											
	78-05-08	35											
	78-09-01	34	90	0.6			18	610					
	79-04-30	40											
D263	51-06-20	24	80		31								
	55-10-10	23	61						373				
	55-10-12	21	67						404				
	55-10-17	22	87		17				353				
	55-10-20	21	67		19				318				
	60-12-09	25											
	62-06-13	21	0.0	0.7	1.6				90/109	0.00			
	65-03-24	20	0.0	0.4	5.0	910			-/111	0.10			
	65-05-26	21	74	0.7	29	100			338/316	0.00			
	72-05-01	19											
	73-05-09	20											
	74-05-06	23											
	75-05-09	20											
	78-09-01	20	13	0.5			50	420					

Table D-7 (Revision 1) (Continued)
WATER QUALITY DATA FOR THE
FLORIDAN AQUIFER IN THE STUDY AREA

Well	Date	Cl (mg/l)	SO_4 (mg/l)	F (mg/l)	SiO_2 (mg/l)	Fe Total (mg/l)	Fe Diss. (mg/l)	Sr (ug/l)	Solids Resid.@ 180° (mg/l)	NO_3 Total (mg/l)	I (mg/l)	Br (mg/l)	Hg (ug/l)
D264	51-07-09	24	80		32								
	55-10-10	23	61						355				
	55-10-12	19	66						373				
	55-10-17	21	95		20				347				
	55-10-20	22	67		28				320				
	60-09-19	23											
	60-12-09	25											
	62-06-13	21	48	0.7	18		10		310/354	.00			
	65-03-24	20	35	0.4	14	1200			-/202	.00			
	65-05-26	20	76	0.7	29	20			326/319	.00			
	72-05-01	18											
	73-05-09	21											
	74-05-06	21											
	75-05-09	22											
	75-07-09	15											
	75-07-10	22											
	76-05-07	26											
D270	60-01-21	35											
	62-05-21	25											
	70-05-01	21											
	72-05-08	20											
	72-05-16	19											
	74-05-08	21											
	75-05-07	22											
	77-05-02	20											
	77-05-02	20	70					1000					
	78-05-01	22											
	79-04-30	28											
D278	62-05-16	27											
	62-12-04	19	63	0.6			200						
	75-08-05	20											
	80-02-01	19	110	0.7				1700			.15	.5	
D360a	75-08-05	190							576				
	75-08-28	175							592				
	76-02-20	180											
	76-05-18	180											
	76-11-26	185											
	77-02-24	192											
	77-05-04	200											
	77-05-04		110					2400					
	78-05-30								725				
	78-09-14	210	130	0.6			20	2400				0.9	
	79-09-14	210	130	0.7				2400	767				
D402	72-05-16	19											
	73-05-08	13											
	74-05-08	22											

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a Well D360 not included in inventory area. Well location is latitude 30°22'43"N, longitude 81°30'04"W.

Table D-7 (Revision 1) (Continued)
WATER QUALITY DATA FOR THE
FLORIDAN AQUIFER IN THE STUDY AREA

Well	Date	Temp. (°C)	Conductivity (umhos/cm)	pH (Units)	CO_2 (diss. mg/l)	Alkalinity (mg/l as $CaCO_3$)	HCO_3 (mg/l)	CO_3 (mg/l)	Hardness (mg/l as $CaCO_3$)	Non-carb. Hardness (mg/l as $CaCO_3$)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)
D264	51-07-09			7.5					236					
	55-10-10			8.0	2.6	135	165	0	248	110	28	43		
	55-10-12			7.9	3.3	135	164	0	246	110	55	25		
	55-10-17			7.9	3.3	136	166	0	250	110	63	22		
	55-10-20			7.9	3.3	135	164	0	252	120	61	24		
	60-09-19													
	60-12-09													
	62-06-13					164	200	99	222	58	53	22	17	1.2
	65-03-24	22.0	321	8.1	1.8	116	141	0	152	36	28	20	14	1.7
	65-05-26	24.0	505	7.5	9.8	159	194	0	238	79	62	19	15	1.1
	72-05-01								220					
	73-05-09								198					
	74-05-06								198					
	75-05-09		461						228					
	75-07-09		497						260					
	75-07-10		510						248					
	76-05-07	25.1	515						248					
D270	60-01-21													
	62-05-21													
	70-05-01								240					
	72-05-08								220					
	72-05-16	22.5							232					
	74-05-08								242					
	75-05-07		481						252					
	77-05-02	21.5	465						250					
	77-05-02	21.5	465			159	193		230		50	24	15	1.8
	78-05-01	22.5	510						240					
	79-04-30	23.0	510						240					
D278	62-05-16													
	62-12-04			7.5	90	156	190		270	114	64	26		
	75-08-05		614						272					
	80-02-01	25.5	535	7.3		150	180		260	110	64	24	13	1.6
D360[a]	75-08-05		1180						415					
	75-08-28	27.0	1187						390					
	76-02-20		1120						400					
	76-05-18	27.9	1008						378					
	76-11-26	28.0	1080	7.2					435					
	77-02-24	28.0	1070	7.1					415					
	77-05-04	27.0	1080						420/390		93	37	73	2.6
	78-05-30	27.5	1120											
	78-09-14					148	180	0	390		94	38	90	3.2
	79-09-14	27.5	1175	7.4	11	138	168	0	400	270	96	39	81	2.2
D402	72-05-16	22.5							148					
	73-05-08								286					
	74-05-08								234					

[a] Well D360 not included in inventory area. Well location is latitude 30°22'43"N, longitude 81°30'04"W.

Table D-7 (Revision 1) (Continued)
WATER QUALITY DATA FOR THE
FLORIDAN AQUIFER IN THE STUDY AREA

Well	Date	Temp. (°C)	Conductivity (umhos/cm)	pH (Units)	CO_2 (diss. mg/l)	Alkalinity (mg/l as $CaCO_3$)	HCO_3 (mg/l)	CO_3 (mg/l)	Hardness (mg/l as $CaCO_3$)	Non-carb. Hardness (mg/l as $CaCO_3$)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)
D485	73-08-23	24.0		7.4	11	156	190		274	118	72	22		
	75-07-23		921						245					
D488	73-07-03	24.0		7.8	5.0	168	204		232	64	61	19		
	74-01-03		539						242					
	74-05-08								232					
	74-08-15	22.0		7.0	26	142	173		248	106	64	21		
	76-05-10	23.5	480						244					
	78-09-13	25.0	495			150	190	0	240	80	56	23	14	1.9
	79-04-30	24.5	525						240					
	79-09-06	25.0	495	7.5	9.3	150	183		240	87	58	22	14	1.6
	80-03-03	24.0	525	7.6		150			240	94	59	23	14	1.5
D489	74-01-03		563						250					
D732	75-08-07		563						244					
D734	75-05-15				12+	254+	309+		322+	68+	65+	39+		
	78-09-13	24.5	458			150	190	0	230	76	53	24	14	2.0
D875	76-01-27		560						264					
D938	76-03-26		570						272					
	79-01-11	20.5	560			151	184		270	120	67	24	13	1.8
D995	76-05-19		490						248					
D998	76-05-18		320						136					
D999	76-05-18		510						252					
D1000	76-05-18		500						248					
D1051	76-05-19		490						248					

Note: A plus sign (+) indicates "greater than".

Table D-7 (Revision 1) (Continued)
WATER QUALITY DATA FOR THE
FLORIDAN AQUIFER IN THE STUDY AREA

Well	Date	Cl (mg/l)	SO_4 (mg/l)	F (mg/l)	SiO_2 (mg/l)	Fe Total (mg/l)	Fe Diss. (mg/l)	Sr (ug/l)	Solids Resid.@ 180° (mg/l)	NO_3 Total (mg/l)	I (mg/l)	Br (mg/l)	Hg (ug/l)
D485	73-08-23	23	112	0.8		70							
	75-07-23	40											
D488	73-07-03	23	76	0.7		200							
	74-01-03	24											
	74-05-08	20											
	74-08-15	23	100	0.6		60							
	76-05-10	19											
	78-09-13	20	78	0.6			140	1300				0.2	
	79-04-30	22											
	79-09-06	20	84	0.6	26	140		1400	338/318			0.2	.5-
	80-03-03	22	83	0.6	27			1400	334/322				
D489	74-01-03	31											
D732	75-08-07	21											
D734	75-05-15	20+	90+	0.5+									
	78-09-13	20	74	0.6								0.1	
D736	76-05-11	18											
D875	76-01-27	17											
D938	76-03-26	17											
	79-01-11	14	120	0.7									
D995	76-05-19	19										0.5	
D998	76-05-18	20											
D999	76-05-18	22											
D1000	76-05-18	22											
D1051	76-05-19	19											

Note: A plus sign (+) indicates "greater than".
A minus sign (-) indicates "less than".

Table D-7 (Revision 1) (Continued)
WATER QUALITY DATA FOR THE
FLORIDAN AQUIFER IN THE STUDY AREA

Well	Date	Temp. (°C)	Conductivity (umhos/cm)	pH (Units)	CO_2 (diss. mg/l)	Alkalinity (mg/l as $CaCO_3$)	HCO_3 (mg/l)	CO_3 (mg/l)	Hardness (mg/l as $CaCO_3$)	Non-carb. Hardness (mg/l as $CaCO_3$)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)
D1127	76-12-28		505						258					
	77-05-02	21.0	515						250					
	77-09-00[a]	24.0		7.2		166	202		250		57	26	14	1.7
D1148	76-09-13		415						204					
D1149	76-10-13		425						224					
	78-09-01					160	190		250	94	55	27	14	1.9
D1150	76-09-13		440						212					
D1151	76-09-13		460						240					
D1158	76-12-28		490						260					
D1255	78-09-01	25.0	495			156	190		230		53	24	14	1.7
D1359	78-12-18	23.0	512			154	187		240	85	54	25	14	1.5
D1363	79-03-29	23.5	532	7.9	3.8	153	187	0	230	81	54	24	15	1.6
D1369	78-09-13	24.0				150	180	0	240	91	57	23	13	1.8
D1908	78-12-00[a]	27.7	710	7.3		153	187		300		70	29	30	1.8

[a] U.S. Geological Survey, Jacksonville, Florida, 1980.

Table D-7 (Revision 1) (Continued)
WATER QUALITY DATA FOR THE
FLORIDAN AQUIFER IN THE STUDY AREA

Well	Date	Cl (mg/l)	SO_4 (mg/l)	F (mg/l)	SiO_2 (mg/l)	Fe Total (mg/l)	Fe Diss. (mg/l)	Sr (ug/l)	Solids Resid.@ 180° (mg/l)	NO_3 Total (mg/l)	I (mg/l)	Br (mg/l)	Hg (ug/l)
D1127	76-12-28	24											
	77-05-02	22											
	77-09-00[a]	21	89					600					
D1148	76-09-13	18											
D1149	76-10-13	16											
	78-09-01	24	80	1.0			50	790				0.2	
D1150	76-09-13	20											
D1151	76-09-13	20											
D1158	76-12-28	20											
D1255	78-09-01	19	81	0.6			20	700				0.2	
D1359	78-12-18	22	86	0.6			10	640				0.6	
D1363	79-03-29	21	85	0.7			0	620				0.2	
D1369	78-09-13	18	69	0.6			30	1200				0.2	
D1908	78-12-00[a]	71	100	0.6				1400				0.7	

[a] U.S. Geological Survey, Jacksonville, Florida, 1980.

Source: U.S. Geological Survey, Water Data Storage and Retrieval System (WATSTORE)

Table D-8 (Revision 1)

SUMMARY OF WATER QUALITY DATA FOR THE FLORIDAN AQUIFER IN STUDY AREA

Parameter	Concentration (mg/l) Minimum	Mean	Maximum
Specific Conductance (umhos/cm)	58	528	1187
Hardness (as $CaCO_3$)	45	248	435
Calcium	11	60	96
Magnesium	4	26	43
Sodium	13	19	90
Bicarbonate	54	186	309
Sulfate	0	88	130
Chloride	13	28	210

Source: U.S. Geological Survey, Water Data Storage and Retrievel System (WATSTORE)

Table D-9
SUMMARY OF FLORIDAN AQUIFER TEST RESULTS

Well	Static Water Level (Ft. above Land Surface)	Discharge/Duration (gpm/hours)	Maximum Drawdown (ft)	Transmissivity[1] (gpd/ft)	Storage[1] Coefficient	Leakance[2] (Per day)
F-1 (Pumping Well)	19.7	1330/22	33.5	1.0×10^5	--	--
D-1255 (Observation Well)	20.1	--	3.4	1.0×10^5	2.8×10^{-4}	4×10^{-4}

1 Average values from time-drawdown and time-recovery solutions.

2 Where leakance = $\frac{K'}{b'}$ and

K' = vertical hydraulic conductivity of confining bed in gallons per day per square foot (gpd/ft^2)
b' = vertical thickness of confining unit in feet

Table D-10 (Revision 1)
FLORIDAN AQUIFER WATER QUALITY[a]
TEST WELL F-1

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	7.5	7.61	7.89	7.60
Calcium	55.5	40.7	54.4	46.2
Magnesium	22.8	25.4	22.9	24.4
Iron	0.025	-	0.4	0.2
Sodium	13.1	11.8	14.7	14.2
Potassium	1.15	0.75	1.7	1.8
Chloride	21.0	10.8	13.70	14.3
Sulfate	125	77.92	64.07	38.6
Silica, Colloidal & Dissolved	23.3	-	-	29.2
Alkalinity, as $CaCO_3$	156	153[b]	154.2	158
Alkalinity, as HCO_3	190	-	188.0	193
Fluoride	0.58	-	-	0.70
Conductivity	521	430	378.0	296
Total Dissolved Solids	348	-	346	272
Total Suspended Solids	0	-	-	1
Color	1	-	-	1
Turbidity	0.40	-	-	0.35
Hardness, as $CaCO_3$	243	216	236	216
Phenols	0.036	-	-	0.006
Ammonia, as NH_4	0.44	-	-	0.33
Nitrate, as NO_3	0.53	-	-	0.04
Nitrite, as NO_2	0.01-	-	-	0
Phosphate, as PO_4	0.06	-	-	0.42
Boron	0.41	-	-	0.05-
Total Organic Carbon	1.5	-	-	2.5
Hydrogen Sulfide	0.60	0.54	0.1	3.3
Mercury	0.0002-	-	-	0.0002-
Aluminum	0.037	-	-	0.2-
Barium	0.066	-	-	0.12-
Selenium	0.01-	-	-	0.01-
Vanadium	0.085-	-	-	0.2-
Cadmium	0.0008	-	-	0.001-
Copper	0.004	-	-	0.005-
Lead	0.021	-	-	0.02-
Manganese	0.002	-	-	0.010
Molybdenum	0.13-	-	-	0.05-
Nickel	0.007-	-	-	0.008-
Silver	0.0004	-	-	0.005-
Zinc	0.007	-	-	0.005
Hexavalent Chromium	0.003-	-	-	0.01-
Arsenic	0.002-	-	-	0.005
Strontium	2.81	0.003-	1.0	1.4
Polychlorinated Biphenyls as Aroclor 1016	0.001-	-	-	0.001-
Gross Alpha	0.2	-	-	2.1
Counting error	±1.0	-	-	± 1.9
Field Measurements				
pH	-	6.9	7.7	6.6
Conductivity	-	360	470	452
Temperature (°C)	-	21.5	22.0	15.8
Alkalinity, as $CaCO_3$ (total)	-	13	-	-

a All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

b Reported as mg/l bicarbonate, as $CaCO_3$

Table D-12 (Revision 1)
SUMMARY OF WATER QUALITY DATA FOR
SHALLOW AQUIFERS IN THE PROJECT AREA

Well	Date	Temp. (°C)	Conductivity (umhos/cm)	pH (units)	Hardness (mg/l as $CaCO_3$)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Cl (mg/l)	SO_4 (mg/l)	Fe, diss. (ug/l)	Sr (ug/l)
DS175	69-01-17	-	-	-	-	-	-	-	-	-	-	510	-
DS186	69-02-03	-	-	-	-	-	-	-	-	-	-	120	-
DS236	76-07-14	-	300/310	-	152/160	-	-	-	-	12	-	-	-
	76-10-04	-	-	-	-	-	-	-	-	-	-	880	-
	77-05-03	-	225	6.9	100/92	21	9.7	8.8	1.1	15	1.5	-	70
DS265	76-10-04	-	-	-	-	-	-	-	-	-	-	110	-

Source: U.S. Geological Survey, Water Data Storage and Retrieval System (WATSTORE)

See Figure D-5 for locations of wells.

Table D-13
WATER QUALITY DATA - NORTH LANDFILL WELL NO.1[a]

Parameter	3-7-77	3-29-77	4-25-77	5-31-77	6-27-77	8-2-77	10-24-77	12-12-77	4-16-78	6-20-78	9-26-78	2-7-79	6-27-79	12-13-79
Specific Conductance	100	72	18	12.5	11	9	16	54	50	50	40	80	50	59
Nitrates	1.7	2.3	0.7	0.1	0.3	.01	0.7	0.3	-	0.1	-	-	-	0.21
Iron	0.4	0.9	0.8	15	10.3	2.31	0.43	24	0.45	0.90	0.9+	0.22	0.5	0.185
Cadmium	0.01-	0.002	0.01-	0.0031	0.004	0.0027	0.0022	0.0039	-	0.0134	-	-	-	0.7-
Chromium	.01-	0.10	0.01	0.072	0.009	0.013	.012	0.035	-	0.002-	-	-	-	3.0-
Copper	.01-	0.07	0.01-	0.07	0.04	0.05-	0.039	0.077	-	0.012	-	-	-	6.5-
Lead	0.02	0.07	0.01-	0.093	0.017	0.024	0.01-	0.008-	-	0.023	-	-	-	0.068-
Total coliform	-	50-	50-	50-	50-	15,000+	20	8	-	230	-	-	-	500
Color	-	-	-	-	-	-	-	-	125	155	150	50	60	23
COD	97	351	392	514	10	216	39	31	31	47	90	63	39	15.5
Turbidity	-	-	-	-	-	-	-	-	35	50	70	30	20	1.3
Hardness	280	175	340	-	6	12	8	22	-	-	-	-	-	-
pH	8	7.6	6.8	6.2	6.4	6.8	6.4	6.6	6.4	6.1	6.5	7.5	7.2	4.2
Temp.	-	-	-	-	-	-	-	-	20	24	25	18	25	17
Lindane	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.03-	0.001-
Heptachlor	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.001-	0.001-
Aldrin	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.02-	0.001-
Heptachlor epoxide	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.02-	0.001-
DDE	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.02-	0.001-
Dieldrin	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.02-	0.001-
Endrin	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.001-	0.001-
DDT	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.001-	0.001-
Methoxychlor	-	-	-	-	-	-	-	-	-	-	0.05-	-	0.005-	0.001-
Toxaphene	-	-	-	-	-	-	-	-	-	-	0.1-	-	0.01-	0.001-

a. All values in milligrams per liter (mg/l), except specific conductance which is in micromhos per centimeter, total coliform which is the number of coliform bacteria present in a 100 milliliter sample, color which is in color units, turbidity which is in turbidity units, pH which is in pH units and temperature which is in degrees centigrade.
(-) indicates concentration less than value indicated.
(+) indicates concentration greater than value indicated.

Source: Sheffield, 1980

Table D-14
WATER QUALITY DATA - NORTH LANDFILL WELL NO.2[a]

Parameter	2-28-77	3-29-77	4-25-77	5-31-77	6-27-77	8-2-77	10-24-77	12-12-77	4-16-78	6-20-78	9-26-78	2-7-79	6-27-79	12-13-79
Specific Conductance	125	21	8	9	12	9	17	5.6	50	60	50	60	50	70
Nitrates	2.2	0.7	0.7	1.1	0.1	0.01	0.3	0.4	-	0.1-	-	-	-	0.75
Iron	1.6	0.2	0.1-	0.35	0.9	0.57	0.34	64	0.9	0.9+	-	0.15	0.8	0.187
Cadmium	0.01	0.001	0.01-	0.0019	0.002	0.0018	0.0011	0.0033	-	0.0032	-	-	-	2.6-
Chromium	0.01	0.01	0.01-	0.004	0.046	0.002	0.010	0.019	-	0.002-	-	-	-	3.0-
Copper	0.1-	.03	0.01-	0.08	0.00	0.05-	0.033	0.073	-	0.012	-	-	-	6.5-
Lead	0.02	0.02	0.01-	0.061	0.102	0.011	0.01-	0.008-	-	0.173	-	-	-	88.0-
Total coliform	4-	4-	30	48	56	100	10	16	-	-	-	-	-	100
Color	-	-	-	-	-	-	-	-	100	200	75	55	60	0
COD	517	205	65	68	27	34	14	12	17	35	20	36	23	5.2
Turbidity	-	-	-	-	-	-	-	-	30	85	-	20	15	3.7
Hardness	207	43	16	12	6	8	4	8	-	-	-	-	-	-
pH	6.6	7.3	7.5	6.2	6.8	7.8	7.6	5.8	6.8	5.9	6.4	6.3	6.0	4.6
Temp.	-	-	-	-	-	-	-	-	20	28	27	17	22	18
Lindane	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.03-	0.001-
Heptachlor	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.001-	0.001-
Aldrin	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.02-	0.001-
Heptachlor epoxide	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.02-	0.001-
DDE	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.02-	0.001-
Dieldrin	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.02-	0.001-
Endrin	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.001-	0.001-
DDT	-	-	-	-	-	-	-	-	-	-	0.02-	-	0.001-	0.001-
Methoxychlor	-	-	-	-	-	-	-	-	-	-	0.05-	-	0.005-	0.001-
Toxaphene	-	-	-	-	-	-	-	-	-	-	0.1-	-	0.01-	0.001-

[a] All values in milligrams per liter (mg/l), except specific conductance which is in micromhos per centimeter, total coliform which is the number of coliform bacteria present in a 100 milliliter sample, color which is in color units, turbidity which is in turbidity units, pH which is in pH units and temperature which is in degrees centigrade.
(-) indicates concentration less than value indicated.
(+) indicates concentration greater than value indicated.

Source: Sheffield, 1980

Table D-15
WATER QUALITY DATA - NORTH LANDFILL WELL NO. 3[a]

Parameter	4-16-78	6-20-78	9-26-78	2-7-79	6-27-79	12-13-79
Specific Conductance	135	100	80	55	60	97
Nitrates	-	-	-	-	-	0.082
Iron	-	-	0.9+	0.35	0.1	0.85
Cadmium	-	0.0166	-	-	-	2.0-
Chromium	-	-	-	-	-	3.0-
Copper	-	0.145	-	-	-	13.0-
Lead	-	0.477	-	-	-	270.0-
Total coliform	-	8	-	-	-	19,000
Color	-	-	150	110	80	0
COD	2461	10,254	111	36	20	5.2
Turbidity	-	-	70	40	15	15
Hardness	-	-	-	-	-	-
pH	6.1	6.8	6.6	6.8	6.5	4.5
Temp.	22	25	27	20	24	22
Lindane	-	-	0.02-	-	0.03-	0.001-
Heptachlor	-	-	0.02-	-	0.001-	0.001-
Aldrin	-	-	0.02-	-	0.02-	0.001-
Heptachlor epoxide	-	-	0.02-	-	0.02-	0.001-
DDE	-	-	0.02-	-	0.02-	0.001-
Dieldrin	-	-	0.02-	-	0.02-	0.001-
Endrin	-	-	0.02-	-	0.001-	0.001-
DDT	-	-	0.02-	-	0.001-	0.001-
Methoxychlor	-	-	0.05-	-	0.005-	0.001-
Toxaphene	-	-	0.1-	-	0.05-	0.001-

[a] All values in milligrams per liter (mg/l), except specific conductance which is in micromhos per centimeter, total coliform which is the number of coliform bacteria present in a 100 milliliter sample, color which is in color units, turbidity which is in turbidity units, pH which is in pH units and temperature which is in degrees centigrade.
(-) indicates concentration less than value indicated.
(+) indicates concentration greater than value indicated.

Source: Sheffield, 1980

Table D-16
TEST WELL AND PIEZOMETER CONSTRUCTION SUMMARY

Piezometer/ Test Well No.	Elevation (Ft. Above MSL)	Total Depth Drilled (Ft.)	Casing Diameter (In.)	Screen/Open Hole Diameter (In.)	Screen/Open Hole Interval (Depth in Ft.)	Elevation of Measuring Point (Ft. Above MSL)
GW-1	14.5	90	4	3 7/8	62.0-90.0	16.4
GW-2	15.4	48.5	4	4	38.5-48.5	16.9
GW-3	15.2	21	4	4	11.0-21.0	16.8
GW-4	13.9	21	2	2	11.0-21.0	15.6
GW-5	14.4	59	2	2	43.0-59.0	15.4
GW-6	14.2	90	4	3 7/8	68.5-90.0	16.7
DP-1A	22.3	150	2	2	52.2-57.2	25.1
DP-1B	22.3	18	2	2	12.8-17.8	25.3
DP-6	15.9	25	2	2	20.0-25.0	24.4
DP-10A	12.2	150	2	2	52.8-57.8	13.2
DP-10B	12.2	18	2	2	12.9-17.9	13.5
DP-101	22.2	25	2	2	20.0-25.0	24.0
DP-103	16	25	2	2	20.0-25.0	18.0
DP-113	15.6	25	2	2	20.0-25.0	17.5
DP-115	18.1	100	2	2	89.1-94.1	19.8
DP-122	16.4	25	2	2	20.0-25.0	18.2
DP-126	9.1	25	2	2	20.0-25.0	10.9
DP-129	15.0	25	2	2	20.0-25.0	16.6
DP-138	9.7	75	2	2	63.5-68.5	12.2
DA-1	22.7	25	2	2	20.0-25.0	24.4
DA-5	10.8	75	2	2	66.5-71.5	12.8
DA-9	4.1	75	2	2	64.5-69.5	6.4
DA-15	12.9	25	2	2	20.0-25.0	14.9
DA-22	12.5	50	2	2	41.2-46.2	13.8
DA-24	13.1	25	2	2	20.0-25.0	15.0
DA-33	17.0	25	2	2	20.0-25.0	18.2
DA-34	16.8	35	2	2	23.0-28.0	18.8
DA-37	13.3	25	2	2	20.0-25.0	15.8
DA-39	10.2	25	2	2	20.0-25.0	12.5
DA-41	13.8	25	2	2	20.0-25.0	15.9
DA-42	7.8	25	2	2	20.0-25.0	9.8
DA-43	3.9	25	2	2	20.0-25.0	6.1
DA-44	27.8	25	2	2	20.0-25.0	29.8

Table D-17
SUMMARY OF AQUIFER TESTING IN TEST-BORINGS AND PIEZOMETERS

Test-Boring[a] or Piezometer No.	Aquifer Tested	Approx. Aquifer Thickness (ft.)	Permeability (GPD/ft^2) Constant Head Test	Transmissivity (GPD/ft) Constant Discharge Test
DP-1A	Intermediate Sands	30	-	4000
DP-1B	Water Table	30	-	320
	Water Table	30	17	-
DP-10A	Intermediate Sands	40	-	160
	Intermediate Sands	40	5	-
DP-10B	Water Table	20	-	640
	Water Table	20	20	-
DP-115	Hawthorn Formation	--	-	6
DP-138	Intermediate Sands	30	-	483
DA-5	Shallow-Rock Aquifer	50	-	1600
DA-7[a]	Water Table	20	49[b,c]	-
DA-9	Shallow-Rock Aquifer	50	-	1600
DA-12[a]	Water Table	10-	5[b,d]	-
DA-18[a]	Water Table	10-	3[b,d]	-
DA-21[a]	Water Table	10	5[b,d]	-
DA-22	Intermediate Sands	40	-	242

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[a] Test boring (no piezometer)

[b] Constant-head aquifer testing in test-borings performed through open-end drill pipe. Calculated permeability may reflect the effects of vertical flow components inherent in the testing procedure.

[c] Average permeability for constant-head tests at 2 intervals in the water table aquifer.

[d] Average permeability for constant-head tests at 5 intervals in the water table aquifer.

- Indicates less than reported value.

Table D-18
SUMMARY OF SHALLOW AQUIFER TESTING IN
WELLS GW-1, GW-2, AND GW-3

Well	Pumping Rate (gallons per minute)	Duration of Pumping (minutes)	Hydraulic Conductivity[1,2] (GPD/Ft^2)	Aquifer Thicknesss (Ft.)	Storage Coefficient[2]	Specific Yield[2]	Aquifer Tested
GW-1	79	360	4×10^2	40	6.5×10^{-5}	--	Shallow-Rock
GW-2	12	267	3×10^2	30	5.8×10^{-4}	--	Intermediate Sands
GW-3	12/20[3]	60/78[3]	3×10^2	20	5.3×10^{-4}	2×10^{-2}	Water Table

1 Hydraulic conductivity obtained by dividing calculated values of transmissivity by aquifer thickness.
2 Average values for time-drawdown and time-recovery solutions.
3 Discharge was adjusted from 12 gallons per minute (gpm) to 20 gpm after 60 minutes because of early stabilization of pumping water levels. The discharge rate of 20 gpm was maintained for an additional 78 minutes.

Table D-19 SUMMARY OF ANALYSES
OF SHALLOW AQUIFER TESTING

WELL DATA				TRANSMISSIVITY (gpd/ft)					STORAGE COEFFICIENT					
				Drawdown		Recovery			Drawdown			Recovery		
Pumping Well	Discharge/Duration (gpm)/(min)	Observation Well	Distance From Pumping Well (ft)	Jacob[a]	Type-Curve	Jacob[a]	Jacob[a,b]	Type-curve[b]	Jacob[a]	Type-Curve	Specific Yield	Jacob[a]	Type-Curve[b]	Specific Yield
GW-1	79/300			19,000	-	16,600	16,400	-	-	-	-	-	-	-
		GW-6	125	16,000	16,200	16,600	17,200	16,800	6×10^{-5}	6×10^{-5}	-	7×10^{-5}	7×10^{-5}	-
		GW-5	97	15,900	16,800	15,100	15,200	15,100	3×10^{-3}	3×10^{-3}	-	3×10^{-3}	3×10^{-3}	-
		GW-2	16.4	15,400	17,400	16,800	17,700	17,400	8×10^{-2}	5×10^{-2}	-	7×10^{-2}	7×10^{-2}	-
GW-2	12.5/270			8,500	-	8,100	8,000	-	-	-	-	-	-	-
		GW-5	80	8,900	9,000	10,200	9,400	8,400	7×10^{-4}	5×10^{-4}	-	5×10^{-4}	6×10^{-4}	-
		GW-1	16.4	14,700	22,000	19,000	17,200	13,000	1×10^{-1}	1×10^{-1}	-	1×10^{-1}	2×10^{-1}	-
		GW-6	109	14,500	14,300	21,400	19,300	17,100	4×10^{-3}	4×10^{-3}	-	3×10^{-3}	3×10^{-3}	-
GW-3[c]	12.0/60			d	d	-	-	-	-	-	-	-	-	-
		GW-4	29	8,800	5,500	-	-	-	3×10^{-4}	4×10^{-4}	4×10^{-3}	-	-	-
GW-3[c]	20/75			d	d	-	-	-	-	-	-	-	-	-
		GW-4	29	5,700	5,100	8,100	4,200	3,300	7×10^{-4}	7×10^{-4}	3×10^{-2}	5×10^{-4}	6×10^{-4}	1×10^{-2}

a Modified non-equilibrium solution
b Corrected recovery
c Discharge was adjusted from 12 gallons per minute to 20 gallons per minute after 60 minutes because of early stabilization of pumping water levels
d Water levels in pumping well stabilized early in test

Table D-20 (Revision 1)
WATER QUALITY[a]
TEST WELL GW-6

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	7.25	8.45	7.10	7.00
Calcium	79.8	75.4	72.0	81.2
Magnesium	10.	9.8	13.8	10.9
Iron	1.12	1.1	1.4	1.3
Sodium	10.7	9.1	9.3	10.2
Potassium	0.95	0.59	0.99	1.2
Chloride	15.0	15.8	7.83	13.0
Sulfate	1.0	2.03	0.11	0.293
Silica, Colloidal & Dissolved	12.7	16.2	17.34	18.1
Alkalinity, as $CaCO_3$	223.8	242	231.0	236
Alkalinity, as HCO_3	272.9	295.1	281.7	288
Fluoride	0.17	0.17	0.22	0.16
Conductivity	478	441	399	390
Total Dissolved Solids	364	354	299	253
Total Suspended Solids	2	3	4	1
Color	1	5	2	3
Turbidity	11	4.8	7.8	8.5
Hardness, as $CaCO_3$	241	238	244	240
Phenols	0.004	0.024	0.011	0.003
Ammonia, as NH_4	0.01-	0.28	0.27	0.28
Nitrate, as NO_3	0.09	0.28	0.01	0.04
Nitrite, as NO_2	0.01-	0.01-	-	0
Phosphate, as PO_4	1.65	3.41	2.02	2.14
Boron	0.009-	0.45	-	0.05-
Total Organic Carbon	9.19	4.2	7.20	2.1
Hydrogen Sulfide	0.03-	0.03-	0.03	0.03-
Mercury	0.0002-	0.0002-	0.00032	0.0002-
Aluminum	0.037-	0.02	0.2	0.2-
Barium	0.040	0.01-	0.01-	0.12-
Selenium	0.01-	0.01-	0.01-	0.01-
Vanadium	0.085-	0.085-	-	0.2-
Cadmium	0.0009	0.0007	0.0011	0.001-
Copper	0.006	0.018	0.004	0.030
Lead	0.024	0.042	0.016	0.02-
Manganese	0.084	0.089	0.088	0.084
Molybdenum	0.013-	0.01-	-	0.05-
Nickel	0.007-	0.005	0.009	0.008-
Silver	0.0009	0.0006-	0.0002-	0.005-
Zinc	0.015	0.026	0.015	0.046
Hexavalent Chromium	0.003-	0.005-	0.003-	0.01-
Arsenic	0.004	0.003-	0.002-	0.0031-
Strontium	1.30	0.003-	-	0.7
Polychlorinated Biphenyls as Aroclor 1016	0.001-	0.0005-	0.001-	0.001-
Gross Alpha	0.7	0.8	0.5	0.1-
Counting error	±1.1	±1.1	± 1.0	± 0.4
Field Measurements				
pH	-	7.7	7.0	6.45
Conductivity	625	410	410	425
Temperature (°C)	20.0	21.0	19.5	16.0
Alkalinity, as $CaCO_3$ (total)	-	18	-	-

[a] All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-20 (Continued) (Revision 1)
WATER QUALITY[a]
TEST WELL GW-3

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	5.0	4.98	4.40	4.42
Calcium	0.690	0.5-	5.7	3.7
Magnesium	2.28	3.8	4.8	3.0
Iron	0.75	1.6	1.7	1.3
Sodium	6.83	19.4	38	28.8
Potassium	0.08	0.24	1.7	1.2
Chloride	13.5	42.4	82.19	51.6
Sulfate	9.0	5.83	9.37	11.0
Silica, Colloidal & Dissolved	1.93	3.72	6.23	4.3
Alkalinity, as $CaCO_3$	3.0	4	0	0
Alkalinity, as HCO_3	3.6	4.88	0	0
Fluoride	0.10-	0.03	0.01-	0.022
Conductivity	70	152	288	190
Total Dissolved Solids	66	86	192	116
Total Suspended Solids	1	1	3	3
Color	12	15	5	10
Turbidity	2.0	1.6	12	1.1
Hardness, as $CaCO_3$	13	20	42.0	27
Phenols	0.011	0.017	0.033	0.001
Ammonia, as NH_4	0.09	0.27	0.42	-
Nitrate, as NO_3	0.18	0.79	0.01	0.08
Nitrite, as NO_2	0.01-	0.01-	-	0
Phosphate, as PO_4	0.52	2.36	1.25	0.42
Boron	0.009-	0.04	-	0.05-
Total Organic Carbon	17.53	10.9	18.06	6.8
Hydrogen Sulfide	0.10	0.03-	0.50	1.3
Mercury	0.0002-	0.0002-	0.0002-	0.0002-
Aluminum	0.550	0.80	2.1	1.1
Barium	0.013-	0.01-	0.01-	0.06
Selenium	0.01-	0.01	0.01-	0.01-
Vanadium	0.085-	0.085-	-	0.2-
Cadmium	0.0004	0.0003	0.0022	0.001-
Copper	0.008	0.006	0.001	0.017
Lead	0.012	0.021	0.020	0.02-
Manganese	0.009	0.010	0.002	0.004-
Molybdenum	0.013-	0.01	-	0.05-
Nickel	0.007-	0.003	0.004	0.008-
Silver	0.0003	0.0003-	0.0002-	0.005-
Zinc	0.058	0.021	0.021	0.12
Hexavalent Chromium	0.003-	0.005-	0.003-	0.01-
Arsenic	0.004	0.006	0.011	0.0031-
Strontium	0.094	0.003-	-	0.2
Polychlorinated Biphenyls as Aroclor 1016	0.001-	0.0005-	0.001-	0.001-
Gross Alpha	2.1	2.2	3.1	2.5
Counting error	±0.7	±0.9	± 1.8	± 1.3
Field Measurements				
pH	-	5.8	4.6	3.8
Conductivity	97	120	275	210
Temperature (°C)	19.0	22.0	20.5	17.0
Alkalinity, as $CaCO_3$ (total)	-	2	-	-

[a] All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-20 (Continued) (Revision 1)
WATER QUALITY[a]
TEST WELL GW-2

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	5.8	5.8	5.50	5.21
Calcium	6.625	5.75	4.8	5.8
Magnesium	3.89	2.0	1.2	1.8
Iron	2.09	2.6	2.8	3.1
Sodium	29.0	12.4	13.0	14.5
Potassium	2.10	0.63	1.1	1.4
Chloride	61.0	21.2	17.61	25.8
Sulfate	11.0	4.44	0.23	0.189-
Silica, Colloidal & Dissolved	16.3	16.5	17.34	18.3
Alkalinity, as $CaCO_3$	24.0	24	14.0	16
Alkalinity, as HCO_3	29.3	29.3	17.1	20
Fluoride	0.15	0.12	0.09	0.13
Conductivity	230	130	101	118
Total Dissolved Solids	212	97	109	79
Total Suspended Solids	3	3	11	1
Color	25	65	30	3
Turbidity	18	5.3	8.3	2.4
Hardness, as $CaCO_3$	38	24	20.4	28
Phenols	0.001-	0.020	0.013	0.015
Ammonia, as NH_4	0.17	0.28	0.55	0.33
Nitrate, as NO_3	0.09	0.25	0.01	0.08
Nitrite, as NO_2	0.01-	0.01-	-	0
Phosphate, as PO_4	1.22	2.77	1.25	1.50
Boron	0.009-	0.17	-	0.05-
Total Organic Carbon	17.19	9.5	18.03	5.0
Hydrogen Sulfide	0.03-	0.03-	0.06	0.4
Mercury	0.0002-	0.0002-	0.0002-	0.0002-
Aluminum	0.110	0.20	2.0	0.2-
Barium	0.054	0.09	0.01-	0.06
Selenium	0.01-	0.01	0.01-	0.01-
Vanadium	0.085-	0.085-	-	0.2-
Cadmium	0.0004	0.0003-	0.0005	0.001-
Copper	0.014	0.003	0.002	0.005-
Lead	0.008	0.014	0.008	0.02-
Manganese	0.034	0.030	0.023	0.014
Molybdenum	0.013-	0.02	-	0.05-
Nickel	0.007-	0.002	0.003	0.008-
Silver	0.0006	0.0003-	0.0002-	0.005-
Zinc	0.047	0.023	0.019	0.028
Hexavalent Chromium	0.003-	0.005-	0.003-	0.01-
Arsenic	0.002	0.004	0.017	0.0049
Strontium	0.33	0.02	-	0.1
Polychlorinated Biphenyls as Aroclor 1016	0.001-	0.0005-	0.0032	0.001-
Gross Alpha	0.6	1.0	0.5	0.9
Counting error	±0.7	±0.7	± 0.5	± 0.6
Field Measurements				
pH	-	6.4	5.7	5.15
Conductivity	460	105	100	120
Temperature (°C)	20.0	20.5	20.5	17.8
Alkalinity, as $CaCO_3$ (total)	-	3	-	-

[a] All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-20 (Continued) (Revision 1)
WATER QUALITY[a]
PIEZOMETER DA-41

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	6.1	5.8	5.95	5.29
Calcium	9.71	3.1	3.3	3.1
Magnesium	3.11	2.4	2.5	2.1
Iron	0.90	0.31	0.40	0.3
Sodium	7.31	5.3	5.8	6.3
Potassium	0.49	0.19	0.30	0.58
Chloride	11.7	10.8	6.85	10.6
Sulfate	12.6	5.83	6.28	5.8
Silica, Colloidal & Dissolved	1.74	24.0	5.14	3.2
Alkalinity, as $CaCO_3$	28.0	13	10.0	10
Alkalinity, as HCO_3	34.1	15.9	12.2	12
Fluoride	0.10-	0.03	0.01	0.003
Conductivity	141	85	61	62
Total Dissolved Solids	118	37	89	40
Total Suspended Solids	58	6	32	1
Color	1	19	5	1
Turbidity	24	6.0	27	0.45
Hardness, as $CaCO_3$	43	20	19.5	21
Phenols	0.016	0.047	0.019	0.002
Ammonia, as NH_4	0.21	0.23	0.19	0.26
Nitrate, as NO_3	0.09	0.25	0.06	0.12
Nitrite, as NO_2	0.01-	0.01-	-	0
Phosphate, as PO_4	0.52	0.69	1.07	0.27
Boron	0.009-	0.05	-	0.05-
Total Organic Carbon	22.29	4.1	12.57	2.4
Hydrogen Sulfide	0.03-	0.03-	0.03-	0.1
Mercury	0.0002-	0.0002-	0.00030	0.0002-
Aluminum	0.368	0.28	1.8	0.2-
Barium	0.040	0.01-	0.01-	0.06
Selenium	0.01-	0.01-	0.01-	0.01-
Vanadium	0.085-	0.085-	-	0.2-
Cadmium	0.0004	0.0001	0.0005	0.001-
Copper	0.883	0.001	0.011	0.053
Lead	0.196	0.010	0.012	0.02-
Manganese	0.042	0.034	0.019	0.015
Molybdenum	0.013-	0.01-	-	0.05-
Nickel	0.007-	0.001	0.006	0.008-
Silver	0.0009	0.0003-	0.0002	0.005-
Zinc	3.19	0.015	0.054	0.13
Hexavalent Chromium	0.003-	0.005-	0.003-	0.01-
Arsenic	0.002	0.003-	0.002	0.0031-
Strontium	0.69	0.003-	-	0.1
Polychlorinated Biphenyls as Aroclor 1016	0.001-	0.0005	0.001-	0.001-
Gross Alpha	0.2	0.6	1.0	0.7
Counting error	±0.3	±0.4	± 0.6	± 0.5
Field Measurements				
pH	-	5.9	6.0	4.3
Conductivity	155	105	70	80
Temperature (°C)	21.0	19.5	20.0	15.2
Alkalinity, as $CaCO_3$ (total)	-	3	-	-

[a] All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-20 (Continued) (Revision 1)
WATER QUALITY[a]
PIEZOMETER DP-1A

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	7.3	7.31	7.11	7.01
Calcium	78.1	75.8	72.5	79.1
Magnesium	6.50	7.21	7.8	8.4
Iron	1.79	2.0	1.8	1.8
Sodium	8.83	8.4	9.0	8.9
Potassium	0.90	0.45	1.0	1.1
Chloride	11.5	11.8	4.89	11.6
Sulfate	1 -	0.1-	0.36	0.293
Silica, Colloidal & Dissolved	14.4	16.5	17.61	18.1
Alkalinity, as $CaCO_3$	227	212	210.0	218
Alkalinity, as HCO_3	277	259	256.1	266
Fluoride	0.26	0.26	0.28	0.31
Conductivity	436	400	363	360
Total Dissolved Solids	325	235	251	219
Total Suspended Solids	10	9	5	7
Color	3	3	5	10
Turbidity	20	20	17	17
Hardness, as $CaCO_3$	223	255	217	222
Phenols	0.010	0.015	0.005	0.008
Ammonia, as NH_4	0.01-	0.28	0.60	0.28
Nitrate, as NO_3	0.09	0.2-	0.23	0.08
Nitrite, as NO_2	0.01-	0.01-	-	0
Phosphate, as PO_4	3.27	3.95	3.64	3.4
Boron	0.022	0.18	-	0.05-
Total Organic Carbon	10.76	5.0	14.96	2.0
Hydrogen Sulfide	0.03-	0.03-	0.03-	0.03-
Mercury	0.0002-	0.0002-	0.0002-	0.0002-
Aluminum	0.037-	0.03	0.21	0.2-
Barium	0.120	0.03	0.01-	0.06
Selenium	0.01-	0.01-	0.01-	0.01-
Vanadium	0.085-	0.085-	-	0.2-
Cadmium	0.0018	0.0005	0.0008-	0.001-
Copper	0.114	0.002	0.014	0.005
Lead	0.031	0.036	0.013	0.02-
Manganese	0.075	0.073	0.073	0.076
Molybdenum	0.013-	0.01-	-	0.05-
Nickel	0.007-	0.003	0.006	0.008-
Silver	0.0021	0.0003	0.0002-	0.005-
Zinc	0.054	0.015	0.0070	0.013
Hexavalent Chromium	0.003-	0.005-	0.003-	0.01-
Arsenic	0.009	0.003-	0.006	0.003-
Strontium	1.46	0.003-	-	0.7
Polychlorinated Biphenyls as Aroclor 1016	0.001-	0.0005	0.001-	0.001-
Gross Alpha	0.6	0.4	1.2	0.9
Counting error	±1.0	±0.7	± 1.3	± 1.3
Field Measurements				
pH	-	6.8	7.4	6.45
Conductivity	475	380	380	420
Temperature (°C)	20.0	21.0	20.5	15.0
Alkalinity, as $CaCO_3$ (total)	-	15	-	-

a All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-20 (Continued) (Revision 1)
WATER QUALITY[a]
PIEZOMETER DP-1B

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	4.95	5.1	4.95	4.80
Calcium	0.634	0.5-	2.4	0.83
Magnesium	0.91	0.88	0.7	1.1
Iron	0.45	0.38	0.37	0.4
Sodium	3.69	3.3	3.5	6.2
Potassium	0.138	0.06	0.08	0.29
Chloride	5.0	1.2	0.98	6.7
Sulfate	3.5	4.25	4.68	1.12
Silica, Colloidal & Dissolved	1.77	2.52	5.92	3.4
Alkalinity, as $CaCO_3$	3.0	4	5.0	2.0
Alkalinity, as HCO_3	3.7	4.9	6.1	2.4
Fluoride	0.10-	0.03	0.01-	0.003
Conductivity	36	33	43	37.8
Total Dissolved Solids	30	28	6	17
Total Suspended Solids	1	1	3	3
Color	0.5	2	2	1
Turbidity	1.2	0.47	0.63	0.31
Hardness, as $CaCO_3$	7.2	8	8.95	10
Phenols	0.001-	0.032	0.009	0.005
Ammonia, as NH_4	0.24	0.28	0.39	0.26
Nitrate, as NO_3	0.13	0.31	0.05	0.12
Nitrite, as NO_2	0.01-	0.01-	-	0
Phosphate, as PO_4	1.43	0.26	1.38	0.58
Boron	0.027	0.09	-	0.05-
Total Organic Carbon	8.37	6.1	10.55	2.5
Hydrogen Sulfide	0.15	0.11	0.25	0.6
Mercury	0.0002-	0.0002-	0.0002-	0.0002-
Aluminum	0.037	0.16	0.29	0.2-
Barium	0.013-	0.01-	0.01-	0.06
Selenium	0.01-	0.01-	0.01-	0.01-
Vanadium	0.085-	0.085-	-	0.2-
Cadmium	0.0004	0.0001-	0.0006	0.001-
Copper	0.006	0.003	0.005	0.005-
Lead	0.004-	0.023	0.008	0.02-
Manganese	0.003	0.002	0.002	0.004-
Molybdenum	0.013-	0.01-	-	0.05-
Nickel	0.007-	0.001	0.002	0.008-
Silver	0.0009	0.0003-	0.0002-	0.005-
Zinc	0.013	0.028	0.013	0.023
Hexavalent Chromium	0.003-	0.005-	0.003-	0.01-
Arsenic	0.03	0.003-	0.006	0.006
Strontium	0.070	0.003-	-	0.1-
Polychlorinated Biphenyls as Aroclor 1016	0.001-	0.0005	0.001-	0.001-
Gross Alpha	0.7	0.7	0.5	0.4
Counting error	±0.4	±0.4	± 0.4	± 0.3
Field Measurements				
pH	-	4.8	5.2	4.1
Conductivity	55	40	40	45
Temperature (°C)	20.5	22.0	19.0	16.2
Alkalinity, as $CaCO_3$ (total)	-	2	-	-

a All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-20 (Continued) (Revision 1)
WATER QUALITY[a]
PIEZOMETER DA-5

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	7.3	7.4	7.20	7.09
Calcium	80.5	75.2	77.6	82.4
Magnesium	16.5	17.79	17.7	18.9
Iron	1.02	1.0	1.1	1.1
Sodium	10.4	9.8	10.9	11.3
Potassium	0.89	0.57	1.1	1.3
Chloride	14.5	13.8	12.72	14.5
Sulfate	1.5	0.69	0.36	0.189-
Silica, Colloidal & Dissolved	15.5	16.7	10.57	17.2
Alkalinity, as $CaCO_3$	244	260	254.4	262
Alkalinity, as HCO_3	298	317	310.2	319
Fluoride	0.15	0.16	0.16	0.19
Conductivity	510	470	423	418
Total Dissolved Solids	326	318	372	282
Total Suspended Solids	8	6	14	24
Color	1	5	3	8
Turbidity	12	6.1	8.9	9.0
Hardness, as $CaCO_3$	271	265	280	266
Phenols	0.001-	0.020	0.028	0.005
Ammonia, as NH_4	0.01-	0.40	0.46	0.46
Nitrate, as NO_3	0.13	0.25	0.06	0.07
Nitrite, as NO_2	0.01-	0.01-	-	0
Phosphate, as PO_4	1.32	1.65	4.64	1.34
Boron	0.009	0.23	-	0.05-
Total Organic Carbon	15.81	6.1	7.43	3.7
Hydrogen Sulfide	0.03-	0.03-	1.0	0.03-
Mercury	0.0002-	0.0002-	0.0002-	0.0002-
Aluminum	0.037-	0.03	0.60	0.2-
Barium	0.080	0.03	0.01-	0.12
Selenium	0.01-	0.01-	0.01-	0.01-
Vanadium	0.085-	0.085-	-	0.2-
Cadmium	0.0013	0.0009	0.0014	0.001-
Copper	0.141	0.010	0.002	0.006
Lead	0.016	0.014	0.022	0.02-
Manganese	0.066	0.063	0.079	0.064
Molybdenum	0.013-	0.01-	-	0.05-
Nickel	0.007-	0.0075	0.009	0.008-
Silver	0.0006	0.0006	0.0002-	0.005-
Zinc	0.061	0.034	0.011	0.020
Hexavalent Chromium	0.003-	0.005-	0.003-	0.01-
Arsenic	0.002-	0.003-	0.002-	0.003
Strontium	1.33	0.003-	-	0.7
Polychlorinated Biphenyls as Aroclor 1016	0.001-	0.0005-	0.0013	0.001-
Gross Alpha	0.7	1.3	0.5	0.1-
Counting error	±1.5	±1.4	± 0.9	± 0.4
Field Measurements				
pH	-	7.0	6.9	6.25
Conductivity	610	430	490	485
Temperature (°C)	20.0	21.5	21.0	17.8
Alkalinity, as $CaCO_3$ (total)	-	17	-	-

a All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-20 (Continued) (Revision 1)
WATER QUALITY[a]
PIEZOMETER DA-22

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	6.15	6.17	6.00	5.99
Calcium	5.50	4.43	5.9	7.6
Magnesium	3.89	4.60	4.1	3.6
Iron	3.98	4.2	3.9	3.9
Sodium	11.2	10.3	11.1	11.3
Potassium	0.46	0.24	0.53	0.77
Chloride	20.0	19.7	16.63	18.8
Sulfate	10.0	0.51	1.35	2.73
Silica, Colloidal & Dissolved	3.20	16.9	11.65	9.0
Alkalinity, as $CaCO_3$	22	25	25.6	36
Alkalinity, as HCO_3	27	30	32.2	44
Fluoride	0.10-	0.06	0.04	0.07
Conductivity	150	140	118	120
Total Dissolved Solids	118	82	155	79
Total Suspended Solids	20	9	18	7
Color	2	3	5	3
Turbidity	39	29	37	3.5
Hardness, as $CaCO_3$	36.0	30	31.9	36
Phenols	0.014	0.017	0.022	0.007
Ammonia, as NH_4	0.01-	0.23	0.21	0.21
Nitrate, as NO_3	0.09-	0.22	0.06	0.07
Nitrite, as NO_2	0.01-	0.01-	-	0
Phosphate, as PO_4	0.73	0.73	1.38	2.29
Boron	0.009-	0.07	-	0.05-
Total Organic Carbon	9.38	4.7	10.00	1.2
Hydrogen Sulfide	0.03-	0.03-	0.03-	0.03-
Mercury	0.0002-	0.0002-	0.00044	0.0002-
Aluminum	0.074	0.21	0.55	0.2-
Barium	0.027	0.01-	0.01-	0.06
Selenium	0.01-	0.01-	0.01-	0.01-
Vanadium	0.085-	0.085-	-	0.2
Cadmium	0.0009	0.0005	0.0009	0.001-
Copper	0.040	0.004	0.001	0.005-
Lead	0.008	0.014	0.005	0.02-
Manganese	0.066	0.069	0.063	0.076
Molybdenum	0.013-	0.01-	-	0.05-
Nickel	0.007-	0.002	0.003	0.008-
Silver	0.0003-	0.0003-	0.0002-	0.005-
Zinc	0.040	0.036	0.014	0.079
Hexavalent Chromium	0.003-	0.005-	0.003-	0.01-
Arsenic	0.002-	0.003-	0.002	0.003-
Strontium	0.19	0.003-	-	0.1-
Polychlorinated Biphenyls as Aroclor 1016	0.001-	0.0005	0.001-	0.001-
Gross Alpha	0.4	0.3	1.6	0.2
Counting error	±0.5	±0.4	± 0.8	± 0.3
Field Measurements				
pH	-	7.4	6.3	5.2
Conductivity	170	110	130	125
Temperature (°C)	19.5	21.5	21.0	16.8
Alkalinity, as $CaCO_3$ (total)	-	3	-	-

a All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-20 (Continued) (Revision 1)
WATER QUALITY[a]
PIEZOMETER WELL DP-10A

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	7.7	7.8	7.68	7.39
Calcium	52.1	48.4	65.8	52.2
Magnesium	10.60	11.1	13.0	11.9
Iron	0.27	0.21	0.69	0.2
Sodium	9.88	9.3	10.2	10.7
Potassium	0.62	0.34	0.79	0.96
Chloride	15.5	16.3	10.76	14.9
Sulfate	1 -	0.1-	0.23	0.189
Silica, Colloidal & Dissolved	9.90	11.7	13.82	12.4
Alkalinity, as $CaCO_3$	156	166	177.0	164
Alkalinity, as HCO_3	190	202	215.8	200
Fluoride	0.19	0.18	0.21	0.21
Conductivity	360	335	311	304
Total Dissolved Solids	234	212	199	196
Total Suspended Solids	12	6	76	3
Color	0.5	3	3	1
Turbidity	8.3	3.8	40	0.70
Hardness, as $CaCO_3$	174	174	230	174
Phenols	0.027	0.020	0.014	0.007
Ammonia, as NH_4	0.01-	0.31	0.24	0.31
Nitrate, as NO_3	0.09	0.22	0.17	0.08
Nitrite, as NO_2	0.01-	0.01-	-	0
Phosphate, as PO_4	1.01	1.13	3.64	0.58
Boron	0.008-	0.04	-	0.86
Total Organic Carbon	9.10	4.4	8.81	1.5
Hydrogen Sulfide	0.03-	0.03-	0.03-	0.03-
Mercury	0.0002-	0.0002-	0.0002-	0.0002-
Aluminum	0.037-	0.02-	1.5	0.2-
Barium	0.040	0.01	0.01-	0.06
Selenium	0.01-	0.01-	0.01-	0.01-
Vanadium	0.085-	0.085-	-	0.2-
Cadmium	0.0009	0.0006	0.0008	0.001
Copper	0.014	0.010	0.004	0.005-
Lead	0.016	0.025	0.018	0.02-
Manganese	0.031	0.028	0.047	0.024
Molybdenum	0.013-	0.01-	-	0.05-
Nickel	0.007-	0.002	0.006	0.008-
Silver	0.0015	0.0003-	0.0002-	0.005-
Zinc	0.015	0.023	0.010	0.005
Hexavalent Chromium	0.003-	0.005-	0.003-	0.01-
Arsenic	0.002-	0.003-	0.006	0.005
Strontium	0.58	0.003-	-	0.2
Polychlorinated Biphenyls as Aroclor 1016	0.001-	0.0005-	0.001-	0.001-
Gross Alpha	0.4	1.1	0.8	0.7
Counting error	±0.7	±1.0	± 1.1	± 0.8
Field Measurements				
pH	-	7.1	7.2	6.5
Conductivity	389	290	340	319
Temperature (°C)	20.0	20.0	21.0	18.0
Alkalinity, as $CaCO_3$ (total)	-	13	-	-

a All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-20 (Continued) (Revision 1)
WATER QUALITY[a]
PIEZOMETER DP-10B

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	6.15	6.0	5.91	5.60
Calcium	31.9	22.8	32.4	28.3
Magnesium	4.78	9.1	4.8	4.1
Iron	2.84	3.0	3.4	2.7
Sodium	20.8	17.4	18.8	19.3
Potassium	1.11	0.67	1.2	1.2
Chloride	39.0	30.6	24.46	14.3
Sulfate	62.0	92.1	82.59	44.1
Silica, Colloidal & Dissolved	2.28	4.78	7.45	5.4
Alkalinity, as $CaCO_3$	18	18	19.0	14
Alkalinity, as HCO_3	22	21.9	23.2	17
Fluoride	0.10-	0.04	0.01	0.11
Conductivity	250	275	271	238
Total Dissolved Solids	281	212	284	156
Total Suspended Solids	3	1	44	4
Color	35	50	10	10
Turbidity	13	2.2	37	1.3
Hardness, as $CaCO_3$	100	96	106	88
Phenols	0.001-	0.015	0.013	0.006
Ammonia, as NH_4	0.31	0.31	0.19	0.26
Nitrate, as NO_3	0.27	0.25	0.05	0.17
Nitrite, as NO_2	0.01-	0.01-	-	0.07
Phosphate, as PO_4	0.52	2.16	2.60	1.04
Boron	0.008-	0.29	-	0.05-
Total Organic Carbon	14.39	9.5	15.77	6.5
Hydrogen Sulfide	0.03-	0.03-	0.03	0.03-
Mercury	0.0002-	0.0008	0.0002-	0.0002-
Aluminum	0.037	0.082	2.2	0.2-
Barium	0.080	0.01	0.01-	0.06
Selenium	0.01-	0.01-	0.01-	0.01-
Vanadium	0.085-	0.085-	-	0.2-
Cadmium	0.0004	0.0001	0.0006	0.001-
Copper	0.002-	0.001	0.002	0.005-
Lead	0.019	0.019	0.011	0.02-
Manganese	0.009	0.010	0.022	0.015
Molybdenum	0.013-	0.01-	-	0.05-
Nickel	0.007-	0.002	0.006	0.008-
Silver	0.0003-	0.0003-	0.0002-	0.005-
Zinc	0.016	0.020	0.014	0.067
Hexavalent Chromium	0.003-	0.005-	0.003-	0.01-
Arsenic	0.002-	0.003-	0.017	0.005
Strontium	2.23	0.003-	-	0.3
Polychlorinated Biphenyls as Aroclor 1016	0.001-	0.0005-	0.001-	0.001-
Gross Alpha	2.0	2.7	2.1	0.1-
Counting error	±1.5	±1.4	± 1.5	± 0.3
Field Measurements				
pH	-	5.8	6.1	5.2
Conductivity	348	250	280	240
Temperature (°C)	20.0	20.0	19.0	17.3
Alkalinity, as $CaCO_3$ (total)	-	3	-	-

[a] All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-20 (Continued) (Revision 1)
WATER QUALITY[a]
PIEZOMETER DA-37

Parameter	Sampling Date August, 1980	November, 1980	April, 1981	July, 1981
pH	-	5.95	6.28	5.84
Calcium	-	12.6	9.9	9.5
Magnesium	-	2.1	1.6	1.1
Iron	-	2.4	1.7	1.1
Sodium	-	9.6	8.2	9.1
Potassium	-	0.36	0.49	0.80
Chloride	-	19.7	6.85	14.0
Sulfate	-	0.63	8.35	0.189-
Silica, Colloidal & Dissolved	-	7.44	7.45	6.6
Alkalinity, as $CaCO_3$	-	42	27.0	26
Alkalinity, as HCO_3	-	52.4	32.9	32
Fluoride	-	0.04	0.02	0.077
Conductivity	-	175	113	84
Total Dissolved Solids	-	139	266	50
Total Suspended Solids	-	364	152	14
Color	-	45	10	5
Turbidity	-	60	45	17
Hardness, as $CaCO_3$	-	44	32.3	32
Phenols	-	0.033	0.011	0.004
Ammonia, as NH_4	-	0.28	0.37	0.32
Nitrate, as NO_3	-	0.36	0.09	0.04
Nitrite, as NO_2	-	0.01-	-	0
Phosphate, as PO_4	-	1.48	1.38	0.74
Boron	-	0.09	-	0.05-
Total Organic Carbon	-	35.2	10.51	2.5
Hydrogen Sulfide	-	0.03	0.1	0.5
Mercury	-	0.0002-	0.0002-	0.0002-
Aluminum	-	3.5	8.2	0.4
Barium	-	0.07	0.01-	0.06
Selenium	-	0.01-	0.01-	0.01-
Vanadium	-	0.0085-	-	0.2-
Cadmium	-	0.0005	0.0005	0.001-
Copper	-	0.014	0.003	0.011
Lead	-	0.031	0.035	0.02-
Manganese	-	0.11	0.11	0.089
Molybdenum	-	0.01-	-	0.05-
Nickel	-	0.003	0.010	0.008-
Silver	-	0.0003-	0.0002-	0.005-
Zinc	-	0.046	0.024	0.052
Hexavalent Chromium	-	0.005-	0.003-	0.01-
Arsenic	-	0.003-	0.002-	0.0057
Strontium	-	0.003-	-	0.1-
Polychlorinated Biphenyls as Aroclor 1016	-	0.0005-	0.001-	0.001-
Gross Alpha	-	1.8	3.8	0.8
Counting error	-	±1.0	± 1.5	± 0.6
Field Measurements				
pH	-	5.8	6.2	5.5
Conductivity	-	185	100	108
Temperature (°C)	-	20.0	20.0	17.0
Alkalinity, as $CaCO_3$ (total)	-	6	-	-

[a] All values in milligrams per liter (mg/l), except pH which is in pH units, conductivity which is in umho/cm, color which is in color units, turbidity which is in nephelometric turbidity units (NTU), and gross alpha which is in picocuries per liter (pCi/l). A minus sign (-) indicates concentration less than reported value.

Table D-21

CONCENTRATION RANGES OF SELECTED DISSOLVED CONSTITUENTS IN SOLID WASTE LEACHATE

Parameter	Fly Ash Leachate (mg/l)[a]	FGD Sludge Liquors (mg/l)[b]		Coal Pile Drainage (mg/l)[c]	
		Median	Maximum	Mean	Maximum
Arsenic	.0006 - 7.3	.02	1.8	0.15	0.36
Barium	<.02 - 79			0.17	0.5
Cadmium	<.00005 - .06	.023	0.1	0.001	0.001
Calcium	36.6 - 1708	700	2600	300	490
Chromium	.008 - .74	0.02	0.5	0.005	0.011
Copper		.015	0.4	0.9	1.4
Iron		.026	0.1		
Lead	<.00001 - 0.7	0.12	0.55	200	1,800
Mercury	<.000001 - 25	.001	.07	0.0005	0.0025
Selenium	.0001 - 1.56	.11	2.7	0.005	0.030
Silver	.0001 - .06			ND	ND
Zinc		.046	27	6.5	16.6
TDS		7,000	70,000	7,500	16,000
Chloride		2,300	5,000	10	20
Sulfate		2,100	30,000	5,000	9,600
Manganese		.17	9.0	30	45
Fluoride		3.2	70		

a EPRI, 1979a
b EPRI, 1979b - Aerospace Corporation Data for eastern coal
c U.S. EPA, February 1979

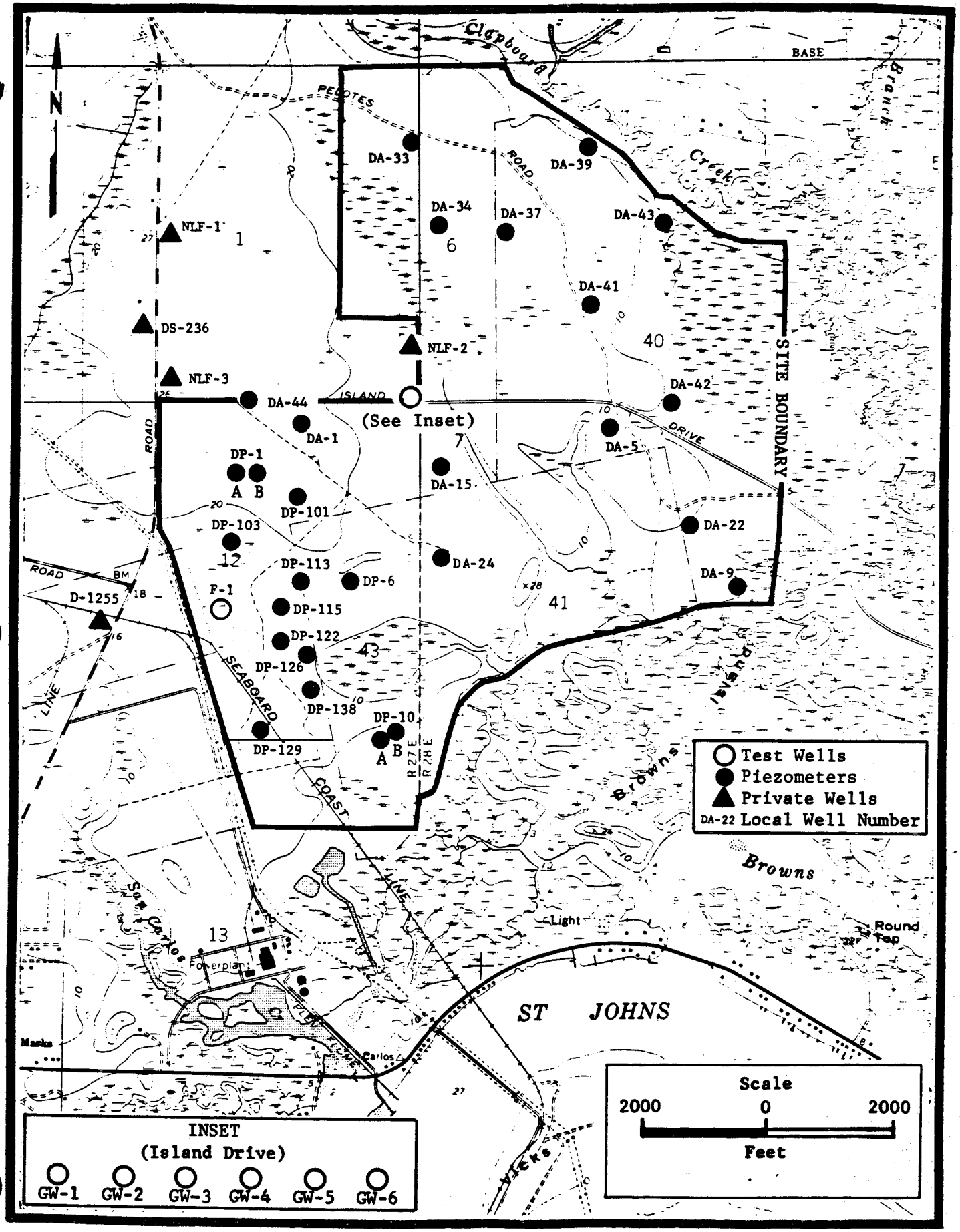
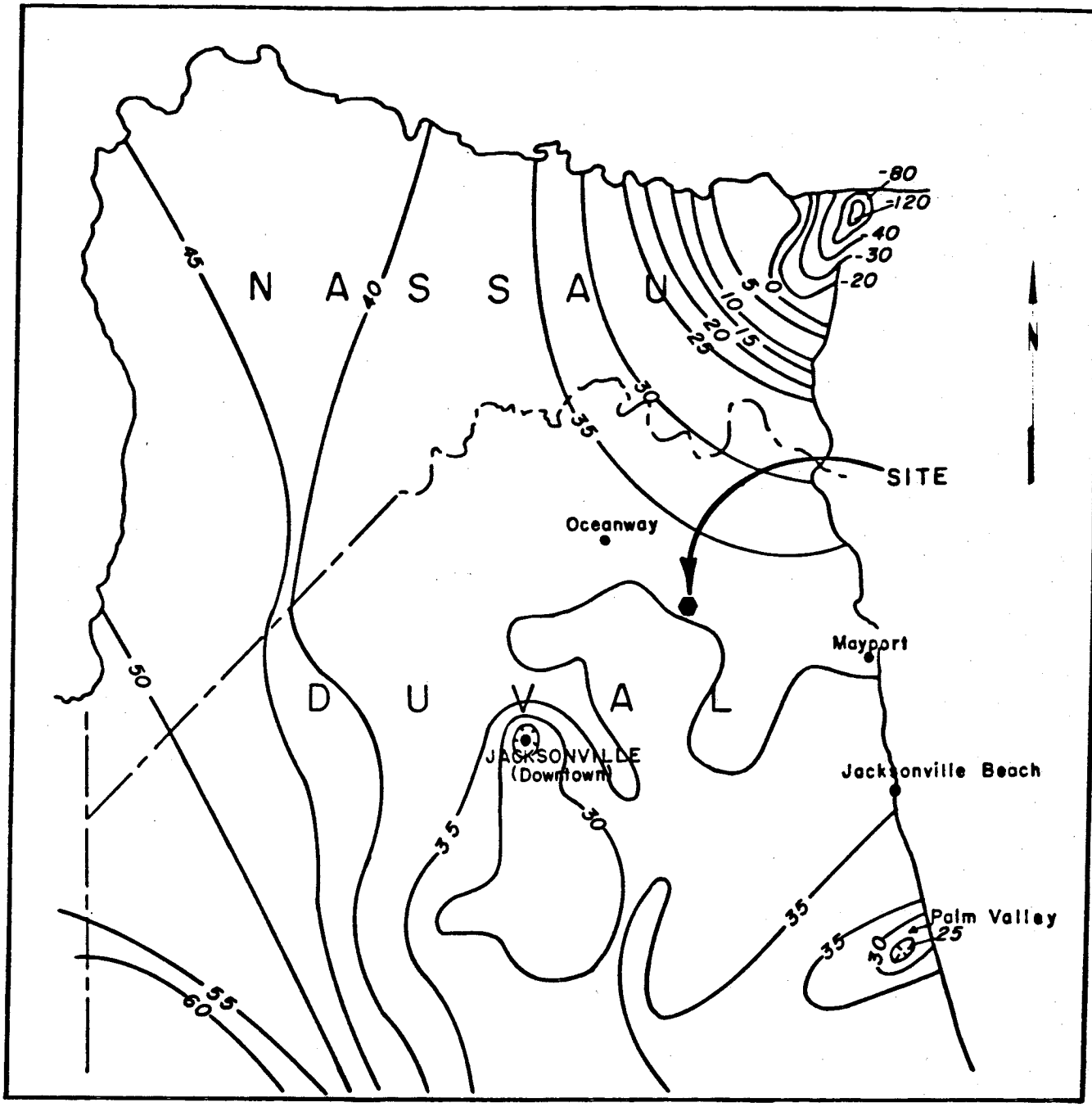


Figure D-1 Locations of Pre-Application Groundwater Monitoring Points



SOURCE: U.S. GEOLOGICAL SURVEY, OPEN-FILE REPORT 80-69, 1980.

—30— POTENTIOMETRIC CONTOUR - Shows altitude at which water level would have stood in tightly cased wells. Hachures indicate depressions. Contour intervals 5, 20, and 40 feet. Datum is National Geodetic Vertical Datum of 1929 (NGVD).

SCALE

10 MILES 0 10 MILES

Figure D-2 Potentiometric Surface Map of the Floridan Aquifer: May, 1979

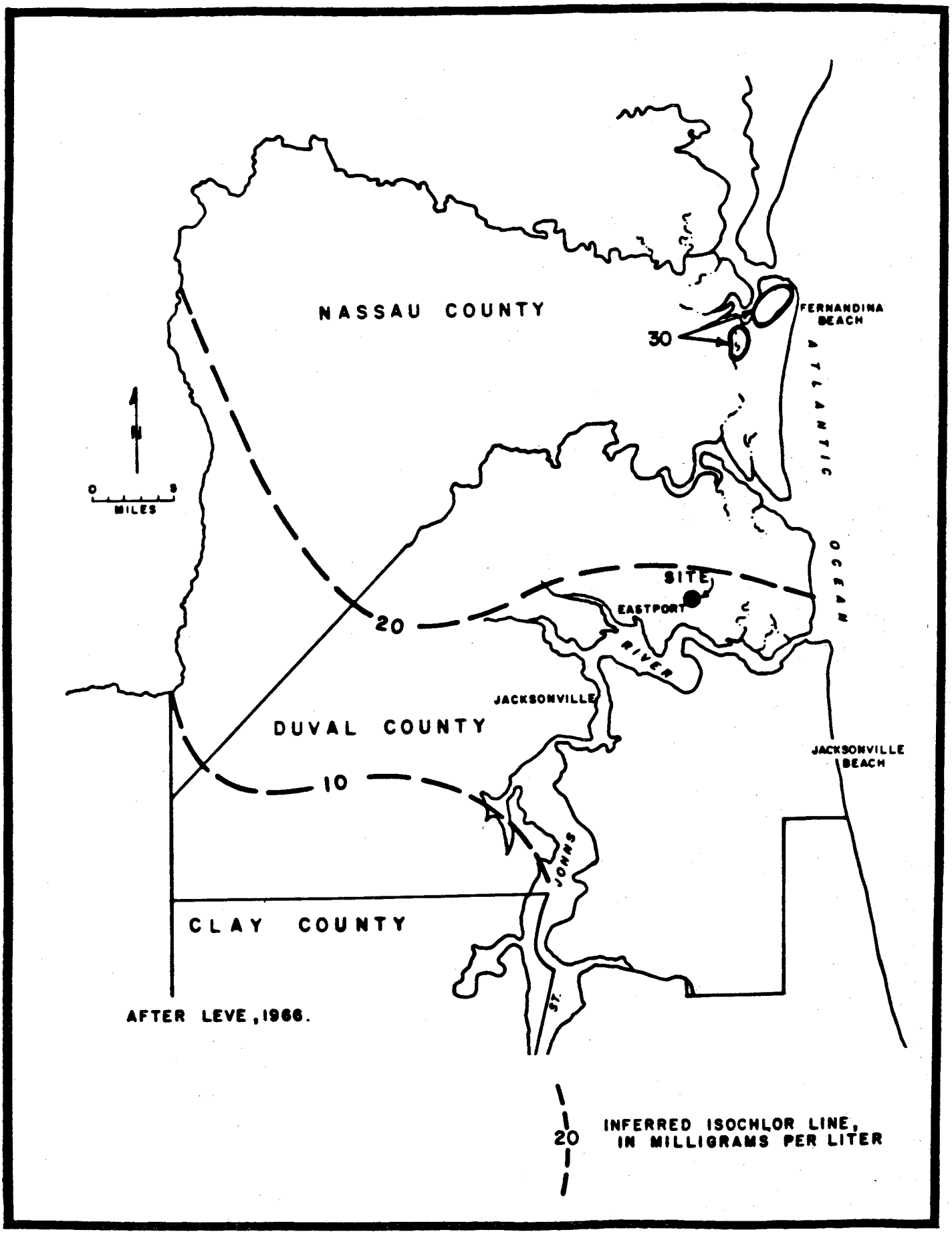


Figure D-3 Map of Duval and Nassau Counties Showing Approximate Chloride Content of Water from Artesian Wells in 1940

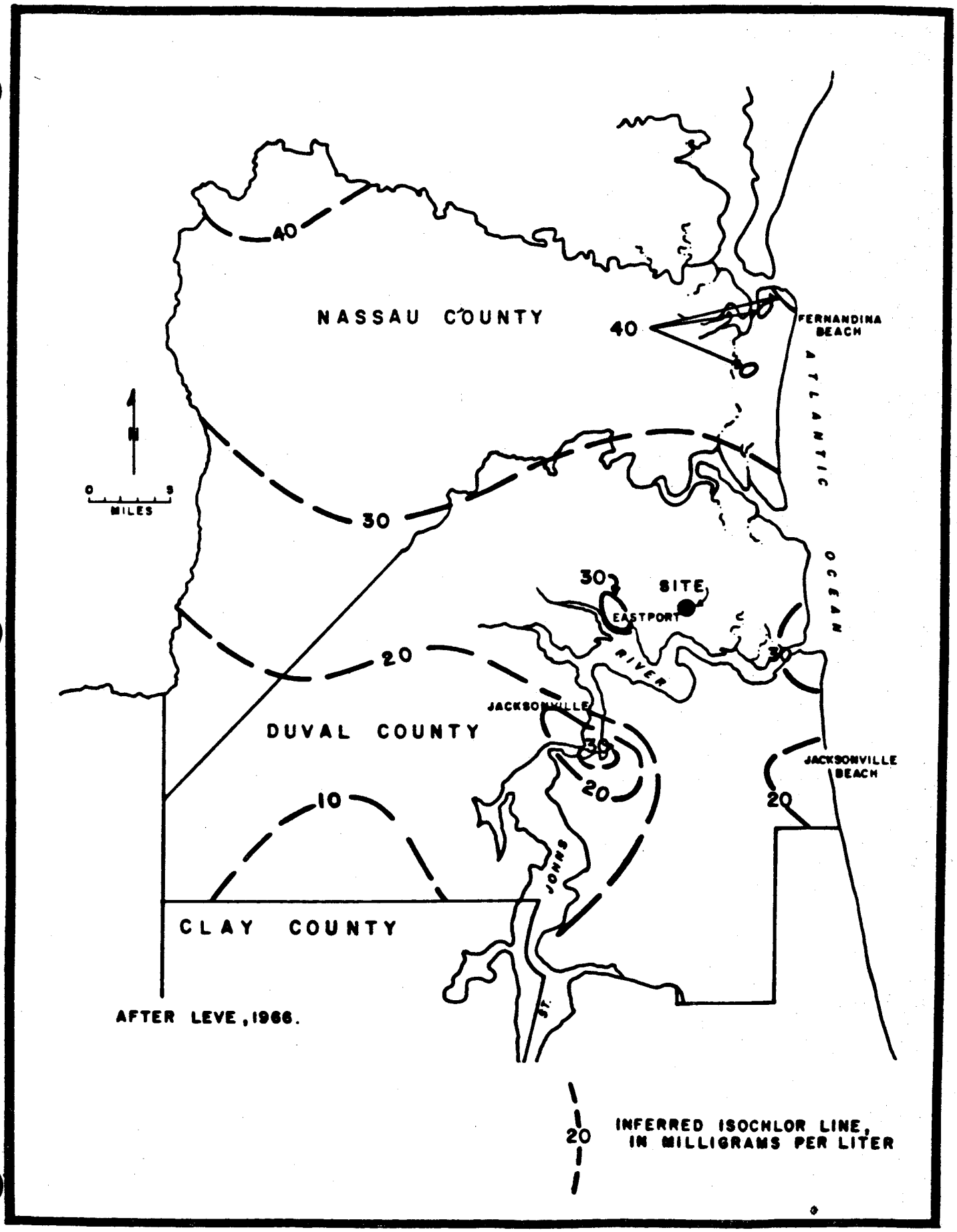


Figure D-4 Map of Duval and Nassau Counties Showing Approximate Chloride Content of Water from Artesian Wells in May 1962

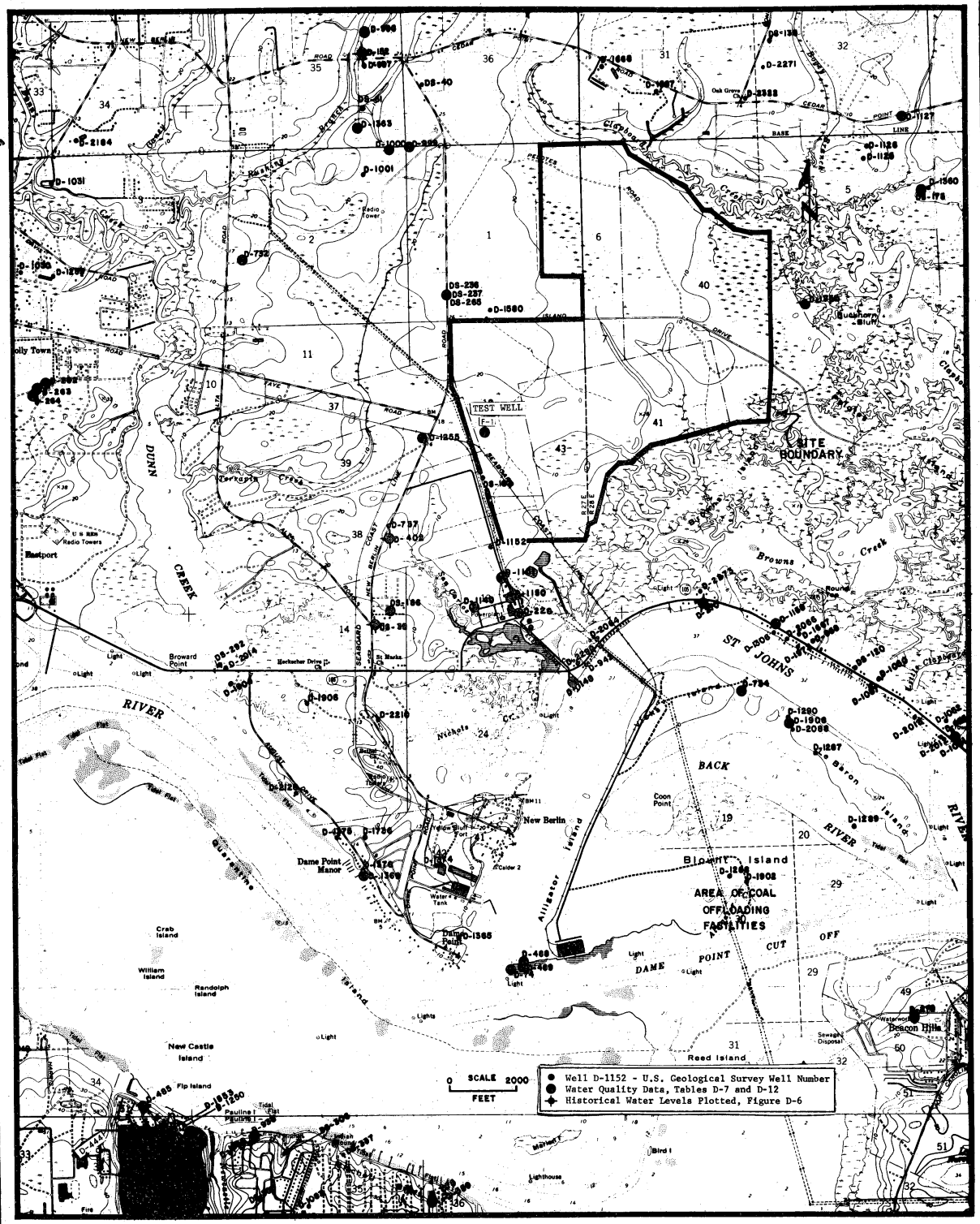


Figure D-5 Inventory of Wells in the Study Area

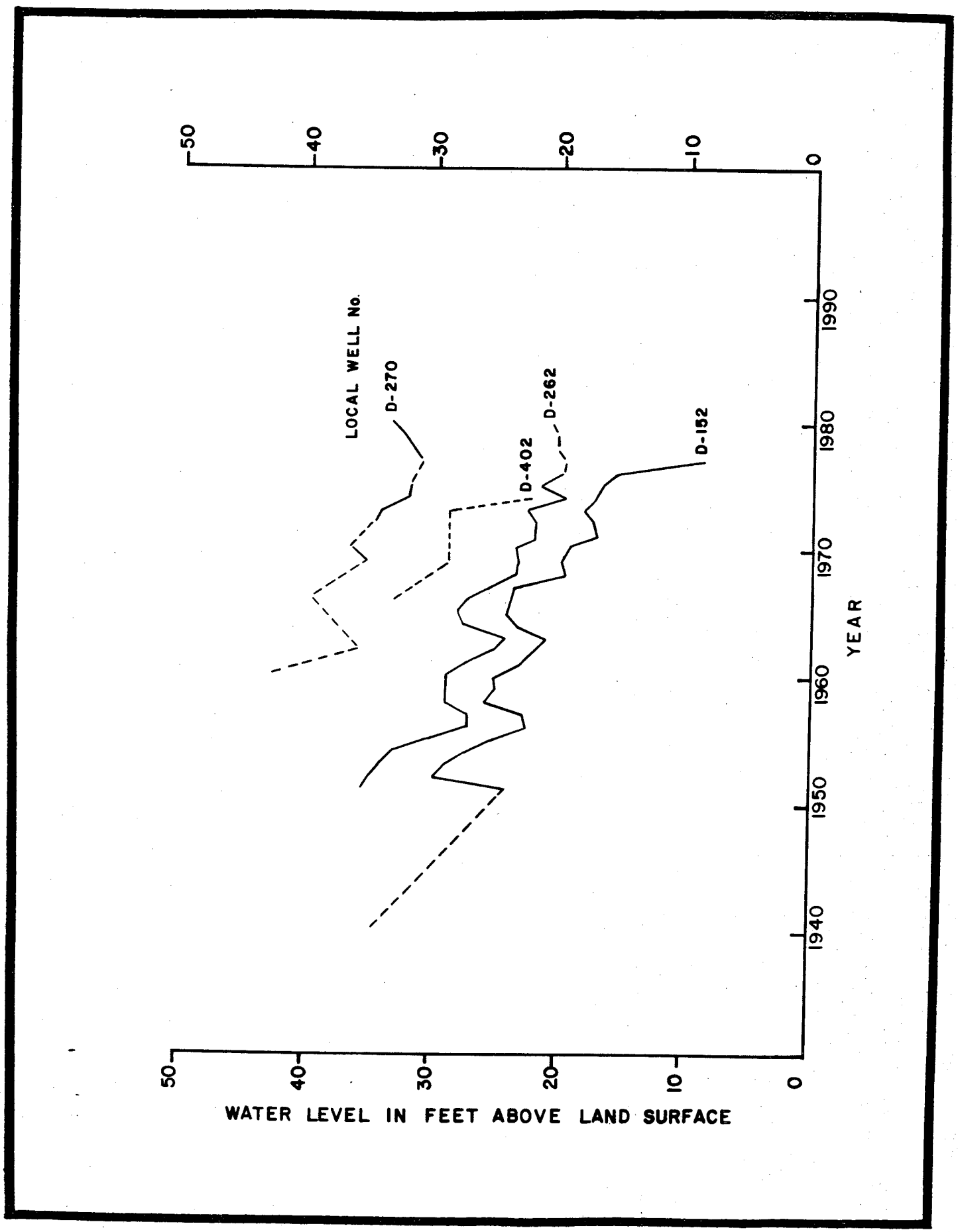


Figure D-6 Water Levels in Selected Floridan Wells in the Vicinity of the Site: Yearly Averages (See Fig. D-5 for Locations of Wells)

ENVIROSPHERE COMPANY

A DIVISION OF EBASCO SERVICES INCORPORATED

LOG OF WELL F-1 SHEET 1 OF 6

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT		ELEVATION AND DATUM	PROJECT NO.: 3332
DRILLING AGENCY: LAYNE ATLANTIC DRILLING CO.		DATE STARTED: 7/28/80 (PILOT HOLE)	DATE FINISHED: 8/14/80
DRILLING EQUIPMENT: LAYNE-ARK	ROD LENGTH: APPROX. 30'	COMPLETION DEPTH: 752'	ROCK DEPTH: 54'
BIT: SIZE 9 7/8, DEPTH 98 PILOT HOLE; SIZE 28", DEPTH 80'		NO SOIL SAMPLES: 10	METHOD: GRAB
BIT: SIZE 17", DEPTH 525; SIZE 9 7/8", DEPTH 752'		NO WATER SAMPLES: 3	WATER LEVEL: +18' (APPROX)
CASING: SIZE 18", DEPTH 80'; SIZE 12", DEPTH		FOREMAN: JOHN DISK - driller	
CASING: SIZE 12", DEPTH 521'; SIZE, DEPTH		INSPECTOR: W HAHN - ENVIROSPHERE CO.	
SCREEN SETTING: SIZE N/A, DEPTH; SIZE, DEPTH			

DEPTH	PENE RATE	CIRC RET	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL
0					fine sand & silt, some clay	
20						
40					Bentonite Mud (Layrite)	
60					partially cemented s.s. and l.s.	
80					calc ss. and limestone	
100	10 MIN				blue & gr. phos. sandy clay and l.s.	
120					calc. sands and green ooze	
140						

DESCRIPTION and COMMENTS

kelly + sub + bit = 39'8"
hole 2.10' a.g.
drill collar 28'4"

top hole 0-100' 28" pipe sample recovery, occasional heaving sands drilled quickly to avoid washout & caving

circulation broke through to rathole

harder, sandstone (?) cuttings all sand, no rock chips

18" surface casing to 80'

Hawthorne Formation

12" A53 Bl St. Casing

CEMENT GROUT

Figure D-7 Drilling Summary: Well F-1 (sheet 1 of 6)

ENVIROSPHERE COMPANY

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LOG OF WELL F-1 SHEET 2 OF 6

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT					ELEVATION AND DATUM	PROJECT NO. 3332	
DRILLING AGENCY					DATE STARTED	DATE FINISHED	
DRILLING EQUIPMENT				ROD LENGTH	COMPLETION DEPTH	ROCK DEPTH	
BIT	SIZE	DEPTH	SIZE	DEPTH	NO SOIL SAMPLES	METHOD	
	SIZE	DEPTH	SIZE	DEPTH	NO WATER SAMPLES	WATER LEVEL	
CASING	SIZE	DEPTH	SIZE	DEPTH	FOREMAN		
	SIZE	DEPTH	SIZE	DEPTH			
SCREEN SETTING	SIZE	DEPTH	SIZE	DEPTH	INSPECTOR		
	SIZE	DEPTH		DEPTH			

DEPTH	PENE RATE	CIRC RET.	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
160							same as above, phosphate more abundant, crse qtz sand grains calc cement
	16 min						
160					H gr to grn. phos. s.s. w/ clay & occ calc cement		slightly harder, sandier, qtz. well rounded to sub-rounded, crse. abndnt phosphate, H gr to gr.
180	17						
							becoming softer, more clay, shell frags. abndnt off white clay w/ sand, feldspathic(?)
200							
	17						slightly harder, incr. qtz. ss.
220							
					gr. clay w/ sand		clay & sand (60/40) olive, some off plastic
240	HT						very hard l.s(?) ledge
					olive gr. s.Hy sand & clay		olive green silty sand, med - crse gr. some light gr keyes
260							12", A-53, Bl. St Csng
	12 min						CEMENT GROUT
280							

Figure D-7 Drilling Summary: Well F-1 (sheet 2 of 6)

ENVIROSPHERE COMPANY

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LOG OF WELL F-1 SHEET 3 OF 6

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT					ELEVATION AND DATUM	PROJECT NO. 3332	
DRILLING AGENCY					DATE STARTED	DATE FINISHED	
DRILLING EQUIPMENT				ROD LENGTH	COMPLETION DEPTH	ROCK DEPTH	
BIT	SIZE	DEPTH	SIZE	DEPTH	NO SOIL SAMPLES	METHOD	
	SIZE	DEPTH	SIZE	DEPTH	NO WATER SAMPLES	WATER LEVEL	
CASING	SIZE	DEPTH	SIZE	DEPTH	FOREMAN		
	SIZE	DEPTH	SIZE	DEPTH			
SCREEN SETTING	SIZE	DEPTH	SIZE	DEPTH	INSPECTOR		
	SIZE	DEPTH	SIZE	DEPTH			

DEPTH	PENE RATE	CIRC RET	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
280	12 min				H gr. to grn. phos. sndy clay		Phos. sndy clay, grn., moderately to slightly hd.
300	H min						very hard ledge
							hard, less clay, cemented ss. l.s fragments
					phos clay		ball clay, with phos inclusions, w/hd felsp ss?
320							12" A53, Bl. St. Csng
					green phos. clay w/ minor sand		CEMENT GROUT
340	13						
					?		
					lt gr to off white calc snd w/ l.s		lmar. sand, pred qtz. becoming crser.
360	12						
380							lower 10', vy soft, off-white, sandy clay
							drilling harder traces of l.s & shell
400	12						
					?		soft
420							soft tan-yellow/brown clay 418-421

Figure D-7 Drilling Summary: Well F-1 (sheet 3 of 6)

ENVIROSPHERE COMPANY

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LOG OF WELL F-1 SHEET 4 OF 6

PROJECT AND LOCATION					ELEVATION AND DATUM	PROJECT NO.
JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT						3332
DRILLING AGENCY					DATE STARTED	DATE FINISHED
DRILLING EQUIPMENT				ROD LENGTH	COMPLETION DEPTH	ROCK DEPTH
BIT	SIZE	DEPTH	SIZE	DEPTH	NO SOIL SAMPLES	METHOD
	SIZE	DEPTH	SIZE	DEPTH	NO WATER SAMPLES	WATER LEVEL
CASING	SIZE	DEPTH	SIZE	DEPTH	FOREMAN	
	SIZE	DEPTH	SIZE	DEPTH		
SCREEN SETTING	SIZE	DEPTH	SIZE	DEPTH	INSPECTOR	
	SIZE	DEPTH	SIZE	DEPTH		

DEPTH	PENE RATE	CIRC RET	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
420				Bentonite Mud			426-429 hard ledge ss.(?)
	23 min						incr. ls. cont. and addtl calc. cement
440							incr in clay cont. dark. w sand
	0'37"						becoming greener
	0'21"						
	6'11"						mud color lightening
460					lt gy to lbw soft clay		begin drilling and washing every 5 feet for sampling
					ls. and shell		shell bed - frags of broken white shells
					Qzite		mud lightening up in color.
					@ 470'		limestone - white, circ from ~464'
480					shell, limestone & calc ss.		fossiliferous, sponge(?) ftr, shell frags, etc, coral(?)
					white, chalky		w/ streaks of gy, plastic clay
					Oc 2nd LS, Top of Floridan Aquifer		~474. mostly f.x., blk shell pcts, fr. blue ls
500							479- mostly shell frags, <30% sand (qtz) fr. p-soft
							no clay
							incr. shell cont w/ ls. frags. decr sand cont
							Mag fossils id'd by GS begin ~470' cuttings
							line to mud. Few core cuttings, many be fx.
							~496-497 drilling slitly harder fr p-soft, fr. clay
520							← 12", A-53 Bl. S. Csng To 521
							TD 10" hole
540				Reverse Air	white limestone w/ shell		
560							

Figure D-7 Drilling Summary: Well F-1 (sheet 4 of 6)

ENVIROSPHERE COMPANY

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LOG OF WELL F-1 SHEET 5 OF 6

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT					ELEVATION AND DATUM	PROJECT NO. 3332	
DRILLING AGENCY					DATE STARTED	DATE FINISHED	
DRILLING EQUIPMENT				ROD LENGTH	COMPLETION DEPTH	ROCK DEPTH	
BIT	SIZE	DEPTH	SIZE	DEPTH	NO. SOIL SAMPLES	METHOD	
	SIZE	DEPTH	SIZE	DEPTH	NO. WATER SAMPLES	WATER LEVEL	
CASING	SIZE	DEPTH	SIZE	DEPTH	FOREMAN		
	SIZE	DEPTH	SIZE	DEPTH			
SCREEN SETTING	SIZE	DEPTH	SIZE	DEPTH	INSPECTOR		
	SIZE	DEPTH	SIZE	DEPTH			

DEPTH	PENE. RATE	CIRC. RET.	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
540						
				White Limestone		White limestone, fossiliferous in places abundant shell frags. in places.
550			mud rotary			
600			1100 gpm	White Limestone w/ shell		*well drilled to 599. Mud began thinning out well began flowing @ 1330 hrs
						Meas. Q in channel: channel 2.8' x 0.65' } ≈ 1170 gpm vel. ≈ 5'/3.5 sec. }
						Water sampled T = 23°C EC = 900 μmhos/cm Sal. <0.5%
620						Began drilling @ 599 w/ air+water @ 13 ≈ 750 cfm air compressor "pegging off" switched over to reverse air
640				soft-med hd white to beige shelly limestone		meas. Q @ 627 ≈ 1100 gpm.
						Sample @ 659' T = 23°C EC = 780 Sal. = <0.5%
660						softer, white to beige shelly l.s.
	9 min					
680						Tiendon ledge
						meas Q 7.5' x 0.7' 14.5 sec/15' ≈ 1000 gpm
700						

Figure D-7 Drilling Summary: Well F-1 (sheet 5 of 6)

ENVIROSPHERE COMPANY

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LOG OF WELL F1 SHEET 6 OF 6

PROJECT AND LOCATION				ELEVATION AND DATUM	PROJECT NO.
JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT					3332
DRILLING AGENCY				DATE STARTED	DATE FINISHED
DRILLING EQUIPMENT			ROD LENGTH	COMPLETION DEPTH	ROCK DEPTH
BIT	SIZE	DEPTH	SIZE DEPTH	NO SOIL SAMPLES	METHOD
	SIZE	DEPTH	SIZE DEPTH	NO WATER SAMPLES	WATER LEVEL
CASING	SIZE	DEPTH	SIZE DEPTH	FOREMAN	
	SIZE	DEPTH	SIZE DEPTH		
SCREEN SETTING	SIZE	DEPTH	SIZE DEPTH	INSPECTOR	
	SIZE	DEPTH	SIZE DEPTH		

DEPTH	PENE RATE	CIRC RET	CIRC CSG	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
700					WHITE TO BUFF LIMESTONE AND SHELL		GENLY SOFT BUFF TO WHITE L.S & SHELL
720							ALTNTNG SOFT & HRD LEDGES
							w hd @ 724' - cutting larger - chips 1/4"
							fr. of chalk? bent. clay(?) white
							733' drill fluid clr - clean cavings
740							738 w/ hd qtz? dolomite? mild reaction to HCl,
	30 min RUN			50+	AVON PARK Cockomatie limestone		along fissures in rock chips & bwn
							vuggy dolomite
							silt - clay, white (chalk)
760				100-150 FREE FLOW			751 - H. to dk bwn. dolomite
							silt seams
							TOTAL DEPTH 752'
							Water Sample @ 752'
780							T = 23°C
							EC = 780 umhos/cm
							Sal. < 0.5 ‰
800							MEASURED DISCHARGE:
							CHANNEL WIDTH = 2.75' DEPTH = 0.75'
							avg vel. = 15'/13.2 sec.
							Q = 1100 gpm
820							MEAS JET HEAD = 3½"
							Q = 1500 gpm
							(probably not valid because of flange on 12")
840							

Figure B-7 Drilling Summary: Well F-1 (sheet 6 of 6)

WELL JEA F-1 (EASTPORT)

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: _____ ELEVATION: GROUND LEVEL _____

TOP OF CASING _____

DRILLING SUMMARY:

TOTAL DEPTH 752'

BOREHOLE DIAMETER 9 7/8"

DRILLER LAYNE ATLANTIC CO.
SAVANNAH, GEORGIA
JOHN DISK - DRILLER

RIG LAYNE - ARK

BIT(S) 23" 17" 9 7/8"

DRILLING FLUID BENTONITE MUD, WATER, AIR (REVERSE)

SURFACE CASING 80', 18" A-53 BL ST.

WELL DESIGN:

BASIS: GEOLOGIC LOG ✓ GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0	80	C1			
+1	521	C2			

CASING: C1 18", 0.375 WALL A-53 Black Steel
C2 12", 0.375 WALL A53 Black Steel
C3 _____
C4 _____

SCREEN: S1 NONE
S2 _____
S3 _____
S4 _____

CENTRALIZERS CASING GUIDES INSTALLED ON 12" CASING

FILTER MATERIAL NONE

CEMENT SURFACE CASING - 100 SACKS
PRODUCTION CASING - 400 SACKS

OTHER _____

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING:				
23" TO 100'	7/28/80	1945 hrs	7/29/80	0830 hrs
17" TO 520'	7/31/80	0730 hrs	8/3/80	1500 hrs
9 7/8" TO 752'	8/12/80	1100 hrs	8/14/80	1800 hrs
GEOPHYS. LOGGING:	8/21/80		8/22/80	
CASING:				
FILTER PLACEMENT:	N/A			
CEMENTING: SURFACE	7/29/80	1335	7/29/80	1355
~~DEVELOPMENT:~~ Prod. Hole	8/1/80	1550	8/1/80	1620
OTHER:				

WELL DEVELOPMENT

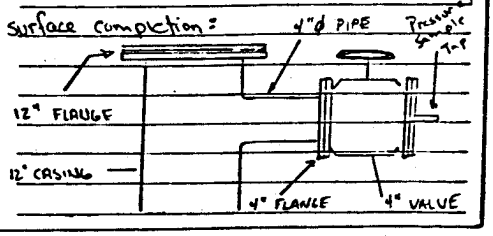
well drilled reverse air - no development required

COMMENTS:

18" CASING TOTAL 80'6"
12" CASING TOTAL 522'0"

well free flowing est. 1000 gpm

Surface completion:



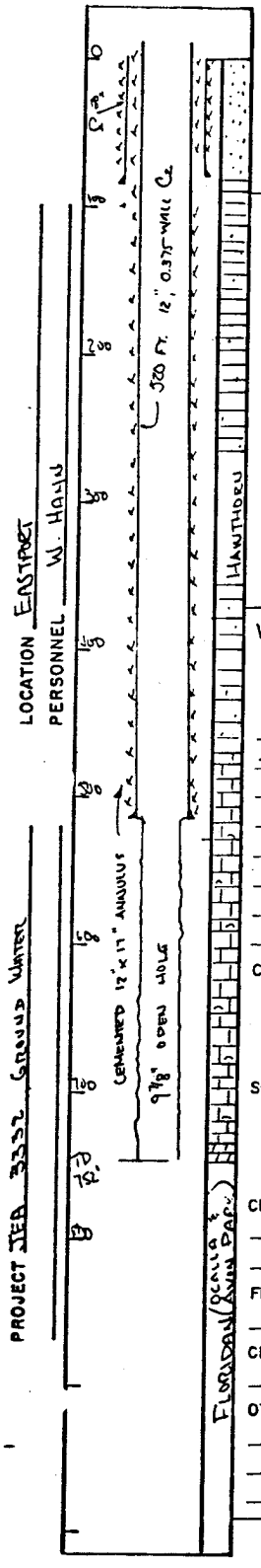


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Figure D-8 Well Construction Summary: Well F-1

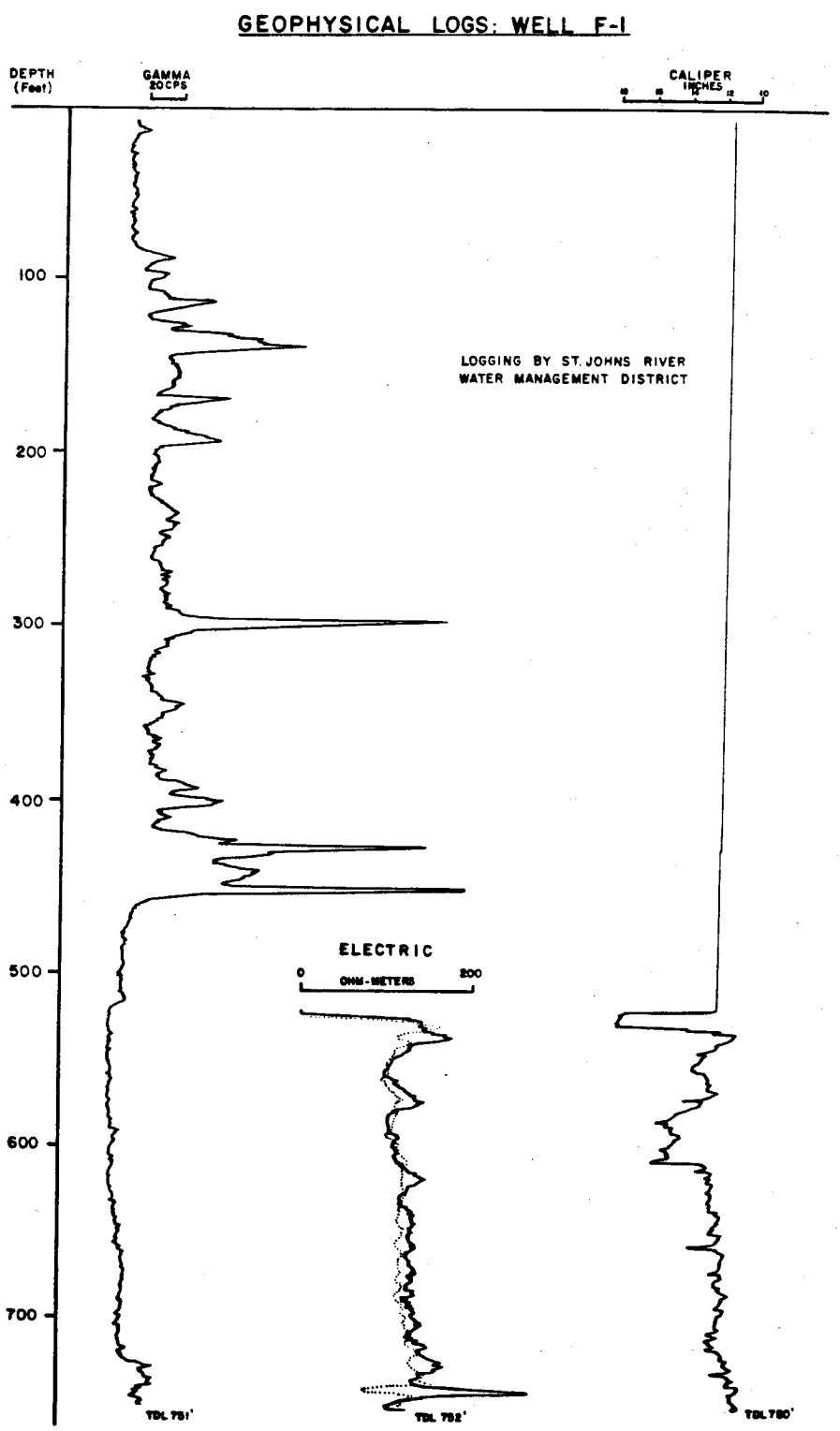

Figure D-9 Geophysical Logs: Well F-1

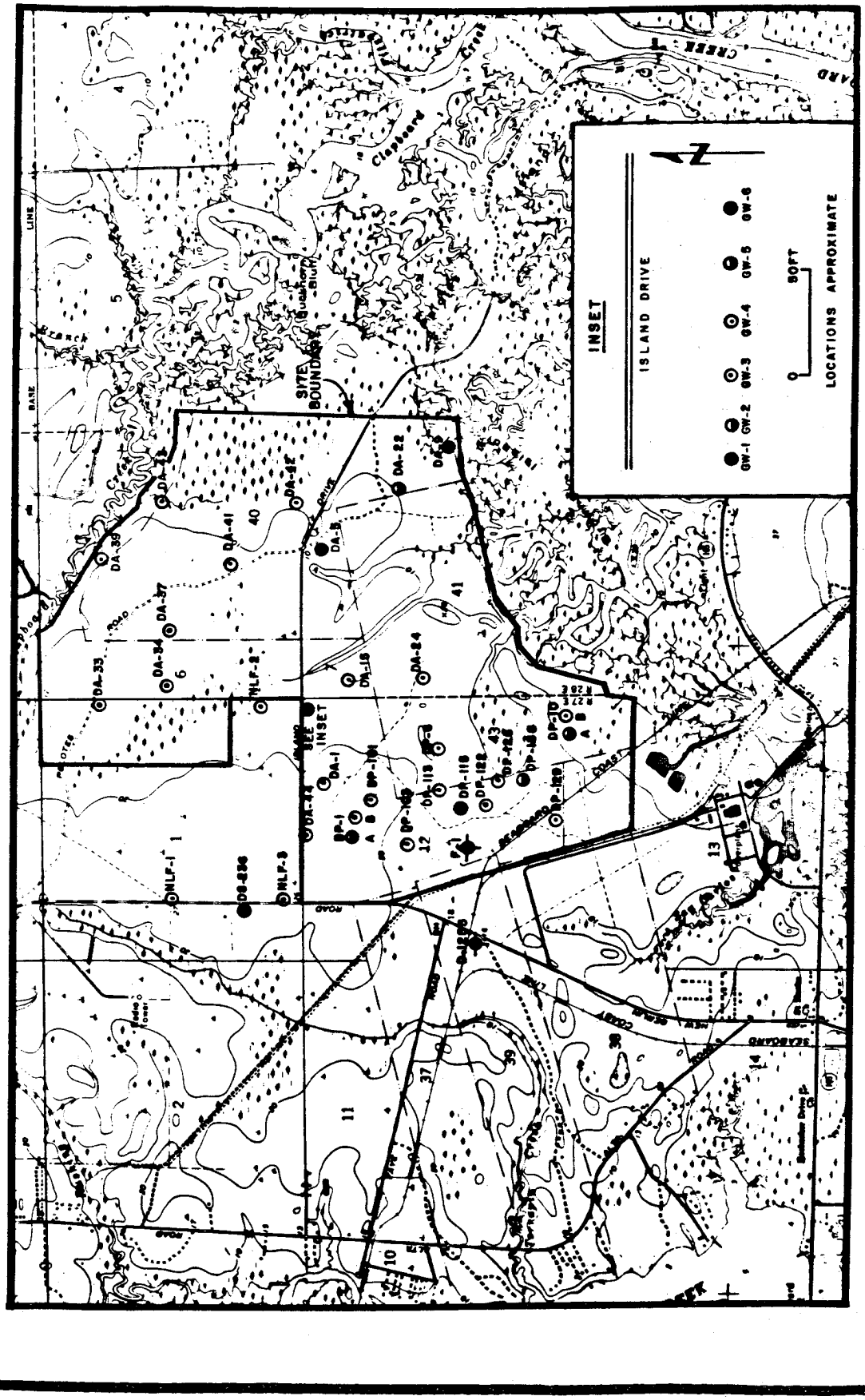

Figure D-10 Locations of Test Wells, Piezometers, and Observation Wells

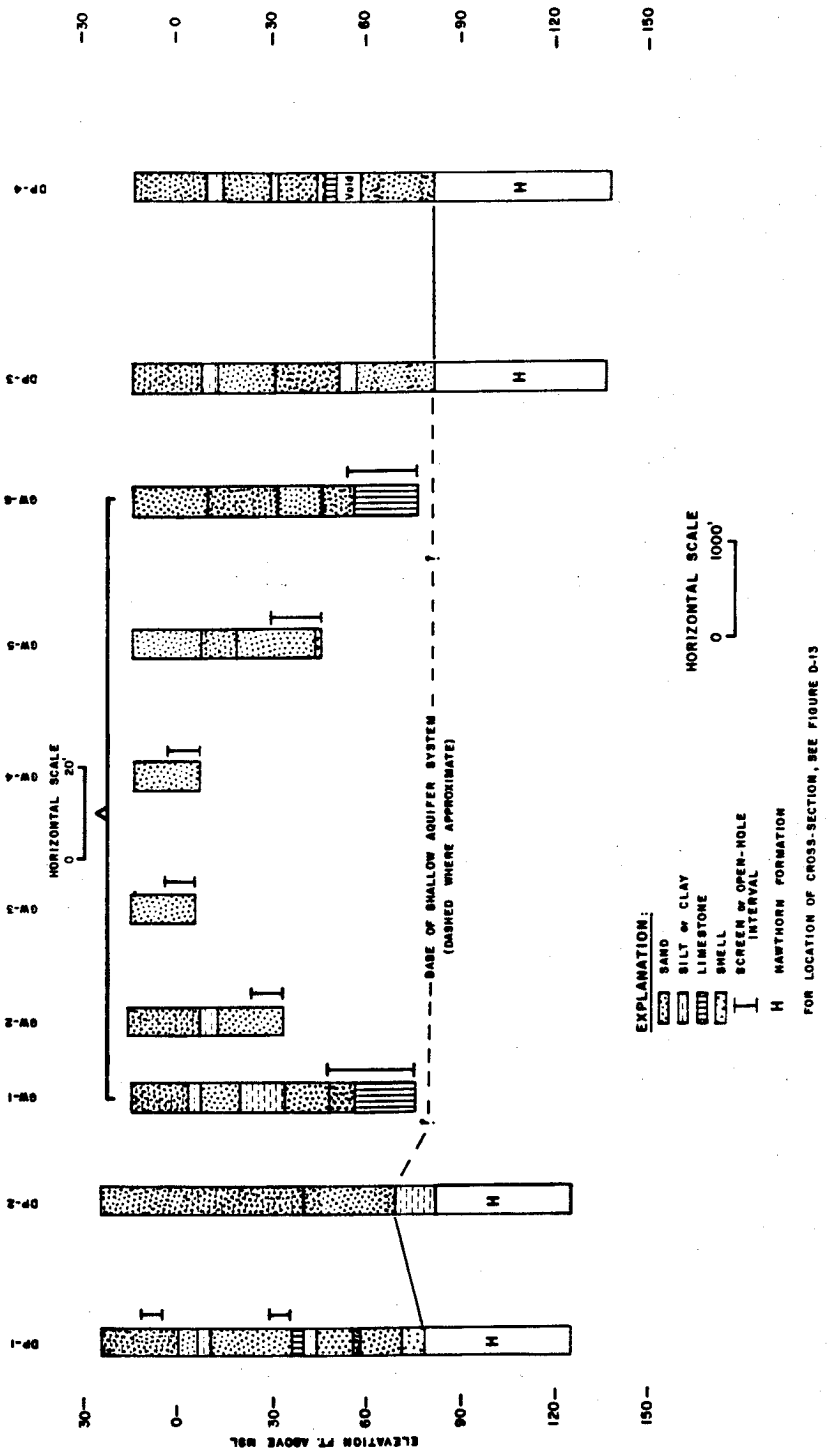

Figure D-11 Stratigraphic Cross-Section A-A

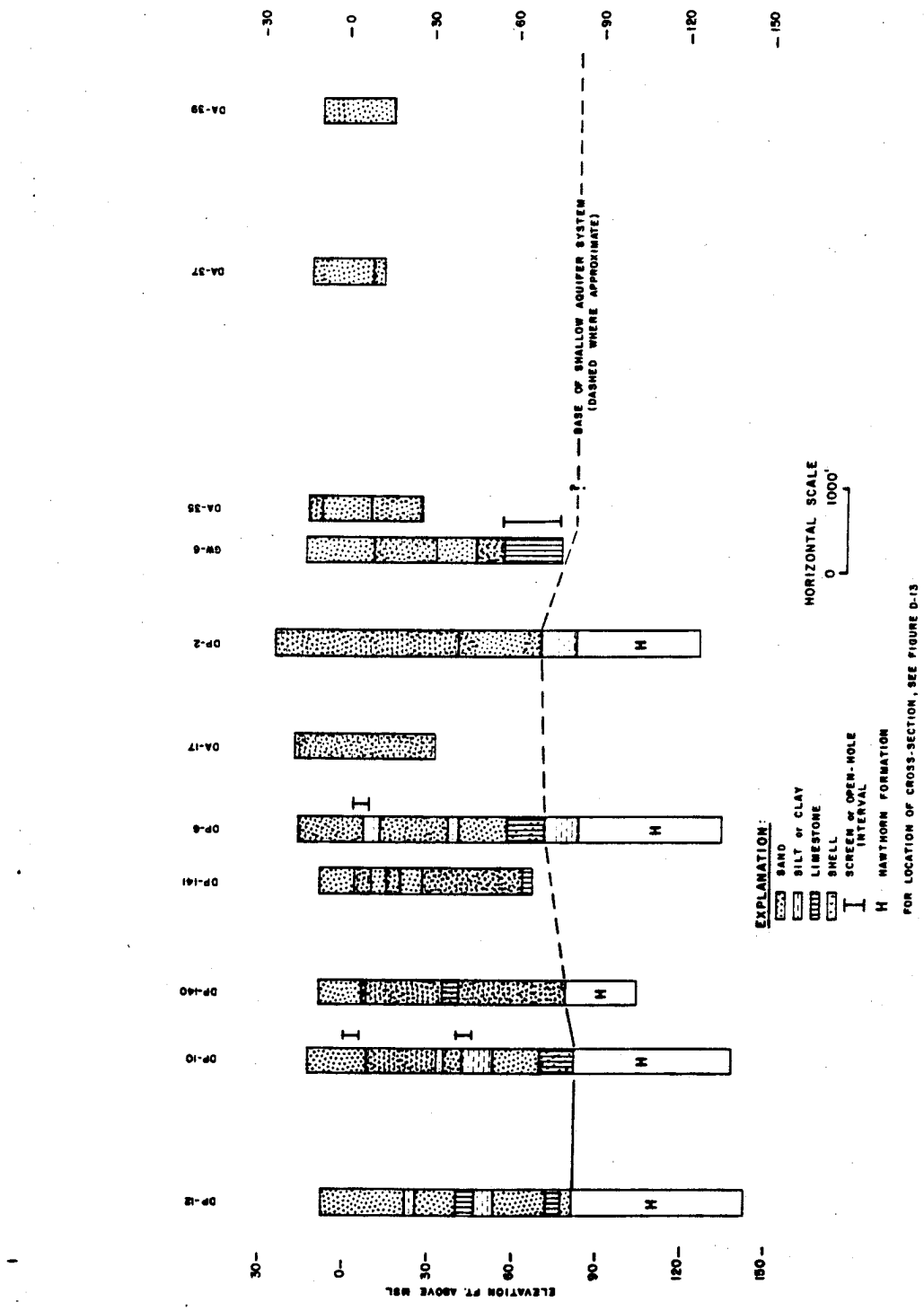

Figure D-12 Stratigraphic Cross-Section B-B

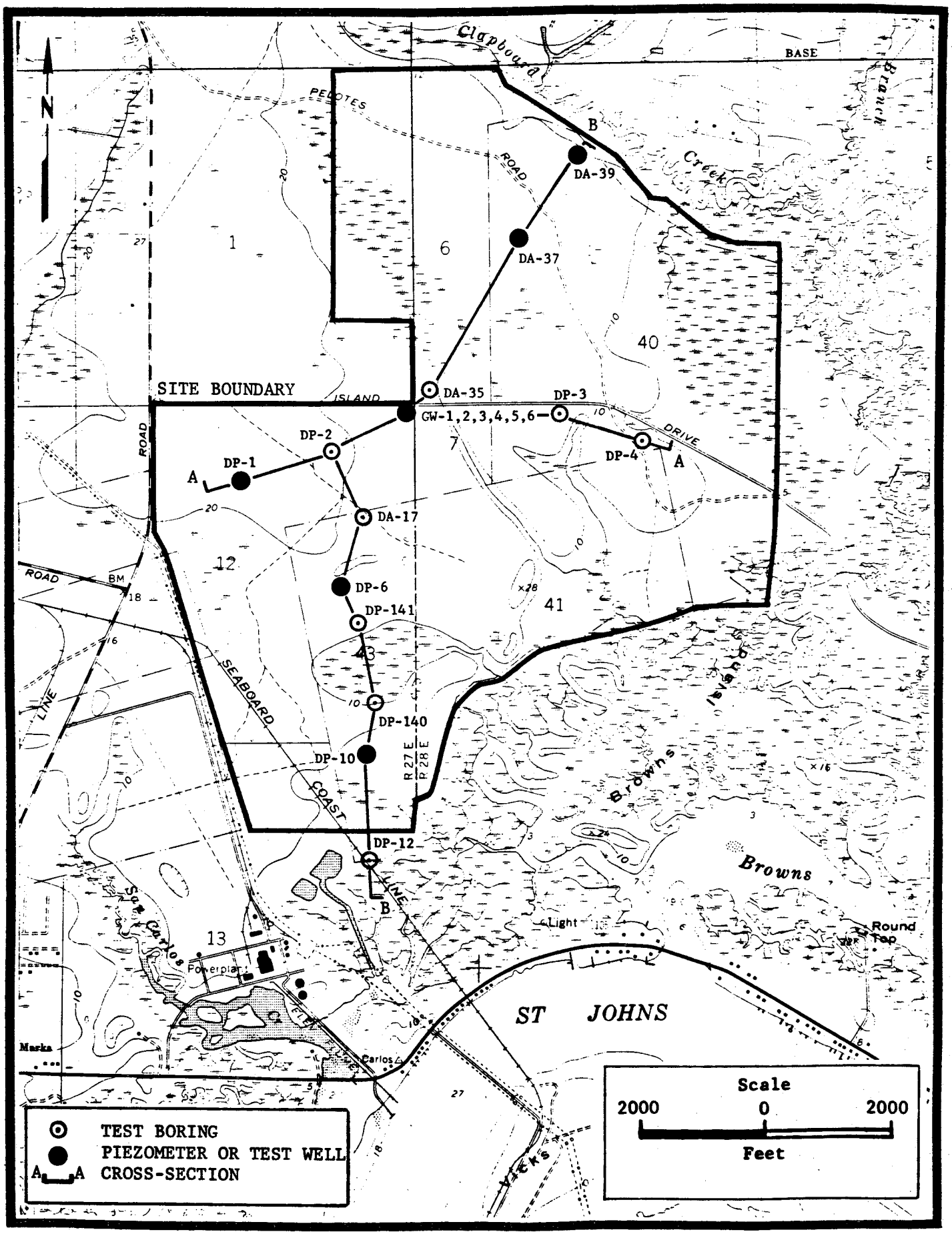

Figure D-13 Locations of Cross Sections A-A and B-B

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LOG OF WELL GW1 SHEET 1 OF 2

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT		ELEVATION AND DATUM	PROJECT NO. 3332
DRILLING AGENCY: PARTRIDGE		DATE STARTED 7-28-80	DATE FINISHED 7-28-80
DRILLING EQUIPMENT: SPEEDSTAR 135 ROTARY RIG	ROD LENGTH	COMPLETION DEPTH 90'	ROCK DEPTH 62'
BIT: SIZE 2 15/16" DEPTH 90' (PILOT) SIZE 3 7/8" DEPTH 90'		NO SOIL SAMPLES 18 METHOD CUTTINGS	
BIT: SIZE 8" DEPTH 62' SIZE DEPTH		NO WATER SAMPLES WATER LEVEL	
CASING: SIZE 4" DEPTH 62' SIZE DEPTH		FOREMAN D. C. CHAMBERLIN	
SCREEN SETTING: SIZE DEPTH SIZE DEPTH		INSPECTOR	

DEPTH	PENE RATE	CIRC RET.	CIRC GPM	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
0					ORGANICS SILTY SAND		PEAT, ORGANICS, ROOTS GRADING TO BLACK SILTY SANDS SANDS ARE FINE GRAINED,
					SL SILTY SAND		MEDIUM GRAINED SAND, WELL SORTED, SLIGHTLY SILTY LIGHT GRAY IN COLOR
10							
					CLAY		DARK GRAY, HIGHLY PLASTIC
					SAND		MEDIUM TO COARSE GRAINED, GRAY
30							
					SAND AND CLAY		SAND WITH 30-40% CLAY, GRAY TO BLUISH GRAY
					CLAY		DARK BLUISH GRAY, PLASTIC, OCC FINE SAND
40							
50					SAND		SAND WITH TRACE OF CLAY, WELL SORTED, GRAY, OCCASIONAL SMALL SHELL FRAGMENTS,
							[CIRCULATION LOSS INDICATING GOOD WATER ZONE AT 48-59']
70					SANDSTONE		MODERATELY CEMENTED LIMEY SANDSTONE, CALCAREOUS CEMENT, MANY SHELLS, YELLOW TO YELLOWISH GRAY
							BECOMING INTERBEDDED WITH SAND LIMESTONE AT 69 FEET

Figure D-14 Drilling Summaries: Well GW-1 (sheet 1 of 2)

ENVIROSPHERE COMPANY

A DIVISION OF EBASCO SERVICES INCORPORATED

LOG OF WELL GW 1 SHEET 2 OF 2

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT					ELEVATION AND DATUM	PROJECT NO. 3332	
DRILLING AGENCY					DATE STARTED	DATE FINISHED	
DRILLING EQUIPMENT				ROD LENGTH	COMPLETION DEPTH	ROCK DEPTH	
BIT	SIZE	DEPTH	SIZE	DEPTH	NO. SOIL SAMPLES	METHOD	
	SIZE	DEPTH	SIZE	DEPTH	NO WATER SAMPLES	WATER LEVEL	
CASING	SIZE	DEPTH	SIZE	DEPTH	FOREMAN		
	SIZE	DEPTH	SIZE	DEPTH			
SCREEN SETTING	SIZE	DEPTH	SIZE	DEPTH	INSPECTOR		
	SIZE	DEPTH	SIZE	DEPTH			

DEPTH	PENE RATE	CIRC RET	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
70					SANDSTONE / LIMESTONE		CONTINUED THIN LENSES OF INTERCLAYED LIMESTONE AND SANDSTONE, MARL BEDS 74-76'
80							SANDIER, WITH LESS CALCAREOUS CONTENT 80-86'
							CIRCULATION LOSS. POSSIBLE SOLUTION CAVITY AT
							BOTTOM OF HOLE IN SANDY LIMESTONE AT 90'.

Figure D-14 **Drilling Summaries: Well GW-1 (sheet 2 of 2)**

ENVIROSPHERE COMPANY

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LOG OF WELL GW2 SHEET 1 OF 1

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT		ELEVATION AND DATUM	PROJECT NO. 3332
DRILLING AGENCY: PARTRIDGE		DATE STARTED 7-29-80	DATE FINISHED 7-29-80
DRILLING EQUIPMENT: SPEEDSTAR 135 Bower B16	ROD LENGTH	COMPLETION DEPTH 48.5	ROCK DEPTH
BIT: SIZE 8" DEPTH 48.5 / SIZE DEPTH	SIZE DEPTH / SIZE DEPTH	NO SOIL SAMPLES 10 METHOD CUTTINGS / NO WATER SAMPLES WATER LEVEL	
CASING: SIZE 4" DEPTH 0'-38.5 / SIZE DEPTH	SIZE DEPTH / SIZE DEPTH	FOREMAN: D.C. CHAMBERLIN	
SCREEN SETTING: SIZE 4" DEPTH 38.5-48.5 / SIZE DEPTH	SIZE DEPTH / SIZE DEPTH	INSPECTOR	

DEPTH	PENE. RATE	CIRC RET.	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
0					GRANITE		PEAT, SILT, PARTIALLY DECOMPOSING PLANTS, BLACK, FIBROUS
					SILTY SAND		BLACK SILTY SAND W/ BURIED ORGANIC HORIZON
							AT 5 FEET, SOME DARK BROWNS
10					SAND		SAND, DARK TO MEDIUM BROWN, MEDIUM
							GRAINED, WELL SORTED, WELL ROUNDED
							GRAINS, OCC. TRACE OF SILTY.
							CHANGING TO GRAYISH BROWN AT 22'
							TRACE OF CLAY 22'-24'
							AGAIN AT 27'
30							
							CLEAN GRAY SAND
							36-48.5'
40							
50							
60							
70							

Figure D-14 Drilling Summaries: Well GW-2

ENVIROSPHERE COMPANY

A DIVISION OF EBASCO SERVICES INCORPORATED

LOG OF WELL GW 3 SHEET 1 OF 1

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT				ELEVATION AND DATUM	PROJECT NO.: 3332
DRILLING AGENCY: PARTRIDGE				DATE STARTED: 7-29-80	DATE FINISHED: 7-29-80
DRILLING EQUIPMENT: SPEEDSTAR 135 ROTARY RIG			ROD LENGTH	COMPLETION DEPTH: 21'	ROCK DEPTH: —
BIT	SIZE 8"	DEPTH 21'	SIZE	DEPTH	NO SOIL SAMPLES: 4 / METHOD: CUTTINGS
	SIZE	DEPTH	SIZE	DEPTH	NO WATER SAMPLES / WATER LEVEL
CASING	SIZE 4"	DEPTH 0' - 11'	SIZE	DEPTH	FOREMAN: D.C. CHAMBERLIN
	SIZE	DEPTH	SIZE	DEPTH	
SCREEN SETTING	SIZE 4"	DEPTH 11' - 21'	SIZE	DEPTH	INSPECTOR
	SIZE	DEPTH	SIZE	DEPTH	

DEPTH	PENE. RATE	CIRC RET	CIRC DISC	AIRLIFT O (ppm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
0					SAND/ORGANICS		MIXTURE OF BLACK AND BROWN ORGANICS WITH SILTY SAND 0-2',
					SAND		SLIGHTLY SILTY SAND, GRAYISH BROWN FINE TO MEDIUM SAND, WELL SORTED
10							MORE GRAY COLOR, LESS SILT AT 16'
							BOTTOM OF HOLE AT 21'
30							

Figure D-14 Drilling Summaries: Well GW-3

ENVIROSPHERE COMPANY

A DIVISION OF EBASCO SERVICES INCORPORATED

LOG OF WELL GW 4 SHEET 1 OF 1

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT		ELEVATION AND DATUM	PROJECT NO.: 3332
DRILLING AGENCY: PARTRIDGE		DATE STARTED: 7-30-80	DATE FINISHED: 7-30-80
DRILLING EQUIPMENT: SPEEDSTAR 135 Rotary Rig	ROD LENGTH	COMPLETION DEPTH: 21	ROCK DEPTH: -
BIT: SIZE 4½" DEPTH 21'	SIZE / DEPTH	NO SOIL SAMPLES: 4	METHOD: Cuttings
BIT: SIZE / DEPTH	SIZE / DEPTH	NO WATER SAMPLES	WATER LEVEL
CASING: SIZE 2" DEPTH 0'-11'	SIZE / DEPTH	FOREMAN: D. C. Chamberlin	
CASING: SIZE / DEPTH	SIZE / DEPTH		
SCREEN SETTING: SIZE 2" DEPTH 11-21	SIZE / DEPTH	INSPECTOR	
SCREEN SETTING: SIZE / DEPTH	SIZE / DEPTH		

DEPTH	PENE. RATE	CIRC RET.	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
0				PEAT, BETWEEN SAND		ORGANIC PORTION OF PEAT, ROOTS, BLACK SILTY SAND
						BROWN SILTY SAND, FINE TO MED GRAINED, WELL SORTED
						THIN (1-2") HARDPAN LENSES FROM 4½' TO 10'
10						LIGHTER BROWN COLOR AT 11½'
						TRACES OF CLAY 14-17'
						BOTTOM OF HOLE AT 21'
30						

Figure D-14 Drilling Summaries: Well GW-4

ENVIROSPHERE COMPANY

A DIVISION OF EBASCO SERVICES INCORPORATED

LOG OF WELL GW 5 SHEET 1 OF 1

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT		ELEVATION AND DATUM	PROJECT NO.: 3332
DRILLING AGENCY: PARTE-26E		DATE STARTED: 7-30-80	DATE FINISHED: 7-30-80
DRILLING EQUIPMENT: SPEEDSTAR 135 ROTARY RIG	ROD LENGTH	COMPLETION DEPTH: 59'	ROCK DEPTH: —
BIT: SIZE 4 1/8" DEPTH 59	SIZE DEPTH	NO. SOIL SAMPLES: 12	METHOD: CUTTINGS
BIT: SIZE DEPTH	SIZE DEPTH	NO WATER SAMPLES	WATER LEVEL
CASING: SIZE 2" DEPTH 0'-43'	SIZE DEPTH	FOREMAN: D.C. CHAMBERLIN	
CASING: SIZE DEPTH	SIZE DEPTH		
SCREEN SETTING: SIZE 2" DEPTH 43-59	SIZE DEPTH	INSPECTOR	
SCREEN SETTING: SIZE DEPTH	SIZE DEPTH		

DEPTH	PENE RATE	CIRC RET	AIRLIFT (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
0				OCEANICS SILTY SAND		PARTIALLY DECOMPOSED PLANTS + ROOTS, BLACK SILTY SAND
						BROWNISH GRAY SAND, TRACES OF CLAY, SL SILTY
10				SAND		HARDPAN LAYER - 9-10 1/2'
						SAND BECOMING GRAY COLORED AT 11, STILL A TRACE OF BROWN, SL SILTY
						FINE GRAINED SAND W/ VERY THIN HARDPAN LAYERS, ALL GRAY 23-36'
30				TRACE CLAY		THIN BLUISH CLAY LENSES, LESS THAN 1' THICK 29-33'
				TRACE CLAY		
						CLEAN, MEDIUM GRAINED GRAY SAND 36-59'
40						
				TRACE SHELLS		SHELL FRAGMENTS, SMALL AMOUNT OF CEMENTATION AT 58'
60						WELL COMPLETED TO 59'

Figure D-14 Drilling Summaries: Well GW-5

ENVIROSPHERE COMPANY

A DIVISION OF EBASCO SERVICES INCORPORATED

LOG OF WELL GW6 SHEET 1 OF 2

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT		ELEVATION AND DATUM	PROJECT NO.: 3332
DRILLING AGENCY: PARTRIDGE		DATE STARTED: 7-30-80	DATE FINISHED: 7-31-80
DRILLING EQUIPMENT: SPEEDSTAR 135 ROTARY RIG	ROD LENGTH	COMPLETION DEPTH: 90	ROCK DEPTH: 60'
BIT: SIZE 8" DEPTH 70; SIZE 3 7/8" DEPTH 90	SIZE / DEPTH	NO. SOIL SAMPLES: 18 METHOD: CUTTINGS	
CASING: SIZE 4" DEPTH 70; SIZE / DEPTH	SIZE / DEPTH	NO. WATER SAMPLES:	WATER LEVEL:
SCREEN SETTING: SIZE / DEPTH	SIZE / DEPTH	FOREMAN: D.C. CHAMBERLIN	
		INSPECTOR:	

DEPTH	PENE RATE	CIRC RET.	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
0					ORGANICS SAND		PARTIALLY DECOMPOSED PLANT ROOTS, BLACK SILTY SAND GRADING TO BROWN SILTY FINE TO MEDIUM GRAINED SAND
10					MIXED W/CLAY		10-15% CLAY
					CLEAN SAND		ONLY GRAY COLORED SAND AT 22'
					MIXED W/CLAY		30-40% BLUE CLAY
30					CLEAN SAND		
40							LOOSER SAND 41-48'
							DENSER LENSE, SOME CEMENTED 48-50'
50							
					SANDSTONE		PARTIALLY CEMENTED SANDSTONE WITH SCATTERED SHELLS 60-65
							WELL CEMENTED W/ $CaCO_3$ CEMENT @ 65
70							INCREASING SHELLS 67-70'

Figure D-14 Drilling Summaries: Well GW-6 (sheet 1 of 2)

ENVIROSPHERE COMPANY

A DIVISION OF EBASCO SERVICES INCORPORATED

LOG OF WELL GW6 SHEET 2 OF 2

PROJECT AND LOCATION: JACKSONVILLE ELECTRIC AUTHORITY - EASTPORT					ELEVATION AND DATUM	PROJECT NO. 3332	
DRILLING AGENCY					DATE STARTED	DATE FINISHED	
DRILLING EQUIPMENT				ROD LENGTH	COMPLETION DEPTH	ROCK DEPTH	
BIT	SIZE	DEPTH	SIZE	DEPTH	NO SOIL SAMPLES	METHOD	
	SIZE	DEPTH	SIZE	DEPTH	NO WATER SAMPLES	WATER LEVEL	
CASING	SIZE	DEPTH	SIZE	DEPTH	FOREMAN		
	SIZE	DEPTH	SIZE	DEPTH			
SCREEN SETTING	SIZE	DEPTH	SIZE	DEPTH	INSPECTOR		
	SIZE	DEPTH	SIZE	DEPTH			

DEPTH	PENE RATE	CIRC RET	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
70					LIMESTONE		CHANGING FROM LIMEY YELLOWISH SANDSTONE TO CHALK WHITE LIMESTONE @ 71'
80							SCATTERED COARSE VERY WELL ROUNDED SILICA SAND GRAINS
							SANDIER AT 84'
							TOTAL CIRCULATION LOSS 87-88½'
							VERY HARD LIMESTONE 88½-90'
100							

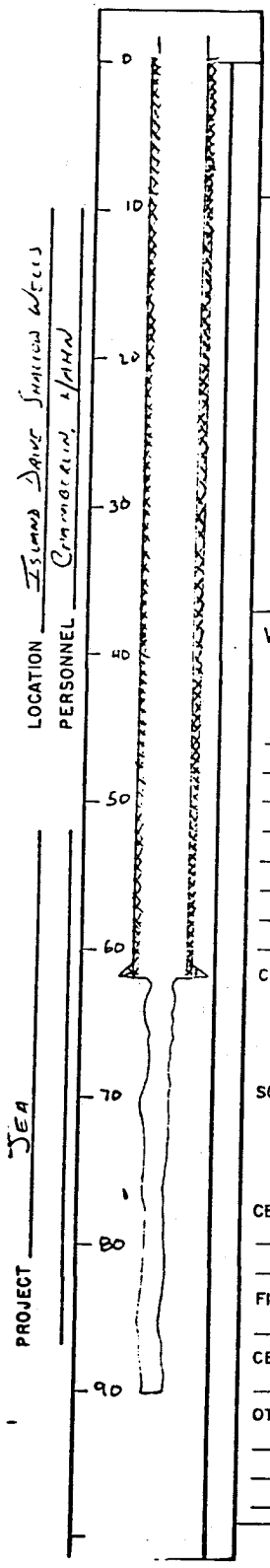
Figure D-14 Drilling Summaries: Well GW-6 (sheet 2 of 2)

WELL GW-1

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: _____ ELEVATION: GROUND LEVEL _____

TOP OF CASING _____



DRILLING SUMMARY:

TOTAL DEPTH 90' BG

BOREHOLE DIAMETER 8" TO 62' BG
3 7/8" 62' TO 90' BG

DRILLER PARTRIDGE WELL DRILLING Co

RIG CME 55TR 135

BIT(S) 8", 3 7/8", PILOT HOLE OR 2 15/16"

DRILLING FLUID BENTONITE

SURFACE CASING _____

WELL DESIGN:

BASIS: GEOLOGIC LOG ✓ GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

+2	62	C			

CASING: C1 4" PVC
C2
C3
C4

SCREEN: S1 NONE
S2
S3
S4

CENTRALIZERS NONE

FILTER MATERIAL NONE

CEMENT 7 SACKS PORTLAND
≈ 2½ GALLONS CaCl

OTHER _____

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING: 2 15/16"	7-28	0940	7-28	1120
8"	7-28	1140	7-28	1210
3 7/8"	7-28	1430	7-28	1530
GEOPHYS. LOGGING:	NONE			
CASING: 4" PVC	7-28	1220	7-28	1230
FILTER PLACEMENT:	NONE			
CEMENTING:	7-28	1240	7-28	1250
DEVELOPMENT:	7-28	1540	7-28	1600
OTHER: WOC	7-28	1250	7-28	1420

WELL DEVELOPMENT

DEVELOPED APPROXIMATELY 20 MINUTES WITH AIR LIFT. MODERATE AMT OF SAND REDUCED TO SMALL AMT.

COMMENTS:

1 1/2 HOURS TO ALLOW CEMENT TO SET UP MAY NOT HAVE BEEN ENOUGH. LOSS OF SEAL INDICATED BY SURFACE BUBBLES IN CEMENTED ANNULUS.
(1) DRILLED OPEN HOLE TOO SOON AFTER CEMENTATION
(2) SHOULD NOT HAVE DEVELOPED THIS DAY

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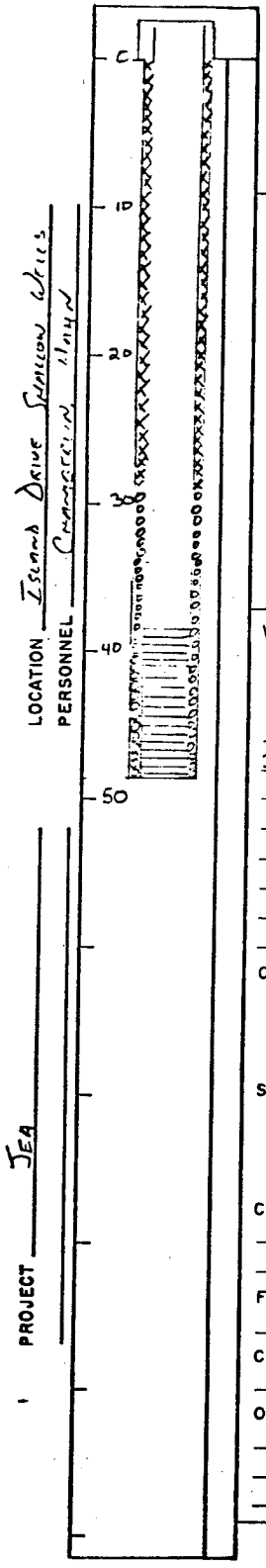
Figure D-15 Well Construction Summaries: Well GW-1

WELL GW-2

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: _____ ELEVATION: GROUND LEVEL _____

TOP OF CASING _____



DRILLING SUMMARY:

TOTAL DEPTH 48.5' BG

BOREHOLE DIAMETER 8"

DRILLER PARTRIDGE

RIG SPEEDSTAR 135

BIT(S) 8"

DRILLING FLUID BENTONITE

SURFACE CASING 6" STEEL W/LATCHED CAP

WELL DESIGN:

BASIS: GEOLOGIC LOG ✓ GEOPHYSICAL LOG ____

CASING STRING(S): C=CASING S=SCREEN

+2	–	38.5	C		–		
38.5	–	48.5	S		–		
	–				–		
	–				–		
	–				–		
	–				–		
	–				–		
	–				–		

CASING: C1 4" PVC

C2 _____

C3 _____

C4 _____

SCREEN: S1 4" 10 SLOT

S2 _____

S3 _____

S4 _____

CENTRALIZERS NONE

FILTER MATERIAL NONE

CEMENT _____

OTHER _____

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING: 8"	7-29	0945	7-29	1125
GEOPHYS. LOGGING:	NONE			
CASING: 4" PVC	7-29	1140	7-29	1145
FILTER PLACEMENT:	NONE			
CEMENTING:	7-29	1450	7-29	1510
DEVELOPMENT:	7-29	1155	7-29	1250
OTHER:				

WELL DEVELOPMENT

DEVELOPED FOR ONE HOUR WITH AIR; WATER WITH ONLY TRACE OF SAND, MAKING 20-30 GPM.

COMMENTS:

GRAVEL PACK EXTENDS FROM BOTTOM OF HOLE TO 29.5 FEET. = 7 SACKS (1:2 (#1)) OF 20-30 SAND.

2 SKS CEMENT SFC. CSNG

7 SKS CEMENT PROD CSNG

SFCE CASING 6" STEEL SCHED 40 ~ +2' TO -2'

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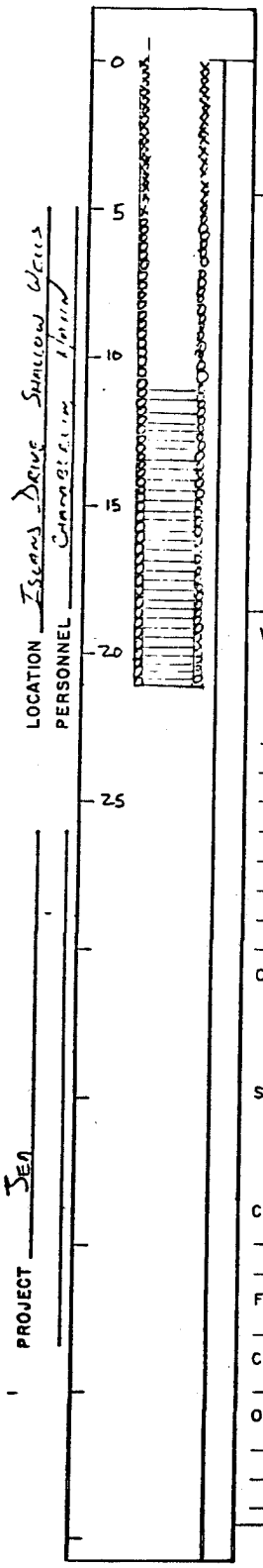
Figure D-15 Well Construction Summaries: Well GW-2



WELL GW-3

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: _____ ELEVATION: GROUND LEVEL _____

TOP OF CASING _____

DRILLING SUMMARY:

TOTAL DEPTH 21' 8"

BOREHOLE DIAMETER 8"

DRILLER PARTRIDGE

RIG SPEEDSTAR 135

BIT(S) 8"

DRILLING FLUID BENTONITE

SURFACE CASING 6" STEEL W/LATCHED CAP

WELL DESIGN:

BASIS: GEOLOGIC LOG ___ GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

+2	11	C			
11	21	S			

CASING: C1 4" PVC

C2

C3

C4

SCREEN: S1 4" 10 SLOT

S2

S3

S4

CENTRALIZERS None

FILTER MATERIAL None

CEMENT ~3 BAGS PORTLAND CEMENT

OTHER

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING: 8"	7-29	1315	7-29	1350
GEOPHYS. LOGGING:	NONE			
CASING:	7-29	1400	7-29	1405
FILTER PLACEMENT:	NONE			
CEMENTING:	7-29	1510	7-29	1515
DEVELOPMENT:	7 29	1405	7-29	1445
OTHER:				

WELL DEVELOPMENT

DEVELOPED FOR 40 MINUTES UTILIZING AIR LIFT. WATER WITH SLIGHT TURBIDITY AT END OF AIR PUMPING

COMMENTS:

GRAVEL PACK OF 20-30 SILICA SAND PLACED TO W/IN 5½ FEET OF GROUND SURFACE

5 BAGS USED

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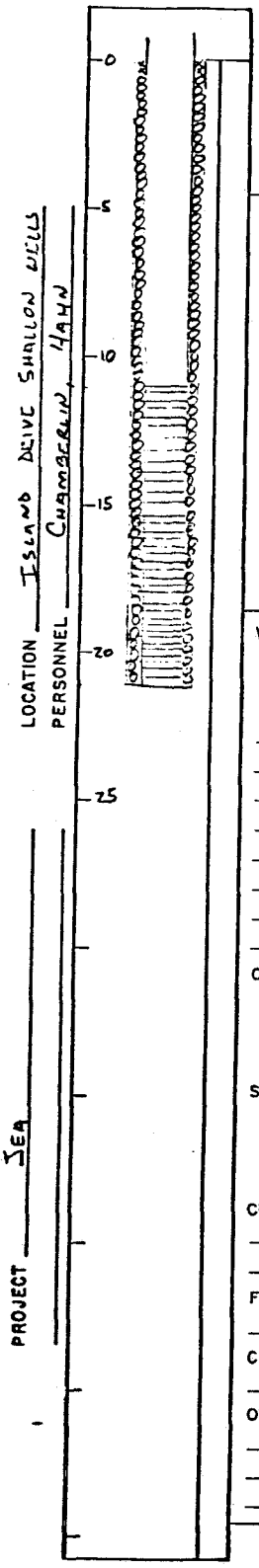
Figure D-15 Well Construction Summaries: Well GW-3

WELL GW-4

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: _____ ELEVATION: GROUND LEVEL _____

TOP OF CASING _____



DRILLING SUMMARY:

TOTAL DEPTH 21' BG

BOREHOLE DIAMETER 4 1/2"

DRILLER PATTRIDGE

RIG SPEEDSTAR 135

BIT(S) 4 1/2"

DRILLING FLUID BENTONITE

SURFACE CASING NONE

WELL DESIGN:

BASIS: GEOLOGIC LOG ✓ GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

+2	–	11'	C		–	
11	–	21'	S		–	
	–				–	
	–				–	
	–				–	
	–				–	
	–				–	
	–				–	
	–				–	

CASING: C1 2" PVC

C2 _____

C3 _____

C4 _____

SCREEN: S1 2" 10-SLOT PVC

S2 _____

S3 _____

S4 _____

CENTRALIZERS None

FILTER MATERIAL None

CEMENT <1 BAG OF PORTLAND CEMENT USED TO SEAL AT SURFACE

OTHER _____

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING: 4 1/2"	7-30	0940	7-30	1000
GEOPHYS. LOGGING:	NONE			
CASING: 2"	7-30	1010	7-30	1015
FILTER PLACEMENT:	NONE			
CEMENTING:	7-30	1535	7-30	1540
DEVELOPMENT:	7-30	1020	7-30	1040
OTHER:				

WELL DEVELOPMENT

20 MINUTES OF AIR LIFT BY 1" STEEL PIPE TO 8' BELOW GROUND.

COMMENTS:

3 1/2 BAGS OF 20-30 SILICA SAND USED AS GRAVEL PACK ALL THE WAY TO THE SURFACE.

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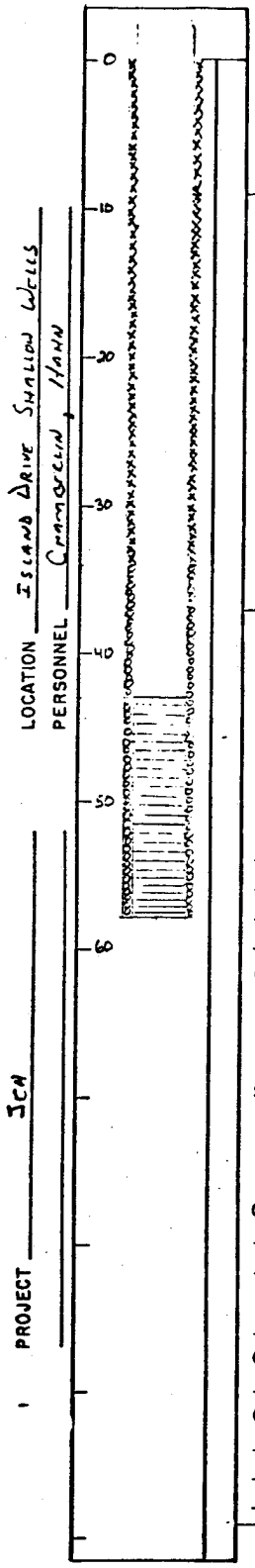
Figure D-15 Well Construction Summaries: Well GW-4

WELL GW-5

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: _____ ELEVATION: GROUND LEVEL _____

TOP OF CASING _____



LOCATION Island Drive Shallow Wells

PERSONNEL Cramerlin, Hann

PROJECT JCM

DRILLING SUMMARY:

TOTAL DEPTH 59'

BOREHOLE DIAMETER 4 1/2"

DRILLER Partridge

RIG Speedstar 135

BIT(S) 4 1/2"

DRILLING FLUID Bentonite

SURFACE CASING None

WELL DESIGN:

BASIS: GEOLOGIC LOG ✓ GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

*2	–	43	C		–		
43	–	59	S		–		
	–				–		
	–				–		
	–				–		
	–				–		
	–				–		
	–				–		

CASING: C1 2" PVC

C2 _____

C3 _____

C4 _____

SCREEN: S1 2" ID-Slot PVC

S2 _____

S3 _____

S4 _____

CENTRALIZERS None

FILTER MATERIAL None

CEMENT ~5 bags of Portland Cement used

OTHER _____

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING: 4 1/2	7-29	1105	7-29	1235
GEOPHYS. LOGGING:	None			
CASING:	7-29	1240	7-29	1250
FILTER PLACEMENT:	None			
CEMENTING:	7-29	1540	7-29	1545
DEVELOPMENT:	7-29	1250	7-29	1310
OTHER:				

WELL DEVELOPMENT

20 minutes of air lift through 1" steel pipe submerged to 30' below ground.

COMMENTS:

5 100 lb bags of 20-30 silica sand used as gravel pack to 34' BG

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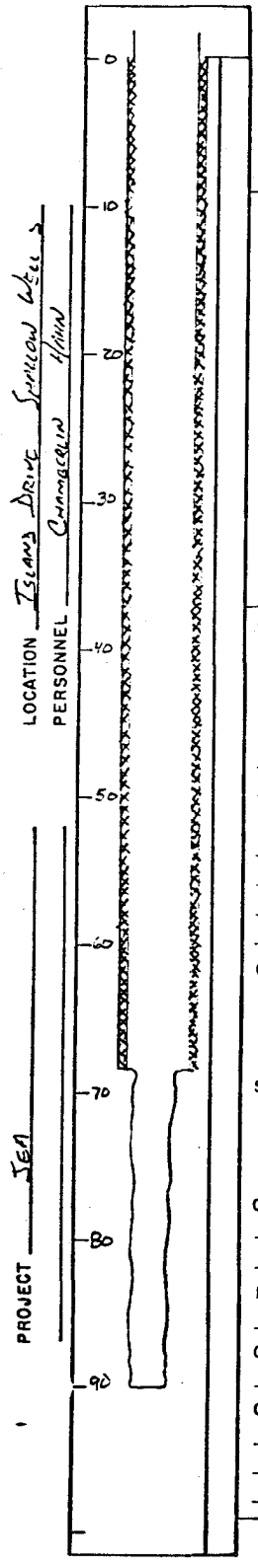
Figure D-15 Well Construction Summaries: Well GW-5

WELL GW6

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: _____ ELEVATION: GROUND LEVEL _____

TOP OF CASING _____



DRILLING SUMMARY:

TOTAL DEPTH 90'

BOREHOLE DIAMETER 8"

DRILLER PARTRIDGE

RIG SPEEDSTAR 135

BIT(S) 8"

DRILLING FLUID BENTONITE

SURFACE CASING 6" STEEL W/ LATCHED CAP

WELL DESIGN:

BASIS: GEOLOGIC LOG ✓ GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

2	-	68.5	C		-		
	-				-		
	-				-		
	-				-		
	-				-		
	-				-		
	-				-		
	-				-		

CASING: C1 4" PVC

C2 _____

C3 _____

C4 _____

SCREEN: S1 NONE

S2 _____

S3 _____

S4 _____

CENTRALIZERS NONE

FILTER MATERIAL NONE

CEMENT 6 SACKS USED

ALLOWED TO SPAN OVERNIGHT

OTHER _____

CONSTRUCTION TIME LOG:

TASK	START DATE	START TIME	FINISH DATE	FINISH TIME
DRILLING: 8"	7-29	1330	7-29	1520
3 7/8"	7-30	0945	7-30	1025
GEOPHYS. LOGGING:	NONE			
CASING:	7-29	1525	7-29	1530
FILTER PLACEMENT:				
CEMENTING:	7-29	1545	7-29	1550
DEVELOPMENT:	7-30	1030	7-30	1130
OTHER:				

WELL DEVELOPMENT

1 HR WITH AIR THROUGH DRILL STEEL. CLEAR WATER AT 100-120 GPM.

COMMENTS:

GOOD WELL

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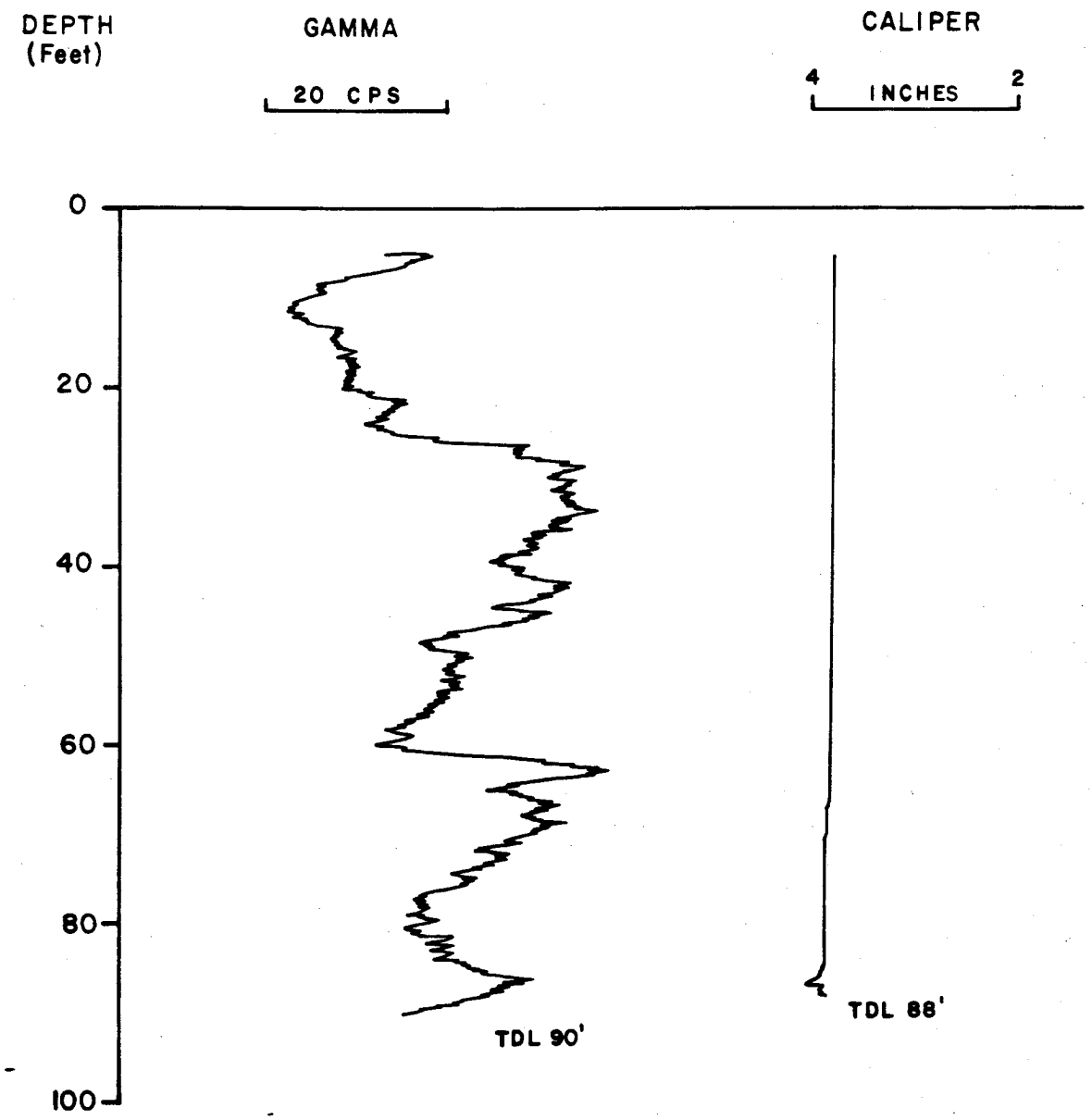
Figure D-15 Well Construction Summaries: Well GW-6

GEOPHYSICAL LOGS: WELL GW-6



LOGGING BY ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Figure D-16 Geophysical Logs: Well GW-6

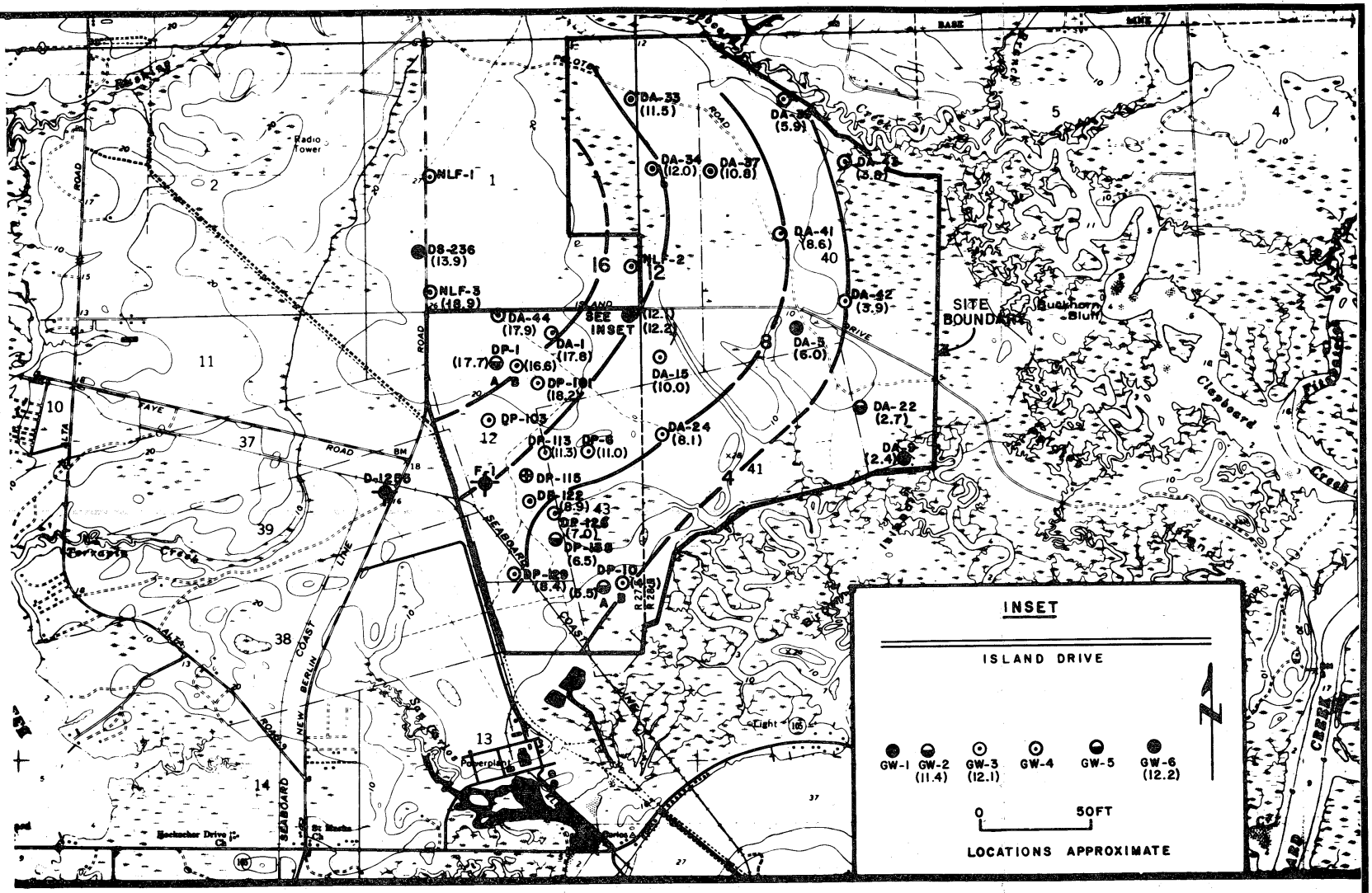


Figure D-17 Water Levels in the Shallow Aquifer System and Potentiometric Surface for the Water Table Aquifer: November 1980

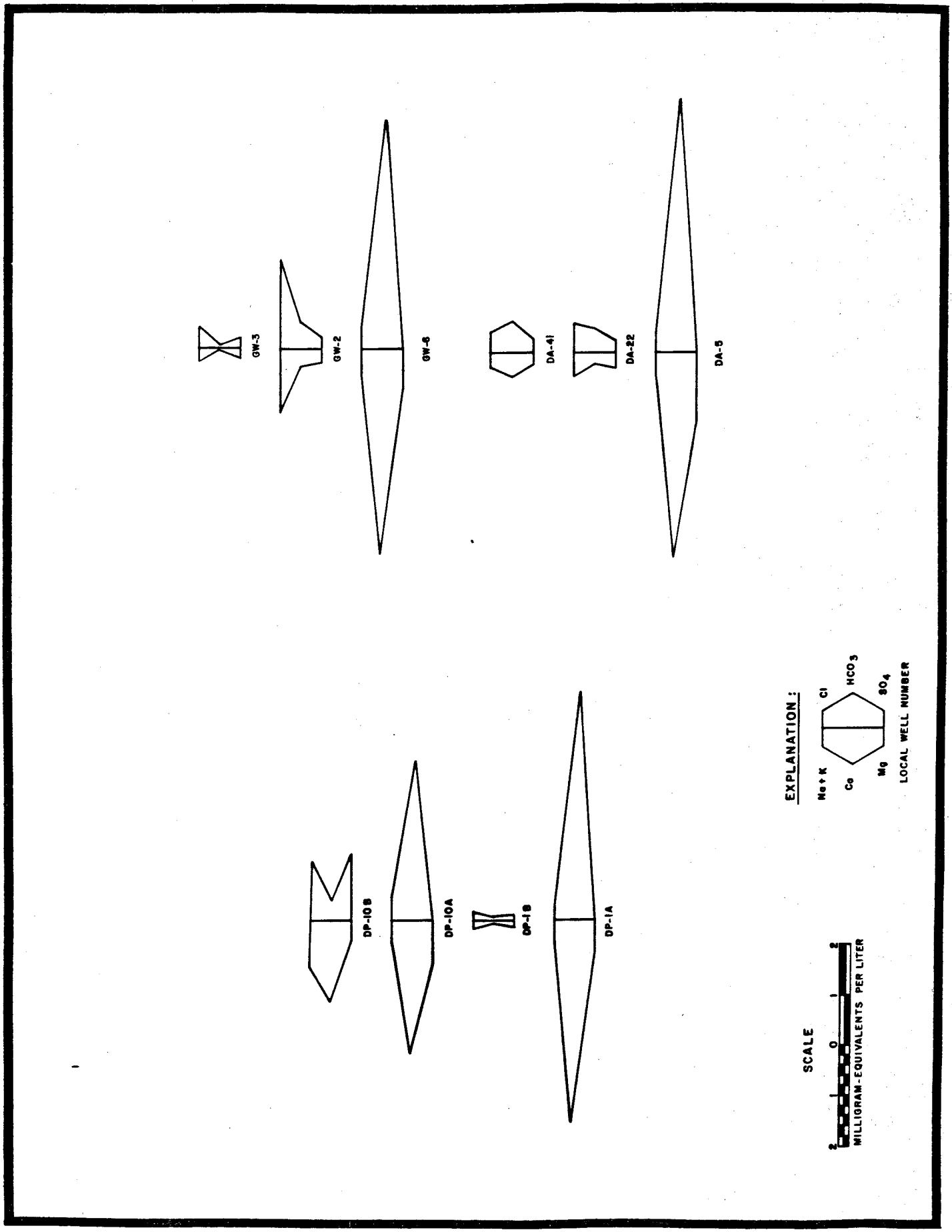


Figure D-18 Results of Analyses of Groundwater From Selected Wells/Piezometers in the Shallow Aquifer System, August 1980: Major Ions

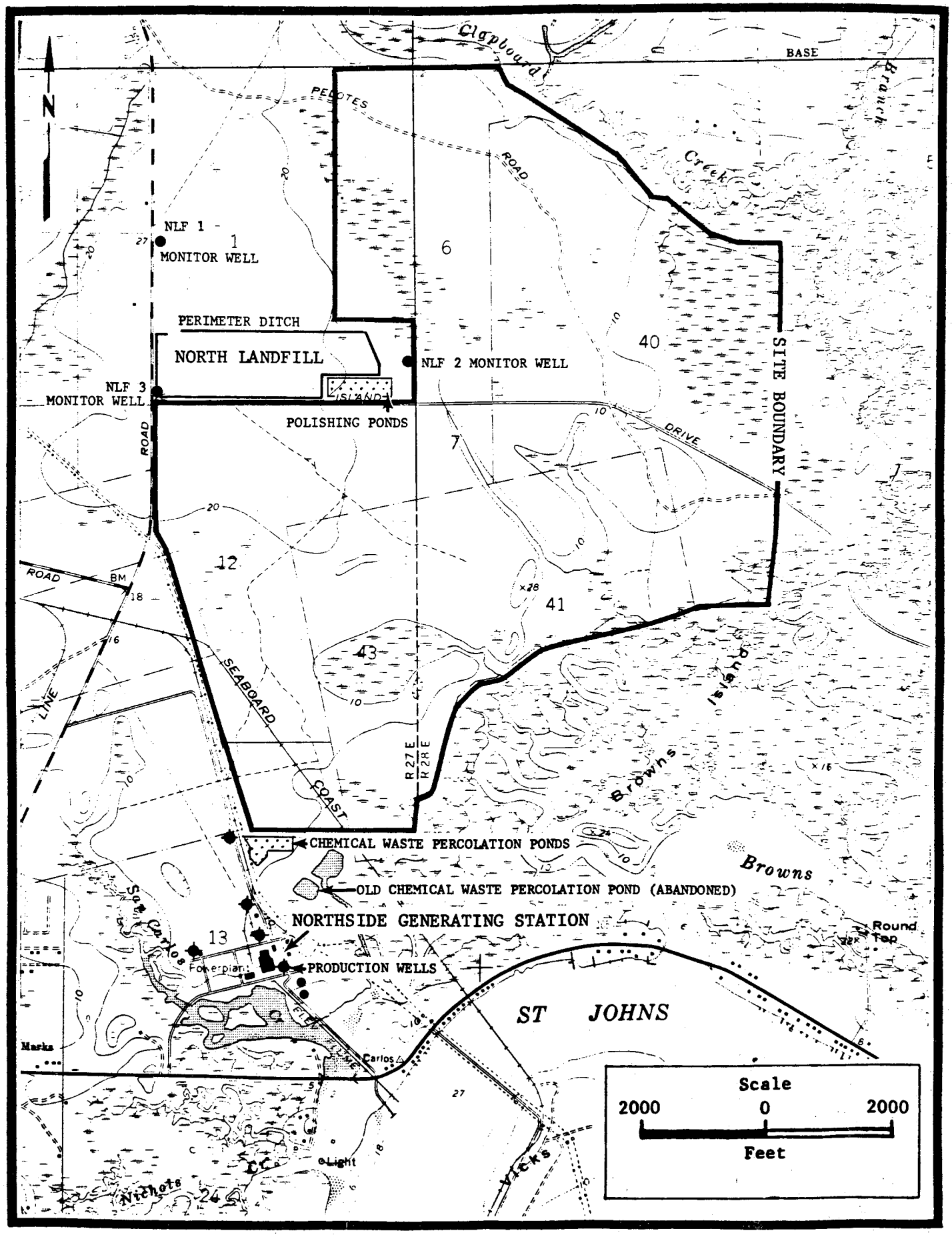


Figure D-19 Locations of Adjacent Facilities

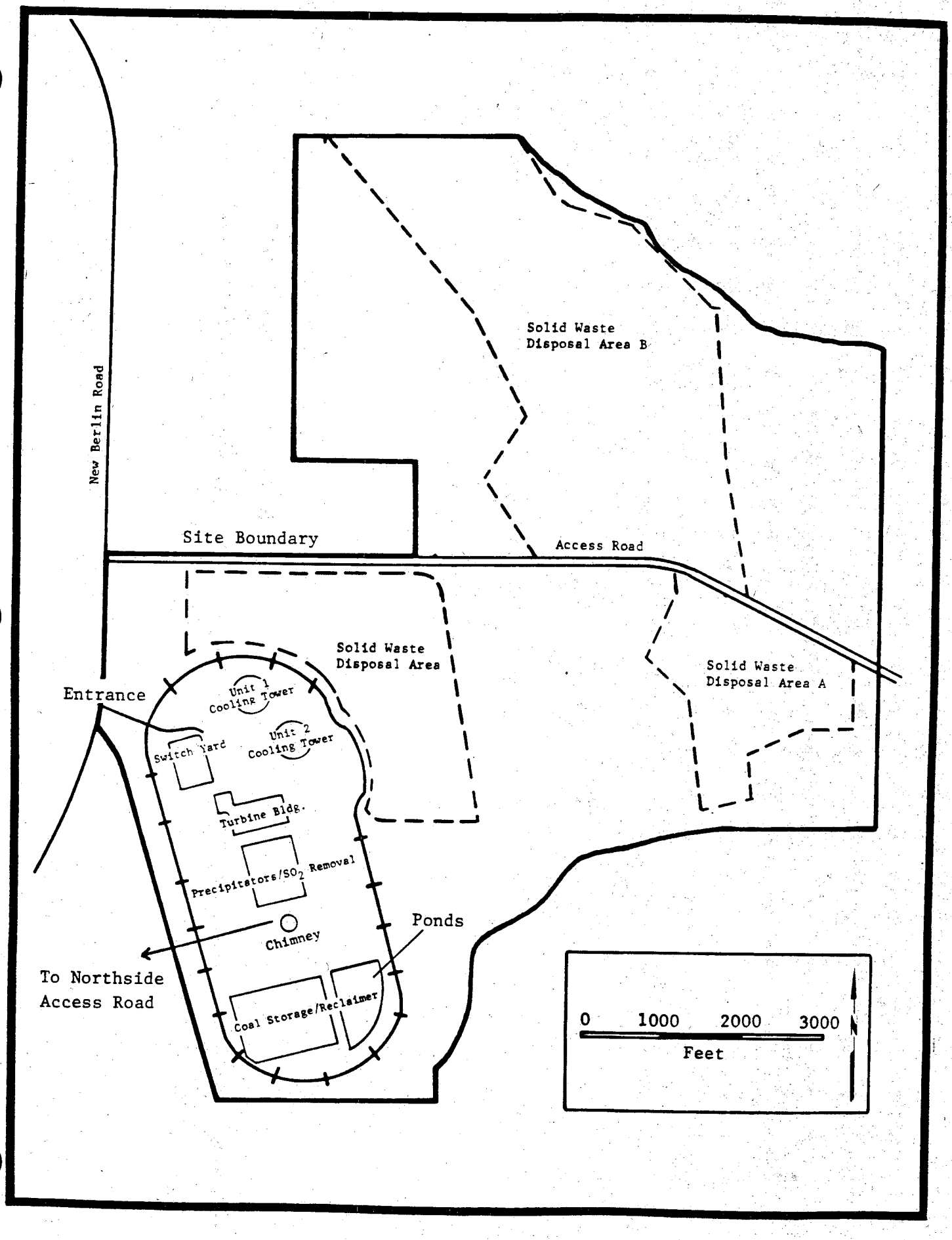
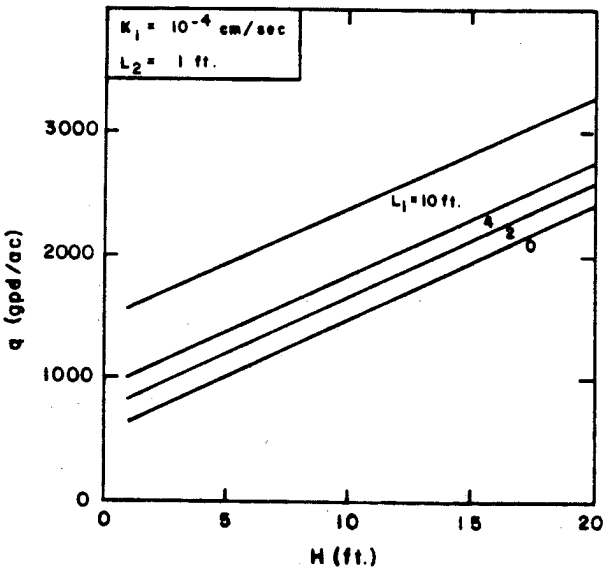
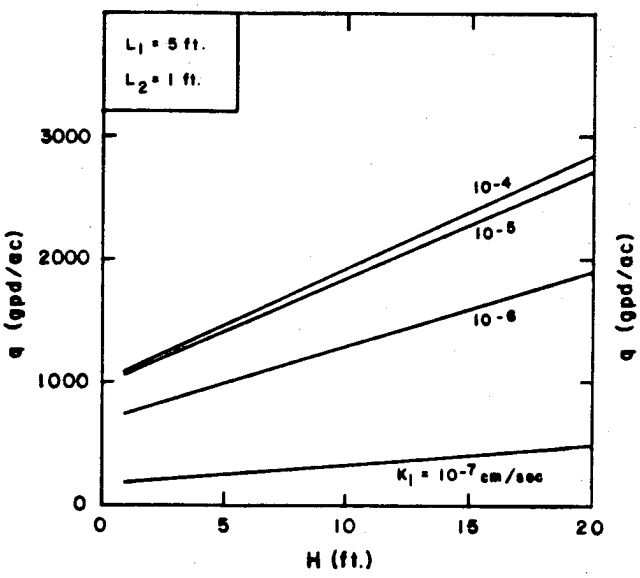


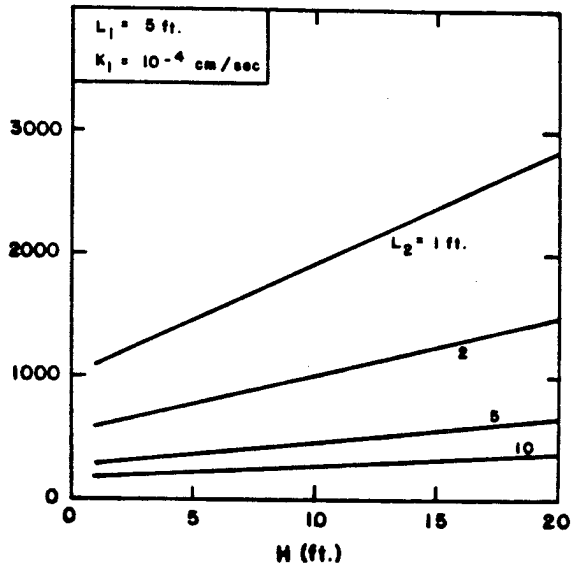
Figure D-20 Layout of Plant and Other Facilities



(a) Sensitivity to L_1



(b) Sensitivity to K_1

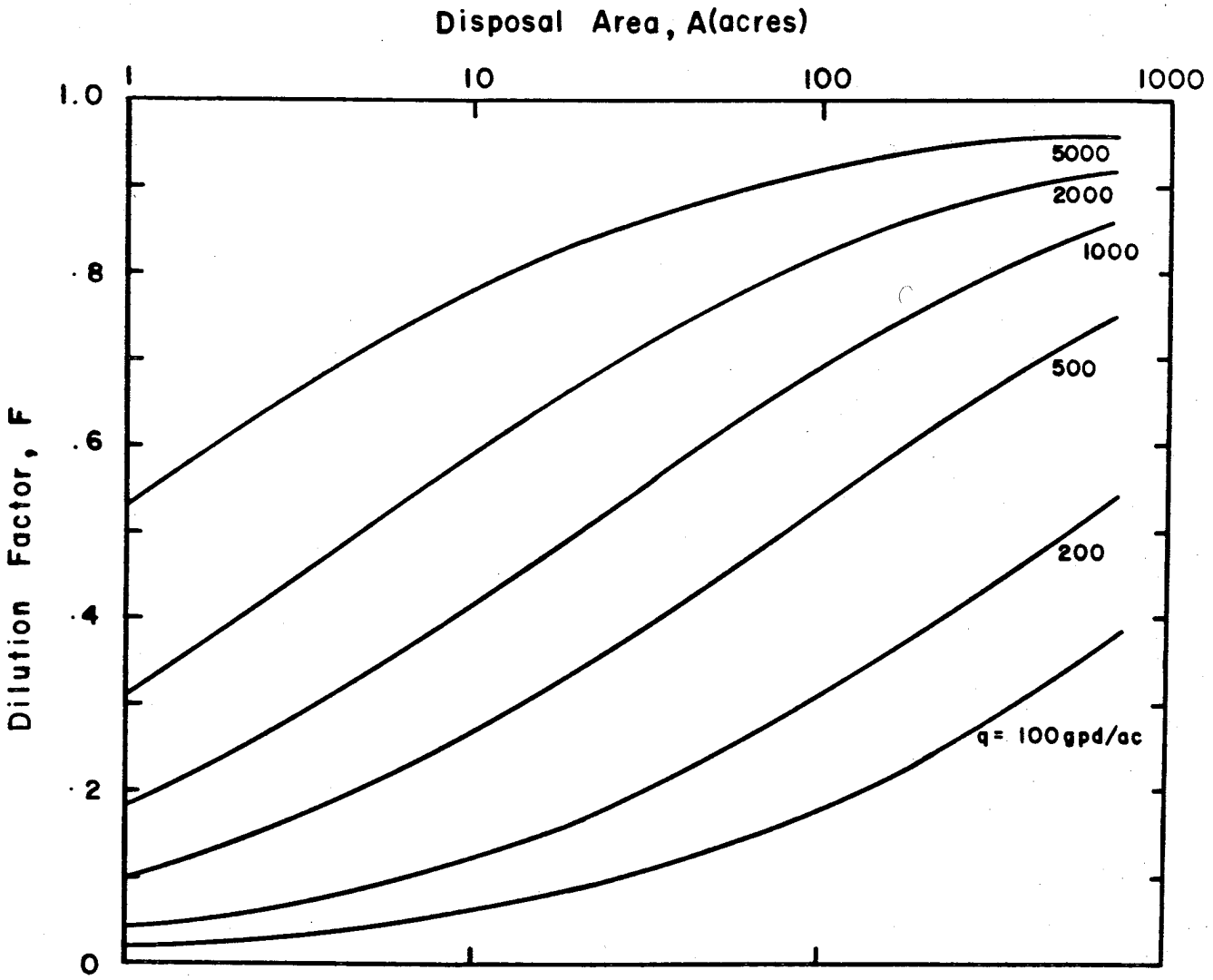


(c) Sensitivity to L_2

Explanation

L_1 = thickness of waste material
K_1 = hydraulic conductivity of waste material
L_2 = thickness of liner
K_2 = hydraulic conductivity of liner = 10^{-7} cm/sec
L_3 = distance from water table to bottom of liner = 5 ft
K_3 = vertical hydraulic conductivity of aquifer material = 10^{-4} cm/sec
H = depth of ponded water
q = rate of seepage

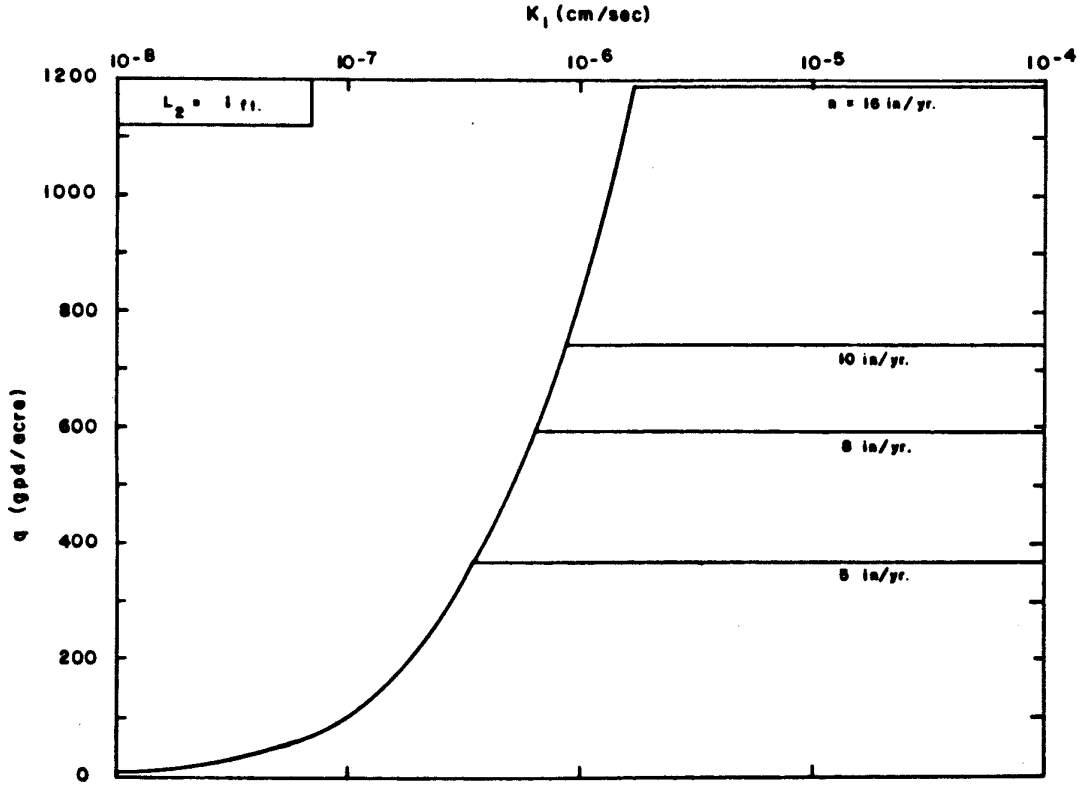
Figure D-21. Sensitivity of rate of waste pond seepage to various hydrologic parameters



Explanation

q = seepage rate

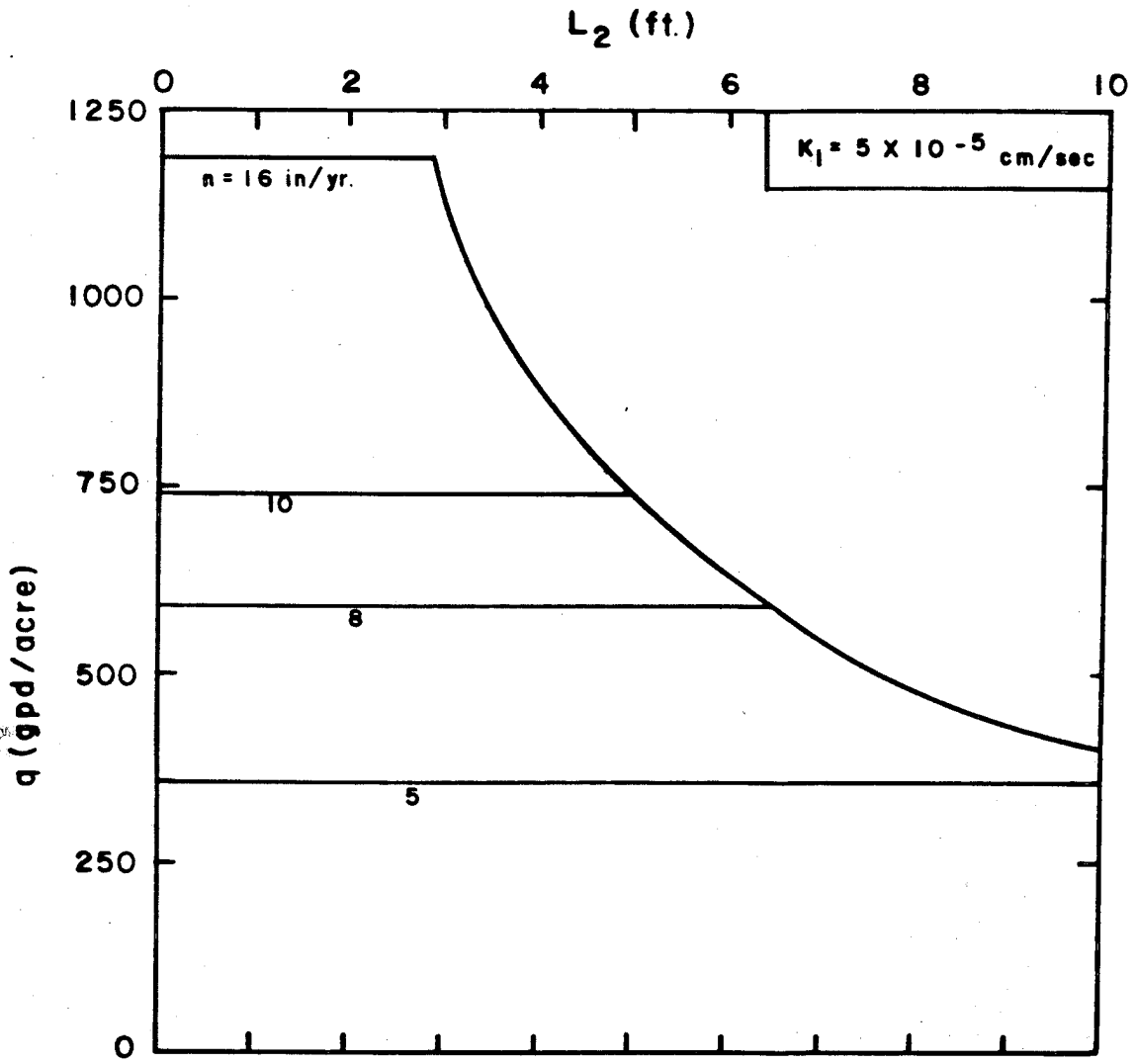
Figure D-22 Dilution factor as a function of disposal area and seepage rate.



Explanation

L_1 = thickness of waste material = 30 ft
K_1 = hydraulic conductivity of waste material
L_2 = thickness of liner
K_2 = hydraulic conductivity of liner = 10^{-7} cm/sec
L_3 = distance from water table to bottom of liner = 5 ft
K_3 = vertical hydraulic conductivity of aquifer material = 10^{-4} cm/sec
q = rate of seepage
n = rate of infiltration

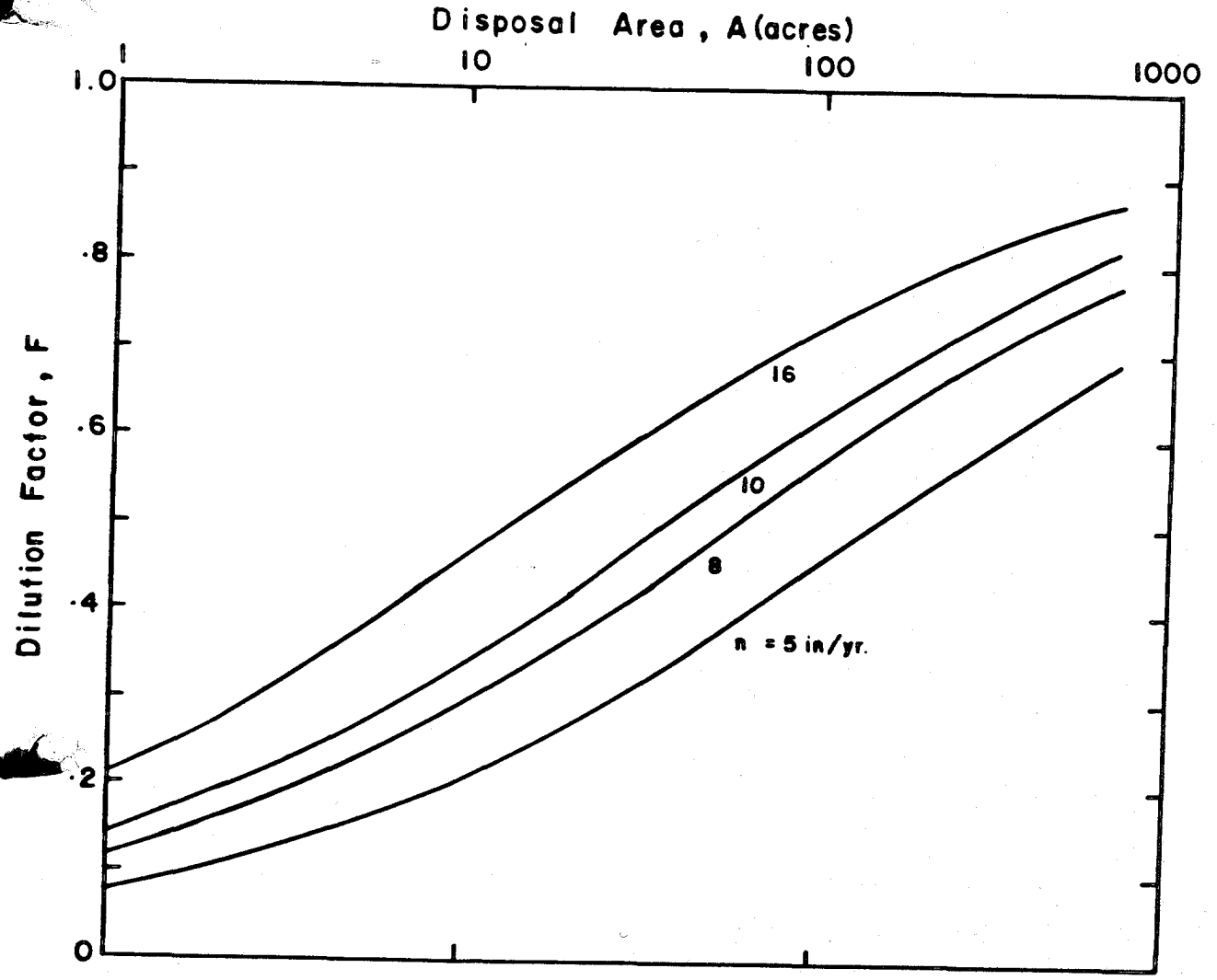
Figure D-23. Leachate seepage as a function of waste hydraulic conductivity



Explanation

L_1 = thickness of waste material = 30 ft
K_1 = hydraulic conductivity of waste material
L_2 = thickness of liner
K_2 = hydraulic conductivity of liner = 10^{-7} cm/sec
L_3 = distance from water table to bottom of liner = 5 ft
K_3 = vertical hydraulic conductivity of aquifer material = 10^{-4} cm/sec.
q = rate of seepage

Figure D-24. Leachate seepage as a function of liner thickness



Explanation

n = infiltration rate

Figure D-25. Dilution factor as a function of disposal area and infiltration rate.