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LETTER REGARDING REVIEW AND COMMENTS ON REMEDIAL INVESTIGATION FOR OPERABLE UNIT 3 (OU 3) NAS JACKSONVILLE FL
7/9/1999
U S DEPARTMENT OF THE INTERIOR

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

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July 9, 1999

Lissa Miller
Harding Lawson Associates
Post Office Box 30399
Jacksonville, Florida 32230

RE: Review comments on the report "Remedial Investigation and Feasibility Study, Operable Unit 3, Naval Air Station, Jacksonville, Florida"

Dear Ms. Miller: Lissa

I have written my corrections directly on the pages of the text and have included these pages with this letter. The comments are generally minor corrections. You will notice that in several places I have doubled the ground-water flow velocities. The reason for this is when the report was published in 1988, we had no way of estimating the aquifer porosity and assumed it was 25%. With the solute transport model, I could estimate the porosity and the best estimate was 12.5%. This means that the velocities from the earlier report (1988) were too slow, the 12.5% porosity will cause them to double. I have corrected the values on the attached pages and figures.

If you have any questions please do not hesitate to call me at 850 942 9500 Ext. 3038.

Sincerely,

Hal Davis

Hal Davis
Hydrologist

Enclosures - as cited

The three major outfalls of the storm sewer systems are located south of Pier 139 near the north end of the bulkhead/sea wall, east of Enterprise Avenue, and south of Building 969 at Black Point (PSC 16). A fourth storm sewer is located east of PSC 16 and drains the southern aircraft parking area and the Kemen Test Cell area. A more detailed description of the storm sewer system is presented in Subsection 3.8.3. Most of the limited direct infiltration of precipitation to the shallow aquifer is located south of Enterprise Avenue.

3.8.2 Groundwater As shown on Figures 3-3 and 3-4, the surficial aquifer in the northern half of OU 3 is composed of two distinct layers. The upper layer is unconfined and extends from land surface to a depth of approximately 15 to 20 feet below sea level; the intermediate layer is confined and extends from the upper layer downward to the top of the Hawthorn Group. In this report, the terms intermediate zone, intermediate layer, or intermediate zone aquifer refer to the intermediate layer of the surficial aquifer and not to the Hawthorn aquifer system. The upper and intermediate layers are separated by a very low-permeability clay layer which is connected with the thick clay plug that separates the northern and southern portions of the intermediate zone of the surficial aquifer. In the southern half of the OU, the upper and intermediate zones are not separated by a single continuous clay layer, but rather several clay lenses exist that are interbedded in the sandy aquifer material. The upper and intermediate layers are directly connected over much of the southern portion of OU 3.

Water-table contours as shown on Figure 3-6 indicate that groundwater flow in the upper layer is strongly influenced by the sea wall along the St. Johns River and by leakage into the storm sewer (Subsection 3.8.3 and Section 3.9). The sea wall partially blocks groundwater flow in the upper layer along the central and northern parts of OU 3. In this area, the sea wall extends downward approximately 20 feet and into the clay layer that separates the upper and intermediate layers. At the southern end of OU 3, the sea wall is set less than 20 feet deep and the clay layer is much less continuous; lower heads in this area indicate that groundwater is seeping under or through the sea wall (Davis, 1998).

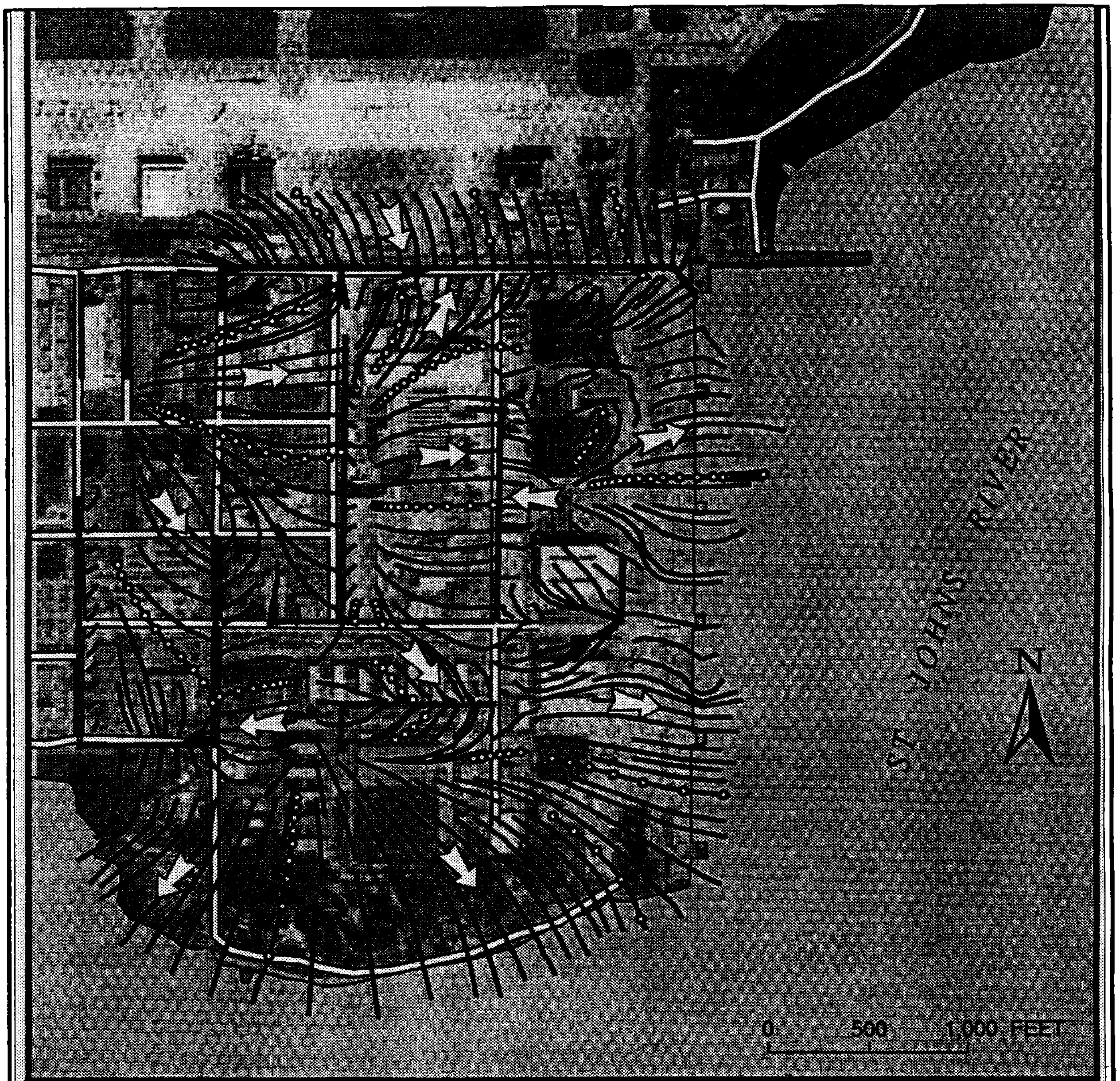
The horizontal hydraulic conductivity in the upper layer of the surficial aquifer at OU 3 ranges from 0.19 to 3.8 feet per day (ft/day), with a mean value of 0.9 ft/day, based on slug tests of seven piezometers (Geraghty and Miller, 1991a). These values are within the range for silty sands described by Freeze and Cherry (1979). A horizontal hydraulic conductivity of 0.6 feet per day for the upper layer was determined from a multiple-well aquifer test conducted at Area A (ABB-ES, 1998a).

The potentiometric surface of the intermediate layer (Figure 3-7) indicates that groundwater flow is generally eastward toward the St. Johns River (ABB-ES, 1995a and ABB-ES, 1998). The eastward movement of groundwater is partially blocked by a naturally occurring, nearly vertical wall of low-permeability channel-fill deposits (Figure 3-5) resulting in a sharp drop in the potentiometric surface from north to south. The horizontal groundwater gradient is significantly larger north of the channel-fill deposits than south of the deposits.

A multiple-well aquifer test was conducted on the intermediate layer at Area D, and a horizontal hydraulic conductivity of 20 ft/day was determined (ABB-ES, 1998). During the test, the intermediate layer was pumped at 17 gpm. Water levels were recorded in three sets of nested piezometers located 20, 50, and 100 and velocity of groundwater flow. A more detailed discussion of model construction, calibration, and analysis of the data is presented in USGS Open File Report 98-68 presented in Appendix O of the EE report (ABB-ES, 1998).

The direction and velocity of groundwater flow was determined using particle-tracking techniques. Groundwater flow in the upper layer was generally eastward toward the St. Johns River. However, leaking storm water drains locally modified the flow system to create small areas with flow that was diverted to the drains. The flow velocities in the upper layer at OU 3 were slow, averaging about 2 feet per year (ft/year). The slow velocities were primarily the result of the low horizontal hydraulic conductivity and, secondarily, the result of the low recharge rate. The simulated rate at which ground water leaked into the storm water drains was low, averaging about 0.0011 cubic feet per second per 100 feet of storm water drainage conduit. Groundwater flow in the intermediate layer moved eastward toward and discharged into the St. Johns River. Flow velocities were significantly higher in this layer than in the upper layer. The velocity was about 35 and 12 ft/year in the northern and southern parts of OU 3, respectively.

Figures 3-9 and 3-10 show particle pathlines for the groundwater flow in the upper layer and intermediate layer, respectively. Figure 3-11 shows a generalized cross-section with particle pathlines. The influences of storm drains on the upper layer flow pattern and the clay plug (low-permeability channel-fill deposits) on the intermediate layer flow pattern are apparent in these figures.



LEGEND

Particle pathline– shows simulated groundwater flowpath in the upper layer; distance between dots represents a travel time of (40) years 20

Storm water drain assumed to be leaking

Groundwater flow arrow – shows direction of groundwater flow along pathlines

Source: Davis,H.J., 1998

FIGURE 3-9
PARTICLE PATHLINES REPRESENTING GROUNDWATER FLOW DIRECTIONS IN UPPER LAYER OF SURFICIAL AQUIFER

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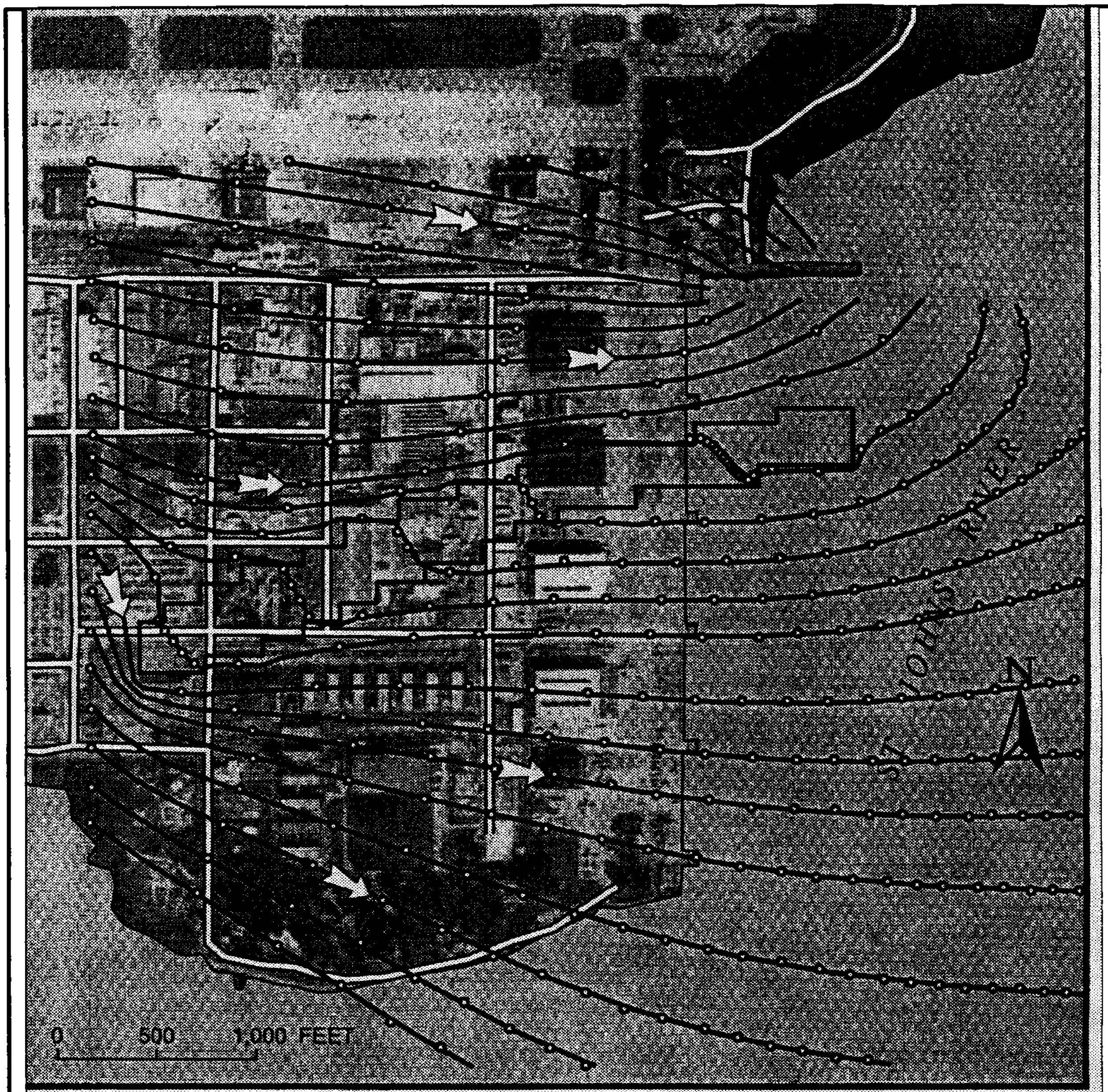
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY OPERABLE UNIT 3

NAVAL AIR STATION JACKSONVILLE JACKSONVILLE, FLORIDA



Source: Davis,H.J., 1998

LEGEND

Particle pathline– shows simulated groundwater flowpath in the intermediate layer; distance between dots represents a travel time of 20 years (10)

Groundwater flow arrow – shows direction of groundwater flow along pathlines

Low–permeability channel–fill deposits

FIGURE 3-10
PARTICLE PATHLINES REPRESENTING GROUNDWATER FLOW DIRECTIONS IN INTERMEDIATE LAYER OF SURFICIAL AQUIFER

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY OPERABLE UNIT 3

NAVAL AIR STATION JACKSONVILLE JACKSONVILLE, FLORIDA

K:\02562\02562-09\RIF\02562530.DWG, -PDP 08/19/98 10:11:08, AutoCAD R14 below the water table in many areas under OU 3, some contaminated groundwater enters the sewer system which provides a direct route to the river.

- Rainfall on buildings and paved surfaces is exposed to pollutants from typical processes and activities such as motor vehicle operation, material handling and storage, pavement disintegration, and normal NADEP maintenance and rework operations on aircraft. This generates contaminated water and sediment which flows to drainage inlets where this runoff enters the sewer system and is eventually transported to the St. Johns River.

Contaminant sources at OU 3 are found either within the groundwater aquifer at the several identified hot spots, or on the impervious surfaces that are subject to rainfall runoff. The soils at OU 3 are, in general, free from contamination.

<u>5.1.1 Groundwater</u> Specific groundwater flow pathlines are shown in Figures 3-9 for the upper layer of the surficial aquifer and in Figure 3-10 for the intermediate layer; a vertical cross-section with groundwater pathlines is presented in Figure 3-11 (see also USGS Open File Report 98-68, Ground-Water Hydrology and Simulation of Ground-Water Flow at Operable Unit 3 and Surrounding Region, U.S. Naval Air Station, Jacksonville, Florida). It can be seen that the groundwater pathlines in the upper layer are strongly influenced by infiltration into the sewers and by the sea wall. Calibration of the groundwater flow model requires an assumption that several reaches of the storm sewer are leaking. The particular reaches of sewer pipe that have been assumed by the model to be leaking are indicated by a bold dark line on Figure 3-9. Routes of migration within the upper layer from Areas A, E, F and G can be clearly seen. The Area A and Area E plumes appear to be migrating directly toward the leaking sewers beneath Wright Street and Enterprise Avenue respectively. There does not appear to be enough leakage into the sewer around Areas F and G to affect the calibration of the groundwater flow pathline model. Also, as discussed in Chapter 4.0, the video survey revealed leakage into the sewer in this area, and contaminated groundwater appears to be migrating preferentially along the backfill around the storm sewer line that passes through the Area G plume, thereby causing the elevated concentration found at CPT point H01 (see Figure 4-7).

As shown in Figure 3-10 and the cross-section view in Figure 3-11, the groundwater flow in the intermediate layer is generally directly east toward the St. Johns River. Because this layer is separated from the upper layer by a clay aquitard (layer 2 in the model, not shown in Figure 3-11; see Figures 3-3 and 3-4), the groundwater flow migrates considerable distances beneath the river before moving vertically upward into the upper layer and ultimately into the river. The contaminant plumes within the intermediate layer at Areas B, C and D appear to be migrating toward a discharge point in the St. Johns River near the dredged channel for the docking facility at the northeast corner of OU 3.

A complicating factor in the assessment of groundwater flow from Area B is the existence of the clay plug that separates the northern portion of the intermediate layer from the southern portion (see Figs 3-3, 3-4 and 3-5). It can be seen from Figure 3-10 that this clay plug lies just south of Area B and that the groundwater pathlines near Area B approach the north side of the thick clay and

Replace

At the time this study was completed it was assumed that the sewers around Areas F and G were not leaking. However, a camera survey later showed that they were leaking in these areas.

then try to flow through the clay which causes the flow lines to bend sharply to take the shortest path to the other side of this low conductivity barrier. The clay barrier also causes a spreading of the flow along its northern side, and a slowing of the flow as it tries to migrate through the clay.

The velocity of the groundwater as it moves along the pathlines shown in Figures 3-9 and 3-10 is indicated by the distance between the dots along each flow path. The travel time between dots is 40 years on Figure 3-9 and 20 years on Figure 3-10. It is apparent that the groundwater is moving very slowly, and since contaminants will be subject to retardation due to adsorption, they will move even slower (see Section 5.3).

<u>5.1.2 Storm Sewer Network</u> The stormwater drainage system is shown in Figure 3-8. Inlets to the sewers for collecting surface runoff are indicated and can be seen to collect runoff from parking lots (for both cars and aircraft), roadways and roof tops. The leaky sewer segments, as discussed in the previous section, cause the groundwater pathlines to directly intersect the sewer line as can be seen in Figure 3-9. Of particular interest are the leaky sewer segments near Areas A and E which provide direct routes for contaminants to migrate from these areas to the St. Johns River. The storm sewer network has four discharge points into the St. Johns River as shown on Figure 3-8; one at the eastern extension of Albermarle Avenue; one at the sea wall directly east from Enterprise Avenue, and two at the southeast corner of OU 3.

<u>5.2 PERSISTENCE AND FATE OF OU 3 CONTAMINANTS</u>. The risk assessment (Chapters 6.0 and 7.0, respectively) has identified organic and inorganic constituents that potentially pose risks and can be attributed to OU 3. Those constituents that pose a risk and that occur at concentrations that are above background are summarized below by medium.

Groundwater	<u>VOCs</u> PCE TCE 1,1-DCE) VC
Storm Sewer Water	<u>VOCs</u> TCE
Sediment	PAHs <u>Inorganic Analytes</u> lead

The VOCs in the groundwater pose a risk to human health as shown in Chapter 6.0, and the PAHs and lead in the sediments pose an ecological risk to aquatic and semi-aquatic receptors as shown in Chapter 7.0.

<u>5.2.1 VOCs</u> The VOCs of concern identified at OU 3 are PCE, TCE, 1,1-DCE and VC, which are found primarily in groundwater. TCE is also found in the storm sewer water at levels that exceed the Florida surface water standards. These VOCs readily volatilize from surface water and once in the atmosphere the

represents the clay aquitard that separates the upper and intermediate aquifer layers, and model layer 3 represents the intermediate aquifer layer. The St. Johns River lies directly over layer 1. Groundwater velocities shown by pathline plots on Figures 3-9, 3-10, and 3-11, are also entered into the MT3D model to provide the advective component of transport.

The dispersive component of contaminant transport is calculated by MT3D through dispersivity values that are provided as input to the model. Values chosen by the USGS for dispersivity were taken from the work of Gelhar et. al. (1992). Using the most conservative approach, dispersivities were taken from the low end of the range of "high reliability" values presented by Gelhar et.al. which are 1.0 ft for longitudinal dispersivity and 0.03 ft for both the vertical and horizontal lateral dispersivities. If mean values of the data presented by Gelhar et. al. were chosen, the dispersivities would increase by at least a factor of ten.

No biological decay was simulated in these model runs in order to provide the most conservative estimates for concentrations at potential exposure points in the St. Johns River. One retardation value was used for the intermediate layer and one for the upper layer. These were ~~conservatively~~ chosen to be ~~the minimum~~ values shown in Table 5-1.

Figures 5-4 and 5-5 show results from the model for the intermediate layer plumes at various times in model layers 1 and 3. The plumes from Areas B, C and D are shown for the intermediate layer at a time of 60 years in Figure 5-3. It can be seen that the Area C plume has reached the area of the dredged channel along the docking facility at the NE corner of OU 3, and has begun to migrate into the upper layer. In fact, as can be seen in Figure 5-4, the Area C plume has reached its maximum concentration (1352 $\mu g/\ell$) in the upper layer at this time of 60 years. However the plumes from Areas B and D have not reached this area yet.

At a time of 60 years (Figure 5-4), considerable spreading of the Area B plume has occurred along the northern side of the clay plug that divides the northern and southern portions of the intermediate layer. The groundwater is trying to carry the plume through the clay plug as well as along it resulting in the large degree of spreading of this plume. Due to this spreading and slowing of migration speed, the Area B plume has not reached the upper layer after 200 years of simulation. The Area D plume can be seen to have spread out to about 150% of its initial length at a time of 60 years, but is still confined to the intermediate layer. After 100 years the Area D plume has reached its maximum concentration (3434 $\mu g/\ell$) in the upper layer. These results indicate that the Area C plume has undergone a reduction in maximum concentration of 3.7 times, and the Area D plume has had its maximum concentration reduced by about 2 times; both due solely to dispersive mixing.

Simulation of the plume migrations at Areas F and G are shown in Appendix E. These plumes show a dispersion to nondetectable concentrations before reaching the St. Johns River. The Area G plume conservatively assumed to have the largest of the measured half-lives of 13.5 years (Section 5.2.1). Simulation of the Area G plume with "no decay" results in a maximum concentration of 138 $\mu g/\ell$ of TCE at the river after 200 years, however it would take only a small amount of decay - halflife of 100 years or more - to degrade this concentration to less than the surface water standard). The migration of the plumes from Areas A and E were not simulated with MT3D as it appears they will be intercepted by the sewer system,