WATER

A. Describe the existing hydrologic conditions (both ground and surface water) on and abutting the site, including identification and discussion of any potential aquifer recharge areas.

SURFACE WATER

Restoration is located within the Northern Coastal Basin (NCB) (part of the Florida East Coast Basin as defined by FDEP) within the Halifax Watershed. The NCB extends nearly 100 miles from lower Duval County south through St. Johns, Flagler, and Volusia counties to Ponce de Leon Inlet near the city of New Smyrna Beach. The NCB encompasses over 679 square miles of coastal lowlands; a series of flat sandy plains differing slightly in elevation, and interspersed with numerous creeks and small rivers draining into shallow bays and lagoons that are separated from the Atlantic by an almost uninterrupted barrier island system. This landscape is believed to have been sculpted by distinct episodes of sea level rise and fall gradually yielding present-day form to the NCB's major watersheds: Tolomato, Guana, Matanzas, Pellicer, and Halifax.

The Halifax River extends south from the artificial channel north of Daytona Beach, exiting the NCB at the Ponce de Leon Inlet. Tidal flow in this area also originates through the Ponce de Leon Inlet. Six causeways that cross the Halifax River estuary within a distance of 10.5 miles, cross the Halifax River estuary between Port Orange and Ormond Beach, and inhibit circulation in the area. The Halifax drainage basin encompasses as area of nearly 208,000 acres and includes portions of Volusia and Flagler counties. Mosquito impoundments, residential development, or silviculture has altered a majority of the estuary's historic watershed drainage. Major drainage into the estuary comes from the Tomoka River, Bulow Creek, Spruce Creek, and their tributaries (Bonnie Holub and Associates, 1998).

Regionally, Restoration is located within the headwaters of several watersheds. The Spruce Creek Swamp touches the west edge of the DRI property, and is the main hydrologic feature in this area. The Spruce Creek Swamp overflows in several directions. To the north, the outlet is through the Samsula Canal into the Spruce Creek Watershed. To the south and southwest, the outlets are to Cow Creek and Sandy Drain into Deep Creek, a tributary of the St. Johns River just north of Lake Harney. The Unnamed Swamp is hydraulically connected to the Spruce Creek Swamp. At the divide of the Unnamed Swamp are outlet(s) to the east into the Turnbull Creek Watershed, and along the west divide into the Deep Creek Watershed. Little Cow Creek drains a small portion of the DRI site in the southeast corner, and has an outlet across I-95 into the Turnbull Creek Watershed. Bonnie Holub and Associates (1998) show the Spruce Creek drainage divide in this area to be approximately at SR-44. The Restoration site is in the Sandy Drain Watershed, tributary to Deep Creek.

According to Brown and Orell (1995), Spruce Creek flows approximately 12 miles from its source to its outfall on the Intercoastal Waterway. The Spruce Creek drainage basin (approximately 71,347 acres) is located in the southeast portion of Volusia County immediately south of the Tomoka watershed. Of the two drainage basins, Spruce Creek has largest percent of area that is urbanized. The southern half of the watershed is drained by the Samsula canal. This canal and its network of contributing canals flow north joining the creek south of where it makes a wide sweeping turn to the east at which point it becomes tidally influenced. Spruce Creek is joined at Strickland Bay with Turnbull Creek, a major tributary from the south.

The topography of the Spruce Creek drainage basin is relatively flat. The highest elevation of the creek at its headwater is 27 ft above MSL. The western boundary is formed by the Atlantic coast Sand Ridge and is bound on the east by the Rima Ridge. The creek eventually flows through a section of the Rima Ridge as it turns to the east. Slope of the creek averages about 1.4 ft per mile, typical of many Florida's streams and rivers. Due to the low topography of the area, stream flow is tidily influenced approximately 10 miles upstream from Strickland Bay. A combination of the creek's low relief and small watershed translates into a relatively small volume of runoff and discharge, but discharge can vary greatly with seasonal differences in rainfall and isolated storm events. Baseflow is as small as 1.0 cfs and can peak at 500 cfs. Velocities have similar variability from about 0.1 to 3.0 fps.

According to Brown and Orell (1995), the natural channel of Spruce Creek is incised downstream of S.R. 40A, and flows north and east into Strickland Bay of the Halifax River. The natural channel of Spruce Creek has been significantly extended to the south by the Samsula canal, which provides substantial drainage of the southern headwaters area of the basin. This area is comprised of extensive forested wetlands and large areas of pine plantations. The middle portion of the basin has extensive areas of agricultural and urban uses adjoining the creek, with interspersed forest, pasture, and pine plantations along the western side. The eastern parts of the basin, along the coastal ridge (east of I-95 at the Restoration site) and the Halifax River, are heavily urbanized, including the areas adjoining Turnbull Creek. The channel way of Spruce Creek, from Strickland Bay upstream to I-95, is characterized by extensive areas of herbaceous marsh, dominated by salt marsh with fringing needle rush.

In the Brown and Orell (1995) riparian buffer study report, the Spruce Creek Basin was divided into four sub-basins: Lower Spruce Creek, Spruce Creek Channel, Spruce Creek Slough, and Turnbull Creek. According to the same report, about 70% of the interface zone of lower Spruce Creek was in natural cover, while 30% was in urban uses. In the mid reaches of the Spruce Creek (Spruce Creek Channel) nearly 50% of the interface zone was dominated by urban uses, stretching along both sides of the river. About 32% of the interface zone was in natural cover, and about 19% was in agricultural uses. In the upper reaches (Spruce Creek slough) the creek's interface zone was dominated by agricultural uses. In this region, natural cover in the interface zone was about 15% of total.

The Restoration site is located in sections 1, 2, 3, 6, 32, 33, 34, and 35 of Townships 17 and 18 South and Ranges 33 and 34 East. The site covers approximately 6,282 acres, a parcel which is bounded on the south by CR 442 and Opossum Camp Road, on the east by Interstate 95 and on the west by the Spruce Creek Swamp. The land surface elevations within the Restoration site vary from 27 to 29 feet NGVD on high ground to 20 to 25 feet NGVD in the low wet areas.

There are no lakes or natural water bodies in the project area. However, numerous wetland parcels exist within the project area. The Samsula canal runs north-south west of the Spruce Creek Swamp. The west part of the DRI site, identified within the Samsula Canal-Sandy Drain basin outlets to the Samsula canal to the north and to the Cow Creek watershed to the south, a tributary of Deep Creek within the St. Johns River watershed. The nearest lake in the vicinity is Lake Ashby, approximately 4.2 miles towards the west.

Two Outstanding Florida Waters (OFW) are downstream of the Restoration site. Turnbull Bay is 2.4 miles northeast from the northeast corner of the site while the Spruce Creek OFW is 4.4 miles north from the northwest corner of the site.

Two active flow gaging stations are operated by the USGS along the Spruce Creek. Daily flow data from these gaging stations were retrieved from USGS website. The longest daily flow record at Spruce Creek near Samsula, USGS gaging station No. 02248000, spans from May 1, 1951 to current. The other site, Spruce Creek near New Smyrna Beach, USGS gaging station No. 02248053, has daily flow records from December 21, 2000 to current. Approximately 33.4 square miles of area drains to the gaging station 02248000, whereas gaging station 02248053 has a contributing area of approximately 60.7 square miles. Details of these gaging stations are summarized in Table A-1, USGS Gaging Stations. Summary statistics reported in Water Resources Data, Florida, Water Year 2004, Volume 1A, Northeast Florida Surface Water, Water Data Report FL-04-1A.

GROUNDWATER

Physiographic Location

The subject property is located within both the Central Atlantic Coastal Strip and the St. Johns Wet Prairie sub-districts of the Eastern Flatwoods physiographic district (Brooks, 1981). This district originated as a sequence of barrier islands and lagoons during the Plio-Pleistocene and Recent time. Solution of limestone has influenced the landscape and the courses of the creeks and rivers in this District. The Central Atlantic Coastal Strip is a strip of land modified by shoreline processes during the Late Pleistocene when the sea was about 18 feet above its present level. The subject property is divided by Turnbull Hammock subdivision of The Central Atlantic Coastal Strip sub-district and the St. Johns Wet Prairie. The Turnbull Hammock subdivision consists of gentle eastward terraces accreted on to a more ancient upland that is generally 25 to 35 feet in elevation. The older upland is dominantly covered by flatwoods and the lower slopes and associated terrace supports cabbage palms with scattered hammocks (Brooks, 1981). The St. Johns Wet Prairie subdivision encompasses the most southwestern section of the subject property and is characterized by marshes and grass prairies.

Geology

The regional surficial and bedrock geology in the vicinity of subject site comprises a stratigraphy of several tens of feet of surficial soils overlying several hundreds of feet of calcareous clay, limestone, and dolomite. Specifically, the geologic sequence in ascending order from Eocene to Recent age consists of: Eocene age-Avon Park and Ocala Group Limestones; and Plio-Pleistocene to Recent age-Undifferentiated surficial soils. This stratigraphy, as well as that of the entire peninsula of Florida, is a typical sedimentary domain resulting from sea level transgressions and regressions. The strata were deposited in generally horizontal layers with little subsequent distortion or warping.

The Avon Park Formation of Eocene age is a major water producing unit of the Floridan Aquifer System. The Avon Park limestones consist primarily of cream, tan, or light brown, soft to well-indurated limestone that is mostly pelletal, but locally micritic. The limestone is interbedded with light to dark brown, fine to medium crystalline, slightly vuggy dolomite. The top of this unit occurs at about 200 feet below mean sea level and is over 800 feet in thickness (FGS W-12904, Rutledge, 1985).
The Ocala Group limestones, which overlay the Avon Park Formation, consists of cream to white generally soft, somewhat friable, porous coquina composed of large foraminifera, bryozoan and echinoid fragments, bound by a matrix of micritic limestone (Applin and Applin 1944). In the area of the subject property the Ocala Group is thin due to extensive erosion and is absent in the

western portion of Volusia County. The Ocala Limestones occurs about 70 feet below sea level and has a thickness of 120 feet (FGS W-12904 and City of Edgewater Production wells).

The Hawthorn Group is missing over most of Volusia County and is likewise missing under the subject site although clay layers of Miocene age at the base of the undifferentiated surficial soils form a confining bed that retards water movement between the surficial aquifer and the Floridan Aquifer System (Rutledge, 1985).

Undifferentiated surficial soils of Plio-Pleistocene to Recent age overlie the Ocala Limestone and typically consist of sand, silty sands, clayey sands, some hardpan, and organic soils. The surficial soils range in thickness from 45 to 100 feet in the vicinity of the project site. These surficial soils comprise the surficial aquifer system.

Hydrogeology

The project site is underlain by a shallow surficial aquifer and the Floridan aquifer. The shallow surficial aquifer consists of surficial sandy soils above clayey or stilly sand beds in the Undifferentiated Deposits containing a confining clay unit between the base of the surficial aquifer and the top of the Floridan aquifer system. The artesian Floridan aquifer consists of Ocala Group Limestones and the Avon Park Formation. Brackish water is present in the eastern and western fringes of the county in the surficial aquifer. Saltwater is present throughout the county in the lower zones of the Floridan aquifer.

The groundwater in the surficial aquifer is recharged primarily by local rainfall and is discharged mainly by evapotranspiration, groundwater pumpage, and by seepage into surrounding low areas, lakes, and streams. Water enters the Floridan aquifer system in Volusia County by downward leakage from the surficial aquifer though the confining layers and by horizontal flow from outside the County (Rutledge, 1985). The rate of recharge into the Upper Floridan aquifer is determined by the leakance of the confining clay unit above the Upper Floridan aquifer, and by the downward head between the two units.

The Restoration site is not in an area known to the local government, based on data collected and interpreted by the U.S. Geological Survey, the SJRWMD, the County or Municipal engineer, and other professional investigators, as important to recharge. According to Veechioli and others (1990), recharge at the DRI site is 0 to 10 inches per year to the Surficial and Floridan aquifers.

The Floridan aquifer is the principle source of artesian groundwater in Florida. The top of the aquifer occurs at an approximate elevation of -70 feet NGVD in the region of the project site. The Upper Floridan aquifer consists of two significant water-bearing zones separated by a less permeable zone. The most productive zones include the upper Ocala Limestone and the upper, more transmissive zone in the Avon Park Formation.

Surficial Aquifer System

The surficial aquifer system in the vicinity of the project site consists of the Undifferentiated Surficial Soils. The ground water table in this non-artesian aquifer system generally reflects topographic contours and is usually within a few to several feet of the ground surface. The base of the aquifer is the top of the first laterally extensive and vertically persistent bed of much lower permeability though these clay zones are inconsistent enough that these do not significantly retard the flow of water in the Surficial aquifer.

The surficial aquifer system is recharged by precipitation. The ground water table will vary across the region depending on the ground surface elevation, distance to topographic relief points and surface water bodies. The depth to ground water exhibits seasonal variations with the lowest water levels occurring during the dry season (November to May). Typical seasonal water-table fluctuations range from 4 to 5 feet with an average depth to water table in most of Volusia County less than 10 feet, though in ridge areas the average depth to water is typically 5 to 15 feet (Rutledge, 1985).

Floridan Aquifer System

The Floridan aquifer system is the major water supply source for most public, industrial and irrigation users in Volusia County and Central Florida. The aquifer consists of more than 1,000 feet of limestone and dolomite within Ocala Limestone and Avon Park limestones (FGS, W-1118). The lower part of the Avon Park Formation, containing lenses of anhydrite and gypsum, are believed to form the lower confining bed for the Floridan aquifer system. Movement within the aquifer is primarily horizontal toward zones of discharge via an extensive pattern of cracks, joints, and solution cavities.

The City of Edgewater has 10 water supply production wells located along I-95 in a north-south direction (six) and along the south edge of the Restoration DRI site in an east-west direction (four). The wells typically are cased to about 105 feet below land surface with a total depth of 200 feet below land surface. At the six wells east of I-95, a 15 to 30-foot thick confining unit of clayey strata separates the surficial from the Floridan aquifer system.

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B. Describe, in terms of appropriate water quality parameters, the existing ground and surface water quality conditions on and abutting the site. (The appropriate parameters and methodology should be agreed to by the regional planning council and other reviewing agencies at the preapplication conference stage.)

SURFACE WATER QUALITY

According to Brown and Orell (1995), numerous sampling stations under a variety of sampling efforts spanning 10 years have been established along the Spruce Creek system. Water quality in Spruce Creek is generally good. There are no direct point source discharges along the creek that might lead to serious water quality degradation. Threats to water quality exist in the form of urban development and agricultural uses within the watershed giving rise to non point source surface discharge. Much of the new development in Port Orange and other areas of development within the basin are required to maintain stormwater retention facilities which in addition to lowering peak discharges during storm events, reduce sediment loads, and to a lesser extent some of the other pollutants that accompany urban storm runoff. This, however, is not the case for the agricultural and pasture land in the southern portion of the watershed.

The dissolved oxygen values for Spruce Creek were generally below 5 mg/l standard set by the state for Class III waters. This is most likely due to naturally occurring conditions not anthropogenic causes. The Spruce Creek is a black water system (water color in Spruce Creek was measured to be between 250 and 500 units). Black water is the result of organic compounds leaching from decaying organic matter that has accumulated in uplands and wetlands boarding the creek and that is carried into the river via ground waters. Black Water Rivers often have lower dissolved oxygen concentrations as a result of low light penetration and high biochemical oxygen demand. Waters flowing from wetland ecosystems are often low in dissolved oxygen as a result of decomposition within wetlands.

Nitrogen and phosphorus were measured in the Spruce Creek but were not excessively high. Concentrations were high enough to cause algae growth; however, it was assumed that low light conditions (resulting from the narrow river channel and dark water) significantly reduced algae growth. Phosphorus levels were extremely variable and were generally higher toward the coast. The highest levels of nitrogen were found in the Samsula Canal which receives water from upland pastures.
Coliform bacteria measured during the sampling periods exhibited high numbers in the big bend area of the creek up into the Samsula Canal but decreased in the most remote sample stations in the canal. The types of bacteria found were of animal origin presumably from pastures and not from urban sewage. Bacterial counts dropped dramatically upon entering the larger, brackish waters of Turnbull and Strickland Bays.

The following summary of water quality for Spruce Creek was given by the Volusia-Flagler Group, Sierra Club (1989b):

> "As a whole, the present water quality in the Spruce Creek watershed may be generally characterized as having moderate to low biodegradable organic content, high color, very low dissolved oxygen, moderate to high nitrogen and phosphorus levels, and very high bacteriological counts. It is difficult to firmly establish whether the overall poor quality is relative mainly to man-made situations or to natural factors...Although they [land areas within the basin] cannot be considered to all be in their original natural state, the direct influence of man should be very minor. Under these conditions, it is entirely possible that the undesirable water quality results primarily from natural factors..."

GROUNDWATER QUALITY

Water chemistry analysis from a composite sample obtained May 3, 2005 for the City of Edgewater's Alan R. Thomas Water Treatment Plant Floridan aquifer wells is provided in Table B-1, Detected Groundwater Quality Data City of Edgewater Floridan Aquifer Wells, May 3, 2005 for detected parameters. Other parameters analyzed from this composite water sample are listed in Table B-2, Nondetected Goundwater Quality Data City of Edgewater Floridan Aquifer Wells, May 3, 2005.

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C. Describe the measures which will be used to mitigate (or avoid where possible) potential adverse effects upon ground and surface water quality, including any resources identified in Subquestion A.

The project will be designed in compliance with regulations of cities of Edgewater and New Smyrna Beach and SJRWMD stormwater, erosion control and consumptive use regulations.

For basins that discharge to Class III surface waters, the stormwater management system will provide treatment of stormwater prior to discharge into offsite water bodies.

Typically, the SJRWMD will require that the City of Edgewater water supply wellfield in the area be designed, permitted and operated to minimize the drawdowns in the surficial aquifer system, and to minimize saltwater intrusion in the Floridan aquifer.

Irrigation supply will be designed to the maximum extent feasible to be from non-potable sources such as recycled stormwater, reclaimed water and horizontal wells in the surficial aquifer system with emergency backup from well(s) in the Floridan aquifer.