

SECTION 3.0 – ENVIRONMENTAL SETTING

3.0	ENVIRONMENTAL SETTING	3-3
3.1	Site Setting	3-3
3.2	Demography/Land Use	3-4
3.3	Meteorology	3-5
3.4	Surface Water	3-6
3.4.1	Tidal Processes	3-6
3.4.2	Upland Surface Water Hydrology	3-6
3.4.3	Groundwater Recharge Capability	3-7
3.5	Site Geology	3-7
3.5.1	Historical Explorations	3-7
3.5.2	Surficial Geology	3-7
3.5.3	Bedrock Geology	3-10
3.6	Site Groundwater Regime	3-14
3.6.1	Overburden Water Levels	3-14
3.6.2	Bedrock Water Levels	3-15
3.6.3	Groundwater Vertical Gradients	3-17
3.6.4	Springs and Seeps	3-18
3.7	Sediment	3-19
3.8	Ecological Setting	3-19
3.8.1	Wetlands	3-19
3.8.2	Marine Habitat	3-20
3.8.3	Terrestrial Habitat	3-21
3.9	Uncertainties and Data Limitations	3-21

LIST OF TABLES

- 3-1 Summary of Storm Drain Outfalls
- 3-2 Pre-RFI Selected Geologic Explorations
- 3-3 Vertical Gradient Direction in Paired Wells

LIST OF FIGURES

- 3-1 Map of Site Watersheds
- 3-2 Map of Plant Area Watersheds
- 3-3 Surficial Geology of Bailey Point
- 3-4 Pre-Construction Ground Surface Topography of Bailey Point
- 3-5 Pre-Construction Bedrock Surface Topography of Bailey Point
- 3-6 Bedrock Contour Map of Bailey Point
- 3-7 Overburden Thickness of Bailey Point and Surrounding Land
- 3-8 Bedrock Geology of Bailey Point
- 3-9A Bedrock Structural Data for Bailey Point
- 3-9B Bedrock Structural Data for Bailey Point
- 3-10A Measured Soil Groundwater Levels – 12/11/01
- 3-10B Measured Bedrock Groundwater Levels – 12/11/01
- 3-11A Measured Soil Groundwater Levels – 04/01/02
- 3-11B Measured Bedrock Groundwater Levels – 04/01/02
- 3-12A Measured Soil Groundwater Levels – 09/16/02
- 3-12B Measured Bedrock Groundwater Levels – 09/16/02
- 3-12C Groundwater Level Graphs for South End of Bailey Point
- 3-12D Groundwater Level Graphs for North End of Bailey Point
- 3-13A Geologic Cross-Section Location Map
- 3-13B Geologic Cross-Sections
- 3-13C Geologic Cross-Sections
- 3-13D Geologic Cross-Sections
- 3-13E Geologic Cross-Sections
- 3-13F Geologic Cross-Sections
- 3-13G Photos of Rock Core
- 3-13H Photos and Logs of Rock Core
- 3-14 Site Wetlands
- 3-15 NWI Wetlands

3.0 ENVIRONMENTAL SETTING

Section 3 outlines the environmental setting for the Bailey Point portion of the Maine Yankee site and a description of the site in relation to its physical surroundings. The section provides a brief outline of site demography, land use, ecology, and meteorology, as well as a description of site surface water, geology, groundwater, and sediment regimes within the Bailey Point area. The physical descriptions are based on historical information, which is supplemented with data collected as part of the RFI. This section concludes with a discussion of uncertainties and limitations of collected environmental data.

3.1 Site Setting

The site is located in the town of Wiscasset, Lincoln County, Maine (**Figure 1-1**). Site coordinates are approximately 43 degrees 57 minutes 5 seconds north latitude and 69 degrees 41 minutes 45 seconds west longitude. The site is located approximately one and one-half miles east of Route 1 and one-half mile west, across Back River, from Westport Island (**Figure 1-2**). The land owned by Maine Yankee is divided by Old Ferry Road, the closest public road, which terminates on the shore of Back River (**Figure 1-3**). The main plant site is located on a peninsula known as Bailey Point, which extends south into Montsweag Bay, which is part of the Sheepscot River estuary system.

The entire site is about 820 acres; of which approximately 670 undeveloped acres (commonly referred to as the Backlands) exist west of Bailey Cove/Young's Brook and north of Old Ferry Road. The remaining 150 acres lie south of Old Ferry Road within the Bailey Point area, which is bounded by Bailey Cove to the west and Back River on the east.

The Back River extends in a northerly direction from a point known as Long Ledge, which is at the northern limit of Montsweag Bay, a distance of about four miles to a confluence with the Sheepscot River at the northern tip of Cushman Point (**Figure 1-2** and Figure 3 in Gerber & Rand, 1980). It varies in width from a maximum of 1,500 feet at Berry Island to a minimum of 500 feet at Cowseagan Narrows. Channel depths vary from 10 to over 60 feet at mean low water, with a maximum depth at the plant site of approximately 36 feet (MY, 1998).

Montsweag Bay extends southward from Back River in the vicinity of Long Ledge a distance of about four miles to Phipps and Hubbard Points, where it connects with Hockomock Bay. Montsweag Bay varies in width from approximately 2,000 feet at its northern and southern limits, to about 8,000 feet midway between these points and has a mean tide level area of about 1,800 acres. Except for a relatively narrow central channel, the bay is quite shallow, with mean low water depths generally less than two feet. Accordingly, extensive intertidal mud flats are exposed at low tide and especially so during spring low tides. The central channel varies in depth from 13 to 50 feet (MY, 1998).

Tidal flows enter and leave the Back River-Montsweag Bay area at the Cowseagan Narrows on the north and through the passage separating Phipps and Hubbard Points to the south. The average tidal range in this area is about nine feet.

The plant site itself is located on a ridge of bedrock running northeast to southwest to form Bailey Point. The maximum elevation of this rock is a knob 75 feet above MSL located about 700 feet northeast of the plant. The general elevation of Bailey Point varies from sea level to 40 feet above mean sea level. The plant industrial area is graded to elevation 21 feet.

3.2 Demography/Land Use

Within five miles of the site, land use consists largely of home sites, small businesses, summer houses, idle farmland and forest. Housing is scattered along principal roads and is concentrated only in the center of Wiscasset. Because of its unique coastal terrain and many bays, the area is a summer recreational center for boating and other water-related activities. This summer recreation and its supportive businesses, motels, restaurants, shops, etc., provide much of the economic base for the area. The resident population density was estimated to average 72 people per square mile in 1990 (MY, 1998).

The waters near the plant site are reported to be relatively low in productivity of fish and shellfish. Some lobstering is carried out in Montsweag Bay and the Back River. The largest commercial marine harvests are marine worms, including two species, the sand worm (*Nereis virens*) and the blood worm (*Glycera dibranchiata*). The worm digging is confined to mudflats in the intertidal areas. The primary boating in the Montsweag Bay-Back River area is done by shallow pleasure crafts (MY, 1998).

The Bailey Point area is bounded to the west and north by the 640-acre undeveloped Backland property. Maine Yankee was granted release of this portion of non-impacted land from their operating license on July 2002 (NRC, 2002). Historically, the Backlands were used for a combination of residential and farming activities. Maine Yankee plans to donate the Eaton Farm portion of the Backland property (approximately 200 acres) to an environmental organization, pursuant to a FERC-approved settlement agreement. The purpose of the donation is to create a nature preserve and an environmental education center and to provide public access to coastal lands in the mid-coast region of Maine (MY, 2002k).

This RFI Report focuses on the approximately 150-acre Bailey Point area, which is the portion of the site where most construction, operation and decommissioning activities have taken place. A separate RFI report discusses the Backlands. Prior to construction of the Maine Yankee facility, the Bailey Point area was used for residential and farming activities.

Notable features within the Bailey Point area include Foxbird Island, a 12-acre peninsula within Montsweag Bay south of the plant forebay; the Independent Spent Fuel Storage

Installation (ISFSI), a 10-acre area north of the plant area and south of Old Ferry Road; and the industrial area, a 12-acre area behind security fencing where the majority of the industrial plant buildings were located. The remaining plant area includes two electrical switchyards and transmission lines, warehouse complexes, administration buildings, and the Bailey Farmhouse. The Bailey Point area includes terrestrial, fresh and salt-water wetlands, and intertidal environments (**Figure 1-3 and Figure 1-4**).

Following decommissioning, most above-grade structures will be demolished. Current plans are to leave the following above-grade structures in place:

- the ISFSI;
- the two electrical switchyards (115 kV and 345 kV) and transmission lines;
- the barge slip and dolphins;
- the road that travels west of the ISFSI, terminating near the 115 kV switchyard;
- the original plant access road, terminating between the ISFSI and the former location of the Information Center;
- the existing railroad that travels the west side of the ISFSI, and its two spurs;
- the Old Ferry Road and public boat landing; and
- some below-grade structures and systems (MY, 2002k).

Two minor archaeological sites have been identified within the Bailey Point area. Both sites are located immediately adjacent to the shoreline, in areas undisturbed during plant construction and decommissioning.

3.3 Meteorology

The Maine Yankee site is located in the mid-coastal region of Maine where the general climatic regime is maritime, with cool air commonly moving in from the North Atlantic. The average annual temperature is about 45°F, with temperatures above 90°F being rare. The highest mean temperature occurs in July and is about 68°F, while the mean low temperature occurs in January and is about 22°F (MY, 1998).

Heavy fog is frequent and sometimes persistent along the coast, and may occur on one day in six during certain portions of the year. When fog is present, the wind speed is ≥ 3 miles per hour (mph) for approximately 60% of the time (MY, 1998).

Precipitation along the Maine coast is influenced by the Atlantic Ocean. Summer thunderstorm activity is somewhat suppressed by the effects of the cool ocean, while winter precipitation is increased by coastal storms such as “Nor’easters”. These combined effects give this area more precipitation in the winter months than in the summer months. Monthly totals average about four inches during winter compared to three inches in summer. Total precipitation averages nearly 46 inches for the Maine Yankee area (MY, 1998).

3.4 Surface Water

The surface water hydrology of the site is dominated by upland runoff processes and by the tidal action of the Sheepscot River estuary system, which surrounds the site (**Figure 1-2**).

3.4.1 Tidal Processes

A tide gage was established at the dock on the east side of Bailey Point in the summer of 2002. Continuous data logger readings of tidal elevation change referenced to 1929 Mean Sea Level (MSL) datum were recorded for a period of about two months (Stratex, 2002d). The semi-diurnal tide cycle is slightly mixed with alternating tides of slightly higher or lower tides than the previous 12 hour and 24 minute cycle. The 100-year and 500-year flood elevations at the site have been determined by the Federal Emergency Management Agency (FEMA) flood mapping program to be 10.6 and 11.4 feet above MSL, respectively. The probable maximum flood elevation at the site is estimated (MY, 1998) at 14.8 feet MSL. Much of Bailey Point is at or above elevation 20 feet MSL, where a steep bank makes an abrupt transition from this elevation down to the upper limit of tidal action.

3.4.2 Upland Surface Water Hydrology

The site consists of a series of ridges and valleys striking north-south that reflect the competency and structural nature of the underlying bedrock. Deep bedrock valleys are filled with glaciomarine clay-silt soil; ridges are characterized by exposed bedrock or thin soil cover over rock. Surface drainage moves both to the north and south along the axes of the topographic valleys and also flows east and west down the flanks of the ridges. **Figure 3-1** shows a simple division of the Site into separate surface watersheds.

In the plant area, where the ground surface is relatively flat, manmade underground storm drains and catch basins were designed to control the surface runoff (**Figure 3-2**). A detailed summary of the storm drain system is provided in **Table 3-1**. As decommissioning proceeds, these underground storm drain systems are being phased out.

The single perennial stream on the Site originates in the formerly-proposed “ash disposal area,” north of Old Ferry Road and directly north of the main access road to Maine Yankee (**Figure 1-3**). The headwaters of this stream occur at the northern end of a deeply incised gully. The gully is supported by bedrock ridges to east and west and relatively shallow bedrock at the northern and upper end of the gully. In this area there are diffuse springs and seeps that gradually coalesce to form the stream that flows into the pond south of Old Ferry Road and north of the ISFSI area. The outlet to this pond is a culvert that is buried beneath the 345 kV transmission lines and discharges on the eastern side of Bailey Cove just above high tide. Other runoff from the Bailey Point peninsula occurs through overland sheet flow and shallow gully or ditch flow.

3.4.3 Groundwater Recharge Capability

The groundwater recharge capability during plant operation was different in the northern half of Bailey Point from the southern half of Bailey Point. This reflects two significant differences in the land cover types that existed during operation. The area north of the Staff Building had much less paving and parking lot area, and generally thicker soils than south of the Staff Building. Overland flow times of concentration were much longer in the north for stormwater runoff, reflecting a less dense drainage network, allowing for more time for precipitation to infiltrate the soil. In the south, a high percentage of the land cover type during plant operation was roof, paving, or dense gravel parking lot surface. In addition, there was a man-made stormwater system with catch basins around the plant area that efficiently moved runoff from the area (**Figure 3-2**). Most infiltration in the southern portion of the site was in grassed strips in and around the paved areas. As discussed in the “Site Groundwater Regime” subsection of Section 5 of the QAPP (Stratex, 2001d), during plant operation approximately 30% of precipitation may have infiltrated the northern half of Bailey Point, but only 10% infiltrated the southern half. Future estimates of recharge potential will be based on values presented in Gerber & Hebson (1996).

3.5 Site Geology

3.5.1 Historical Explorations

The site geology has been studied through a series of site mappings, geophysical explorations, test pits, and borings that have been completed since 1966. Most of the historical data are presented and discussed in RGGI, 1991. The locations of the historical investigations are shown in Figures 5, 6, 7, 8, 9, 10A and 10B of the QAPP and are keyed to the specific reports associated with the various explorations. **Table 3-2** is updated from the QAPP and summarizes basic information on historical data points used to develop the figures in this section. Past studies created over 500 subsurface explorations and provided one of the starting points for planning the RFI. The content of **Figures 3-3** through **3-9** and **Figure 3-13** are based on a combination of both historical and RFI data.

3.5.2 Surficial Geology

The regional surficial geology is shown in Figure 2 of Gerber and Rand, 1980. The surficial geology of Bailey Point is shown in **Figure 3-3**. Construction activities over the years have significantly modified the original surface and probably on the order of 50% of Bailey Point is now covered with fill. About half of this fill is predominantly clay-silt and half is sand and gravel. For those areas not filled, the surface is either exposed bedrock or consists of soils derived from glaciomarine clay-silts or fine sands. There is a thin, discontinuous layer of diamicton (glacial till) overlying bedrock. The different units are described in more detail below. The engineering properties of the site materials are described in detail in RGGI, 1991.

Several figures have been prepared to assist in the interpretation of the major changes on the site due to cut and fill activities. **Figure 3-4** shows the pre-construction ground surface topography of Bailey Point, based on on-the-ground surveys from the late 1960s. Notice that the large lowland in the north-central part of the point has been filled and that the south-central part of the Point has been cut to a lower elevation. **Figure 3-5** shows the pre-construction bedrock surface in the industrial area of the site. Comparing these elevations with existing elevations indicates that as much as 10 to 20 feet of rock was cut to prepare the industrial area base grade which is in the 20 to 21 foot MSL range.

The interpolated contours on the surface of the current day bedrock surface are shown in **Figure 3-6**, which can be compared with the pre-construction bedrock surface shown in **Figure 3-5**. A bedrock contour map and cross sections in the forebay area are shown in Stratex, 2002d. Overburden thickness is illustrated on **Figure 3-7**. The general thickness of fill in each area can be interpreted from the geologic cross sections provided in **Figure 3-13A through 3-13F**. The thickest deposits (up to 60 feet) of glaciomarine clay-silt on Bailey Point can be found north of the ISFSI, as shown on **Figure 3-7 and Figure 3-13B**. There are four depressions in the bedrock surface worthy of note on Bailey Point. The largest depression begins under the ISFSI and extends north under the area of the former pre-operations cleaning basin (see **Figure 1-4** for basin location). There is a second, more elongate, depression under the 345 kV line area that fades off to the south under the former Fire Pond and under the former topographic valley shown on **Figure 3-4**. Two smaller depressions occur: one under Warehouse 2/3 and one under the Staff Building. A small localized valley in the bedrock surface slopes downward to the west, beginning on the south side of the overhead crane, which lies to the northwest of the containment building. We infer that these localized low surfaces in the top of the bedrock represent the effects of glacial erosion on rock surfaces that were softer than the rocks forming the ridges. Zones of soft schist are shown in Figure 13(B) of the Backlands RFI Report (MY, 2004). The schist is most easily eroded and may have formerly occupied these valley areas.

3.5.2.1 Glaciomarine Clay-silt

As shown on **Figure 3-3**, this unit consists predominantly of natural, in-situ clay-silt of glaciomarine origin. Detailed logs from Gerber and Rand, 1980, and **Appendices A through C** describe the stratigraphy in detail. There may be localized fills to support roads or utilities within this unit. Typically the top 10 feet of this unit consists of stiff fissured clay-silt, which has a moderate permeability relative to the underlying soft clay-silt. The stiff clay-silt may have a higher vertical permeability than horizontal permeability, based on detailed work done on other sites in Maine (RGGI, 1994a). The soft clay-silt beneath the stiff clay-silt has thin horizontal sand and silt seams and has a higher horizontal permeability than vertical permeability. The soft clay-silt is a relatively low permeability material and is also moderately compressible. A thin sand zone of higher permeability is common at the bottom of this unit. Less common, but present in places on the site, is a thin layer of silty diamicton (glacial till) lying directly over bedrock. This unit can be seen in several locations in the cross sections provided in **Figures 3-13A through 3-13F**.

3.5.2.2 Glaciomarine Fine Sand

As shown on **Figures 3-3, 3-13C, and 3-13E** there is a thin zone that is dominated by glaciomarine fine sand along the east side of Bailey Point. Stiff, fissured, clay-silt may lie on top of or be sandwiched within this fine sand unit. Fine sand does occur in abundance in several other sections of the site. This fine sand lies under the eastern portion of the ISFSI and thickens to the south (Cross-section 5-5'—**Figure 3-13C**). Fine sand also lies at the bottom of the glaciomarine unit under the southwestern corner of Warehouse 2/3, and is found overlying rock in MW-407A and MW-401A. The sand has interbedded silt, sandy silt, and silty sand beds and seams and scattered gravel particles.

3.5.2.3 Clay-silt Fill

There is a large surface fill of clay-silt material north of the Knoll (under and to the north and west of ISFSI) and west of the eastern access road into the site from Old Ferry Road. There were three major filling episodes that created this fill: a) upland glaciomarine soils removed from the surface of the rock in the industrial area; b) the original hydraulic dredging of bay sediments from the circulating cooling water intake channel; and c) bay sediments removed from the forebay area during its construction. The upland soils were placed primarily under the current ISFSI area. Some blasted rock and minor amounts of other soil types are intermixed in this fill. The hydraulic dredge spoils from the intake channel were placed in the lowland area north of the ISFSI and under the “ball field” area. These soils have been found to consist primarily of clay-silt texture. South of the ball field area there is a mixture of fill types, including construction debris (see Test Pit descriptions in **Appendix C**), topped by primarily clay-silt fill taken from the area of the forebay and deposited there by truck behind a berm formed of shot rock (blasted bedrock) and other fill along the edge of the current salt marsh.

Miscellaneous surface fills have occurred since construction and most materials have had a clay-silt texture (see discussion in Attachment 2 of Change Order 3 in **Appendix C** of the QAPP). Silty material has been used to fill the former Fire Pond. Most of the clay-silt fill is very stiff to hard, except at depth. It has a fissured structure allowing the movement of groundwater similar to that in a fractured media. It was generally easy to discern the interface with the original ground surface. Although the cross sections provided in **Figures 3-13A through 3-13F** shows the fills quite well, they may be missing in the section at old boring locations such as B5-66, which was drilled prior to filling activity.

3.5.2.4 Sand and Gravel Fill

Most of the industrial area, all the parking lots, the 345 & 115 kV switchyards, and part of the ridge where the former truck maintenance garage was located have a surface fill of sand or gravelly sand. The fill is quite thick in places around the containment building (see cross sections provided in **Figures 3-13A through 3-13F**). This fill material was placed as structural fill and backfill and the subbase and base materials for roads and

parking lots. It has scattered cobbles and areas of shot rock fill. Some sticks, roots, and minor construction debris (usually wood) can be found in the fill. It is free draining.

3.5.2.5 Soil less than 5 feet to Bedrock

This map unit on **Figure 3-3** represents a mixture of different soil textures and includes some fill material but is generally less than 5 feet thick over bedrock. The shoreline areas expose the bottom of the glaciomarine unit and scattered glacial till deposits. The upland soils on the Knoll may have some till-like materials, too. Thin soils in the developed areas such as the industrial area consist of sand and gravel fill.

3.5.3 Bedrock Geology

Three important bedrock units lay beneath Maine Yankee: a) the basic "country" rock of the Cape Elizabeth Formation; b) small, localized granites and migmatized rock; and c) pegmatites (Rand, 1967). Additional background on regional bedrock geology and the detailed geology of portions of the Backlands can be found in Gerber and Rand, 1980. As part of our RFI, we have found that the migmatites occupy a significant volume of the rock under the site and have, therefore, defined the migmatites as a separate rock type, as shown on the bedrock geology map of **Figure 3-8**. The granites, pegmatites, and migmatites seem to be generally interlayered with depth (see **Figure 3-13H**, which contains the simplified core logs of B3-66, MW-303, and MW-409). The schist unit, as we have defined it, is relatively rare on Bailey Point. It apparently occupied those portions of the rock that have been most eroded by glacial action. The ridges are dominated by the pegmatites. There is a broad zone of granite along the western edge of Bailey Point and on the southeastern-most point of land. Near the granite and pegmatite intrusions, the schist has been re-heated, partially melted, and re-crystallized into granite-like migmatites, making the host schist into banded micaceous gneiss.

Accessory minerals of note include pyrite and garnet. Secondary mineralization has been found in fractures in the rock core and consists of calcite, epidote (yellowish alteration products of ferromagnesiums), talc-like weathering products (but probably not true talc), limonite (weathering of iron-bearing minerals), and probable kaolin from localized weathering of feldspars. Our description of the rock types focuses primarily on those features of the rock that will affect contaminant fate and transport.

3.5.3.1 Lithologic Descriptions

The Cape Elizabeth Formation is medium- to fine-grained biotite schist with locally thin, impure quartzite interbeds. The schistose rocks exhibit well-developed foliation and layered fabric defined by the successive alternations of micaceous, quartzitic and feldspathic interbeds. The rock is foliated or separated along thin planar partings (usually along biotite concentrations) like the pages of a book. We have defined "schist" for this report as those rock units exposed on the surface or in drill core that have fairly planar foliation, an absence of granite or pegmatite, a dominance of biotite layers, and an absence of hornfels and other structural and mineralogical features typical of migmatized rock. The prevalence of granite and pegmatite in rock core throughout Bailey Point

demonstrates the proximity to high heat and temperature conditions that created the widespread migmatites on the site. Of the 4 major rock types on the site, the schist is the most easily broken and eroded and probably passes the most groundwater per volume of rock. Drill core splits readily along the biotitic foliation planes and calcite deposition and rust staining attest to the movement of water on these planes. Figure 13 of the Backlands, RFI report (MY, 2004) is a picture of an upright biotite schist bed enclosed in much more competent quartzitic and feldspathic strata. At the Relic Dump 2 area, boudinage structures show the effects of differential strain that was related to the last major folding event. **Figure 3-13G** (from MW-417 at Relic Dump 2) shows xenoliths of the original schist enclosed within the migmatite.

The granites and pegmatites are distinct rock types but are juxtaposed directly in places. The pegmatites represent late stage, fluid-rich granitic melt that form dikes or veins that intrude the granite rock. The major difference between the two is that the pegmatites have larger feldspar and quartz crystals that formed in the late stage water-rich melt. The pegmatites are generally quite competent in both outcrop and rock core (see **Figure 3-13G**, a photo of MW-306 rock core). However, several drill cores showed moderate weathering where the pegmatite is disaggregated to gravel-sized particles (see **Figure 3-13G**, a photo of MW-311 rock core). Granite also shows weathered zones (see **Figure 3-13H**, a photo of MW-420 rock core, and **Figure 3-13G**, a photo of a piece of weathered granite from MW-409). The detailed core logs of the RCRA borings are contained in **Appendix B** of this report. The granite and pegmatite have steep contacts with the schist and appear to have been injected along foliation planes. The major structural features of granite and pegmatite are steeply inclined joints and horizontal or gently inclined sheet jointing, both of which show rust-stained surfaces.

The migmatites have a non-planar schistosity and are generally harder and more competent than the schist. **Figure 3-13H** is a photo of a particularly biotite-rich migmatite in MW-424. The average dip of the schistosity is steep, as in the schist, and the migmatites also separate in drill core along biotite-rich zones.

3.5.3.2 Bedrock Structural Features and Influence on Groundwater Movement

The original geologic map of Bailey Point produced by John Rand (1967) (also reproduced in RGGI, 1991, and Figure 13 of Stratex, 2002a) contains the structural mapping of the bedrock. The schist and migmatites exhibit well-developed foliation and layered fabric defined by the successive alternations of micaceous, quartzitic and feldspathic interbeds. The dip and strike information on the joints and foliation has been grouped and summarized in rose diagrams and lower hemisphere stereonet plots in several different ways for this report on **Figures 3-8 and 3-9A and B**.

The partings or foliation planes in the schist and migmatites are nearly vertical in orientation and the line formed by the intersection of a horizontal plane with the foliation or a joint is called the "strike". A "joint" is a planar fracture in the rock with no differential movement across the fracture. The angle which the joint or foliation makes with a horizontal plane, as measured in the plane normal to the strike, is called the "dip".

The rose diagrams reflect the predominant direction (relative to true north) of the strike. The dip and strike can be inferred from the stereonet plots, which are contour plots of the locations of the intersections of a pole perpendicular to the joint or foliation plane with the lower half of a sphere. The system of north-south ridges and valleys reflects the doubly plunging (both to north and to the south) folds in the country rock. Non-foliated, massive fabric characterizes the intrusive granites and pegmatites, although joints (brittle fractures) do penetrate these rocks.

The rose diagram on **Figure 3-9A** shows the strike of all foliation measurements (in both schist and migmatite) on Bailey Point, as taken by Jack Rand prior to the start of construction of the plant. Notice that there is a tight band between N10W to N10E with 50% of the measurements in the N0E to N10E band and 28% in the N0E to N10W band. Only a very few measurements strayed outside of this group and probably reflect distortion due to nearby granite or pegmatite intrusion. The stereonet plot on **Figure 3-9A** shows that most of the foliation dips are in the range of 75 to 85 degrees from the horizontal. Comparing the dips measured in the bedrock cores with those measured on outcrop in the field suggests that foliation dips in the cores might average slightly less than those measured in outcrop. **Figure 3-8** contains additional summary bedrock structural data, from which one can see the differences between rocks on the east and west halves of Bailey Point. Notice that the rose diagrams for foliation on the east side of Bailey Point show a slight east-of-north bias in strike, compared with the foliation strike on the west side of Bailey Point.

Joints occur in all the rock types on the site. **Figure 3-9B** shows rose diagrams for joints in schist (and migmatite) and for granite (and pegmatite). Although the trends are very similar, the schist (and migmatite) has a somewhat higher percentage striking east-west and the granite (and pegmatite) has a slightly higher percentage striking N75W. **Figure 3-9B** shows the stereonet plots of the same data. In the schist and migmatite the joint dips are all greater than 50°. The high-angle granite and pegmatite joints have similar dips, but the granitic rock also has sheet joints, resulting in some flatter dips. Because sheet joints are difficult to measure in outcrop, they may be under-represented in the stereonet. In fact, review of the rock core suggests that sheet joints are more common than high-angle joints in the granite and pegmatite. Sheet joints are much more common in the top 20 feet of the core than at greater depth.

Comparing joint distribution between the east and west sides of Bailey Point as shown on **Figure 3-8**, there is a similarity in the N70E steeply-dipping joints, but the east side also has a N75W steep southerly dipping set that is all but missing on the west side of the point. Finally, the rose diagram of all fractures in all rock on all of Bailey Point on **Figure 3-9A** shows that the fracture sets are basically orthogonal due to the joint sets lying more or less normal to the foliation strike. In Gerber and Rand, 1980, it was concluded that the foliation was about 5 to 10 times more transmissive than the extensional cross jointing. This was because most of the cross-joints were short and discontinuous. The important water-bearing cross-joints are the N70E set, but they are spaced about 10 feet apart on average. The foliation plane spacing is much smaller by a factor of 10 to 100, thus implying a much greater transmissivity along foliation than in the cross joints. In the granitic rock, where there is an absence of foliation, transmissivity

may have an equivalent isotropic character due to the intersection of the sheet joints and the N70W high-angle joints.

Estimates of the average effective porosity of the bedrock can be taken from numbers back-calculated from previous contaminant migration studies on the Maine Yankee site following a leak from the Secondary Component Cooling (SCC) system, and modeling done to track the fate of sodium chromate in the bedrock (Robert G. Gerber, Inc., 1989a). Stratex, LLC, 2002a, made an estimate of fracture surface area per unit volume of rock from an analysis of the average spacing of fractures in rock core logged on the site between 1967 and June of 2002. Seventy-five discrete high angle fractures in 786.9 feet of drill core have been identified for an average spacing of 10.5 feet between high angle fractures. Sheet joints in the granitic rock were typically spaced from 0.2 to 1 foot apart. Foliation partings in the schist were typically 0.1 to 1 foot apart. Overall, maximum fracture spacing of all types was 1 foot; minimum spacing of all types was 0.1 foot. Therefore the range in fracture area per unit volume is 1 square foot per cubic foot to 10 square feet per cubic foot. Average aperture spacing is taken from the literature and considered to be in the range from 1 to 100 microns with foliation plane apertures being in the low end of the range and sheet and high angle joints being about 10 microns at depth and wider in the upper 20 feet of rock.

The bedrock is a generally a very competent rock and foundation material. Of 61 bedrock cores taken on Bailey Point, only 14 show broken rock zones or more than slight weathering. Of 9 RCRA bedrock monitoring wells installed in core holes with moderate weathering or broken rock zones, only 3 had low flow pumping capacities of over 100 mL/minute (**Table 2-5**). The Wiscasset area, as a whole, has an average bedrock well yield that is significantly lower than that of the coast of Maine. There are very few high yield bedrock wells in the Wiscasset area (Gerber and Rand, 1980). In fact, four bedrock wells classified as "dry" have been drilled on the Maine Yankee property south of Old Ferry Road (Table 1 of Gerber and Rand, 1980).

The only major fault of regional significance is one postulated by Arthur Hussey (WGC, 1981) to extend under and parallel to the Back River (the Georgetown-Edgecomb Fault). Extensive geophysical investigations in the Back River by Maine Yankee have failed to find any evidence of disrupted sediments. No post-glacial faulting is either known or inferred for the area. The postulated fault does not affect the hydrogeology of the site. Two very localized small faults are exposed on the eastern shore of Bailey Point (Rand, 1967). One fault lies about 100 feet east of MW-425 and strikes N7E and dips 85°E. MW-425 has a high yield and slickensides were noted in the bedrock core. The other fault lies about 400 feet northeast of MW-425 and strikes N52E and dips 68° to the northwest. The N7E fault is coincident with foliation, but the N52E fault does not parallel other measured features on the site to any significant degree. Photolinear analysis summarized in Robert G. Gerber, Inc. (1994b) shows only 3 weak photolines on the southern half of Bailey Point, all oriented at N75E. There is one strong photolinear north of Old Ferry Road that has the N52E orientation.

Other than MW-425, slickensides were only noted in 3 other of the 61 cores taken from the site: B101-67; B102-67; and B108-67. B101-67 and B102-67 lie on a north trending depression in the original bedrock surface (**Figure 3-4**), beginning on the shore just east of the east dike of the forebay and trending north, passing just east of the containment building. B101-67 and B109-67 (which are also on the bedrock low trending north from the shore) both showed weathering and/or broken rock zones. B108-67 was located very close to MW-401A. There is a zone of rock in the general vicinity of the Warehouse 2/3 and extending to the south that shows significant weathering effects. Nine of the 14 borings on the site showing moderate weathering and/or broken rock zones are in this area and include: MW-311 (see photo in **Figure 3-13G**); MW-401A; MW-402; MW-408; MW-409 (see photo in **Figure 3-13G**); MW-420 (see photo in **Figure 3-13H**); MW-421; MW-422A; and B12-66. B9A-66 lies to the north, but directly on strike, of this area and also shows moderate weathering. Of these wells, MW-408, MW-420, and MW-421 have higher than 100 mL/minute well capacities (**Table 2-5**). This area also shows irregular bedrock surface topography with steep-sided depressions (**Figure 3-6**). B111-67 and MW-424A are the only two borings showing moderate weathering or broken rock that cannot be linked to a possible bedrock structural feature at this time.

3.6 Site Groundwater Regime

The groundwater regime at the Maine Yankee facility is comprised of two aquifers: (1) a discontinuous surficial aquifer in the unconsolidated glaciomarine soils and fill material and (2) a bedrock aquifer. The surficial aquifer is not present continuously across the site, as the overburden soils are thin to non-existent in some portions of the site. This is especially true in the southern portion of Bailey Point. The bedrock aquifer is present below the entire site and vicinity. Much historical groundwater data and detailed discussions of those data are included in the QAPP and in Stratex, LLC, 2002a. Because both documents have been presented to the MDEP and EPA, that information will not be repeated here. This document will focus on the presentation and interpretation of the water level data gathered on Bailey Point since the start of the RCRA program. Because of the sequential installation of monitoring wells throughout Phase 1A and Phase 1B of the RCRA studies, not all wells have had water level readings more than one time. However, many wells have been measured 3 times. Synoptic water level readings at the site were taken on December 11, 2001, April 1, 2002, and September 16, 2002. On November 13, 2002, a special synoptic round of water levels was recorded for wells in the area west of containment and in the Warehouse 2/3 area. Measured RCRA water elevations on Bailey Point are summarized in **Table 2-6**. Figures 5-24, 5-25, and 5-26 of the QAPP contain selected historical water level data for the Site. Appendix F of Stratex, LLC, 2002a, contains historical data for the industrial area.

3.6.1 Overburden Water Levels

Contour maps of the measured water elevations in RCRA monitoring wells in soil are given in **Figures 3-10A, 3-11A, and 3-12A**. Graphs of groundwater elevation fluctuations are given in **Figure 3-12C** for all RCRA wells on the southern half of Bailey Point, and on **Figure 3-12D** for all RCRA wells on the northern half of Bailey Point. In

general, most groundwater elevations were near all time low points at the end of the 2001 drought in December. The water levels rose during the spring of 2002, but then declined again to end-of-summer lows in September 2002 (it was a wet spring, but a hot, dry summer). MW-303B was the only aberrant overburden well, rising between April and September 2002, instead of declining.

There were a total of 30 RCRA wells capable of measuring water levels in the overburden. Several wells actually spanned the bedrock interface where the highest water table was very close to this interface, but most were sealed above the bedrock surface. The water table maps for three synoptic measurements show a similar pattern with a high in the middle of the site at the knoll and contours generally parallel to existing ground surface contours. From December 2001 to April 2002 typical water level rises were about 2 feet. However, MW-316 showed about a 6-foot rise and MW-304B showed a 7-foot rise. The area near the groundwater divide—near the ISFSI—had the largest change in groundwater elevation as would be predicted by theory. The maximum decline over the summer of 2002 was about 5 feet with most water levels dropping only 1 to 2 feet.

Of possible importance to this study is a seasonal shift in the position of the groundwater divide in the area of the former concrete truck maintenance garage, east of the ISFSI. The groundwater divide is somewhere in this area and probably moves seasonally. The location of this divide could determine whether the area of the former maintenance garage is the source of petroleum observed in groundwater in the area north of the ISFSI.

Overburden is generally thin north of Old Ferry Road, except in the stream valley that lies about 500 feet northwest of the Bailey Farm House. Figure 12 of Gerber and Rand, 1980, shows a water table map of the stream under the formerly proposed “Ash Disposal Area” in the Backlands. This map was developed from actual measurements of groundwater levels in 13 borings placed in that valley. The lowest elevation, on the south end of the valley, just north of Old Ferry Road, is elevation 30 feet above MSL. None of the groundwater levels on the north side of Old Ferry Road are more than 15 feet below ground surface. The lowest ground elevations north of Old Ferry Road and immediately northeast of the Ballfield are elevation 40 feet MSL, located in drainages where groundwater is discharging to the surface. The highest groundwater elevation measured in the RFI under the 345 kV transmission lines was near elevation 20 feet. This suggests that groundwater to the north of Old Ferry Road is elevated well above the groundwater levels under the 345 kV transmission lines and flowing toward it.

3.6.2 Bedrock Water Levels

Contour maps of the measured water elevations in RCRA monitoring wells in bedrock are given in **Figures 3-10B, 3-11B, and 3-12B**. Graphs of groundwater elevation fluctuations are given in **Figure 3-12C** for all RCRA wells on the southern half of Bailey Point, and on **Figure 3-12D** for all RCRA wells on the northern half of Bailey Point. In general, most groundwater elevations were near all time low points at the end of the 2001 drought in December. There are 31 RCRA wells sealed in bedrock and several more that

span the bedrock/soil interface. Bedrock wells do not extend so far north of the ISFSI as do soil wells; however, there are more bedrock wells in the industrial area than soil wells since the water table in that area has historically been predominantly below the top of rock. All wells except MW-303A, MW-304A, MW-409A, MW-424A, B-201, and B-202 are sealed within 20' of the bedrock surface. The other wells may be sealed at deeper depths, up to 50 feet into rock.

The water level in the bedrock wells generally only rose a few feet from December 2001 to April 2002. The maximum rise of 5 feet was in MW-303A, in a groundwater divide area near the ISFSI. With the exception of MW-312, all other bedrock water levels were lower in September 2002 than in April 2002. For those wells measured in both September and November 2002, all bedrock water levels except those in MW-406A rose. Only wells MW-308 and MW-311 had water level measurements on all four different synoptic rounds. The levels in these two wells in November 2002 were not quite so high as in April 2002.

Although the 5-foot groundwater elevation contour map, **Figure 3-10B**, suggests no north-south groundwater divide as do the figures representing April and September 2002, the MW-302A level was actually lower by 2.5 feet than the MW-304A level, indicating that some type of divide did exist near the ISFSI. Groundwater modeling results shown in Figure 5-23 of the QAPP suggest that in the deep bedrock (several hundred feet below top of rock), there may be no north-south groundwater divide on Bailey Point.

As with the overburden regime on the north side of Old Ferry Road, all previously measured or inferred bedrock levels to the north of the road are no more than 15 feet below ground surface. Since the ground surface of the land on the north side of the road is at least 15 feet higher than the average ground surface under the 345 kV transmission lines, we can expect that groundwater is higher to the north of the road and flowing across the road to the south in the length of road from the Bailey Farm House to the Ballfield.

We have attempted to reflect the effects of the containment foundation sump drain and the deep rock cuts for the circulating water discharge pipe and pedestrian access tunnel (between Staff Building and Administration Building) in some of the groundwater contour maps.

In bedrock composed mostly of schist or migmatite, we would expect that there would be an anisotropy in the bedrock transmissivity that is about 5 to 10 times greater in a north-south direction than in the east-west direction. Thus the groundwater flow lines in the bedrock of the site will be primarily north-south, except near the east and west sides of the peninsula. As with the overburden water level data, it is difficult to determine the location of the east-west groundwater divide in the vicinity of the ISFSI. For the area of the former truck maintenance garage, see the more detailed discussions in **Section 4.8**.

3.6.3 Groundwater Vertical Gradients

The only known groundwater vertical gradient data for the site has been gathered from the RCRA RFI in 11 locations on Bailey Point. These data are summarized in **Table 3-3**.

Well pairs MW-302, -303, -304, and -305 surround the ISFSI. Based on groundwater contours drawn from RCRA data (**Figures 3-10, 3-11, and 3-12**) MW-303 and -304 appear to be located on or near a major groundwater divide on the site. This is confirmed by the vertical gradient calculations in **Table 3-3**, which indicate downward movement during all three episodes of measurement. The MW-305 well pair showed upward movement in all three episodes and it is only about 200 feet from a discharge location. The MW-302 well pair is on the north side of the ISFSI and indicated upward groundwater movement in December 2001 (very low time for most wells) and April 2002 (typical spring level), but downward in September 2002 (another low period for wells). Since this well is not far from the wetland and pond north of the ISFSI, upward gradients would be expected. The downward gradient observed in September 2002 may be related to a recent precipitation event.

Well pair MW-401 is located west of containment, about halfway to the shoreline at its closest point. The bedrock well is located in a small depression in the bedrock, below sea level, and exhibits saltwater intrusion. The bedrock is overlain by a permeable glaciomarine sand unit, which is in turn overlain by low permeability clay-silt, in which the upper well is located. The sharp increase in permeability with depth below the upper well is probably responsible for the strong downward gradient seen in this well in two different monitoring episodes.

Well pairs MW-406, -407, and -409 are located under and just to the southeast of Warehouse 2/3. Given the distance from discharge areas, a downward gradient would be normal as seen in MW-407 and -409. During the dry period of September 2002, there was a very slight upward gradient in MW-406, under the warehouse, but this was reversed to a strong downward gradient later that fall in November. The top of bedrock is just about at sea level and both the soil well and bedrock well had low specific capacity as shown in **Table 2-5**.

Well pairs MW-422 and -423 are just north of Outfalls 005 and 006. With locations very near a discharge point, upward gradients might be expected. In November 2002, MW-422 had a strong downward gradient and MW-423 had a somewhat weaker upward gradient. In September of 2002, MW-423 had a strong downward gradient. Both overburden wells are located in low permeability glaciomarine clay-silt. At MW-423, a 1.2-foot rise in the bedrock well, but a 1.9-foot decrease in the overburden well relative to the September values resulted in a reversal of gradient direction in MW-423. The implied specific capacity of all 4 wells at this location is low, based on **Table 2-5**.

The MW-424 well pair is located at the south end of the area of interest that includes the former concrete truck maintenance garage. Both wells in this pair are sealed within

bedrock, as bedrock was shallow. This location is near the mapped groundwater divide based on contouring of groundwater measurements. In the single set of measurements taken in the low period of September 2002, there was a slight downward groundwater gradient in a rock mass of relatively low implied transmissivity.

In summary, although well pairs near groundwater divides and near discharge areas had somewhat predictable vertical groundwater gradient directions, localized non-homogeneities in the geologic stratigraphy and the differential response of these different stratigraphic units to seasonal and short-term responses to recharge caused groundwater gradient reversals to be observed.

3.6.4 Springs and Seeps

Small seeps and springs associated with spring and late fall high groundwater events can be found throughout the Maine Yankee property. Most of these occur as a result of shallow interflow discharge in small gullies and intermittent streams in the dense drainage network of the site. The flow from these springs is very slight and often diffuse and originates relatively close (normally within a 100 feet or so) to the seep. On Bailey Point, these intermittent springs and seeps are limited to the area of the stream and pond north of the ISFSI, the drainage ditch on the northwest edge of the “ball field,” the wetland north of the 345 kV switchyard, a small gully south of the 115 kV switchyard, and very short small gullies along the east side of Bailey Point.

Another class of seeps is groundwater flow seen in the spring of the year at the soil/bedrock interface along the shoreline of Bailey Point where bedrock is present. This type of flow was seen to be very low and generally not sufficient flow for sampling. The origin of groundwater from these springs is less certain and could come from as far away as the groundwater divides on the site.

A third class of seeps and springs are those that occur within or just above the intertidal zone around Bailey Point. Of interest is the fact that no natural springs or seeps have been found in the intertidal or “top-of-tide” zone along the east side of Bailey Point.

On the west side of Bailey Point, **Figure 3-1** shows the locations of identifiable seeps in intertidal or supra-tidal locations. Seeps 1 and 2 may be representative of groundwater passing through the fill under the 345 kV line. Seeps 3 and 4, also west of the 345 kV line fill, are small areas of cat-o-nine tails and localized seeps whose origin may be from beneath the 345 kV yard fill. No other significant seeps are found except on the northern half of the western edge of the western forebay dike. Here there are three concentrated springs observed during a falling tide that appear to represent seepage through or under the forebay dike at rates of several tens of gallons per minute. Seepage paths within the forebay dikes and other hydrogeologic information relating to the forebay is given in Stratex, 2002d.

3.7 Sediment

The sediments of potential concern are in the intertidal (i.e., the area between high and low tide) and shallow subtidal areas surrounding Bailey Point. In these areas there is a layer dominated by fine silt and clay from approximately two to six inches thick. The surface of this layer is subject to resuspension, homogenization and redeposition with the daily tidal currents. The surface layer of sediment is underlain by coarser material (e.g., sand) and fragments of marine mollusk shells. The lack of a constant unidirectional current in the area results in deposition and build up of fine particles, which are a productive habitat for sediment dwelling estuarine organisms.

3.8 Ecological Setting

Maine Yankee is located on a peninsula that is bounded by the Back River to the east, mainland to the north, Montsweag Bay to the south, and Bailey Cove to the west. The site is approximately 13 miles inland from the open ocean. The coastline around the site varies between salt marsh and mudflat, with some rocky areas where the surface gradient is steepest. The eastern and southern sides of the site are characterized predominantly by a rocky shoreline with a moderately steep gradient; small patches of salt marsh are found along the immediate shoreline and mud flats are found in the intertidal zone. Bailey Cove is characterized by extensive mud flats.

3.8.1 Wetlands

As indicated in **Figure 3-14** there are only limited freshwater wetlands on Bailey Point. There is a small permanently flooded palustrine wetland system located along Old Ferry Road near the main entrance to the facility (**Figure 3-15**). The wetland is comprised of two small ponds that are hydrologically connected to one slightly larger pond. The vegetation is typical of a shallow open water system, with emergent aquatic vegetation such as pickerel weed and water lily in the shallow flooded areas, and cattails bordering the perimeter in areas with saturated soils. In addition to this area, there are two small scrub-shrub, deciduous wetlands that are seasonally flooded located in the Backlands. One of the wetlands is located north of Old Ferry Road along the western edge of the Maine Yankee property, and the other is located along Young Point Road and forms the headwater of a small tributary of Young's Brook. The small size and adjacent human activity limit the value of these wetlands as significant wildlife habitat. Similarly, the management of runoff on the site influences the hydrologic importance of the wetlands.

The majority of the wetlands found at the Maine Yankee facility are intertidal, estuarine wetlands that are flooded on a regular basis by tidal action (**Figure 3-15**). Along the shoreline of the peninsula where the main facility is located the bulk of the estuarine wetlands are comprised of mudflats, with bordering intertidal, rocky shore wetlands that are flooded irregularly. In the upper reaches of Bailey Cove near Young's Brook, there is an extensive area of emergent, estuarine wetland dominated by salt-marsh grasses. Similar areas of emergent estuarine wetland are found along the western shore of the

backlands area in Chewonki Creek. Common plant species in these areas may include smooth cordgrass, salt hay cordgrass, salt grass, salt marsh bulrush, salt marsh sedge, and others.

3.8.2 Marine Habitat

The benthic invertebrate community of Montsweag Bay and Back River is both abundant and diverse. The invertebrate species of commercial or food value includes the American lobster (*Homarus americanus*), the soft-shelled clam (*Mya arenaria*), the blue mussel (*Mytilus edulis*), the blood worm (*Glycera dibranchiata*), and the sand worm (*Nereis virens*). In summer, the most abundant finfish species in the area include the migratory alewives (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), and menhaden (*Brevoortia tyrannus*). Smaller but appreciable numbers of smelt (*Osmerus mordax*), mackerel (*Scomber scombrus*), and striped bass (*Morone saxatilis*) are also found in the area in summer. In winter, all of the above finfish species leave the area except for smelt, which remain widely distributed throughout the estuary and are found at all depths. In spring and fall, large numbers of juvenile sea herring (*Clupea harengus harengus*) appear, but this species is completely absent in summer and winter.

The most abundant demersal (bottom-living) fish is the tomcod (*Microgadus tomcod*), which occurs in large numbers in lower Montsweag Bay in summer, but does not extend into the northern end of the Bay or in to the Back River during that time of year. Of secondary importance in abundance are winter flounder (*Pseudopleuronectes americanus*) and smooth flounder (*Liopsetta putnami*). The grubby sculpin (*Myoxocephalus aeneus*) is a weak fourth in numerical importance. The last three species are more evenly distributed throughout the area than are the tomcod.

Most of the adult fish are concentrated in the central channel areas of the Bay and Back River. Juvenile flounder, alewives, and bluefish (*Pomatomus saltatrix*) are found in flooded flats and a few species, such as mummichogs (*Fundulus heteroclitus*), silversides (*Menidia menidia*), and sticklebacks (*Family Gasterosteidae*) are restricted to the shallow areas.

There are many aquatic birds that use the marine habitat surrounding the site and the Montsweag Bay area, including several nesting osprey (*Pandion haleaetus*) at the site. In addition, Montsweag Bay, the Back River, and the surrounding areas provide abundant waterfowl habitat. Previous baseline surveys of migratory waterfowl in the area identified American black duck (*Anas rubripes*), bufflehead (*Bucephala albeola*), and goldeneye (*Bucephala clangula*) as the three most abundant waterfowl species using the area (Maine Department of Inland Fisheries and Game, 1971). Other migratory waterfowl known to use the area include mallard (*Anas platyrhynchos*), teal (*Anas spp.*), scaup (*Aythya spp.*), scoters (*Melanitta spp.*), common merganser (*Mergus merganser*), Canada geese (*Branta canadensis*), and old squaw (*Clangula hyemalis*). The area also provides plentiful habitat for shorebirds, such as great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), and various sandpipers (*Tringa spp.*). In addition to osprey, other piscivorous birds, such as the belted kingfisher (*Ceryle alcyon*) frequently use the

area, and it is also likely that bald eagles occasionally forage there as well. Finally, herring gulls (*Larus argentatus*) and other gulls are common in this area.

3.8.3 Terrestrial Habitat

The terrestrial habitat surrounding the facility and including Foxbird Island is comprised of a mixture of mature, mixed deciduous-coniferous forest, intermingled with old field habitat and shrub/brush land. Coniferous species include primarily a mixture of spruce, balsam fir, hemlock, and white pine. Hardwood species include primarily a mixture of beech, sugar and red maple, paper and yellow birch, white and red oak, quaking and bigtooth aspen, and black cherry. Some portions of the facility are maintained as mowed grass areas. A variety of birds and mammals likely use the site, as portions of the site, such as Foxbird Island, provide quality habitat.

Some of the mammals known to use the site include: white-tail deer, red fox, raccoon, red and gray squirrels, striped skunk, muskrat, and woodchuck. A variety of small mammals, such as snowshoe hare, mice, moles, shrews, weasels, and similar mammals are also likely to use the site.

Many species of migratory songbirds are likely to use the terrestrial portions of the site, including warblers, finches, sparrows, and similar species. Resident species also include black-capped chickadee, white-breasted and red-breasted nuthatch, tufted titmouse, blue jay, ruffed grouse, and others. Terrestrial birds of prey, such as red-tailed hawk, broad-winged hawk, American kestrel, Eastern screech owl, great horned owl, and barred owl are also likely visitors to the site.

In addition to birds and mammals, there are likely a variety of reptiles and amphibians found throughout the site. These might include species such as the eastern garter snake, northern redbelly snake, eastern milk snake, northern spring peeper, green frog, wood frog, spotted salamander, and redback salamander, among others.

3.9 Uncertainties and Data Limitations

Uncertainties and data limitations are discussed in this section of the report in the context of the ability to model contaminant fate and transport in the geologic environment.

The RFI field investigation was undertaken following the approved QAPP procedures. Those procedures focused primarily on the choice of sampling locations and methods of sampling and testing for chemical constituents. Sample acquisition and testing were subjected to a high degree of QA/QC and should, therefore, have few uncertainties or limitations other than those defined in the data validation reports. Uncertainties in the representativeness of the data are managed in the risk assessment process through statistical approaches as described in Sections 5 and 6 of this RFI Report.

Interpretation of geologic information cannot be specified so completely as the reporting of laboratory analytical results. Although soil sample and rock core logging procedures

were standardized to the extent possible, multiple field personnel were engaged in the collection and logging of geologic media. We attempted to minimize the variability of having different personnel logging the samples by having one person review and edit for uniformity all RFI geologic media descriptions, and one person compare all rock core with the rock core logs and edit the final core logs.

Because there has been such widespread filling activity on Bailey Point, it was not possible with certainty to delineate the boundary between fill and native in-situ material at all locations. Furthermore, there may be isolated incidences where a notation of “refusal” in a soil log may not represent the actual top of bedrock, but rather may represent a boulder in glacial till or large diameter rocks at the bottom of fill.

Historical and RFI investigations have found steep-sided depressions in the bedrock surface and ubiquitous and rather irregular distributions of softer schistose rock juxtaposed with harder granites and pegmatites. The density of explorations is not uniform over the site; therefore, the standard error of estimate in defining the elevation of the bedrock surface and the thickness of overburden is quite variable across the Bailey Point site. Similarly, widely-spaced groundwater monitoring wells and widely-spaced readings of water levels in time create a large variability in the standard error of estimate in the water level contour maps. The location of the east-west groundwater divide in both soil and bedrock fluctuates seasonally. Groundwater gradients between surface and deep (several hundred feet deep) bedrock have not been measured. Groundwater elevations and flow directions have not been measured in deep bedrock. Nevertheless, refinements in the geologic database are not likely to significantly change the conclusions of the risk assessment or improve the discussion of contaminant fate and transport. To the extent that lack of geologic data affect the Corrective Measures Study (CMS), these limitations can be covered with the appropriate sensitivity analyses.

There are no insitu hydraulic conductivity test results for the site; however, low flow sampling yields can be used as surrogates to estimate insitu hydraulic conductivity. The percentage of precipitation that contributes to groundwater recharge can only be estimated and used as a calibration parameter in groundwater modeling. Since there are no tracer studies on the site, bedrock porosity and fracture aperture width has been estimated from literature values and estimates of bedrock fracture spacing are based on analysis of fracture frequency in cores (Stratex, 2002a). Bedrock transmissivity anisotropy can only be estimated based on qualitative considerations and must be treated as a sensitivity parameter in modeling. There are no site-specific data on specific yield and storativity in soil and bedrock, so transient groundwater simulations, if needed, would estimate these parameters from the literature.

Annual and seasonal variation in recharge to the groundwater system may result in fluctuations in contaminant concentrations detected in groundwater, surface water seeps, and springs. Sufficient information on seasonal contaminant variability was collected to support risk characterization; however, comprehensive seasonal variability characterization was not part of the scope of work for the RFI. Assessment of the bedrock flow system is subject to the inherent limitation of having to use a finite number

of monitoring wells. There is a general internal consistency of distribution of most of the chemicals of concern in site groundwater. With the possible exception of molybdenum, which has an irregular distribution most likely related to an unknown mineral distribution in site bedrock, groundwater contaminant distributions conform to our current understanding of the nature of the strength and distributions of the sources. Since the conclusions of the risk assessment are conservative because the highest recorded concentrations on the site for each contaminant of concern were used, the average groundwater exposure is unlikely to exceed our current estimates, even with the addition of more sampling points and sampling episodes.

The type and strength of contaminants on the site have been well bounded by the biased sampling program. It is unlikely that any substantial sources or those of different character than those already encountered will be found. The RFI has been designed consistent with the potential sources and source risks known or inferred for this site and with a similar density of sampling points as other RCRA closure sites with comparable risks. The ubiquitous nature of hydrocarbons in groundwater suggests that the site had a history of multiple small petroleum spills. During the course of the RCRA program, a number of previously unidentified spills were encountered. There may be additional residual petroleum sources that have not been found on the site due to the finite nature of the sampling program. Similarly, construction fill material has been found in explorations widely dispersed about the site. There may be additional buried waste materials that have not been found on the site, also due to the finite nature of the sampling program. The groundwater investigation adequately characterizes the site, regardless of whether all sources have been identified.

We have attempted to overcome uncertainties of the types described above by taking soil samples at known or suspected locations of spills (biased sampling) and also by randomly choosing a large number of soil and groundwater sampling locations over a wide distribution throughout Bailey Point. The uncertainty in the spatial distribution of contaminant concentrations can be evaluated with geo-statistical methods. We have also taken as many samples as possible in zones where large areas of groundwater flow are focused, such as in identified springs and seeps and in bedrock surface troughs. The containment foundation sump was sampled, as it is a collector of groundwater over a significant portion of the RA. Based on historical data, we also attempted to place groundwater monitoring wells in zones of inferred high transmissivity bedrock in order to maximize the possibilities of capturing a large contributory area of groundwater flow. Finally, sediment samples were taken from locations of surface water discharge and expected groundwater discharge areas.

At the planning stage of the QAPP, there was uncertainty over the possible depth to which site-related impacts could penetrate intertidal and subtidal sediments. One of the objectives of the QAPP was to verify that the sediment samples were collected from the appropriate depth in order to evaluate historical site releases. Prior to sediment sample collection, the sediment was cored at various locations around Bailey Point with clear plastic core tubes that allowed a visual examination of the sediment column. Visual observation of the sediment column did suggest that sediment generated since the start of

construction of Maine Yankee is discernable and that effects of both plant construction and operation did not extend much deeper than about 6 inches from the surface. This observation was confirmed following sediment chemistry analysis performed at several depths around Bailey Point as summarized in Sections 4 and 6 of this RFI Report.

Localized feasibility studies for the remediation of specific contaminant plumes may require that more data be gathered for parameters that sensitivity modeling shows to be important to fate and transport studies. All parameters would be subjected to sensitivity analysis in conjunction with any contaminant fate and transport analysis.