Table 3-1 Wetlands Summary, NAS Brunswick

Wetland ID	Primary Functions and Values	Wetland Community Type[1]	Hydrologic Connection	Additional Comments
FA 32	GWR, FFA, S&TR, NR&R, PE, WLH, S&S	PEM	Possible hydrologic connection to an unnamed tributary of Mere Brook	Emergent wetland surrounding a stream from a storm water detention culvert under First Street. Drains south where it is culverted under Chickadee Circle and converges with FA 36 and into FA 27.
FA 33	S&TR	PFO	Possible hydrologic connection to an unnamed tributary of Mere Brook	Small forested wetland depression between residential development and roadway. Likely drains into storm water system along First Street.
FA 34	S&TR	PFO	Possible hydrologic connection to an unnamed tributary of Mere Brook	Forested wetland dominated by red maple between residential development and roadway. Likely drains into storm water system along First Street.
FA 35	FFA, S&TR	PFO	Possible hydrologic connection to an unnamed tributary of Mere Brook	Forested wetland dominated by red maple, white pine, and red spruce (*Picea rubens*). This wetland connects to FA 36 by a small stream.
FA 36	FFA, S&TR	PEM	Possible hydrologic connection to an unnamed tributary of Mere Brook	Storm water detention pond within a residential area dominated by cattails (*Typha* spp.). Connected to FA 35 by a small stream. Culverted under Neptune Drive.
FA 37	GWD, FFA, S&TR	PEM	Possible hydrologic connection to an unnamed tributary of Mere Brook	Emergent wetland within ROW dominated by soft rush (*Juncus effusus*) and sedges (*Scirpus* spp.). Drains to the east into a forested wetland bordering a small stream – FA 38.
FA 38	Connecting tributary		Possible hydrologic connection to an unnamed tributary of Mere Brook	Small stream draining from FA 37. Dominated by red maple. Culverted under Neptune Drive, where it converges with FA 27.
Cluster 4				
FA 20	GWR	PFO	Hydrologic connection to an unnamed tributary of Mere Brook	Narrow border of forested wetland along an unnamed tributary of Mere Brook. Culverted in several places under roadways, including Neptune Drive, before converging with FA 22 and draining to FA 23.

Table 3-1 Wetlands Summary, NAS Brunswick

Wetland ID	Primary Functions and Values	Wetland Community Type[1]	Hydrologic Connection	Additional Comments
FA 21	GWR, FFA, S&TR, S&S	POW	Hydrologic connection to an unnamed tributary of Mere Brook	Ponded area with some emergent border from culvert on NW side likely from under airfield. Culverted under dirt road where it becomes FA 22.
FA 22	GWR, S&TR, REC, WLH, S&S	PEM	Hydrologic connection to an unnamed tributary of Mere Brook	Emergent marsh bordering a slow, meandering stream. Drains south into a ponded area – FA 23.
FA 23	GWR, F&SH, S&TR, REC, S&S	POW	Hydrologic connection to an unnamed tributary of Mere Brook	Open water area adjacent to FA formed by drainage from FA 22, FA 20, FA 25, and FA 26. Appears degraded – cloudy water, little emergent or submerged vegetation, posted signs indicating no fishing or swimming. Drains via culvert to FA 24.
FA 24	GWR, FFA	PSS	Hydrologic connection to an unnamed tributary of Mere Brook	Wetland bordering perennial stream originating via culvert from FA 23. Scrub-shrub wetland dominated by speckled alder (*Alnus incana*). Flows south into FA 47.
FA 47	GWR, FFA, F&SH, WLH	PEM	Hydrologic connection to an unnamed tributary of Mere Brook	Emergent wetland bordering perennial stream dominated by grasses and sensitive fern (*Onoclea sensibilis*). Stream flows south to its confluence with Mere Brook.
Cluster 5				
FA 28	GWR, WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Isolated wet depression in maritime spruce fir forest dominated by balsam fir (*Abies balsamea*), red spruce, and white pine.
FA 29	GWD	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Isolated wet depression in maritime spruce fir forest dominated by balsam fir, red spruce, and white pine.
FA 30	GWR/D, FFA, WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Isolated wet depression in maritime spruce fir forest dominated by balsam fir, red spruce, and white pine.
FA 31	GWR/D, FFA, WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Isolated wet depression in maritime spruce fir forest dominated by balsam fir, red spruce, and white pine.

Table 3-1 Wetlands Summary, NAS Brunswick

Wetland ID	Primary Functions and Values	Wetland Community Type[1]	Hydrologic Connection	Additional Comments
Cluster 6				
FA 1	FFA, NR&R, PE, WLH	E2EM	Hydrologic connection to Mere Brook	Salt marsh wetland adjacent to a small stream dominated by cordgrass (*spartina* spp).
FA 2	FFA, PE, WLH	E2EM	Hydrologic connection to Mere Brook	Salt marsh wetland adjacent to a small stream.
FA 48	PE, WLH	PEM	Hydrologic connection to Mere Brook	Emergent wetland bordering Mere Creek. Wetland contains significant vernal pool no. 32.
FA 49	PE, WLH	PSS	Hydrologic connection to Mere Brook	Scrub/shrub wetland bordering Mere Creek dominated by meadowsweet (*Spirea latifolia*), steeplebush, and a variety of emergent vegetation.
FA 60	GWD, WLH	PFO	Hydrologic connection to Mere Brook	Forested wetland dominated by red maple, balsam fir, and skunk cabbage. Drains south into brackish tidal marsh along Mere Brook.
FA 61	WLH	PFO	Hydrologic connection to Mere Brook	Forested wetland dominated by red maple, red spruce, balsam fir, cinnamon fern (*Osmunda cinnamomea*), and sphagnum. Connects with FA 60.
FA 63	GWR/D, S&TR, NR&R, PE, WLH	PFO	Hydrologic connection to Mere Brook	Forested wetland dominated by red maple bordering open water with cattails at southern end. Flows into a perennial stream bordered by FA 64.
FA 64	Connecting tributary		Hydrologic connection to Mere Brook	Small stream draining from FA 64. Culverted and draining through Weapons storage compound to Mere Brook.
FA 65	GWR, F&SH, S&TR, PE, WLH	PSS	Hydrologic connection to Mere Brook	Shrub wetland bordering an impounded area of Mere Brook. This is culverted under a road as a perennial stream.
FA 66	Tributary to Mere Brook		Hydrologic connection to Mere Brook	Small stream draining into Mere Brook.
FA 67	Tributary to Mere Brook		Hydrologic connection to Mere Brook	Small stream draining into Mere Brook.

Table 3-1 Wetlands Summary, NAS Brunswick

Wetland ID	Primary Functions and Values	Wetland Community Type[1]	Hydrologic Connection	Additional Comments
Cluster 7				
FA 3	S&TR, NR&R, WLH	PSS	No Apparent Surface Water Connection to Waters of the U.S.	Scrub/shrub swamp
FA 4	GWR, S&TR, WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Forested wetland dominated by balsam fir and spruce.
FA 40	GWR, REC, WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Southern forested portion of isolated wetland. Northern portion is FA 41. Dominated by red maple and balsam fir.
FA 41	GWR, REC, WLH, ED/S	PSS	No Apparent Surface Water Connection to Waters of the U.S.	Northern shrub swamp portion of isolated wetland. Southern portion is FA 40. Dominated by steeplebush, meadowsweet, speckled alder, soft rush, and sedges.
FA 42	GWR, WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Western forested portion of isolated wetland. Eastern portion is FA 43. Dominated by red maple, red oak, and balsam fir.
FA 43	GWR	PSS	No Apparent Surface Water Connection to Waters of the U.S.	Eastern shrub swamp portion of isolated wetland. Western portion is FA 42. Dominated by unknown shrubs, possibly speckled alder.
FA 44	WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Three north/south linear depressions hold water in this forested wetland dominated by red maple, balsam fir, and white pine.
FA 45	WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Southern forested portion of isolated wetland. Northern portion is FA 46. Dominated by red maple, balsam fir, and white pine.
FA 46	WLH	PSS	No Apparent Surface Water Connection to Waters of the U.S.	Northern shrub swamp portion of isolated wetland. Southern portion is FA 40. Dominated by meadowsweet, speckled alder, soft rush, and sedges.
FA 62	S&TR, NR&R, PE	PSS	No Apparent Surface Water Connection to Waters of the U.S.	Shrub swamp adjacent to pond on eastern side of EOD pit. Dominant species include specked alder and meadowsweet.
Cluster 8				
FA 50	F&SH, PE	E2EM	Hydrologic connection to Harpswell Cove	Emergent wetland adjacent to spartina salt marsh. Ponded water upstream drains through a culvert into the wetland before flowing into Harpswell Cove.

Table 3-1 Wetlands Summary, NAS Brunswick

Wetland ID	Primary Functions and Values	Wetland Community Type[1]	Hydrologic Connection	Additional Comments
FA 51	FFA, S&TR, N&RR, WLH	PFO	Hydrologic connection to unnamed tributary to Harpswell Cove	Forested wetland that has been bermed, impounding water, with a culverted outflow. Culvert drains into FA 50. Wetland originates from a small stream draining from FA 52.
FA 52	PE, WLH	PFO	Hydrologic connection to unnamed tributary to Harpswell Cove	Forested wetland dominated by balsam fir, red spruce and red maple. Drains into a small stream flowing into impounded area of FA 51.
Cluster 9				
FA 56	GWD, PE, REC	PFO	Hydrologic connection to unnamed tributary to Mere Brook	Forested wetland bordering perennial stream running through golf course. Groundwater seepage observed. Flows into impounded are that is culverted under roadway.
FA 57	PE, REC	PSS	Hydrologic connection to unnamed tributary to Mere Brook	Scrub/shrub wetland bordering perennial stream running through golf course. Flows into impounded area that is culverted under roadway.
FA 58	PE	PFO	Hydrologic connection to unnamed tributary to Mere Brook	Forested wetland dominated by red maple bordering perennial stream running through golf course. Flows from culvert under roadway.
FA 59	GWR, FFA, S&TR, NR&R, PE, REC, WLH	PEM	Hydrologic connection to unnamed tributary to Mere Brook	Emergent wetland bordering perennial stream flowing into Mere Brook. Wetland dominated by cattails and grasses.
FA 68	GWR/D	PEM	Hydrologic connection to unnamed tributary to Mere Brook	Emergent wetland located in grasslands in the southwest portion of the airfield. Ditched and draining south into a perennial stream.
FA 69	GWD, PE	PSS	Hydrologic connection to unnamed tributary to Mere Brook	Large shrub swamp formed in depressions within forested area. Drains into a tributary of Mere Brook.

Table 3-1 Wetlands Summary, NAS Brunswick

Wetland ID	Primary Functions and Values	Wetland Community Type[1]	Hydrologic Connection	Additional Comments
FA 70	GWR, WLH	PFO	Hydrologic connection to unnamed tributary to Mere Brook	Large forested wetland formed in depressions within forested area.
FA 71	GWR, WLG	PFO	Hydrologic connection to unnamed tributary to Mere Brook	Forested wetland adjacent to a small seasonal stream. Wetland dominated by red maple, skunk cabbage, cinnamon fern.
FA 76	S&TR, NR&R	PEM	Possible hydrologic connection to unnamed tributary to Mere Brook	Emergent wetland at the northern extent of the golf course driving range. Appears to connect to an ephemeral stream course across the dirt road to the east of the driving range.
FA 77	S&TR, PE, WLH, S&S	PFO	Hydrologic connection to unnamed tributary to Mere Brook	Forested wetland narrowly bordering the convergence of an ephemeral stream and a perennial stream that flow south.
FA 79	FFA, S&TR	PEM	Hydrologic connection to unnamed tributary to Mere Brook	Scrub-shrub wetland adjacent to airfield dominated by meadowsweet, nannyberry (*Viburnum lentago*), and steeplebush.
FA 80	GWR, S&TR	PEM	Hydrologic connection to unnamed tributary to Mere Brook	Emergent wetland drainage along the edge of the airfield.
Cluster 10				
FA 53	NR&R, PE, WLH	PSS	Hydrologic connection to unnamed tributary of Middle Bay Cove	Scrub shrub wetland supplemented by runoff from the adjacent golf course and culverted in to a small stream flowing into Middle Bay Cove. Wetland is dominated by speckled alder, willow (*Salix* spp.), grey birch (*Betula populifolia*), and red maple saplings.
FA 55	FFA, S&TR, NR&R, S&S	PUB	Hydrologic connection to unnamed tributary of Middle Bay Cove	Ponded area adjacent to golf course culverted under roadway into a perennial tributary of Middle Bay Cove.

Table 3-1 Wetlands Summary, NAS Brunswick

Wetland ID	Primary Functions and Values	Wetland Community Type[1]	Hydrologic Connection	Additional Comments
Cluster 11				
FA 73	GWR, S&TR, PE, REC, WLH	PFO	Possible hydrological connection to Miller Brook	Forested wetland dominated by red maple bordering seasonal stream flowing south.
FA 74	FFA, WLH	PSS	Possible hydrological connection to Miller Brook	Scrub/shrub wetland dominated by speckled alder bordering seasonal stream flowing south.
Cluster 12				
FA 54	S&TR, NR&R, WLH, ED/S	PEM	No Apparent Surface Water Connection to Waters of the U.S.	This is a large isolated emergent wetland that serves as a significant vernal pool.
FA 72	FFA, S&TR, WLH	PSS	No Apparent Surface Water Connection to Waters of the U.S.	Red maple swamp within forested depression adjacent to Harpswell Road. TRC significant vernal pools 42 & 44.
FA 75	GWR/D, WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Isolated forested wetland within a topographic depression.
FA 82	GWR, WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Small forested wetland area in depression between to upland ridges. Wetland is bisected by dirt road cutting off hydrologic connection to FA 73 and 74.
FA 83	GWR, S&TR	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Small forested wetland in a depression by dirt road. Cut off from a possible hydrologic connection with FA 72 by the roadway.
FA 84	S&TR, NR&R, WLH	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Small forested wetland in a depression within upland forested area.
Cluster 13				
FA 81	GWR, FFA, WLH	PFO	Possible hydrologic connection to Mere Brook	Forested wetland dominated by red maple and cinnamon fern.
FA 86	GWR	PFO	Possible hydrologic connection to Mere Brook	Forested wetland depression dominated by red maple.

Table 3-1 Wetlands Summary, NAS Brunswick

Wetland ID	Primary Functions and Values	Wetland Community Type[1]	Hydrologic Connection	Additional Comments
FA 87	WLH	PFO	Possible hydrologic connection to Mere Brook	Large forested wetland that functions as valuable vernal pool habitat.
FA 88	S&TR	PSS	Possible hydrologic connection to Mere Brook	Scrub-shrub swamp adjacent to airfield.
FA 89	GWD, FFA, PE	PEM	Possible hydrologic connection to Mere Brook	Emergent wetland adjacent to airfield.
FA 90	S&TR	PFO	Possible hydrologic connection to Mere Brook	Forested wetland adjacent to airfield.
Cluster 14				
FA 91	S&TR	PFO	No Apparent Surface Water Connection to Waters of the U.S.	Small isolated linear wetland in a topographic depression along road. Dominated by red maple.
FA 92	FFA, S&TR	PSS	No Apparent Surface Water Connection to Waters of the U.S.	Small isolated wetland in a topographic depression along road. Dominated by willow, meadowsweet, and steeplebush.
FA 93	S&TR, WLH	PSS	No Apparent Surface Water Connection to Waters of the U.S.	Small isolated wetland in a topographic depression within an open field. Maintained areas nearby. Dominated by leatherleaf (*Chamaedaphne calyculata*), willow, meadowsweet, and steeplebush.
FA 99	F&SH, REC, WLH	PSS	No Apparent Surface Water Connection to Waters of the U.S.	Ponded area bordered by scrub-shrub wetland dominated by willow.
Cluster 15				
FA 85	WLH	PFO	Hydrologic connection to unnamed tributary of Mere Brook	Large forested wetland that functions as valuable vernal pool habitat.
FA 94	GWR/D, FFA, PE, WLH	PSS	Hydrologic connection to unnamed tributary of Mere Brook	Forested wetland dominated by red maple. Converges with FA 95 and drains into FA 100.

Table 3-1 Wetlands Summary, NAS Brunswick

Wetland ID	Primary Functions and Values	Wetland Community Type[1]	Hydrologic Connection	Additional Comments
FA 95	GWR/D	PFO	Hydrologic connection to unnamed tributary of Mere Brook	Narrow forested wetland bordering small stream. Dominated by red maple. Small seepage from steeply sloping sides. Drains into FA 100.
FA 96	GWR/D, FFA, S&TR, NR&R, WLH	PEM	Hydrologic connection to unnamed tributary of Mere Brook	Emergent wetland in maintained field with antennae site. Site of TRC Vernal pools 29B and 29C.
FA 97	GWR, FFA, PE, WLH, S&S	PSS	Hydrologic connection to Mere Brook	Scrub-shrub wetland dominated by willow and speckled alder bordering Mere Brook.
FA 100	GWR,/D, F&SH, S&TR, PE, WLH	PFO	Hydrologic connection to unnamed tributary of Mere Brook	Narrow forested wetland bordering small stream. Dominated by red maple, skunk cabbage, and jewelweed. Drains from FA 95 into Mere Brook.
FA 101	GWR/D, FFA. F&SH, S&TR, NR&R, WLH	PFO	Hydrologic connection to unnamed tributary of Mere Brook	Narrow forested wetland bordering small stream. Dominated by red maple and skunk cabbage. Drains in to Mere Brook.
FA 102	GWR/D, FFA, S&TR, PE, WLH, S&S	PSS	Hydrologic connection to Mere Brook	Shrub wetland broadly bordering Mere Brook. Dominated by speckled alder with red maple along the forested edges.
FA 103	GWR, S&TR, PE, WLH	PFO	Hydrologic connection to unnamed tributary of Mere Brook	Forested wetland bordering a small stream. Dominated by red maple, skunk cabbage, and cinnamon fern.
FA 104	GWR, FFA, WLH	PFO	Hydrologic connection to Mere Brook	Forested wetland dominated by red maple.
FA 105	WLH	PFO	Hydrologic connection to Mere Brook	Forested wetland area within a white pine plantation.

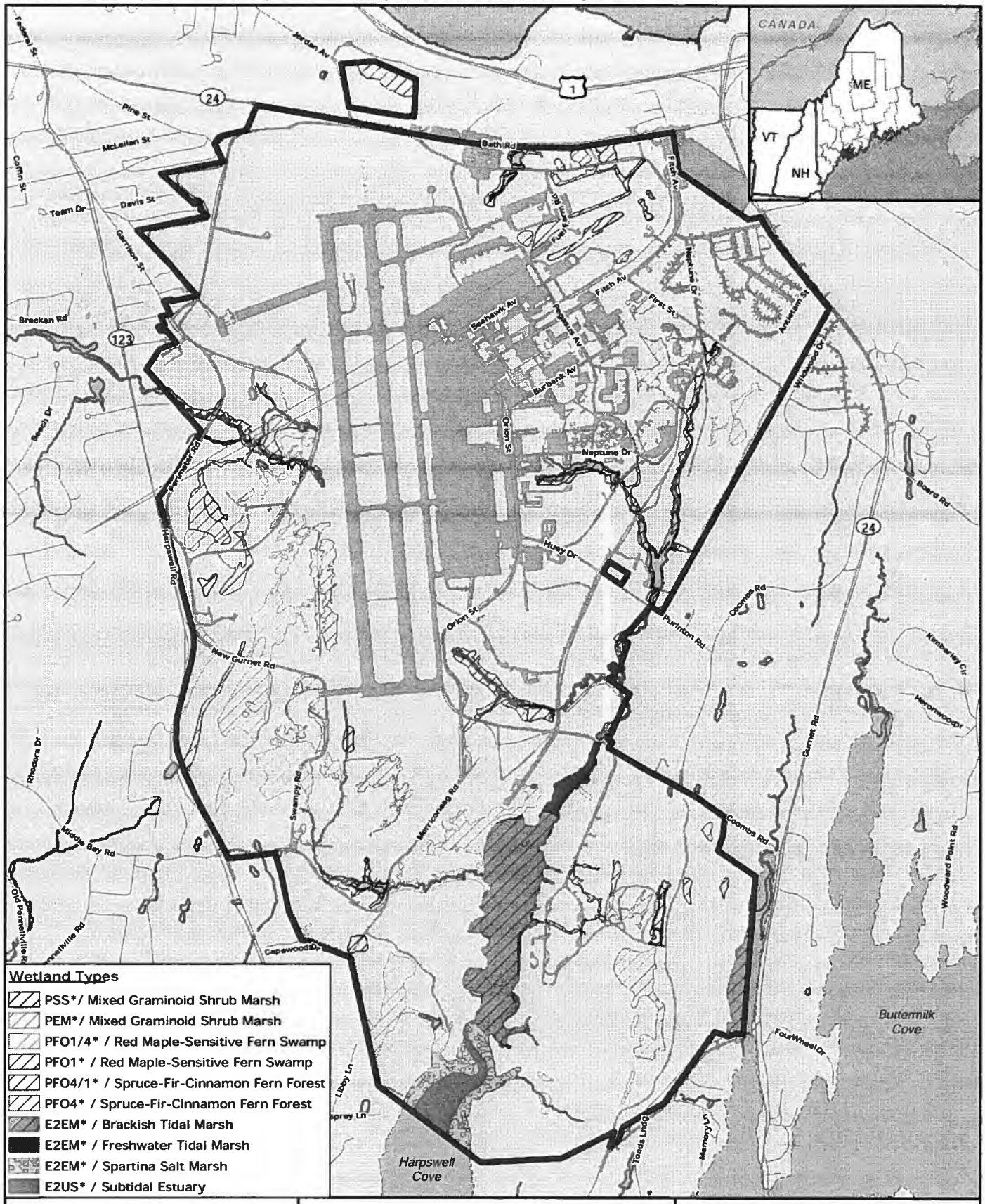
Table 3-1 Wetlands Summary, NAS Brunswick

Wetland ID	Primary Functions and Values	Wetland Community Type[1]	Hydrologic Connection	Additional Comments
FA 106	GWR, S&TR, PE, WLH	PSS	Hydrologic connection to unnamed tributary of Mere Brook	Narrow scrub-shrub wetland bordering a tributary to Mere Brook.
FA 107	GWR, S&TR, PE, WLH	PEM	Hydrologic connection to unnamed tributary of Mere Brook	Emergent wetland bordering a tributary draining from the airfield.
FA 108	GWR, FFA, S&TR, WLH,	PSS	Hydrologic connection to unnamed tributary of Mere Brook	Scrub-shrub wetland dominated by speckled alder, willow, and sensitive fern.

Note:
[1] Based on Cowardin et al. 1979.

Key:
Functions and Values
- ED/S = Educational/scientific value.
- ESH = Endangered species habitat.
- F&SH = Finfish habitat.
- FFA = Floodflow attenuation.
- GWD = Groundwater discharge.
- GWR = Groundwater recharge.
- NR&R = Nutrient removal/retention/transformation.
- PE = Production export.
- REC = Recreation.
- S&S = Sediment/shoreline stabilization.
- S&TR = Sediment/toxicant/pathogen retention.
- U/H = Uniqueness/heritage.
- WLH = Wildlife habitat.

© Ecology & Environment, Inc. GIS Department Project #
\L:\Buffalo\Brunswick\Maps\MXD\DEIS\Draft\May20_2009\Avian_Study\East_Brunswick_Grassland_Survey_Pts.mxd



Wetland Types

- PSS*/ Mixed Graminoid Shrub Marsh
- PEM*/ Mixed Graminoid Shrub Marsh
- PFO1/4* / Red Maple-Sensitive Fern Swamp
- PFO1* / Red Maple-Sensitive Fern Swamp
- PFO4/1* / Spruce-Fir-Cinnamon Fern Forest
- PFO4* / Spruce-Fir-Cinnamon Fern Forest
- E2EM* / Brackish Tidal Marsh
- E2EM* / Freshwater Tidal Marsh
- E2EM* / Spartina Salt Marsh
- E2US* / Subtidal Estuary

Legend

- Stream
- NAS Brunswick
- County Boundary

Figure 3-1
Wetlands of
NAS Brunswick
Brunswick, Maine

N

0 500 1,000 2,000 3,000 4,000

Feet

4 Wetlands Types

According to the 2008 reconnaissance-level survey, there are approximately 280 acres of freshwater wetlands, 109 acres of tidal wetlands, and 9 acres of ponds at NAS Brunswick (E & E 2008). Figure 3-1 identifies the wetland types at NAS Brunswick according to the Cowardin et al. (1979) classification system and the *Natural Landscapes of Maine* (Gawler and Cutko 2004). The Cowardin et al. system classifies wetland vegetation according to the community structure.

The freshwater, or palustrine, wetlands were generally classified as emergent (PEM), shrub-scrub (PSS), and forested (PFO) wetlands. The forested wetlands (PFO) were composed of predominantly deciduous tree species (hardwoods) (PFO1), coniferous species (PFO4), or a mixture of both (PFO1/4 or PFO 4/1). Tidal, or estuarine, wetlands were generally classified as subtidal (E1) or intertidal wetlands (E2). The classification of the wetlands according to Cowardin et al. (1979) was then compared to the descriptions of the ecological communities for freshwater wetlands in *Natural Landscapes of Maine* (Gawler and Cutko 2004). Typically, the Cowardin et al. (1979) classification is broader than Gawler and Cutko (2004) and is not detailed enough for determining species composition of a specific wetland community. Below is a brief description of each of the wetland community types identified by E & E in July 2008. A more detailed description can be found in the Ecological Communities and Wetland Resources Report (E & E 2008).

4.1 Spruce-Fir-Cinnamon Fern Forest

Spruce-fir-cinnamon fern forests are forested wetlands dominated by black spruce (*Picea mariana*) or red spruce and balsam fir. These systems are defined as PFO4, and approximately 40 acres of this wetland type are present on the installation. This community occurs within the maritime spruce-fir forest in the southeastern portion of NAS Brunswick in a long, poorly drained valley between two ridges. This community has pronounced pit and mound topography. The herb layer is productive and dominated by cinnamon fern, but it also contains a variety of sedges, grasses, and other herbs such as three-seeded sedge (*Carex trisperma*), mannagrasses (*Glyceria* spp.), golden thread (*Coptis trifolia*), saxifrage (*Saxifraga pensylvanica*), and skunk cabbage. There are a few scattered shrubs, mainly wild raison (*Viburnum cassinoides*) and winterberry (*Ilex verticillata*). The forest floor is blanketed with sphagnum mosses.

4.2 Red Maple-Sensitive Fern Swamp

Red maple-sensitive fern swamps are a common forested wetland community type in Maine. Red maple-sensitive fern swamps have been identified at NAS Brunswick in several areas, including along the edges of the retention ponds in the eastern portion of the installation; adjacent to Mere Brook in the northwest portion of the installation; in the weapons compound; and in the northern clear zone parcel, north of Bath Road. There are approximately 162 acres of this wetland type at NAS Brunswick, comprising 5% of the installation's area.

The structure of this community varies, with the canopy ranging from open to closed and the shrub layer ranging from prominent to nonexistent. Red maple-sensitive fern swamps with balsam fir as a co-dominant tree species are classified as PFO1/4 or PFO 4/1 in the Cowardin et al. (1979) classification system. Wetlands in which balsam fir is dominant over the deciduous tree species but still comprises approximately less than 75% are classified as PFO4/1. Wetlands in which the deciduous trees species comprise more than 50% of the coverage, with balsam fir comprising enough cover to be considered dominant, are classified as PFO1/4. Red maple-sensitive fern swamps in which balsam fir is not a dominant species are classified as PFO1.

4.3 Mixed Graminoid-Shrub Marsh

Mixed graminoid-shrub marsh, a common community in Maine, is present throughout NAS Brunswick. These areas may be transitional to other wetland types or to open water, or they may occur as a large wetland complex. The plant community structure ranges from containing only herbs and no shrubs to having a dominant shrub layer (Gawler and Cutco 2004). In the Cowardin et al. (1979) classification system, the wetlands with predominately herbaceous cover are classified as PEM wetlands, and those with predominately shrubs as cover are classified as PSS wetlands. At NAS Brunswick, these communities range from being dominated by herbs to dominated by shrubs. There are an estimated 78 acres of mixed graminoid-shrub marsh at NAS Brunswick. Mixed graminoid-shrub marshes dominated by herbs were observed at the southern end of the airfield; in a meadow adjacent to an antenna field on the west side of the airfield; and in a wetland located in the south-central portion of the installation. Mixed graminoid-shrub marshes dominated by shrubs were observed in the weapons compound.

4.4 Freshwater Tidal Marsh

Freshwater tidal marshes are found in the upper reaches of tidal influence and are typically fed by a freshwater stream or river. The salinity is typically less than 0.5 parts per thousand (ppt) (Gawler and Cutco 2004). In the Cowardin et al. (1979) classification system, these wetlands are classified as E2EM. Freshwater tidal marshes are found in small areas where Mere Brook and other smaller tributaries empty into Harpswell Cove and Buttermilk Cove. There are approximately 9 acres of freshwater tidal marshes on NAS Brunswick. This wetland community type is dominated by herbaceous vegetation, including cattails, rice cutgrass (*Leersia oryzoides*), northern water plantain (*Alisma triviale*), and pickerelweed (*Pontederia cordata*).

4.5 Brackish Tidal Marsh

Large expanses of brackish tidal marshes are located along the coastal areas of NAS Brunswick. In the Cowardin et al. (1979) classification system, these wetlands are classified as E2EM. These marshes were identified in the upper portion of Harpswell Cove and Buttermilk Cove, downgradient of the freshwater tidal marsh communities, and were also identified along the edges of the estuaries. Salinity levels within this community can range from 0.5 to 18 ppt (Gawler and Cutko 2004). The vegetation consists of a mixture of saltmeadow cordgrass (*Spartina patens*), smooth cordgrass (*Spartina alterniflora*), and a variety of rushes and sedges. Approximately 77 acres of brackish tidal marsh are located at NAS Brunswick.

4.6 Spartina Salt Marsh

Spartina salt marshes are dominated by smooth cordgrass and are often referred to as "high marshes." In the Cowardin et al. (1979) classification system, these wetlands are classified as E2EM. The name "high marsh" comes from the higher elevation in which the salt marsh forms. They are typically found on elevated plateaus in which organic matter can build up to several meters thick. Spartina salt marshes are able to tolerate high levels of salinity. This coastal wetland community is found on the southern portion of NAS Brunswick, in Harpswell Cove. Approximately 23 acres of spartina salt marshes are located at NAS Brunswick.

4.7 Subtidal Estuary

Brunswick is a coastal area that boarders Casco Bay of the Atlantic Ocean. Harpswell Cove and Buttermilk Cove are subtidal estuaries within Casco Bay. Subtidal estuaries are characterized as open-water areas heavily influenced by the tide. They support submerged and floating plants but, due to the varying conditions, not emergent vegetation. These areas include tidal flats, which serve as important feeding areas for shorebirds and habitat for a variety of fish and crustaceans. The locations of the estuaries were visually noted during the 2008 field surveys, but surveys for plant community composition were not conducted. Approximately 18 acres of subtidal estuaries are located at NAS Brunswick.

5 Wetland Functions and Values

5.1 Functions and Values Assessed

Wetland functions are the dynamic ecological properties provided or performed by a wetland. These functions are developed by biotic and abiotic means within the wetland, with self-sustaining properties that are not gauged or affected by human values. The benefits that society derives from one or more of the wetland functions are the wetland values. The following sections outline the functions and values that the USACE takes into account during the Section 404 permit process. These definitions were taken directly from the *Highway Methodology Workbook* (USACE 1993).

5.1.1 Functions

Groundwater Recharge/Discharge

This function considers the potential for a wetland to serve as a groundwater recharge and/or discharge area and refers to the fundamental interaction between wetlands and aquifers, regardless of the size or importance of either.

Floodflow Alteration

This function considers the effectiveness of the wetland in reducing flood damage by water retention for prolonged periods following precipitation events and the gradual release of floodwaters. It adds to the stability of the wetland ecological system or its buffering characteristics and provides social or economic value relative to erosion- and/or flood-prone areas.

Fish and Shellfish Habitat

This function considers the effectiveness of seasonal watercourses or permanent waterbodies associated with wetlands for fish habitat.

Sediment/Toxicant/Pathogen Retention

This function reduces or prevents degradation of water quality. It relates to the effectiveness of the wetland as a trap for sediments, toxicants, or pathogens in runoff water from surrounding uplands or upstream eroding wetland areas.

Nutrient Removal/Retention/Transformation

This function considers the effectiveness of the wetland as a trap for nutrients in runoff water from surrounding uplands or contiguous wetlands and the ability of

the wetland to process these nutrients into other forms or trophic levels. One aspect of this function is to prevent ill effects of nutrients entering aquifers or surface waters such as ponds, lakes, streams, rivers, or estuaries.

Production Export
This function evaluates the effectiveness of the wetland to produce food or usable products for humans or other living organisms.

Sediment/Shoreline Stabilization
This function considers the effectiveness of a wetland to stabilize stream banks and shorelines against erosion.

Wildlife Habitat
This function considers the effectiveness of the wetland to provide habitat for various types and populations of animals typically associated with wetlands and the wetland edge. Both resident and/or migrating species must be considered.

5.1.2 Values

Recreation (Consumptive and Non-consumptive)
This value considers the suitability of the wetland and associated watercourses to provide recreational opportunities such as hiking, canoeing, boating, fishing, hunting, or other active or passive recreational activities. Consumptive opportunities consume or diminish the plants, animals, or other resources that are intrinsic to the wetland. Non-consumptive opportunities do not consume or diminish the resources of the wetland.

Educational/Scientific Value
This value considers the suitability of the wetland as a site for an "outdoor classroom" or as a location for scientific study or research.

Uniqueness/Heritage
This value considers the effectiveness of the wetland or its associated water bodies to provide certain special values. These may include archaeological sites, critical habitat for endangered species, its overall health and appearance, its role in the ecological system of the area, and its relative importance as a typical wetland class for this geographic location. These functions are clearly valuable wetland attributes relative to aspects of public health, recreation, and habitat diversity.

Visual Quality/Aesthetics
This value considers the visual and aesthetic quality or usefulness of the wetland.

Endangered Species Habitat
This value considers the suitability of the wetland to support threatened or endangered species (either federal or state listed).

In total, 103 wetland areas at NAS Brunswick were assessed for the functions and values listed above (see Table 5-1). Attachment 3 includes a series of figures identifying wetlands assessed by cluster.

Table 5-1 Wetland Functions and Values

Functions	Values
Groundwater Recharge/Discharge	Recreation
Floodflow Alteration	Education/Scientific Value
Fish and Shellfish Habitat	Uniqueness/Heritage
Sediment/Toxicant/Pathogen Retention	Visual Quality/Aesthetics
Nutrient Removal/Retention/Transformation	Endangered Species Habitat
Production Export	
Sediment/Shoreline Stabilization	
Wildlife Habitat	

5.2 Cluster 1

Eleven wetlands (FA 5, 6, 7, 11, 13, 15, 16, 17, 18, 19, 78) in the northern portion of NAS Brunswick have a possible hydrologic connection with the Androscoggin River (see Figure 1 of Attachment 3). These wetlands are predominately classified as forested wetlands (FA 11 and FA 16 are PSS, and FA 15 is PEM) within upland communities of white pine plantation or mixed forest dominated by white pine, red oak, and red maple. Many of these wetlands have been highly impacted by development within and adjacent to NAS Brunswick and the construction of the storm water system on the site and are generally of low quality. Primary functions of these wetlands include groundwater recharge, floodflow alteration, sediment/toxicant/pathogen retention, and nutrient removal/retention/transformation.

5.3 Cluster 2

Four wetlands (FA 8, 9, 10, 12) in the northern portion of NAS Brunswick do not have an apparent surface water connection to waters of the U.S (see Figure 2 of Attachment 3). These isolated wetlands still perform many of the same functions as other wetlands; however, they may not be considered jurisdictional by the USACE and, therefore, would not be regulated under the Clean Water Act. These are forested wetlands formed in topographic depressions dominated by red maple within upland communities of white pine plantation or mixed forest dominated by white pine, red oak, and red maple. These wetlands exhibit many of the functions normally associated with wetlands; however, due to their position in the landscape and the degradation caused by adjacent development, the level of functionality is minimal and these wetlands are therefore of low quality. The primary functions of these wetlands include groundwater recharge, floodflow alteration, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation and limited wildlife habitat.

5.4 Cluster 3

Eleven wetlands (FA 14, 25, 26, 27 32, 33, 34, 35, 36, 37, 38) in the northeastern portion of NAS Brunswick have a hydrologic connection to an unnamed tributary of Mere Brook (see Figure 3 of Attachment 3). These are forested wetlands or emergent wetlands primarily bordering the unnamed tributary of Mere Brook.

Adjacent upland communities are forested areas of red oak-northern hardwoods-white pine, or maritime spruce-fir habitat. Many of these wetlands have been highly impacted by development on the site. The wetlands within the developed areas (FA 14, 32, 33, 34, 35, 36, 37, 38) are generally of low quality due to habitat fragmentation and alteration. Their primary functions include groundwater recharge, floodflow alteration, sediment/toxicant/pathogen retention, nutrient removal and retention, production export, wildlife habitat, and sediment/shoreline stabilization. The wetlands within the forested portions (FA 25, 26, 27) are less impacted and have greater function and value, including groundwater discharge, floodflow alteration, wildlife habitat, recreation, and production export.

5.5 Cluster 4

Six wetlands (FA 20, 21, 22, 23, 24, 47) in the eastern-central portion of NAS Brunswick have a hydrologic connection to an unnamed tributary of Mere Brook (see Figure 4 of Attachment 3). These are forested, emergent, and scrub-shrub wetlands primarily bordering the unnamed tributary of Mere Brook. Adjacent upland communities are forested areas of red oak-northern hardwoods-white pine, white pine plantations, or maritime spruce-fir habitat. These wetlands have been highly impacted by development on the site. The wetlands within the developed areas (FA 20, 21, 22) are generally of low quality due to habitat fragmentation and alteration. Their primary functions include groundwater recharge, floodflow alteration, sediment/toxicant/pathogen retention, and sediment/shoreline stabilization, with some limited functions as wildlife habitat. The wetlands within the forested portions (FA 23, 24, 47) are less impacted and provide greater function and value, including groundwater recharge, floodflow alteration, sediment/toxicant/pathogen retention, wildlife habitat (including finfish habitat), and sediment/shoreline stabilization. The upland forest bordering these wetlands currently provides recreational value with a picnic area, ball fields, and hiking trails; however, activities within the wetlands and open water, such as fishing and swimming, are prohibited.

5.6 Cluster 5

Four wetlands (FA 28, 29, 30, 31) in the eastern portion of NAS Brunswick do not have an apparent surface water connection to waters of the U.S (see Figure 5 of Attachment 3). These are forested wetlands formed in topographic depressions dominated by red maple within upland maritime spruce-fir communities. While these wetlands exhibit many of the functions normally associated with wetlands, the degree of functionality is minimal due to their position in the landscape and degradation caused by nearby development. Primary functions of these wetlands include groundwater recharge, floodflow alteration, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, and wildlife habitat. In addition, these wetlands serve an important function as vernal pools, providing crucial habitat for breeding amphibians such as spotted salamanders (*Ambystoma maculatum*) and wood frogs (*Rana sylvatica*) (E & E 2009).

5.7 Cluster 6

Eight wetlands in the east-central (FA 48, 49, 60, , 61, 63, 64, 65, 66, 67) and southeastern (FA 1, 2) portions of NAS Brunswick have a surface hydrologic connec-

tion to Mere Brook where it reemerges to the surface from under the eastern side of the airfield (see Figure 6 of Attachment 3). The northern six wetlands are forested, emergent and scrub-shrub wetlands primarily bordering Mere Brook (FA 48, 49, 60, 65) or alternately draining into Mere Brook through an adjacent wetland or small tributary (FA 61, 63, 64, 66, 67). Adjacent upland communities are forested areas of red oak-northern hardwoods-white pine, or maritime spruce-fir habitat. These wetlands provide a variety of functions and values, including groundwater recharge and discharge, floodflow alteration, production export, and wildlife habitat, including vernal pool habitat and potentially finfish habitat (E & E 2009). These wetlands are currently located within a fenced area with restricted access and, therefore, provide limited recreational value. In addition, there are potential safety concerns due their proximity to an explosive ordnance disposal pit.

Two of these wetlands are located adjacent to Mere Brook in the southeastern portion of the site, where they are tidally influenced: FA 1 (a spartina salt marsh) and FA 2 (a brackish tidal marsh). The adjacent upland is maritime spruce-fir forest. The primary functions of these wetlands include floodflow alteration, production export, and wildlife habitat. In addition, this large forested area remains undeveloped and has the potential to provide recreational value for hiking.

5.8 Cluster 7

Ten wetlands (FA 3, 4, 40, 41, 42, 43, 44, 45, 46, 62) in the southeastern portion of NAS Brunswick do not have an apparent surface water connection to waters of the U.S (see Figure 7 of Attachment 3). These are forested and scrub-shrub wetlands formed in topographic depressions within upland communities of mixed red oak-northern hardwoods-white pine, or maritime spruce-fir forest. While these wetlands exhibit many of the functions normally associated with wetlands, the functions they perform may be limited due to the lack of hydrologic connections resulting from their position in the landscape. The primary functions of these wetlands include groundwater recharge, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, and wildlife habitat (including significant vernal pool habitat) (E & E 2009). In addition, this large forested area remains undeveloped and has the potential to provide recreational value for hiking and educational/scientific value for the study of vernal pools and their inhabitants.

5.9 Cluster 8

Three wetlands (FA 50, 51, 52) in the southern portion of NAS Brunswick are hydrologically connected to each other by a small stream and culverts, which have a hydrologic connection to Harpswell Cove (see Figure 8 of Attachment 3). The adjacent upland community is maritime spruce-fir forest. While these wetlands have been altered (FA 51 is impounded by a berm and outflow is culverted into FA 50), these wetlands provide a variety of functions. Their primary functions include floodflow alteration, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, production export, and wildlife habitat (including significant vernal pool habitat and potential finfish habitat) (E & E 2009). In addition, this large forested area remains undeveloped and has the potential to

provide recreational value for hiking and educational/scientific value for the study of vernal pools and their inhabitants.

5.10 Cluster 9

Twelve wetlands (FA 56, 57, 58, 59, 68, 69, 70, 71, 76, 77, 79, 80) in the southern portion of NAS Brunswick have a surface hydrologic connection to Mere Brook from the western side of the installation through several unnamed tributaries (see Figure 9 of Attachment 3). Surrounding forested upland communities include mixed red oak, northern hardwoods and white pine, and aspen-birch woodlands. Many of these wetlands border the main tributary that flows through the golf course and have been highly altered to drain runoff from the course. In addition, several impounded areas within the golf course are bordered by wetlands.

Wetlands FA 56, 57, 58, 59, 68, and 77 are relatively narrow, directly bordering unnamed perennial tributaries. These are forested, emergent, and scrub-shrub wetlands. Their primary functions include groundwater recharge and discharge, floodflow attenuation, sediment/toxicant/pathogen retention, production export, and wildlife habitat, and they also provide value for recreation.

Wetlands FA 69, 70, 71, 76, 79, and 80 are larger areas of forested, scrub-shrub and emergent wetlands that drain into unnamed perennial tributaries of Mere Brook. Their primary functions include groundwater discharge, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, production export, wildlife habitat, and sediment and shoreline stabilization.

In addition, in 2008 and 2009, Cluster 9 wetlands were found to contain 12 vernal pools, some of which are considered significant (TRC 2008; E & E 2009).

5.11 Cluster 10

Two wetlands (FA 53, 55) in the southwestern portion of NAS Brunswick have surface hydrologic connections to unnamed tributaries of Middle Bay Cove (see Figure 10 of Attachment 3). Wetland FA 53 is a large scrub-shrub wetland bordered by forested upland communities, including maritime spruce fir and mixed red oak, northern hardwoods, and white pine. This wetland, which is located adjacent to the golf course, is formed in a depression within the forest landscape and is bisected by a dirt road. It is connected to an ephemeral tributary of Middle Bay Cove by a system of culverts. While this wetland is highly altered, its primary functions include nutrient removal/retention/transformation, production export, and wildlife habitat, including significant vernal pool habitat (E & E 2009).

FA 55 is a large ponded area within a mixed red oak, northern hardwoods, and white pine forest. Located adjacent to the golf course, this area is culverted under the roadway into a perennial tributary of Middle Bay Cove. Due to its highly altered condition, this area provides limited wetland functions, but does provide some level of floodflow alteration, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, production export, and sediment/shoreline stabilization.

5.12 Cluster 11

Two wetlands (FA 73, 74) in the southwestern portion of NAS Brunswick have a potential surface hydrologic connection to Miller Brook (located outside of the installation boundaries) were it flows from an impoundment on the western side of Harpswell Road (see Figure 11 of Attachment 3). Both wetlands border a seasonal stream that is culverted under the roadway. Wetland FA 73 is a forested wetland dominated by red maple and speckled alder. Wetland FA 74 is a scrub-shrub wetland dominated by speckled alder. The surrounding upland is red oak, mixed hardwoods, and white pine forest. These wetlands appear to be of high quality due to limited impacts resulting from the development at NAS Brunswick; however, construction of a roadway to the north of these wetlands appears to have isolated FA 82 from this drainage. The primary functions of these wetlands are groundwater recharge, floodflow alteration, wildlife habitat, production export. These wetlands have the potential for recreational value by providing hiking opportunities.

5.13 Cluster 12

Six wetlands (FA 54, 72, 75, 82, 83, 84) in the southwestern and western portions of NAS Brunswick do not have an apparent surface water connection to waters of the U.S (see Figure 12 of Attachment 3). These wetlands are primarily forested wetlands (FA 54 is emergent and FA 72 is scrub-shrub) formed in topographic depressions dominated by red maple within upland communities of maritime spruce fir. While these wetlands exhibit many of the functions normally associated with wetlands, the level of functionality is minimal due to their position in the landscape and degradation caused by adjacent development; therefore, these wetlands are of low quality. Though limited, the primary functions these wetlands provide include groundwater recharge, floodflow attenuation, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, production export, and wildlife habitat. In addition, this cluster of wetlands serves an important function in terms of wildlife habitat and were found to contain significant vernal pool habitat (TRC 2008; E & E 2009). These wetlands also have potential value for recreation and educational opportunities.

5.14 Cluster 13

Six wetlands (FA 81, 86, 87, 88, 89, 90) in the western portion of NAS Brunswick have a potential hydrologic connection to Mere Brook (see Figure 13 of Attachment 3). These wetlands are located in low-laying areas to the west of the airfield and, based on topography, appear to drain northward and converge at a location that either links underground to Cluster 12 or drains under the airfield into Mere Brook. These wetlands are predominantly forested (FA 88 is scrub-shrub and FA 89 is emergent) surrounded by upland forested communities of red oak-northern hardwoods-white pine, or aspen-birch forest. These wetlands have been altered and degraded due to the development of the airfield and other facilities at NAS Brunswick. However, they do provide the primary functions of groundwater recharge, floodflow alteration, sediment/toxicant/pathogen retention, production export, and wildlife habitat. In addition, these wetland provide valuable vernal pool habitat for breeding amphibians (TRC 2008).

5.15 Cluster 14

Four wetlands (FA 91, 92, 93, 99) in the western portion of NAS Brunswick do not have an apparent surface water connection to waters of the U.S (see Figure 14 of Attachment 3). These isolated wetlands still perform many of the same functions as other wetlands; however, they are not considered jurisdictional by the USACE and are not protected by the Clean Water Act. These wetlands are predominantly scrub-shrub wetlands (FA 91 is forested) formed in topographic depressions within upland communities of white pine plantation or aspen-birch woodland. While these wetlands exhibit many of the functions normally associated with wetlands, the level of functionality is minimal due to their position in the landscape and degradation caused by adjacent development; therefore, these wetlands are of low quality. The primary functions they provide include floodflow alteration, sediment/toxicant/pathogen retention, and wildlife habitat. In addition, FA 99 surrounds a pond that may provide finfish habitat and limited opportunities for recreation.

5.16 Cluster 15

Fourteen wetlands (FA 85, 94, 95, 96, 97, 100, 101, 102, 103, 104, 105, 106, 107, 108) in the western portion of NAS Brunswick have a surface hydrologic connection to unnamed tributaries of Mere Brook or directly to Mere Brook (see Figure 15 of Attachment 3). Many of these wetlands have been highly impacted by development of the airfield. Mere Brook flows under the airfield and reemerges on the eastern side. The primary functions of these wetlands include groundwater recharge and discharge, floodflow alteration, sediment/toxicant/pathogen retention, production export, and wildlife habitat. In addition, in 2008 this cluster of wetlands was found to contain a significant vernal pool (TRC 2008).

6 Conclusions and Summary

Considering these wetlands as individual units or smaller groupings would minimize their functionality and reduce their value to the ecosystem. Alternatively, considering all of the site's wetlands as one large unit with tidal and non-tidal components, including forested, scrub-shrub, and emergent cover types and the interspersed upland communities, would unnecessarily increase their assessed value to the ecosystem. Therefore, it was concluded that assessing these wetlands in functionally related clusters based on their degree of hydrologic connection/ interdependence and/or physical location and proximity within the landscape was the most effective way in which to assess the functionality of the site's wetlands.

Owing to the unique nature of the site as a limited-access naval base, the site's wetlands do not currently provide recreational or educational value. However, following redevelopment of the installation, several areas could provide high recreational or educational value.

No known endangered or threatened species are known to utilize the wetlands on the installation. However, many of the wetland areas provide valuable wildlife habitat, including significant vernal pools that serve as primary breeding habitat for amphibians (TRC 2008; and E & E 2009).

At many locations the visual/aesthetic appeal of the landscape has been compromised by significant site development. In addition, many wetlands have been highly altered to provide for the storm water detention and drainage system on the site. These alterations, while necessary for prior development on the site, have limited the ability of many wetlands to provide functions such as groundwater recharge and discharge, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, production export, and wildlife habitat by channelizing drainages and artificially directing the flow of water on the site.

The primary wetland functions identified include groundwater recharge, floodflow alteration, sediment/toxicant/pathogen retention, nutrient removal/retention/transformation, production export, wildlife habitat, and sediment/shoreline stabilization. All of these functions are served to some extent by the installation's wetlands. Future site development that would impact site wetland functions may require further analysis and quantification of wetland functions.

7 References

Cowardin, L.M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. U. S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.

Ecology and Environment (E & E). 2008. *Ecological Communities and Wetland Resource Report for the Environmental Impact Statement for the Disposal and Reuse of NAS Brunswick.* Prepared for Naval Air Station Brunswick, Brunswick, Maine. December 2008.

Ecology and Environment, Inc (E & E). 2009. Vernal Pool Survey Report. May 2009.

Environmental Laboratory. 1987. *Corps of Engineers Wetland Delineation Manual*. Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Gawler, S.C. and A.R. Cutko. 2004. *Natural Landscapes of Maine: A Classification of Vegetated Natural Communities and Ecosystems*. Maine Natural Areas Program, Maine Department of Conservation. Augusta, Maine.

McNab, W.H. and E.A. Avers. 1994. *Ecological Subregions of the United States*. Washington, DC. USDA Forest Service, Washington Office.

Normandeu Associates. 1998. *Naval Air Station Brunswick Wetland Survey*. Report No. P-16674.0000. Yarmouth, Maine.

TRC Environmental Corporation (TRC). 2008. *Naval Air Station Brunswick Vernal Pool Summary Report*. Prepared for Bowdoin College. May 2008.

U.S. Army Corps of Engineers (USACE). 1993. *The Highway Methodology Workbook: Integrating Corps Section 404 Permit Requirements with Highway Planning and Engineering and the NEPA EIS Process*. United States Army Corps of Engineers, New England Division. NAEEP-360-1-30. Concord, Massachusetts.

U.S. Army Corps of Engineers (USACE). 1999. *Highway Methodology Workbook Supplement: Wetland Functions and Values, a Descriptive Approach.* U.S. Army Corps of Engineers, New England Division. NAEEP-360-1-30a. Concord, Massachusetts.

U.S. Army Corps of Engineers (USACE). 2007. Modified Functions and Values Assessment for Significant Nexus. Retrieved May 15, 2009, from U.S. Army Corps of Engineers, New York Division, Web site: http://www.nan.usace.army.mil/business/buslinks/regulat/formdocs/functions.pdf.

Vernal Pool Survey Report

A Technical Report in Support of the Environmental Impact Statement for the Disposal and Reuse of NAS Brunswick
Naval Air Station Brunswick
Brunswick, Maine

June 2009

Prepared for:

U.S. Department of Navy
BRAC Project Management Office - Northeast
Philadelphia, Pennsylvania

Prepared by:

ECOLOGY AND ENVIRONMENT, INC.
368 Pleasant View Drive
Lancaster, New York 14086

Table of Contents

List of Tables

List of Figures

List of Abbreviations and Acronyms

AMSL	above mean sea level
E & E	Ecology and Environment, Inc.
EIS	Environmental Impact Statement
GPS	Global Positioning System
MEDEP	Maine Department of Environmental Protection
NAS	Naval Air Station
NRPA	Natural Resources Protection Act
TRC	TRC Environmental Corporation

1 Introduction

This report has been prepared to support the Environmental Impact Statement (EIS) for the disposal and reuse of Naval Air Station (NAS) Brunswick in Brunswick, Maine. The Navy contracted with Ecology and Environment, Inc. (E & E) to survey vernal pools at NAS Brunswick and its outlying properties in the spring of 2009.

Vernal pools are considered important resources in the state of Maine. According to the Maine Department of Environmental Protection (MEDEP):

> *"a vernal pool, also referred to as a seasonal forest pool, is a natural, temporary to semi-permanent body of water occurring in a shallow depression that typically fills during the spring or fall and may dry during the summer. Vernal pools have no permanent inlet and no viable populations of predatory fish. A vernal pool may provide the primary breeding habitat for wood frogs (Rana sylvatica), spotted salamanders (Ambystoma maculatum), blue-spotted salamanders (Ambystoma laterale), and fairy shrimp (Eubranchipus sp.), as well as valuable habitat for other plants and wildlife, including several rare, threatened, and endangered species"* (06-096 CMR Chapter 335).

If a vernal pool supports a certain abundance of vernal pool indicator species (wood frogs, spotted salamander, blue-spotted salamander, or fairy shrimp) or supports a threatened, endangered, or rare species for a critical part of its life history, the pool is considered a "significant" vernal pool by the state of Maine. To be deemed a significant vernal pool, the abundance of wood frog, spotted salamander, and blue-spotted salamander egg masses must reach at least 40, 20, and 10, respectively, within the pool area. Only a single species must meet its critical level for the pool to be considered significant. The presence of fairy shrimp at any life stage meets the requirements for significant vernal pool status.

Significant vernal pools may also provide valuable habitat for other plants and wildlife, including several rare, threatened, and endangered species, such as Blanding's turtle (*Emydoidea blandingii*), spotted turtle (*Clemmys guttata*), wood turtle (*Glyptemys insculpta*), ringed boghaunter dragonfly (*Williamsonia linteri*), and ribbon snake *Thamnophis sauritus*). Significant vernal pool habitat, including

critical terrestrial habitat around the vernal pool depression within a 250-foot radius, is protected under the Maine Natural Resources Protection Act (NRPA).

With the exception of the vernal pool survey conducted by TRC in 2008 (see section 5 of this report), no previous formal vernal pool surveys had been conducted at NAS Brunswick. The following report provides a brief site description, an overview of the methodology used to identify and categorize vernal pools, and a discussion of the survey results.

APPENDIX B
Vernal Pool Report

2 Site Description

NAS Brunswick is located on approximately 3,117 acres in the town of Brunswick, Cumberland County, Maine (see Figure 2-1). Three outlying properties (the McKeen Street Housing Annex, East Brunswick Radio Transmitter Site, and Sabino Hill Rake Station) that are being reviewed in the EIS were initially included as part of this study; however, these properties do not support vernal pool habitat. The East Brunswick Radio Transmitter Site and Sabino Hill Rake Station are characterized entirely as upland communities and neither site supports habitat that could be considered vernal pool. The McKeen Street Housing Annex does support limited wetland habitat on the south end of the property; however, no vernal pool habitat was identified during the site survey conducted by E & E biologists in April 2009. Therefore, these three properties are not discussed further in this report.

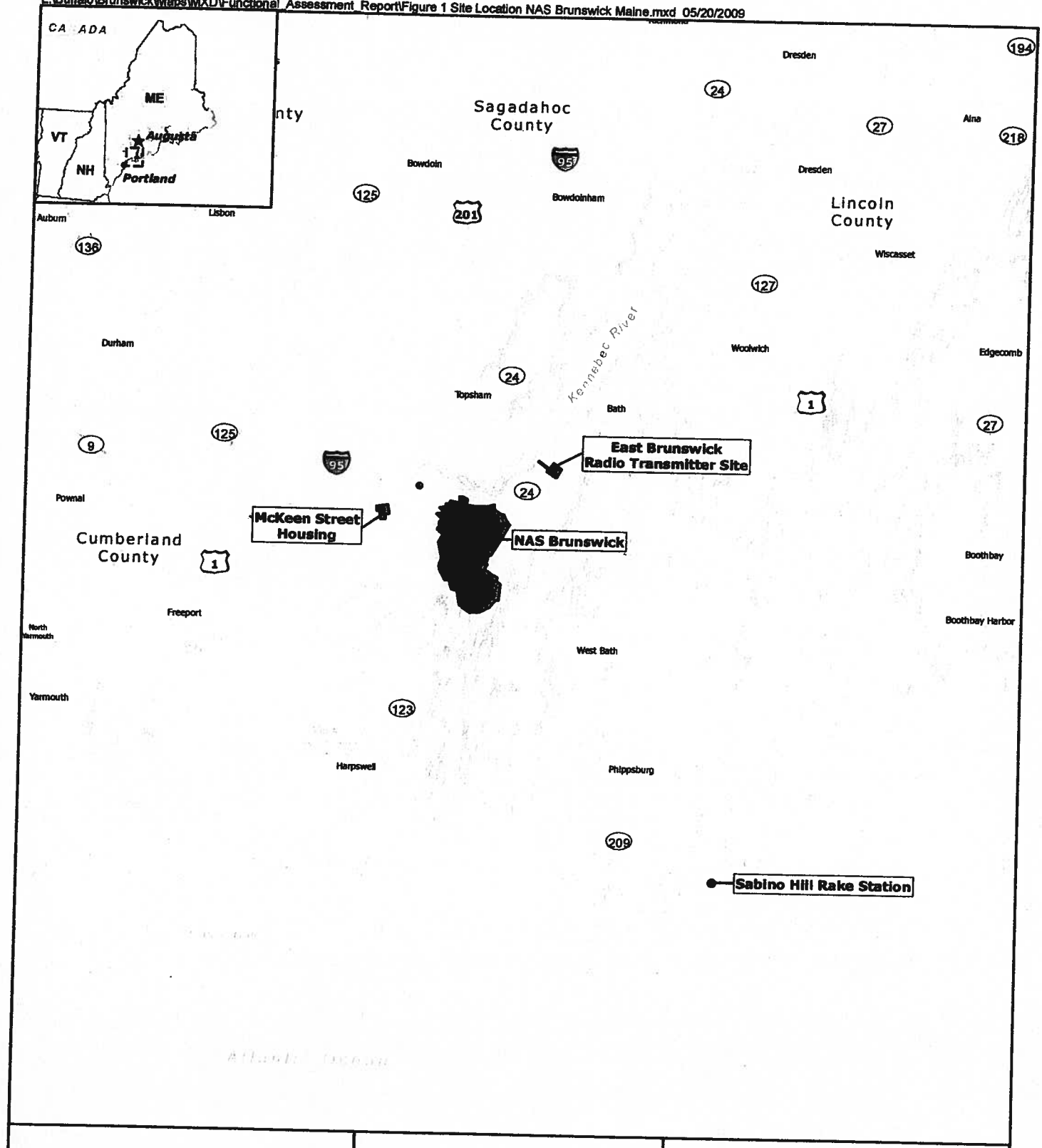
NAS Brunswick is located within the Central Maine Coastal and Interior Ecoregion. This area is comprised of glacially scoured and dissected peneplain, which slopes toward the coast and exhibits glacial features such as kames, eskers, and terraces. The topography is relatively flat to gently rolling, with elevations ranging from sea level to 1,000 feet above mean sea level (AMSL). Forests are the dominant vegetation type and consist of northern hardwood, northern hardwood-spruce, northern coastal spruce-fir, and spruce-fir-northern hardwood communities. Coastal pitch pine communities are known to occur in this ecoregion but are now uncommon. Open communities such as grasslands and tidal marshes also occur, but they do not comprise a large percentage of the overall land cover of this ecoregion (McNab and Avers 1994).

The land surrounding NAS Brunswick is predominantly residential with areas of undeveloped forests and wetlands. Upland forests are the dominant vegetation community on the installation, covering approximately 1,242 acres (41%) of the total land area (E & E 2008). Large forested communities are located on the western, southern, and eastern portions of the base. These forested communities are interspersed with wetlands, ponds, and streams. Other vegetation communities at NAS Brunswick include a variety of grasslands, wetlands, and maintained lands. Developed areas occupy the central and north-central portions of the installation. Much of the eastern and western portions of the installation are forested and interspersed with wetlands, streams, and ponds. The southern and sou-

theastern portions of the base are characterized by forest and tidal wetlands associated with Harpswell Cove and Buttermilk Cove.

NAS Brunswick is located within four watersheds: the Mere Brook/Harpswell Cove watershed, Buttermilk Cove watershed, Middle Bay watershed, and the Androscoggin River watershed. The installation is located within 0.5 mile of the Androscoggin River and Casco Bay. The installation is bisected by Mere Brook, which eventually drains into Harpswell Cove. Numerous streams, wetlands, and permanent freshwater ponds are scattered throughout the installation. Approximately 465 acres of wetlands are present on NAS Brunswick, 71% of which are freshwater and 29% are tidal (E & E 2008).

© Ecology & Environment, Inc. GIS Department Project #
L:\Buffalo\Brunswick\Maps\MXD\Functional Assessment Report\Figure 1 Site Location NAS Brunswick Maine.mxd 05/20/2009



NAS Brunswick
Municipal Boundary
County Boundary

Figure 2-1
NAS Brunswick and
Outlying Properties
Brunswick, Maine

N

0 1 2 4 6 8
Miles

3 Methodology

The vernal pool survey was conducted by E & E according to methodologies recommended by the Maine DEP for vernal pool surveys (Maine DEP 2009). The significance of a vernal pool must be determined and documented by an individual qualified by sufficient experience and training in either wetland ecology or wildlife ecology. In order to successfully identify vernal pools, field surveys must be conducted during the amphibian breeding season in early spring. In southern Maine, the MEDEP recommends conducting surveys for wood frogs between April 7 and April 21 and spotted salamanders between April 20 and May 21 (MEDEP 2009).

Prior to conducting the field survey, a desktop analysis was conducted to identify potential vernal pools at NAS Brunswick. The desktop analysis included a review of recent aerial photographs and previously mapped wetlands.

The field portion of the vernal pool survey was completed in three phases:

Phase 1: Initial survey to locate pooled areas (April 2-10)
Phase 2: Initial round of egg mass counts (April 13-17)
Phase 3: Second round of egg mass counts (April 28-30)

The installation was divided into seven search zones to facilitate the survey schedule and assist with data management. During the initial survey period, each search zone was walked in transects to ensure complete coverage of the area. Any pooled areas containing standing water several inches deep were identified as "Potential Vernal Pools." Each pool location was photographed, and a single Global Positioning System (GPS) point was taken with a Trimble GeoXH unit. In addition, information about the habitat within 250 feet surrounding the pool was recorded on standardized datasheets.

During the second phase of the survey, all of the previously identified potential vernal pools were revisited. If the sites were dry, they were recorded as such and were not revisited during the third phase. If the pool contained standing water, the pool was checked for the presence of vernal pool indicator species. The number of species and/or egg masses was recorded, and an assessment was made to determine whether the pool was significant based on the MEDEP criteria (see Table 3-1).

Table 3-1 Presence and Abundance Criteria for Determining Significant Vernal Pool Status in Maine

Species	Abundance Criterion
Wood frog	Presence of 40 or more egg masses
Spotted salamander	Presence of 20 or more egg masses
Blue-spotted salamander	Presence of 10 or more egg masses
Fairy shrimp	Presence in any life stage

Source: MEDEP 2009.

Pools identified as significant during the second phase were not revisited during the third phase. If the count was lower than the abundance criteria for determining a pool as a significant vernal pool, the site was revisited during the third phase of surveys. Pools visited during the third phase were assessed further to determine whether they were significant.

Specific characteristics of each vernal pool and significant vernal pool (i.e., water depth, water temperature, pool dimensions, and dominant vegetation) were recorded on standardized datasheets. The perimeter of each pool was delineated using the Trimble GeoXH GPS unit. The photolog and datasheets for the vernal pools and significant vernal pools are provided in Appendix A and Appendix B, respectively.

4 Results

During the initial search period, 169 pooled areas were identified (see Figure 4-1 and Table 4-1). Of these, 27 were identified as vernal pools, and 20 of these were identified as significant vernal pools using the criteria set by the MEDEP (MEDEP 2009). Blue-spotted salamander egg masses or fairy shrimp were not observed within any of the vernal pools. The delineated boundaries of vernal pools and significant vernal pools are identified on Figures 4-2 through 4-9.

Pool 119 contained a significant number of wood frog and spotted salamander egg masses (≥ 47 and ≥ 89, respectively) but was determined to be permanent; therefore, this pool was not included in the total significant vernal pool count. According to MEDEP Chapter 335, vernal pools are temporary to semi-permanent. While permanent ponds may provide habitat for vernal pool breeding amphibians, they are not designated as vernal pools by the state of Maine (06-096 CMR Chapter 335).

Table 4-1 Pooled Areas Detected within NAS Brunswick

Pool Identification Number	Total Egg Mass Count		Presence of Fairy Shrimp	Pool Classification
	Wood Frog	Spotted Salamander		
	Significant Vernal Pool Criteria			
	≥40 egg masses	≥20 egg masses	Yes/No	
Pool 1	No egg masses detected		No	Pooled Area
Pool 2	No egg masses detected		No	Pooled Area
Pool 3	No egg masses detected		No	Pooled Area
Pool 4	No egg masses detected		No	Pooled Area
Pool 5	No egg masses detected		No	Pooled Area
Pool 6	No egg masses detected		No	Pooled Area
Pool 7	No egg masses detected		No	Pooled Area
Pool 8	4	0	No	Vernal Pool
Pool 9	No egg masses detected		No	Pooled Area
Pool 10	9	0	No	Vernal Pool
Pool 11	No egg masses detected		No	Pooled Area
Pool 12	No egg masses detected		No	Pooled Area
Pool 13	No egg masses detected		No	Pooled Area
Pool 14	37	0	No	Vernal Pool

Table 4-1 Pooled Areas Detected within NAS Brunswick

Pool Identification Number	Total Egg Mass Count		Presence of Fairy Shrimp	Pool Classification
	Wood Frog	Spotted Salamander		
	Significant Vernal Pool Criteria			
	≥40 egg masses	≥20 egg masses	Yes/No	
Pool 15	2	0	No	Vernal Pool
Pool 16	No egg masses detected		No	Pooled Area
Pool 17	No egg masses detected		No	Pooled Area
Pool 18	No egg masses detected		No	Pooled Area
Pool 19	No egg masses detected		No	Pooled Area
Pool 20	No egg masses detected		No	Pooled Area
Pool 21	No egg masses detected		No	Pooled Area
Pool 22	No egg masses detected		No	Pooled Area
Pool 23	No egg masses detected		No	Pooled Area
Pool 24	No egg masses detected		No	Pooled Area
Pool 25	4	12	No	Vernal Pool
Pool 26	No egg masses detected		No	Pooled Area
Pool 27	No egg masses detected		No	Pooled Area
Pool 28	No egg masses detected		No	Pooled Area
Pool 29	No egg masses detected		No	Pooled Area
Pool 30	No egg masses detected		No	Pooled Area
Pool 31	No egg masses detected		No	Pooled Area
Pool 32	**0**	**≥ 20**	**No**	**Significant Vernal Pool**
Pool 33	11	1	No	Vernal Pool
Pool 34	No egg masses detected		No	Pooled Area
Pool 35	**3**	**27**	**No**	**Significant Vernal Pool**
Pool 36	**≥ 40**	**10**	**No**	**Significant Vernal Pool**
Pool 37	No egg masses detected		No	Pooled Area
Pool 38	No egg masses detected		No	Pooled Area
Pool 39	0	3	No	Vernal Pool
Pool 40	No egg masses detected		No	Pooled Area
Pool 41	No egg masses detected		No	Pooled Area
Pool 42	No egg masses detected		No	Pooled Area
Pool 43	No egg masses detected		No	Pooled Area
Pool 44	No egg masses detected		No	Pooled Area
Pool 45	No egg masses detected		No	Pooled Area
Pool 46	No egg masses detected		No	Pooled Area
Pool 47	No egg masses detected		No	Pooled Area
Pool 48	**69**	**0**	**No**	**Significant Vernal Pool**
Pool 49	No egg masses detected		No	Pooled Area
Pool 50	No egg masses detected		No	Pooled Area
Pool 51	0	17	No	Vernal Pool
Pool 52	**74**	**0**	**No**	**Significant Vernal Pool**
Pool 53	2	0	No	Vernal Pool

Table 4-1 Pooled Areas Detected within NAS Brunswick

Pool Identification Number	Total Egg Mass Count		Presence of Fairy Shrimp	Pool Classification
	Wood Frog	Spotted Salamander		
	Significant Vernal Pool Criteria			
	≥40 egg masses	≥20 egg masses	Yes/No	
Pool 54	**44**	**0**	**No**	**Significant Vernal Pool**
Pool 55	No egg masses detected		No	Pooled Area
Pool 56	No egg masses detected		No	Pooled Area
Pool 57	No egg masses detected		No	Pooled Area
Pool 58	No egg masses detected		No	Pooled Area
Pool 59	No egg masses detected		No	Pooled Area
Pool 60	No egg masses detected		No	Pooled Area
Pool 61	No egg masses detected		No	Pooled Area
Pool 62	No egg masses detected		No	Pooled Area
Pool 63	No egg masses detected		No	Pooled Area
Pool 64	No egg masses detected		No	Pooled Area
Pool 65	No egg masses detected		No	Pooled Area
Pool 66	No egg masses detected		No	Pooled Area
Pool 67	No egg masses detected		No	Pooled Area
Pool 68	No egg masses detected		No	Pooled Area
Pool 69	No egg masses detected		No	Pooled Area
Pool 70	No egg masses detected		No	Pooled Area
Pool 71	No egg masses detected		No	Pooled Area
Pool 72	No egg masses detected		No	Pooled Area
Pool 73	No egg masses detected		No	Pooled Area
Pool 74	No egg masses detected		No	Pooled Area
Pool 75	7	4	No	Vernal Pool
Pool 76	No egg masses detected		No	Pooled Area
Pool 77	No egg masses detected		No	Pooled Area
Pool 78	0	1	No	Vernal Pool
Pool 79	0	3	No	Vernal Pool
Pool 80	**161**	**2**	**No**	**Significant Vernal Pool**
Pool 81	No egg masses detected		No	Pooled Area
Pool 82	No egg masses detected		No	Pooled Area
Pool 83	**≥ 40**	**6**	**Yes**	**Significant Vernal Pool**
Pool 84	No egg masses detected		No	Pooled Area
Pool 85	**57**	**0**	**No**	**Significant Vernal Pool**
Pool 86	No egg masses detected		No	Pooled Area
Pool 87	No egg masses detected		No	Pooled Area
Pool 88	No egg masses detected		No	Pooled Area
Pool 89	No egg masses detected		No	Pooled Area
Pool 90	No egg masses detected		No	Pooled Area
Pool 91	No egg masses detected		No	Pooled Area
Pool 92	No egg masses detected		No	Pooled Area

Table 4-1 Pooled Areas Detected within NAS Brunswick

Pool Identification Number	Total Egg Mass Count		Presence of Fairy Shrimp	Pool Classification
	Wood Frog	Spotted Salamander		
	Significant Vernal Pool Criteria			
	≥40 egg masses	≥20 egg masses	Yes/No	
Pool 93	No egg masses detected		No	Pooled Area
Pool 94	3	5	No	Vernal Pool
Pool 95	No egg masses detected		No	Pooled Area
Pool 96	No egg masses detected		No	Pooled Area
Pool 97	0	14	No	Vernal Pool
Pool 98	2	12	No	Vernal Pool
Pool 99	No egg masses detected		No	Pooled Area
Pool 100	**51**	**0**	**No**	**Significant Vernal Pool**
Pool 101	No egg masses detected		No	Pooled Area
Pool 102	No egg masses detected		No	Pooled Area
Pool 103	No egg masses detected		No	Pooled Area
Pool 104	No egg masses detected		No	Pooled Area
Pool 105	No egg masses detected		No	Pooled Area
Pool 106	No egg masses detected		No	Pooled Area
Pool 107	No egg masses detected		No	Pooled Area
Pool 108	No egg masses detected		No	Pooled Area
Pool 109	No egg masses detected		No	Pooled Area
Pool 110	No egg masses detected		No	Pooled Area
Pool 111	4	4	No	Vernal Pool
Pool 112	No egg masses detected		No	Pooled Area
Pool 113	No egg masses detected		No	Pooled Area
Pool 114	**12**	**3**	**Yes**	**Significant Vernal Pool**
Pool 115	No egg masses detected		No	Pooled Area
Pool 116	No egg masses detected		No	Pooled Area
Pool 117	No egg masses detected		No	Pooled Area
Pool 118	**54**	**8**	**No**	**Significant Vernal Pool**
Pool 119 (permanent)	≥ 47	≥ 89	No	Permanent Pool
Pool 120	**47**	**35**	**No**	**Significant Vernal Pool**
Pool 121	No egg masses detected		No	Pooled Area
Pool 122	14	0	No	Vernal Pool
Pool 123	**≥ 50**	**0**	**No**	**Significant Vernal Pool**
Pool 124	14	0	No	Vernal Pool
Pool 125	No egg masses detected		No	Pooled Area
Pool 126	No egg masses detected		No	Pooled Area
Pool 127	No egg masses detected		No	Pooled Area
Pool 128	2	5	No	Vernal Pool
Pool 129	No egg masses detected		No	Pooled Area
Pool 130	No egg masses detected		No	Pooled Area

Table 4-1 Pooled Areas Detected within NAS Brunswick

Pool Identification Number	Total Egg Mass Count		Presence of Fairy Shrimp	Pool Classification
	Wood Frog	Spotted Salamander		
	Significant Vernal Pool Criteria			
	≥40 egg masses	≥20 egg masses	Yes/No	
Pool 131-1	No egg masses detected		No	Pooled Area
Pool 131-2	No egg masses detected		No	Pooled Area
Pool 132	No egg masses detected		No	Pooled Area
Pool 133	No egg masses detected		No	Pooled Area
Pool 134	No egg masses detected		No	Pooled Area
Pool 135	No egg masses detected		No	Pooled Area
Pool 136	No egg masses detected		No	Pooled Area
Pool 137	No egg masses detected		No	Pooled Area
Pool 138	0	8	No	Vernal Pool
Pool 139	No egg masses detected		No	Pooled Area
Pool 140	No egg masses detected		No	Pooled Area
Pool 141	No egg masses detected		No	Pooled Area
Pool 142	96	10	No	Significant Vernal Pool
Pool 143	6	0	No	Vernal Pool
Pool 144	≥28	≥ 22	No	Significant Vernal Pool
Pool 145	No egg masses detected		No	Pooled Area
Pool 146	19	≥62	Yes	Significant Vernal Pool
Pool 147	No egg masses detected		No	Pooled Area
Pool 148	No egg masses detected		No	Pooled Area
Pool 149	0	11	No	Vernal Pool
Pool 150	No egg masses detected		No	Pooled Area
Pool 151	No egg masses detected		No	Pooled Area
Pool 152	No egg masses detected		No	Pooled Area
Pool 153	1	6	No	Vernal Pool
Pool 154	2	1	No	Vernal Pool
Pool 155	No egg masses detected		No	Pooled Area
Pool 156	No egg masses detected		No	Pooled Area
Pool 157	No egg masses detected		No	Pooled Area
Pool 158	4	49	No	Significant Vernal Pool
Pool 159	No egg masses detected		No	Pooled Area
Pool 160	No egg masses detected		No	Pooled Area
Pool 161	No egg masses detected		No	Pooled Area
Pool 162	17	0	No	Vernal Pool
Pool 163	36	23	No	Significant Vernal Pool
Pool 164	No egg masses detected		No	Pooled Area
Pool 165	No egg masses detected		No	Pooled Area
Pool 166	11	0	No	Vernal Pool
Pool 167	104	1	No	Significant Vernal Pool
Pool 168	0	8	No	Vernal Pool

Table 4-1 Pooled Areas Detected within NAS Brunswick

Pool Identification Number	Total Egg Mass Count		Presence of Fairy Shrimp	Pool Classification
	Wood Frog	Spotted Salamander		
	Significant Vernal Pool Criteria			
	≥40 egg masses	≥20 egg masses	Yes/No	
Totals				
			Pooled Areas	**121**
			Vernal Pools	**27**
			Significant Vernal Pools	**20**
			Permanent Pools	**1**

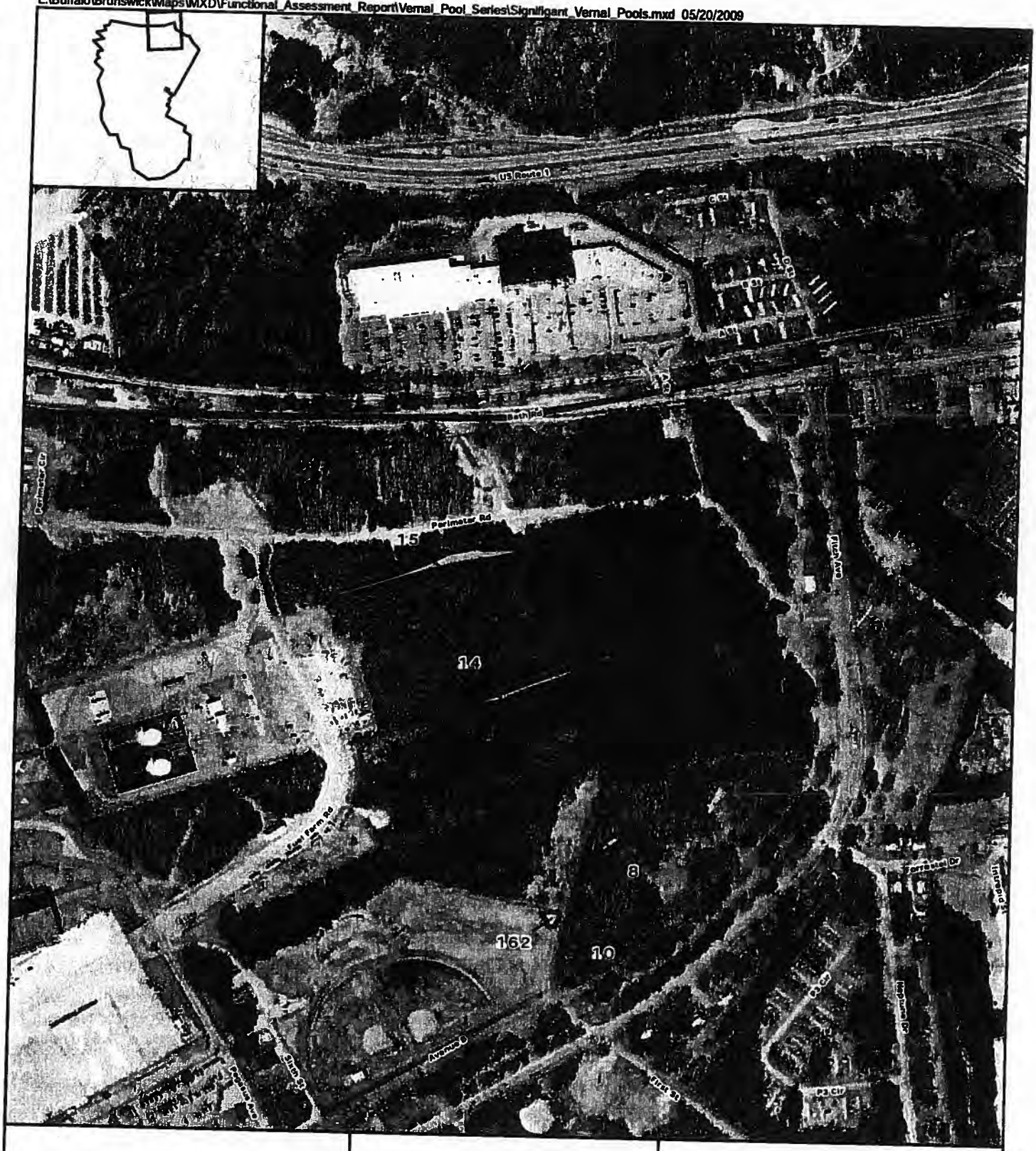
Blue = Significant Vernal Pool
Note: Values for wood frog and spotted salamander egg masses reflect the maximum number detected over three potential visits for each species.

Approximately 75% of the significant vernal pool habit identified at NAS Brunswick was located within mixed forest communities. Dominant tree species identified at these locations included white pine (*Pinus strobus)*, red maple (*Acer rubrum*); and balsam fir (*Abies balsamea*). The remaining 25% of the significant vernal pool habitat was identified within successional shrubland or grassland communities.

Significant vernal pools ranged in length from 41 to 239 feet and had an average length of 136.9 feet. These pools ranged in width from 10 to 137 feet and had an average width of 47.6 feet. Significant vernal pool depth ranged from 4 to greater than 48 inches and averaged 14.6 inches. Pool temperatures at these locations ranged from 38 to 68 degrees Fahrenheit and had a mean temperature of 52.1 degrees Fahrenheit.

Figure 4-1
Pooled Areas at
NAS Brunswick
Brunswick, Maine

© Ecology & Environment, Inc. GIS Department Project #
L:\Buffalo\Brunswick\Maps\MXD\Functional_Assessment_Report\Vernal_Pool_Series\Significant_Vernal_Pools.mxd 05/20/2009



Vernal Pool
Significant Vernal Pool
NAS Brunswick Property Boundary

Figure 4-2
Significant Vernal Pools and
Vernal Pools at
NAS Brunswick
Brunswick, Maine

N

0 250 500 1,000
Feet

© Ecology & Environment, Inc. GIS Department Project #
L:\Buffalo\Brunswick\Maps\MXD\Functional_Assessment_Report\Vernal_Pool_Series\Significant_Vernal_Pools.mxd 05/20/2009

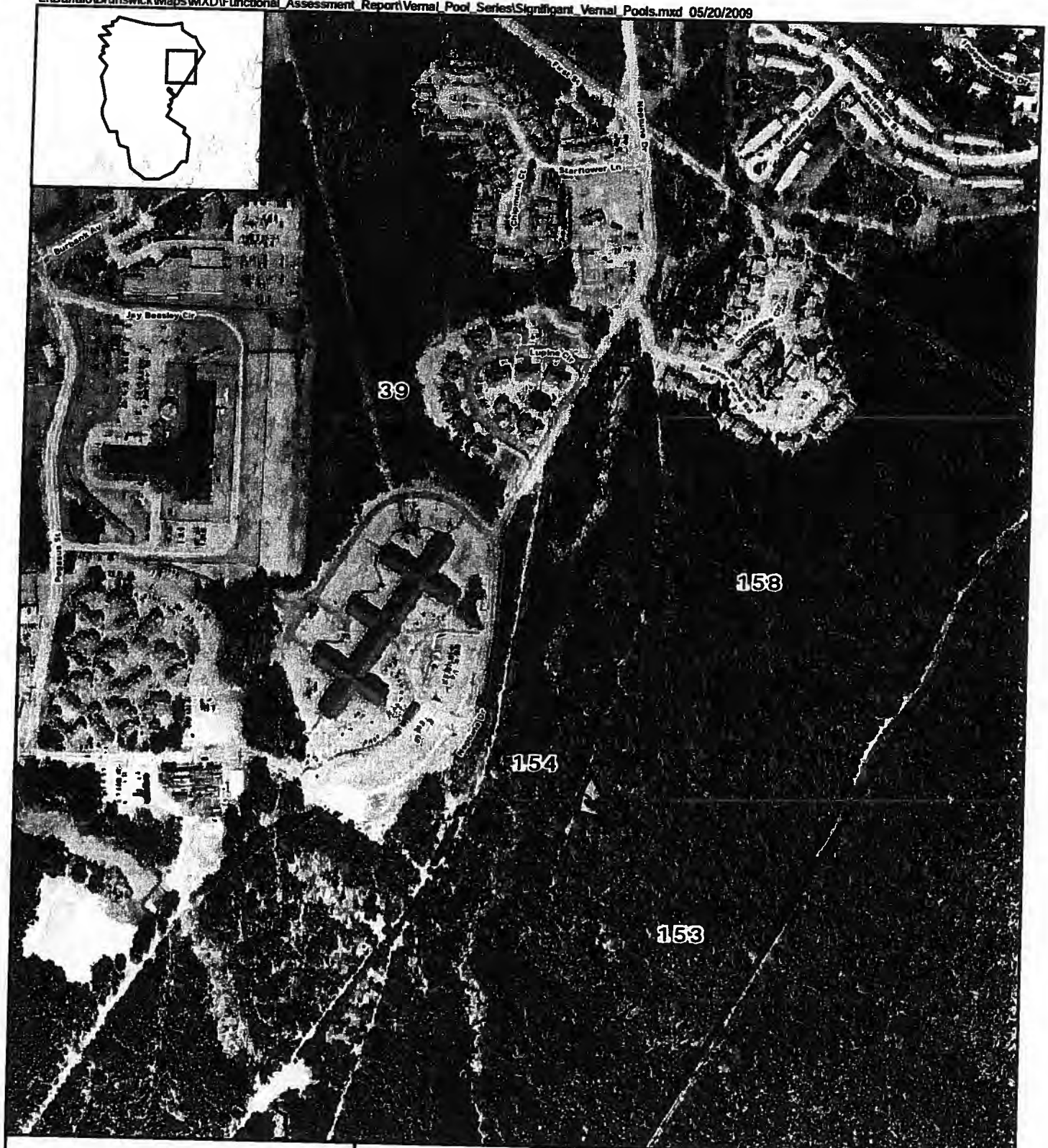
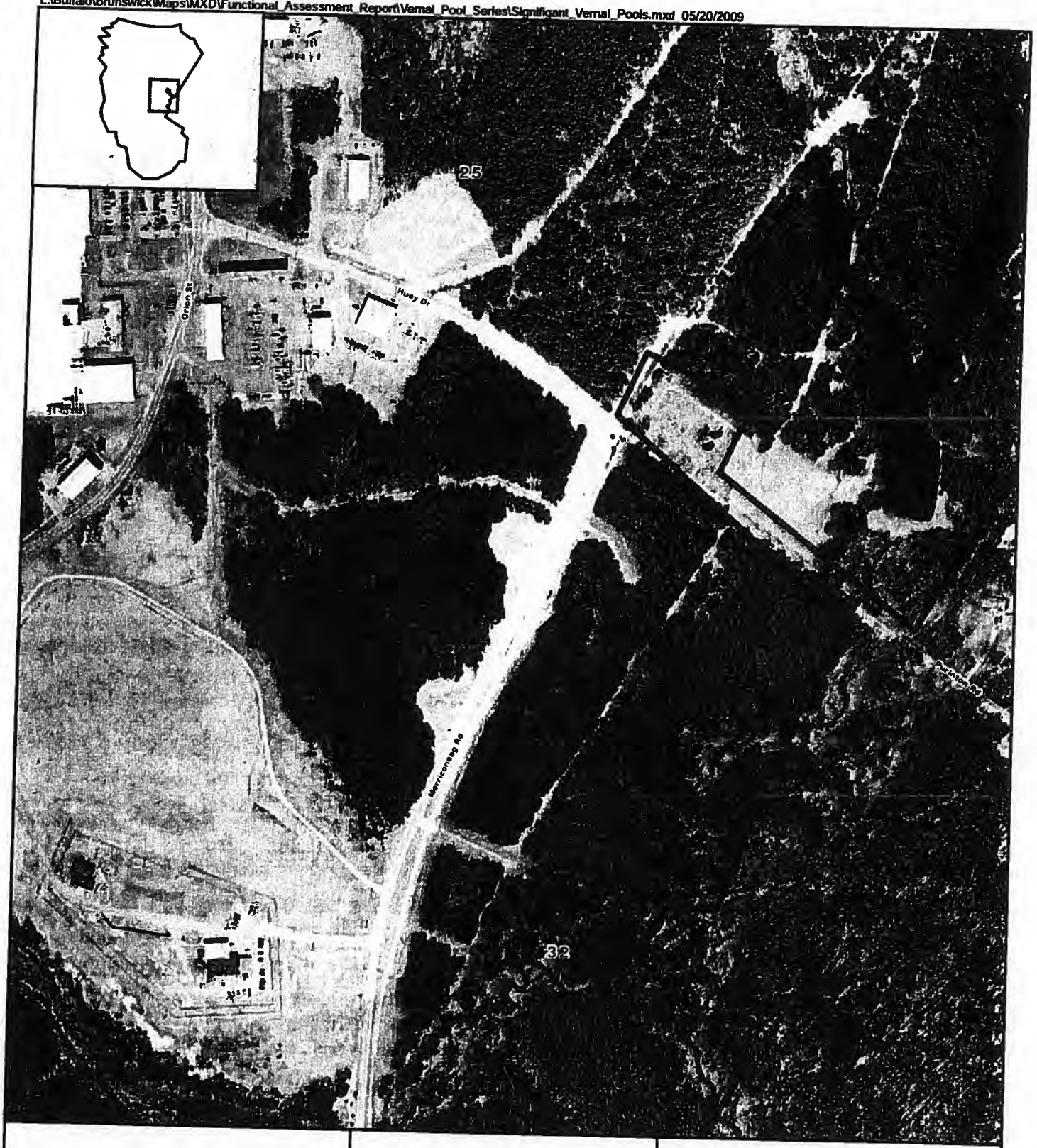


Figure 4-3
Significant Vernal Pools and
Vernal Pools at
NAS Brunswick
Brunswick, Maine

© Ecology & Environment, Inc. GIS Department Project #
L:\Buffalo\Brunswick\Maps\MXD\Functional_Assessment_Report\Vernal_Pool_Series\Significant_Vernal_Pools.mxd 05/20/2009



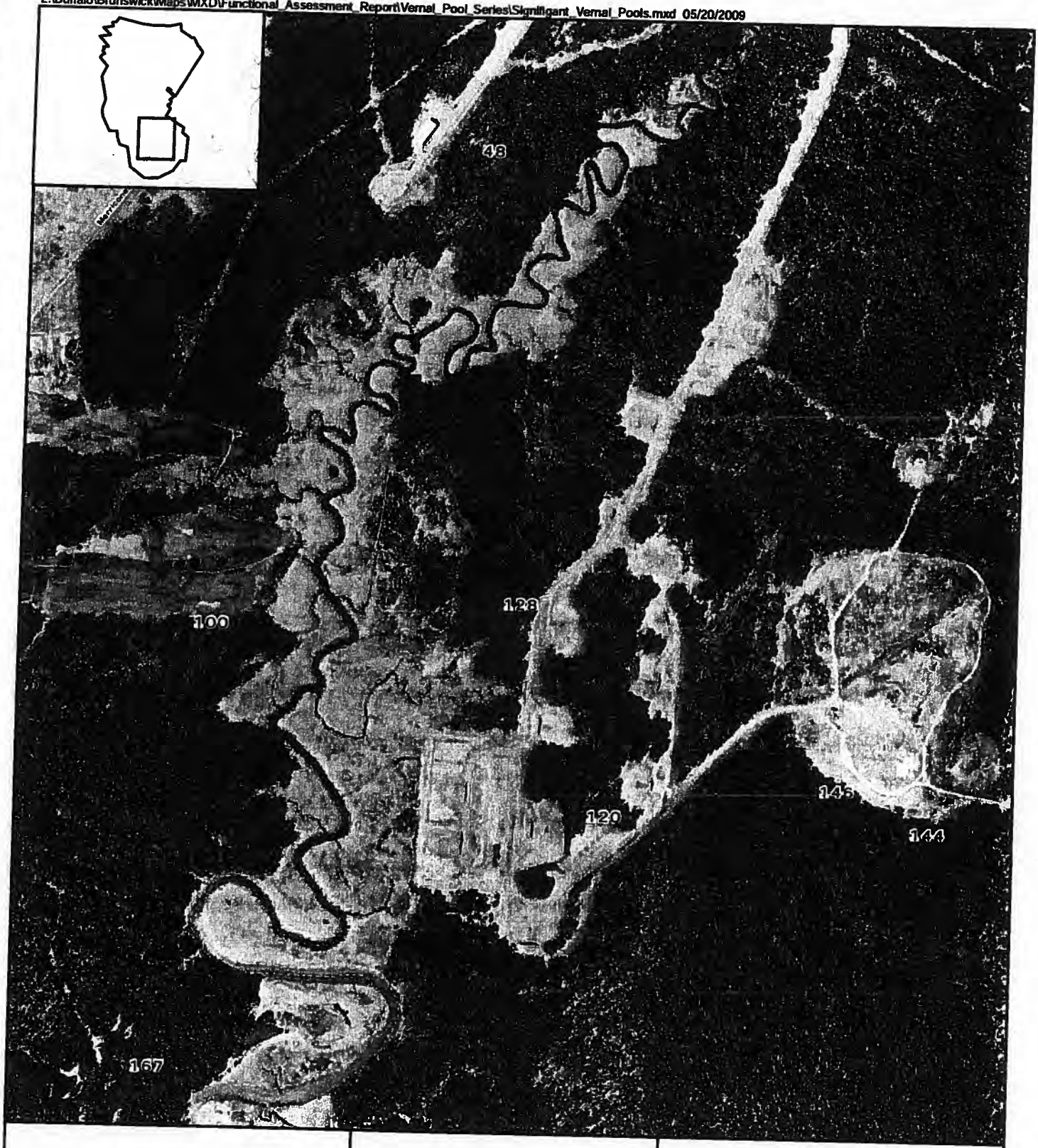
Vernal Pool
Significant Vernal Pool
NAS Brunswick Property Boundary

Figure 4-4
Significant Vernal Pools and
Vernal Pools at
NAS Brunswick
Brunswick, Maine

N

0 250 500 1,000
Feet

© Ecology & Environment, Inc. GIS Department Project #
L:\Buffalo\Brunswick\Maps\MXD\Functional_Assessment_Report\Vernal_Pool_Series\Significant_Vernal_Pools.mxd 05/20/2009



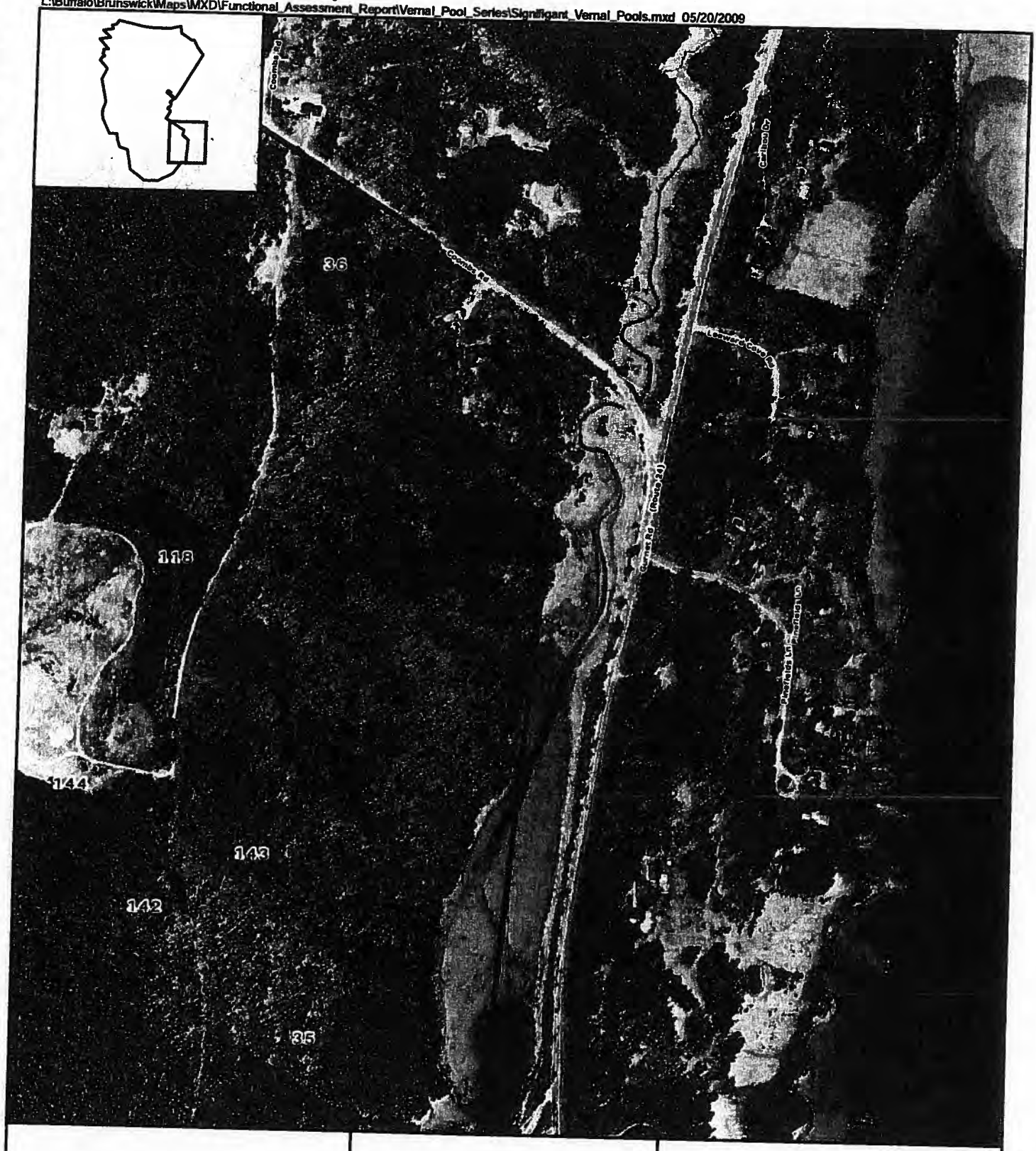
Vernal Pool
Significant Vernal Pool
NAS Brunswick Property Boundary

Figure 4-5
Significant Vernal Pools and
Vernal Pools at
NAS Brunswick
Brunswick, Maine

N

0 250 500 1,000
Feet

© Ecology & Environment, Inc. GIS Department Project #
L:\Buffalo\Brunswick\Maps\MXD\Functional_Assessment_Report\Vernal_Pool_Series\Significant_Vernal_Pools.mxd 05/20/2009



Vernal Pool
Significant Vernal Pool
NAS Brunswick Property Boundary

Figure 4-6
Significant Vernal Pools and
Vernal Pools at
NAS Brunswick
Brunswick, Maine

N

0 250 500 1,000
Feet

© Ecology & Environment, Inc. GIS Department Project #
L:\Buffalo\Brunswick\Maps\MXD\Functional_Assessment_Report\Vernal_Pool_Series\Significant_Vernal_Pools.mxd 05/20/2009

Vernal Pool
Significant Vernal Pool
NAS Brunswick Property Boundary

Figure 4-7
Significant Vernal Pools and
Vernal Pools at
NAS Brunswick
Brunswick, Maine

N

0 250 500 1,000
Feet