functioning wetlands, and farms and will lead the way into a new and more truly sustainable economy.

Outside of economic considerations, management of woodlands requires a careful examination of the suite of services forests provide. Clean water, wildlife and biological resources as well as recreational considerations all need to be examined as part of any timber plan in an effort to reach a balanced and sustainable management policy.

East River Marsh Complex

The upper reaches of the East River trends northwest/southeast adjacent to the post agricultural fields and the private Goss homestead, and defines the western boundary of the property. This landscape lies within Connecticut's coastal ecoregion, with relatively level but rolling near shore lands and elevations less than 400 feet to near sea level. The metamorphic bedrock is rarely obvious within the tidal marsh system, except to define near shore pockets of upland trees, predominately red cedars. Glacial alluvium – evident in the adjacent fields – is overlain in the tidal wetlands with organic deposits that form the foundation of the marsh ecosystem. At low tide, extensive mudflats are exposed beyond the vegetated fringe of the marsh.

The tidal wetlands on the property are brackish grading to increasingly freshwater on a south to north axis. Seasonally this gradation changes, influenced by the upland watershed spring freshet and late season salt influence, explaining the diversity of both salt and freshwater plant species found at the site.

North of the Foote's Bridge there is a narrow band of freshwater tidal marsh vegetation dominated by sweetflag (*Acorus calamus)*, arrow arum (*Peltandra virginica)* and cattail (*Typha angustifolia)*, interspersed with jewelweed (*Impatiens capensis)*, royal fern (*Osmunda regalis)*, water parsnip (*Sium suave)* and Canadian rush (*Juncus Canadensis)*. Swamp rose (*Rosa palustris)* occurs on the higher elevations adjacent to this narrow marsh fringe.

The predominant natural community found at the upper East River marsh complex is the narrow leaf cattail (*Typha angustifolia*) tidally flooded grassland, with some areas dominated by common reed (*Phragmites australis*), and to a lesser extent bulrush (*Schoenoplectus robustus*) [*Bolboschoenus robustus*], and smooth cordgrass (*Spartina alterniflora*).

Small areas of broadleaf arrowhead (*Sagittaria latifolia*) occupy the mudflats of the northern most marsh area, and wild rice (*Zizania aquatica*) grades from north to south, largely disappearing after the first large bend in the river. Plants occurring to a lesser extent in the northern fringes of the marsh

complex include soft-stem bulrush (*Schoenoplectus tabernaemontani),* mock bishop-weed (*Ptilimnium capillaceum*), water smartweed (*Polygonum punctatum*), Beggar-ticks [bur-marigolds] (*Bidens* spp), and common three-square rush (*Scirpus pungens*). Where drier land prevails within the marsh, isolated copses of eastern red cedar (*Juniperus virginiana*), bayberry (*Myrica pensylvanica),* highbush blueberry (*Vaccinium corymbosum*) occur along with poison ivy (*Toxicodendron radicans)* and patches of climbing hempvine (*Mikania scandens*). Water hemp (*Amaranthus cannabinus*) occurs throughout the marsh complex, from north to south.

Throughout the entire marsh complex, the lower marsh elevations that border the mainstem of the river and tidal inlets is fringed with smooth cordgrass (*Spartina alterniflora*). This area also supports bulrush (*Schoenoplectus robustus*) [*Bolboschoenus robustus*], water hemp, prairie cordgrass (*Spartina pectinata*), and to the north, soft-stemmed bulrush. To the south, this fringe area grades into pockets of high marsh saltmeadow cordgrass (*Spartina patens*), revealing the greater influence of salt as the river passes under the bridge at Clapboard Hill Road.

As the East River winds southward, while the basic plant community dominated by narrow-leaved cattail prevails, there are gradual and often subtle shifts of individual species that reflect the gradation of salinity. To the south, annual and perennial salt marsh aster (*Aster subtulatus* and *Symphyotrichum tenuifolium,* respectively) can be found, as well as marsh orach (*Atriplex patula*).

Of particular interest, throughout the entire marsh complex, interspersed within the broad stands of cattail, there are small openings dominated by smooth cordgrass, often stunted, and varying amounts of water hemp (*Amaranthus cannabinus*), asters, and to the south, orach (*Atriplex patula*) and saltmeadow cordgrass. Several of these openings are dominated by mudwort (*Limosella australis)* a species of special concern in Connecticut.

The midsections of the East River marsh complex have the highest concentrations of common reed (*Phragmites australis*), often associated with drainage ditches. These stands are particularly robust and monotypic.

Marsh Management – The upper watershed features of the East River marshes found in the project site provide important nutrient and energy inputs to the marsh system further downriver as well as, ultimately, to the Long Island Sound estuary. This includes the resources that support globally significant species such as the saltmarsh sparrow (*Ammodramus caudacutus*) and least shrew (*Cryptotis parva*).

The upper East River marshes in the project area are critical nursery, feeding, resting and shelter habitat for a broad spectrum of migratory and resident fish

and waterfowl species. As such they support species of Greatest Conservation Need (GCN) as identified in Connecticut's Comprehensive Wildlife Strategy. Although these marshes are narrow, collectively they may support rails and/or bitterns; a comprehensive callback survey would determine the viability of the marshes to support these species, and then what management strategies would be necessary to maintain or improve habitat for these birds.

Providing artificial nest boxes (for ducks, bluebirds, purple martins or tree swallows) comes with the added need for maintenance, including regular checking and cleaning. To the extent possible, providing and even creating (by girdling) mature standing cavity trees along the field edge and/or within the riparian corridor would create much needed wildlife cavity sites.

A professional fish survey would provide more specific baseline data from which a current and future understanding of habitat quality could be assessed; it would also confirm the presence or absence of historic fish species known to the area, such as the rainbow smelt (*Osmerus mordax*). Similarly, a survey of freshwater mussels could reveal species previously unknown from the area, and provide a confirmation of healthy fish populations. Connecticut DEP Inland Fisheries Division unpublished data suggests that larger streams in the East River watershed support annual runs of river herrings, sea-run brown trout and American eel, and is one of the few watersheds west of the Connecticut River that support sea lamprey runs. The presence of these fish implies that the West River is ecologically important.

The greatest existing threat to the tidal marsh complex is the spread of the non-native invasive common reed (*Phragmites australis*). This plant has its greatest foothold in the middle portion of the marsh, adjacent to the private Goss property. Although the existing vegetation within the marsh complex is reasonably diverse, if left unchecked *Phragmites* can become dominant, resulting in diminished ecosystem function, and most notably wildlife habitat. Although management by hand cutting and select herbicide application is possible, a large-scale removal project and follow-up applications over several years is likely to deliver the most effective control. The objective should not be to eliminate *Phragmites*, but to reduce its overall coverage so that it is a component, and not dominant element of the marsh system.

Management considerations for (potential) listed plant species found at the site: salt marsh bulrush (*Scirpus cylindricus*), mudwort (*Limosella subulata*) and arrowleaf (*Sagittaria subulata*), fall under the rubric of maintaining a healthy, functioning brackish tidal marsh system. The spread of *Phragmites*, at this point, is the single greatest threat to these listed plant species by replacing habitat and altering hydrology.

The marsh was also ditched as part of the historic effort to drain surface standing water in the 1930's. The unnatural straight edge of these ditches takes away from the aesthetic appeal of a natural, untouched marsh. Most of these ditches are lined with Spartina grasses; filling the ditches may provide more habitat for these native salt marsh grasses, and the attendant wildlife species that use them. To the extent that these grid ditches impact marsh hydrology by draining surface waters more quickly than an unditched marsh, one could argue for their removal; alternatively, they also convey brackish water further into the marsh, serving as vectors for native plant species and habitat and, conceivably, the means for influencing the less salt tolerant non-native *Phragmites*. This would be increasingly true as sea level rises. Although not a pressing need, filling the grid ditches could provide aesthetic and habitat amenities, as well as restoring historic views of this impressive marsh complex.

The interface between the tidal marsh and upland requires several important considerations for management. Although natural erosion is occurring on several steep slopes in the riparian area adjacent to the marsh, most of this is related to slope instability associated with the natural sinuosity of the East River, undercutting as the channel moves. Natural leaf litter and woody debris associated with bordering riparian vegetation is an important element of the nutrient and energy system of the river, providing cooling shade and important structural habitat for fish; it should not be removed or any efforts made to "clean up" fallen trees.

Sea level rise will challenge the long-term survival of the East River marsh system, particularly where steep bedrock uplands border the existing marsh at the southern end of the project site. Where the agricultural fields border or lie in close proximity to the marsh to the east the opportunity exists to accommodate advancing high marsh vegetation. Management of the existing upland boundary of the marsh should include the flexibility to accommodate advancing tidal waters, including the upland advance of the fringing riparian vegetation. This ultimately will impinge on the total amount of agricultural land, but the timeframes for this transition are broad. The gentler slopes along the more northern fringes of the East River tidal marshes should be considered as flexible transition areas for the eventual inland migration of these natural communities. As the scientific community expands its understanding of sea level rise, it is not too early to consider establishing upland buffer areas that can accommodate advancing water levels and permit marsh migration inland. Baseline inventory and periodic surveys to track invasive species advance and introductions is recommended.

Periodic water quality testing (parameters such as DO, N and fecal coliform are useful) is recommended to alert managers to potential problems up river or to current practices on the property. Scientific inquiry at the site could yield important baseline information for the property.

Clockwise from top left: ◆ Example of small opening in cattail, dominated by smooth cordgrass, often stunted, and varying amounts of water hemp, aster, and to the south, orach and saltmeadow cordgrass. ◆ Wild rice (*Zizania aquatica)* in northern marsh area. ◆ Bulrush (*Schoenoplectus robustus*) found throughout the marsh complex. ◆ Orach (*Atriplex patula*), a familiar saltmarsh native, is found in the brackish marsh as well. ◆ Looking west across the marsh: *Typha* dominates (tan), *Phragmites* grows higher than the typha (green, to left), and *Spartina* rims the ditches (bright green) that lead away from the mainstem of the East River. Edge species line the bank in the foreground. ◆ Prairie cordgrass (*Spartina pectinata),* often found in the southern marsh area associated with *Spartina alterniflora.*

J Preston 2010