

Baseline vegetation survey of Calstock wetland

Introduction.

As part of the annual *Schoenoplectus* monitoring programme on the Tamar Estuary Natural England have requested a more detailed vegetation survey of the newly created Calstock wetland tidal retreat site where triangular club rush and its hybrid form have been established.

The Calstock wetland creation scheme was completed in November 2021 to provide a new flood defence solution, to the south-east of Calstock. The previous flood defence embankment maintained by the EA after recent extensive strengthening works was deemed still in poor condition and that retaining the old embankment was not economically viable. An important part of the scheme was the creation of approximately 11ha of intertidal habitat, required to satisfy legal requirements of the Habitats Directive.

The intertidal habitat was required to compensate for losses identified in the Tamar Estuary. The Tamar Estuary is a Special Area of Conservation (SAC) designated under the EU Habitats Directive and part of the estuary is also a Special Protection Area (SPA, designated under the European Union (EU) Birds Directive. Maintaining and improving existing flood defences would result in the loss of European designated intertidal habitat caused by coastal squeeze (the loss of existing intertidal habitat in front of defences as a result of rising sea levels that drown out the habitat). This will adversely affect the integrity of the Plymouth Sound and Estuaries SAC and Tamar Complex SPA. Under the Habitats Regulations, it was therefore a statutory requirement for the Environment Agency to create habitat to compensate for that lost.

The Calstock Flood Defence and Habitat Creation Scheme included the construction of new set back earth embankments to improve the flood resilience of Calstock; the excavation of a creek network and the breaching of the old flood defence embankment, which allows tidal inundation of the site. It was anticipated that the 11ha habitat site would develop as a mosaic of reed bed, mudflats and creeks.

The breach in the old flood bank (made on 13th November 2021), allowed tidal water to flood the old grazing fields allowing intertidal habitat to develop. Excavated material was placed in the old toe drain in order to channel ebb and flood flows within the creek network that had been excavated to provide material for the new flood banks and produce a greater physical diversity for later habitat development. It was anticipated that natural colonisation by reeds (*Phragmites australis*), would form the majority of the new intertidal habitat, with some diversification of salt meadow species along the creek edges. The breach was bridged with a pedestrian bridge to allow public access along the footpath on top of the old estuary defences. Since the breach the ebb flow has created significant scour at the confluence with the main channel causing shear failure of the banks and is working the erosion face back into the new inter-tidal area undermining the bridge supports and moving inland exposing old land drains.

It was the stated intention to allow the site to develop naturally although some selective planting was to be acceptable and areas were landscaped to optimum levels to accommodate later planting of *Schoenoplectus* species. This planting took place in both 2022 and 2023 resulting in established and flowering stands of both the pure and hybrid forms of the triangular club-rush .

In order to monitor the development of the vegetation within the intertidal areas and its subsequent influences on the introduced rushes a baseline survey was requested within two years of the initial breach taking place. Attempts to identify the exact plant community structure of the vegetation prior to the breach have so far been unsuccessful. The initial

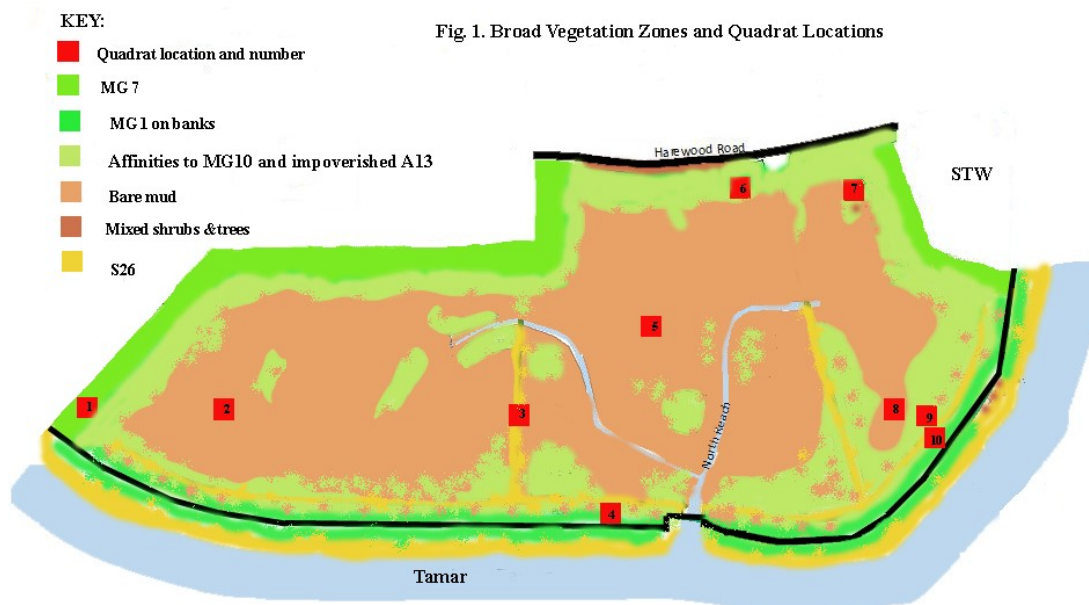
Preliminary Environmental Assessment undertaken by Mott MacDonald in 2017 prior to any engineering works is described as “Improved or semi-improved neutral grassland consisting of four large (two containing sheep) and two small improved fields within the survey extent, the larger fields have areas of nettles and are primarily comprised of perennial ryegrass *Lolium perenne*, cocks foot *Dactylis glomerata* and Yorkshire fog *Holcus lanatus* grasses. The small fields are over grazed fields, one of which has horses. On the left bank of the river there is a small improved field bordered by a footpath and a strip of reedbed habitat.”

“Species include meadowsweet *Filipendula ulmaria*, ivy leaved toadflax *Cymbalaria muralis* (within a culvert wall), rosebay willow herb *Chamerion angustifolium*, meadow foxtail *Alopecurus pratensis*, timothy *Phleum pratense*, corky fruited water dropwort *Oenanthe pimpinelloides*, soft rush *Juncus effusus*, sweet vernal grass *Anthoxanthum odoratum*, lesser celandine *Ranunculus ficaria*, hogweed *Heracleum sphondylium*, wavy bitter cress *Cardamine flexuosa*, mouse ear *Cerastium vulgatum*, cow parsley *Anthriscus sylvestris*, meadow buttercup *Ranunculus acris*, cleavers *Galium aparine*, spanish bluebell *Hyacinthoides hispanica* and ribwort plantain *Plantago lanceolata*. The semi improved grassland strip then merges into a reedbed habitat that borders the River Tamar.”

“The toe drain at the base of the flood defence embankment has a number of aquatic plants including duckweed *Lemnoideae* sp. and brooklime *Veronica beccabunga*.”

My personal experience of the site prior to the breach suggested that the site was floristically richer than described in the PEA referenced above and contained a wider range of plant communities from aquatic submerged and emergent plants dominated by common reed within the ditches and pond to various wet-dry neutral grassland and marginal scrub communities. These were managed variously by grazing or cutting or clearance regimes and also influenced by variable water levels within the site.

The area defined by this study covers all land below MHWS within the newly created intertidal habitat area and the historic and newly created banks and landward marginal vegetation communities as shown on Figure 1.



Survey Method.

Desk Survey.

A review was undertaken of information held by the client, Statutory Authorities, standard text and web site searches.

Field survey.

Site evaluation is was undertaken during five site visits during August and September 2023. The plant survey followed that set out in the British Plant Communities series for appraisal of the National Vegetation Classification. This basically comprises an initial walk over survey appraising the broad habitat types and compiling a higher plant species list of those plants present on site on a present/absent basis but no attempt was made to be comprehensive or access abundance. The nomenclature of species follows that given in Stace (1997).

10 survey plots of 2m x 2m were then selected randomly within at least one representative habitat and the species and their abundance recorded within each plot and allocated to the vegetation community that most closely resembles the community structure. Fig 1 shows quadrat locations.

The accuracy of the identification of the exact location these quadrats was established where possible by the use of a hand held GPS Garmin 12XL receiver, whose accuracy appears variable. These quadrat sites were therefore cross-referenced or entirely generated by using Google Arial photographs or Magic Map. So it is probable that the plots are not precisely geo-located but every attempt was made to ensure accuracy. Past experience of using permanent land markers in such sites had shown a poor medium to long-term resilience to pegs or other markers identifying quadrats sites.

Areas in the centre of the intertidal area proved inaccessible for walking access owing too deep liquid mud and proved too shallow for boat work as the vegetation or its absence during high water was obscured by the high turbidity. This resulted in surveys at these spots being undertaken estimating area and species densities using binoculars. This was deemed acceptable as the plant communities at these open sites were simple monocultures or often bare mud. Identified Selection of these open mud sites was simply to establish a baseline and later monitoring location as succession took place.

Background and General Description.

Prior to the breach and following the initial earth works the site was left unmanaged for over a year while the newly constructed defences settled prior to a final grading and top soiling and seeding. During this period the land previously a drained marsh became wetter and the margins of the excavated borrow pits became colonised by soft rush and the undisturbed pasture became rank with coarse grasses.

Following the breach die back of the remaining pasture was initially slow and it was not until the following spring that over a brief period extensive dieback of the sward and a newly deposited silt layer became evident (P. Thompson pers.comm.).

Over the following year most of the intertidal areas below MHWS has become covered with a thick deposit of saturated silt to a recorded depth of some 100mm within the accessible margins. The four major scxrapes and their interconnecting channels have risen at a faster rate to the point where the earlier depressions are now largely indistinguishable from the surrounding unexcavated land. All are largely covered with a layer of glutinous, water, saturated silt. This habitat now dominates the site and is largely devoid of higher vegetation,

becoming colonised by diverse assemblages of photosynthetic diatoms, cyanobacteria, flagellates, and green algae that inhabit the surface layer of sediment. Some isolated patches of curled and broad-leaved dock, floating sweet-grass, common water-starwort soft rush, marsh foxtail, ivy-leaved water-crowfoot, creeping and celery-leaved buttercup were recorded. The invasive New Zealand pygmy weed is become very evident forming mats on both the open mud areas and within and beside the historic ditches and northern bank margins.

Areas of higher ground within the inter tidal zone that receiving less frequent inundation and without major damage to the old sward are fast being converted to more open mud flat as the silts accumulate and are being colonised by plant species that produce an assemblage with affinities to NVC S22 *Glycerietum fluitantis* community but retain some affinities to the NVC MG10 communities that the new habitat is replacing.

Common reed dominate the plant community of the retained ditches having affinities to NVC S26 *Phragmites australis-Urtica dioica* fen and soft rush NVC MG10 the margins of the flood banks.

Other species of note within the retained ditches and bank margins include water plantain, curled pondweed, ivy-leaved water-crowfoot, creeping and celery-leaved buttercup and floating sweet-grass. The species assemblages do not appear to fit neatly within the NVC system and have affinities with a number of UK aquatic plant communities. Above this on the lower banks are extensive patches of common water-starwort interspersed with floating sweet-grass and soft rush that grade into and creeping bent below dense beds of creeping buttercup, mixed docks and soft rush. With close affinities to the NVC MG10 community. The next higher zone of the new estuary defences have been seeded with a rye grass, clover mix with red fescue, common bent and meadow grasses now being diversified with the encroachment of common ruderal species.

The upper regions of the older defence banks are more complex, on the landward side largely having affinities to various sub communities of NVC MG1 rank grassland. Historically seeded but now naturalised and until 2017 mown by the Environment Agency. On the estuary side the vegetation community is dominated by stands of the common reed with close affinities to the NVC S26 *Phragmites australis-Urtica dioica* fen *Oenanthe crocata* sub-community.

Other identifiable vegetation communities exist on site The residual grassland to the north of the site and on the unexcavated higher land retain some of the characteristics of the historic pasture but lack of grazing and disturbance by heavy plant has increased the species diversity as these areas now contain a large number of ruderal species.

Areas of higher ground within the inter tidal zone that receiving less frequent inundation and without major damage to the old sward are fast being converted to more open mud flat as the silts accumulate and are being colonised by plant species that produce an assemblage with affinities to NVC S22 *Glycerietum fluitantis* community but retain some affinities to the NVC MG10 communities that the new habitat is replacing.

A plan showing the approximate boundaries of these vegetation communities is shown in Fig 1 and also a selective species list for the whole site including the northern boundary hedge. Fig 1 also identifies the locations of the fixed quadrats whose species components and abundance values are given below.

Quadrat Survey Data.

Quadrat 1: SX 4388 6821.

Sampled in late August from new boundary bank.

Soils.

Newly created flood bank with introduced topsoils.

Quadrat 2x2m SX 4388 6821.

Species	Domin. Scale
<i>Agrostis capillaris</i>	4
<i>Festuca rubra</i>	5
<i>Lolium perenne</i>	7
<i>Poa pratensis</i>	4
<i>Ranunculus repens</i>	4
<i>Rumex conglomeratus</i>	2
<i>Trifolium repens</i>	7

Quadrat 2 : SX 4395 6823.

Sampled in late August from central mud area of West Lake using binoculars.

Soils.

Liquid mud suspension.

Quadrat 2x2m SX 4395 6823.

Species	Domin. Scale
Bare mud	9
Diatoms, cyanobacteria, flagellates, and green algae	5

Quadrat 3: SX 4416 6830.

Sampled in late August from West Ditch using binoculars. A relic drainage ditch not directly impacted by recent engineering works.

Soils.

Liquid mud suspension

Quadrat 2x2m SX 4416 6830.

Species	Domin. Scale
<i>Agrostis stolonifera</i>	5
<i>Glyceria fluitans</i>	2
<i>Holcus lanatus</i>	4
<i>Phragmites australis</i>	8

Quadrat 4 : SX 44250 6826.

Sampled in late August from landward slope of old estuary bank.

Soils.

Made ground formed from estuary alluvium.

Quadrat 2x2m

Species	Domin. Scale
<i>Agrostis capillaris</i>	3
<i>Agrostis stolonifera</i>	4
<i>Arrhenatherum elatius</i>	4
<i>Dactylis glomerata</i>	6
<i>Elytrigia repens</i>	3
<i>Holcus lanatus</i>	5
<i>Heracleum sphondylium</i>	3
<i>Poa trivialis</i>	2
<i>Ranunculus repens</i>	5
<i>Rumex conglomeratus</i>	2
<i>Rumex crispus</i>	2
<i>Trifolium repens</i>	4

Quadrat 5: SX 4422 6837.

Sampled in late August from central mud area of Middle Pond using binoculars.

Soils.

Liquid mud suspension

Quadrat 2x2m

Species	Domin. Scale
Bare mud	9
Diatoms, cyanobacteria, flagellates, and green algae	5

Quadrat 6: SX 4425 6852.

Sampled in late August from residual pasture now a marginal area of the tidal shore.

Impacted by heavy plant movement during the engineering works.

Soils.

Silty clay alluvial mud.

Quadrat 2x2m

Species	Domin. Scale
<i>Agrostis stolonifera</i>	4
<i>Alopecurus pratensis</i>	7
Bare mud	4
<i>Callitriche stagnalis</i>	4
Green algae	5
<i>Juncus effusus</i>	3
<i>Ranunculus hedreaceus</i>	7
<i>Ranunculus repens</i>	5

<i>Rumex conglomeratus</i>	4
<i>Scrophularia auriculata</i>	1

Quadrat 7: SX 4435 68568.

Sampled in late August from residual old wet area beside willow clump next to STW.

Soils.

Silty clay alluvial mud.

Quadrat 2x2m

Species	Domin. Scale
<i>Agrostis stolonifera</i>	4
<i>Alopecurus pratensis</i>	4
Bare mud	7
<i>Callitriche stagnalis</i>	4
<i>Crassula helmsii</i>	4
<i>Glyceria fluitans</i>	7
Green algae	5
<i>Juncus effusus</i>	8
<i>Ranunculus hedreaceus</i>	4
<i>Ranunculus repens</i>	5

Quadrat 8: SX 4439 6839.

Sampled in late August from open mud marginal section of East Pond in an open area landscaped to accommodate the newly planted *Schoenoplectus* species.

Soils.

Silty clay alluvial mud.

Quadrat 2x2m SX 4439 6839.

Species	Domin. Scale
<i>Bare Ground</i>	7
<i>Schoenoplectus triqueter</i>	5
Diatoms, cyanobacteria, flagellates, and algaegreen algae	5

Quadrat 9: SX 4439 6839.

Sampled in late August from residual grassland pasture now with tidal impact but with little silt deposition located alongside the old toe ditch by the East Pond.

Soils.

Silty clay alluvial, mud.

Quadrat 2x2m SX 4439 6839.

Species	Domin. Scale
<i>Agrostis stolonifera</i>	4
<i>Alopecurus pratensis</i>	4
Bare mud	4
<i>Callitriche stagnalis</i>	4
<i>Cirsium arvense</i>	4
<i>Crassula helmsii</i>	4
<i>Glyceria fluitans</i>	7
Green algae	5
<i>Juncus artuculatus</i>	4
<i>Juncus effusus</i>	8
<i>Ranunculus hedreaceus</i>	4
<i>Rannunculus repens</i>	5
<i>Rumex crispus</i>	4
<i>Rumex conglomeratus</i>	6

Quadrat 10: SX 4442 6837.

Sampled in late August within retained toe ditch

Geology.

Silty clay alluvial, liquid mud suspension.

Quadrat 2x2m SX 4442 6837

Species	Domin. Scale
<i>Calystegia sepium</i>	6
<i>Juncus effusus</i>	4
<i>Phragmites australis</i>	9
<i>Urtica dioica</i>	4

Selective Species List from Calstock Wetlands, Ditches and Banks

Species	English Name
<i>Acer campestre</i>	Field Maple
<i>Acer pseudoplatanus</i>	Sycamore
<i>Achillea millefolium</i>	Yarrow
<i>Agrostis canina</i>	Velvet Bent
<i>Agrostis capillaris</i>	Common Bent
<i>Agrostis stolonifera</i>	Creeping Bent
<i>Alisma plantago-aquatica</i>	Water plantain
<i>Ajuga reptans</i>	Bugle.
<i>Alopecurus pratensis</i>	Meadow Foxtail
<i>Alopecurus geniculatus</i>	Marsh Foxtail
<i>Angelica sylvestris</i>	Wild Angelica
<i>Anthriscus sylvestris</i>	Cow Parsley
<i>Apium nodiflorum</i>	Fool's Watercress
<i>Arrhenatherum elatius</i>	False Oat-grass
<i>Arum maculatum</i>	Lords-and-Ladies
<i>Atriplex patula</i>	Common Orache
<i>Callitriche stagnalis</i>	Common Water-starwort
<i>Calystegia sepium</i>	Hedge Bindweed
<i>Capsella bursa-pastoris</i>	Shepherd's-purse
<i>Cardamine pratensis</i>	Cuckoo-flower
<i>Centaurea nigra</i>	Common Knapweed
<i>Cerastium fontanum</i>	Common Mouse-ear
<i>Cerastium glomeratum</i>	Sticky Mouse-ear
<i>Chamaerion angustifolium</i>	Rosebay Willowherb
<i>Cirsium arvense</i>	Creeping Thistle
<i>Cirsium vulgare</i>	Spear Thistle
<i>Corylus avellana</i>	Hazel
<i>Crassula helmsii</i>	New Zealand Pigmy-weed
<i>Crataegus monogyna</i>	Hawthorn
<i>Cynosurus cristatus</i>	Crested Dog's-tail
<i>Dactylis glomerata</i>	Cock's-foot
<i>Deschampsia caespitosa</i>	Tufted Hair-grass
<i>Elytrigia repens</i>	Common Couch
<i>Epilobium hirsutum</i>	Great Willowherb
<i>Epilobium parviflora</i>	Willowherb
<i>Euonymus europaeus</i>	Spindle
<i>Festuca gigantea</i>	Giant Fescue
<i>Festuca rubra</i>	Red Fescue
<i>Filipendula ulmaria</i>	Meadowsweet
<i>Fraxinus excelsior</i>	Ash
<i>Galium aparine</i>	Cleavers
<i>Galium palustre</i>	Common Marsh-bedstraw
<i>Geranium dissectum</i>	Cut-leaved Crane's-bill
<i>Geranium lucidum</i>	Shining Crane's-bill
<i>Glechoma hederacea</i>	Ground Ivy
<i>Glyceria declinata</i>	Small Sweet-grass

<i>Glyceria fluitans</i>	Floating Sweet-grass
<i>Hedera helix</i>	Ivy
<i>Heracleum sphondylium</i>	Hogweed
<i>Holcus lanatus</i>	Yorkshire-fog
<i>Hyacinthoides hispanica</i>	Spanish Bluebell
<i>Hypericum perforatum</i>	Perforate St. John's-wort
<i>Ilex aquifolium</i>	Holly
<i>Impatiens glandulifera</i>	Indian Balsam
<i>Iris pseudacorus</i>	Yellow Iris
<i>Juncus articulatus</i>	Jointed Rush
<i>Juncus effusus</i>	Soft Rush
<i>Lapsana communis</i>	Nipplewort
<i>Lathyrus pratensis</i>	Meadow Vetchling
<i>Lemna minor</i>	Common Duckweed
<i>Leontodon autumnalis</i>	Autumn Hawkbit
<i>Lolium perenne</i>	Perennial Rye-grass
<i>Lonicera periclymenum</i>	Honeysuckle
<i>Lotus pedunculatus</i>	Greater Bird's-foot-trefoil
<i>Lychnis flos-cuculi</i>	Ragged-Robin
<i>Lycopus europaeus</i>	Gypsywort
<i>Lythrum salicaria</i>	Purple-loosestrife
<i>Mentha aquatica</i>	Water Mint
<i>Myosotis scorpioides</i>	Water Forget-me-not
<i>Oenanthe crocata</i>	Hemlock waterdropwort
<i>Persicaria maculosa</i>	Redshank
<i>Phalaris arundinacea</i>	Reed Canary-grass
<i>Phleum pratense</i>	Timothy
<i>Phragmites australis</i>	Common reed
<i>Picris echioides</i>	Bristly Oxtongue
<i>Plantago lanceolata</i>	Ribwort Plantain
<i>Plantago major</i>	Greater Plantain
<i>Poa annua</i>	Annual Meadow Grass
<i>Poa pratensis</i>	Smooth Meadow-grass
<i>Poa trivialis</i>	Rough Meadow-grass
<i>Polygonum aviculare</i>	Knotgrass
<i>Polygonum hydropiper</i>	Water Pepper
<i>Potamogeton crispus</i>	Curled pondweed
<i>Potentilla anserina</i>	Silverweed
<i>Prunus spinosa</i>	Blackthorn
<i>Pulicaria dysenterica</i>	Common Fleabane
<i>Quercus robur</i>	Oak
<i>Ranunculus acris</i>	Meadow Buttercup
<i>Ranunculus ficaria</i>	Lesser Celandine
<i>Ranunculus hedreaceus</i>	Ivy-leaved Water-crowfoot
<i>Ranunculus repens</i>	Creeping Buttercup
<i>Ranunculus scleratus</i>	Celery-leaved Buttercup
<i>Rosa sp.</i>	Dog Rose
<i>Rubus sp.</i>	Bramble
<i>Rumex acetosa</i>	Common Sorrel
<i>Rumex crispus</i>	Curled Dock

<i>Rumex obtusifolius</i>	Broad-leaved Dock
<i>Rumex conglomeratus</i>	Clustered Dock
<i>Salix cinerea</i>	Sallow
<i>Salix viminalis</i>	Osier
<i>Sambucus nigra</i>	Elder
<i>Schonoeplectus x kuekenthalianus</i>	Hybrid Triangular Club-rush
<i>Schoenoplectus triqueter</i>	Triangular Club-rush
<i>Scrophularia auriculata</i>	Water Figwort
<i>Senecio jacobaea</i>	Ragwort
<i>Senecio vulgaris</i>	Groundsel
<i>Silene dioica</i>	Red Champion
<i>Sisymbrium officinale</i>	Hedge Mustard
<i>Solanum dulcamara</i>	Bittersweet
<i>Sonchus arvensis</i>	Perennial Sow-thistle
<i>Sonchus oleraceus</i>	Smooth Sow-thistle
<i>Sonchus asper</i>	Prickly Sow-thistle
<i>Stachys palustris</i>	Marsh Woundwort
<i>Stellaria media</i>	Common Chickweed
<i>Taraxacum sp</i>	Dandelion
<i>Torilis japonica</i>	Upright Hedge-parsley
<i>Trifolium pratense</i>	Red Clover
<i>Trifolium repens</i>	White Clover
<i>Typha latifolia</i>	Bulrush
<i>Urtica dioica</i>	Nettle
<i>Veronica beccabunga</i>	Brooklime
<i>Veronica chamaedrys</i>	Germander Speedwell
<i>Vicia cracca</i>	Tufted Vetch
<i>Vicia sativa</i>	Common Vetch