Restoration plan for the creation of a coastal wetland area in Santa Marija Bay, Comino (Malta)

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Contents

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A consultancy report for the Environment and Resources Authority and the Priority Actions Programme Regional Activity Centre – UNEP/MAP prepared by BirdLife Malta and appointed consultants in the frame of Project SIDA subject to agreement between UNEP and PAP/RAC: SSFA/2022/5119.

Written by Louis F Cassar, Sandro Lanfranco, Nicholas Barbara & Mark Gauci

Illustration by Victor Falzon - Digitisation by Martin Caruana

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1. **Background and Rationale**

1.1 Overview. The island of Comino (*Malt. = Kemmuna*) lies between the two larger islands, that is, the main island of Malta and the smaller and relatively more rural island of Gozo (*Malt. = Ghawdex*). Although Comino has a permanent population of only two individuals, it is a heavily frequented destination by both locals and tourists alike, especially during the warmer months. This allure results from the island's physical setting, comprising coves, sea-cliffs and relatively clear blue waters, as well as a perceived peaceful setting. Notwithstanding its protected status, numerous conflicts arise from a lack of visitor management, particularly within and around the island's bathing areas, with the Blue Lagoon and Santa Marija Bay being predominantly, but not exclusively, the main areas of convergence for most visitors to the island. In view of the dearth of trees and seemingly hyper arid hinterland, most visitors tend to view the island's interior as somewhat inhospitable and thus uninviting, especially during the dry season. Consequently, the vast majority tend to flock to areas on the immediate littoral, on seacraft and the seashore, rather than venture inland; in many respects, this is positive from the standpoint of conservation because it limits the extent of visitor impact but it does intensify the magnitude of such impact on the immediate coastline.

Figure 1: Satellite images - Comino and inset of island group [sources: Google Earth, 2022; public domain].

1.2 Conservation potential and policy framework. Comino in its entirety has been designated a Special Area of Conservation (of International Importance) and a Special Protection Area (of International Importance) as per the Habitats and Birds Directives, respectively. The island therefore forms part of the Natura 2000 conservation network. The entire island is also protected as a Bird Sanctuary and Nature Reserve. In addition, specific areas within Comino have been afforded additional designations as Areas of Ecological Importance, Sites of Scientific Importance, and Tree Protection Areas.

From the perspective of conservation of biological diversity, particularly avifauna, the island of Comino has long been recognised as an important staging area for migratory birds, especially but not exclusively during the spring migration. The Maltese Islands lie just off the central Mediterranean flyway; however, notwithstanding the significant number of birds that visit on a bi-annual basis, the two larger islands (especially Malta) are quite densely populated. Moreover, *artificial light at night* (ALAN) is both widespread and intense across the two main islands. Conversely, the island of Comino is relatively less light polluted and, therefore a crucial stopover site during migration. The island also hosts significant populations of Yelkouan Shearwater (*Puffinus yelkouan*) and Scopoli's Shearwater (*Calonectris diomedea*), with nesting colonies interspersed along the cliffs of Cominotto islet and the cliffs beneath Santa Marija tower, together with the caves at L-Imnieri and the cliffs further along the east coast. Nesting colonies of these Annex I species (Birds Directive) are extremely sensitive to light and noise pollution, and, given that artificial light is not so intense, Comino tends to offer an important sanctuary to these species of international importance.

As the island is geographically nestled between two larger landmasses and supports a number of relatively sheltered valley systems, along with coastal cliffs facing the northwest, west and east, it tends to afford a host of suitable habitats that are moderately well sheltered from prevailing winds for migratory birds. Although the vegetation cover is fairly uniform, it nonetheless attracts a variety of species. Several passerines, among these *Anthus trivialis*, *Saxicola rubetra*, *Phoeniicurus phoenicurus*, *Erithacus rubecula* and *Sylvia communis*, are commonly observed during spring and autumn passage, often foraging amongst scrub-type vegetation. Within the marshland area per se, the *Tamarix* sp. woodlot, which lies on the consolidated segment of the dune, provides both shelter and food for most Phylloscopi species. As for breeding species, the area habitually holds 2 to 3 pairs of the locally common breeder *Sylvia melanocephala*. This species is known to construct one or two nests per season/pair within bushes of *Dittrichia viscosa*; this ruderal herbaceous perennial tends to colonise a sizeable area within the wetland area that is naturally disturbed by surface runoff. The island also hosts between 11 and 38 breeding pairs of Short-toed Lark (*Calandrella brachydactyla*), which is an Annex 1 (Birds Directive) species.

The planned works related to restoration ecology and habitat creation are expected to have a positive outcome on both species richness and diversity, given that the design, once implemented, will provide an enhanced habitat gradient as well as various ecological niches considered suitable to a number of taxa. The newly created shallow 'ponds', which would be expected to hold water during the wet season, along with the envisaged reintroduction of a *Phragmites* bed within a sizeable area (currently hosting a ruderal assemblage), will undoubtedly provide optimal wintering grounds for Annex 1 species such as *Luscinia svecica* and *Acrocephalus melanopagon*. The restored new habitat will have the potential of attracting new breeding species to the island of Comino, including *Acrocephalus scirpaceus*, *Cettia cetti* and *Cisticola juncidis*, known to favour the proposed reed-dominated habitat assemblage. The newly restored habitat will provide a suitable migratory stop-over to a myriad of species, ranging from herons and other large coastal birds, such as flamingos and spoonbills, to ospreys and marsh harriers, among others. The planned dense stands of *Laurus nobilis* (described under EUNIS 32.18 code [5230] and Annex I habitat type [code 5310]) are expected to provide a suitable habitat for *Luscinia megarhynchos*. Furthermore, the existing pool (likely to hold water all year round), together with the planned shallower extended side lobes that are projected to flood during the wet season and afford a mudflat environment during the drier months, are envisaged to provide a prime habitat for Charadriiformes species, as a result of an extended feeding edge. The designed inclination is expected to accommodate a diversity of feeding strategies for a host of wading avifauna as the level of the water recedes, or conversely increases.

At a policy level, the proposed restoration actions would support the objectives of restoration actions for wetland habitats in the Mediterranean in the framework of the ICZM Protocol, as well as align with the UN's Decade on Ecosystem Restoration. The area is indeed what one might term a degraded coastal wetland, and what this report presents is largely an action plan to set the restoration of a number of target habitats going.

1.3 Landform-Biotope relationship. The karstic topography of Comino is fairly varied despite its relatively small size (3.5 km²), with a gently rolling terrain incised by a number of shallow valleys, and a coastline bound by sheer cliffs, rocky shores and a number of natural coves. A handful of small pocket beaches and associated accumulations of a mobile sandy substrate lie on the northern shores of the island (including the islet of Cominotto – *Malt. Kemmunett*), with the largest occurring within the Santa Marija embayment. In terms of habitat-types, Comino provides an array of garrigue, phrygana and low-maquis biotopes, as well as a number of archaeophytic assemblages, typified by carob (*Ceratonia siliqua*) and olive (*Olea europaea*), among other species introduced into the Maltese Islands in antiquity. Overall, the island of Comino is characterised by a scrub-like vegetation represented by afore-mentioned biotope-types, colonising the island's semi-arid karstland where *ground armour* (resulting from accelerated erosion) is prevalent.

Stratigraphic exposures on Comino comprise various Members of the Upper Coralline Limestone, as well as several sheen deposits, infills and conglomerates of Quaternary age. These rocks essentially contribute towards the sedimentary dynamics that subsequently nourish the small pocket beaches on Comino; in the case of Il-Bajja ta' Santa Marija, aeolian processes also contribute towards the formation of the sand dune. The interconnectedness between fluvial fluxes, sediment transfer and deposition (involving both terrestrial and marine processes), and the formation of wetlands cannot be understated. In many parts of the Mediterranean, sand dune systems and wetlands, particularly coastal marshlands, often occur adjacent to one another. Although such landforms appear to undergo vastly different formation processes, they both benefit from a common hydrology; the sand dune and former wetland complex at Il-Bajja ta' Santa Marija in Comino are no exception.

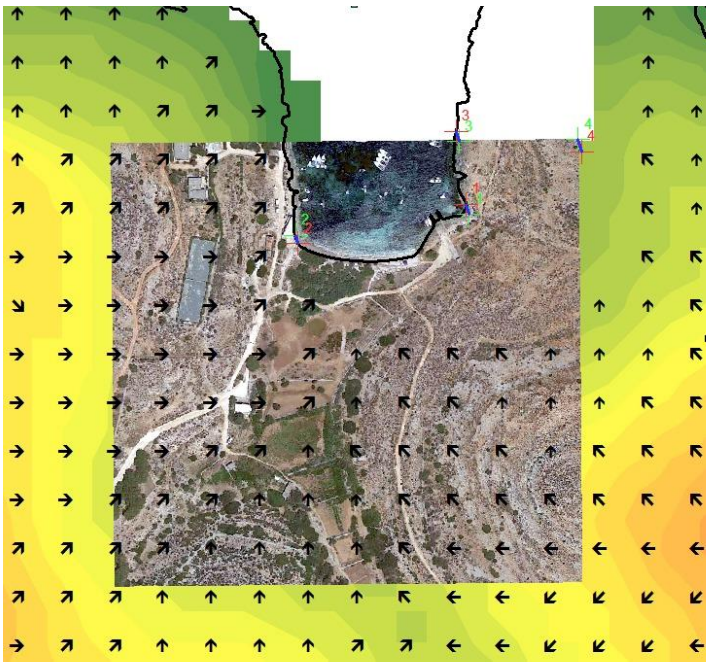

Figure 2: Flow map of freshwater runoff at Santa Marija embayment, its surroundings and immediate hinterland.

1.4 A mismanaged resource. The Santa Marija back-beach area has been subjected to an array of changes and ensuing impacts by the human agency. In historic times, albeit within living memory, parts of the marshland were used for agricultural purposes, basically to sow a potato crop on areas cleared of Common Reed. When, in the late 1980s, the area on which the Santa Marija wetland once stood was declared a camping site, so-called engineering works that followed wreaked havoc on important perennial biotic elements that colonised the marshland, while in the process changing the sedimentary and hydrological dynamics of the site in quite a significant manner. Despite good intentions, mismanagement and misguided interventions led to a drastic decline of the *Vitex agnus-castus* stand and the complete eradication of the once extensive Phragmites reedbed. So forceful and misdirected were the works that the reeds never re-established themselves, while management practices over the years that followed, both lacking in initiative and strategy, led to further degradation, including the proliferation of the highly invasive Tree-of-Heaven (*Ailanthus altissima*). Years of uncontrolled camping activity, coupled by piecemeal and often technically misguided decision-making (to appease commercial and leisure interests) further degraded the site. In summary, this eventually led towards a lack of synchrony in the dynamics that would normally exist between the beach and dune, and the adjacent wetland. Having subsequently existed at variance for so many years, these formerly interconnected coastal geomorphological entities continued to develop in a disjointed manner. This narrative thus provides the basis for the methodological framework that follows, for recommended intervention.

2. Project Terms of Reference

The objectives and scope of the restoration plan are set in **Annex 1** and **Annex 5** of the '***invitation to tender***', adapted and outlined as follows, and as confirmed throughout the contract agreement signed between BirdLife Malta and the Priority Actions Programme Regional Activity Centre on the 16th March 2022

a. To develop a restoration plan aimed at restoring and enlarging the extant wetland area (area of interest);
b. To enhance the structure and function of Mediterranean and thermo-Atlantic halophilous scrubs (**Sarcocornetea fruticosi**) in line with the Kemmuna u l-Gzejjer ta' Madwarha Managament Plan objective, i.e. -
    i. detail how such a habitat can be restored;
    ii. investigate what further interventions shall be needed to ensure that such a habitat is sustained and, potentially, extended further.
c. To ensure that invasive species within the area of study are eradicated and do not re-establish themselves;
d. To recommend what indigenous species can be planted, augmented or reintroduced to the area of interest;
e. To recommend what habitat restoration and engineering interventions are needed to achieve an extension of the wetland and respective increased habitat coverage, through an understanding of the hydro-dynamics of the watershed and the engagement of appropriate ecological restoration techniques;
f. To recommend what interventions are needed to establish the area of interest as a refuge for, essentially but not exclusively, avifauna, by encouraging bird species, including both breeding and on those on migration, to exploit resources present within the restored biotope/habitat, through foraging, resting/shelter, and breeding. In particular, restoration efforts will aim to create and cater for the different foraging strategies of bird species likely to utilise such habitat.
g. To consult with stakeholders on the proposed plan and report on the outcome of such consultations.

3. Approach

In order to achieve the Objectives, set out in the *Terms of Reference* above, the following methodology was employed. The Area of Study was visited multiple times between April and June, with a view to conduct walkover and drone surveys, as well as to collect soil samples and test the water quality of the existing pool. Augering was carried out in selected areas within the AoS to acquire a better understanding of the soil profile and the immediate underlying geology to a depth of < 1 metre. The primary aim was to establish whether a Blue Clay aquiclude exists and explore its potential depth. Literature reviews were carried out of both published (scientific contributions) and unpublished (grey literature consisting of internal reports and archived historical aerial photographs) records, the latter mainly through consultations and one-on-one meetings with botanists and other such specialists, to gain insights into vegetation distribution patterns, surface runoff flow patterns and land-uses in historic times.

Figure 3: General Area of Study (AoS), which also provided the delineation for the biotope baseline.

Baseline information was gathered via a broad-brush survey of the Area of Study in April and May 2022, in order to map the various biotopes and associated assemblages, and any identify areas with invasive ruderals, including alien species. The various assemblages are presented in the form of a map, compiled using Geographic Information Systems (GIS).

While field and historical data were being compiled, given the relatively short, allocated assignment period, stakeholder consultations with key actors were held concurrently. Stakeholder categories identified in the context of Comino included Official Agencies, e-NGOs, Specialists, Resource Users and Affected Locals. Such discussions were deemed crucial for the creation of a restoration design in view of potential feedback on the proposed plan.

All information gathered was considered, particularly during internal meetings by the appraisal team, to identify prevalent threats, risks, pressures and impacts to the wetland and its adjacent habitats, notably but not exclusively the sand dune. This was done to mitigate against any potential and existing ecological perturbations to the site and its assets, both geomorphological and ecological.

In preparing for the actual implementation, that is, the work leading to the restoration plan, various actions were considered and discussed internally and with relevant stakeholders, including (i) the use of mechanical means and associated intervention management to achieve the desired habitat/biotope configuration, (ii) conservation considerations and potential consequences at both habitat and species level, especially where *(a)* Red Data Book species and *(b)* possible introduction of floral and faunal elements were concerned, and (iii) proposed sensitive interventions to control and potentially eradicate invasive species that afflict sections of the site. A digital cartographic depiction of the desired restoration, involving the recommended interventions within the AoS, together with installations of both infrastructure and introduced assemblages to mitigate against identified impacts and enhance the area through desired habitat outcomes, is presented in Section 6 below.

4. Current physical state

As indicated in the Background and Rationale section above, the area in question has undergone several changes over the last decades, both intended and unplanned, because of human activities.

4.1 Cursory on-site observations. A recent preliminary visit to the site, which served both as a recce and for the team to familiarise itself with issues pertaining to the fluvio-sedimentary regime within the Area of Study (AoS) and its hinterland (Area of Influence - AoI), revealed a powder-dry surface substrate within much of the marshland basin *per se*. At the time of the field visit, this area was in part colonised by ruderals, including invasive floral species; it was also evident that the beach and former wetland lacked any form of physical connectivity in terms of dynamic processes, hydrological and/or aeolian. The potential reasons for this are varied, but initial on-site observations point to the alteration of the hydrological cycle which operates within the catchment that would otherwise drain into the former marsh area and onward into the embayment. Whether this change results from latent changes in the climate or from anthropogenic interference, or a combination of both, remains to be seen.

4.2 Barrier to sediment transport. Another reason for the lack of physical linkage stems from the fact that the tamarisk trees, mostly planted in historical times on the back of the sandy portion of the bay, have become quite overgrown and have since formed an impenetrable thicket, which, to a large degree, acts as a barrier that impedes aeolian sediment from moving inland from the zone of accretion above the strandline. As a consequence, the dense thicket has, over time, accumulated both Posidonia remains and sand, which collectively form a low mound that potentially acts as a bank to absorb rainwater runoff that would otherwise convey sediment into the embayment. Although this was not measured quantitatively through the use of sediment traps, the impact is nonetheless apparent; the tamarisk thicket and accompanying sand laden Posidonia banquette will have effectively cut off the dual directional supply of sediment.

4.3 Sediment budget deficit. As the scale of sediment transport reaching the sea via valley runoff is curtailed, so will the rate of beach (and dunal) nourishment eventually decrease over time due to the overall sediment deficit within the system. Such will be the impact that a prolonged negative beach-dune sediment budget will result in deflation of the dunal surface, leading to potential changes in the physico-chemical composition of the sandy soil as sand supply declines and decomposing Posidonia material continues to increase. Based on this scenario, sediment will only be expected to reach the bay from the hinterland during exceptional runoff episodes following heavy downpours, when some spill-over may occur. Likewise, sediment washed up onto the strandline by wave refraction or longshore drift and subsequently gusted onshore from the beach's accretion zone would be prevented from reaching the marshland, again, as it is likely to be trapped by the semi-natural barrier created by the dense mass of the unmanaged tamarisk woodlot.

4.4 Accelerated erosion. Moreover, given the fact that the marshland no longer supports an extensive perennial vegetation cover *per se* but is rather mostly colonised by a ruderal assemblage (characterised mainly by pioneer species such as *Glebionis coronaria* and *Galactites tomentosa*, and accompanied by a sparsely scattered perennial, but likewise early succession species, *Dittrichia viscosa*), it is envisaged that strong winds will have led to drier conditions in respect to surface and subsurface sediment. The sparse vegetation cover, coupled by protracted exposure to wind turbulence (most significantly, from northerly winds funnelling inland and north-easterlies affecting the site's more exposed flank), would perceptibly increase the rate of deflation and attrition, as well as scouring, via the agency of wind and surface runoff respectively.

4.5 Artificial pool. A relatively large pond was recently excavated on the Santa Marija marshland close to the shoreline, which seems to hold water all year round. At the time of writing, this artificial 'wetland' comprised a fairly shallow pond that was created through excavation of the surface sediment by heavy-plant machinery. The sources of water input had not been verified during the reconnaissance visit but were likely to include direct precipitation, surface runoff from surrounding higher ground and subsurface infiltration of seawater (refer to Findings below). This, of course, goes contrary to the natural cycle of typical Mediterranean coastal marshlands, many of which predictably dry up during the hot summer months. Characteristically, such wetland-type would maintain a degree of sub-surface moisture or mesic conditions, the extent of which is regulated by the dynamics operating within the *vadose zone*, comprising the capillary fringe and unsaturated zone. From initial field investigations, including a brief examination of the excavated material dumped on land immediately behind the former wetland, it appears that the impermeable clay layer that forms an aquiclude may well have been ruptured. As a consequence, to the perforation of the wetland's natural lining, seawater intrusion is likely to have occurred. Such breach may therefore be the reason for the year-round body of water. (See results of field investigations below).

Figures 4a and 4b: General view of the Santa Marija AoS (4a); aerial view of the excavated pond (4b).

5. Findings

This section comprises the team's findings in relation to (i) the watershed of the Santa Marija embayment, recognised as the Area of Influence (AoI); (ii) the vegetation that, at the time of survey, colonised the Area of Study (AoS), as well as a desk-study to better understand how the vegetation profile changed over time; and (iii) the excavated pool.

5.1 Areas of Study (AoS) and Influence (AoI). The area identified as the AoS comprises the terrestrial component of the Santa Marija embayment and immediate hinterland (see Figure 3). However, since the AoS *per se* forms part of a wider catchment (lying at the mouth of a more extensive watershed system made up of dry-river valleys, notably Wied Imdied (pers. comm. A. Camilleri/LfC) and the more extensive Wied l-Ahmar/Wied Ta' Bieqa system), the confluence (Wied tal-Kola) of the runoff conduits and adjoining slopes at Santa Marija were thus factored into this study. The recommended design in Section 6 below is based on the direction of flow of natural freshwater through these runoff conduits and their surrounding slopes, with a view to take the process of sediment transfer from the hinterland to the valley mouth (Wied tal-Kola) into account.

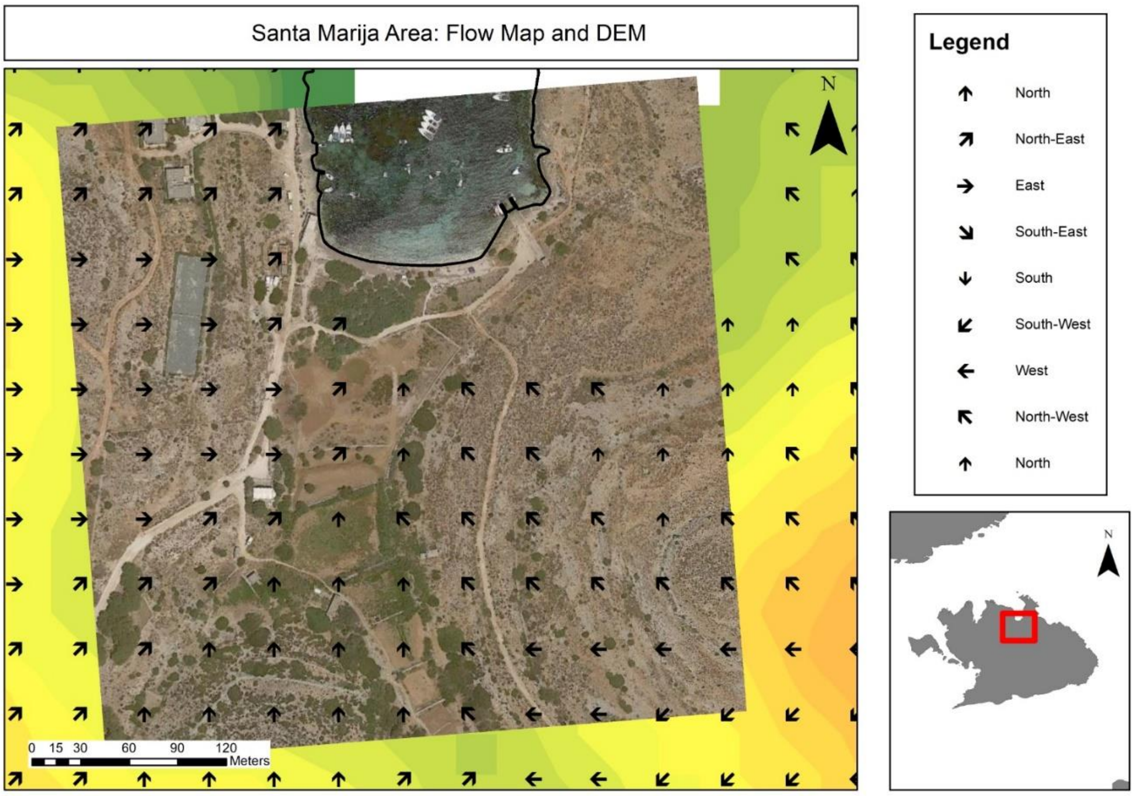

Figure 5: General direction of freshwater flow calculated via a digital elevation model (DEM).

5.2 Artificial pool characteristics. During the familiarisation visit of April 18th (2022), a cursory inspection of the water body did not indicate any microscopic algae. Moreover, agitation of the bottom sediment around the outer rim or margin of the pool uncovered a layer of unoxidized organic matter, suggesting anoxic conditions in the sediment. Consequently, a small sample of water was collected from the margins of the artificial water body and examined using a microscope in the laboratory. This indicated the presence of the dinoflagellate *Peridinium* sp., although not in densities typical of a harmful algal bloom. Few other aquatic microbiota were observed at the magnifications utilised (x40 to x600). Had there not been any mechanical interventions, the site is unlikely to support a permanent wetland given the interaction of current climatic and hydrological conditions. Any ecological restoration of the area concerned should be rooted in the natural hydrological dynamics influencing the site. The most probable scenario is accumulation of water at points of lower relative topographic elevation in the backshore area during the wet season. Hydroperiods would be dependent on replenishment of water from direct precipitation and incoming surface runoff from the hinterland, as well as on loss of water from evapotranspiration and infiltration into the sediment.

Under natural conditions, given the proximity to the shoreline, input from marine aerosols and potentially an element of subsurface infiltration of seawater is also likely and would be expected to influence water balance and water quality. Past mechanical interventions and modifications to the terrain may also have led to seawater intrusion. However, it is considered financially and logistically unfeasible to remedy any such breach via the use of underwater concrete (UCW), otherwise referred to as *Portland Pozzolana Cement* (PPC).

Two other visits were carried out on May 6th and May 10th, with a view to test the water in the pool.

Figure 6: Use of probes was employed to test water quality in the artificial pool on two specific occasions, that is, during a prolonged dry period (May 6th) and immediately after a rain episode (May 10th).

5.2.i Electrical conductivity (EC) of the pool water. The EC was measured on 6 May 2022 (n=27), after a long period without significant rainfall and on 10 May 2022 immediately following heavy rain (n=49). The ranges of these measurements are shown in Figure 7. These readings are outside the range for 'freshwater' and 'brackish water' as defined by the United States Geological Survey (USGS) and fall well within the 'saline' category of the USGS. The median EC was lower, and showed greater variation, on 10 May, presumably a consequence of dilution by rainwater.

These results suggest that the source of the pool water is predominantly infiltrated seawater, diluted by freshwater derived from direct rainfall and surface runoff.

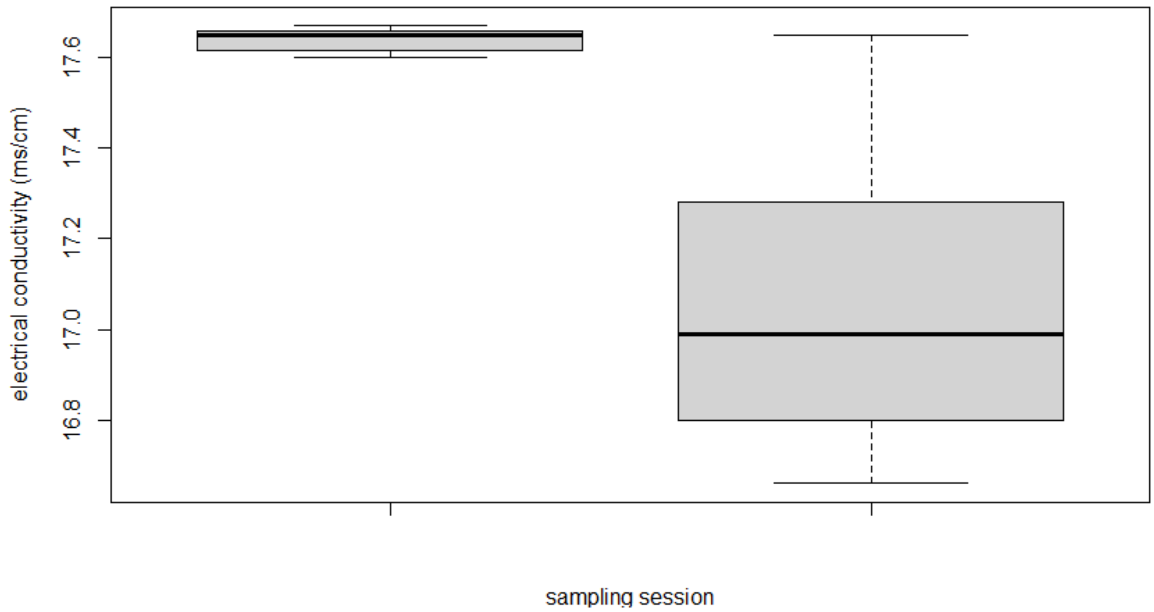

Figure 7: Electrical conductivity of pool water during each sampling session (Session 1: 6 May 2022; n=27. Session 2: 10 May 2022; n=49).

5.2.ii Electrical conductivity (EC) of the soil. Samples of surface soil were collected at five different points (n=2 for each point) from within the former wetland, labelled A through E, located at increasing perpendicular distance from the shoreline. The results are shown in Figure 8. The electrical conductivity of the soil was comparable to that of 'brackish' water. No specific trend of change in electrical conductivity with distance from the shoreline was detected suggesting that salinisation of the soils in this area is not the result of a simple process, but rather a complex one.

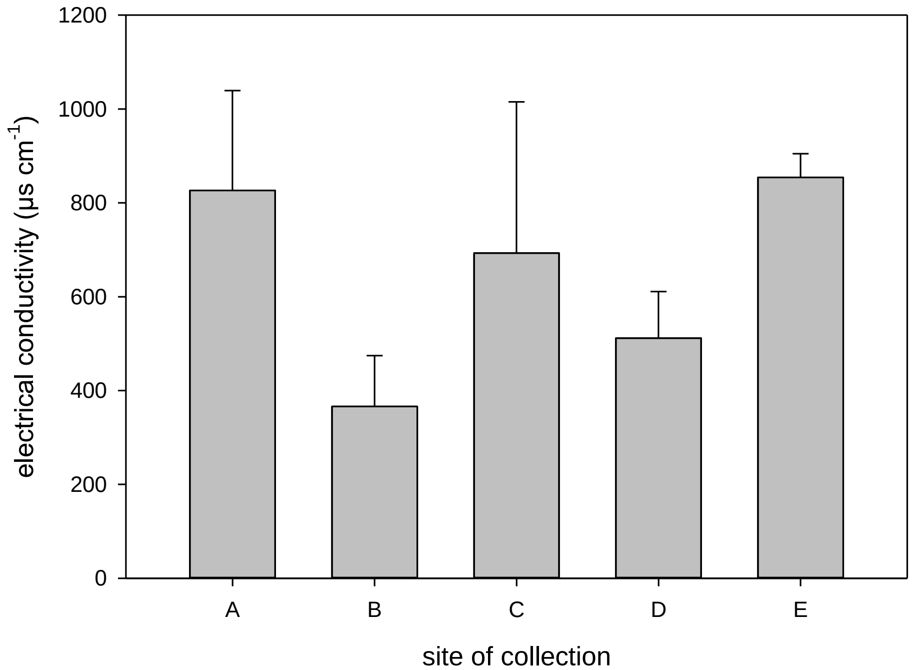

Figure 8: Electrical conductivity of surface soil at five different points A-E. 'A' was the closest to the shoreline and 'E' the furthest. The error bars represent one standard deviation from the mean value (n=3 for all sampling points).

5.3 Baseline of ecological assemblages (flora) within the AoS (refer to Figure 9). The exposed stratigraphy of the island consists of Upper Coralline Limestone and this is much the same case with Il-Bajja ta' Santa Marija, which lies at the mouth of a number of stream-eroded valley systems (see 5.1 above). The area *per se* is referred to in historic cartography as Il-Wied tal-Kola (presumably derived from 'qala', a semitic word that refers to a sheltered embayment). The existing floral assemblages are a far cry from what colonised the area in the recent past. One of the authors (LFC) vividly remembers the extensive reedbed on the marsh proper and a more widespread stand of *Vitex agnus-castus* on the north-western segment of the embayment that colonised the site in the mid-1970s. The *Vitex* stand colonised an area on which mobile sand accumulated on the marsh-back beach interface, which demonstrates that sand mobility at the time was far more prevalent than it is at present. A decrease in aeolian dynamics is mostly due to the thickening of the *Tamarix* assemblage, which as indicated, was augmented via the planting of *T. gallica* that subsequently enlarged the footprint, along with native the *T. africana* woodlot, to form a physical barrier that separated the beach from the marsh.

Presently, the area of study is colonised by a continuous tamarisk thicket on the back of the beach and a remnant population of *Vitex agnus-castus*; the latter is encroached upon by a copse of acacias that were planted in the late 1970s/early 1980s. Extensive tree-planting was taking place on the entire island of Comino then (and elsewhere on the other islands as part of an ill-advised national strategy using alien tree species to afforest tracts of karstland, at the time, deemed unimportant). Archaeophytes, notably carobs (*Ceratonia siliqua*), figs (*Ficus carica*) and olives (*Olea europaea*), that were planted in antiquity bear testimony of past rural existence as means of reliance upon a somewhat frugal subsistence by Comino's native residents. These mature trees, which are accompanied by other species, such as *Prunus dulcis*, often occur on the peripheries of fields and on karstic areas where soil accumulates as a result of colluvial processes; in some cases, such trees also occur in the middle of formerly cultivated parcels of land. Other elements within the AoS that are associated with rural practices and landscape management of the historical past include the stands of Prickly Pear (*Opuntia ficus-indica*), which occur along both flanks of the embayment. Although *Opuntia ficus-indica* is considered an invasive alien species, introduced into the Mediterranean region following the 'Colombian Exchange', in circumstances where it lacks the capacity to spread and compete with indigenous species (due to a lack of suitable habitat, including shallow soils), it has been known to serve as an important vehicle for connectivity, among other functions.

An important, albeit restricted and somewhat degraded biotope is the coastal sand dune. This biotope is spatially restricted for a number of reasons, most notably, the encroaching tamarisk thickets on the western sector, the dirt-track and low ashlar wall on its southern flank and the gently rising karstic topography on south-eastern periphery. Notwithstanding its limited size, the dune supports a host of stenotopic flora, including species of the foredune and fixed dune (*Cakile maritima, Echium arenarium, Lotus cytisoides, Pancratium maritimum, Scolymus hispanicus, Glaucium flavum* and *Ononis natrix* ssp. *ramosissima*, among others), as well as a suite of other species relating to the aerohaline community, such as *Limbarda crithmoides* and *Crithmum maritimum*. The dune's proximity to the public beach renders it quite vulnerable to trampling and littering, despite the rope-and-groyne delineators to mark the importance of the site.

The area that occupies the immediate dunal hinterland, mostly characterised by shallow soils, exposed bedrock and some sand accumulations, is colonised by a population of *Cynara cardunculus* and an Ermes assemblage, dominated at the time of survey by *Ferula melitensis*. Parts of this area, particularly those segments that are either degraded or lack vegetation, can be considered for dunal regeneration, with a view to enlarge the sand dune biotope (see Restoration Plan Recommendations below). After all, the two areas were joined before the track that connected the coast at Santa Marija to the government isolation pig-farm was established in the 1980s. From aerial photographs available, it is evident that fragmentation of the habitats occurred at this time.

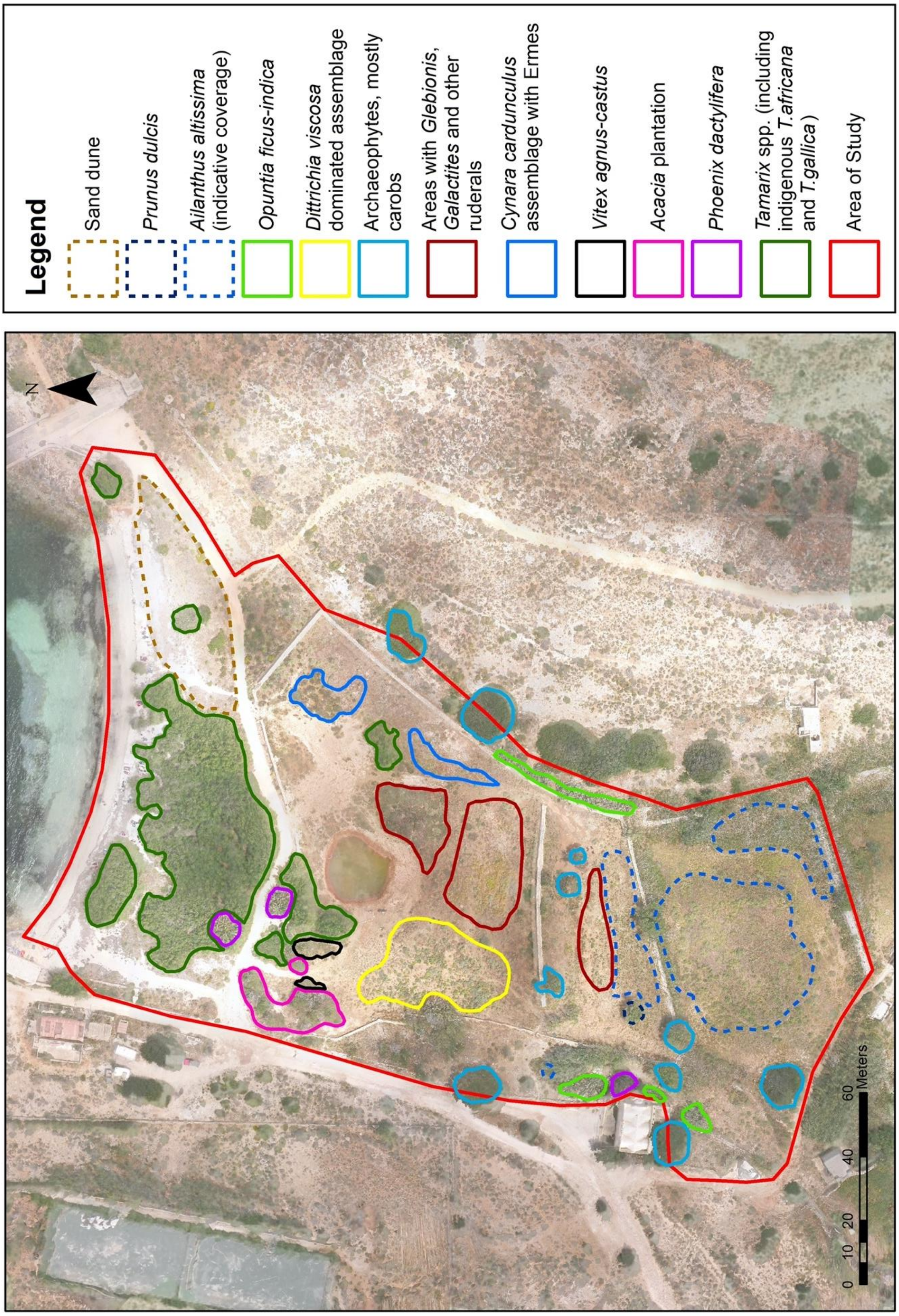

Figure 9: Main ecological assemblages and related assets.

Over the last decades, the area underwent significant change resulting from (i) alterations to the terrain through the use of heavy-plant machinery, particularly when the area was ear-marked as a camping site in the late 1980s, (ii) trampling and neglect, and (iii) the disruption of natural fluvial and sedimentary processes and dynamics.

Consequently, extensive tracts within the AoS are now colonised by ruderals and other more long-lived species, both alien and indigenous, including, but not exclusively, *Galactites tomentosa*, *Glebionis coronaria* and *Ailanthus altissima*. The latter species has spread across most of the former agricultural plots on the valley-bed and, notwithstanding past attempts at eradicating the stand, efforts have failed to even reasonably control the spread of the species. Particularly tall stands of *Ailanthus* occur nearer the rubble walls which delineate field plots.

On the more open areas of the valley mouth (previously occupied by Common Reed), freshwater runoff tends to disturb surface soils; the species that are prevalent include *Galactites tomentosa* and *Glebionis coronarium*. These two short-lived ruderal species have a tendency to colonise areas where freshwater runoff temporarily accumulates and creates some ponding. Naturally, the runoff acts as a vehicle for dispersal of these species' seeds and, once relatively dry, the mesic conditions will provide suitable conditions for the proliferation of these and other invasive species. Adjacent to these patches, one finds the herbaceous perennial *Dittrichia viscosa*, which colonises a sizeable portion of the former marsh (see Figure 9 for indicative distribution of floral resources).

6. Restoration Plan Recommendations

6.1 A philosophy for action. Restoration ecology, as opposed to mere efforts in afforestation, needs to account for both processes (landform and hydrology related) and ecological context (including basic phytosociology). Restoration ecology can take many forms and various approaches can be employed. However, in any situation, a number of decisions need to be made from the onset, essentially on principle. These hinge upon (i) the need to **halt** and **potentially reverse the degradation**, often through tangible actions such as *(a)* reducing the influence of edge-to-area ratio due to habitat fragmentation, and *(b)* creating linkages for connectivity; (ii) deciding on how far back in time restoration should go.

Another pertinent question in dealing with extirpated species is genetic affinity and, hence the source/s of provenance of reintroduced assemblages. How important it is to acquire material from population stock that existed in a particular area (naturally, if such a genetic pool still exists elsewhere) is a fundamental decision. Should the intervention be based on **scientific values** and **assumptions** or on the concept of ensuring a **stage-managed effect**, or a reasoned combination of both? Other significant questions, based on ethical considerations, include: (i) how invasive should an intervention be and under what circumstances is it permissible to influence existing biota to achieve the set restoration goals? What are acceptable means of achieving restoration goals?

Moreover, reliance upon habitat engineering for positive outcomes can be complicated and the long-term consequences cannot easily be predicted, even through the employment of sophisticated computer models. Therefore, how intensive an intervention should be is yet another important question that needs to be factored into early decision-making. While it is acknowledged that there are different ways of tackling restoration ecology, there really is no 'right and ready' cut-and-paste method that can be extrapolated from other examples, since the dynamics that operate within each site are often quite unique. No matter which approach is selected, the intended outcome should simply point towards the reassembly, repair and/or adjustment (of a habitat) so that it eventually functions well.

6.2 Choice of technique. Possible applications of restoration ecology techniques, as already indicated, differ greatly. The simplest form, at one end of the spectrum, involves the removal of a perturbation to allow natural recovery; at the other end of the spectrum, the recreation of a resilient assemblage with the capacity to recover from stress can also be considered. Aldo Leopold (1949)[*] described it as a synthesis of theory and practice that results from the combination of science (ecology) and art (design). From a science point of view, it needs to be borne in mind that nature is not static and that biotopes and their abiotic environment do change over time through a myriad of processes, not least ecological succession and climatic patterns. The distribution of vegetation within a biotope is often patchy and will not normally show a clear-cut delineation between adjacent assemblages as they tend to grade into one another without sharp boundaries. The design, on the other hand, may harbour a degree of 'artistic licence' so long as it does not go contrary to prevailing dynamics (sediment transport, etc.) and respects the basic processes operating within the given site.

In the case of the Santa Marija restoration plan, the choice of technique is based on a hybrid approach, which amalgamates elements of:

reclamation (to repair damaged habitats);

[*] *A Sand County Almanac: And Sketches Here and There* – published a year after Leopold's death.

rehabilitation (to endeavour to reinstate some components, perceived important, of what existed in biotope prior disturbance);

recovery (as opposed to neglect, to allow nature to take its course); and,

enhancement (designed to improve the biotope).

Caveat: no attempt is being made herein to reinstate a replica of what existed within the biotope prior disturbance, given that a detailed historical baseline does not exist. Data pertaining to the AoS is thus qualitative at best, with information largely reliant upon firsthand memory (LFC), photographic evidence and limited published material as well as grey literature. As a result, the final outcome may not recover all the value that was lost through decades of damage and neglect, even if a fair degree of success is achieved in restoring the system to a quasi-pre-disturbed structure.

6.3 Way forward (basic steps to implementation). Without a doubt, the time to go back to, in respect to restoration, would be to environmental conditions associated with the present climatic regime, ideally, within the historical recent past. In this manner, the use of species that already occur within the central Mediterranean should be strongly considered for any interventions/introduction of biota, since these would already be well adapted and acclimatised to local conditions (as characterised by the Köppen-Geiger category classification).

In the case of the plan for the wetland at Santa Marija, the main goal has dual objectives, first, to improve the fluvio-sedimentary regime with a view to reinstate perceived dynamics relating to dune development and adjacent wetland hydrology; second, to improve the vegetation structure in accordance with the abiotic environment within the AoS. Once achieved, both objectives will inherently generate a far more attractive environment to a host of avifaunal species, for rest/shelter, foraging and potentially, also breeding.

Having established the preferred approach (see 6.2), discussions were held with a number of key stakeholders with a view to determine the best possible strategy to implement the plan. As with most cases in restoration ecology, patience underpins any meaningful outcome, given that restoration takes time. An outline of the intervention plan is presented in Figure 10, while an artist's impression (axonometric view) of the final phase of the project is shown in Figure 11.

In an effort to embrace the notion of restoration as a paradigm for biodiversity conservation and environmental management, a number of key decisions were taken, namely, to endeavour to:

(i) remove sources of degradation through the eradication of invasive species, such as the Tree-of-Heaven (*Ailanthus altissima*),
(ii) restore the physical environment through habitat engineering, as outlined below,
(iii) restore the biotic structure and consider reintroduction/introduction of species.

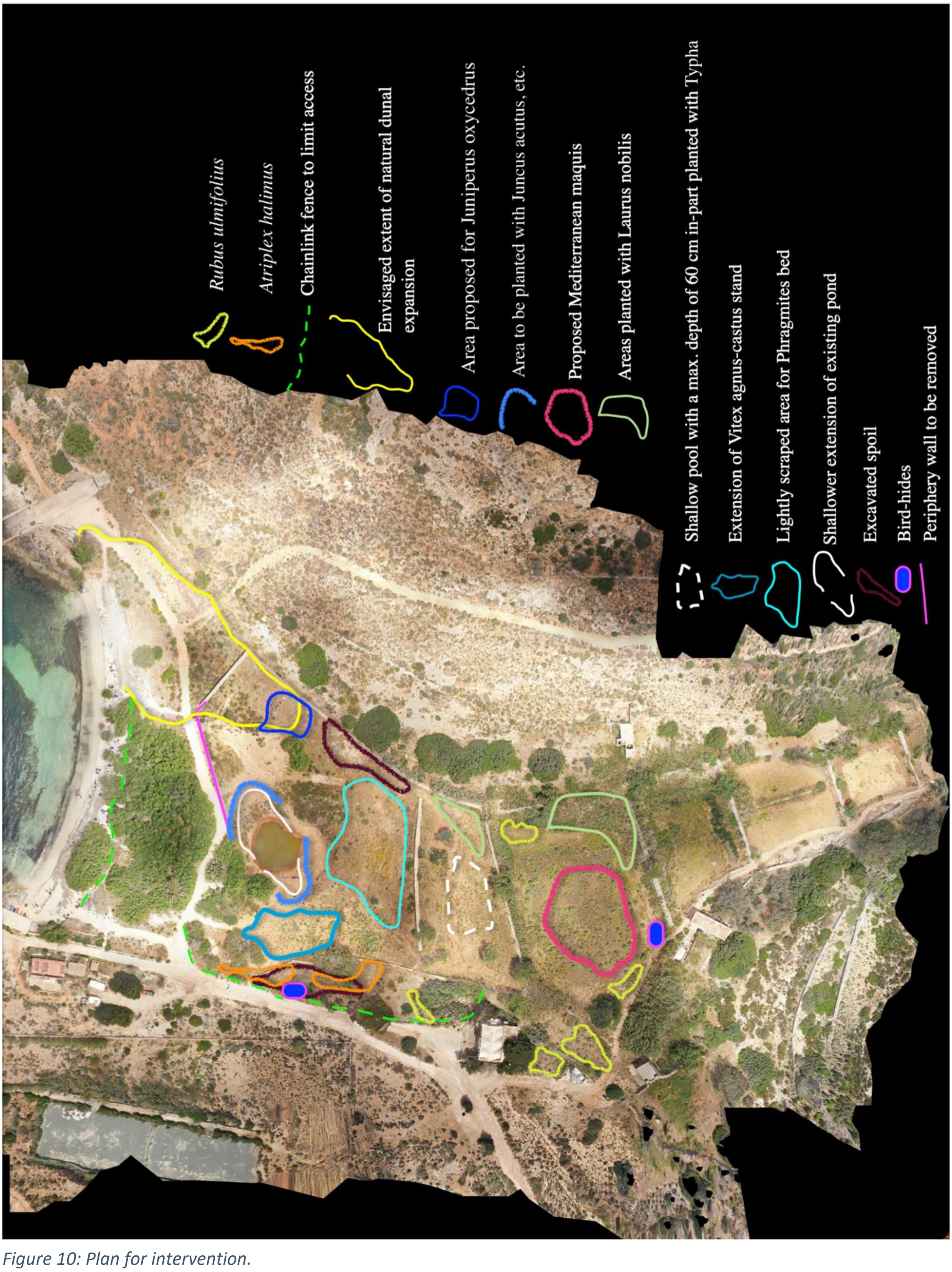

Figure 10: Plan for intervention.

6.4 Interpretation of the Plan.

<table>
<tr><th colspan="2">Interventions by heavy-plant machinery and associated habitat engineering:</th></tr>
<tr><td colspan="2">The Plan and specifications associated with all interventions requiring heavy plant machinery have been discussed and agreed upon with specialists and field supervisory staff from Ambjent Malta, both on site and at the agency’s offices. AM, it was further agreed, shall take care of all permits/authorisations necessary from counterpart national agencies.

Heavy-plant machinery, in the context of this Plan, will only be used to excavate and move soils within the Area of Study. Notably, the following tasks will be carried out according to specifications listed in Table 1 in the Annex below.</td></tr>
<tr><td>Enlargement of existing pool</td><td>As elucidated in 4.5 and 5.2 above, any effort to prevent seawater intrusion into the artificial pool will be a laborious and costly affair. However, since this pool lies at the mouth of the valley system, on the bed of Wied tal-Kola, freshwater surface runoff from upstream areas is expected to flood the pool during the wet season. For this reason, two shallower lobes will be excavated on the NE and SW perimeter of the existing pool.

As vertical stratification occurs due to the salinity gradient expected in the wet season, less saline water will tend to occupy the upper regions of the pool; conversely, as salinity increases, so does the density and, as a result, denser saline water will sink to the deeper part of the pool. As the dry season sets in and the weather gets progressively drier, the water level will start to decrease. As this occurs, these lobes on the side of the pool will slowly turn into mudflats, while the central part of the pool will sustain a body of water, albeit saline, across the dry season.</td></tr>
<tr><td>Planting of stenotopic flora around pool edges</td><td>The mudflat environment which will be created as a result of a receding waterline/level shall provide an ideal habitat for foraging waders and other species of avifauna, among other faunal groups.

At the uppermost edge, it is planned to plant species typical of marshland habitats, including Juncus acutus and species of the Mediterranean and Thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi) – an Annex I habitat type (code 1420)</td></tr>
<tr><td>Preparation for Phragmites bed</td><td>The area on which a Common Reed bed occurred some decades ago will have its uppermost layer of topsoil scraped (through raking action) by a mechanical shovel. This area is envisaged to cover >820 m^2, with a maximum length of 24 m and a width, at its broadest point, of 42 m. The depth should not exceed 60 cm.

<u>Note of caution</u>: should any clay material appear during the raking of the surface, the planned depth should decrease.</td></tr>
<tr><td>Creation of a shallow pool to act as freshwater runoff catchment</td><td>It is planned to create a shallow pool in the central area of the smallest of the three land parcels within the AoS. The siting was determined on the basis of the flow diagram (Figure 5), which envisages to ‘catch’ some freshwater runoff, while much of the volume of surface water that passes through this site will continue to flow downstream. The surface area of the pool will occupy > 240 m^2 of the land parcel in question, while the depth of the excavation will <u>not exceed</u> one metre but may be shallower (= 60 cm) if any clay material appears during excavations.

The notion behind this pool is to create a freshwater habitat (contrary to the outer, saline pool near the tamarisk thicket), to provide the site with</td></tr>
</table>

	an aquatic environment, at least, during the length of the wet season. The vegetation cover planned for this pool will mainly comprise of *Typha domingensis*. Presently, the area is overrun by the invasive *Ailanthus altissima*, a most persistent alien species, which may require drastic measures to control it. In this regard, a selective herbicide application (that conforms with EU standards and regulations) should be considered.
Siting of excavated spoil	Excavated material will be moved to two main areas within the AoS, namely, on the eastern and western flanks, where planned planting is envisaged. The spoil will be piled in a sloping manner against the rubble wall on the eastern flank; particular care will be taken so as not to block the existing weepholes at the base of the rubble wall. Created spoil area will be planted with *Atriplex halimus* and *Rubus ulmifolius* on the chapel side, and with stands of *Laurus nobilis* on the opposite flank.
Removal of ashlar wall (refer to **dune enlargement** below).	The low-lying ashlar wall (*xulliel* construction) between the wetland area and the tamarisk thicket will be removed (*phase 1* or *phase 2* of the works, depending on timeframes available), for the sand dune to be able to expand inland. Without the said wall, sand transport via aeolian dynamics will be able to occur naturally (especially once the 'wind-tunnels' – created through selective pruning within the tamarisk thicket – are functioning as planned).

Fencing:
The installation of fences as a preventive access mechanism is envisaged for two areas, namely, (i) the area between the AoS and the public dirt-road near the chapel, in order to deter unauthorised access into the wetland; and (ii) within the tamarisk thicket in order to prevent access into the wetland from the beach. The fence in the tamarisk thicket will be quite inconspicuous and will also act to prevent members of the public from using the thicket as an outdoor public convenience. While chain-link fencing could serve the purpose within the tamarisk-thicket, in other more exposed areas a fence of with wood piles or plasticrete material (for added durability) could be considered.
Creation of wind-tunnels:
There is little doubt that the tamarisk thicket, in its present form, impedes the movement of wind-blown sand from the beach onto the hinterland and vice-versa (see 4.2 and 4.3 above). To counter this issue, it is proposed to sensitively prune some lower branches within the thicket, at a height of 60 to 70 cm (maximum), perpendicular to the beach. This will allow the movement of loose grains through aeolian dynamics and thus 'connect' the beach and the area behind the tamarisks. Ideally, a number of these 'wind-tunnels' are created across the tamarisk stand (e.g. three to six). **Note**: the chain-link fence will discourage and even deter members of the public from gaining access to the wetland via these 'wind-tunnels'.
Prep layout for dune enlargement:
With the eventual removal of the low ashlar wall and some sections of rubble walling (*xulliel*) that exist behind the tamarisk thicket, it is expected that sand material will be transported through aeolian dynamics from the beach and the sand dune onto the area foreseen for natural dunal enlargement. As sand starts to accumulate on this area, so will some of the flora associated with dunes. However, given the probability that a seed pool of inland plant species already exists on the area in question, there may be a need for selective weeding over time to ensure that sand dune flora gains a foothold in the newly formed habitat.

Planting of Juniperus oxycedrus	A small copse of *J. oxycedrus* is proposed for a small area on which the dune enlargement will take place. This species represents the vegetation climax of sand dunes in the Mediterranean, often, characterising the consolidated segment of dune fields. The planting of these trees will provide a natural marker to indicate the end of the dunal habitat.

Enlargement of Vitex agnus-castus stand:

The *Vitex agnus-castus* stand was far more extensive in the recent past, as can be attested by aerial photographs taken half a century or so ago. The species extended into the edge of the former wetland and onto the back of the sand dune which existed, at the time, near the police station. This again will be extended to reflect its former footprint. Plants will be grown from cuttings taken from the Comino population in order to preserve the local gene pool.

Figure 11: A 1957 aerial photograph of Santa Marija Bay showing an afforested area of Tamarix and Vitex stands extending inland (Source: Planning Authority)

Creation of a Thermo-Med. maquis:

During the second phase of the works, it is envisaged to plant a woodlot composed of species typical of a central Mediterranean Thermo-Med. assemblage. The assemblage will be based on species of the Sclerophyllous scrub, mainly components of the **Quercetalia ilicis** arborescent matorral with elements of the Thermo-Mediterranean shrub formations. This woodlot will occupy an area of > 900 m^2 and is expected to provide a woodland habitat, albeit spatially restricted, that would eventually become self-regenerating as a result of additional space allocated around the planned initial footprint.

Planting of Laurus nobilis population to enhance code 5230:

In addition to its being a national obligation to increase the national coverage of the species (EUNIS **code 5230**), it is being proposed to plant *Laurus nobilis* thickets on the more humid parts of the site, where mesic conditions seem to be prevalent. The soil moisture appears to be higher in the selected areas than in other adjoining sections due to the relative shelter provided by rubble walls and mature trees, as well as the direction of freshwater runoff (see ***Figure 5***) due to existing topography (lie of the land).

Planting of Atriplex halimus; Rubus ulmifolius:

Introducing *Atriplex halimus* and *Rubus ulmifolius* into the site will serve to create a corridor function for a suite of micro-mammals, reptiles and invertebrates within the areas identified, while also acting as a barrier to control unnecessary trampling on the newly restored area. *A. halimus* is typical of coastal areas within the central Mediterranean and once mature, its large bushy aspect will provide a crucial buffer between the lower marsh area and the somewhat popular dirt-road adjacent to the chapel. *R. ulmifolius*, on the other hand, will provide yet another function, considered a significant ecosystem service, that is, pollination. Subsequently, the provision of berries, from which numerous biota will stand to benefit, adds considerable value to an island which endures a dearth of such vegetation. The only negative aspect of *R. ulmifolius* is its potential to become invasive. However, the tentative areas identified for its introduction support shallow soils and exposed bedrock. For this reason, it is unlikely that this plant would pose such a problem in the future and in any case, it is envisaged that the wetland, once restored, will be manned and managed.

Installation of bird-hides:

Bird hides made of easily removable materials (reversable), such as wood, will be installed during a second phase of the project. Two bird observation hides are planned for the western and southern peripheries of the AoS. The hides will be used for field observations of avifauna and other biota as well as function as reception areas for visitors to the area, which aims to add value in terms of biodiversity conservation and awareness raising. The location of such hides would be such to conduce visiting the area through established pathways only.

Figure 12: A wooden bird hide at Salina Natura 2000 site.
Two similar bird observation hides are being proposed for the wetland

Figure 13:. Axonometric view of the wetland at Santa Marija, Comino (Kemmuna) – artwork: Victor Falzon.

6.5 Monitoring considerations. As a matter of routine, monitoring needs to be given serious thought and at least three basic monitoring regimes will thus be implemented:

(i) **Physicochemical** monitoring of all water bodies within the wetland area, including the created pools and ephemeral water bodies that may form within and around the site. Regular measurement of precipitation of the AoS *per se* will also provide crucial information for environmental management purposes. Relevant gauges may be installed, with appropriate permission, at the police station.

(ii) On-going **monitoring programme of the flora**, including both planted species and those occurring naturally.

(iii) **Faunistic seasonal monitoring programme**, will include a focus on ***(a)*** avifauna – primarily, a breeding bird survey for any breeding species within the wetland (March to June), as well as migratory counts during spring and autumn passages; and ***(b)*** invertebrates, via the possible use of pitfall, malaise and light (M.V.) traps, as well as netting techniques during the day, especially but not exclusively during spring and autumn, all based on the principle of catch-and-release for field data recording.

Further recommendations for the future:

- The potential for **augmenting the hydrological input** should be explored and the restoration and reactivation of the dilapidated sewage treatment facility at Wied l-Ahmar, which is currently under the responsibility of the Water Services Corporation, may offer such option.

- The **dirt-track** that lies at the back of the tamarisk thicket and which effectively splits the woodlot from the wetland area, currently permits access by off-road vehicles and on foot. Ideally, such access should be regulated in a manner that allows minimal 'trespass' into this area, unless necessary and justified, in order to limit disturbance as much as possible. Minimal use of the said dirt-track would potentially result in its colonisation by flora of targeted biotopes/habitats, allowing a natural gradation between the dune and the marshland areas, rather than the present artificially defined delineation. For such to happen, access to the slipway and quayside would need to be selective and used only for emergency purposes, unless alternative arrangements for accessing the sea during strong northeasterlies are arranged via another slipway/quayside elsewhere. The removal of the dirt-track would potentially allow the restoration of the area to pre-1988 levels (See Figure 14 for reference).

- Part of the sandy beach near the police station, where remnant elements of the dunal assemblage still persist, currently serves as a point of access for quad bikes operated by members of the Police Force. The area in question, however, also offers the potential for **sand dune habitat recovery**. Such a possibility would only be achievable if vehicular access and trampling were to cease in order for the stenotopic dune flora to recuperate. In this context, it may be appropriate to explore the notion of alternative linkages with the relevant authorities.

- Once the restoration works are executed, and the wetland area is exposed to the elements and through a couple of rainy seasons, the various restored floral assemblages as well as hydrodynamics of the area should allow for a further consideration for the introduction of fauna typical of wetland and sand dune habitats. The Santa Marjia wetland could accordingly act as a refugium for species found in (and limited to) other wetland areas across the Maltese Islands which could gain in being introduced or even relocated to Comino to ensure their longevity. Species such as *Aphanius fasciatus,* and marine invertebrates such as crustaceans and molluscs could eventually colonise the recreated habitats, in turn serving to attract avifauna in a relatively safer setting than elsewhere across the Maltese Islands. Such initiatives would be vetted and endorsed by the Environment and Resources Authority, once management of the wetland would be established.

- Finally, the setting up of an **'insect hotel'** is also being proposed. It has become a trend for protected areas across many parts of the world to create specific habitats for wood-boring beetles (Coleoptera) and Hymenoptera, among other invertebrate groups which favour such specialised habitats. These habitats tend to augment the biodiversity within an area significantly. A typical 'insect hotel' set-up is shown in **Figure 12**.

Figure 14: A comparison of aerial photos of Santa Marija Bay in 1978 (left) and 1988 (right). In the ten-year interim, the construction of a pig farm on the island led to the creation of a dirt-track on the back-side of beach which is still in use today, and which segmented several habitats making part of the wetland. The removal of the dirt-track would restore to a certain point such a lost connectivity

Figure 15: An example of a typical 'insect hotel'.

Annex I – Measurements and timeframes

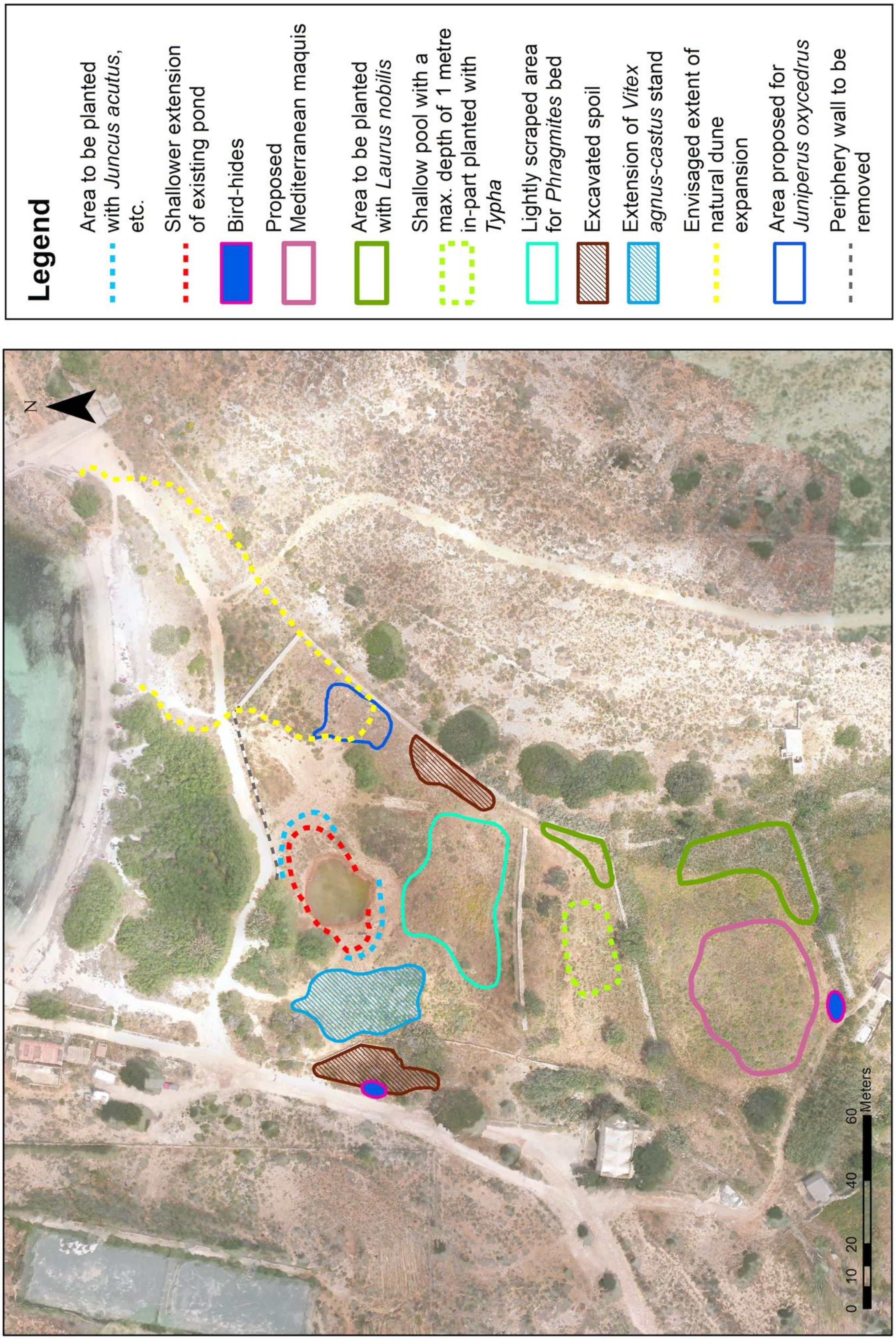

Figure 16: Digitised version of the Plan for a more accurate spatial measurement of polygons.

Table 1: Specific measurements for each of the polygons.

Comino Plan - Dimensions				
Name:	**Area (in square m)**	**Length (in m)**	**Width at widest point(in m)**	**Width at narrowest point (in m)**
Proposed Mediterranean maquis	908.55	30.5	38	
Area proposed for *Juniperus oxycedrus*	191.84	15.8	13.1	
Shallow pool with max depth of 60cm in-part planted with *Thypha*	243.85	23.17	11.7	
Lightly scraped area for *Phragmites* bed	822.11	24	42	
Extension of *Vitex agnus-castus* stand	434.1	31	15	
Area 1 to be planted with *Laurus nobilis*	93.11	20.68	12	4
Area 2 to be planted with *Laurus nobilis*	405.45	29	25.5	10
Excavated spoil (Area 1)	224.56	30	10	
Excavated spoil (Area 2)	147.66	25	6	
Bird Hide 1	22	6	3	
Bird Hide 2	22	6	3	

Name:	**Dimension (m)**
Shallower extention of existing pond (Western side)	5
Shallower extention of existing pond (Eastern side)	8
Length of periphery wall to be removed	47.26
Area to be planted with Juncus acutus - Distance from extended pond (West Bank)	2
Area to be planted with Juncus acutus - Distance from extended pond (East Bank)	3

Table 2: GANTT Chart outlining timeframes for deliverables.

Wetland Restoration of Santa Marija Bay: Proposed activities

Wetland Restoration of Santa Marija Bay: Proposed activities	2022 Jul	Aug	Sep	Oct	Nov	Dec
Remove sources of degradation						
Eradication of *Alianthus altissima*	■					
Installation of chain fencing to limit trespass				■	■	
Control of IAS				■	■	■
Physical interventions on site						
Enlargement of existing pool	■					
Preparation of Phragmites bed (scarring of surfaces)	■					
Creation of shallow pool for runoff catchment	■					
Placement of excavated spoil to consolidate areas as per plan	■					
Carting of past beached material (sand) to dune area						
Removal of ashlar wall between dune and marshland						
Installation of bird hides						
Restoring biotic environment						
Planting of stenotipic flora around pool edges						■
Prepare area for dune enlargement including planting of *Juniperus oxycedrus*						
Enlargement of *Vitex agnus-castus* strand						■
Planting of Phragmites				■	■	
Creation of Thermo-Med maquis						■
Planting of *Laurus nobilis*						■
Planting of *Atriplex halimus, Rubus ulmifolius*						■
Monitoring						
Monitoring of physico-chemical characteristics of pools	■	■	■	■	■	■
Monitoring of flora/invertebrates						
Monitoring avifauna	■	■	■	■	■	■
Monitoring report with suggestions for next physical interventions and habitat restoration work depending on progress achieved						
Future considerations						
Removal of back road to beach						
Rerouting access to protect sand dune area near police station						

Activity	2023 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Remove sources of degradation												
Eradication of *Alianthus altissima*						■	■					
Installation of chain fencing to limit trespass												
Control of IAS	■	■	■	■	■	■	■	■	■	■	■	■
Physical interventions on site												
Enlargement of existing pool						■	■					
Preparation of Phragmites bed (scarring of surfaces)												
Creation of shallow pool for runoff catchment												
Placement of excavated spoil to consolidate areas as per plan						■	■					
Carting of past beached material (sand) to dune area						■	■					
Removal of ashlar wall between dune and marshland						■	■					
Installation of bird hides							■	■				
Restoring biotic environment												
Planting of stenotipic flora around pool edges	■	■										■
Prepare area for dune enlargement including planting of *Juniperus oxycedrus*								■	■			■
Enlargement of *Vitex agnus-castus* strand	■	■										■
Planting of Phragmites										■	■	
Creation of Thermo-Med maquis	■	■										■
Planting of *Laurus nobilis*	■	■										■
Planting of *Atriplex halimus, Rubus ulmifolius*	■	■										■
Monitoring												
Monitoring of physico-chemical characteristics of pools	■	■	■	■	■	■	■	●	■	■	■	■
Monitoring of flora/invertebrates			■		■		■	●	■		■	
Monitoring avifauna	■	■	■	■	■	■	■	●	■	■	■	■
Monitoring report with suggestions for next physical interventions and habitat restoration work depending on progress achieved								●				
Future considerations												
Removal of back road to beach												
Rerouting access to protect sand dune area near police station											◆	◆

Activity	2024 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Remove sources of degradation												
Eradication of *Alianthus altissima*						■	■					
Installation of chain fencing to limit trespass												
Control of IAS	■	■	■	■	■	■	■	■	■	■	■	■
Physical interventions on site												
Enlargement of existing pool												
Preparation of Phragmites bed (scarring of surfaces)												
Creation of shallow pool for runoff catchment												
Placement of excavated spoil to consolidate areas as per plan												
Carting of past beached material (sand) to dune area												
Removal of ashlar wall between dune and marshland												
Installation of bird hides												
Restoring biotic environment												
Planting of stenotipic flora around pool edges	■	■										
Prepare area for dune enlargement including planting of *Juniperus oxycedrus*	■	■										
Enlargement of *Vitex agnus-castus* strand	■	■										
Planting of Phragmites												
Creation of Thermo-Med maquis	■	■										
Planting of *Laurus nobilis*	■	■										
Planting of *Atriplex halimus, Rubus ulmifolius*	■	■										
Monitoring												
Monitoring of physico-chemical characteristics of pools	■	■	■	■	■	■	■	●	■	■	■	■
Monitoring of flora/invertebrates	■		■		■		■	●	■		■	
Monitoring avifauna	■	■	■	■	■	■	■	●	■	■	■	■
Monitoring report with suggestions for next physical interventions and habitat restoration work depending on progress achieved								●				
Future considerations												
Removal of back road to beach						■	■					
Rerouting access to protect sand dune area near police station	◆	◆										

Activity	2025 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Remove sources of degradation												
Eradication of *Alianthus altissima*												
Installation of chain fencing to limit trespass												
Control of IAS	■	■	■	■	■	■	■	■	■	■	■	■
Physical interventions on site												
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Planting of *Atriplex halimus, Rubus ulmifolius*												
Monitoring												
Monitoring of physico-chemical characteristics of pools	■	■	■	■	■	■	■	●	■	■	■	■
Monitoring of flora/invertebrates	■		■		■		■	●	■		■	
Monitoring avifauna	■	■	■	■	■	■	■	●	■	■	■	■
Monitoring report with suggestions for next physical interventions and habitat restoration work depending on progress achieved								●				
Future considerations												
Removal of back road to beach												
Rerouting access to protect sand dune area near police station												

Annex II - Summary of Consultations held in the preparation of the restoration plan

The project for the preparation of the restoration plan kicked off in March 2022, with the first visit to the site being held on the 18th April with all relevant stakeholders. During the site visit, the authors of this report (BirdLife Malta and appointed consultants), accompanied officials from Ambjent Malta and the Environment and Resources Authority in order to have an initial outlook of the current state of the wetland, its potentials for interventions and to also gather a general idea of the vision such institutions had for the site's future as a functional restored wetland. Particular attention was given to structures on site such as rubble walls, weep holes, the existing pond, as well as to what level of interventions could Ambjent Malta afford for the area. Given Comino is a relatively remote island, the logistics of getting equipment on site needed to be understood for the restoration plan to be able to plan realistic and achievable interventions.

Following the 18th April visit, a separate visit was coordinated on the 6th May 2022 between BirdLife Malta and the appointed consultants. Ambjent Malta officials joined once more briefly and further discussions were held on site. Samples were taken from the saline pool and soil to gauge salinity profiles.

On the 4th May 2022, a further site visit was held between BirdLife Malta nature reserves staff and Ambjent Malta staff. Equipped with a one metre earth borer the idea was to prepare pilot holes in the areas earmarked for eventual excavation and scraping to be sure that the work would not penetrate the clay bedding resulting in potential sea water seepage. As it turns out at one metre depth there was no sign of clay and therefore sea water incursion after the proposed works would be discounted.

On the 27th May a final meeting was held with Ambjent Malta officials, where the restoration plan was presented in its entirety at Ambjent Malta's premises. A presentation and discussion ensued to explain to Ambjent Malta officers why certain interventions (and limitations) were proposed. Ambjent Malta officials understood the proposals made and acknowledged that the entity would be willing to execute such plans if ERA approved and consented.

On the 15th June, a final draft of the report was submitted to ERA, with a meeting held on the 27th June 2022 to clarify some points from the proposal and with some added recommendations from ERA officers. The current version of this report is the finalised restoration plan with input from the above-mentioned entities.

Unfortunately given the restriction in time to prepare this plan, and the need for Ambjent Malta and ERA to proceed with initial works for the site, the consultations for the plan were mostly focussed with such entities, which could tangibly and realistically start executing the proposed plan in the weeks that follow.