

**Thorne Moors
Internal Drainage Board Partnership**

**Thorne, Crowle and Goole Moors Site of
Special Scientific Interest**

Water Level Management Plan

March 2010

Final Report

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AUTHORISED SIGNATURES

The under mentioned, being representatives of the appropriate organisations and duly authorised, have ratified this Water Level Management Plan as prepared by JBA Consulting for the Tween Bridge Internal Drainage Board.

The signatories confirm by their signature below that they agree with the findings and recommendations of this Water Level Management Plan. The actions set out in this Plan would achieve the water level management appropriate for securing the target condition of the SSSI

The Tween Bridge Internal Drainage Board is committed to enacting this plan immediately following ratification by the signatories below and receipt of grant aid from Defra.

TWEEN BRIDGE INTERNAL DRAINAGE BOARD



.....

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Name: Mr J Burtwistle

Date:..2 March 2010.....

NATURAL ENGLAND



.....

Position: Conservation Officer

Name: Mr T Kohler

Date:..28 February 2010.....

REVISION HISTORY

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Water Level Management Plan Consultation Draft September 2008		Tim Kohler Natural England Helen Kirk – THM Conservation Forum (electronic copy)
Water Level Management Plan Consultation Draft April 2009		Tim Kohler Natural England

CONTRACT

This document has been produced by JBA Consulting for the Tween Bridge IDB which is representing the Thorne Moors Internal Drainage Board Partnership. It has been prepared solely as a Water Level Management Plan for Thorne, Crowle and Goole SSSI. It should be noted that no site investigation can guarantee complete assessment or predication of the natural environment. David Patrick and Steve Judge of JBA Consulting carried out the work.

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ABBREVIATIONS

Defra	Department for Environment, Food and Rural Affairs
MAFF	Ministry of Agriculture Fisheries and Food
SSSI	Site of Special Scientific Interest
WLMP	Water Level Management Plan
IDB	Internal Drainage Board
EAP	Environmental Action Plan
EIA	Environmental Impact Assessment

1 INTRODUCTION

1.1 Summary

Thorne, Crowle and Goole Moors were designated a Site of Special Scientific Interest (SSSI) in 1986 and form the largest extent of lowland raised mire in England supporting habitats with rich assemblages of species. The importance of the site has been internationally recognised and has been designated Thorne Moors Special Protection Area (SPA), under EC Directive 79/409 on the Conservation of Wild Birds, and Thorne Moors candidate Special Area of Conservation (cSAC) under the EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora.

The aim of this Water Level Management Plan is to achieve Natural England's conservation aims for the site by the management of water levels in the watercourses and land surrounding the moors.

Thorne Moor was classified a SPA on 16 August 2000 because of its European ornithological importance. The site qualifies under article 4.1 of the Directive (79/409/EEC), as 1% or more of the Great Britain population of Nightjar *Caprimulgus europaeus* in any season use it regularly. The site also supports small numbers, at non qualifying levels, of other species that include Hen Harrier *Circus cyaneus*, Merlin *Falco columarius* and Short-eared Owl *Asio flammeus*, which hunt over the site in winter, and at least one pair of Hobbies *Falco subbuteo* that feed over the site in summer. Also notable are Nightingales *Luscinia megarhynchos* breeding at one of their most northerly regular sites in Britain.

Thorne Moor has been recommended as a cSAC because it contains habitat types and/or species which are rare or threatened within a European context. The European interest lies in the degraded raised bog still capable of natural regeneration. Thorne Moor is considered to be one of the best areas in the UK for this type of habitat

Since the mid 19th Century, and until quite recently, peat was commercially extracted from the Moors. This operation has significantly altered the Moors, destroying the original bog surface and altering the natural bog-forming processes with the cutting of drainage channels across the site taking water away from the raised mire into the drainage systems operated by the six Internal Drainage Boards (IDBs) which surround the SSSI.

1.2 Thorne Moors IDB Partnership

Thorne Moors IDB Partnership is an informal partnership of the six independent Internal Drainage Boards whose Drainage Districts surround the SSSI. The partnership exists with the sole aim of allowing the IDBs to work together to fund and produce this Water Level Management Plan.

The six Internal Drainage Boards are listed, with their grouping, in Table 1-1 with Tween Bridge IDB designated as the lead authority.

Table 1-1 IDBs with groupings

Grouping Name	IDB Name
Shire Group	Black Drain IDB Tween Bridge IDB Goole Fields IDB Reedness & Swinefleet IDB
Lower Aire and Don	Dempster IDB
Independent	Thorntree IDB

JBA Consulting (formerly Grantham, Brundell & Farran) was appointed by the Partnership to prepare the Plan.

2 PURPOSE OF THE PLAN

2.1 Purpose of the Plan

This Plan has been drawn up in accordance with guidelines set out by the Ministry of Agriculture, Fisheries and Food (MAFF) in *Water Level Management Plans – A Procedural Guide for Operating Authorities* published in 1994 and the *Additional guidance notes for operating authorities* published in 1999. It attempts to take into account the aims of all interested parties on and around the site including conservation, agriculture and flood risk management.

This Plan is intended to be a reference document to help provide continuity and stability in site management that can assist the landowners/occupiers, Natural England and the Operating Authorities in fulfilling their statutory duties and obligations to nature conservation.

The Thorne Moors IDB Partnership is collectively responsible for the implementation and development of this Plan so that it fulfils the members' statutory obligations:

- To maintain and where possible enhance the conservation value of Thorne, Crowle and Goole Moors SSSI by managing water levels, to a specified regime and to agreed levels.
- To undertake various research and investigations as identified within the Plan to maintain and enhance the conservation value of the SSSI and the surrounding land.
- To ensure that damage to the SSSI is not caused by the operations of the various Internal Drainage Boards that operate in the areas surrounding the site.

2.2 Policy

In 1991, the Ministry of Agriculture, Fisheries and Food (MAFF) published a policy guidance document entitled *Conservation Guidance for Drainage Authorities* which stated that *Water Level Management Plans should be produced for areas where water levels are managed and that priority should be given to Sites of Special Scientific Interest*. This was reinforced in 1994 with the publication of *Water Level Management Plans – A Procedural Guide for Operating Authorities* and *Additional guidance* published in 1999. Grant aid to implement Plans was made available to Internal Drainage Boards.

In 2000, MAFF published High Level Targets for flood defence operating authorities which specifically tasked IDBs to produce Water Level Management Plans for national and internationally important wetland sites. These targets were revised in 2005, but still included WLMP preparation and implementation as well as a measurable target. In 2008, Defra published a series of Outcome Measures to replace the High Level Targets and *Outcome Measure 4 - Nationally important wildlife sites* – records the delivery of flood, water level and coastal management remedies which contribute toward the government target of having 95% of Sites of Special Scientific Interest in favourable condition by 2010.

Each of the Internal Drainage Boards covered by this Plan will fulfil its duties under the Land Drainage Act 1991, the Wildlife and Countryside Act 1981 and as competent authorities under the Conservation (Natural Habitats &c.) Regulations 1994. In addition to these statutory commitments, the IDBs are committed to play their full role in sustaining the water level management plans prepared for the SSSI and, in conjunction with Natural England, surrounding landowners and other interested parties, review the plans in accordance with Defra guidance.

2.3 Water Level Management Plan Review

Natural England is responsible for monitoring the condition of SSSIs, at least once every six years, using a set of common standards. The latest assessment of Thorne, Crowle and Goole Moors SSSI was made on 1 September 2008. This found that the site is in an unfavourable condition. Approximately 30% of the site is considered to be either *unfavourable declining* or *unfavourable no change*, and without intervention, these areas will become progressively worse. All the units listed

as being in below target condition have drainage listed as one of the causes of the condition. Management measures are in place for the other half of the site, which is considered to be *unfavourable, recovering*.

In 2004, Defra and English Nature (Natural England) carried out a review of SSSIs in England. Of those SSSIs where water management was judged to be an issue, the review identified 87 sites where water level management was the main reason for unfavourable condition. These sites have been designated as Priority sites for Water Level Management Plans and Thorne, Crowle and Goole Moors SSSI falls within this priority group. The Internal Drainage Boards surrounding the SSSI have primary responsibility, as the operating authorities, for implementing a plan to bring those features of the site which are degraded, through inappropriate water management, to favourable or unfavourable recovering condition, by appropriate water level management.

Thorne, Crowle and Goole Moors SSSI is identified as a priority site nationally and water level management is essential to delivering favourable condition. To achieve the Government target outlined above, the Internal Drainage Boards are required to prepare a WLMP for the site, in consultation with Natural England. By producing and implementing a WLMP, the Internal Drainage Boards are fulfilling their statutory duties to nature conservation. The WLMP review process is shown in Figure 2-1 below.

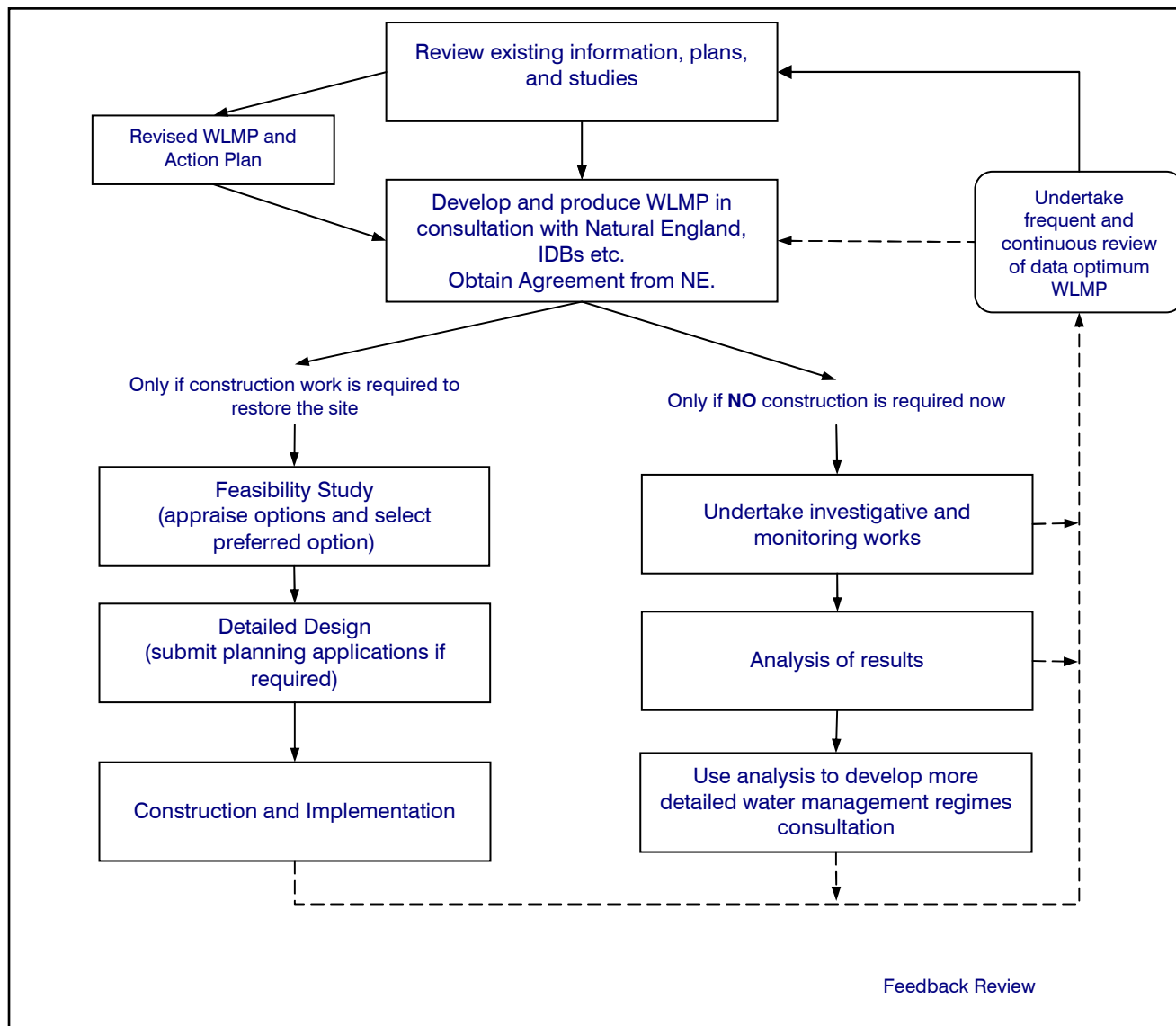
This document will bring together the relevant results of previous studies and will aim to provide a greater understanding of the site's hydrological regime and its interaction with the agricultural land which surrounds it and the effects on urban areas of any changes in water management. The Thorne, Crowle and Goole Moors SSSI WLMP aims to take into account the aims of all interested parties on or around the site including conservation, agriculture and flood risk management.

2.4 Objectives

The objectives of this Water Level Management Plan, through research and water management, are to:

- Bring the site into "target" condition by 2010 through appropriate water level management, investigation and research whilst considering the interests of all parties on and around the site, including conservation, agriculture and flood risk management issues.
- To maintain and where possible enhance and restore the conservation value of Thorne, Crowle and Goole Moors SSSI by managing water levels, within the plan area, to a specified regime and to agreed levels.
- To ensure that damage to the SSSI is not caused through the operations of the Internal Drainage Boards surrounding the site.

Figure 2-1 Water Level Management Plan Production and Review Process



3 SITE DETAILS

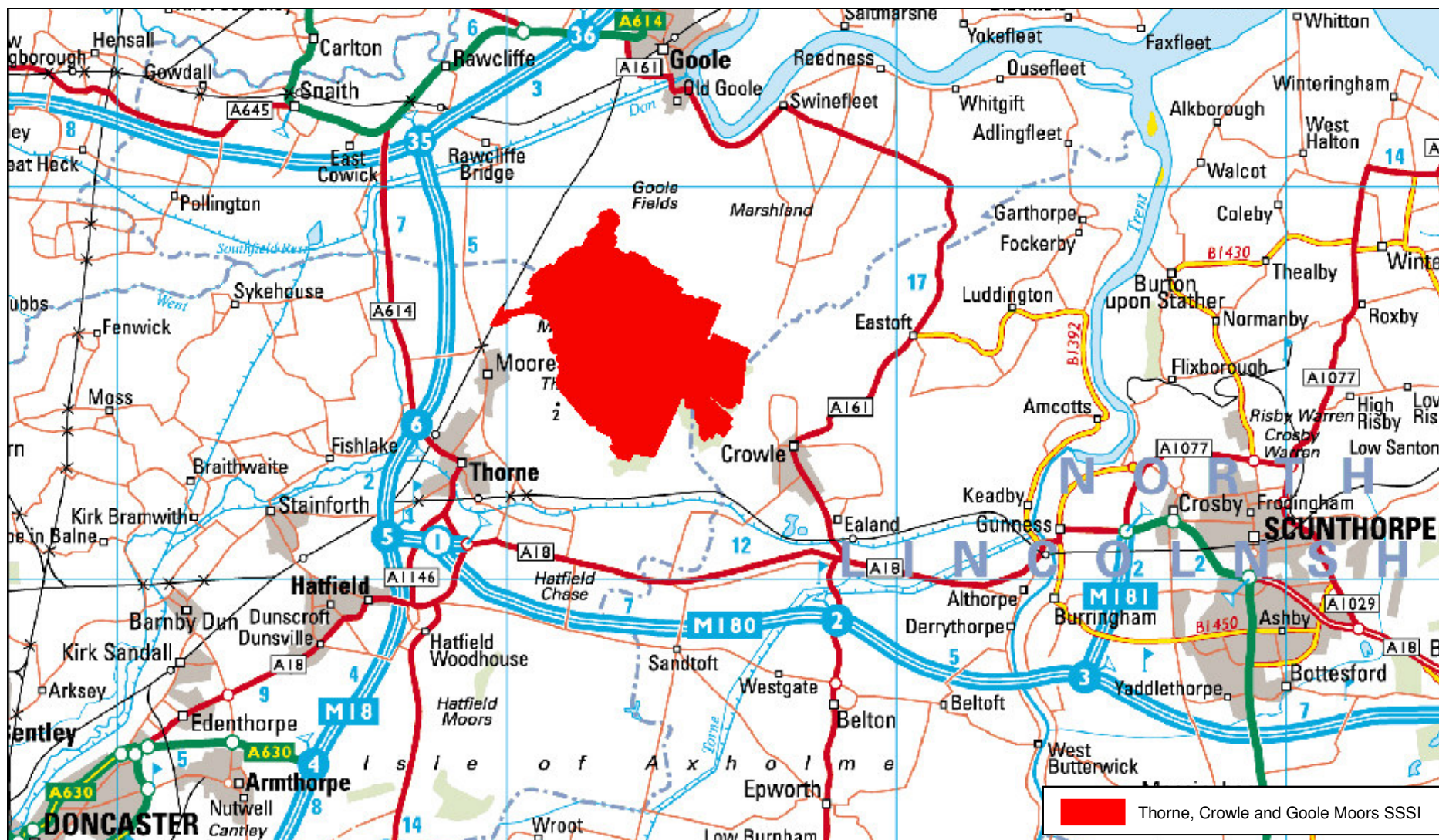
3.1 Site Details

Thorne, Crowle and Goole Moors SSSI, collectively known as Thorne Moors, are located approximately 5km northeast of Thorne, South Yorkshire, lying between the Rivers Don and Trent (Map 1).

A summary of the site details is shown in Table 3-1 below.

Table 3-1: Summary of Site Details

Site Name	Thorne, Crowle & Goole Moors
Site Status	Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981 Special Protection Area (SPA) under the 1979 Conservation of Wild Birds Directive (79/409/EEC) Candidate Special Area of Conservation (SAC) under the 1992 European Habitats Directive (92/43/EEC). National Nature Reserve (NNR) under the National Parks and Access to the Countryside Act 1949 and Wildlife & Countryside Act 1981
Notified	SSSI under the Wildlife & Countryside Act 1981 in 1986 SPA on 16 August 2000 cSAC on 16 August 2000
County	East Riding of Yorkshire North Lincolnshire South Yorkshire
Local Planning Authority	Doncaster Metropolitan Borough Council East Riding of Yorkshire Council North Lincolnshire Council
Grid Reference	SE730160
Area of Site (ha)	1919.04ha
Operating Authorities	Black Drain Drainage Board Dempster Internal Drainage Board Goole Fields Internal Drainage Board Reedness & Swinefleet Drainage Board Thorntree Internal Drainage Board Tween Bridge Internal Drainage Board Environment Agency (Midlands Region) Environment Agency (Yorkshire Region)
Natural England Office	South Yorkshire Team
Owners/Occupiers	1448 ha owned by Natural England 172 ha owned by Lincolnshire Wildlife Trust 298.6 ha in private ownership
Wayleaves and Licences	A number of Public Rights of Way lead to the SSSI. Common Rights are registered under the Registration of Commons Act 1965.



Map 1: SSSI Location

4 NATURE CONSERVATION

4.1 Nature Conservation Interest

Thorne, Crowle and Goole Moors SSSI, located approximately 5km northeast of Thorne, South Yorkshire, forms the largest extent of lowland raised mire in England supporting habitats with rich assemblages of over 4,000 species of plants and animals. The citation for the site is included at Appendix A.

Since the middle of the 19th Century, commercial peat extraction and warping destroyed large parts of the original bog surface, however, remnants of the former bog flora remain and have re-colonised former worked areas where active bog management including shallow flooding has been undertaken and suitable conditions exist.

The mire communities in the wet peat cuttings are dominated by Common Cotton-grass *Eriophorum angustifolium* with Soft Rush *Juncus effusus* and carpets of bog mosses *Sphagnum* spp. The old mire surface between the cuttings is dominated by species typical of wet woodland, wet heath and Hare's Tail Cotton-grass *Eriophorum vaginatum*. Fen, woodland and other habitats have also developed over the site supporting rich assemblages of species.

Thorne Moors are highly regarded for their invertebrate fauna, in particular peat bog and fen species of insect including several nationally rare as well as local insects such as the Bog Bush Cricket *Metrioptera brachiptera*, the Scarce Vapourer Moth *Orgyia recens*, the bug *Globiceps woodreffeii* and the beetle *Bembidion humerale*. There is also a strong population of Large Heath Butterfly *Coenonympha tullia*.

The site is important for its breeding and wintering bird populations. Breeding species characteristic of dry scrub and heathland include Nightjar *Caprimulgus europaeus*, Nightingale *Luscinia megarhynchos*, Woodcock *Scolopax rusticola* and Whinchat *Saxicola rubetra* with Teal *Anas crecca*, Snipe *Gallinago gallinago*, Reed Warbler *Acrocephalus scirpaceus* and Grasshopper Warbler *Locustella naevia* associated with the wet heath and fen habitats. The breeding population of Nightjars on the Moors is of national importance as its numbers regularly exceed 1% of the total British breeding population (see Appendix A).

4.2 Conservation Aims

Natural England has produced a set of Conservation Objectives for the European Interest Features on the SSSI. These contain the following conservation aims:

- To restore to favourable condition the area currently notified as degraded raised bog
- To maintain in favourable condition the habitats for the populations of nightjar (Annex 1 species of European importance) with particular reference to degraded bog capable of natural regeneration as a precursor of active raised bog.

There is no comparable set of objectives for that part of the site which does not have European designation

To achieve this, Natural England aims to:

- Maintain, and enhance the current extent, diversity and condition of the wetland habitats through appropriate monitoring and subsequent management of the raised mire.
- Meet all the requirements of international treaties relating to wetland conservation (Ramsar Convention and Habitats Directive).
- Restore and enhance the hydrology, water quality and management of wetland sites that are currently in sub-optimum condition following peat working.
- Seek opportunities for habitat creation of wetland habitats.
- Maintain and enhance important populations of wetland plants and animals and carry out appropriate monitoring to determine their status.

- Maintain a favourable hydrological regime to encourage the development of peat-forming vegetation by maintaining water levels across the site within the ranges + 30cm to -20cm of the peat surface.

These aims have been and will continue to be addressed within the framework offered by this Water Level Management Plan.

4.2.1 Humberhead Peatlands NNR site objectives

The following site objectives were developed from those originally outlined in the Humberhead Peatlands NNR Management Plan Consultation Document (December 2005). Subsequent modifications were made, and will continue to be made, throughout the Management Plan development process. The NNR site objectives will need to be considered when developing options to provide water levels for favourable condition at Hatfield Moor SSSI.

Table 4-1: Humberhead Peatlands NNR site objectives

	NNR Objective	Details
1	To restore and maintain lowland raised mire habitat over the greater part of the NNR	<ul style="list-style-type: none"> • Areas targeted for mire restoration will be retained at optimum water levels, surface-milling fields will be kept wet and water loss from these areas will be minimised. This will be achieved primarily by manipulation of water levels. • Specific actions include: <ul style="list-style-type: none"> – installation of bunds, dams and sluices – works to reduce seepage – management of areas of trees and shrubs – use of supplementary water from elsewhere (if required) as appropriate
2	To maintain and develop the full range of wetland habitats currently present on the NNR	<ul style="list-style-type: none"> • Existing mire habitat will be enhanced by maintaining high and stable water levels in mire areas and controlling inappropriate vegetation. • Marginal screen of appropriate mire edge habitat will be retained and developed in suitable locations and other appropriate habitats including wet woodland, heathland and fen. • Open water areas will be maintained as mesotrophic or oligotrophic systems.
3	To maintain and enhance the population of Nightjar in and around the NNR	<ul style="list-style-type: none"> • Nightjar habitat will be maintained and developed in drier areas.
4	To develop an active wider area programme to support the nature conservation objectives of the site	<ul style="list-style-type: none"> • Natural England will work with external partners to minimise water loss from the peat body and manage discharges from the site. • Actions include: <ul style="list-style-type: none"> • statutory review of consents • WLMPs • management agreements • formal links with adjacent farming and drainage interests
5	To maintain the existing invertebrate interest on the site wherever possible	<ul style="list-style-type: none"> • Management will be modified to reduce risk to key species and encourage habitat diversity. • Reintroductions of key species will be considered.
6	To maintain and develop appropriate habitats for key bird species	<ul style="list-style-type: none"> • Habitat management will be conducted to maintain and develop populations of key species. • Protection of ground nesting species will be undertaken where necessary.
7	To maintain populations of other species of key conservation importance	<ul style="list-style-type: none"> • Appropriate surveys, habitat management and mitigation techniques for key species will be employed where necessary.

8	To maintain and enhance the cultural values and uses of the NNR	<ul style="list-style-type: none"> • Develop links with adjacent farming and drainage interests. • Access and interpretation and education opportunities will be promoted where this will not be detrimental to the ecological interests of the site. • Management of the site will take account of the need to retain identified archaeological interest features.
9	To fulfil all legal obligations	<ul style="list-style-type: none"> • Cooperation with neighbours • Health and safety obligations • Quality control for procedures and resources • Environmental standards and appropriate assessments to be undertaken as required by the Habitats Regulations.

4.3 Conservation Management

The conservation management conducted on the SSSI is primarily the responsibility of Natural England as the principal landowner of the site. Lincolnshire Wildlife Trust also maintains its land holding for nature conservation purposes. Other landowners/occupiers are subject to agreed Management Statements with Natural England.

Natural England is currently undertaking works across a large proportion of the site to bring the degraded raised bog into a favourable condition. Written plans for conservation management and restoration of Thorne Moor are in constant development by Natural England. The site management plan will relate primarily to vegetation and internal water management and monitoring at the site and this WLMP should complement it. Comments made during the last site condition assessment suggest that some scrub clearance has taken place, although inappropriate scrub control is cited as a reason for the SSSI not being in target condition.

Lincolnshire Wildlife Trust has undertaken extensive scrub clearance on areas of wet heath on their Crowle Moor Nature Reserve. The Trust's flock of Hebridean sheep now graze these areas.

Internal Drainage Boards (IDBs) have a statutory duty for nature conservation under the Land Drainage Act 1991 (as amended in 1994). In addition to this, Boards have a duty to promote biodiversity as enshrined in the Natural Environment and Rural Communities Act 2006 and most recently via the IDB Biodiversity Action Plans brought forward in the Defra IDB Review.

As part of this commitment, the Boards, within the Shire Group of IDBs, adopted an Environmental Policy that looks at sensitive ditch management. Responsibility for the maintenance of other ditches rests with the riparian owner, that is, the landowner adjacent to the ditch.

5 OTHER LAND USES

5.1 Within the SSSI

Large scale peat extraction finally ceased in 2002 and the land formally owned by Scotts was handed over to Natural England. Today the land that makes up the SSSI is predominantly managed as a nature reserve or via conservation orientated management. Some small scale peat winning is still undertaken on the eastern side of the Moors.

5.2 Land Adjacent to the SSSI

The land surrounding the SSSI is predominantly arable land. The majority of the land surrounding Thorne Moors SSSI has Grade 2 Agricultural Land Classification with Grade 1 to the northeast of the SSSI and Grade 3 to the southwest.

The agricultural production of this open, low-lying land is very dependent upon gravity and pumped land drainage systems that are operated throughout the Internal Drainage Districts by the individual Boards and the Environment Agency.

6 PHYSICAL FEATURES

6.1 Background

Thorne, Crowle & Goole Moors SSSI comprises the degraded remnants of a flood plain raised mire that typically lies 1.0 - 3.5m above sea level.

Peat extraction has destroyed large areas of the original bog surface of the Moors, significantly altering the natural hydrological processes of the site. The cutting of drainage channels has further altered the hydrological regime across the site, draining and directing water away from the raised mire.

6.2 Topography

A topographic survey of the SSSI in 1991 showed that the variation in height over the Moors is only about 3m. Most of the surface topography is an artefact of peat cutting. Surveys of the basal contours of the peat revealed that it is deepest in the central area of Thorne Moors and beneath Crowle Moors (about -0.5 to -1.0m AOD). This is perhaps the hollow in which the raised mire began to develop. Raised areas (between 1.5 and 2.0m above AOD) occur in the northwest around Rawcliffe Moor, in the eastern part of Goole Moor and in the southern part of Thorne Moors.

6.3 Geology

6.3.1 Solid Geology

The underlying geology of the site is Triassic rocks overlain by variable thicknesses of Quaternary glacial, fluvial and lacustrine drift deposits of late Devensian and Holocene age. The Triassic sequence comprises the Sherwood Sandstone Group (Bunter Sandstone), which dips eastwards along a North/South line on the eastern fringe of the Moors beneath the Mercia Mudstone (Keuper Marl).

6.3.2 Drift Geology

The sequence of drift deposits (from the base up) comprises fluvial sandy gravels, pebble-free sands, ridges of glacial sands and gravels, laminated lacustrine clays, silty sands, fine gravels, silts and silty clays and finally peat and alluvium.

The glacial sands and gravels are believed to be ice age morainic deposits which outcrop in a series of NNW-SSE ridges at Thorne, Tudworth Hall, Lindholme and Wroot.

6.4 Soils

Much of the SSSI is covered by soils of the Longmoss series which are described by the Soil Survey of England and Wales (1983) as thick very acid peat soils.

Other soil series are found around Thorne Moors and are detailed in Table 6-1.

Table 6-1: Soils Associations and General Properties (Soil Survey of England and Wales 1984)

Association	Soil Survey Number	Type	Description	Direction to Thorne Moors
Blacktoft	532a	Marine alluvium	Deep stoneless permeable calcareous fine and coarse silty soils. Some calcareous clayey soils. Flat land. Groundwater controlled by ditches and pumps.	Northwest to West
Romney	532b	Marine alluvium	Deep stoneless permeable calcareous coarse and fine silty soils. Flat land. Groundwater controlled by ditches and	North to East to South

			pumps.	
Foggathorpe	712i	Glaciolacustrine clay	Slowly permeable seasonally waterlogged stoneless clayey and fine loamy over clayey soils. Some similar coarse loamy over clayey soils.	West
Conway	811b	River Alluvium	Deep stoneless fine silty and clayey soils variably affected by groundwater. Flat land. Risk of flooding.	South
Longmoss	1011a	Raised bog peat	Thick very acid peat soils. Largely undrained and perennially wet. Many areas cut over or partly burnt.	SSSI itself

6.5 Climate

The site is situated in Agro-climatic Area 16, which gives a precipitation value of 622mm per annum with a range of 540-800mm (MAFF Technical Bulletin 34). The driest months are February to April with the wettest months being August and November. Bulletin 34 gives the mean return to field capacity as November 28 and the mean end of field capacity as April 7. The soil moisture deficit in any one year can range from 33mm to 117mm. Table 6-2 provides a summary of the mean monthly climatic details for the period 1941-70 (MAFF Technical Bulletin 34).

Table 6-2: Mean Monthly Rainfall, Evaporation and Actual Effective Rainfall (mm)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall (mm)	51	62	54	54	42	43	42	52	49	56	65	52
Potential transpiration (mm)	20	4	1	1	10	32	57	84	93	93	71	44
Actual Effective Rainfall (mm)	31	58	53	53	32	11	-15	-32	-44	-57	-6	8

6.6 Hydrology of Thorne Moors

6.6.1 Hydrological Overview

The natural hydrological processes of Thorne Moors have been significantly altered by past commercial peat extraction that destroyed large areas of the original bog surface.

Under natural conditions, raised bogs, such as Thorne, Crowle and Goole Moors, are largely isolated from groundwater influence and are recharged entirely by precipitation. Water is lost from the site primarily via evaporation and evapotranspiration but some surface run-off would have occurred, depending upon the slope of the water table and the permeability of the acrotelm – the actively growing surface layer of the bog composed of living *Sphagnum*. Lateral discharge through deeper peat layers would likely constitute only small losses of water from the site.

In degraded mire systems, such as Thorne, Crowle & Goole Moors, the hydrological situation is considerably more complex. The cutting of drainage channels to allow peat extraction has enhanced the lateral seepage from the peat and the general lowering of the water table. The removal of peat and the concomitant loss of the acrotelm structure has resulted in the exposure of deeper peats causing a relocation of the water table and increases in evaporation from these areas. There are numerous drainage channels dissecting Thorne Moors that have in the past directed flows towards the main watercourses that leave the site or flow along and form sections of the site boundary.

The Moors are surrounded by intensively drained high quality agricultural lands that rely on pumped drainage for the maintenance of suitable water levels.

6.6.2 Surface Water Drainage

The SSSI lies on the watershed between the Rivers Don and Trent and flows are directed to the two rivers via a drainage system that dates back to the 17th century when in 1626 King Charles I commissioned Cornelius Vermuyden to undertake land drainage improvement. These works comprised the diversion of the River Don (which originally discharged into the River Trent) to the River Ouse at Goole, the excavation of new drains and the construction of floodbanks. There are over 100 miles of 'main' drains within the system, which is now designed to give flood protection to settlements and infrastructure, as well as provide suitable levels for agricultural land use.

Drainage was initially by gravity, however, this has since been replaced by pumped drainage in many catchments. The pumping stations are listed in Table 6-3 and the Internal Drainage Districts are on Map 2.

Table 6-3: Sub-catchments within Each Drainage District

River Catchment	Drainage District	Pumped Sub-Catchments	Gravity Sub-Catchments
River Ouse (Don)	Black Drain	Inlet and Outlet Pumping Stations	Capitol Park Outfall
River Ouse (Don)	Dempster	Swang Pumping Station	Earnshaw Clough Outfall
River Ouse	Goole Fields	Cross Drain Pumping Station	Shipcote Drain Outfall
River Ouse	Reedness & Swinefleet	Reedness Junction Pumping Station	Warping Drain Outfall Reedness Drain Outfall
River Ouse (Don)	Thorntree	Thorntree Clough Pumping Station	
River Trent	Tween Bridge	Elmhirst Pumping Station Medge Hall Pumping Station New Zealand Pumping Station (Environment Agency)	

In the Trent catchment, all water is finally pumped to Keadby Pumping Station operated by the Environment Agency. In the Ouse catchment, water is mainly pumped to the River Don (now an Ouse tributary) or allowed to gravitate (after storage) into the River Ouse. There are also a number of smaller field pumps operated by farmers throughout the area.

Pumping stations have historically been operated with two distinct regimes – low winter levels to maximize storage available, and higher summer levels to provide water for wildlife and irrigation. The switch from summer to winter levels was usually made in November. Summer levels were then resumed in June. However, the wide variations in rainfall mean that summer and winter levels are operated as necessary throughout the year depending upon rainfall conditions.

The pumping system is automated with control telemetry installed in critical stations, allowing the remote control of systems.

6.6.3 Flooding around the SSSI

Without the major flood banks of the rivers Trent, Ouse and Don and the pumping system, the moors and surrounding area would flood frequently, often following tidal patterns with high river flows exacerbating the effects. The rivers Trent, Ouse and Don have 1 in 100 year flood defences and the pumping stations and IDB systems provide protection to a 1 in 50 or 1 in 10 year standard.

At present there are no problems with regular property flooding, as the system is currently managed, in normal conditions. Heavy rainfall, surface water ponding and localised incidents have caused problems and there have been reports of flooding to farmland caused by runoff from the SSSI area. There are currently no available records of flooding around the site; however, in future, these will be recorded and made available.

6.6.4 Surface water movements on Thorne, Crowle and Goole Moors

Surface water flows from the Moors principally via gravity-fed drains which then flow to the IDB pumping stations. At the head of Swinefleet Warping Drain a permanent pump pumps water from the Moors into the Warping Drain which then flows into the River Ouse.

Surface water levels in the ditches influence and are affected by groundwater levels in the surrounding strata. Pumping also influences them. There are significantly higher water levels in summer compared with winter, as levels are kept high in summer for irrigation and to maintain high groundwater levels to allow crops to uptake moisture from soil.

As part of its restoration works, Natural England has installed peat bunds and several sheet pile dams (with penstocks) at the site. The primary objective of these works is to hold water levels within 15cm of ground level (above or below). This will allow cotton grasses to establish, which, in turn, will provide a foothold that *Sphagnum* spp. can begin to colonise. Cotton grasses also create a more humid microclimate in the 10cm above the mire surface so that the bog mosses are less likely to desiccate. *Sphagnum cuspidatum* is a pioneer species which has started to spread in the restoration areas.

The approach taken to restoration involves creating cells using peat bunds. These bunds are not completely watertight and membranes have been used in some areas to ensure they are more watertight. Each cell has a set water level and a water control pipe. The maximum water depth of each cell is 20cm over the ground level of the cell. Above this level, the vegetation would be inundated. The water control pipe therefore transfers water above this level to the drains.

There are some uncertainties concerning the hydrological effect of the restoration works on land adjacent to the SSSI boundary. Further investigation is required to address these uncertainties, which is a key feature of this Plan

6.7 Internal Drainage Boards Surrounding Thorne Moors

There are six Internal Drainage Boards that operate around the Thorne Moors (Map 2). These are described in brief below and summarised in Table 6-3.

6.7.1 Black Drain Drainage District

This is 1950ha in area lying between Thorne Moors in the east and the River Don in the west. Agricultural land accounts for approximately 75% of the total land use within the district. Part of the eastern portion of the Drainage District lies within the boundary of the SSSI. The system is primarily pumped through three pumping stations to the River Don, although part of the southern area is drained by gravity.

6.7.2 Dempster Drainage District

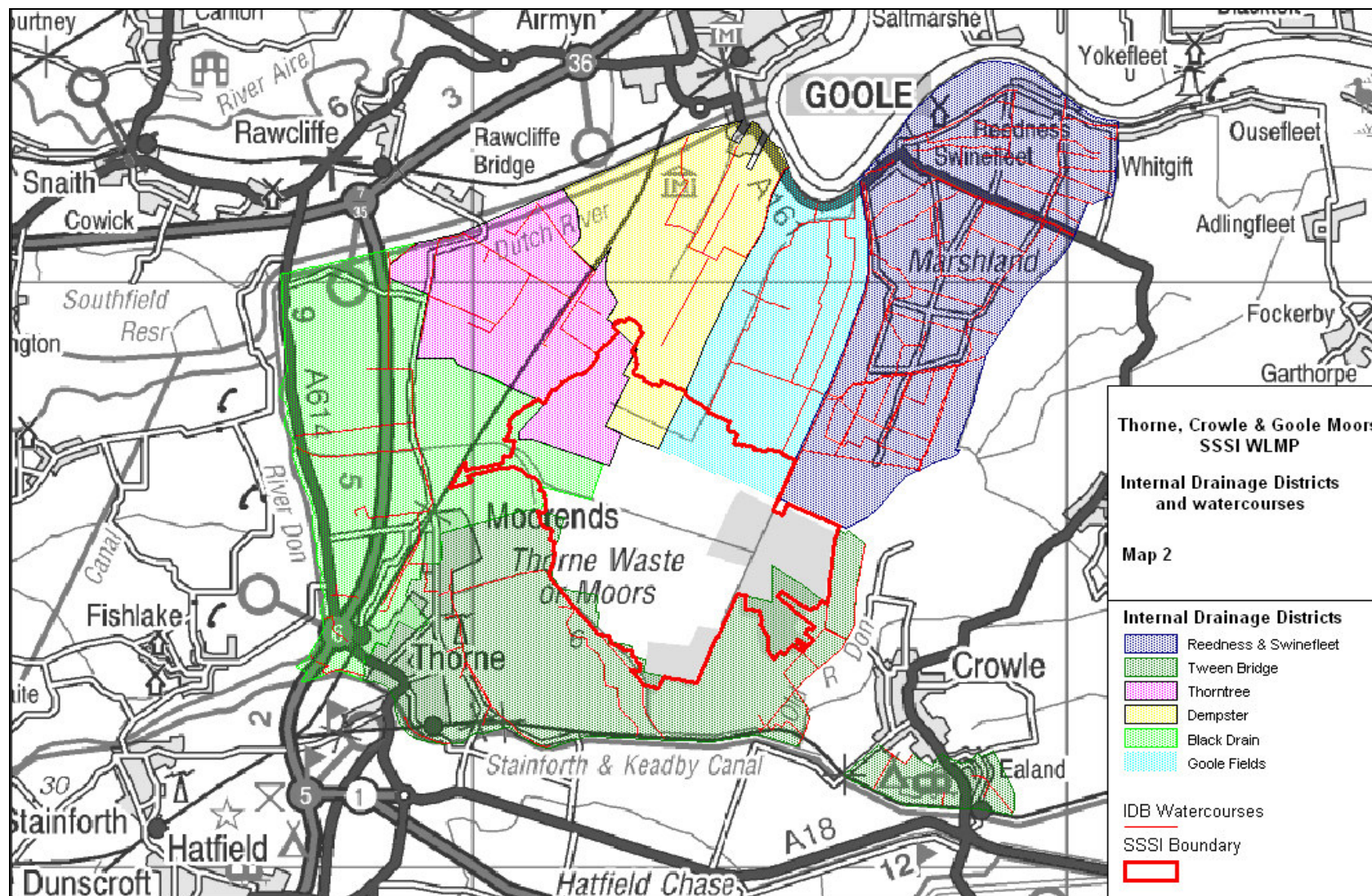
The Dempster District is 1200ha of low-land lying with Thorne Moors to the south and Goole to the north. Agricultural land accounts for over 90% of the total land use within the district. Parts of the southern areas of the Drainage District lie within the boundary of the SSSI.

6.7.3 Goole Fields Drainage District

The Goole Fields Drainage District covers approximately 1050ha of low-land lying between Thorne Moors in the south and the River Ouse in the north. Agricultural land accounts for over 90% of the total land use within the district. Parts of the southern areas of the Drainage District lie within in the boundary of the SSSI. The system principally discharges to the River Ouse by gravity although it is partially pump assisted. This pumps from the district into the Swinefleet Warping Drain which discharges into the River Ouse at low tide.

6.7.4 Reedness & Swinefleet Drainage District

To the east of Goole Fields District this district is 2185ha in area lying between Thorne Moors in the south and the River Ouse in the north. Agricultural land accounts for over 90% of the total land use within the district. No part of the Drainage District lies within in the boundary of the SSSI. The system discharges to the River Ouse through two large gravity outfalls and is partially pump assisted. This pumps from the district into the Swinefleet Warping Drain, which discharges into the River Ouse.



Map 2: Internal Drainage Boards and watercourses

6.7.5 Thorntree Drainage District

The Thorntree Drainage District covers 1056ha of low-land lying between Thorne Moors in the south and the Dutch River in the north. Agricultural land accounts for over 90% of the total land use within the district. Parts of the southern areas of the Drainage District lie within the boundary of the SSSI.

6.7.6 Tween Bridge Drainage District

The Tween Bridge District is situated to the southeast, south and southwest of the Moors and covers 2100ha. Agricultural land accounts for over 70% of the total land use within the district with the remaining 30% being urban, industrial and infrastructure. Parts of the eastern and western areas of the Drainage District lie within the boundary of the SSSI. The whole of the drainage system is pumped to the River Trent.

6.8 Uncertainties

The behaviour of surface and sub surface water on the Moors and the land adjacent to it has historically raised a number of questions as to their interrelationships. Flooding on the adjacent land, allied to fears about increased flood risk brought about by the activities of Natural England in the restoration of the Moors habitat, have led to a number of uncertainties being identified which require further study.

An improved understanding of the drainage of the moors and the land around, which these additional studies will develop, will allow a more robust and sustainable plan to be developed, as well as identifying geographic areas where special measures for water management might be required.

Table 6-4: Uncertainties and suggested further study

	Uncertainty	Additional study required
1	What are the possible destinations for the additional site water resulting from the reduction in holding capacity of the re-wetted moor?	<ul style="list-style-type: none"> Modelling should be undertaken to investigate options including the use of the Swinefleet Warping Drain, gravity draining to the north west of the moor and other possible scenarios.
2	<p>What are the losses due to evaporation/transpiration compared with vertical or horizontal seepage?</p> <p>What are the effects of inappropriate scrub management on water levels when compared to drainage effects?</p>	<ul style="list-style-type: none"> Actual evaporation/transpiration estimates can be obtained from continuous dipwell data when the water table is close to the ground surface. Losses due to horizontal or vertical seepage (depending on location within the site) can be investigated by looking at dipwell data from a dry, cool winter period of several days. If there are losses, these can be attributed to seepage as evaporation/transpiration losses should be virtually zero.
3	Does holding back water on the Moor deprive surrounding areas of water for irrigation or will restoration of the Moor result in increased surface water runoff and/or lateral seepage to surrounding land (and therefore flooding and/or waterlogging)?	<ul style="list-style-type: none"> Simple modelling work should be undertaken to compare surface water drainage in a peat extraction situation and restoration situation. Current Environment Agency and Internal Drainage Board pumping operations should be reviewed
4	What is the impact of climate change on rainfall and evaporation/transpiration and how could this affect how much water is available to the Moor?	<ul style="list-style-type: none"> The Environment Agency's statistical downscaling of the effects of climate change on weather could be used. The downscaling tools use regional-scale outputs from Global Circulation Models and predict climate changes at the site scale. However, the relative degree of uncertainty with climate change modelling should be considered.

6.9 Current Site Condition

Natural England has assessed the site and divided it into areas known as units, which have their condition assessed according to a national set of guidance standards. There are 29 units, all of

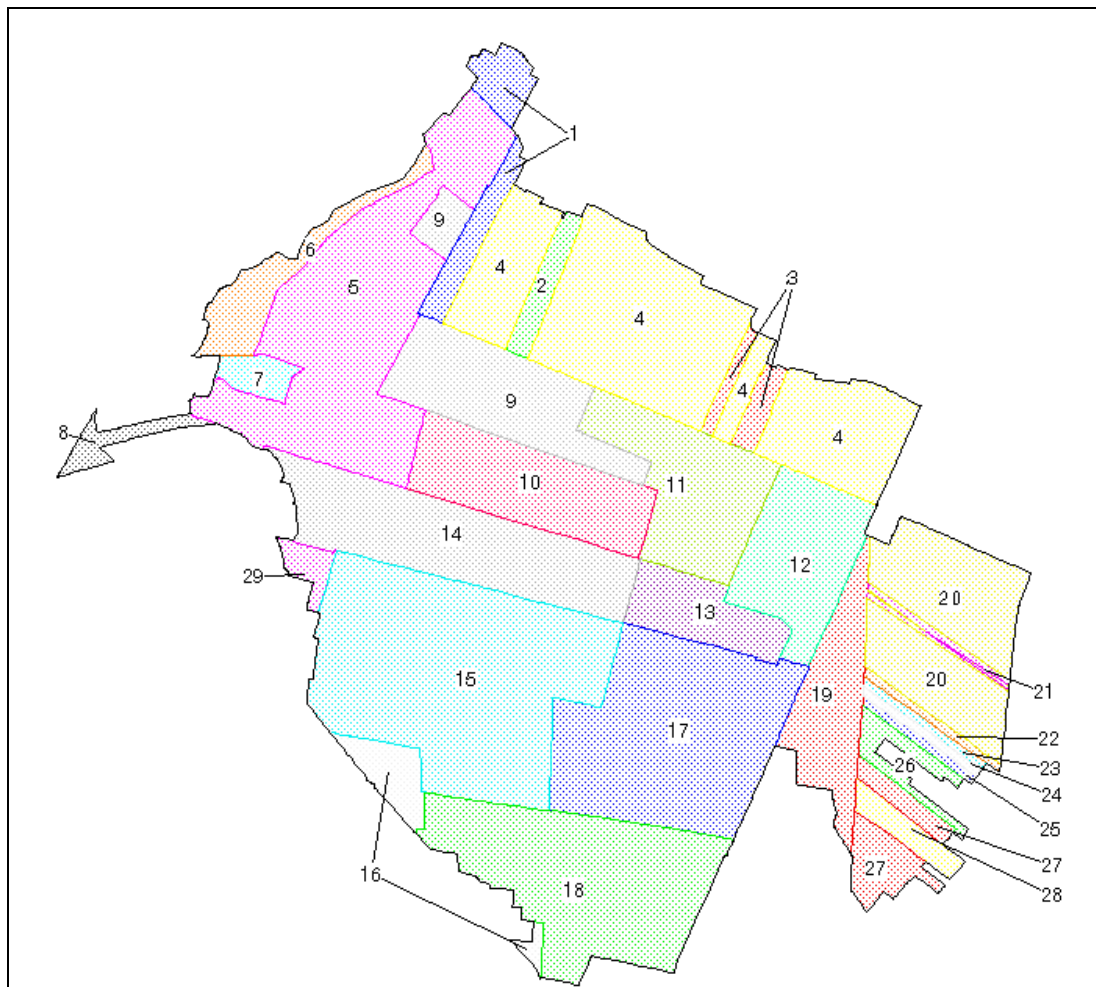
which are classed as lowland bog with the exceptions of units 8 and 12, which are neutral lowland, grassland and lowland broadleaved, mixed and yew woodland respectively. The units are shown on Map 3.

Of the areas listed in the most recent assessment as being below the PSA Target condition, i.e. they are listed as *unfavourable declining* or *unfavourable no change*, all 17 units (comprising 572.75ha) have drainage listed as a contributory factor in their condition. A summary of the management failings for these units is shown in Table 6-5 and their location in Map 3.

Table 6-5: Units below Target Condition with management failings

Unit No	Condition Assessment	Area (Ha)	Drainage	Scrub Control	Ditch management	Weed control	Peat extraction	Undergrazing	Air pollution
1	Unfavourable declining	36.14	✓	✓					
2	Unfavourable declining	15.78	✓	✓					
3	Unfavourable declining	16.20	✓	✓					
4	Unfavourable no change	245.59	✓	✓					
7	Unfavourable no change	12.64	✓						
8	Unfavourable declining	12.42	✓					✓	
16	Unfavourable declining	22.78	✓	✓					
20	Unfavourable no change	110.76	✓	✓					
21	Unfavourable no change	7.68	✓	✓	✓				✓
22	Unfavourable declining	5.80	✓	✓	✓	✓	✓		✓
23	Unfavourable declining	5.46	✓	✓	✓	✓			✓
24	Unfavourable no change	5.30	✓	✓	✓				✓
25	Unfavourable declining	5.52	✓	✓	✓	✓			✓
26	Unfavourable declining	15.85	✓						
27	Unfavourable declining	30.79	✓						
28	Unfavourable no change	14.39	✓	✓	✓	✓			✓
29	Unfavourable declining	9.65	✓	✓		✓			
Area Unfavourable Declining		176.39							
Area Unfavourable No Change		396.36							
Total Area below PSA Target Condition		572.75							

Map 3: Condition Assessment Units



Natural England's most recent condition assessment for the whole site, dated 1 September 2008, indicates the site to be in unfavourable condition.

Table 6-6: Site Condition Assessment (1 September 2008)

Area Favourable *	0%
Area Unfavourable Recovering *	70.15%
Area Unfavourable No Change †	20.65%
Area Unfavourable Declining †	9.19%
Area Destroyed/Part Destroyed	0%

'Unfavourable recovering' and 'favourable' are both conditions which meet the requirements of the PSA target

† 'Unfavourable no change' and 'Unfavourable declining' do not meet the requirements of the PSA target

The area designated as being in unfavourable recovering condition is currently undergoing restoration to its previous habitat of active raised bog. This is still in its early stages. Peat-cutting, drainage, adjacent landowner requirements, air pollution and other management practices affect the potential to successfully restore the degraded bog.

7 WATER QUALITY

7.1 Introduction

Water quality information is an important factor in the management of water levels on ecologically sensitive sites. Usually, the concern is regarding the level of nutrients in the water, which may be too high to benefit the vegetation on the site. Often, high nutrient levels can lead to undesirable changes in flora and fauna.

7.2 Water Quality

There is no information available on the water quality of either the standing water on-site or the water discharging from the SSSI. There is currently no water quality monitoring in the IDB maintained watercourses. The site is primarily rain fed.

Surface water which drains the Plan area has a water quality characteristic of the peat deposits which occur within sites such as Thorne and Hatfield Moors and which underlie much of the fertile agricultural land. The acidic conditions within the peat may lower the pH of water and subsequently mobilise metals.

Surface drainage from urban areas, particularly Thorne, Moorends and Crowle, is susceptible to contamination from paved area runoff, sewage systems and industrial discharges and runoff.

8 WATER LEVEL MANAGEMENT OBJECTIVES

8.1 Water Level Management Objectives

There is a single objective for the Thorne, Crowle and Goole SSSI WLMP which is

to provide water levels to bring the site into favourable condition (or unfavourable recovering condition) by 2010.

To achieve this objective, a series of specific targets are outlined below.

Within the favourable condition table it is considered that the water level requirements of the degraded lowland raised bog habitat are:

- Water table close to ground level (within approximately 10cm of the surface) and indicative of anaerobic conditions. The mean free groundwater level over the mire expanse should not fall more than 25cm below the surface in more than one year in five.
- Stable water levels close to ground level around the edges of the raised bog. Water levels in ditches are not to fall more than 50cm below ground level in more than one year in five.
- Appropriate habitat such as lagg fen should surround the bog for such a distance as hydrological studies recommend.

The desired distribution of designated habitats, and their water level requirements will determine the targets for water level management for the SSSI. From the review of existing information to date, key targets have been identified for the SSSI in order to achieve the overall objective. Key targets and actions for water level management are outlined in Table 8-1.

Table 8-1: Actions and Targets for Water Management

	Target	Action	Responsibility
1	CONSERVATION – bog habitat		
1a	Water table within approximately 10cm of surface.	<ul style="list-style-type: none"> • Develop a robust understanding of the hydrological regime by: <ul style="list-style-type: none"> ◦ Reviewing previous studies undertaken on the Moor ◦ Collaborate with current studies ◦ Collecting and analysing new data as appropriate • Develop options to manage hydrological inputs and outputs to provide the water levels required for favourable condition • Apply the Hydrological Protection Zone approach to the site 	IDB Group Natural England
1b	Stable water levels close to ground level around the edges of raised bog		
1c	Water levels in internal ditches not to fall more than 50cm below ground level in more than one year in five.		
2	FLOOD DEFENCE		
2a	No increase in flood risk to people or property.	<ul style="list-style-type: none"> • Undertake flood risk assessments of the current and future management scenarios as part of the options development • Investigate alterations to the drainage network to allow greater flexibility in management 	IDB Group
3	AGRICULTURAL LAND		
3a	Appropriate water levels for land use	<ul style="list-style-type: none"> • Undertake review of the current pumped drainage operating regime to assess its capacity to accommodate increased surface water runoff 	IDB Group
3b	Alter water management practices	<ul style="list-style-type: none"> • Investigate appropriate agri- 	Natural England

		environment support to allow altered water levels	IDB Group
4	WATER RESOURCES		
4a	Sufficient ditch water levels retained in summer for use by licensed abstractors.	<ul style="list-style-type: none"> Discuss collaboration with Environment Agency on abstraction modelling 	IDB Group Environment Agency
5	CLIMATE CHANGE		
5a	Climate change accommodated within water level management	<ul style="list-style-type: none"> Investigate impact of climate change on the water management of the Moor 	IDB Group
6	WATER QUALITY		
6a	Limit pollution of watercourses from land drainage associated with water level management.	<ul style="list-style-type: none"> Investigate water quality as part of options development. 	IDB Group
7	NIGHTJAR		
7a	No significant adverse effect on Nightjar populations as a result of implementing the WLMP.	<ul style="list-style-type: none"> Undertake assessment of any construction works and changes in water levels on Nightjar habitat as part of the Plan. 	English Nature/ Environment Agency

9 SITE CONSTRAINTS AND IMPACT ON ADJACENT GROUND

9.1 Introduction

The implementation of this plan will not be a simple activity. There are many practical, financial and environmental constraints present on this site – not least posed by the size of the site. As the plan is implemented these will be identified and quantified.

9.2 Practical and financial constraints

9.2.1 Technical and economic feasibility

The site poses overall constraints in terms of what is practical and technically possible from an engineering viewpoint. As part of the Plan a series of appropriate feasibility studies will be undertaken to assess the technical and economic feasibility of options considering the following issues:

- A robust and thorough understanding of the hydrological regime of the SSSI and surrounding land is essential to ensuring that a suitable and sustainable solution is developed.
- Climate affects the amount of water available to the SSSI. Intervention to raise water levels may be undermined by climate change impacts such as low rainfall and sea level rise.
- The raising of water levels in the SSSI has the potential to increase the flood risk of adjacent land and property. Ensuring that there is no increase to flood risk to property may present a practical constraint.
- The level of maintenance and operation required for a completed set of options may be a practical and financial constraint. A solution requiring least maintenance would be desirable.
- Services crossing the Plan area could restrict the nature and location of any construction works required. Prior to any works, information should be collected to determine the location of these services.
- The operation of the surrounding land drainage system has historically been based upon maintaining low water levels on the Moor – this was consistent with the mineral exploitation activity – and any operation to raise water levels could require a complete redesign of sections of the drainage infrastructure.

9.2.2 Planning permission and other consents

Potential consent requirements are outlined below:

- Planning permission from the Local Planning Authority (Doncaster MBC, North Lincolnshire District Council or East Riding of Yorkshire Council) may be required for some of the works as it may not be possible to undertake works using the IDBs Permitted Development Rights.
- An Environmental Statement may be required under the Town and Country Planning (Environmental Impact Assessment) Regulations of the Environmental Impact Assessment (Land Drainage Improvement Works) Regulations 1999.
- Works which affect a watercourse within the Internal Drainage Board District will require consent from the IDB under the Land Drainage Act 1991 Section 23.
- An abstraction licence is required from the Environment Agency, by anyone who wishes to take water from a surface or underground source under the Water Resources Act 1991 (excepting by an IDB in a drainage district for the purposes of water management).
- An impounding licence is required from the Environment Agency for the impounding of any watercourse, ditch or stream, for example by dam or weir under the Water Resources Act 1991, unless covered by an IDB consent
- Natural England assent is required for “operations likely to damage the special interest”.

9.2.3 Requirement for Appropriate Assessment

It is very likely that any activities to implement a solution will require an Appropriate Assessment under the Habitat Regulations. This will be an ongoing process throughout the implementation of the WLMP.

9.3 Environmental constraints and opportunities

The existing environment has been reviewed briefly during preparation of this WLMP. The study area is considered to present the following potential environmental constraints and opportunities for implementing the WLMP.

9.3.1 Environmental Constraints

- There is an obvious risk of damaging the habitat for which the SSSI is designated. Some damage to habitats is expected during construction works and close working with Natural England will be essential when considering which areas should not be disturbed.
- There are some areas of woodland within and adjacent to the site which may be of local nature conservation importance. These habitats may also be important for breeding birds, in particular, Nightjar, and may be of local landscape importance. Consideration should be given to these areas when assessing options to provide water levels for favourable condition.
- There are potentially a number of protected species such as reptiles within the study area. Protected species habitat should not be disturbed or damaged during construction works and consideration should be given to potential habitat loss as a result of changes in water levels.
- Although high stable water levels at the site will be beneficial for the cultural heritage resource, there is a risk that any construction works required might have an adverse effect.
- There is a risk of increased flooding or waterlogging in surrounding agricultural land. This could affect agricultural land use adjacent to the SSSI.

9.3.2 Environmental Opportunities

- Create or restore habitats adjacent to Thorne, Crowle and Goole Moors SSSI for wider biodiversity gains potentially through the use of agri-environment schemes.
- Protect buried archaeological assets and the palaeo-environmental record through raised water levels.

A suitable mitigation strategy will be devised in response to any significant environmental effects resulting from the preferred options. An Environmental Action Plan (EAP) will be prepared which will include a series of specific mitigation measures. The EAP will identify specific environmental objectives, targets and actions against which the success of the project can be measured.

10 ALTERATIONS TO INFRASTRUCTURE AND PROCEDURES

10.1 Introduction

The Plan does not currently propose to alter infrastructure or operating procedures on or around the site; however, this may be necessary as management progresses and the hydrology of the site is modified. As part of the implementation of the Plan a number of options will be considered for the achievement of target condition. The preferred option is likely to be a combination of several options to suit the site requirements and constraints. A series of potential options (which are by no means exhaustive) are outlined in Table 10-1.

Table 10-1: Potential Options for water management

Possible Option	Objective	Possible description
Store water within SSSI boundary.	Retain rainfall on the site and prevent lateral seepage into surrounding land.	<ul style="list-style-type: none"> • Sheet pile around whole site to prevent lateral seepage into surrounding land. • Sheet pile selected areas around the site to prevent lateral seepage into surrounding land. • Double ditch systems to provide wet boundaries.
Alter pumping operations.	Remove excess surface water run off from site during high rainfall events to prevent flooding of surrounding land.	<ul style="list-style-type: none"> • Alter pumping operations to allow more water to be removed from the site during high rainfall events and, as a last resort, for water to be let back into the site during drier periods. • Installation of new/improved outfalls and changes to increase capacity of surrounding drainage, to address reduced holding capacity of re-wetted moor
	Take water from drainage system during drier periods.	<ul style="list-style-type: none"> • Pumping into the site could lead to water quality problems, which would require further investigation as part of the feasibility study.
Wetland creation.	Create a buffer zone between Hatfield Moor and surrounding agricultural land.	<ul style="list-style-type: none"> • Create wetlands/washlands in land surrounding the raised mire habitat to store surface water runoff and lateral groundwater losses from the site.

11 PROPOSED ACTION

11.1 Proposed Data collection and Research

The following list of research and data collection activities are proposed for the life of the plan. For each area, a rationale is given.

11.1.1 To obtain suitable high quality information on the levels of land within and immediately surrounding the SSSI sites and the watercourses

Undertake a suitable survey of the watercourses and lands adjacent to the areas which are below target condition. Obtain suitable land level data – from survey, Natural England or Environment Agency e.g. LiDAR - to produce a suitably detailed catchment terrain model.

11.1.2 To improve hydrological definition and understanding of the site and its environs

Review historic studies on the site and collaborate with current studies to determine current knowledge and gaps.

Define and map the extent of the sub-catchments of the critical units.

Survey all watercourses within the catchments and describe the surface water features.

Identify the significance of groundwater contributions to the site.

Identify locations where it is suitable to monitor surface and ground water levels and flows and install datalogging equipment.

Evaluate surface, shallow and deep ground water quality and quantity.

Maintain records of flooding events in and around the site.

Investigate options for the removal of excess water generated by the reduced holding capacity of re-wetted moor.

Construct a suitable model of the drainage system around the site and determine its effects on the levels.

11.1.3 To determine the extent of surface flooding and subsurface waterlogging/wetting, to allow perimeter effects to be evaluated and facilitate the most effective water management on the site

Construct a hydraulic surface water model to determine the most appropriate water levels for the conservation interest of the site and plot these on the level data.

Undertake a suitably detailed site survey for hydrological features to calibrate model.

Determine whether the optimum water level will

- affect land adjacent to the SSSI
- affect land not adjacent to the SSSI
- adversely affect land outside the SSSI

11.1.4 To improve knowledge of soils and geology within the defined hydrological unit

Undertake soils and solid geology desktop studies followed up with field surveys to Soil Survey standards to define boundaries and layers. Assess hydraulic conductivity using field methods where possible and necessary.

11.1.5 Improve knowledge of water level change on the site by monitoring shallow groundwater levels, ditch levels and rainfall

Install dipwells to monitor soil water levels.

Install a site rainguage and surface water level gauges to allow calibration of the model.

Improve knowledge of peat soils on the site.

11.1.6 Assess and measure water quality from surface water sources and determine suitability for the site as a source to increase water levels

Develop and implement a series of water quality investigations on the surface water bodies within and surrounding the site to determine suitability. Measure sub surface water quality on the site and assess the water quality requirements of vegetation communities.

11.2 Key Tasks in the Project

This Water Level Management Plan recognises the essentially fluid nature of site investigations and plan development and it is considered that a number of Key Tasks will be undertaken within the outline presented in this Plan. These are listed below but it is not a comprehensive or exhaustive list.

11.2.1 Review of existing management to include:

- the effectiveness of the existing water management practices undertaken by the IDBs in delivering the management of optimum water levels in the areas of the site below target condition;
- the water level requirements to bring the SSSI into favourable condition by 2010 under the PSA Target;
- any other factors that may influence water levels on the site;
- an analysis of existing data and studies on the site, including those made available by the Internal Drainage Boards, Natural England, Environment Agency and Lincolnshire Wildlife Trust.

11.2.2 Topographic survey

- Suitable level surveys of the site, watercourses and adjacent lands, including the tying-in of existing survey data which may be available;
- Levels survey of adjacent lands and/or watercourses;
- Obtaining and interpreting digital land level data, e.g. LiDAR data, which may be available.

11.2.3 Hydrological and Hydro-geological Investigation to:

- Provide a better understanding of the hydrological regime of the land drainage system and the control exerted by the pumping stations and the gravity systems;
- Determine how the hydrology and hydrogeology influence the vegetation communities;
- Determine the boundaries of the hydrological unit or units which affect water management.

11.2.4 Water Level Management Analysis to include:

- Analysis of the hydrological regime of the affected areas of the SSSI and the wider land drainage system, including the requirements of the urban, industrial, agricultural and infrastructure systems;
- Analysis of the hydrological regime controlling the distribution of the vegetation communities within the site;
- Analysis of the impacts of water quality on the site;
- If hydrological processes within the site are implicated in the present vegetation community status, analyse options available to address this by controlling water levels within the site without creating adverse impacts on the surrounding land and properties;
- Recommendations for future monitoring of the hydrological regime;
- Recommendations for a future water level management regime to achieve and maintain favourable status in the following situations:
 - Containing water within the site.
 - Unconfined management of water levels within the catchment.
- Assessment of flood risk using the principles in PPS25 or similar;
- Modelling of IDB systems to balance flood risk and environmental conservation.

11.2.5 Production and consultation of water level control options

Development and implementation of WLMP objectives and options including an outline design sufficient to develop works on the ground.

11.2.6 Water Level Management Plan Delivery

Following completion of the studies in this Plan it will be necessary to formulate a new WLMP which will deliver the options developed in this report. The new Plan will also include detailed design as well as construction and monitoring of the effectiveness of the mechanisms.

11.3 Stakeholder Group

The entire project will be completed to the satisfaction of the Internal Drainage Boards and Natural England.

The assessment of progress and the development of progress interim briefs and guidance will be assessed by a group of stakeholders with a core of representatives from:

- Each of the Internal Drainage Boards nominating a member and/or officer;
- Natural England;
- Lincolnshire Wildlife Trust;
- Environment Agency.

Meetings of the Stakeholder Group will be held after the completion of the individual study phases. Interim meetings may be defined by the Group as necessary to review progress. A minimum of two meetings will be held each year with a view to reporting to the full Internal Drainage Board meetings which will be held between 1 January and 14 February each year in accordance with the Land Drainage Act 1991. Other Stakeholders may be co-opted onto the Group as required.

JBA Consulting will attend meetings and provide secretariat services to the Group.

11.4 Summary and Costs

The development of a scheme to assess the various influences on the SSSI, determine their interactions and then produce a costed proposal is not appropriate at this stage in the Water Level Management Plan.

Finance will be sought from the Environment Agency to undertake the studies described in 11.1 and 11.3 to achieve the water management objectives described in Chapter 8. Tween Bridge IDB and Reedness & Swinefleet IDB, which are in the Environment Agency Midlands and Yorkshire Regions respectively, will seek finance at 100% under the Priority Water Level Management Plan system equally.

The costs attributed to the activities are listed in Table 11-1. Project Supervision will be by the Stakeholder Group, which will direct investigations and budget management for ratification by the group of IDBs and the meetings of the finance holding IDBs.

Table 11-1: Summary of Estimated Costs

Activity	Estimated Cost
Project management	£3,500
Collection and review of existing hydrological and other data/information on the site and land surrounding it.	£10,000
Installation of dipwells and raingauges to monitor water levels.	£8,000
Monitoring of water levels	£9,000

Topographic survey	£10,000
Hydrological survey of all watercourses and surface water features.	£8,000
Water quality analysis of surface and sub-surface waters.	£5,000
Hydraulic modelling and understanding of site and its surrounds	£17,000
Soil and geology surveys and determination of soil hydraulic conductivity.	£4,000
Assess existing plant communities on the site to determine water level requirements.	£3,000
Determination of water level requirements and timings	£5,000
Analysis of water level requirements and identification of the actions required to bring the SSSI into favourable condition	£4,000
Report production and writing including identifying options and outlining the design of favoured options	£5,000
Contingency – 10%	£9,150
Estimated Total Costs	£100,650

12 CONTINGENCY MEASURES

12.1 Flood

Any incidence of flooding caused by blockages in an Internal Drainage Board maintained watercourse will be dealt with to restore the normal drainage regime to the affected area outside the SSSI. In the event of a major flooding incident the Internal Drainage Board will take no action.

12.2 Drought

Consideration will be given by the Board for the placing of temporary control structures in the drains under their authority.

12.3 Pollution

Upon discovery of a pollution incident, immediate assistance will be sought from the Environment Agency Pollution Control whilst appropriate action will be taken to contain/exclude pollution until specialist help is available.

12.4 Dispute

Any disputes arising between occupiers over water levels or drainage standards must, as soon as is practicably possible, be brought to the attention of the Operating Authority, who will then arbitrate. This process will be governed by the Land Drainage Act 1991. In the event of an unresolved dispute between the Operating Authority and an occupier, the matter shall be referred to an appropriate authority under the Act.

13 UNRESOLVED ISSUES

13.1 Unresolved Issues

The Environment Agency is currently undertaking a strategic study to consider options for the future of Keadby Pumping Station, which takes land drainage water from the south of the Moors. One of the options under consideration is to cease pumping and revert to a gravity drainage system. This issue cannot be resolved under this WLMP but liaison should be maintained between the affected IDBs and the Environment Agency over the future of the pumped drainage system.

Flooding of adjacent farmland by overland flow from the SSSI appears to happen quite frequently and at inappropriate times for farming operations. This will be monitored and assessed as part of this Plan.

14 OTHER MATTERS

14.1 Introduction

This plan will be reviewed annually from the date of signature by Natural England, or earlier by request of any consultee to the Operating Authorities.

The Operating Authorities will notify each consultee identified in Chapter 15 of any review.

14.2 Purpose of Review

Review of the Plan is not intended to comprise a wholesale rewrite of the Plan.

The review process is to

- assess whether the investigations and actions specified in the Plan are still appropriate;
- assess research progress;
- receive research reports and recommendations;
- prepare supplemental or additional research based upon above;
- agree future direction for the Plan for the next 12 months.

14.3 Review

Each review will commence with a half-day meeting organised and chaired by Tween Bridge IDB, as the lead Operating Authority, or their nominee. The meeting will consist of at least the following items/areas of interest:

1. review of progress to date of agreed data collection and research project;
2. overview of findings in 1 above;
3. presentation of individual research progress reports and final reports where required;
4. presentation of revisions to water levels management plan as required;
5. date and place of next meeting.

Each consultee organisation will nominate one individual to attend the meeting.

A pre-meeting briefing note will be circulated to all nominated consultees ten days prior to the meeting.

Consultee organisations and individuals may make presentations at the meeting by prior arrangement with the Operating Authority.

Review will not take more than 6 weeks from the Operating Authority issuing the pre-briefing notes to consultees.

15 CONSULTTEES

15.1 Unresolved Issues

All consultees are included in Table 5 below.

Table 15-1: List of Consultees

Consultee	Summary of Interest
Natural England South Area Team Bull Ring House Northgate WAKEFIELD WF1 3BJ	Statutory Agency responsible for the notification of the Site of Special Scientific Interest and the maintenance of that interest through the owners, occupiers, and the operating authority. Owner of part of the SSSI.
Tween Bridge IDB Black Drain IDB Goole Fields IDB Reedness & Swinefleet IDB Denison House Hexthorpe Road DONCASTER DN4 0BF	Operating Authorities responsible for the maintenance and operation of pumping stations and main watercourses for flood risk management whilst maintaining environmental obligations.
Thorntree IDB 4 Belgravia Way GOOLE DN14 5BU	
Dempster IDB Halcyon House Landing Lane Newport BROUGH HU15 2RU	
Lincolnshire Wildlife Trust Banovallum House Manor House Street Horncastle Lincolnshire LN9 5HF	Owner of 162ha of the SSSI

16 REFERENCES

16.1 References

CATHCART, R. (2004)

Achieving the Public Service Agreement Target for SSSIs: A Review of the Contribution of Water Level Management Plans. London: Defra.

MAFF (1999)

Water Level Management Plans – Additional Guidance Notes for Operating Authorities. Prepared by the Water Level Management Plan Advisory Group. London: MAFF.

MAFF (1976)

Climate and Drainage. Technical Bulletin 34. London: MAFF.

SOIL SURVEY OF ENGLAND AND WALES (1983)

Soil Map of England and Wales 1:250 000 Sheet 1 Soils of Northern England. Harpenden, Herts.

APPENDICES

Appendix A: - SSSI Citation

COUNTY: HUMBERSIDE/SOUTH YORKSHIRE
SITE NAME: THORNE, CROWLE AND GOOLE MOOR
DISTRICT: BOOTHFERRY/DONCASTER

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981 as amended.

Local Planning Authority: Doncaster Metropolitan Borough Council, Boothferry Borough Council

National Grid Reference: SE 730160 **Area:** 1918.6 (ha.) 4740.9 (ac.)
Ordnance Survey Sheet 1:50,000: 112 **1:10,000:** SE 71 NE, NW, SE, SW
Date Notified (Under 1949 Act): 1970 **Date of Last Revision:** 1975
Date Notified (Under 1981 Act): 1986 **Date of Last Revision:** 1986

Other Information:

- 1) This site is listed in 'A Nature Conservation Review' (1977) edited by D A Ratcliffe. Cambridge University Press.
- 2) Part of Crowle Waste is managed as a nature reserve by the Lincolnshire and South Humberside Trust for Nature Conservation.
- 3) Site boundary changed at renotification by partial deletion and small extension.
- 4) 1309.1 hectares (3234.7 acres) lie in South Yorkshire and 609.5 hectares (1506.1 acres) lie in Humberside.

Description:

Thorne, Crowle and Goole Moors are situated 8km south of Goole, lying between the Aire and Trent. These moors form the largest extent of lowland raised mire in England, even though much modified by peat cutting. The peat deposits are of variable depth, possibly up to 4m and these are underlain by lacustrine clays and silts. The site lies at round 0.5-1m above sea level.

Since the middle of last century commercial peat winning and warping have destroyed the original bog surface of moss hummocks, wet hollows and shallow pools. However, traditional methods of peat extraction have ensured continuity of suitable conditions for the recolonisation by remnants of the original flora and fauna, while fen habits, containing rich assemblages of species, have also developed.

Wet peat cuttings are typically dominated by common cotton-grass *Eriophorum angustifolium* and occasionally soft rush *Juncus effusus* but locally there are carpets of bog mosses *Sphagnum spp* containing species such as cranberry *Vaccinium oxycoccus*. The old mire surface between the cuttings is dominated by downy birch, bracken, heather and hare's tail cotton-grass *Eriophorum vaginatum*. Such dry birch communities are particularly well developed in the south-eastern portion of the site, and also occur on warped land (i.e. land subject to deliberate flooding with river water).

Other habitats, notably the extensive series of canals linking the cuttings, contain a wide range of plant species, including some elements of the original raised mire flora, e.g. bog rosemary *Andromeda polifolia*, cranberry, royal fern *Osmunda regalis*, sundew *Drosera rotundifolia* and several *Sphagnum* moss species. A number of characteristic fenland plants such as marsh cinquefoil *Potentilla palustris*, great fen-sedge *Cladium mariscus* and common reed occur within clay-lined canals while on warped land there is a well developed fen vegetation containing marsh arrow-grass

Triglochin palustris, southern marsh orchid *Dactylorhiza praetermissa* and common meadow-rue *Thalictrum flavum*.

Thorne, Crowle and Goole Moors are highly regarded for their invertebrate fauna in particular for insects. They support typical assemblages of peat bog and fen species including several nationally rare as well as local insects such as the bog bush cricket *Metrioptera brachiptera*, the scarce vapourer moth *Orgyia recens*, the bug *Globiceps woodreftei*, and the beetle *Bembidion humerale*. There is also a strong population of large heath butterfly *Coenonympha tullia*.

This site is important for its breeding and wintering, bird populations. Breeding species characteristic of dry scrub and heathland include nightjar, nightingale, woodcock and whinchat while teal, snipe, reed and grasshopper warblers are associated with the wet heath and fen habitats. The breeding population of nightjars on the Moors is of national importance as its numbers regularly exceed 1% of the total British breeding population.