= South Forty @-@ Foot Drain =

The South Forty @-@ Foot Drain , also known as the Black Sluice Navigation , is the main channel for the land @-@ drainage of the Black Sluice Level in the Lincolnshire Fens . It lies in eastern England between Guthram Gowt and the Black Sluice pumping station on The Haven , at Boston . The Drain has its origins in the 1630s , when the first scheme to make the Fen land available for agriculture was carried out by the Earl of Lindsey , and has been steadily improved since then . Water drained from the land entered The Haven by gravity at certain states of the tide until 1946 , when the Black Sluice pumping station was commissioned .

The Drain was navigable until 1971 , when improvements to the pumping station led to the entrance lock being removed . It is currently being upgraded to navigable status by the Environment Agency , as part of the Fens Waterways Link , with a new entrance lock being completed in December 2008 , giving access to the first 12 miles (19 km) of the drain , and the upgrading of the southern section , including a link to the River Glen to allow navigation to Spalding forming phase 2 of the project .

= = History = =

The Lincolnshire Fens are an area of low @-@ lying land which have been subject to flooding and attempts to prevent it for centuries . In medieval times , the Midfen Dyke was built to drain the area , but by 1500 , this was regarded less as a drain for the land than as a boundary marker between the Parts of Holland and the Parts of Kesteven , two of the three medieval subdivisions of Lincolnshire which functioned as county councils until their abolition in 1974 . The first serious attempt to drain the area to the south west of Boston , now known as the Black Sluice Area but formerly known as the Lindsey Level , was from 1635 to 1638 , when the Earl of Lindsey agreed with the Commissioners of Sewers for Lincolnshire to carry out drainage works which would make 36 @,@ 000 acres (150 km2) of land available for agricultural use . The Earl and a group of Adventurers paid for the works , in return for land grants .

The cost of the work was £ 45 @,@ 000 , and involved the construction of a sluice near Boston , called Skirbeck Sluice , the construction of the first 8 miles (13 km) of the South Forty @-@ Foot Drain , from Boston to Great Hale , the construction of two drains from there to Guthram , which were called the Double Twelves , and the construction of the Clay Dyke Drain .. The scheme was not popular with the local fenmen , who made a living from fishing and wildfowling , or with the Commoners , who had a right to graze animals on the common land when it was not flooded . They attempted to get Parliament to rule in their favour , but after three years of trying , they abandoned the idea of legal redress , and took direct action . They destroyed much of the work , as well as buildings and crops , and burnt Skirbeck Sluice . The Earl of Lindsey 's contract with the Commissioners of Sewers was revoked by parliament , and it was another hundred years before the next attempt to drain the area .

In an attempt to drain Holland Fen , and prevent flooding from the River Witham , an adventurer called Earl Fitzwilliam constructed a drain in 1720 , which runs broadly parallel to the River Witham , and terminated at Lodewick 's Gowt , a sluice which he constructed on the Witham close to the location of the present Grand Sluice . The drain was for many years called Earl Fitzwilliam 's drain , but is now called the North Forty @-@ Foot Drain . The scheme was not entirely successful .

= = = Second Sluice = = =

In 1762 , the Witham Drainage Act was passed by Parliament , and among other things constituted the Commissioners of Sewers for the Second and Sixth District , which covered the area including Asgarby , Ewerby , Great Hale , Heckington , Holland Fen , Howell , Little Hale and South Kyme . Much of the area to the south and west of Boston , some 91 square miles (240 km2) , was inundated by the Great Flood of 1763 , and against this background , the Black Sluice Drainage and Navigation Act 1765 was obtained which created the Black Sluice Commissioners , giving them power to raise taxes and authority to carry out drainage works . The scheme largely revived the Earl

of Lindsey 's original scheme . The initial design work was carried out by the civil engineer Langley Edwards , on loan from the Witham Commissioners . Some of the surveying was performed by John Landen , who was the steward of the estate of Earl Fitzwilliam at Peterborough , and a proficient amateur mathematician . The two men were jointly appointed Surveyors of the Works , acting as engineers for the scheme , while John Chapman and Richard Strattard were assistants . A new sluice , called the Black Sluice , was built at Boston as a direct replacement for the Skirbeck Sluice , having three openings with a total width of 40 feet (12 m) . The 8 miles (13 km) of the drain were scoured from Boston to Great Hale , beyond which the Main Drain was upgraded by cutting a new 14 @-@ mile (23 km) channel , effectively extending the South Forth @-@ Foot Drain to Guthram , on the banks of the River Glen . A total of 65 miles (105 km) of highland streams were improved by scouring and raising of the banks . The estimated cost of £ 16 @,@ 000 was raised by issuing bonds , but the project overran , and another Act of Parliament was obtained in 1770 to authorise the raising of the drainage taxes , to cover the difference . By mid @-@ 1769 , when Landen and Edwards left the project , because the work was largely complete , the scheme had cost £ 24 @,@ 000 . They were replaced by Edward Hare as Surveyor of Works , with Chapman and Strattard continuing as assistants . A historian called W. H. Wheeler , who chronicled the Lincolnshire fens , wrote that " the works were efficiently carried out and , being well @-@ designed , entirely answered expectation . "

On the River Witham , the Grand Sluice was constructed and opened on 15 October 1766 , and this prevented tidal water from entering the river , and hence flooding the Holland Fen . The Boston Harbour Commissioners were created by the Boston Port Act 1766 , and they carried out improvement works to The Haven , which resulted in lower water levels at the Black Sluice , and hence more efficient draining from the South Forty @-@ Foot Drain . Water was pumped into the drain by a series of windmills driving scoop wheels . Maps of the area produced in 1783 by Edward Hare show 46 such mills , which provided drainage for 32 @,@ 000 acres (130 km2) of agricultural land . Extreme high tides in 1810 and again in 1820 resulted in widespread flooding , and further thought was given to improving the flood defences .

With the improvements to the River Witham , the final section of Earl Fitzwilliam 's drain to Lodewick Gowt was filled in , and the channel was diverted to join the South Forty @-@ Foot Drain . Renamed the North Forty @-@ Foot Drain , it now supplies Cook 's Lock and Holland Fen pumping stations .

= = = Third Sluice = = =

Reports on improvements to the system were produced in 1843 by the surveyor Mr W Lewin and in 1845 by Sir John Rennie . Rennie 's scheme involved the provision of a catchwater drain to collect water draining from the higher ground to the west before it entered the fenlands , but an Act of Parliament to authorise its construction was defeated , and so in 1846 a report by Mr W Cubit which proposed improvements to the existing infrastructure was accepted by the Commissioners . A new Black Sluice , including a 20 @-@ foot (6 @.@ 1 m) wide navigation lock , was constructed to the south of the original one , with the cill level 6 feet (1 @.@ 8 m) lower , which enabled the gradient of the South Forty @-@ Foot Drain to be increased to 3 inches per mile (5 cm / km) . Many of the tributary drains were also improved . 1846 also marked the beginning of the use of steam engines for pumping . Ten years later , a map covering 18 @,@ 000 acres (73 km2) of the Black Sluice area showed nine steam @-@ powered and eight wind @-@ powered drainage engines in use .

The River Witham Outfall Improvement Act 1880 authorised further improvements to the mouth of the Witham , to which the Black Sluice Commissioners contributed £ 65 @,@ 000 . This work led to a further drop of 4 feet (1 @.@ 2 m) in the low water level at the Black Sluice . Oil and paraffin engines began to replace steam and wind engines from 1910 , and by 1935 there were 15 such engines pumping water into the South Forty @-@ Foot Drain . The passing of the Land Drainage Act 1930 resulted in the Commissioners being replaced by the Black Sluice Internal Drainage Board , while responsibility for the rivers in the area passed to the Witham and Steeping Rivers Catchment Board . With war imminent , the Rivers Board took over the Black Sluice and the South Forty @-@

Foot Drain in 1939 , and although progress was interrupted by the Second World War , a £ 374 @,@ 000 scheme to construct the Black Sluice pumping station and to widen 11 miles (18 km) of the drain from Boston to Donington Bridge was completed in 1946 . The pumping station contained three 100 @-@ inch (2 @.@ 5 m) pumps , each powered by a 900 @-@ horsepower (670 kW) 5 @-@ cylinder vertical diesel engine manufactured by Ruston .

= = = Modern era = = =

Paraffin and oil engines gave way to electrically powered pumping stations in the 1950s , with the Board constructing six electric and one diesel pumping station to improve drainage to an extra 11 @,@ 000 acres (45 km2) of land . In 1960 , the decision was taken to further improve drainage of an area of 70 @,@ 000 acres (280 km2) , as part of a £ 1 @.@ 4 million scheme which included the addition of two extra pumps at the Black Sluice , replacement of existing pumps elsewhere , and the widening of 7 miles (11 km) of the South Forty @-@ Foot Drain from Donington Bridge to Rippingale Running Dyke . Jurisdiction for the Drain and the sluice passed to the Lincolnshire River Board at this time . The work , which began in 1962 and was completed in 1968 , proved successful in preventing flooding during severe wet weather in the winter of 1968 / 9 . With three 900 @-@ horsepower (670 kW) and two 925 @-@ horsepower (690 kW) diesel engines , the upgraded pumping station can pump 800 thousand gallons per minute (60 m3 / s) . Responsibility for the drain and the sluice passed to the National Rivers Authority in 1990 , and to the Environment Agency in 1995 .

Despite all the improvements , serious flooding occurred in 1999 when the bank of the drain was breached near Pinchbeck . Staff from the Environment Agency and the Black Sluice Internal Drainage Board successfully repaired the breach before properties were flooded , and a review of the flood defences was then carried out . The report recommended improvements to some of the banks , but funding for the work was not available , and so no work was done at the time .

= = Functions = =

The South Forty @-@ Foot Drain serves as a district boundary over the length where it runs roughly south to north . South of Donington High Bridge , the Drain separates South Kesteven to the west from South Holland to the east . The boundary then continues southwards along the River Glen . North of Donington , the boundary between the borough of Boston to the east and North Kesteven to the west follows the line of the Drain . As the Drain crosses the line of the Midfen Dyke , just before the Nottingham to Boston railway joins it at Great Hale pumping station , the boundary turns northwards , following its medieval course .

The main job of the Drain is to gather the waters pumped from the Kesteven Fens , the Holland Fens and the Weir Dyke , a soak dike in Bourne North Fen , alongside the Bourne Eau and River Glen , northwards and eastwards to the Black Sluice at Boston , where they are discharged to the tidal waters of The Haven . The Weir Dyke takes its name from a weir in the bank of the Bourne Eau at Tongue End , which was constructed by the Black Sluice Commissioners , to allow water from the Bourne Eau to overflow the bank when excess water could not flow into the River Glen in times of flood . The overfall weir became redundant when the Tongue End pumping station was constructed in 1966 .

The South Forty @-@ Foot Drain and the Black Sluice pumping station , together with most of the side channels which run into the drain are the responsibility of the Environment Agency . Management of the drainage ditches which drain the Fens are the responsibility of the Black Sluice Internal Drainage Board , who maintain 34 pumping stations and three gravity stations in the region . Of these , 21 are situated on the banks of the Drain , and pump directly into it , while one , the Black Hole Drove pumping station , is constructed over the channel , and acts as a boundary between the part of the Drain managed by the Environment Agency , and that managed by the Drainage Board .

= = Navigation = =

Prior to 1971 , the Drain had been navigable , but this privilege was removed at that time . It is unclear whether there was ever a right of navigation , or whether the Black Sluice Commissioners simply allowed it . The entrance lock was 72 by 20 feet (21 @.@ 9 by 6 @.@ 1 m) , and most trade was between Boston and Donnington Bridge , with pleasure boating not being allowed prior to 1962 . The lock was closed and removed in 1971 , with little protest being made . More recently , the East Anglian Waterways Association promoted the idea that the Drain could again be made navigable as part of a larger scheme to improve leisure facilities . The local authorities which were part of the Fens Tourism consortium conducted a feasibility study , and this report was formally adopted as the Fens Waterways Link by the Environment Agency in 2004 , with the support of the local authorities , the East Anglian Waterways Association and the Inland Waterways Association .

The scheme involved a total of 150 miles (240 km) of waterway , of which 50 miles (80 km) would be new cruiseway , while the rest would be existing waterways which could be upgraded or have their access improved . When completed , it would connect the Rivers Witham , Glen , Welland , Nene and Great Ouse , and was heralded as the biggest waterway enhancement project in Europe by the Environment Agency . In 2007 they obtained funding for the link between Boston and Spalding . Work on a new lock beside the Black Sluice pumping station at Boston - to connect The Haven and the South Forty @-@ Foot Drain - was formally started on 8 February 2008 , and was completed in December 2008 , with the official opening ceremony being held on 20 March 2009 . The lock project formed phase 1 of the scheme , and the cost of £ 8 @.@ 5 million was jointly funded by the European Regional Development Fund , the East Midlands Development Agency , and Lincolnshire County Council . The lock is designed to be used for a period either side of high tide , and so there is a rise from the Drain to the Haven . It has conventional mitre gates at one end , but uses rotating sector gates at the tidal end , each one weighing 12 @.@ 1 tonnes .

The lock opened up nearly 12 miles (19 km) of waterway . As part of the upgrade , new 48 @-@ hour moorings were constructed on The Haven , for boats about to enter the Drain , and on the South Forty @-@ Foot Drain near the Black Sluice pumping station at Boston , at Swineshead Bridge and at Hubbert 's Bridge . The upper limit of navigation was initially Donington High Bridge , where the Swaton Eau joins the South Forty @-@ Foot Drain and provides a wider section where boats can be turned . Beyond the bridge , the drain was officially only suitable for canoes and kayaks . However , eight narrow boats cruised on the waterway at Easter 2009 , and although the channel was narrower and not as deep after Donington Bridge , all of them successfully reached Kingston 's Bridge , some 3 @.@ 7 miles (6 @.@ 0 km) further on , where the outlets from Dowsby Fen and Gosberton pumping stations provided enough width to turn a 70 @-@ foot (21 m) boat . Further progress was blocked by scaffolding erected so that the bridge could be re @-@ decked , rather than by lack of water .

The drain has been renamed as the Black Sluice Navigation by the Environment Agency . In order to use the navigation , an Environment Agency licence is required , and as there are no permanent moorings available on the drain , these are available for one day or seven days . Water levels are maintained at a lower level during the winter months , when flows are high , and the Drain needs to be able to cope with higher volumes of rainfall , than during the summer months , when navigable levels are maintained . As on the neighbouring River Witham , the switch between winter and summer levels is normally made at the beginning of April .

= = = Development = = =

Phase 2 of the Fens Waterway project involves the link between Donington Bridge and Crowland and Cowbit Washes , which are located on the River Welland near Spalding . In order to make the financing of the phase more viable , it was split into two halves , with phase 2a covering the section from Donington to Surfleet Seas End on the River Glen , and phase 2b covering from there onwards . The initial technical assessment and obtaining of planning permission for phase 2 , which involved widening of the South Forty @-@ Foot Drain from Donington to a new road crossing under the A151 , a new lock and a junction with the River Glen at Guthram Gowt was funded by the East Midlands

Development Agency . This section would involve changes at Black Hole Drove pumping station , which has been built across the drain and hence would prevent navigation . Major contracts for this phase were expected to be awarded in April 2009 , but appraisal of the technical assessment revealed that more than one route needed to be considered before the best solution could be selected . While the obvious solution would be to connect the Glen and the drain where they are only a short distance apart , the Lincolnshire Waterways Partnership also considered the creation of new channels up to 9 @.@ 3 miles (15 @.@ 0 km) long to form the link . In the meantime , the economic situation changed , so that sources of funding were not so freely available , and by the end of 2010 , no clear dates had been set for the next construction phase .

By late 2011 , there were ten different routes under consideration , and an assessment of them was expected to be delivered in spring 2012 . Halcrow Group , the engineering consultancy , were responsible for carrying out the assessment , which looked at the benefits that each route might provide , not only for navigation but also for water quality , water resources and habitat for wildlife . The study was expected to provide a short @-@ list of routes , which would then be the subject of further consultation . By mid @-@ 2012 , the merits of the ten routes had been considered , including the economic , environmental and technical issues involved , and a broad outline of the corridor for the link was scheduled to be published in September . After that , consultation with landowners and stakeholders took place , to establish the final route , for which design of the channel and the associated locks , bridges , moorings and pumping stations could then begin . By the end of the assessment process for the ten routes , two remained . One was route 1 , the original suggestion which used the existing course of the South Forty @-@ Foot Drain for most of its length , while the second was a new route , designated as route 11 . Route 11 had become the preferred route by the summer of 2014 . It involves widening the South Forty @-@ Foot Drain from Donington to Surfleet , to a point near to the Black Hole Drove pumping station . A new lock would be needed at this location , but would connect to a new channel , rather than to the rest of the drain . It would pass under a new bridge on the A151 , and the connection to the River Glen would involve another new lock . An environmental survey of other watercourses near to the route revealed that several provide habitat for nationally important plants and invertebrates .

= = = Precursors = = =

The idea of a link between the South Forty @-@ Foot Drain and the River Nene is not new , as the first plans for such a connection were proposed in 1809 . In that year , proposals for a new canal between the Oakham Canal at Oakham and the Stamford Canal at Stamford , which had been discussed in 1785 , were revived , as part of a larger plan for a 7 @-@ mile (11 km) link from Stamford to the River Nene at Peterborough , and a connection from near Market Deeping , where the Stamford Canal rejoined the River Welland , northwards to the South Forty @-@ Foot Drain . A bill for this , together with one for a rival scheme to link Stamford to the Grand Junction Canal , which also included a connection to the South Forty @-@ Foot Drain , were put before Parliament in 1811 , but neither met with any success . The idea was raised again in 1815 and 1828 , but no further action was taken .

= = Route = =