High level design using the 'intermediate approach' from BSI 8515:2009, assuming an occupancy rate of 2.4, implies a tank size of approximately 1,200 l. The Scoping and Outline WCS estimated that a 2,000 l tank would provide a suitable resilience to ensure continuity of non-potable supply during the driest month recorded from 2000 to 2010.

It is however worth noting that under exceptional conditions such as prolonged droughts, RWH systems would not be sufficient. Additional storage, and back up supplies via the potable water networks, may be required, which has implications on cost and drinking water quality (due to infrequent use of this network).

The viability of RWH on individual non-residential developments will vary depending on the building use, and ownership patterns (for example a retail space with a shared RWH system serving a number of owners or tenants, some of whom require varying levels of non-potable supplies, can be problematic in terms of management and maintenance).

5.6.2 Neighbourhood RWH

As illustrated in Figure 5-7, an alternative option for capturing and using local water resources would be the collection of rainwater via a separate drainage network/ SuDS scheme, treatment at a local centre, and then return to the properties via a dedicated non-potable network.

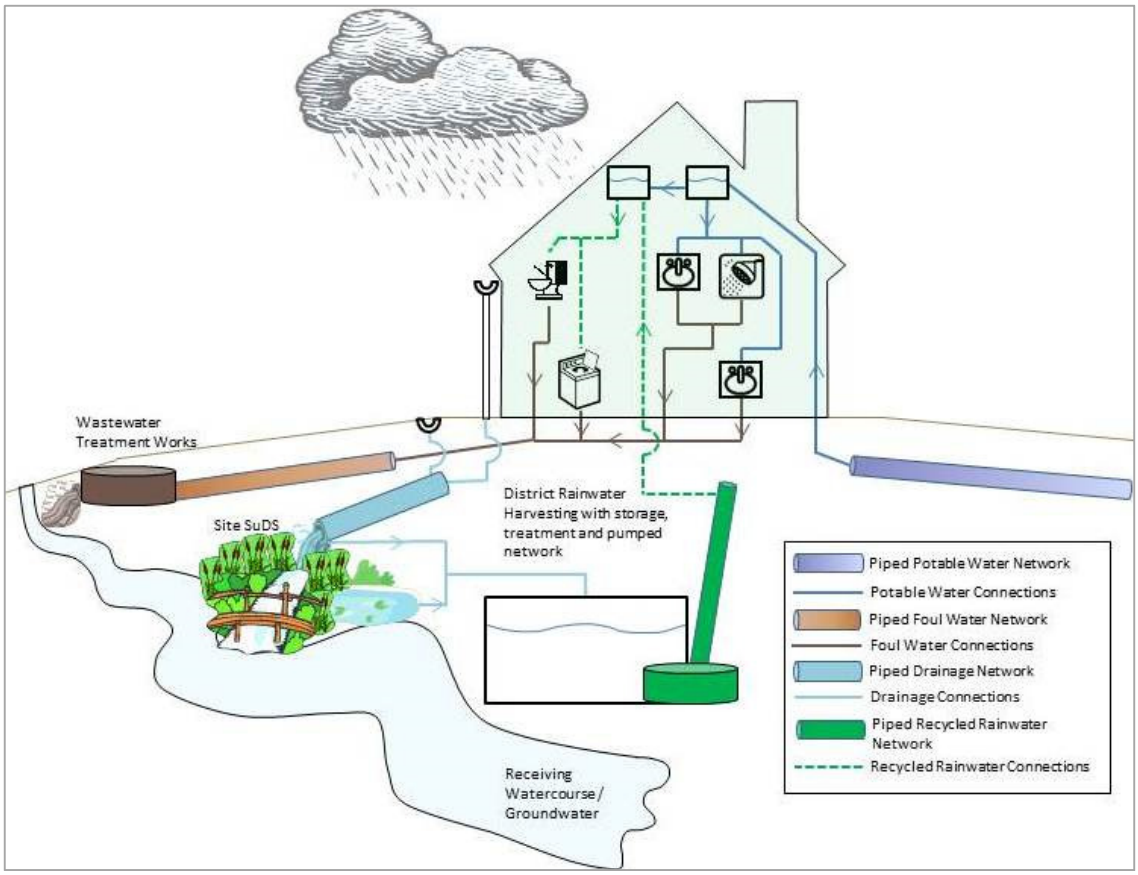


Figure 5-7 Neighbourhood RWH schematic

Centralised treatment and distribution allows better management of technical risks and future process upgrades than domestic level systems, and eradicates the risk that homeowners may let their domestic systems deteriorate until the failsafe connection of potable water replaces any non-potable supply from their RWH.

As discussed in the Section above, there would be a favourable comparison between the potential yield of rainwater from roofs in the area if harvested at the domestic level, and the non-potable demand within the new efficient homes.

The provision of a separate non-potable network and centralised storage and treatment is also appealing for non-residential developments, as management and maintenance issues are simplified for owners/ tenants. Additionally, this offers a resource for non-residential properties to use to further reduce their potable water demand in line with the requirements of BREEAM. For example, a multi-storey densely occupied office building may have difficulty obtaining an excellent BREEAM rating for water as the production of a rainwater/greywater resource would be relatively low, compared to a relatively high non-potable demand for toilet flushing. A centralised network would assist in matching non-residential non-potable demand with supply from elsewhere in the development.

It would be expensive and energy intensive to construct a separate piped drainage network to convey just rainwater from roofs to the non-potable treatment plant. Instead, additional resilience can be provided to the development by utilising run-off from other impermeable areas, providing that water is abstracted far enough along the SuDS treatment train (for example in the downstream wetland areas) to mitigate water quality risks.

Additionally, subject to the details of any environmental permits, it would be possible to maintain a constant flow in to the SuDS/wetland system by discharging treated wastewater effluent here. Providing the non-potable treatment process could treat this sufficiently, this would provide a year round resource in to the non-potable system to ensure that potable water is not required to top up the non-potable system during drought periods.

The logical locations for the non-potable treatment works would be the peripheries of the gravity sub-catchments, allowing the collection of rainwater primarily via gravity, whilst still allowing community level control, treatment and distribution. However, for operational and commercial purposes it is likely that a proliferation of smaller facilities would be avoided by the chosen operator. This would mean that a proportion of the rainwater would have to be pumped to the facility, and then pumped back in to supply via a separate non-potable network.

5.6.3 Property level GWR

The British Standard for greywater systems[15] suggests that the most preferable sources to collect domestic greywater from are showers, baths and wash/ hand basins, and that this water should be considered (once treated) to be suitable for non-potable uses i.e. toilet flushing and washing machines.

As illustrated in Figure 5-8, domestic level GWR would involve the installation of a self-contained storage and treatment unit for each property. This system would collect and treat water drained from showers, baths and wash/ hand basins, and then pump this supply of non-potable water for use in toilets and washing machines.

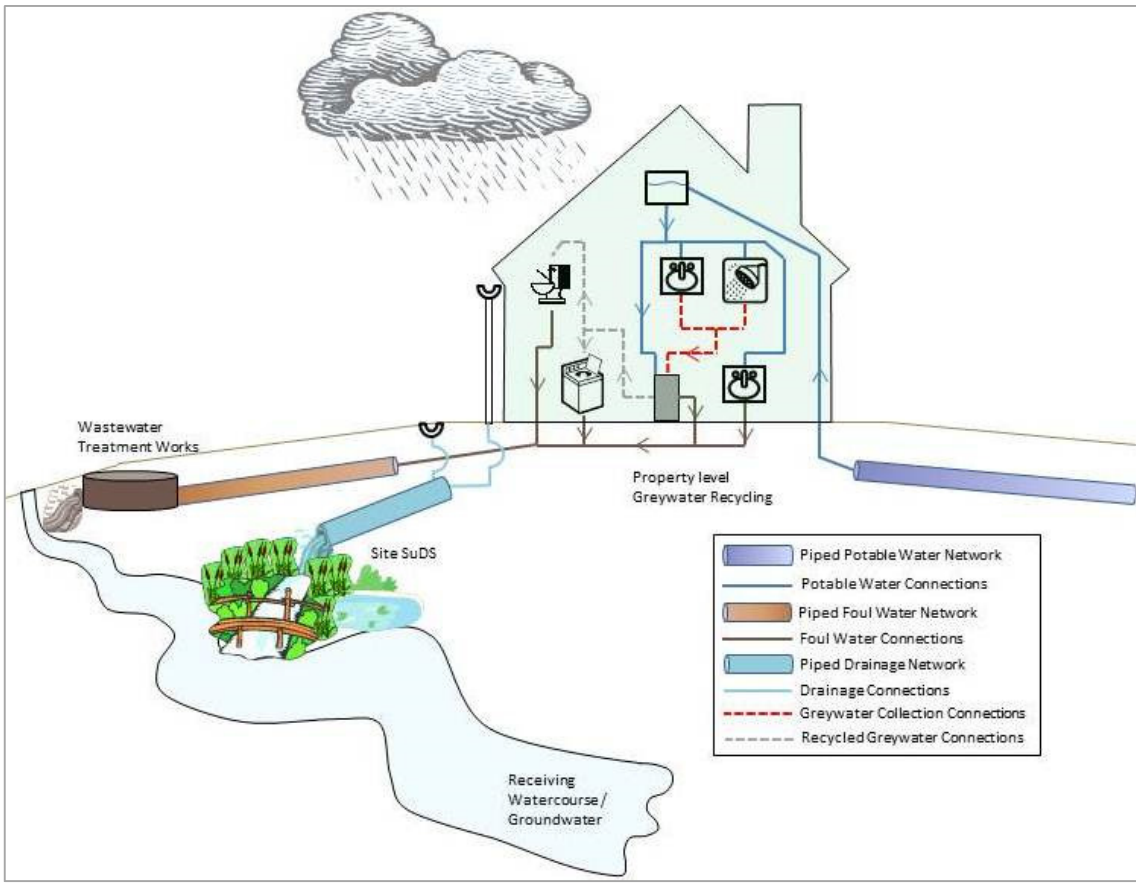


Figure 5-8 Property level GWR schematic

Greywater must be collected separately to wastewater from the toilets or kitchen sinks (high levels of grease and food particles make this unsuitable for local recycling). As with RWH, the GWR must be returned to the toilet and washing machine via non-potable plumbing, separate to other potable water plumbing in the house.

Package systems exist for the domestic markets which utilise a combination of filtration, chemical/ UV disinfection or biological processes to achieve the required treatment. However, assuming that treatment is provided by a small MBR package, the EA advise that the operational energy required for such a system would be more than three times as energy/ carbon intensive as the equivalent property level RWH system[16].

The BRE tool calculates that a typical house built to CSH Level 3/4 water efficiency would provide approximately 67 l/p/d of greywater from these sources. Allowing for a 50% collection and recycling rate would still provide more than the 30 l/p/d non-potable requirement, and hence achieve an overall potable water PCC less than 80 l/p/d.

There would be excess greywater collected compared to the non-potable demand. The higher biological content of greywater as opposed to rainwater means that long term storage should be avoided, to reduce the risk of bacterial growth. It is assumed that a GWR unit would be sized to treat and store a volume of water equivalent to the daily non-potable demand, and a separate header tank would not be used (the unit would store the required volume to allow better control of quality). Therefore, any additional greywater collected would overflow to the conventional wastewater sewers serving the house.

Domestic GWR for non-potable use reduces the volume of wastewater received at the WwTW, by around 30 l/p/d, which theoretically allows more properties to be served within the same

hydraulic capacity and volumetric discharge consent. However, the wastewater received by the WwTW will be proportionately stronger, as it will be less diluted. The WwTW process will still have to remove the same mass of pollutants to achieve the consent, so savings in terms of process energy may be negligible. Additionally, it is unlikely that capital savings from reduced sizing of WwTW hydraulic/ process components would be realised, as TWUL (or an inset undertaker) would have to ensure that sufficient capacity existed in case of the GWR units being bypassed in the future.

It should be noted that the treatment used in domestic GWR systems can be susceptible to shock changes in chemical and biological loading from changes in user behaviour. BS8525-1:2010 gives the example of wash basins in the bathroom being used for hair colouring, or disinfection of cotton nappies, as potential problems if treatment processes are not sufficiently robust. It can therefore be concluded that domestic GWR is more onerous than domestic RWH in terms of the behavioural changes demanded from occupiers.

Additionally, the reduced flows entering the sewers due to this option would mean that conventional sewer design standards would have to be reconsidered. To account for the risk of the property level GWR units being abandoned in the future, the sizing of new sewerage pipes would likely have to be based on conventional flows. However, the reduced flows anticipated would mean that steeper gradients would be required to achieve the necessary self-cleansing velocities. Steeper network gradients result in increased construction and operational costs.

5.6.4 Neighbourhood GWR

As discussed above, the BRE tool calculates that, from a home achieving a PCC of 105 l/p/d, approximately 67 l/p/d of greywater would be produced. In this option, this greywater would be transported from homes to a centralised recycling location via an additional sewer network (separate to both the surface water sewers, and the foul water sewers) as illustrated in Figure 5-9.

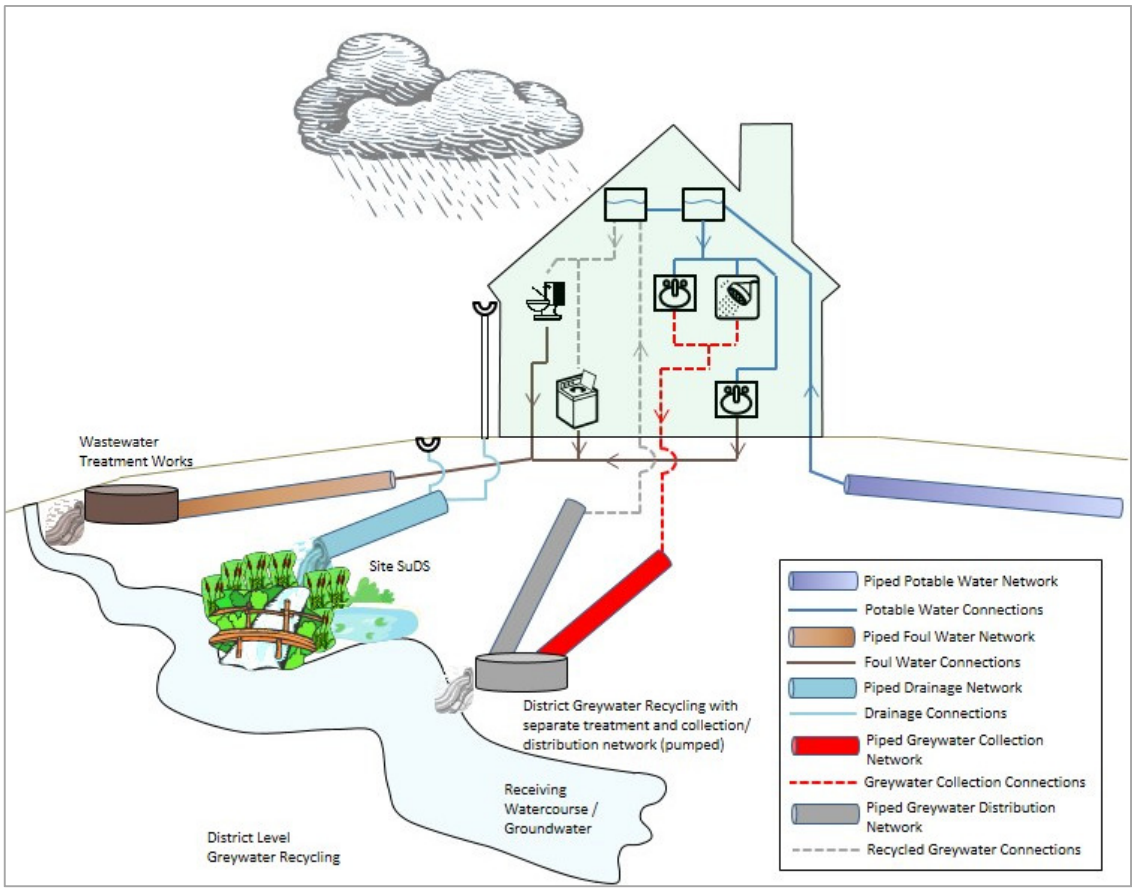


Figure 5-9 Neighbourhood GWR schematic

Similar to neighbourhood RWH, this potential solution offers the benefit of centralised control of treatment and redistribution. This allows for more efficient maintenance and upgrades, and would likely be more favourable for residents and operators as it removes a maintenance burden from individual homes.

Again, similar to neighbourhood RWH, this solution has the potential to allow more of the non-residential developments to achieve a BREEAM excellent rating for water, as their non-potable demands can be met from the centralised network, rather than relying on property level resources.

It should however be noted that this option would be the most intensive in terms of pipework/ infrastructure, as separate collection and distribution systems would be required both within buildings and streets.

As with the above, this option would serve to reduce the DWF received at the WwTW, and would additionally allow foul sewers and WwTW hydraulic components to be reduced in size (albeit that the flows received would now be more concentrated, which may prevent any cost savings in terms of process).

Assuming 90% efficiency in collection, treatment and resupply of greywater equates to a possible non-potable resource of 60 l/p/d. This exceeds the projected non-potable demand in the proposed houses by 100%; hence there would be no requirement for approximately half of the water treated. This excess non-potable water would have to be discharged local to the greywater recycling plant, or could be stored for landscaping purposes, although water quality would have to be monitored and potentially periodically improved to allow irrigation of public areas.

5.6.5 Local reclamation of treated wastewater

An option for producing a non-potable resource on site would be to divert and treat a proportion of foul water flows from the sewerage network. If the preferred wastewater solution is a traditional sewer system to Bicester WwTW, the required proportion for reclamation could be abstracted from this network prior to it leaving the development site (a process referred to as sewer mining).

An alternative local source for non-potable water would be to reclaim effluent from after the wastewater treatment processes. Due to the stringent wastewater effluent quality standards which would likely be imposed on any WwTW, this effluent could then potentially be transformed in to a reliable non-potable supply via moderate chlorination.

Given the distance to the existing Bicester WwTW, and the potential complications of constructing and operating third party assets in close proximity to existing TWUL site, it is unlikely that this option would be implemented at the existing WwTW site.

Additionally, given the increased operational and water quality risks it is highly unlikely that this technology would be implemented at a property level.

The most viable arrangement would likely be a local reclamation works within the development site (or number of, to maximise use of gravity flows), reclaiming a proportion of the wastewater. If the preferred wastewater solution is an on-site WwTW discharging to local watercourses, it would likely be cost efficient for the reclamation process to be located on the same site, as illustrated in Figure 5-10.

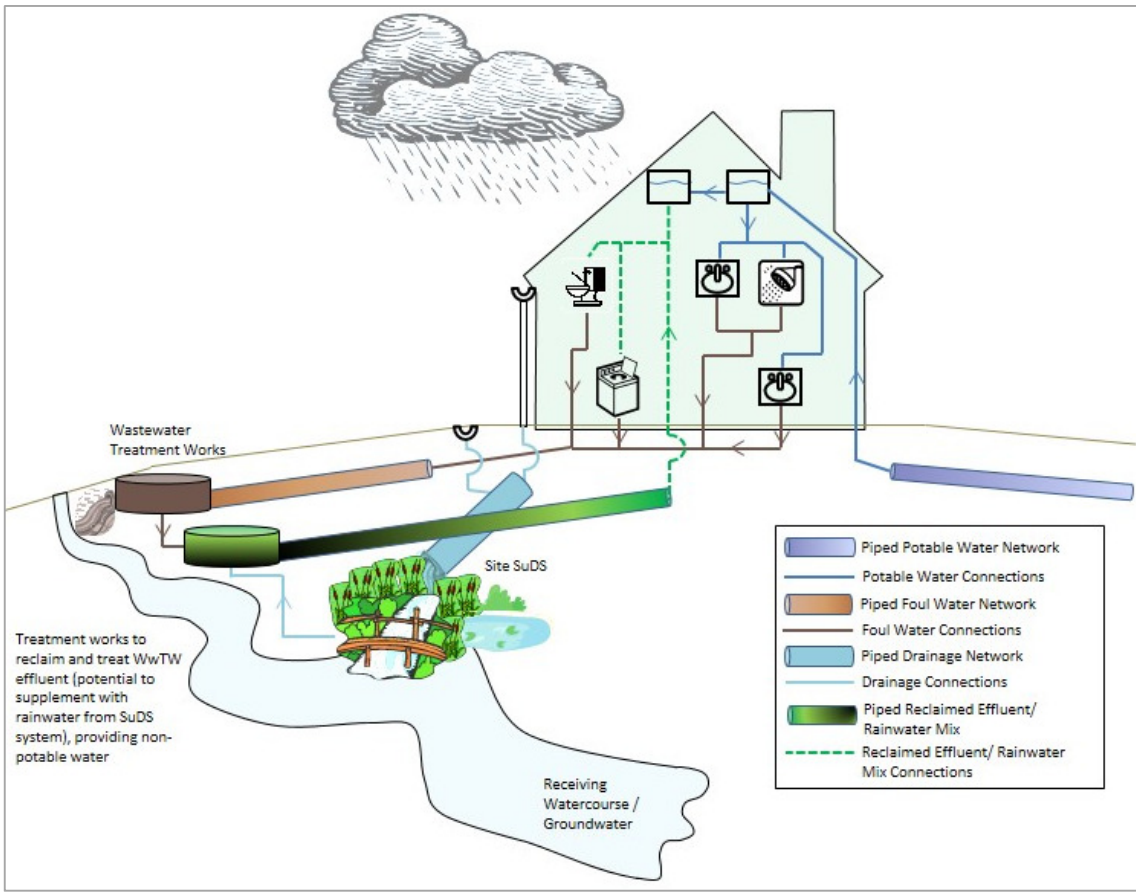


Figure 5-10 Treated wastewater reclamation schematic

Depending on the minimum flows of surface water through the SuDS network required to support any amenity and biodiversity features, it may also be possible to use surface water from the on-site SuDS network to supplement the effluent reclamation. Advantages of this approach are that it assists with dilution and provides some resilience should the WwTW process fail. However, disadvantages are that it may not be available year round, and the potential for upstream contamination of the SuDS network means that the quality of influent to the reclamation process may be variable. Technically feasible treatment processes exist for both approaches, and if this solution were preferred, the strategy would be determined by the operator during detailed process design.

Similar to neighbourhood RWH and GWR, this option has the benefit of providing a centralised non-potable supply which can be managed by a single entity, and provide the opportunity to match non-residential non-potable demand to the available non-potable supplies from across the development, potentially facilitating higher BREEAM ratings for the non-residential developments.

6 SEWERAGE AND WASTEWATER

The following Sections outline the methodologies used to assess the impact of the growth proposals on the existing wastewater treatment and foul water sewerage network in the study area, and determine the likely provision of new wastewater infrastructure.

As illustrated within the Drainage Strategy for the Masterplan, and in keeping with the preferred hierarchy in the Flood and Water Management Act (FWMA), Building Regulations and emerging National Standards for SuDS, it is the firm intention for the development that surface water drainage remain separated from the foul water network.

To aid further discussion of opportunities and constraints, two potential wastewater options were considered for the development:

- **On-site WwTW** – the provision of an on-site WwTW to serve the development, discharging to the Town Brook/ River Bure, allowing for some reclamation of resource should this become the preferred option for sourcing a non-potable supply; or
- **Existing WwTW** – transporting the new DWF from the development site to the existing TWUL Bicester WwTW for treatment and discharge in to the Langford Brook.

6.1 Wastewater capacity: methodology

The potential increase in wastewater generated by the proposed development is therefore calculated in terms of dry weather flow (DWF). DWF is used in the calculations as it assumes the separation of stormwater from foul sewers, and allows for the comparison of the potential flows with the existing volumetric discharge consents at Bicester WwTW.

DWF from the proposed development has been calculated as follows:

$$DWF\ (m^3/d) = \frac{Population \times PCC\ (l/p/d) + Infiltration\ Allowance + Trade\ Flows}{1{,}000}$$

These calculations include the following assumptions:

- Population - increases in residential population are calculated from development trajectories and based on an occupancy rate of between 2.2 and 2.3;
- The trajectory for new residential properties outside of the development, but within the Bicester WwTW catchment, is assumed to match the latest trajectory from the CDC Annual Monitoring Report[17], which totals 4,179 new properties by 2030/31;
- When considering other properties to be built within Bicester, the worst case PCC rates is considered to be 125 l/p/d, minus an allowance of 5 l/p/d for outside usage which does not enter the foul water sewers, similar to the assumptions in the Building Regulations;
- Infiltration allowance - to account for unplanned infiltration of surface water and misconnections to these new sewers in the long term, an additional proportion of unaccounted for flows has been included in the calculations. The value of this (25% of DWF) is in accordance with TWUL estimates used in high level planning for the Region;
- Non-residential DWF - an allowance for the domestic wastewater generated from the proposed 4,400 employees (including home workers and the proposed non-residential development areas) has been calculated, based on 90 l/employee/d, in keeping with the British Water Code of Practice[18];

- Trade flows – the wastewater generated from future industrial processes in new employment areas cannot be accurately estimated, as businesses will have to enter in to a separate financial agreement with the wastewater undertaker on this matter. However, in keeping with Sewers for Adoption[19], an allowance of 0.75 l/s/ha has been made for the proposed 5.8 ha of B2 industrial use;
- Both the non-residential DWF and trade flows are assumed to increase proportionately in line with the residential development build out;
- Non-residential DWF and trade flows from other proposed non-residential or mixed use developments across the CDC area have not been assessed, as this is a matter for CDC and TWUL to consider separate to this WCS;
- Any scenarios involving GWR have assumed that the flows to the foul water sewers reduce proportionately in line with the greywater held back for recycling;

The capacity of WwTW which may serve the development is assessed in three components:

- The volumetric consent (or environmental permit) – the DWF (expressed as m^3/d) which the wastewater undertaker is permitted to discharge to the receiving watercourse, as agreed by the EA under the provisions of the Water Resources Act 1991, and more recently the Environmental Permitting Regulations 2010;
- The process capacity – the ability of the biological and chemical process components to treat the load from the population to the required physio-chemical standards, as stipulated in the consent to discharge/ environmental permit. In the case of the existing WwTW, this was ascertained from discussion with TWUL; and
- The hydraulic capacity – the ability of the physical components in the works to accommodate the wastewater flows, normally expressed in terms of flow to full treatment (FTFT) i.e. the peak wastewater flows which the main process of the WwTW will be designed to handle, excluding any increases due to stormwater (typically stored for later treatment, or screened and discharged separately). Again, this was ascertained from discussions with TWUL.

The sensitivity of the wastewater calculations to varying PCC rates has been assessed in this WCS by considering the following wastewater demand scenarios:

WwTW location	Worst Case PCC l/p/d	Best Case PCC l/p/d	Planned PCC l/p/d
Existing TWUL Bicester WwTW	120 : *Building Regs minus 5 l/p/d*	105 : *CSH 3/4*	105 : *CDC Policy ESD3*
New on-site WwTW	105 : *CSH 3/4*	80 : *CSH 5/6 – assumes some greywater reclaimed prior to treatment works*	*105 : CSH 5/6, but assuming that if any wastewater is reclaimed to meet the 80 l/p/d target, this is after treatment*

Table 6-8 DWF PCC scenarios

6.2 Wastewater capacity: DWF results

Based on the calculations in the Section above, Figure 6-11 illustrates the predicted DWF that would be generated from the proposed development site, in terms of trade flows, non-residential DWF and total DWF including the residential development with two separate PCC rates.

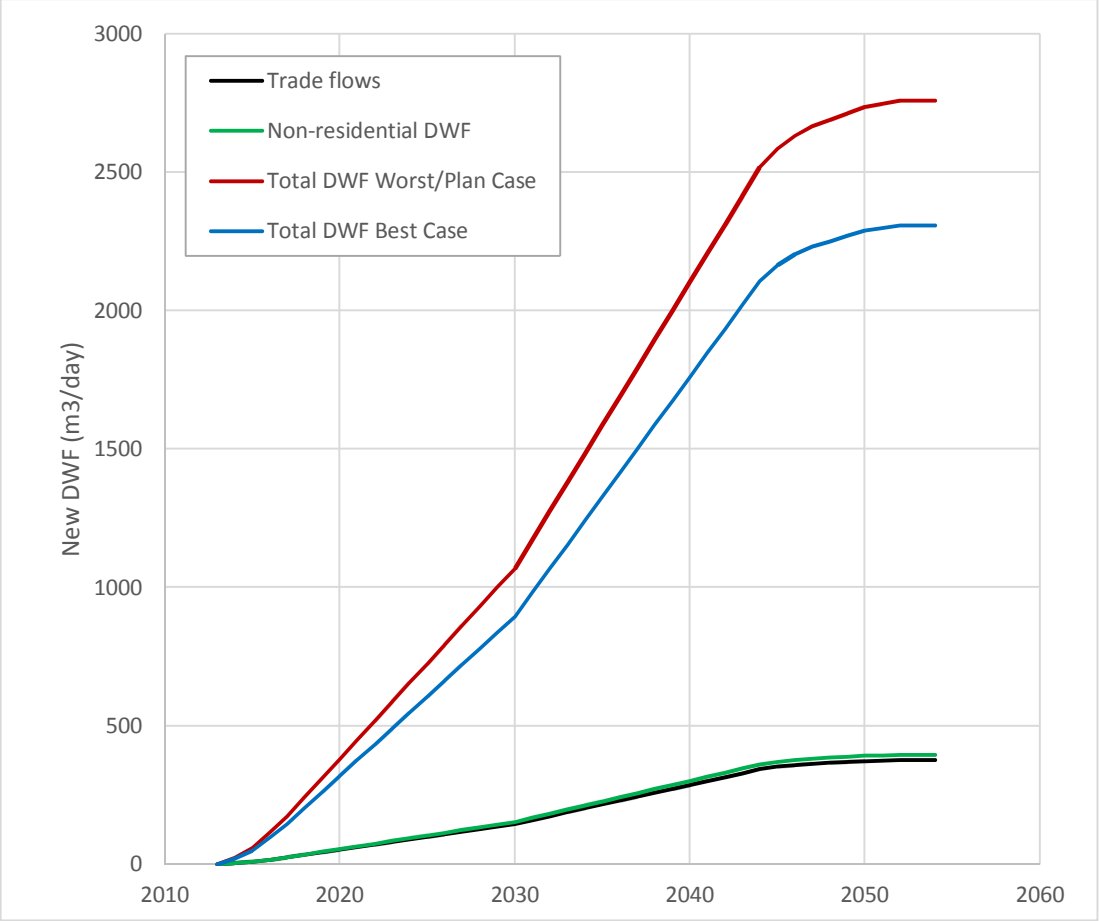


Figure 6-11 New DWF from NW Bicester development site

The calculations suggest, that by the end of the build out period, a DWF of 2,759 m^3/d would be generated (assuming the Worst Case or Plan PCC rates). If GWR were used at a property level to reclaim and treat approximately 25 l/p/d of this wastewater, the DWF would reduce to 2,309 m^3/d.

Figure 6-12 below illustrates the calculation results when considering the DWF from the NW Bicester development in conjunction with the other additional residential development in Bicester. The DWF generated by the end of the build out period is predicted to be 3,626 m^3/d under the Best Case scenario, 4,076 m^3/d under the Plan scenario, and 4,264 m^3/d under the Worst Case scenario.

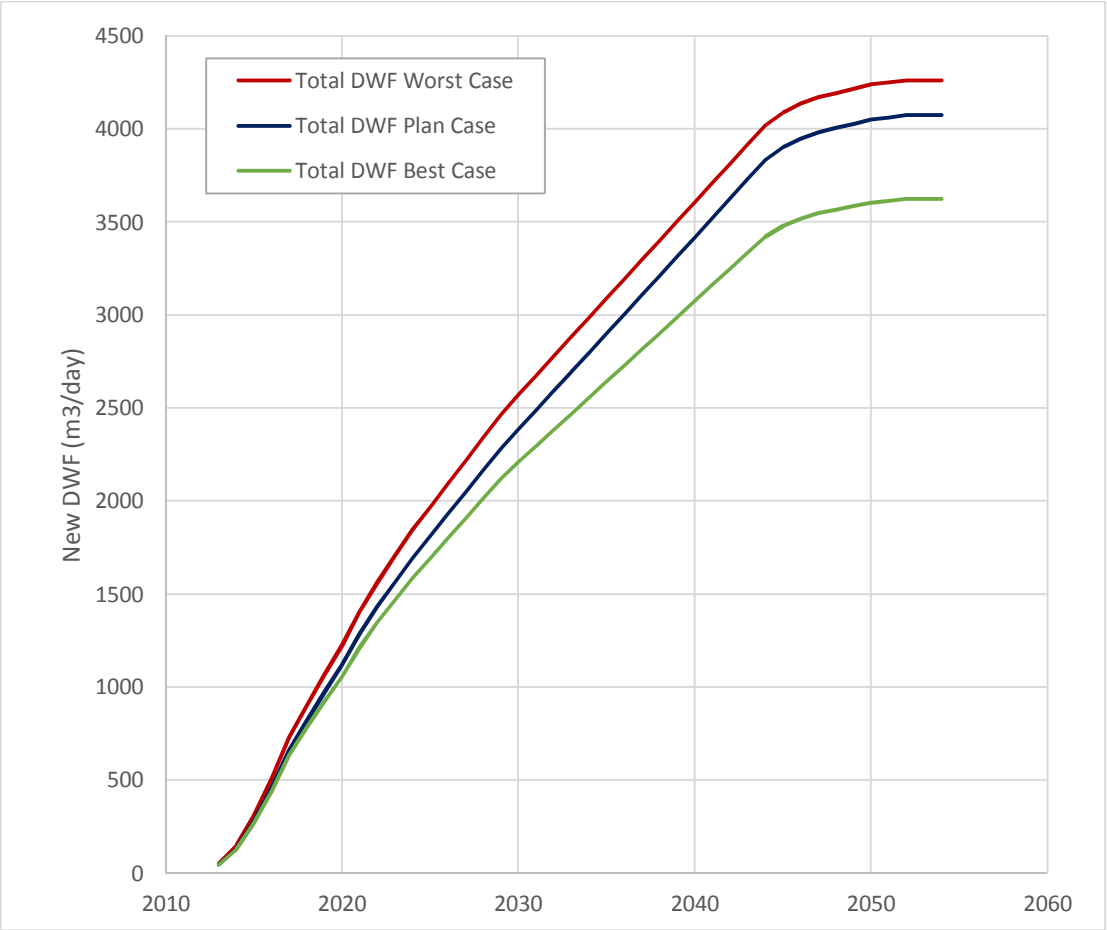


Figure 6-12 New DWF from NW Bicester development site and other Bicester development

6.3 Wastewater capacity: existing WwTW capacity

The current discharge consent/ environmental permit for Bicester WwTW allows for a maximum DWF volumetric consent of 13,427 m^3/d, with the following physio-chemical consent standards:

- Suspended solids – 25 mg/l
- BOD – 10 mg/l
- Ammonia – 2 mg/l
- Phosphate – 2 mg/l

In 2013 TWUL advised that the flows currently being discharged equated to 11,500 m^3/d. When this current headroom of 1,927 m^3/d is considered in conjunction with the DWF increases calculated above, it is predicted that the WwTW would require a new DWF consent to be agreed between 2024 and 2027 (depending on PCC rates realised). Table 6-9 illustrates this in more detail.

DWF PCC Scenario	Date existing consent exceeded	No. of homes in NW Bicester Site at this date	No. of new homes in surrounding catchment at this date
Best Case	2027/28	1,875	3,767
Plan Case	2025/26	1,575	3,459
Worst Case	2024/25	1,425	3,305

Table 6-9 Timeframe in which a new DWF consent will be required at Bicester WwTW

In order to protect the quality of the receiving water environment, the granting of an increased DWF volumetric consent by the EA would likely be accompanied by a tightening in the physio-chemical consent standards required under the provisions of the WFD. The water quality implications of such a solution are discussed further in Section 6.4.

Additionally, in 2013 TWUL advised that the current physical, biological and chemical process capacity at Bicester WwTW would allow for the load from an additional 5,000 to 10,000 PE (population equivalent) to be processed, although that it may be possible to extend this capacity by further optimisation of the processes.

Even discounting any trade flows or non-residential DWF, assuming an occupancy rate of 2.3, this 5,000 or 10,000 PE capacity would be exhausted by 2018/19 or 2023/24 respectively. However, TWUL advise that improvement works to Bicester WwTW are proposed under the AMP6 business plan (as TWUL have been aware of the proposed Bicester growth for some time).

Whilst the TWUL business plan is yet to be approved by Ofwat, it is reassuring to note that TWUL are expecting to undertake a capital project to provide additional capacity prior to 2020/21. Additionally, TWUL advise that there are no land acquisition constraints which may hamper the expansion of the capacity at Bicester WwTW.

6.4 Wastewater capacity: existing WwTW water quality

For the purposes of comparing indicative consent results, the following physio-chemical standards have been assumed to represent current and future best practice:

Colour convention shown is used throughout further Sections of this WCS report	**BOD mg/l** (95%ile)	**Amm. N mg/l** (95%ile)	**SRP mg/l** (Annual Average)
Limits typically considered as reliably economically achievable using conventional technologies*.	**7-8**	**3-5**	**1-2**
Limits that may be currently achieved by enhanced operation of conventional and emerging processes. Although not as reliable as the above, it is assumed that consents such as these will become more common over the study period if water quality constraints are to be met*.	**5-7**	**0.5-3**	**0.5-1**
Limits more stringent than the above, where it is assumed unlikely a water company or process supplier would be able to guarantee such performance in the foreseeable future at a large scale without resorting to energy intensive processes normally reserved for potable water treatment**.	**<5**	**<0.5**	**<0.5**

Table 6-10 Current and future standards assumed to be economically achievable using conventional technology

*The above is based on current and emerging work with a number of UK water companies – however the limits should not be considered definitive, as the industry is currently investing in research and development to explore the processes required to meet WFD requirements.
** If such standards were required, it is likely the water company and the EA would have to agree to set lower targets for the water body under the provision of the WFD, allowing the failure to meet good status for reasons of technical feasibility or disproportionate cost. This would be reviewed every 6 years under the WFD, until such a time that the technology was judged to be sufficiently reliant at a price appropriate for customers. It is likely that further research and pilot schemes during AMP6 will contribute to this body of knowledge.

Based on the proposed increase in DWF calculated in Section 6.2, the indicative consent results from the EA RQP modelling exercise are illustrated below. This is based on the existing DWF of 11,500 m3/d, plus the additional flows from NW Bicester and other development.

DWF – scenario and timeframe (m^3/d)	**BOD mg/l** (95%ile)	**Amm. N mg/l** (95%ile)	**SRP mg/l** pre 2015 (Annual Average)	**SRP mg/l** post 2015 (Annual Average)
11,652 – worst case, end of AMP5	**29**	**6.7**	**0.84**	**0.25**
13,757 – plan case, end of AMP8	**5.9**	**1.5**	**0.18**	**0.09**
14,190 – best case, end of AMP9	**5.6**	**1.5**	**0.17**	**0.09**

Table 6-11 Indicative consent results for Bicester WwTW

Awaiting results from additional RQP calculations currently being undertaken by the EA

TWUL and the EA advise that negotiations are on-going regarding the tightening of the existing P consent standard at Bicester WwTW for the next round of improvements under the WFD (post 2015). TWUL have advised this WCS that, should the P consent standard be tightened to less than 0.5 mg/l, they will have to reassess any planned process improvement works for AMP6.

The P consent standards required at the end of the proposed development period are currently considered to be such that a water company or process supplier would be unable to guarantee such performance in the foreseeable future at a large scale without resorting to energy intensive processes normally reserved for potable water treatment, such as membrane bioreactors.

6.5 Wastewater capacity: off-site sewerage network

In 2013 TWUL advised that the existing sewerage network serving Bicester has some design capacity remaining in terms of DWF, but due to the combined nature of some areas of the network, this capacity is not available during wet weather.

TWUL have a network model of the sewers in Bicester, but advise that this will require additional verification and recalibration via the deployment of flow monitors, to enable it to be used accurately to inform any sewer requisition submitted in relation to the NW Bicester development if it involves discharging to the existing sewer network.

In order to consider the extent of new sewerage infrastructure required, this WCS has adopted a precautionary approach, and assumed that a new off-site sewer requisition to serve the NW Bicester Development would require an entirely new link around the south of the town directly to the WwTW. This is considered conservative, as TWUL have advised that there may be some available capacity (subject to modelling) in a new 600 mm sewer recently constructed along Middleton Storey Road to serve the Southwest Bicester development.

Similar to the Surface Water Drainage Strategy, it is assumed that the on-site foul water network would be constructed to encourage flow via gravity to the lowest elevations within the three areas referred to as catchment A, B, and C.

Figure 6-13 illustrates the likely gravity collection points for the new on-site foul water sewerage, and indicative routes for the primary sewer mains. Given the fluid nature of the master planning process, a proportionate area approach has been used to apportion the new residential DWF, non-residential DWF and trade flows across the three catchments. Given the inherent uncertainty regarding exact unit distribution, employment uses, occupancy rates and infiltration

rates, this is considered to be an appropriately accurate approach for high level design; particularly as foul sewer and sewage pumping station (SPS) design allows for flows approximate to 3 x DWF.

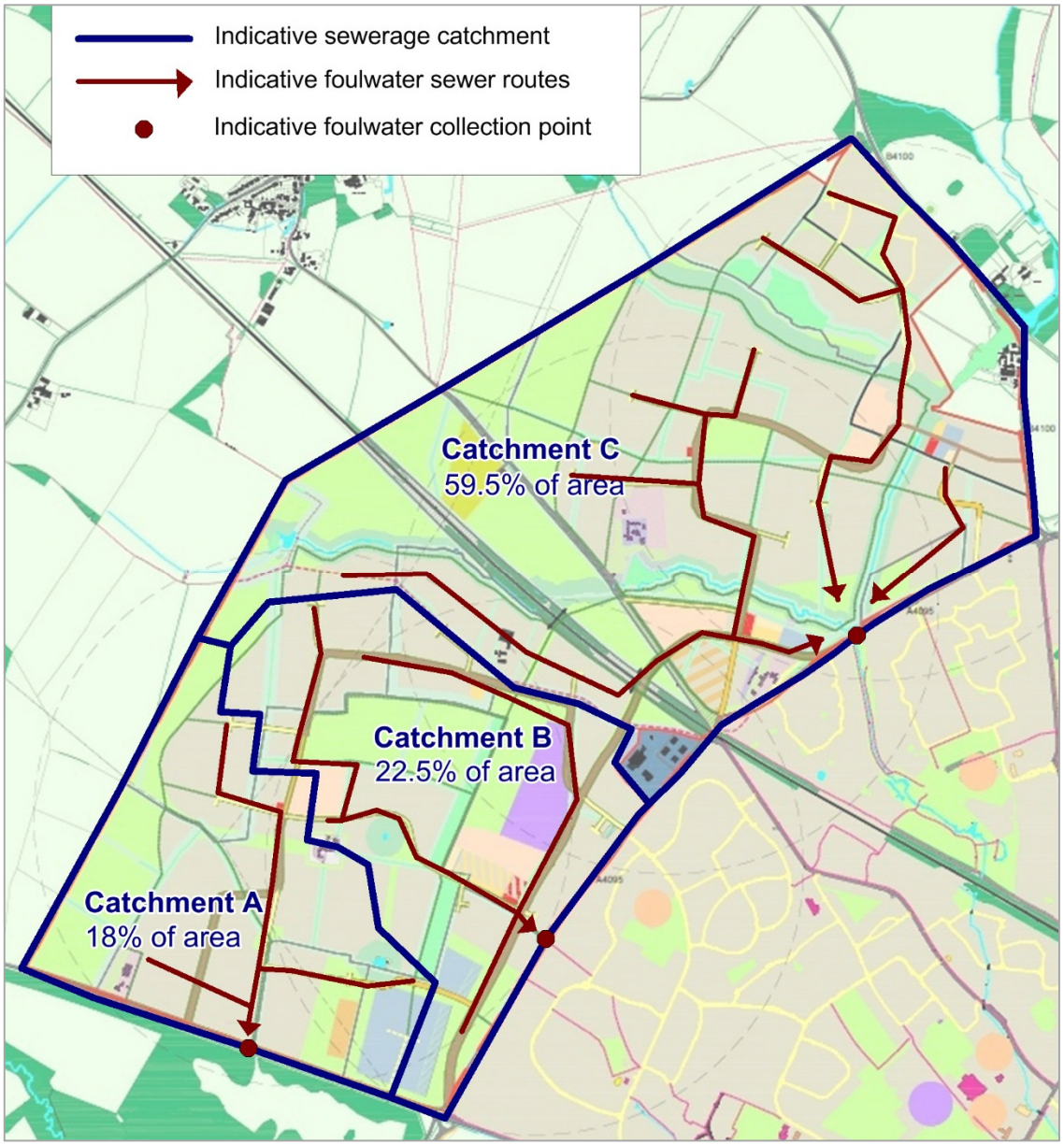


Figure 6-13 Indicative on-site gravity sewerage routes (Contains Ordnance Survey data © Crown copyright and database right (2013))

Whilst there are a number of possible routes to providing the off-site sewerage, for simplicity at this stage it has been assumed that a sewer requisition would have to include new gravity sewers from catchment A and catchment B, to a collection point on the southern corner of the development site. Given the slightly lower elevations, flows from catchment C would require pumping over the watershed to join the network in Catchment B.

From this southern collection point, a new gravity sewer would be required southwards along Middleton Storey Road. However, given the relatively slack gradient available between here and the existing WwTW, it is likely that a new terminal SPS would have to be requisitioned to pump the flows south-eastwards to the WwTW inlet.

Figure 6-14 illustrates the indicative off-site sewerage design undertaken by Hyder.

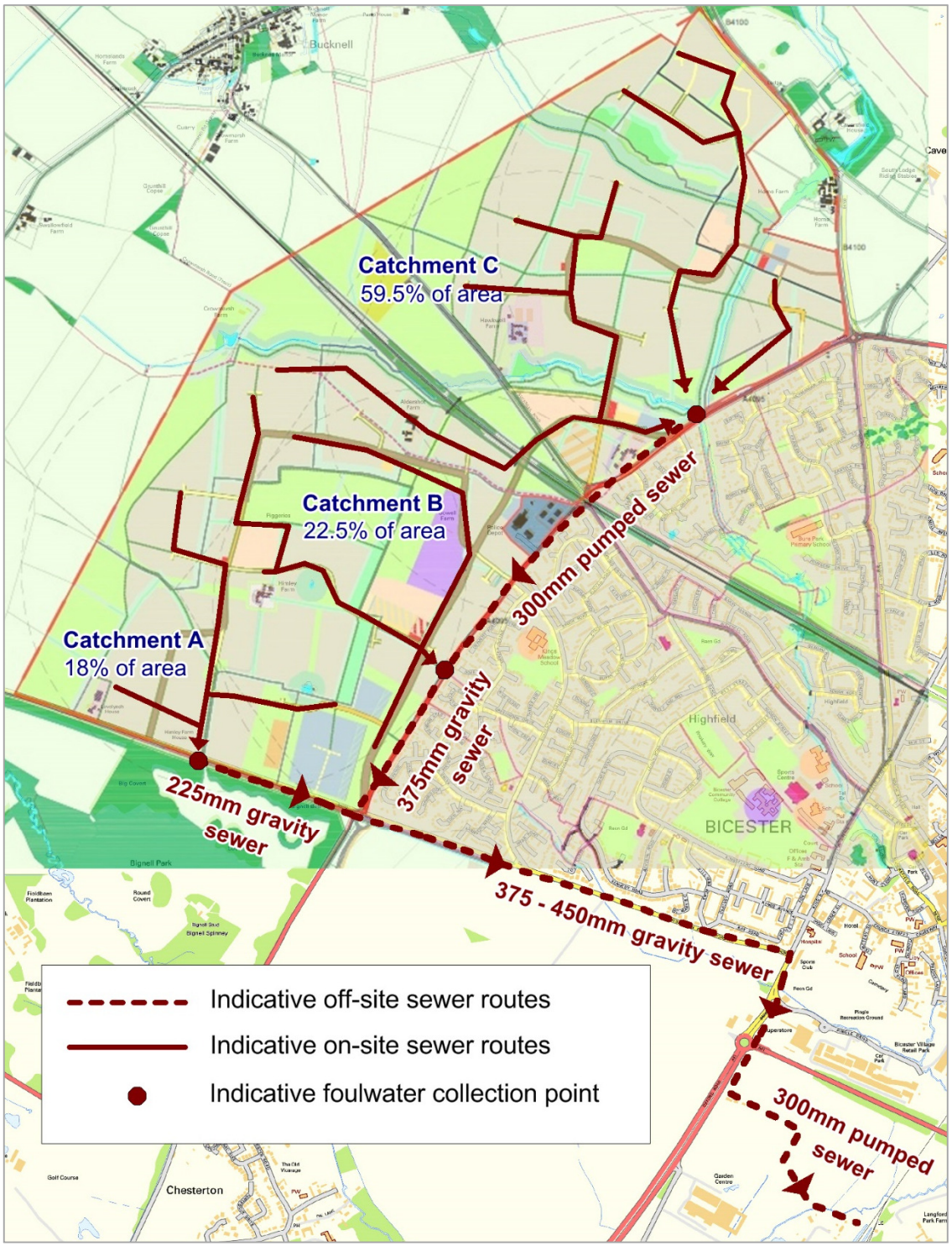


Figure 6-14 Indicative off-site sewerage routes (Contains Ordnance Survey data © Crown copyright and database right (2013))

The final route and configuration of any off-site sewer requisition would be subject to the design of TWUL, following network modelling and verification. However, the above provides a conservative indicative design to assist with cost comparisons.

Using experience gained from working on capital delivery projects for a number of wastewater undertakers, Hyder has estimated that the above off-site sewer connections (and two SPS)

would cost approximately £3.5M, including land and planning fees, project management, design and power connections.

Assuming a standard 12 year calculation period for the relevant deficit, it is estimated that the relevant deficit payable by the developer to TWUL would be approximately £3.3M. This is relatively high, as the income generated from the new properties stretches over a much longer timeframe than the 12 year financing arrangement for the capital works. Notably, this calculation makes a number of assumptions regarding income per property, financing costs and inflation, which would need verifying by TWUL through the formal requisition process.

TWUL advise that, as their discretion, a commercial commuted sum arrangement can be used to fund a sewer requisition, rather than the statutory relevant deficit arrangement. This may be more appropriate given the longer timescale of the proposed development.

Additionally, oversized sewer assets can produce operational problems in terms of septicity (requiring additional chemical treatment within the network), and the failure to achieve self-cleansing velocities leading to silting up and potential blockages. Given the long development timeframe, TWUL may design off-site sewer capacity enhancements in phases more appropriate to the development trajectory, and other development and capacity within the wider network. This would alter the estimates of capital costs and relevant deficits.

Hyder have submitted an initial request to TWUL on behalf of A2Dominion to undertake preliminary investigations and prepare a budget estimate of the capital costs/ relevant deficit, to provide additional clarity on the above matters, and provide steer to the next design phase of the development.

It is estimated that the requisition, design and construction of large scale off-site sewers may take up to three years. This may mean that, if this is the preferred option for sewerage, then at least the initial two years of the NW Bicester development will have to rely on an alternative method of connecting to the Bicester sewer network. However, the sewer connection for the entire Exemplar Site (393 new homes) has already been agreed with TWUL and the remaining development is unlikely start until 2018/19. Therefore, there is sufficient timeframe to construct the new large scale off-site sewers to serve the remaining development prior to occupation.

6.6 Wastewater capacity: new on-site WwTW

An alternative to the above would be to collect and treat wastewater on site, and discharge to the Town Brook/ River Bure. An area of over 3 ha has been set aside within the master plan boundary, adjacent to the Town Brook, to facilitate such a solution.

As discussed in Section 5.6, an on-site WwTW offers the opportunity to combine this with a reclamation facility to enable a non-potable supply to be returned to the development, and therefore facilitate the achievement of the required PCC standards.

The water quality implications of such a solution are discussed further in Section 6.7. Given the low dilution available (approximately five times less than at the Langford Brook), and sensitive downstream water environment, the physio-chemical consent standards required are stringent.

Given that the final works will treat a DWF of between 2,309 m^3/d and 2,759 m^3/d, and a residential PE of up to 6,000 dwellings, to relatively high standards, and may be required to be built in modular phasing to better align with development build out, the choice of appropriate treatment technology is limited.

6.7 Wastewater capacity: on-site WwTW water quality

Based on the proposed new DWF to be discharged to the Town Brook, as calculated in Section 6.2, the indicative consent results from the EA RQP modelling exercise are illustrated below:

DWF – scenario and timeframe (m^3/d)	**BOD mg/l** (95%ile)	**Amm. N mg/l** (95%ile)	**SRP mg/l** pre 2015 (Annual Average)	**SRP mg/l** post 2015 (Annual Average)
15 – best case, end of AMP5	**253**	**53.8**	**7.2**	**1.8**
20 – worst/plan case, end of AMP5	**191**	**40.7**	**5.4**	**1.4**
653 – worst/plan case, end of AMP7	**10**	**2.3**	**0.3**	**0.12**
856 – best case, end of AMP8	**8.8**	**2**	**0.26**	**0.11**

Table 6-12 Indicative consent results for on-site WwTW

Awaiting results from additional RQP calculations currently being undertaken by the EA

Similar to the indicative consent results for Bicester WwTW, the P consent standards required at the end of the proposed development period are currently considered to be such that a water company or process supplier would be unable to guarantee such performance in the foreseeable future at a large scale without resorting to energy intensive processes normally reserved for potable water treatment, such as membrane bioreactors.

As part of this WCS, consultation has been undertaken with TWUL and a number of potential inset wastewater undertakers regarding the above mentioned indicative discharge standards. Whilst the details of these consultations are currently considered to be commercially sensitive, the following points have emerged from these discussions:

- The WwTW process likely to be selected may be a membrane bioreactor works with both an aerated zone and anoxic treatment zone, or a submerged aerated filter;
- This could potentially provide an effluent with Amm.N concentrations less than 0.5 mg/l, and SRP concentrations less than 0.05 mg/l (with appropriate chemical treatment or enhanced biological treatment);
- Tertiary treatment of the effluent via a reedbed/ constructed wetland may not be required;
- A proportion of the high quality effluent from such a process could be collected and chlorinated relatively easily on-site to provide the non-potable resource essential for meeting the PCC targets across the development;
- The capital contribution that A2Dominion may need to make towards such a solution would be in the region of £4.5M to £8M, which would likely be more expensive than a conventional off-site sewerage requisition (estimated at £3.3M as discussed in Section 6.5);
- Inset companies believe that this such a works could be operated at a cost which did not result in customer bills any higher than the equivalent TWUL rates; and

- The modular nature of the proposed treatment process would fit easily within the allocated masterplan area, and would allow a phased delivery in line with the development build out.

6.8 Wastewater capacity: on-site sewerage network

Should on-site treatment be the preferred option, it is suggested that gravity sewers are employed to collect the majority of the wastewater, to avoid the need for a multitude of on-site SPS. Similar to Section 6.5, it is suggested that these would terminate at the low points within the three catchments. A new on-site SPS at each of these three locations would then be required to return the wastewater to the on-site WwTW.

Such a solution is illustrated in Figure 6-15. However, there may also be opportunity to gravitate Catchment A and B to a final collection point at the southern corner of the development and then use a single pumping main to the on-site WwTW. This can be investigated during the detailed design stage.

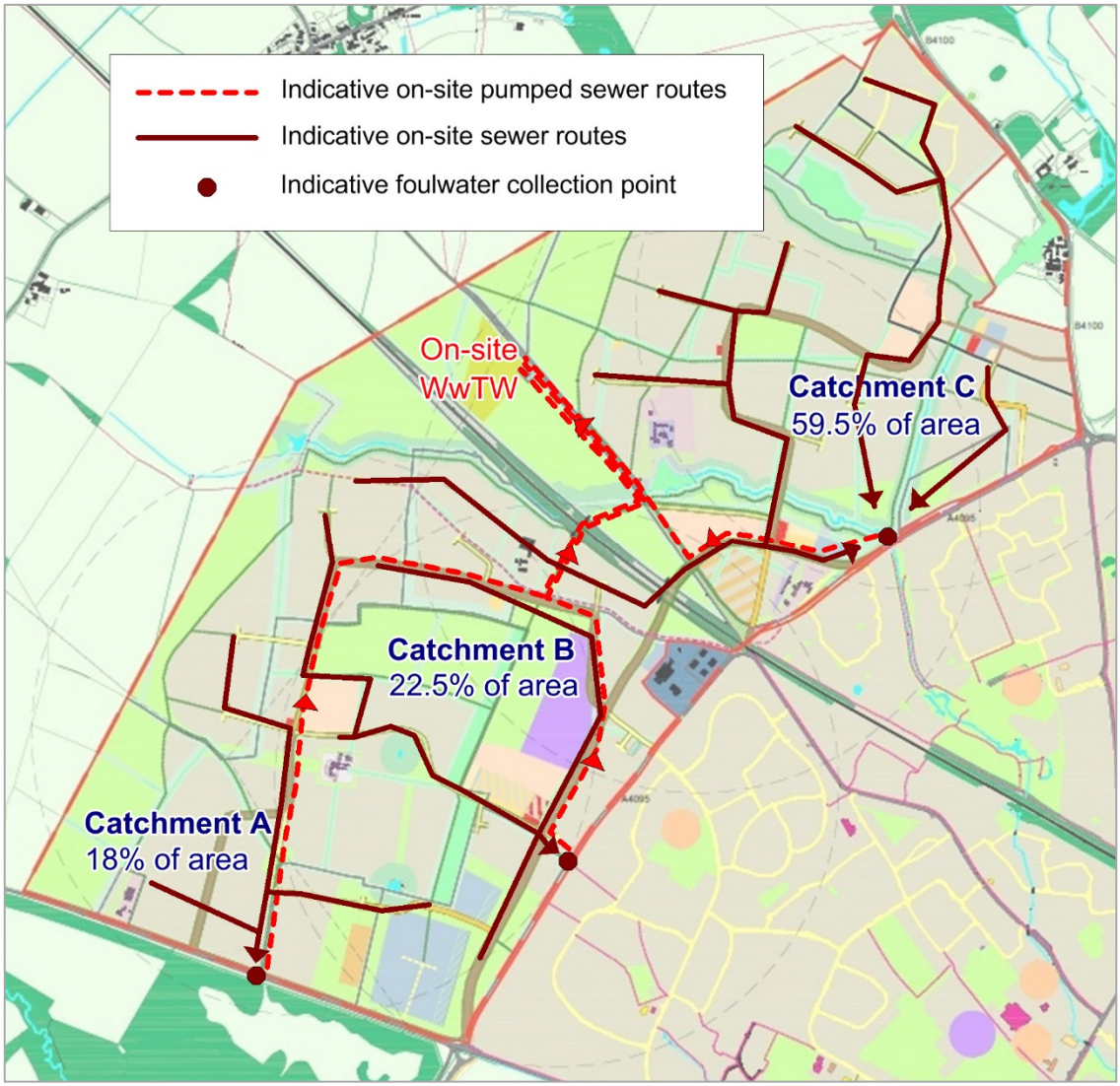


Figure 6-15 Indicative on-site pumped sewerage routes (Contains Ordnance Survey data © Crown copyright and database right (2013))

A sewerage solution such as the above offers the following benefits:

- It is more easily designed and constructed to align with the development build out;
- A more phased delivery avoids the cost/timeframe disparity which may make a traditional off-site requisition unattractive;
- Capital savings can be achieved as the on-site pumped sewers can potentially be constructed at the same time as other utilities across the site; and
- Disruption to the existing town (in terms of construction impacts on traffic), and sewer network works, is minimised.

7 CONCLUSIONS

Following this detailed WCS, the following conclusions can be made regarding the NW Bicester development:

- TWUL are in the process of finalising their 25 year plan to manage the water resources and potable water demand across the wider area, whilst mitigating climate change risks and ensuring best value for their customers. The growth at Bicester has been accounted for within these plans, and the exemplary potable water usage rates proposed for both the residential and non-residential development will mean that the increase in demand is less than that accounted for by TWUL;
- In order to achieve the above mentioned reductions in potable water demand, the proposed development must incorporate best practice water efficiency measures, and provide a reclaimed source of non-potable water to substitute with potable water used for toilet flushing and laundry;
- This non-potable water supply would be most efficiently managed if provided from a centralised location via a separate non-potable network, connected to separate non-potable plumbing in the new buildings;
- In terms of water neutrality, achieving the above mentioned water usage reductions will result in the net increase in potable water demand being limited to between 39%-41% of what it could have possibly been if conventional water usage rates were permitted;
- Whether the potable water supply to the development is provided by the incumbent water undertaker, or via an inset appointee, the existing TWUL network adjacent to the development site is readily capable of supplying this water, with any required upgrades already undertaken or planned through TWUL's standard investment cycle;
- Two viable options exist for the provision of sewerage infrastructure (subject to the finally chosen WwTW solution below) in a timely manner to serve the development – the potential delivery of this infrastructure is well understood, and negotiations with providers are progressing positively;
- The discharge of treated effluent from either an on-site WwTW, or the existing TWUL WwTW at Bicester, will require stringent physio-chemical standards to ensure that the objectives of the WFD are not compromised; and
- These consent standards are beyond those which are currently considered economically achievable using conventional methods – however, consultation with potential inset wastewater undertakers reveals that technical solutions exist, and that they believe the inset market can deliver such solutions at an attractive price which proves viable for both A2Dominion, and the end users.

[1] Environment Agency, *Water neutrality advice note*, 2010

[2] Natural England, *Bure Park* [online] *http://www.lnr.naturalengland.org.uk/special/lnr/lnr_details.asp?themeid=1134227,* Last updated 25/03/2013

[3] Natural England, *Wendlebury Meads and Mansmoor Closes SSSI Citation,* revised 1987

[4] Natural England, Otmoor SSSI *Citation,* revised 1972

[5] UK Technical Advisory Group, *UK Environmental Standards and Conditions*, Apr 2008

[6] Environment Agency, *River Basin Management Plan, Thames River Basin District, Annex B: Water body status objectives*, Dec 2009 (amended January 2011)

[7] Environment Agency, *Cherwell, Thame and Wye Catchment Abstraction Licensing Strategy,* December 2012

[8] Hyder Consulting UK Ltd, *NW Bicester Eco Development – Groundwater Supply: Feasibility Study*, October 2013

[9] Thames Water Utilities Ltd, *Revised Draft Water Resources Management Plan 2015-2040 Main Report,* October 2013

[10] Meeting between Hyder and TWUL, Reading, 26/09/2013

[11] The Institute of Plumbing, *Plumbing Engineering Services Design Guide,* 2002

[12] Building Research Establishment Group, *Code for Sustainable Homes Water Efficiency Calculator Tool, Ver. 02,* 2012

[13] Building Research Establishment Group, *BREEAM: New Construction Non-Domestic Buildings Technical Manual,* 2011

[14] British Standards Institution, *BS 8515:2009: Rainwater Harvesting systems – Code of Practice,* 2009

[15] British Standards Institution, *BS 8525-1:2010: Greywater systems – Part 1 : Code of Practice,* 2010

[16] Environment Agency, *Energy and carbon implications of rainwater harvesting and greywater recycling,* 2010

[17] Cherwell District Council, *Annual Monitoring Report,* 2013

[18] British Water, *Code of Practice Flows and Loads – 4: Sizing Criteria, Treatment Capacity for Sewage Treatment Systems,* 2013

[19] Water UK/WRc plc, *Sewers for Adoption Sixth edition,* 2006

north
west
bicester

a2dominion

THINKING ABOUT TOMORROW

A2Dominion, Godstow Court, 5 West Way, Oxford, OX2 0GE

APPENDIX 11.2
WATER FRAMEWORK DIRECTIVE SCREENING ASSESSMENT

Himley Village: Water Framework Directive – Screening

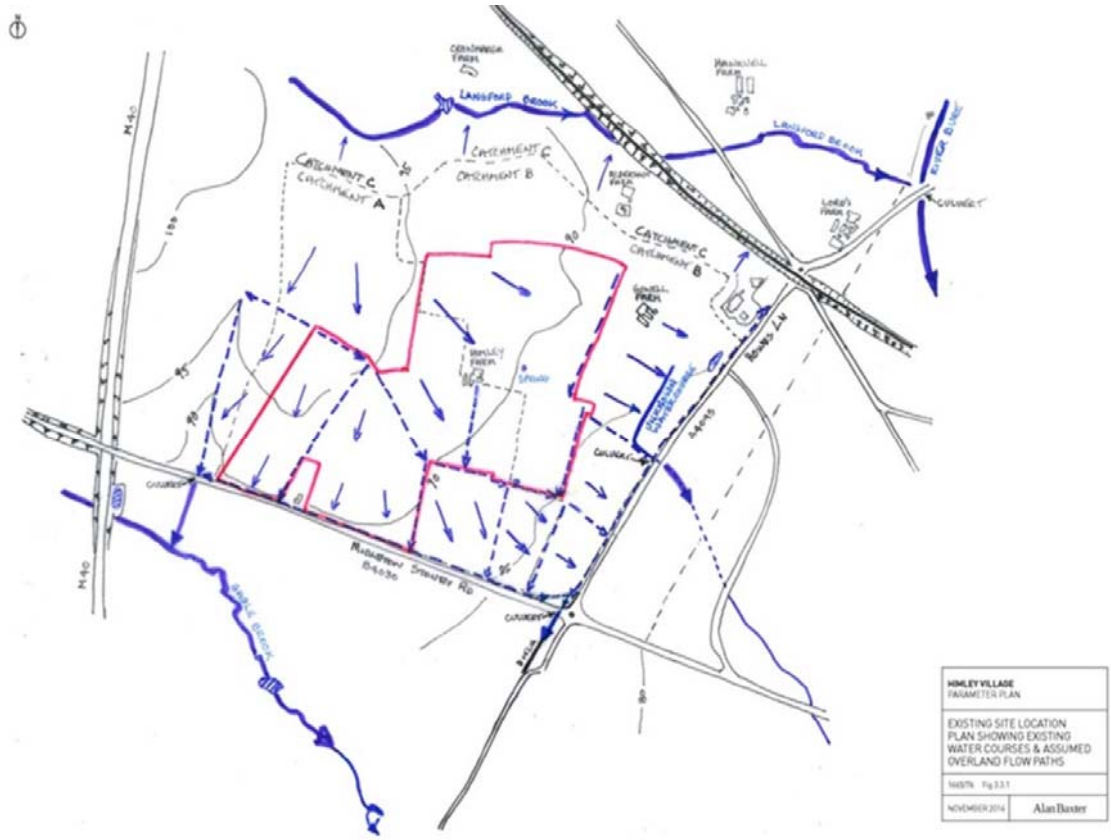
1.1. The Water Framework Directive (WFD) (Directive 2000/60/EC) and the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 state that it is mandatory to determine whether a development has the potential to cause deterioration of the Ecological Status or Ecological Potential[1] of a waterbody. It is also important to determine whether a development could prevent a waterbody from achieving a 'Good' Status / Potential in the future.

1.2. In accordance with the Directive, this document has been prepared to assess likelihood of effects as a result of the Himley Village Development on nearby waterbodies and whether a WFD Compliance Assessment is required.

1.3. The Himley Village Development, situated to the north west of Bicester, is centred on National Grid Reference SP559 233. The nearest surface waterbodies to the Site are:

- Gagle Brook (Environment Agency (EA) reference, GB106039030140), located approximately 260m south of the Site boundary having a 'Moderate' Ecological Status and to achieve a 'Good' Status by 2027;
- Langford Brook (EA reference, GB106039030160), located approximately 400m north of the Site boundary having a 'Moderate' Ecological Status and to achieve a 'Good' Status by 2027; and
- An unknown waterbody (drainage ditch) and therefore unknown Ecological Status, located approximately 165m east of the Site boundary.

Figure 1: Site Location Plan with Key Drainage Features (Extract from: Himley Village Surface Water Drainage Strategy and Flood Risk Assessment, Alan Baxter, December 2014)



WFD Screening

1.4. As set out in the outline planning application documentation, the proposals for Himley Village comprises: *"Development to provide up to 1,700 residential dwellings (Class C3), a retirement village (Class C2), flexible commercial floorspace (Classes A1, A2, A3, A4, A5, B1 and C1), social and community facilities (Class D1), land to accommodate one energy centre and land to accommodate one new primary school (up to 2FE) (Class D1). Such development to include provision of strategic landscape, provision of new vehicular, cycle and pedestrian access routes, infrastructure and other operations (including demolition of farm buildings on Middleton Stoney Road)*".

1.5. There would be no direct intervention to any of the aforementioned waterbodies as a result of the Development.

1.6. With regard to the proposals for site drainage and the potential for effects on both surface and groundwater, the Sustainable urban Drainage Strategy (SuDS) proposed for the site (see Flood Risk Assessment, Alan Baxter, December 2014) includes appropriate measures to improve the quality of surface water runoff and infiltration to the groundwater. Source control measures would be used to prevent discharge of pollutants to receiving watercourses for the first 5mm of any rainfall event, by using infiltration and other SuDS techniques. These would include rainwater harvesting, rain gardens, permeable paving and where possible, infiltration. At the confluence of swales and at the heads of selected swales, course gravel infiltration beds would be included within the SuDS network to provide water treatment. The above measures would help to prevent deterioration of the Ecological Status of the nearby waterbodies.

1.7. Therefore, on account of the location of the Site at a minimum of 165m from a waterbody, the fact that no changes are to be made to the waterbodies and that SuDS measures would help to prevent deterioration of the waterbodies, a full WFD Compliance Assessment would not be required for this Development.

[1] Each waterbody is initially classified according to its current Ecological Status or Potential (for Heavily Modified Waterbodies). The classification is based on:

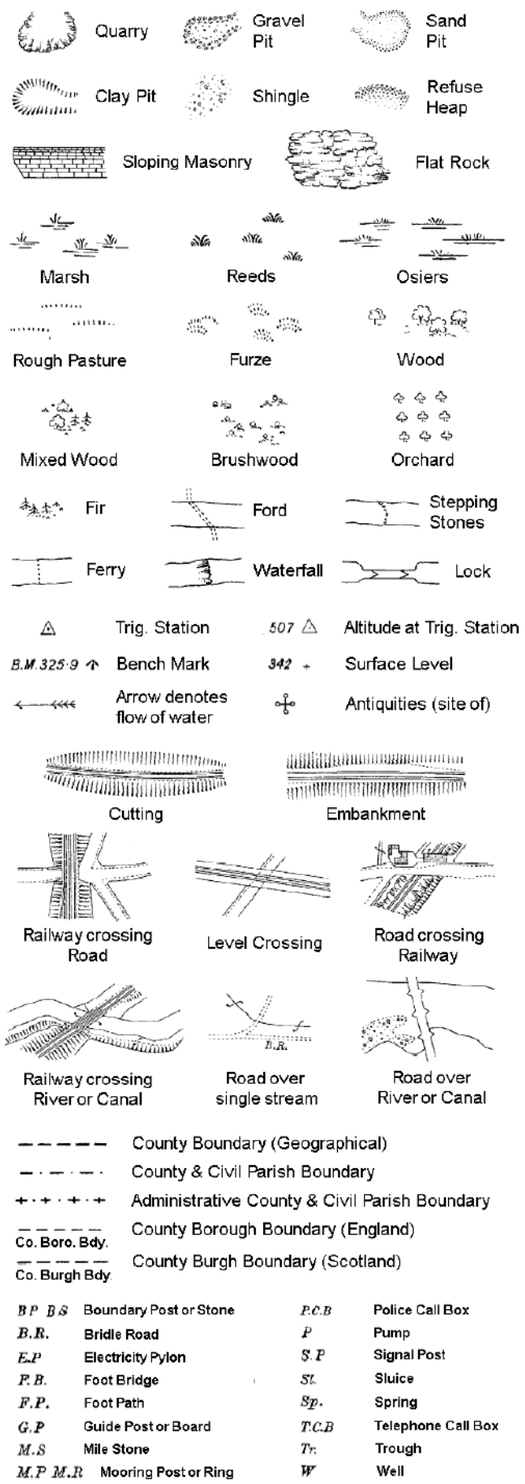
- The condition of biological elements, for example fish;
- Concentrations of supporting physico-chemical elements, for example dissolved oxygen or ammonia;
- Concentrations of specific pollutants, for example copper; and
- For high status, largely undisturbed hydromorphology.

Ecological status is recorded on the scale of High, Good, Moderate, Poor or Bad. 'High' denotes largely undisturbed conditions and the other classes represent increasing deviation from this natural condition.

APPENDIX 12.1
LANDMARK ENVIROCHECK REPORT AND HISTORICAL MAPS

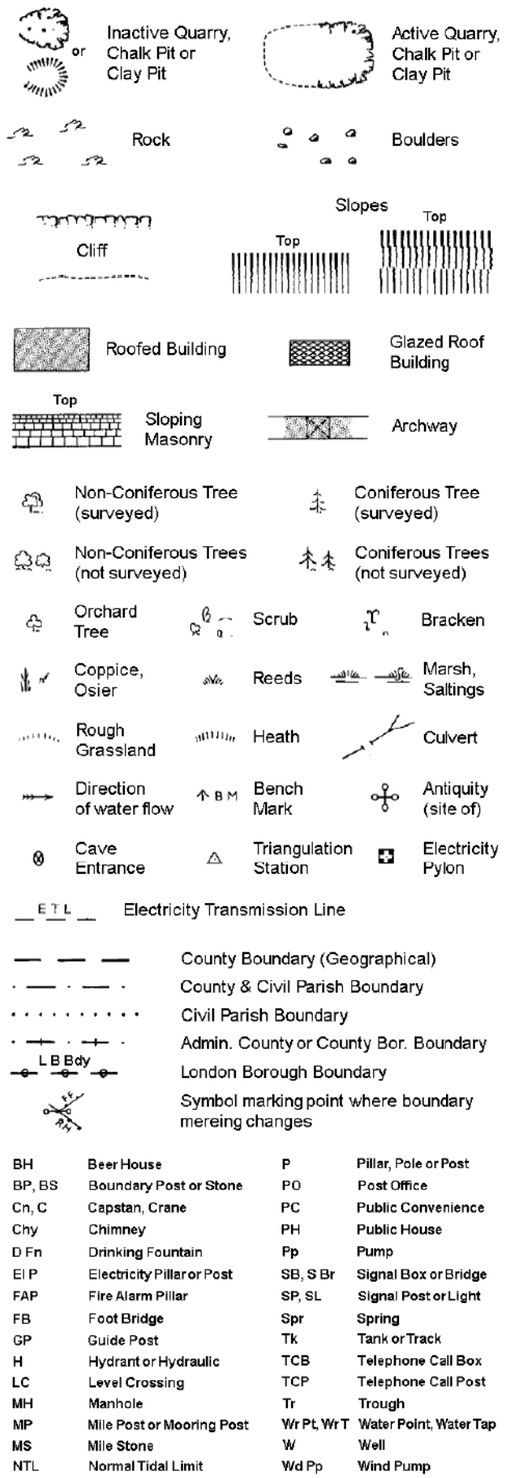
Historical Mapping Legends

Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



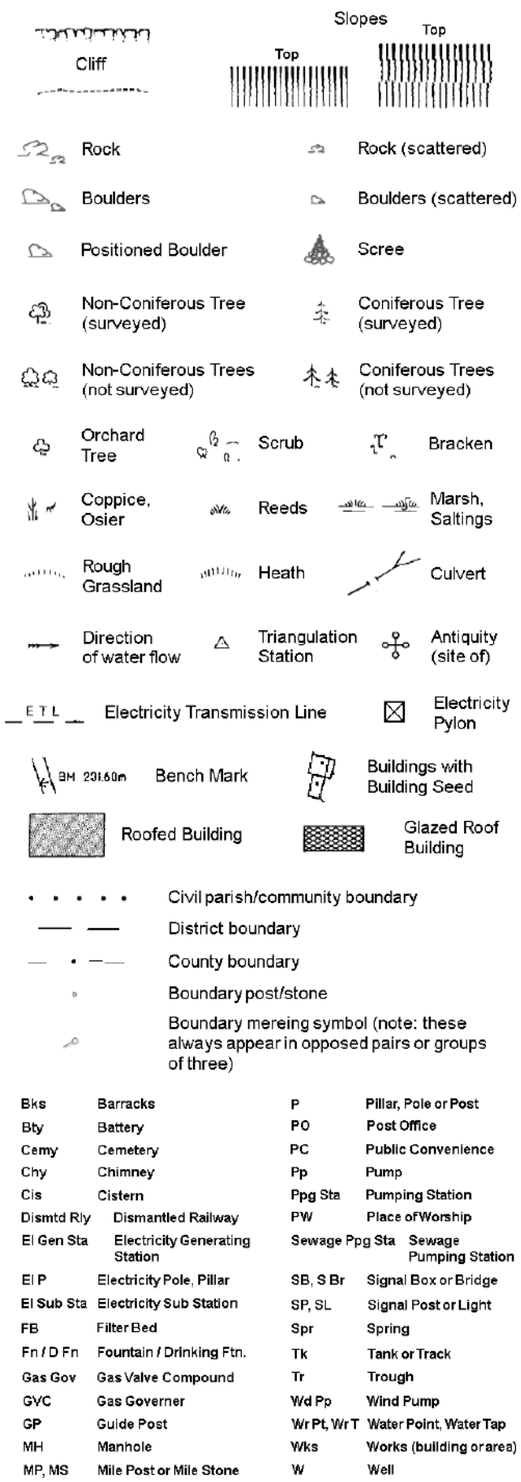
B.P B.S	Boundary Post or Stone	P.C.B	Police Call Box
B.R.	Bridle Road	P	Pump
E.P	Electricity Pylon	S.P	Signal Post
F.B.	Foot Bridge	St.	Sluice
F.P.	Foot Path	Sp.	Spring
G.P	Guide Post or Board	T.C.B	Telephone Call Box
M.S	Mile Stone	Tr.	Trough
M.P M.R	Mooring Post or Ring	W	Well

Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



BH	Beer House	P	Pillar, Pole or Post
BP, BS	Boundary Post or Stone	PO	Post Office
Cn, C	Capstan, Crane	PC	Public Convenience
Chy	Chimney	PH	Public House
D Fn	Drinking Fountain	Pp	Pump
El P	Electricity Pillar or Post	SB, S Br	Signal Box or Bridge
FAP	Fire Alarm Pillar	SP, SL	Signal Post or Light
FB	Foot Bridge	Spr	Spring
GP	Guide Post	Tk	Tank or Track
H	Hydrant or Hydraulic	TCB	Telephone Call Box
LC	Level Crossing	TCP	Telephone Call Post
MH	Manhole	Tr	Trough
MP	Mile Post or Mooring Post	Wr Pt, Wr T	Water Point, Water Tap
MS	Mile Stone	W	Well
NTL	Normal Tidal Limit	Wd Pp	Wind Pump

Large-Scale National Grid Data 1:2,500 and 1:1,250



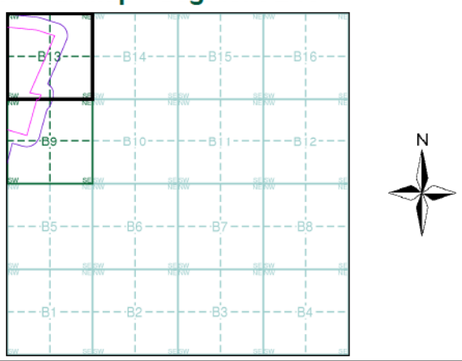
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity Pole, Pillar	SB, S Br	Signal Box or Bridge
El Sub Sta	Electricity Sub Station	SP, SL	Signal Post or Light
FB	Filter Bed	Spr	Spring
Fn / D Fn	Fountain / Drinking Ftn.	Tk	Tank or Track
Gas Gov	Gas Valve Compound	Tr	Trough
GVC	Gas Governer	Wd Pp	Wind Pump
GP	Guide Post	Wr Pt, Wr T	Water Point, Water Tap
MH	Manhole	Wks	Works (building or area)
MP, MS	Mile Post or Mile Stone	W	Well

Waterman

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Oxfordshire	1:2,500	1881	2
Oxfordshire	1:2,500	1899	3
Oxfordshire	1:2,500	1922	4
Ordnance Survey Plan	1:2,500	1967 - 1968	5
Ordnance Survey Plan	1:2,500	1971	6
Additional SIMs	1:2,500	1980 - 1985	7
Additional SIMs	1:2,500	1985	8
Additional SIMs	1:2,500	1988	9
Additional SIMs	1:2,500	1990	10
Large-Scale National Grid Data	1:2,500	1994	11
Large-Scale National Grid Data	1:2,500	1995	12
Large-Scale National Grid Data	1:2,500	1996	13

Historical Map - Segment B13



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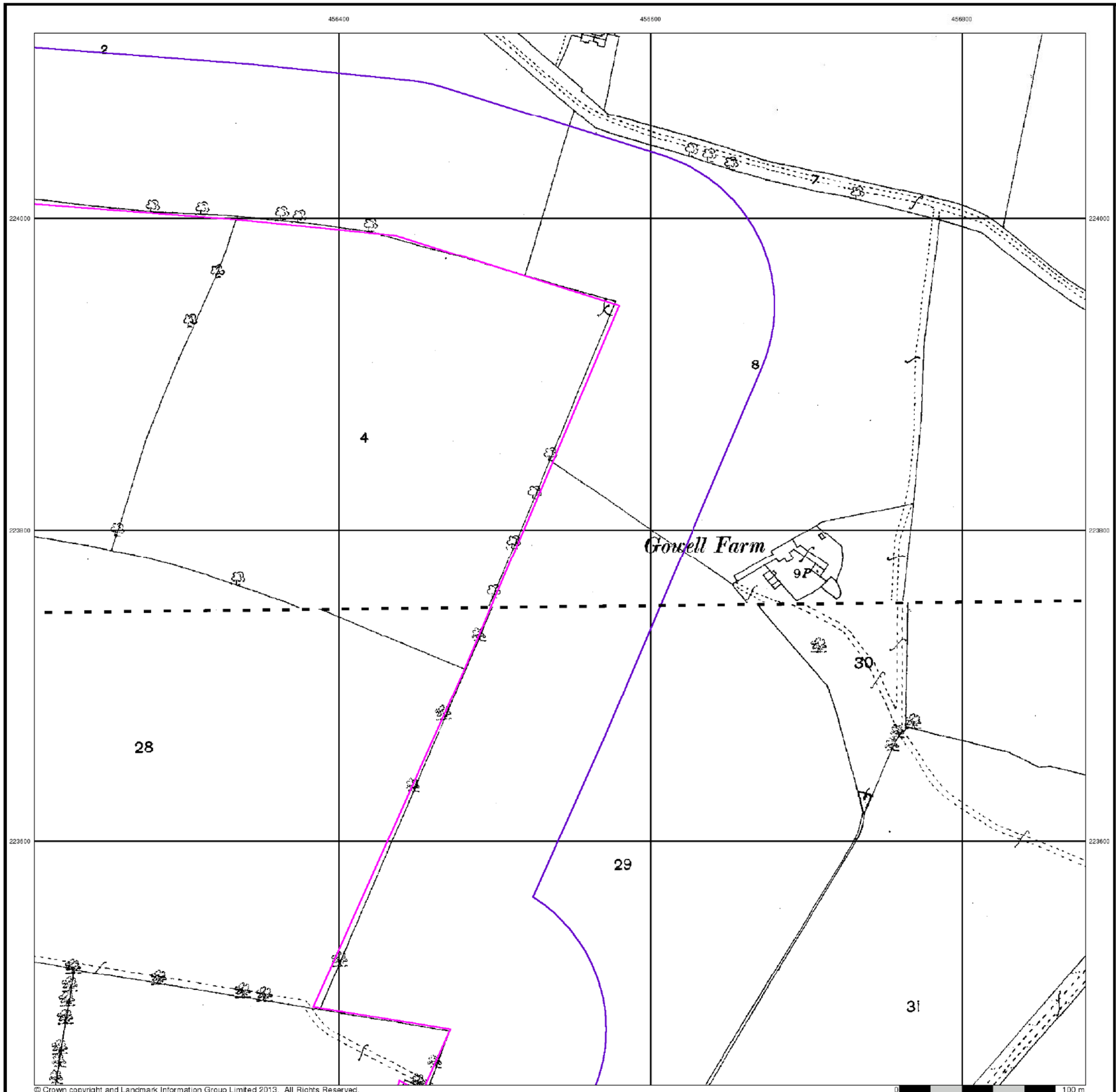
National Grid Reference:	456780, 223190
Slice:	B
Site Area (Ha):	90.42
Search Buffer (m):	100

Site Details

Himley Village

Landmark Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



0 100 m

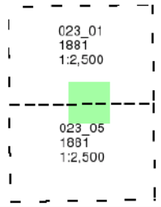
Oxfordshire

Published 1881

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



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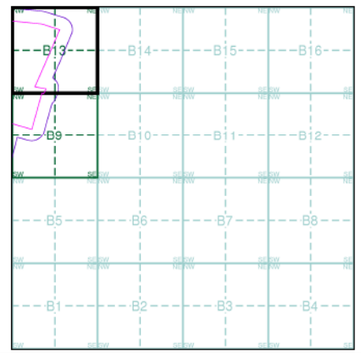

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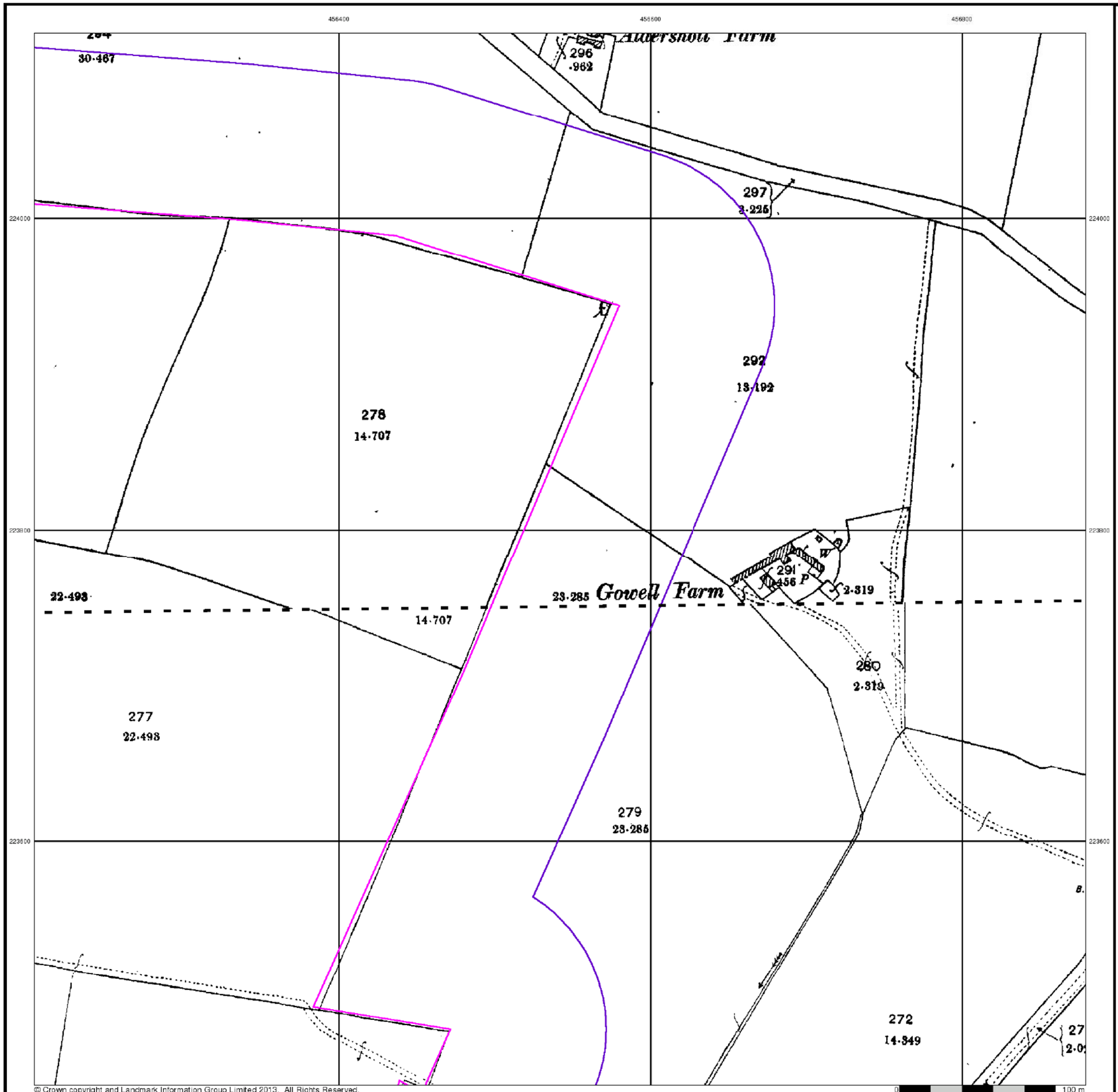

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Oxfordshire

Published 1899

Source map scale - 1:2,500

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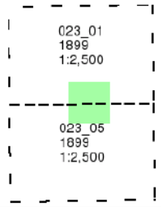
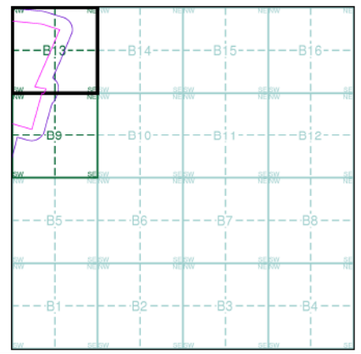


Historical Map - Segment B13



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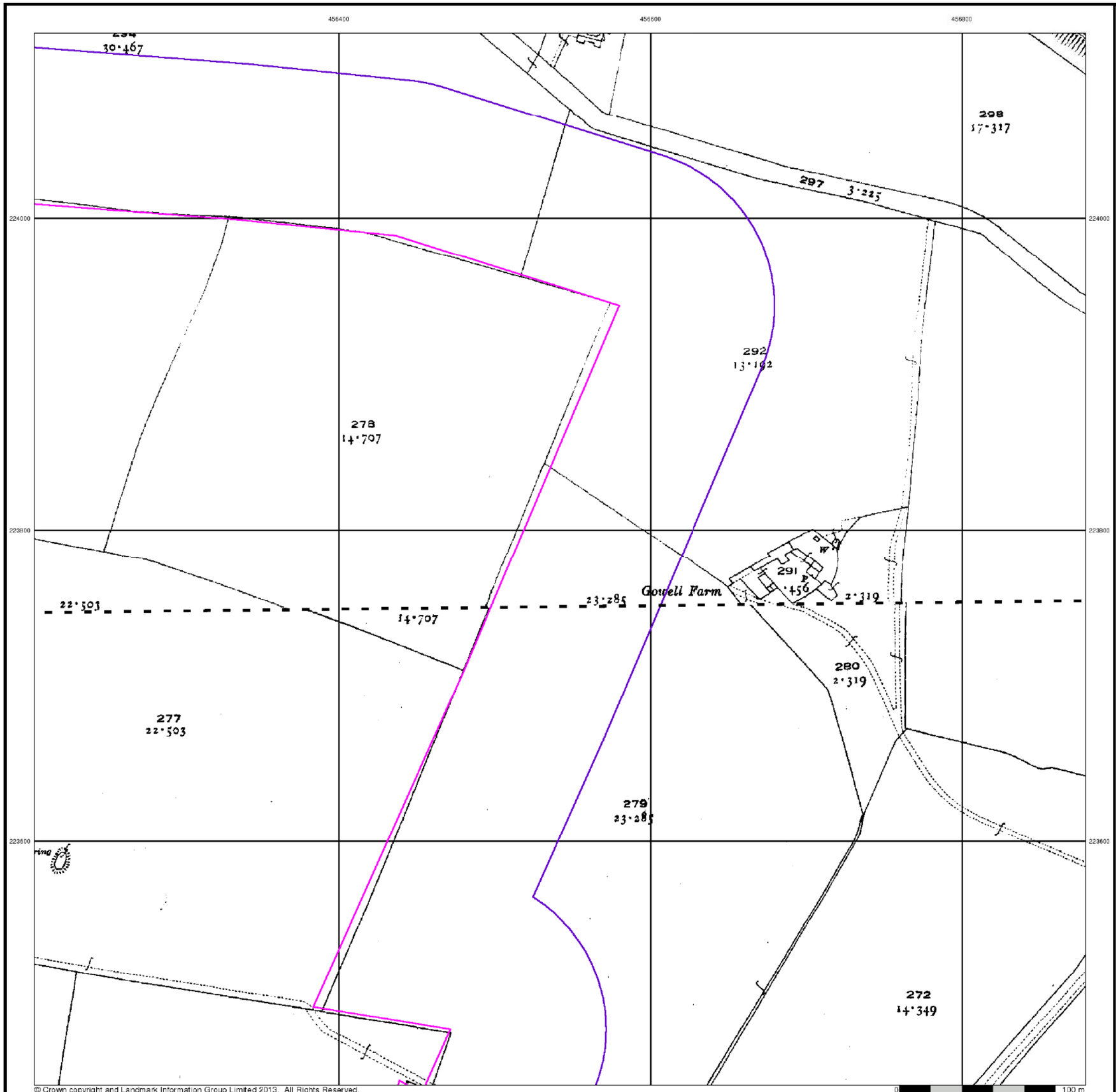

Oxfordshire

Published 1922

Source map scale - 1:2,500

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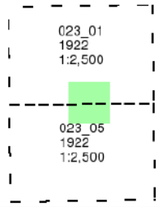
Map Name(s) and Date(s)



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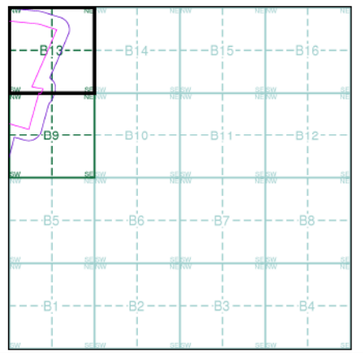

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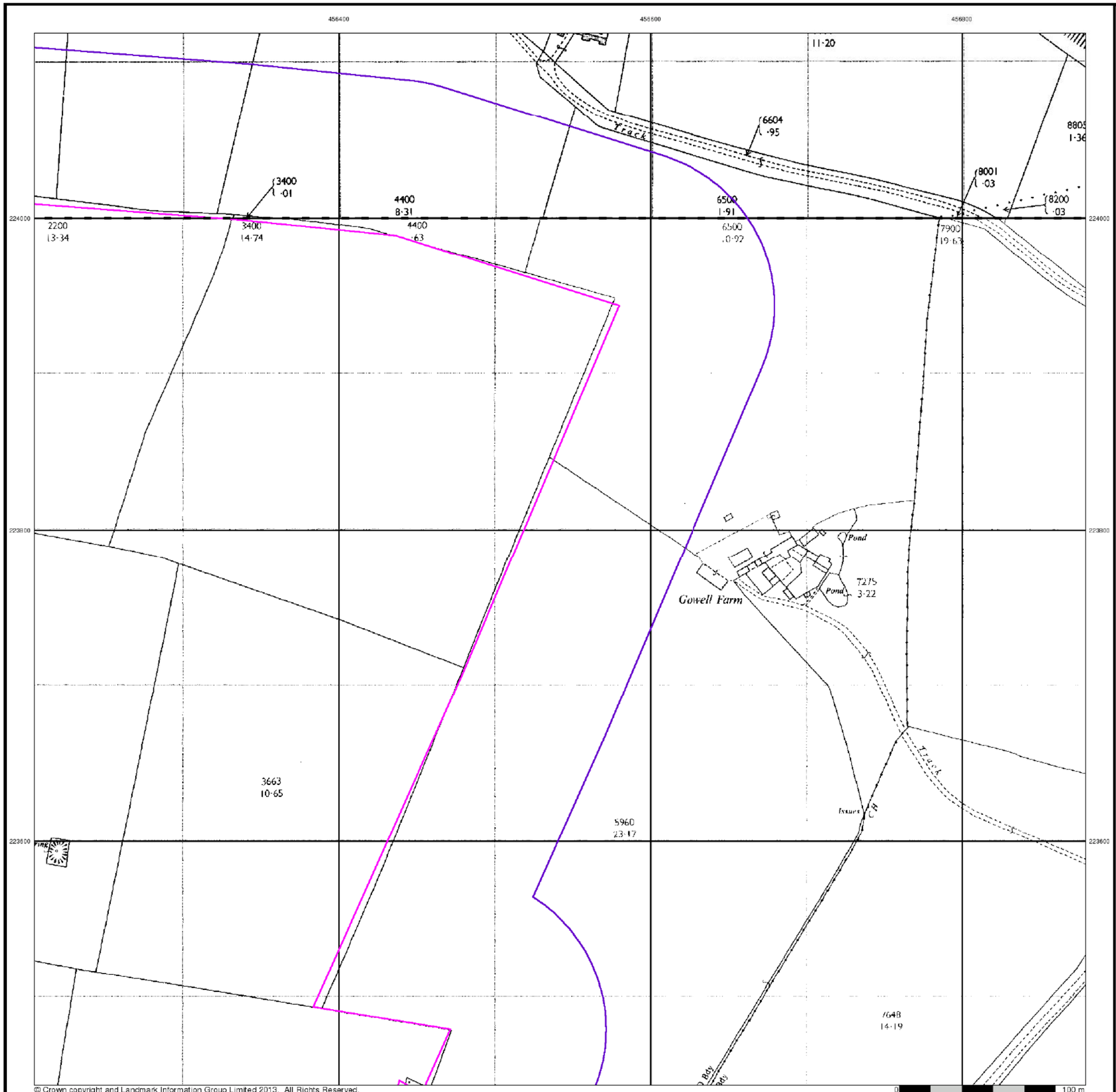

Waterman

Ordnance Survey Plan

Published 1967 - 1968

Source map scale - 1:2,500

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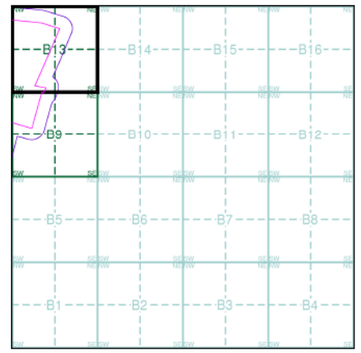
Map Name(s) and Date(s)

SP5624
1968
1:2,500

SP5623
1967
1:2,500

Historical Map - Segment B13



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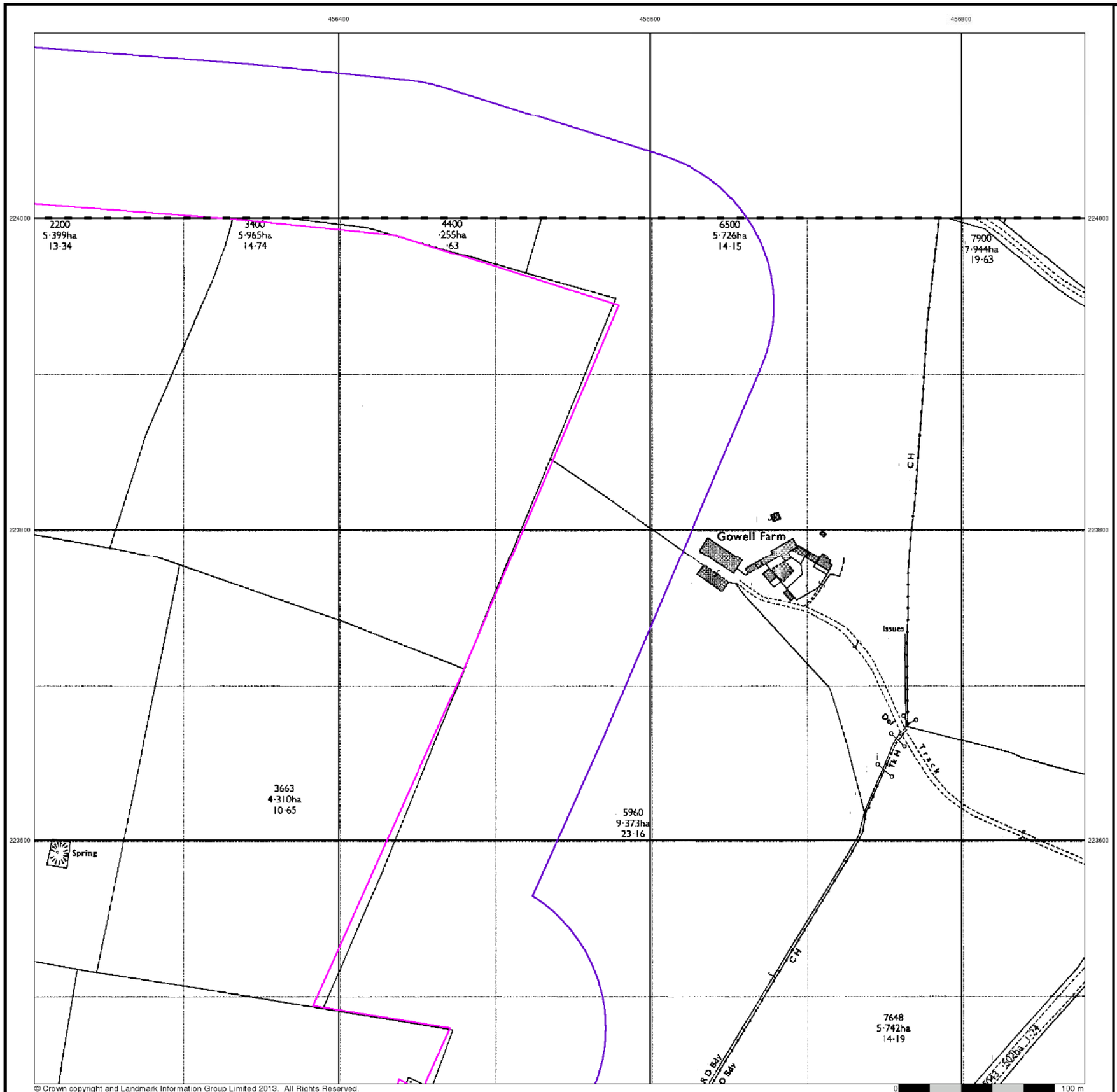


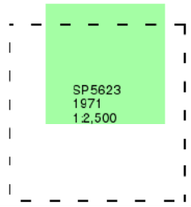
Ordnance Survey Plan

Published 1971

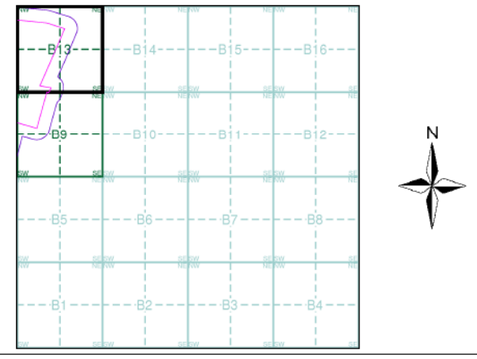
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment B13



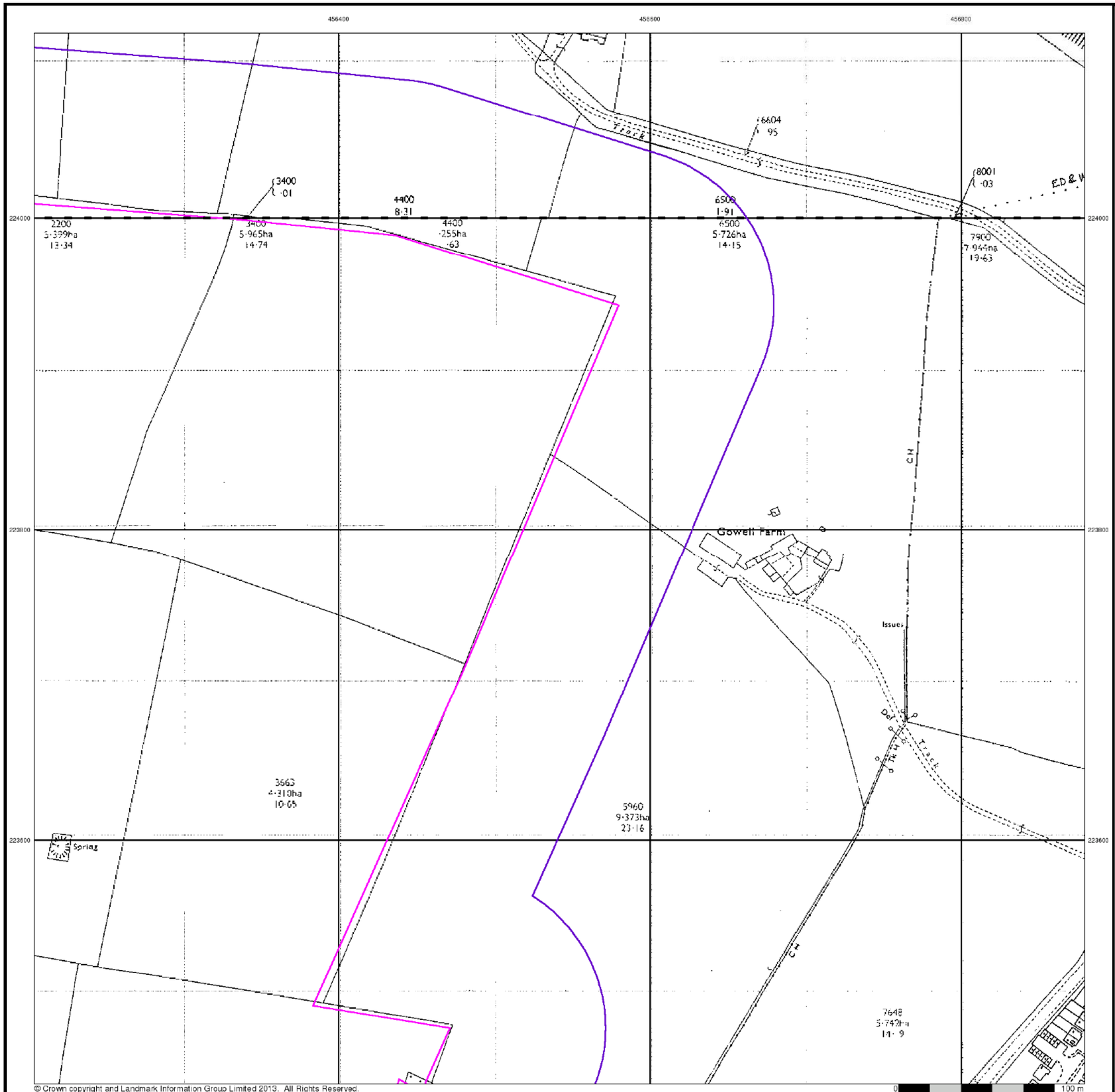
Order Details

Order Number:	62370009_1_1
Customer Ref:	EED14995-100
National Grid Reference:	456780, 223190
Slice:	B
Site Area (Ha):	90.42
Search Buffer (m):	100

Site Details

Himley Village

Landmark Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Waterman

Additional SIMs

Published 1980 - 1985

Source map scale - 1:2,500

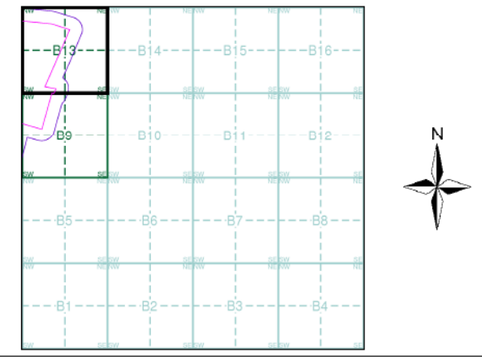
The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

SP5624
1985
1:2,500

SP5623
1980
1:2,500

Historical Map - Segment B13



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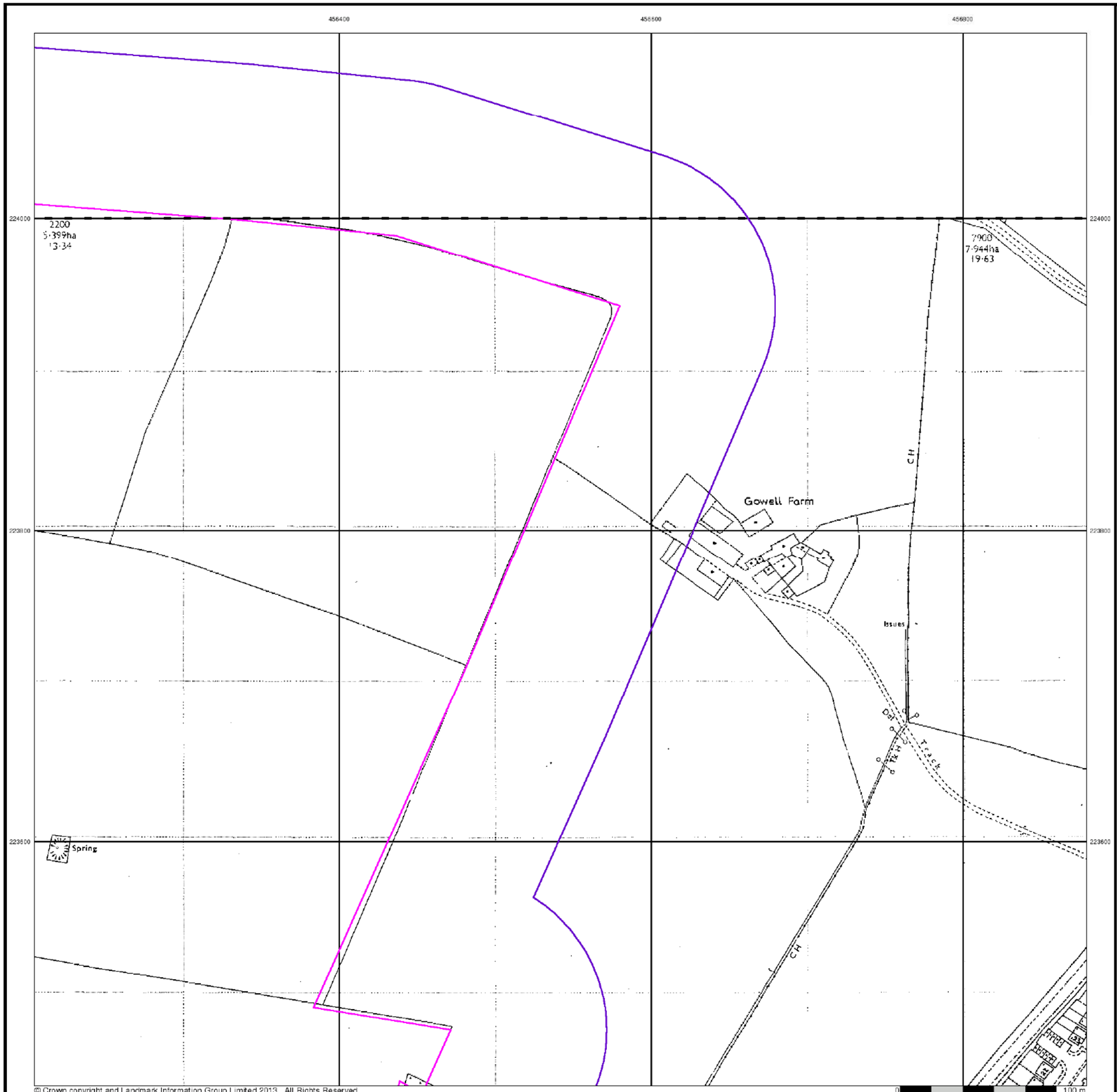


Waterman

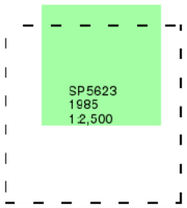
Additional SIMs

Published 1985

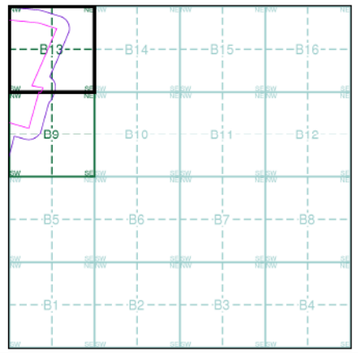
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B13



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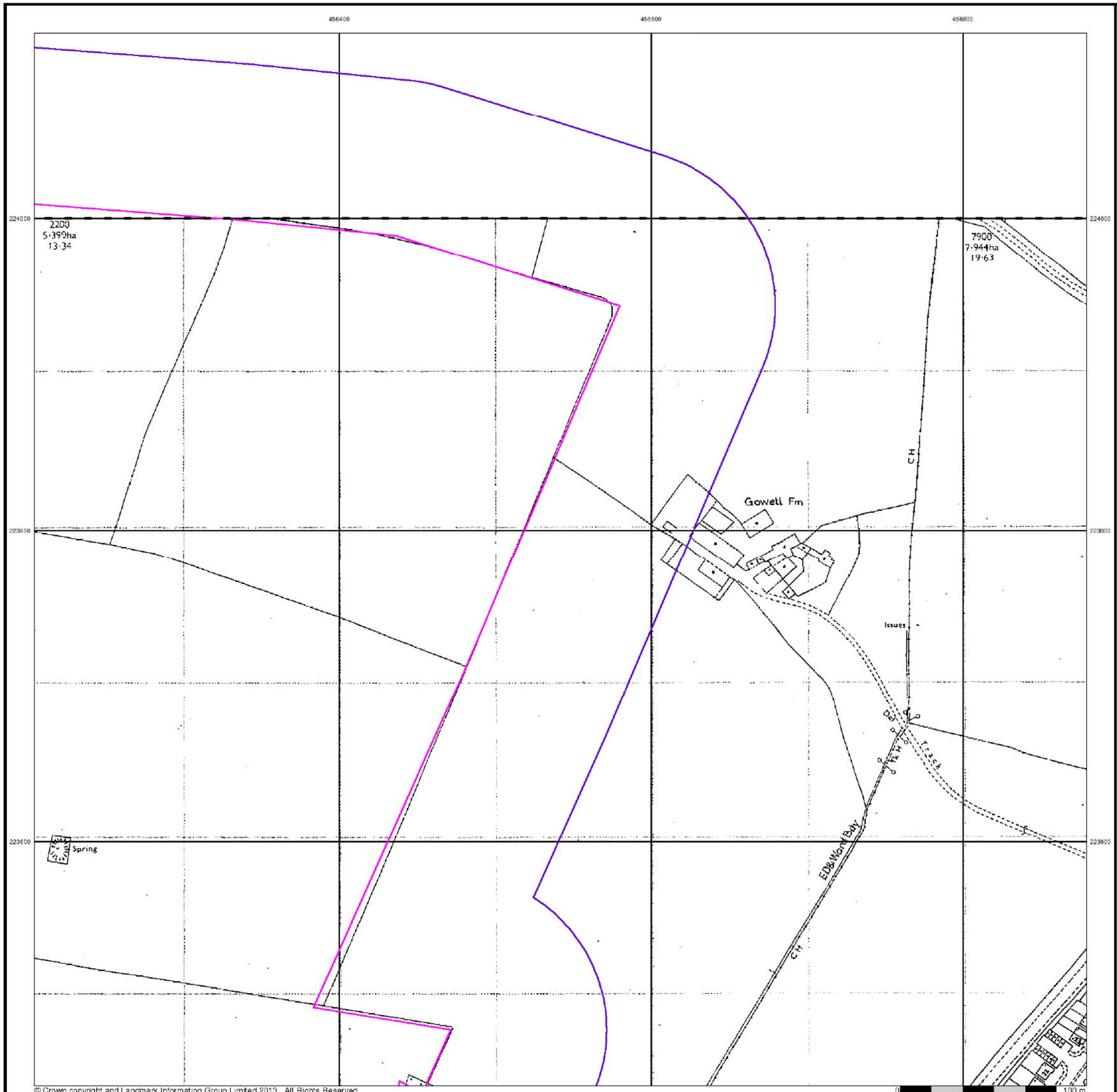


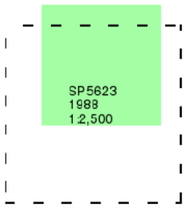
Additional SIMs

Published 1988

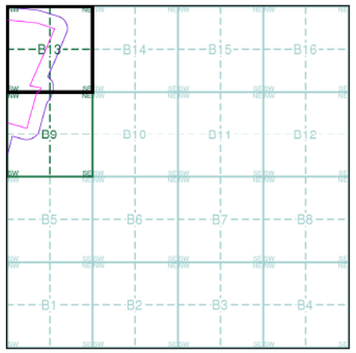
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B13



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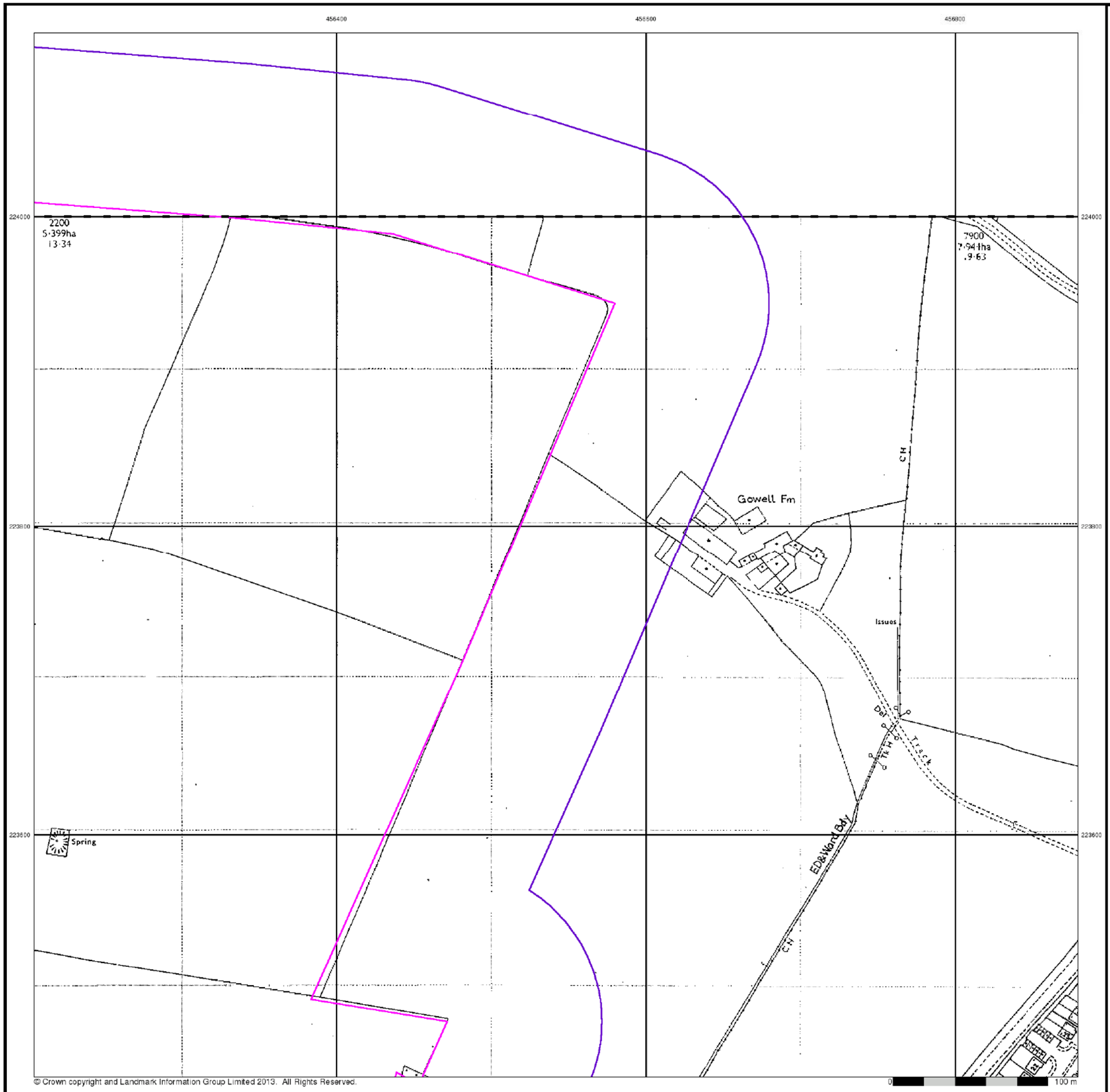


Waterman

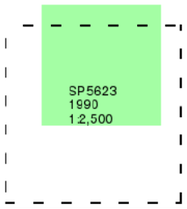
Additional SIMs

Published 1990

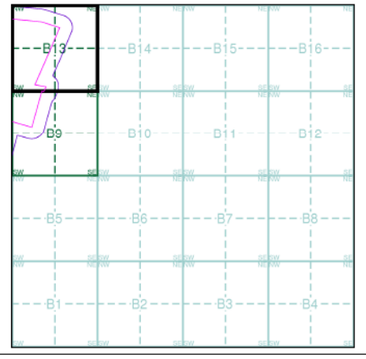
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B13



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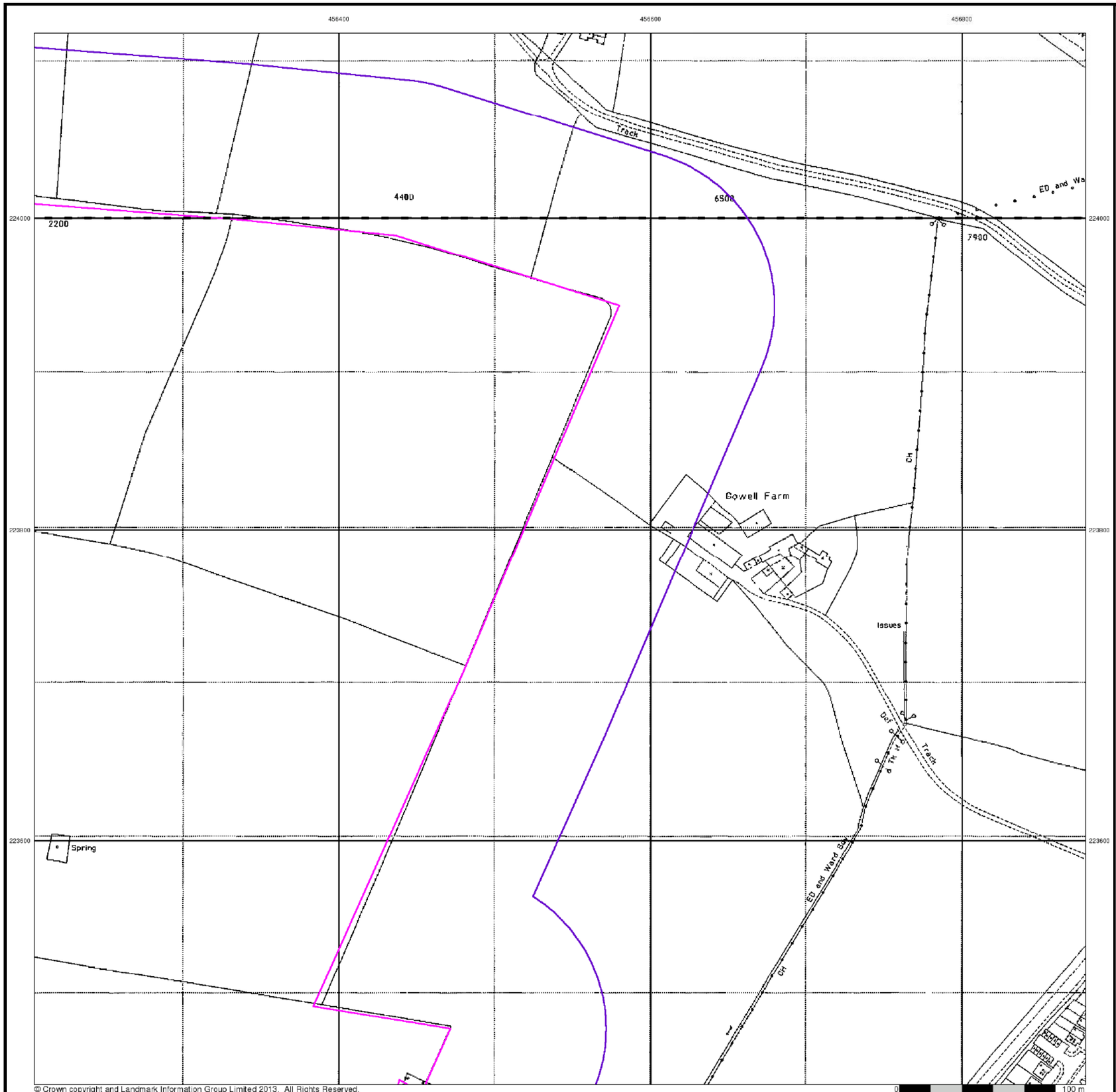


Large-Scale National Grid Data

Published 1994

Source map scale - 1:2,500

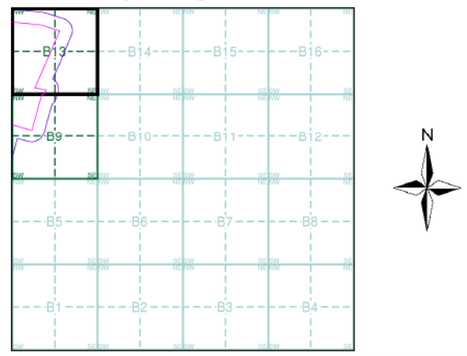
'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

SP5624
1994
1:2,500

SP5623
1994
1:2,500

Historical Map - Segment B13



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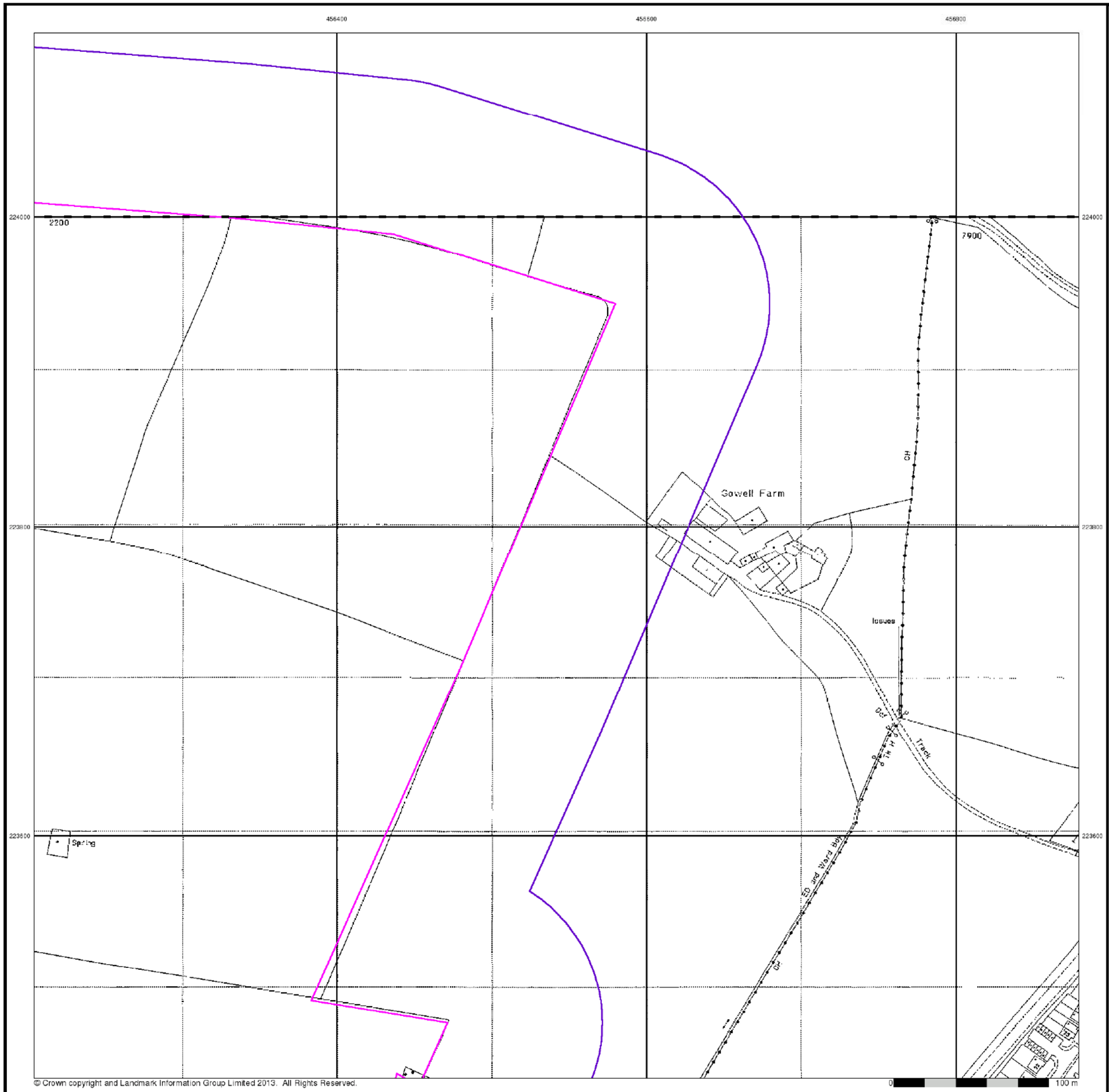

Large-Scale National Grid Data

Published 1995

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

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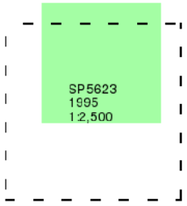
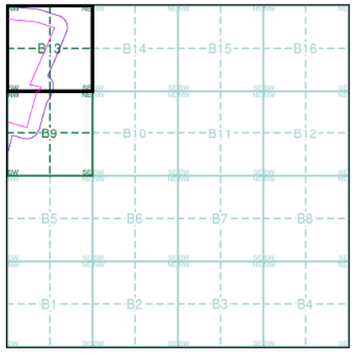


Historical Map - Segment B13



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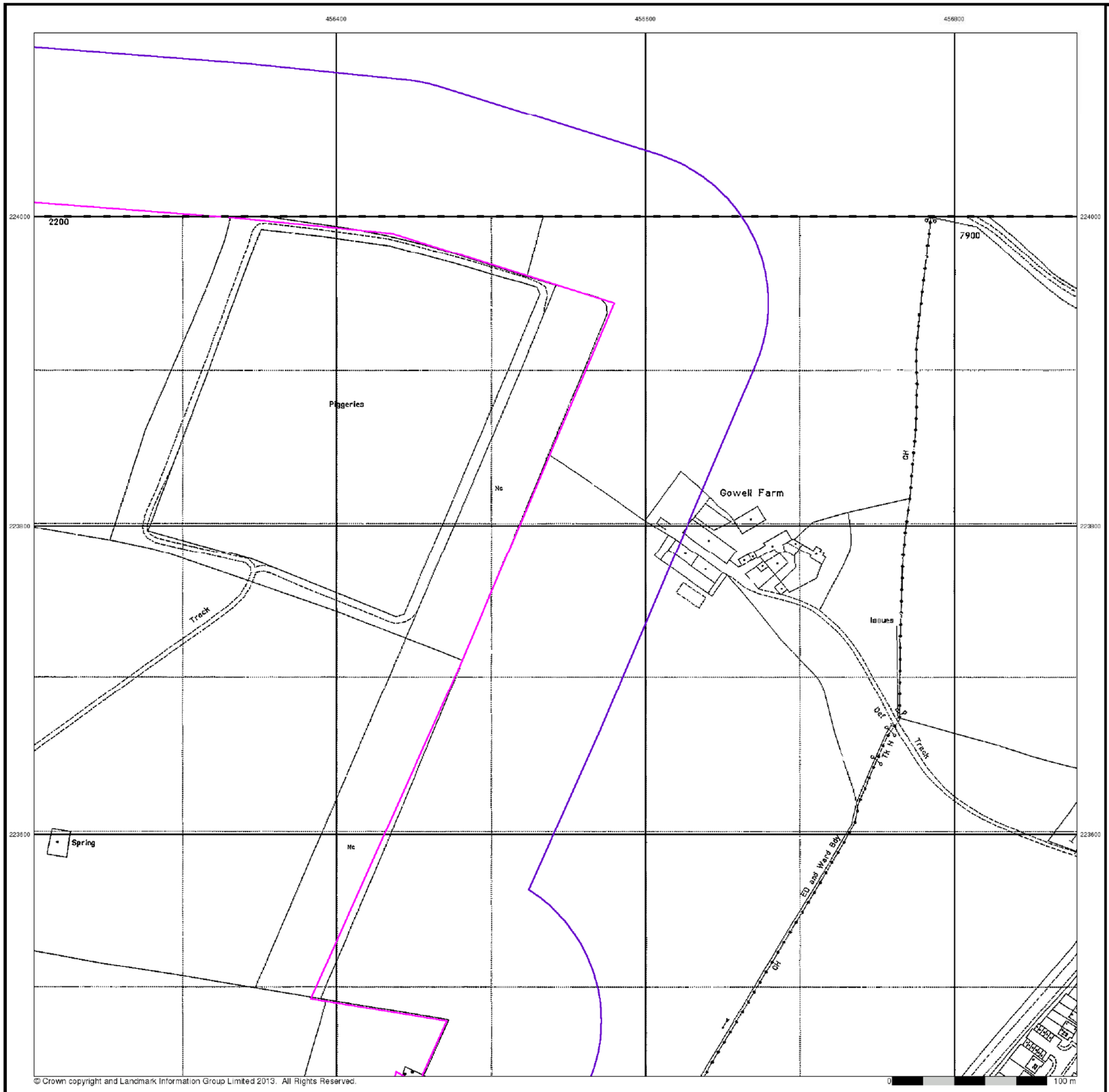


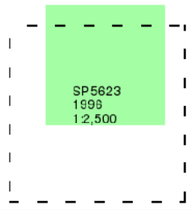
Large-Scale National Grid Data

Published 1996

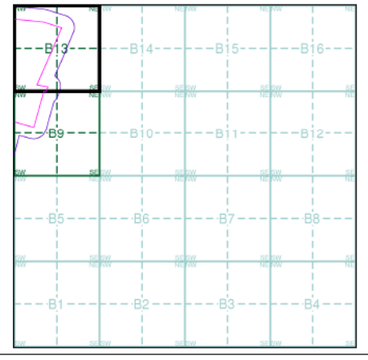
Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B13



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Slice:	B
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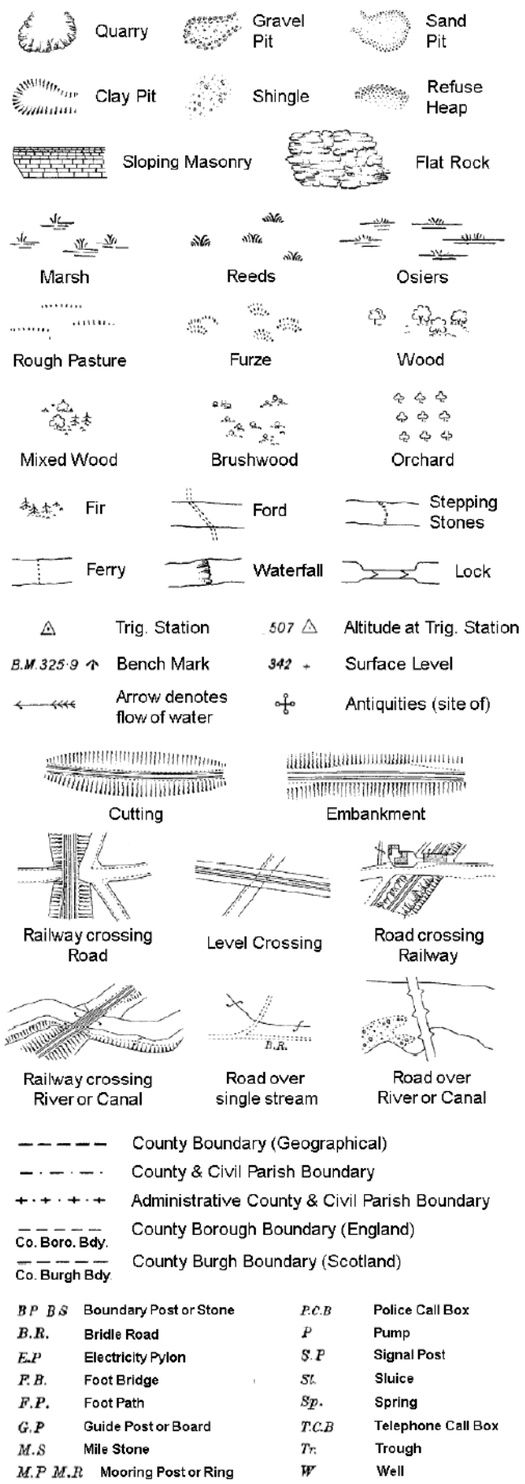
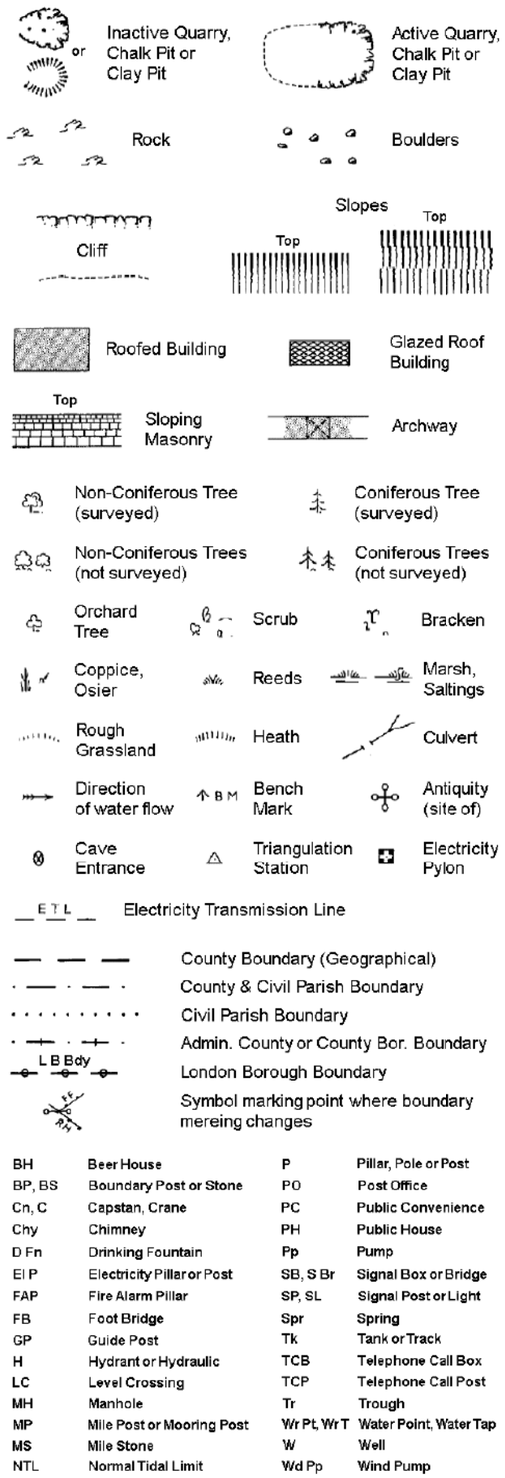
Historical Mapping Legends

Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



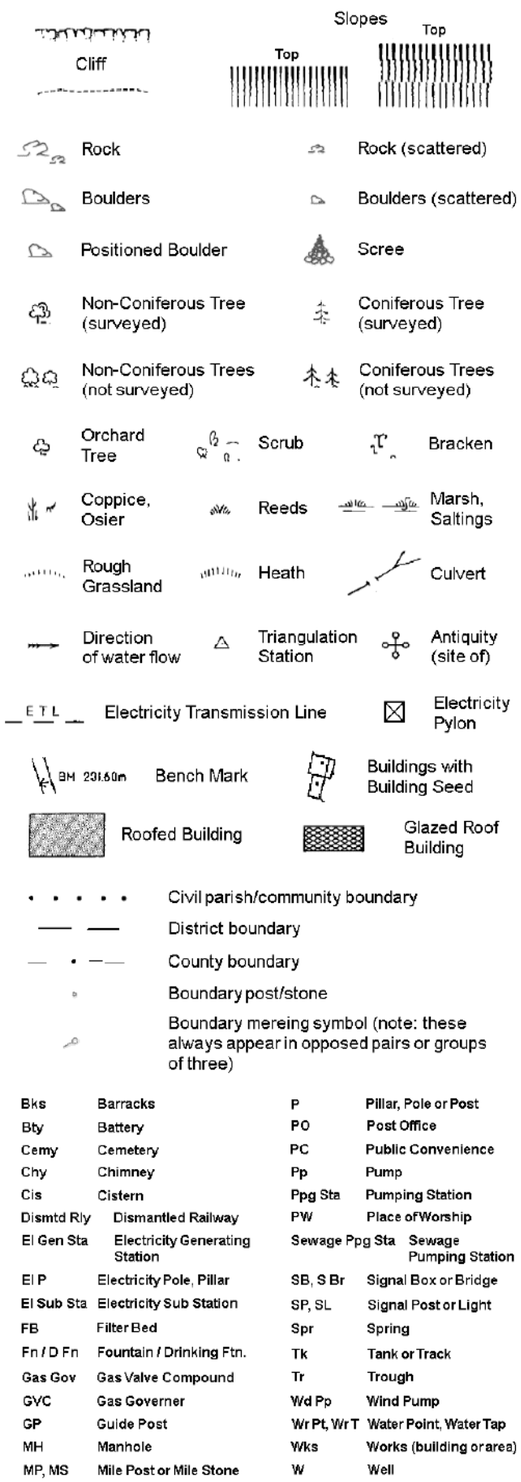
B.P B.S	Boundary Post or Stone	P.C.B	Police Call Box
B.R.	Bridle Road	P	Pump
E.P	Electricity Pylon	S.P	Signal Post
F.B.	Foot Bridge	St.	Sluice
F.P.	Foot Path	Sp.	Spring
G.P	Guide Post or Board	T.C.B	Telephone Call Box
M.S	Mile Stone	Tr.	Trough
M.P M.R	Mooring Post or Ring	W	Well

Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



BH	Beer House	P	Pillar, Pole or Post
BP, BS	Boundary Post or Stone	PO	Post Office
Cn, C	Capstan, Crane	PC	Public Convenience
Chy	Chimney	PH	Public House
D Fn	Drinking Fountain	Pp	Pump
El P	Electricity Pillar or Post	SB, S Br	Signal Box or Bridge
FAP	Fire Alarm Pillar	SP, SL	Signal Post or Light
FB	Foot Bridge	Spr	Spring
GP	Guide Post	Tk	Tank or Track
H	Hydrant or Hydraulic	TCB	Telephone Call Box
LC	Level Crossing	TCP	Telephone Call Post
MH	Manhole	Tr	Trough
MP	Mile Post or Mooring Post	Wr Pt, Wr T	Water Point, Water Tap
MS	Mile Stone	W	Well
NTL	Normal Tidal Limit	Wd Pp	Wind Pump

Large-Scale National Grid Data 1:2,500 and 1:1,250



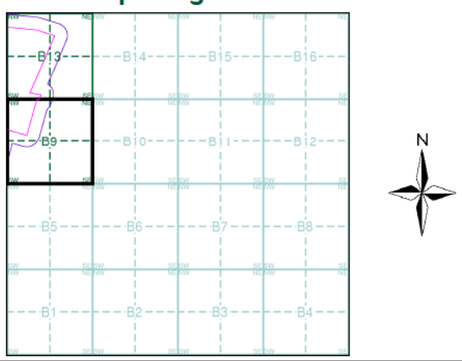
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity Pole, Pillar	SB, S Br	Signal Box or Bridge
El Sub Sta	Electricity Sub Station	SP, SL	Signal Post or Light
FB	Filter Bed	Spr	Spring
Fn / D Fn	Fountain / Drinking Ftn.	Tk	Tank or Track
Gas Gov	Gas Valve Compound	Tr	Trough
GVC	Gas Governer	Wd Pp	Wind Pump
GP	Guide Post	Wr Pt, Wr T	Water Point, Water Tap
MH	Manhole	Wks	Works (building or area)
MP, MS	Mile Post or Mile Stone	W	Well

Waterman

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Oxfordshire	1:2,500	1881	2
Oxfordshire	1:2,500	1899	3
Oxfordshire	1:2,500	1922	4
Ordnance Survey Plan	1:2,500	1967	5
Additional SIMs	1:2,500	1967 - 1980	6
Ordnance Survey Plan	1:2,500	1971	7
Additional SIMs	1:2,500	1980 - 1985	8
Additional SIMs	1:2,500	1984 - 1988	9
Additional SIMs	1:2,500	1988 - 1990	10
Large-Scale National Grid Data	1:2,500	1994	11
Large-Scale National Grid Data	1:2,500	1995	12
Large-Scale National Grid Data	1:2,500	1996	13

Historical Map - Segment B9



Order Details

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Site Details

Himley Village

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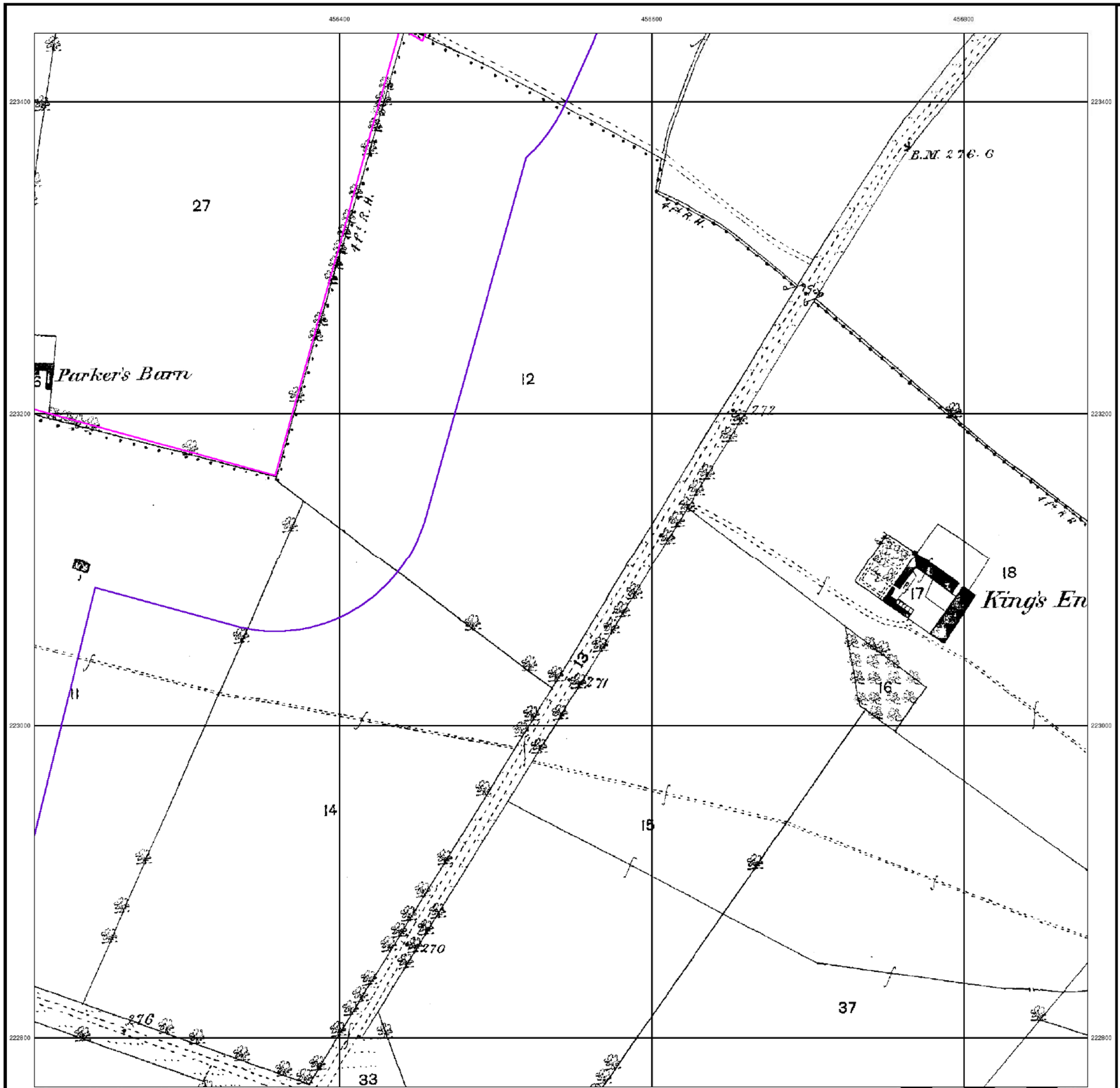


Waterman

Oxfordshire

Published 1881

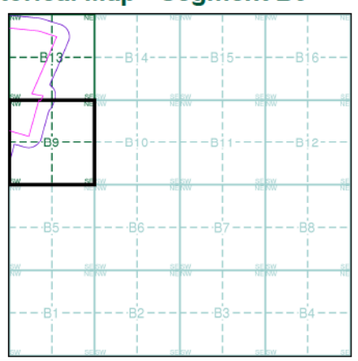
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)

023_05
1881
1:2,500

Historical Map - Segment B9



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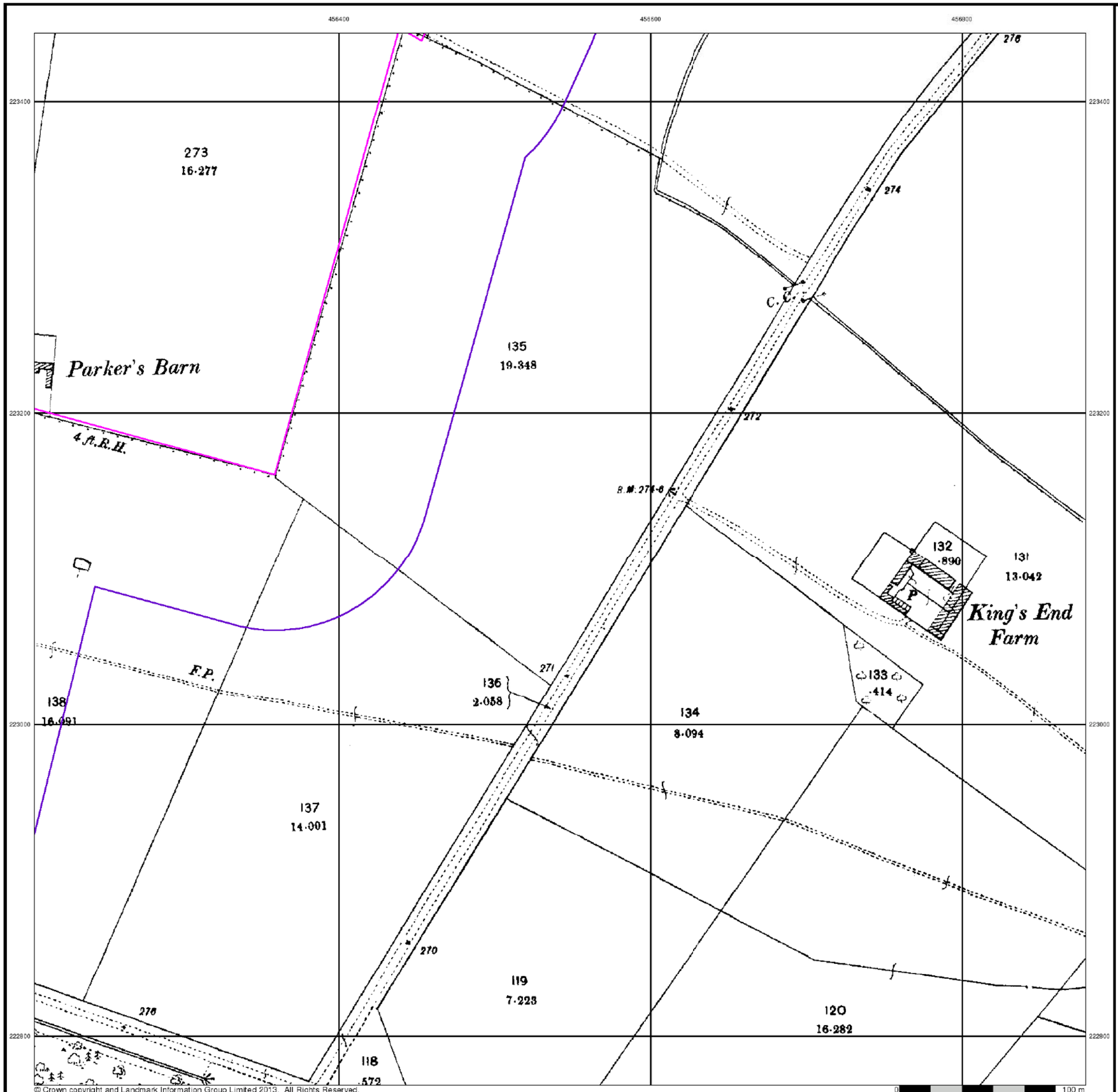

Oxfordshire

Published 1899

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

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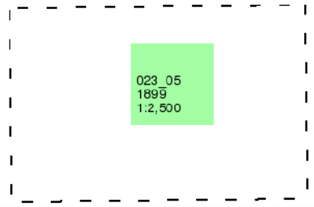
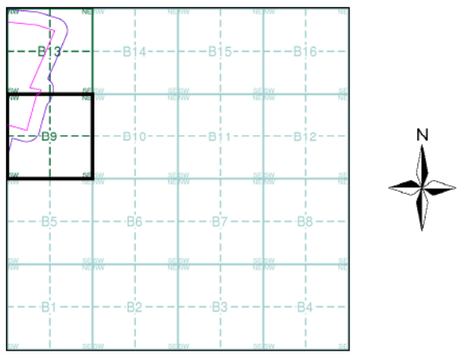


Historical Map - Segment B9



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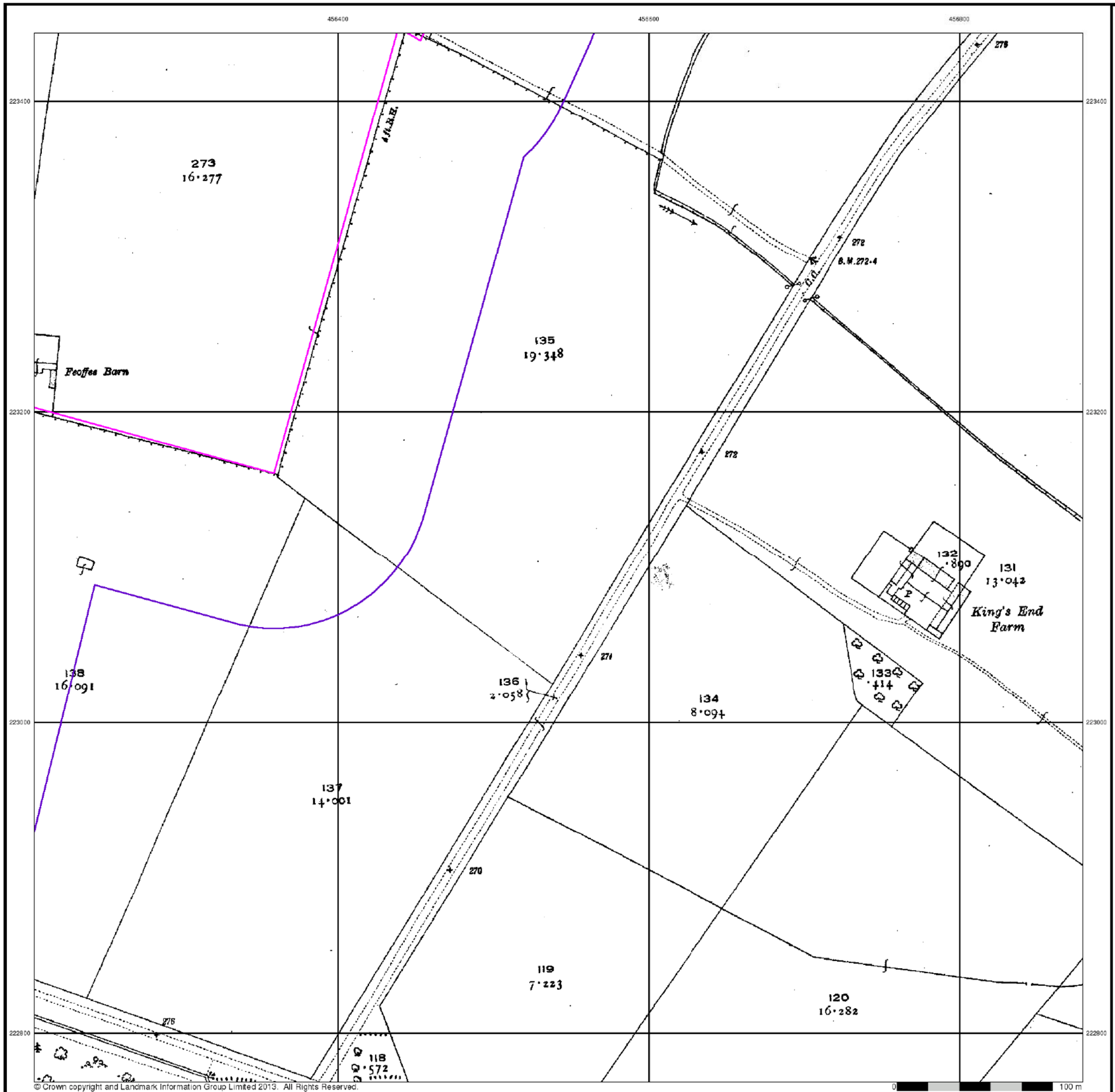

Waterman

Oxfordshire

Published 1922

Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

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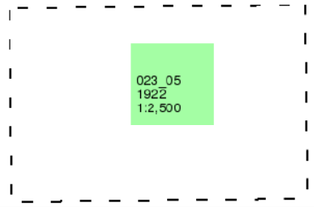
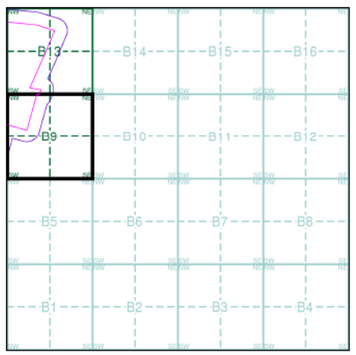


Historical Map - Segment B9



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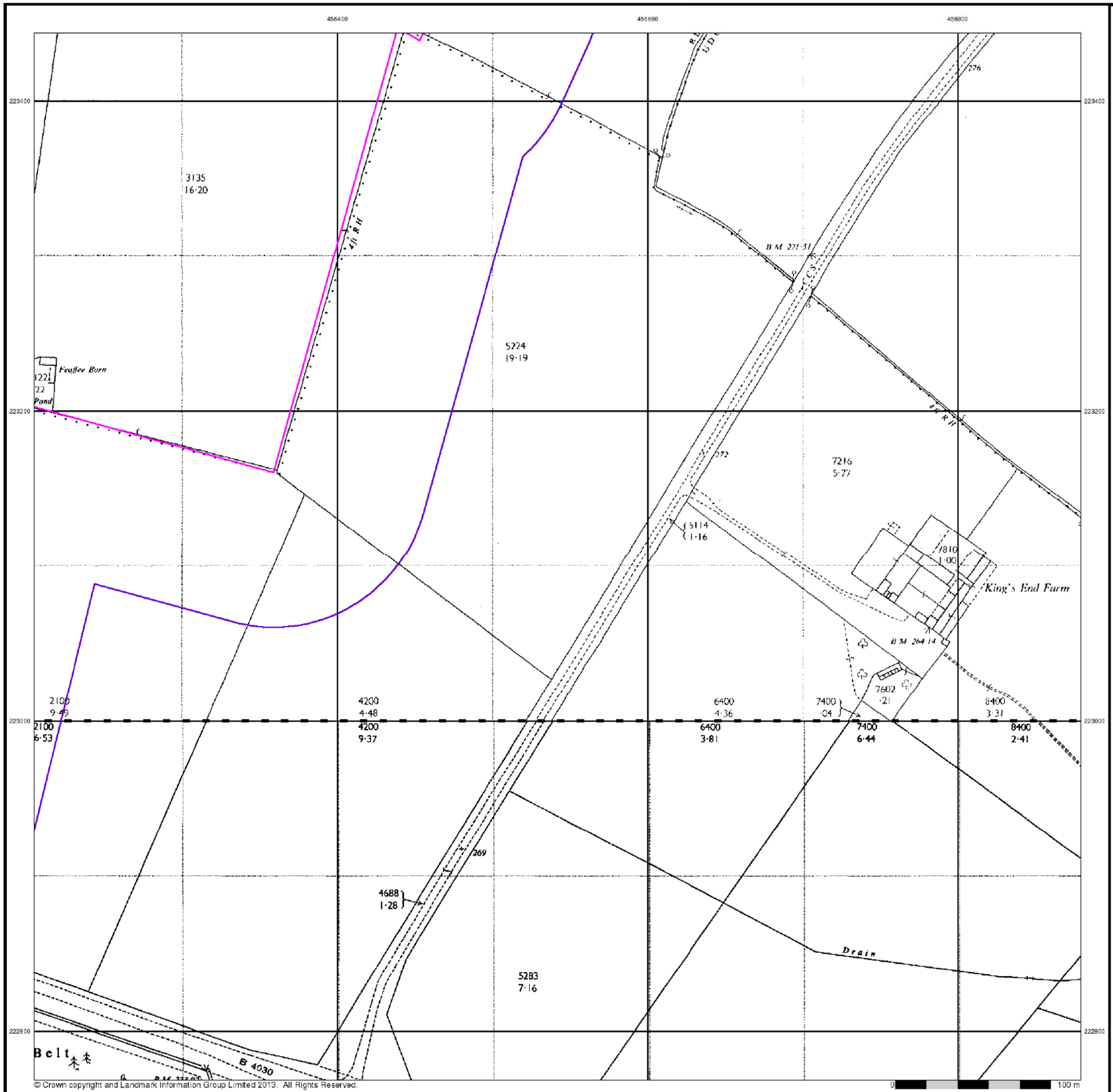
Order Number:	62370009_1_1
Customer Ref:	EED14995-100
National Grid Reference:	456780, 223190
Slice:	B
Site Area (Ha):	90.42
Search Buffer (m):	100

Site Details

Himley Village

Landmark Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Waterman

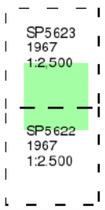
Ordnance Survey Plan

Published 1967

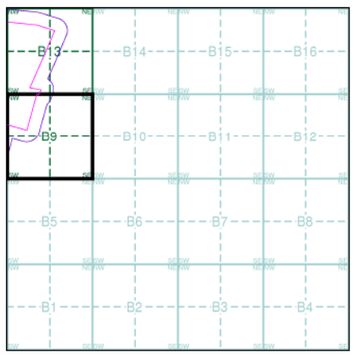
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment B9



Order Details

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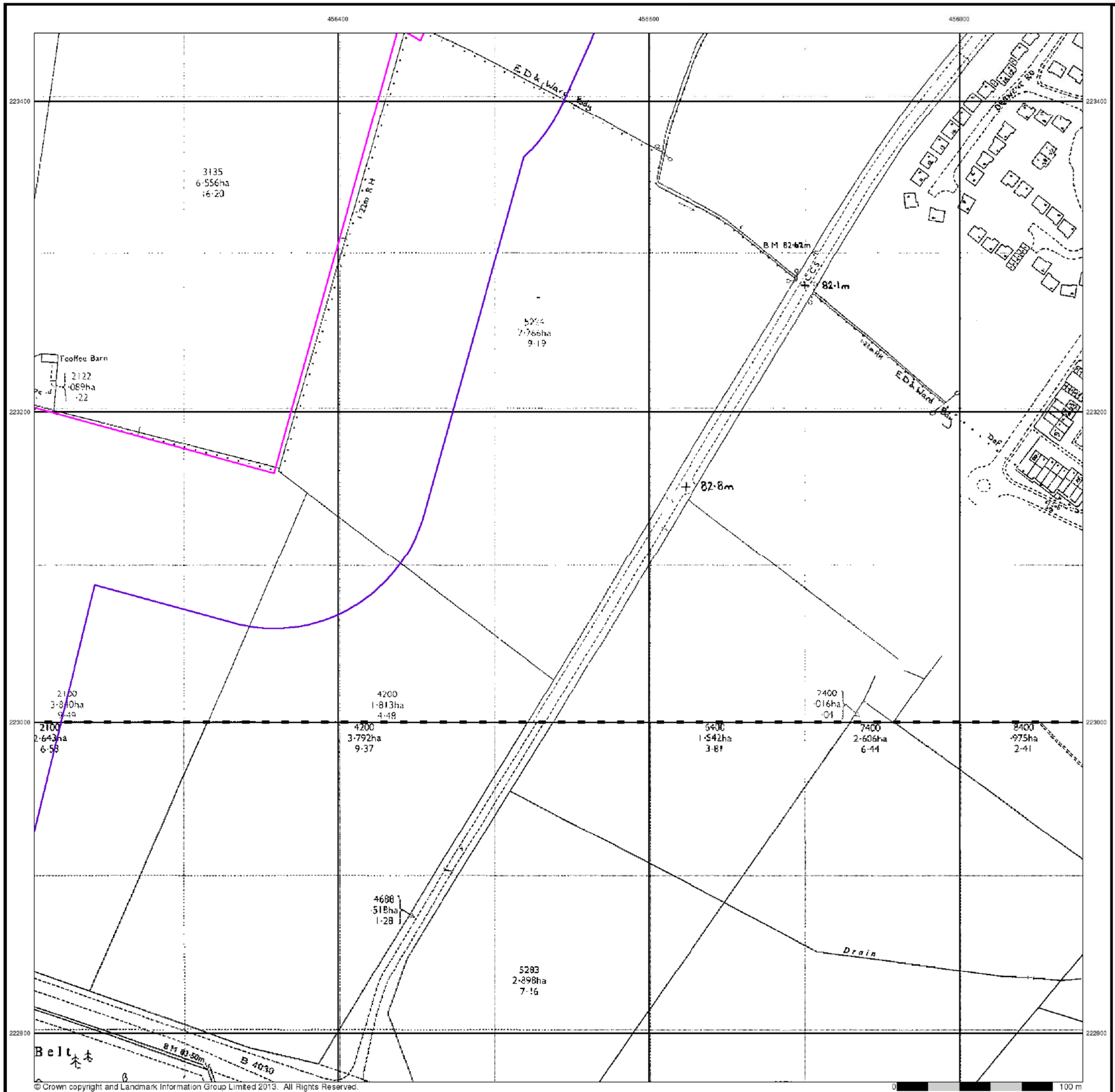


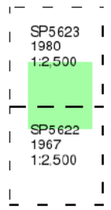
Additional SIMs

Published 1967 - 1980

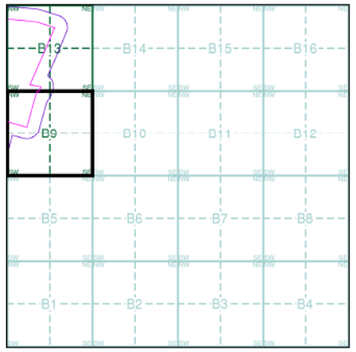
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B9



Order Details

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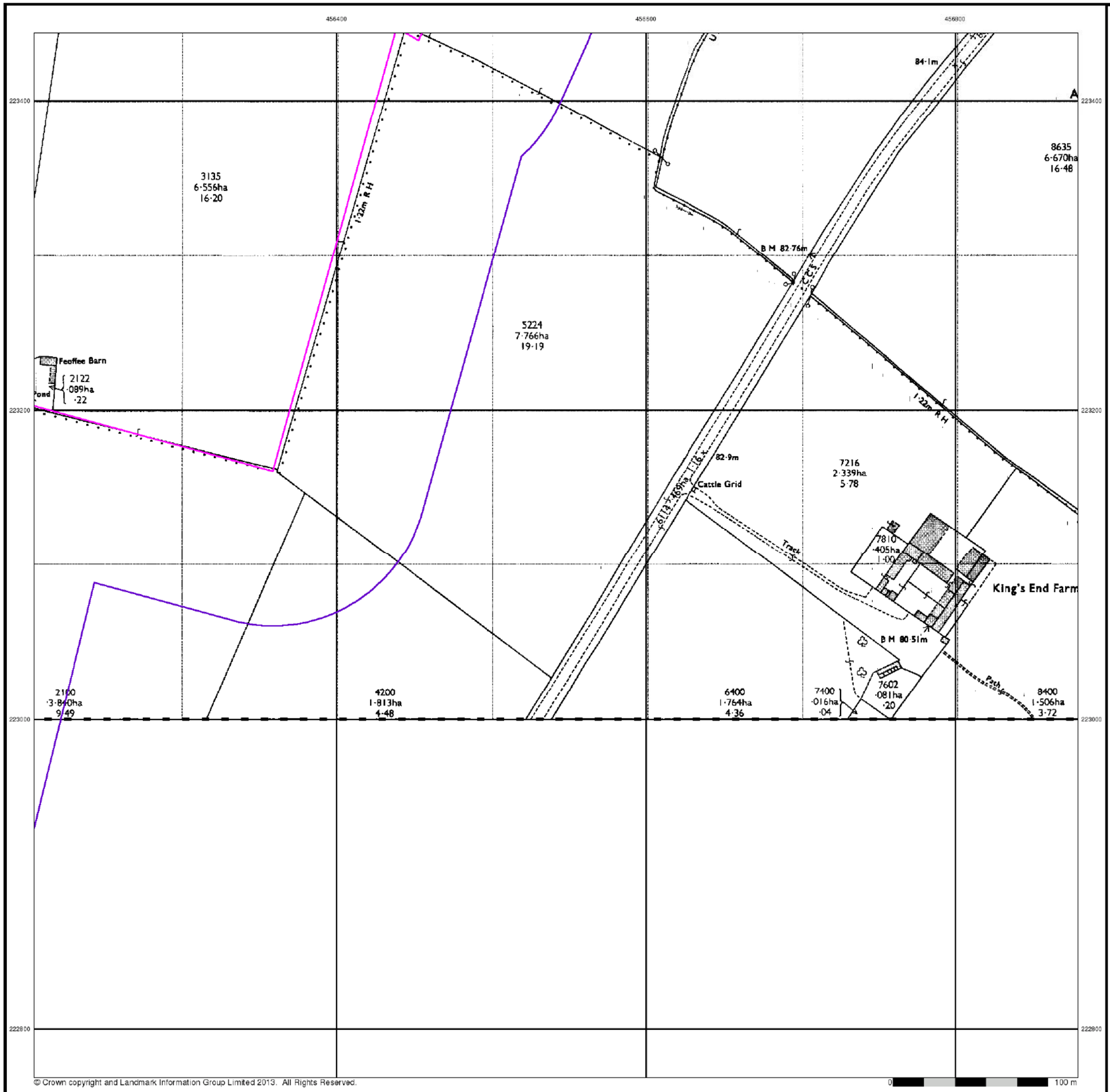


Waterman

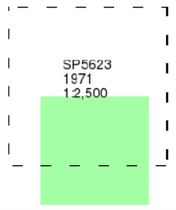
Ordnance Survey Plan

Published 1971

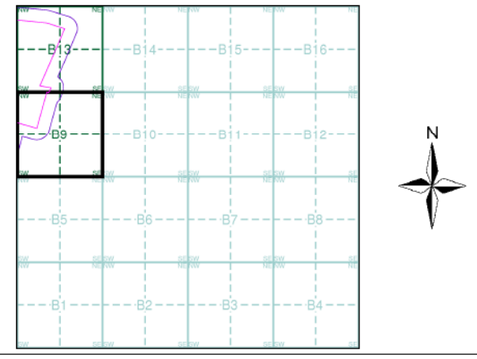
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment B9



Order Details

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Site Details

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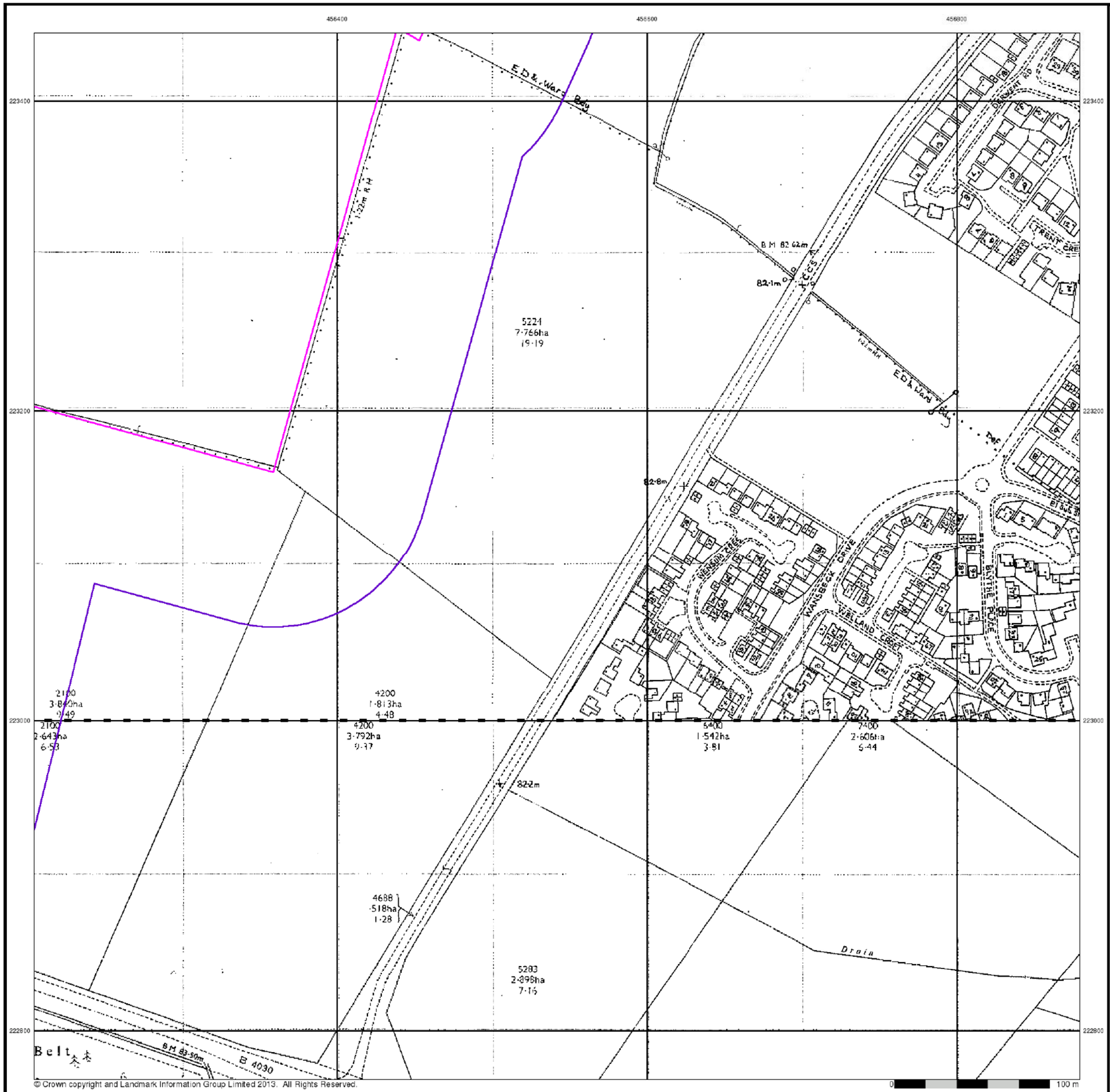


Waterman

Additional SIMs

Published 1980 - 1985

Source map scale - 1:2,500

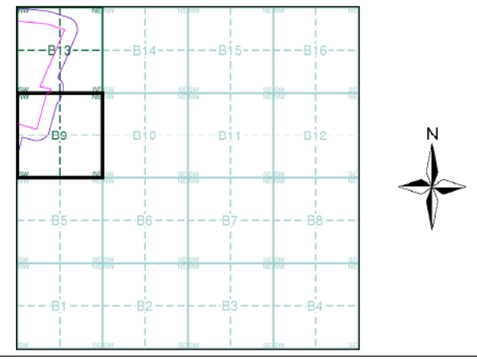
The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

SP5623
1985
1:2,500

SP5622
1980
1:2,500

Historical Map - Segment B9



Order Details

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Site Details

Himley Village

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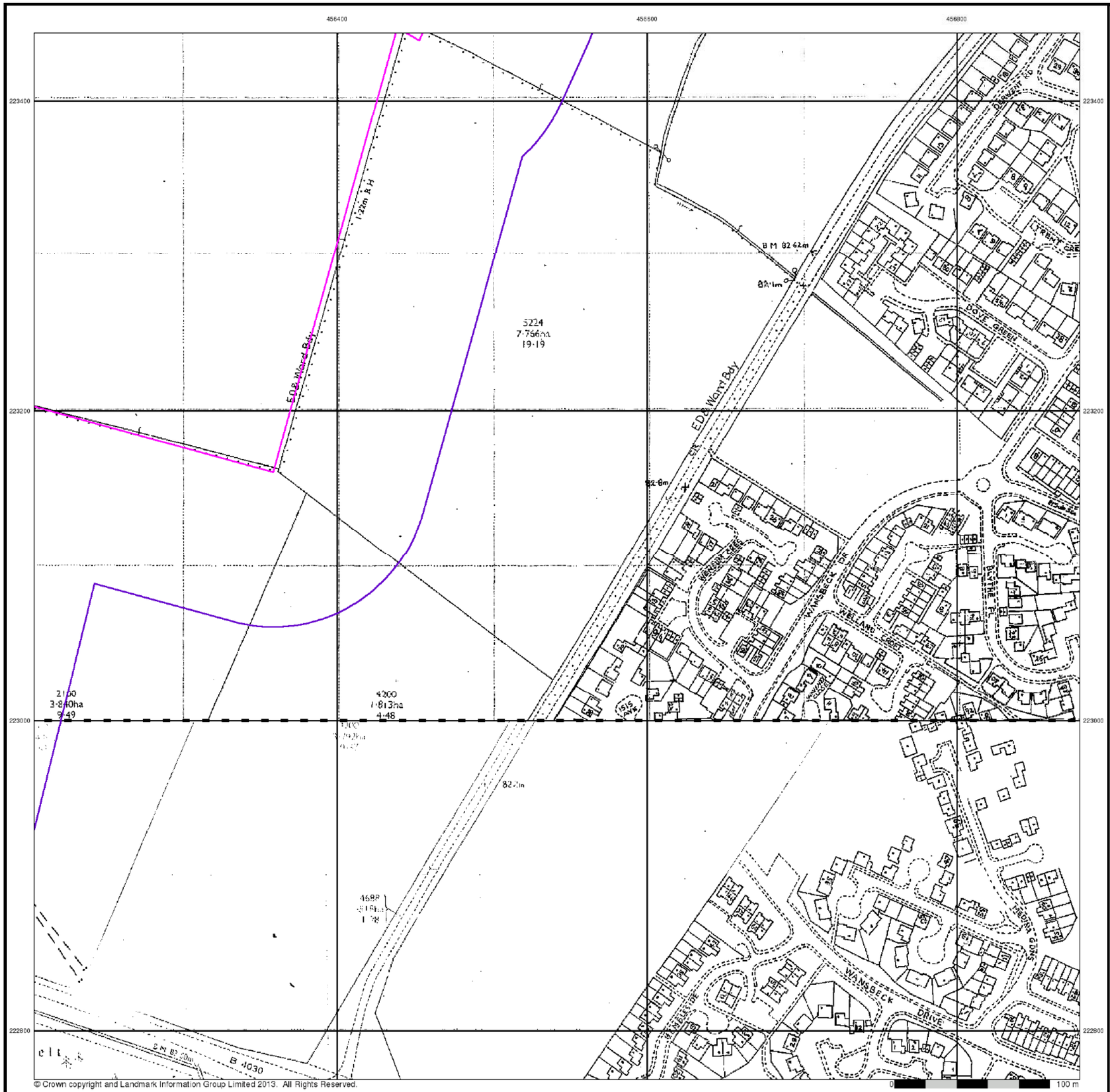


Waterman

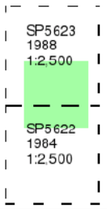
Additional SIMs

Published 1984 - 1988

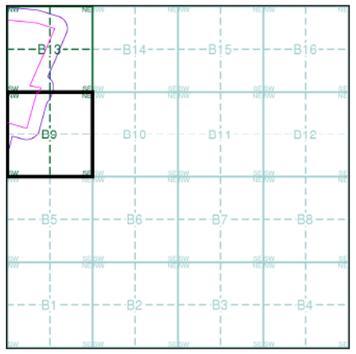
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B9



Order Details

Order Number:	62370009_1_1
Customer Ref:	EED14995-100
National Grid Reference:	456780, 223190
Slice:	B
Site Area (Ha):	90.42
Search Buffer (m):	100

Site Details

Himley Village

Landmark Information Group
Tel: 0844 844 9952
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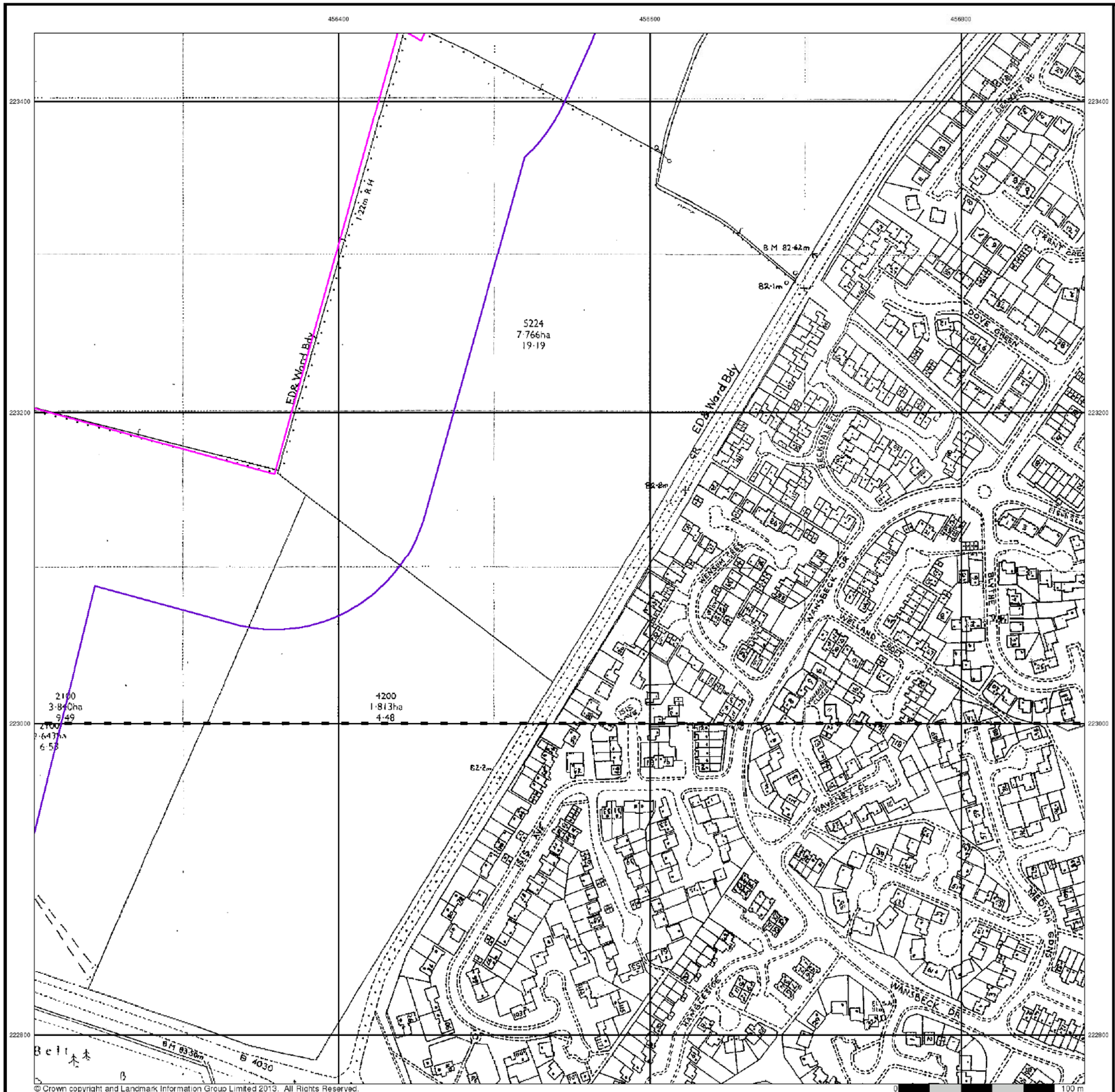


Waterman

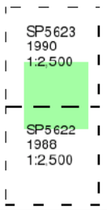
Additional SIMs

Published 1988 - 1990

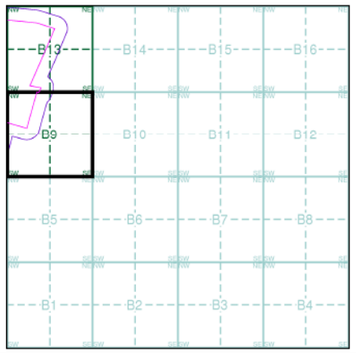
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B9



Order Details

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National Grid Reference:	456780, 223190
Slice:	B
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Site Details

Himley Village

Landmark Information Group

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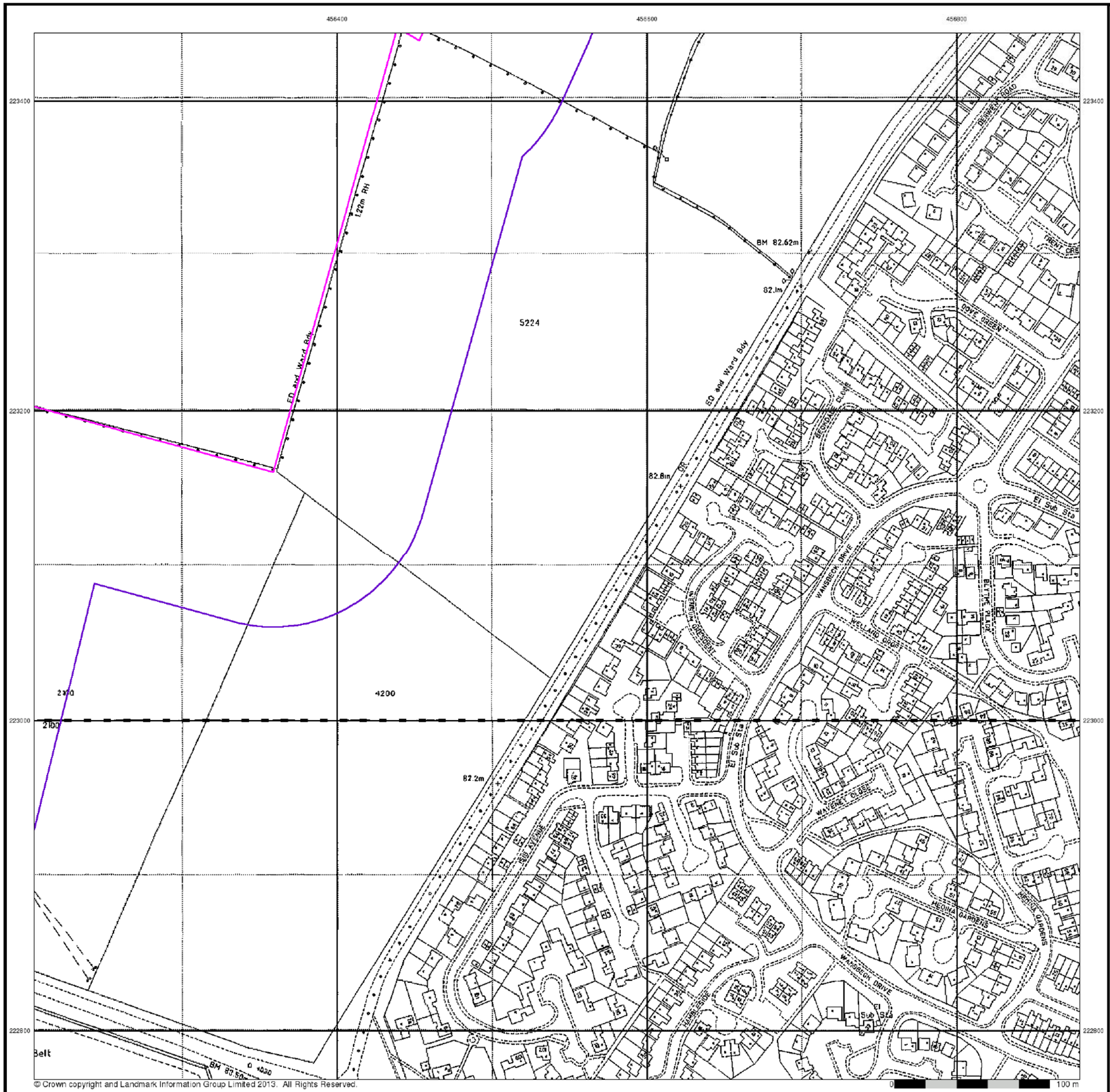


Waterman

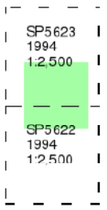
Large-Scale National Grid Data

Published 1994

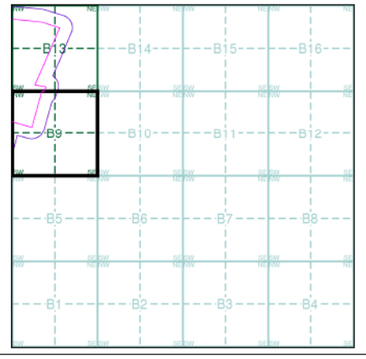
Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B9



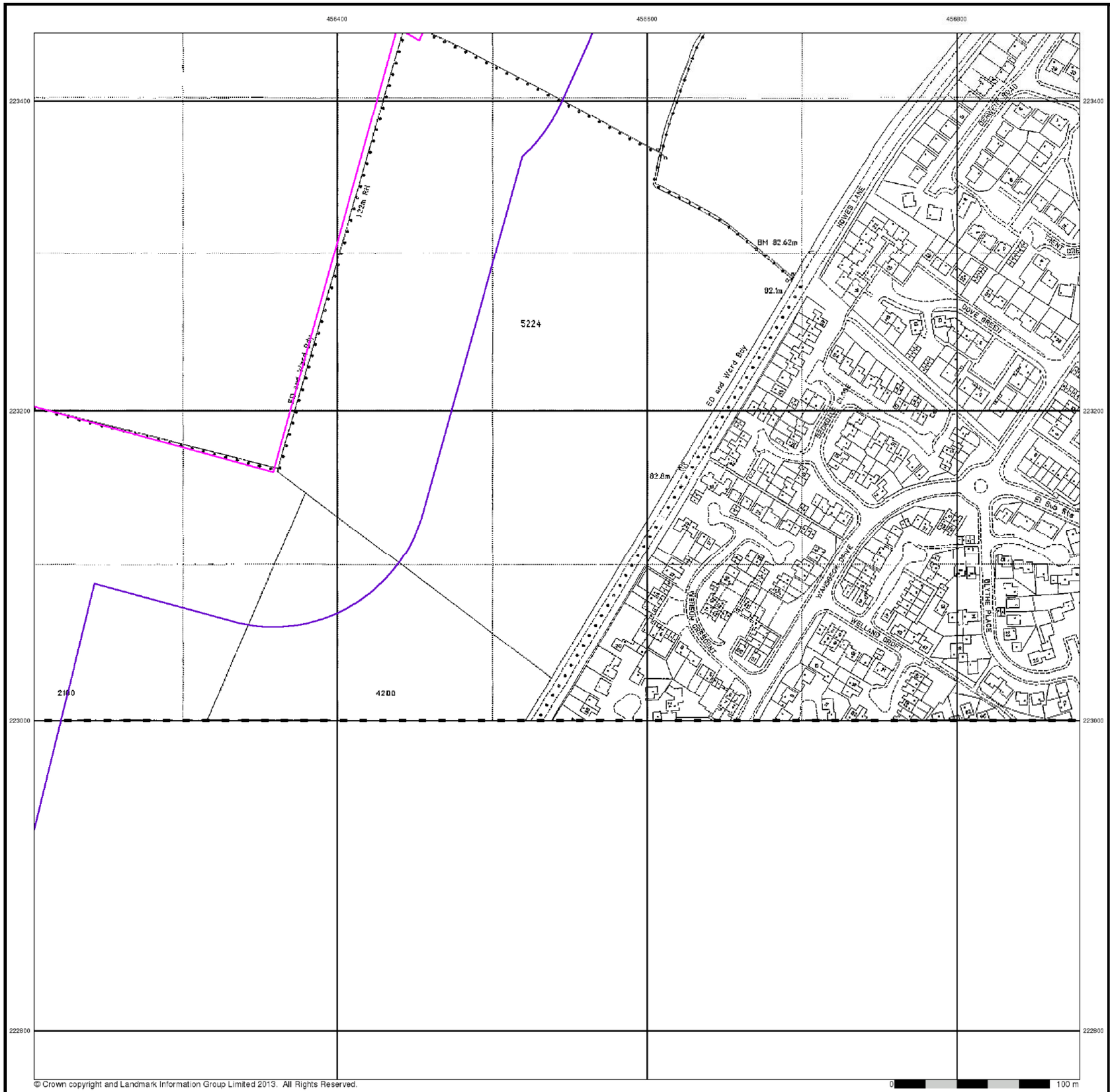
Order Details

Order Number:	62370009_1_1
Customer Ref:	EED14995-100
National Grid Reference:	456780, 223190
Slice:	B
Site Area (Ha):	90.42
Search Buffer (m):	100

Site Details

Himley Village

Landmark Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Waterman

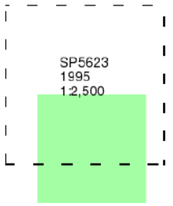
Large-Scale National Grid Data

Published 1995

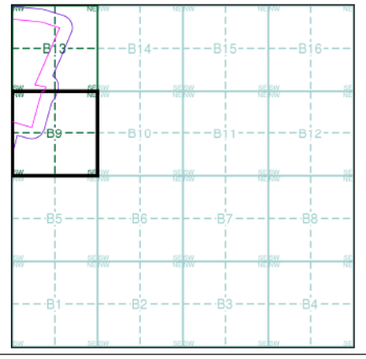
Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B9



Order Details

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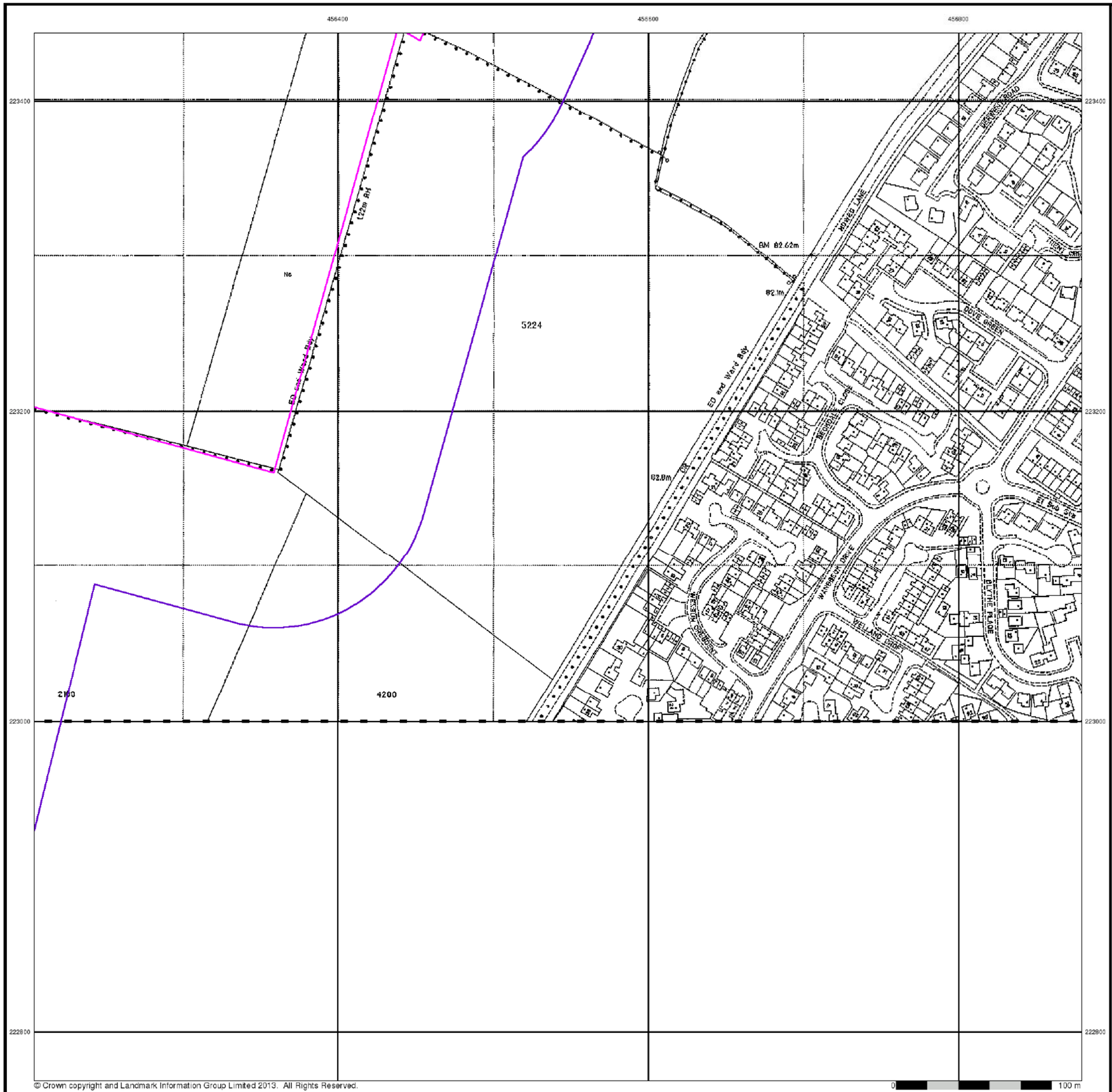


Waterman

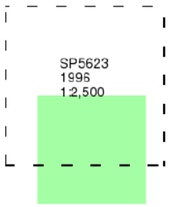
Large-Scale National Grid Data

Published 1996

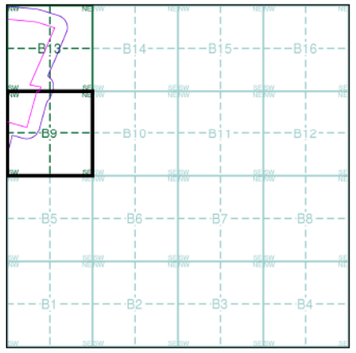
Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment B9



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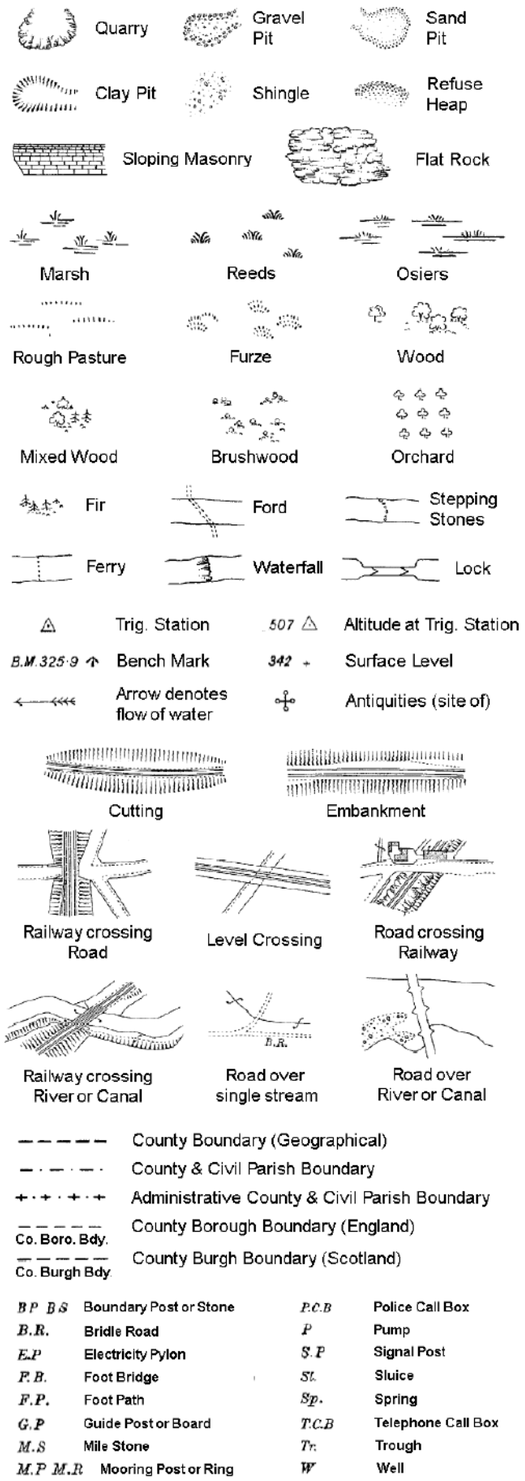
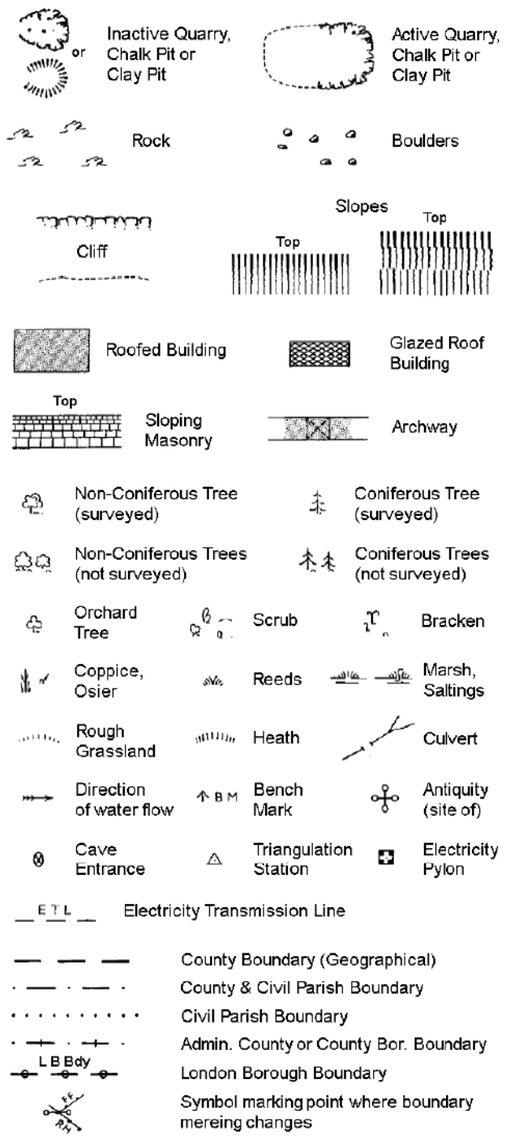
Historical Mapping Legends

Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



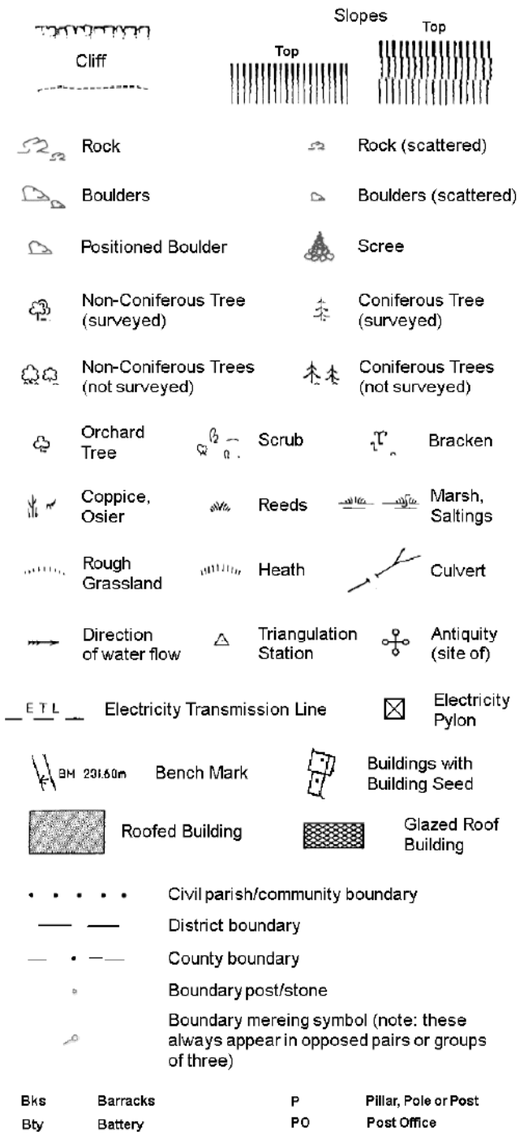
B.P B.S	Boundary Post or Stone	P.C.B	Police Call Box
B.R.	Bridle Road	P	Pump
E.P	Electricity Pylon	S.P	Signal Post
F.B.	Foot Bridge	St.	Sluice
F.P.	Foot Path	Sp.	Spring
G.P	Guide Post or Board	T.C.B	Telephone Call Box
M.S	Mile Stone	Tr.	Trough
M.P M.R	Mooring Post or Ring	W	Well

Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



BH	Beer House	P	Pillar, Pole or Post
BP, BS	Boundary Post or Stone	PO	Post Office
Cn, C	Capstan, Crane	PC	Public Convenience
Chy	Chimney	PH	Public House
D Fn	Drinking Fountain	Pp	Pump
El P	Electricity Pillar or Post	SB, S Br	Signal Box or Bridge
FAP	Fire Alarm Pillar	SP, SL	Signal Post or Light
FB	Foot Bridge	Spr	Spring
GP	Guide Post	Tk	Tank or Track
H	Hydrant or Hydraulic	TCB	Telephone Call Box
LC	Level Crossing	TCP	Telephone Call Post
MH	Manhole	Tr	Trough
MP	Mile Post or Mooring Post	Wr Pt, Wr T	Water Point, Water Tap
MS	Mile Stone	W	Well
NTL	Normal Tidal Limit	Wd Pp	Wind Pump

Large-Scale National Grid Data 1:2,500 and 1:1,250



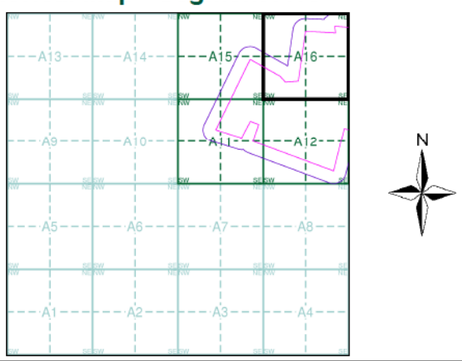
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity Pole, Pillar	SB, S Br	Signal Box or Bridge
El Sub Sta	Electricity Sub Station	SP, SL	Signal Post or Light
FB	Filter Bed	Spr	Spring
Fn / D Fn	Fountain / Drinking Ftn.	Tk	Tank or Track
Gas Gov	Gas Valve Compound	Tr	Trough
GVC	Gas Governer	Wd Pp	Wind Pump
GP	Guide Post	Wr Pt, Wr T	Water Point, Water Tap
MH	Manhole	Wks	Works (building or area)
MP, MS	Mile Post or Mile Stone	W	Well

Waterman

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Oxfordshire	1:2,500	1881	2
Oxfordshire	1:2,500	1899	3
Oxfordshire	1:2,500	1922	4
Ordnance Survey Plan	1:2,500	1967 - 1968	5
Ordnance Survey Plan	1:2,500	1971	6
Additional SIMs	1:2,500	1980 - 1985	7
Additional SIMs	1:2,500	1985	8
Additional SIMs	1:2,500	1988	9
Additional SIMs	1:2,500	1990	10
Large-Scale National Grid Data	1:2,500	1994	11
Large-Scale National Grid Data	1:2,500	1995	12
Large-Scale National Grid Data	1:2,500	1996	13

Historical Map - Segment A16



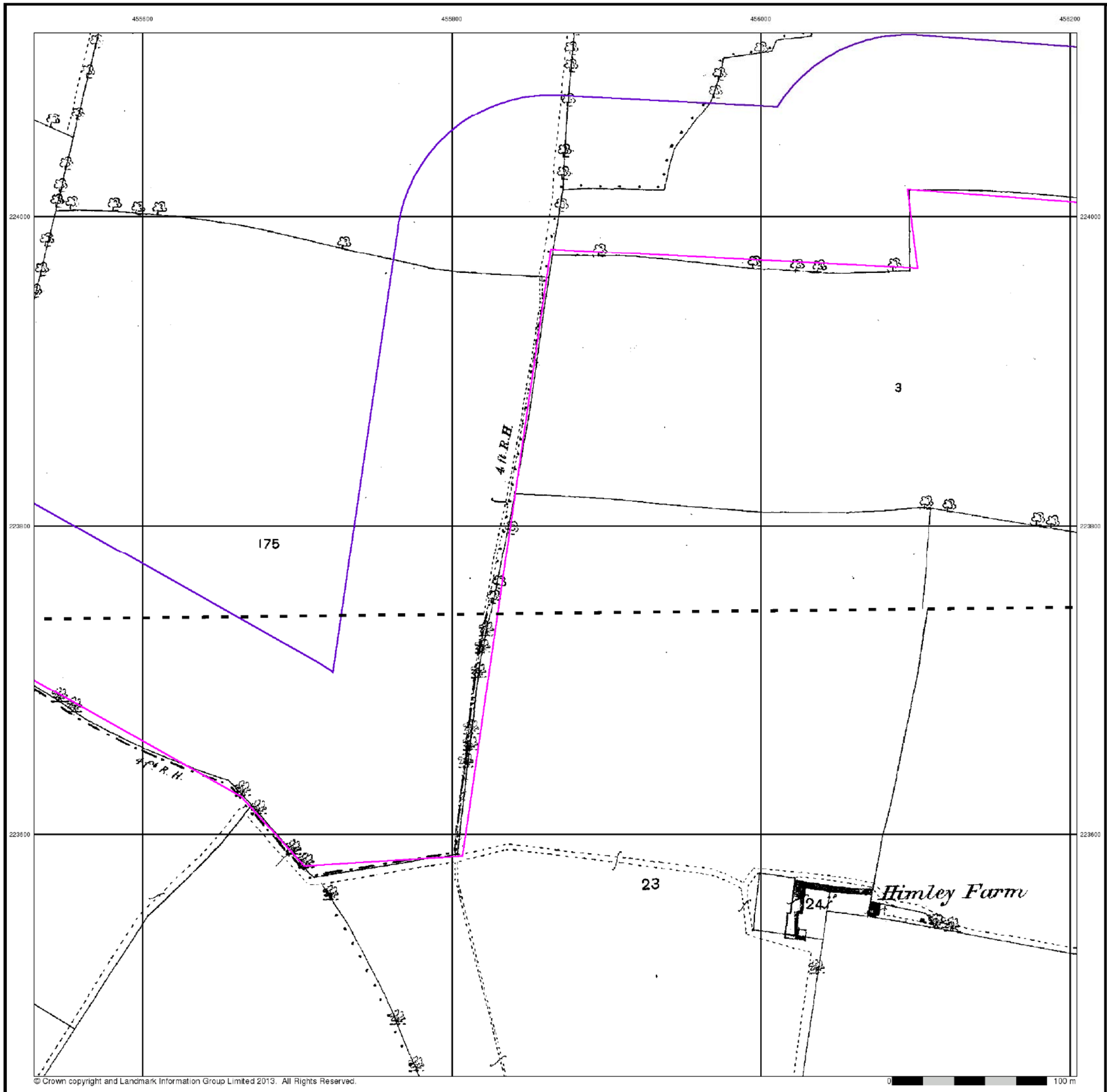
Order Details

Order Number: 62370009_1_1
Customer Ref: EED14995-100
National Grid Reference: 455290, 223110
Slice: A
Site Area (Ha): 90.42
Search Buffer (m): 100

Site Details

Himley Village

Landmark Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Waterman

Oxfordshire

Published 1881

Source map scale - 1:2,500

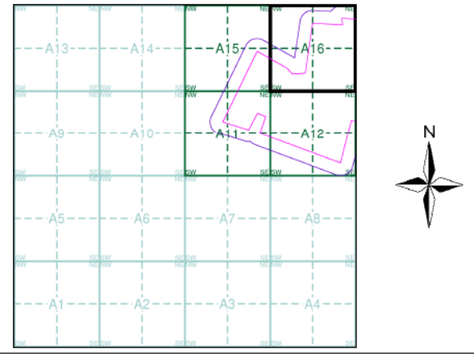
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)

023_01
1881
1:2,500

023_05
1881
1:2,500

Historical Map - Segment A16



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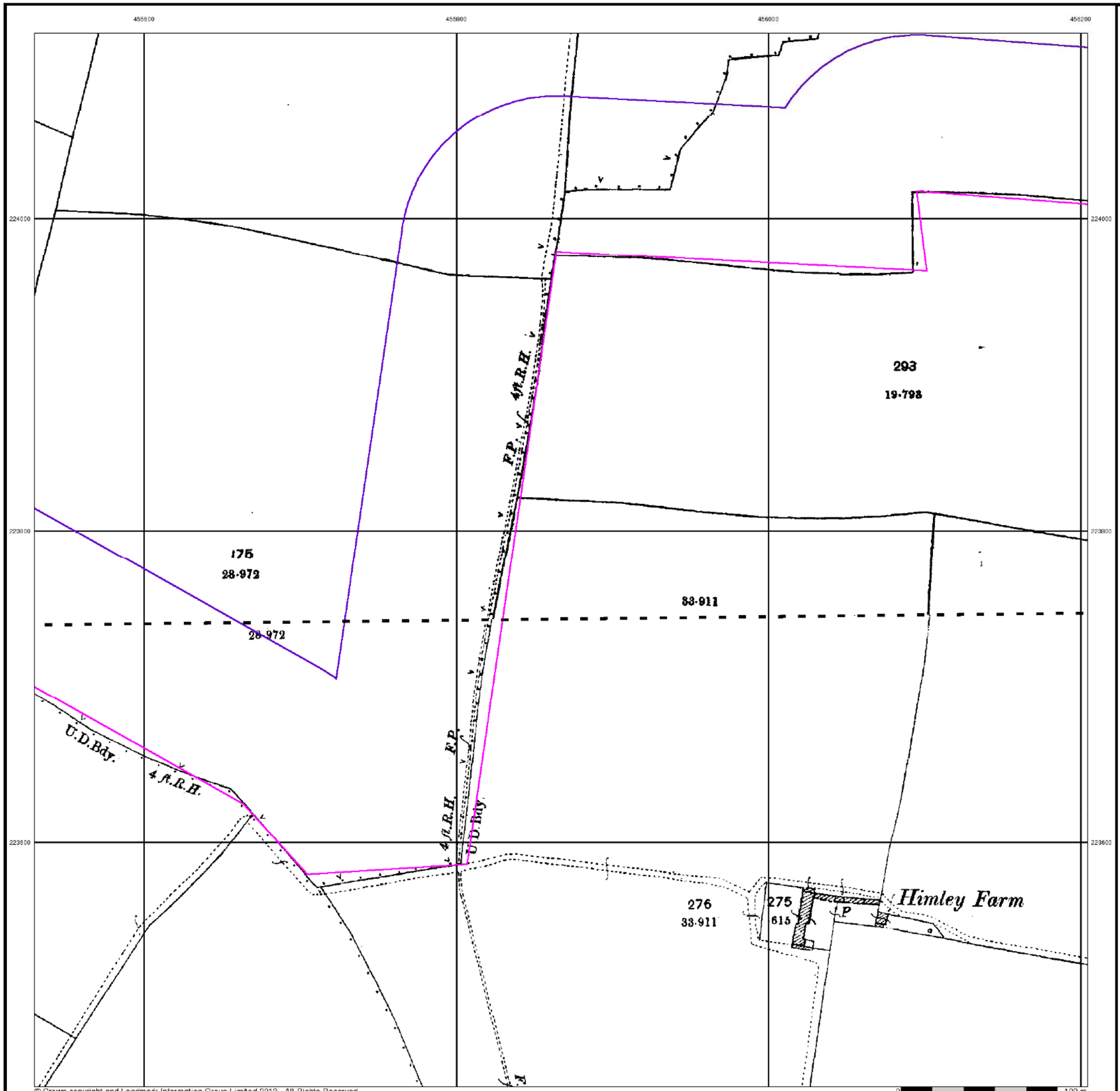


Oxfordshire

Published 1899

Source map scale - 1:2,500

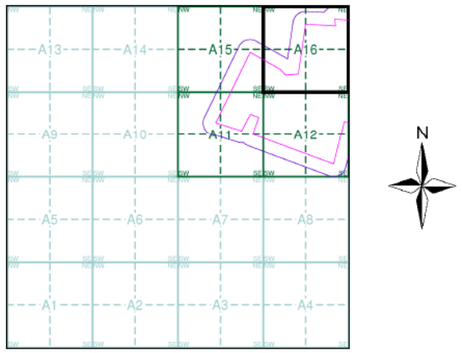
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)

023_01
1899
1:2,500

023_05
1899
1:2,500

Historical Map - Segment A16



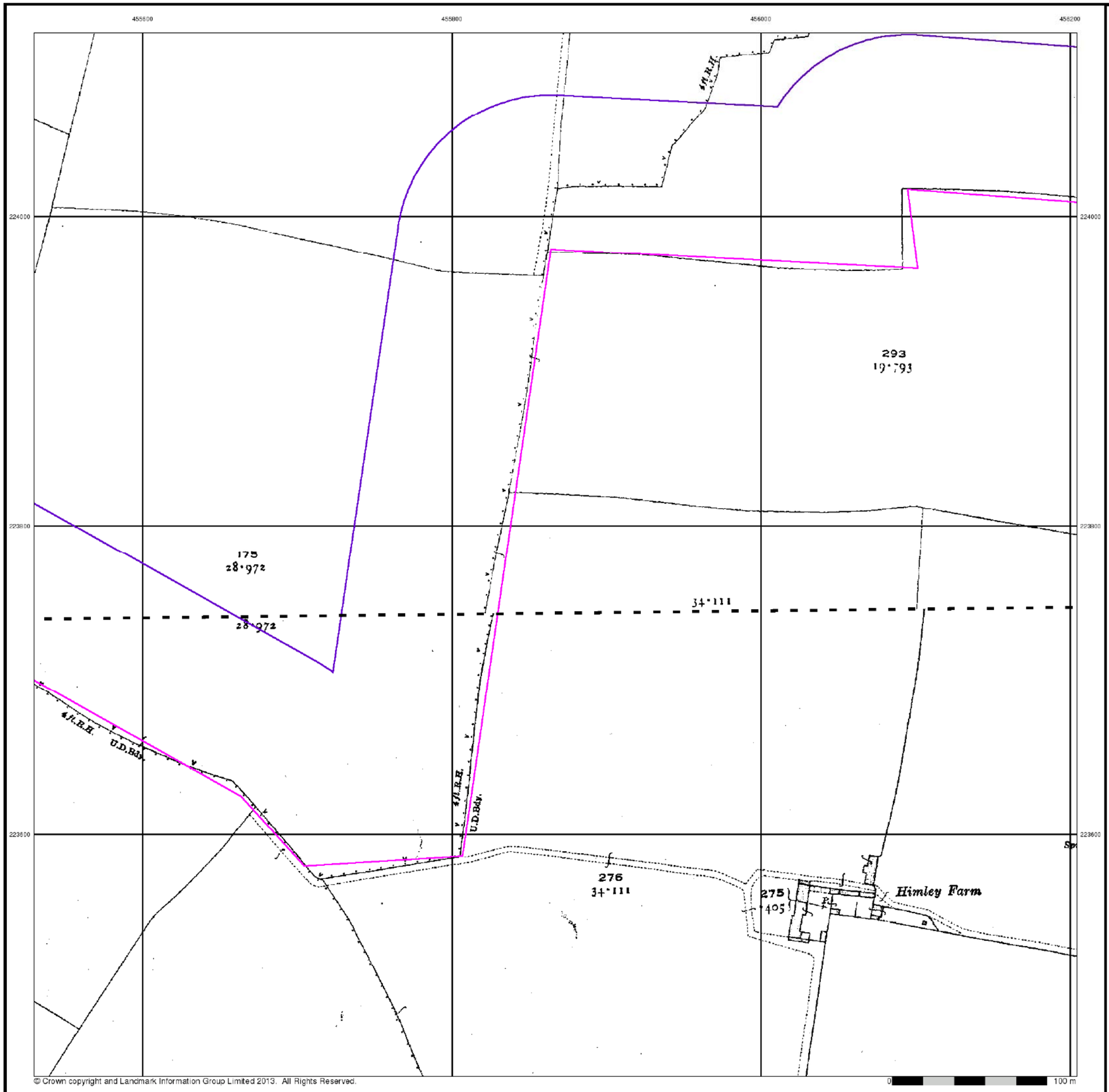
Order Details

Order Number:	62370009_1_1
Customer Ref:	EED14995-100
National Grid Reference:	455290, 223110
Slice:	A
Site Area (Ha):	90.42
Search Buffer (m):	100

Site Details

Himley Village

Landmark Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Waterman

Oxfordshire

Published 1922

Source map scale - 1:2,500

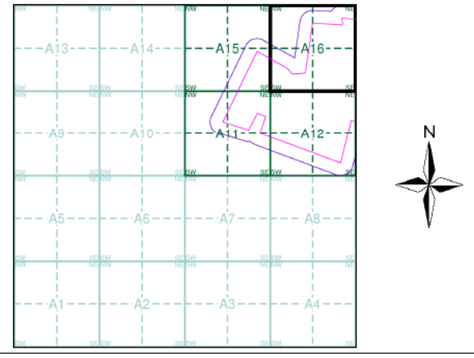
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)

023_01
1922
1:2,500

023_05
1922
1:2,500

Historical Map - Segment A16



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