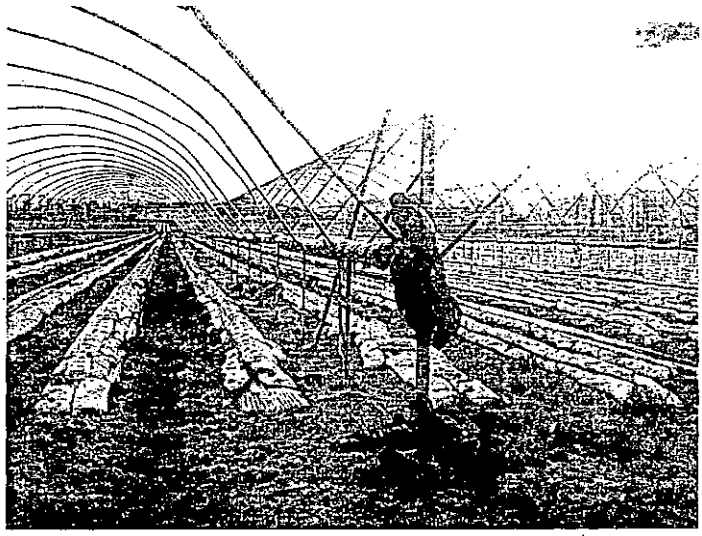
SOFT FRUIT POLYTUNNEL DEVELOPMENT, DOG KENNEL FIELD, GROVES FARM, UPPER BOGNOR ROAD, COLWORTH, CHICHESTER, WEST SUSSEX, PO20 2DX

FLOOD RISK ASSESSMENT

As part of the submission of a planning application

for



Merston Farm Ltd.
Groves Farm
Upper Bognor Road
Colworth
Chichester
West Sussex
PO20 2DX

by



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Ref: P:\HHP Groves Farm (5934)\Dogkennel FRA\FRA v1.doc
December 2008

JDIH ENVIREAU

ARUN DISTRICT COUNCIL BE/81/10/

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DOG KENNEL FIELD FLOOD RISK ASSESSMENT
NON TECHNICAL SUMMARY

A planning application for 18 hectares of polytunnel (Spanish Tunnel) development at Dog Kennel Field, Groves Farm, Upper Bognor Road, Colworth (Chichester District Council), will be submitted on behalf of Merston Farm Ltd., by planning consultants Douglas Briggs Partnership. This Flood Risk Assessment (FRA) has been written and submitted in accordance with FRA1 Guidance Note "Development greater then 1 hectare in Flood Zone 1".

The FRA follows guidelines laid out in Planning Policy Statement 25 (PPS25) and sets out calculations that were undertaken to assess "greenfield" runoff rates and volumes of runoff generated during storm events. The approach undertaken is that detailed in Defra/Environment Agency document "Preliminary rainfall runoff management for developments. R&D Technical Report W5-074/A/TR/1 Revision C, re-published June 2007".

A key technical issue when using this approach is that Dog Kennel Field is an agricultural drainage issue and not an urban drainage issue.

At all stages of the analysis, assumptions and selection of parameter values has been based on conservative decisions. The analysis assumes that polytunnels are covered all year, when in practice the covers are often removed in the winter. This adds to the conservative nature of the analysis.

The analysis uses a 1 in 100 year storm as a basis, and takes into account a 20% climate change surcharge in accordance with PPS25.

Long Term Storage calculations resulted in an additional storage requirement for the polytunnel area subject to the planning permission of 220m^3/ha. This FRA shows that this storage requirement can be accommodated within two long term storage areas situated outside the polytunnel area. Linings and flow restrictors placed in polytunnel leg rows channels will act to reduce the rate at which runoff leaves the polytunnel area and will also provide additional storage within the channels themselves. Therefore, the leg row channels in effect become swales throughout the polytunnel areas. The additional storage provided in the leg row channels has not been included in the sizing of the Long Term Storage areas.

This assessment has demonstrated that the polytunnel development at Dog Kennel Field will not have a detrimental impact on drainage and flooding on or off site providing storage is provided for within the specified storage areas.

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DOG KENNEL FIELD FLOOD RISK ASSESSMENT

1 INTRODUCTION

A planning application for 18 hectares of polytunnel (Spanish Tunnel) development at Dog Kennel Field, Groves Farm, Upper Bognor Road, Colworth (Chichester District Council), will be submitted on behalf of Merston Farm Ltd by planning consultants Douglas Briggs Partnership. This Flood Risk Assessment (FRA) has been written and submitted in accordance with FRA1 Guidance Note "Development greater then 1 hectare in Flood Zone 1". The principal objective of this FRA is to demonstrate that the amount of water running off the site for the polytunnel development will not exceed the amount running off in a "Greenfield" scenario.

The FRA includes:

1. Rainfall runoff calculations for the land for storm events for a 1 in 100 year storm event plus a 20% increase to accommodate climate change as outlined in PPS25; and in accordance with EA/Defra guidance booklet "Preliminary rainfall runoff management for developments – R&D Technical Report W5-074/A/TR/1 Revision C".

2. Location plans showing geographical features, watercourses, the existing site and the development proposals.

3. Topographic data showing surface water flow routes from polytunnels to receiving watercourses;

4. Details of how runoff is collected, stored and transferred off site.

This report has been prepared by JDIH Envireau [JDIH], a specialist, independent water resources and water management consultancy. The lead consultant was James Dodds, the Managing Director of JDIH, who has some 20 years experience in water management consulting.

The approach taken for this study duplicates that taken in other areas, which has been reviewed and accepted by the Environment Agency.

2 SITE DESCRIPTION

2.1 General

The boundary of the proposed development site at Groves Farm is shown on Figure 1. The site is currently used for general agricultural use. The planning application is for the erection of polytunnels across the site that incorporates the "in ground" method for growing soft fruits. The site is located near Colworth, approximately 4km to the southeast of Chichester. The farm is centred at grid reference SU 902 026 covering an area of approximately 68ha with elevations across the field at approximately 5m to 5.8m AOD.

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Based on Ordnance Survey mapping at a scale of 1:10 000, the topography of the field site is contained by one small drainage catchment (Figure 1) that have gradients of 0.42% or less. The catchment drains to a field drain south east of the site and subsequently through a network of field drains flowing south east. These field drains join a series of rifes which are tributaries of the Aldingbourne Rife. The Aldingbourne Rife is approximately 2km east of the site. Based on the connectivity of the rifes and the relatively small distances involved, once water reaches one of the rifes it will quickly flow to the Aldingbourne Rife. As a result of this the whole farm area has been considered as a single catchment (Figures 1 and 2).

The geology of the site has been identified from British Geological Survey Map 317/332 (Chichester/Bognor) and consists of thick deposits of aeolian silts, and gravels underlain by older Upper Cretaceous Chalk.

The Soil Survey of England and Wales classify the soils north of the site as Sub-group 571z: Deep stoneless well drained silty soils and similar soils affected by groundwater; over gravel locally. The majority of the soils at the site are classified as Sub-group 841e: Deep stoneless silty soils variably affected by groundwater.

The surface topography is isolated from the deep Chalk aquifer by the intervening aeolian silts, although the shallow superficial deposits will support their own perched groundwater system. This system will have a very shallow "water table" largely controlled by drainage to the rifes. Groundwater levels could be less than 1m deep.

Planning permission has already been granted for two existing polytunnel areas north of the proposed polytunnel area (planning application 08/02777/FUL) (Figure 2).

3 QUALITATIVE ASSESSMENT OF PROPOSED POLYTUNNEL DEVELOPMENT

3.1 Hydrological Characterisation

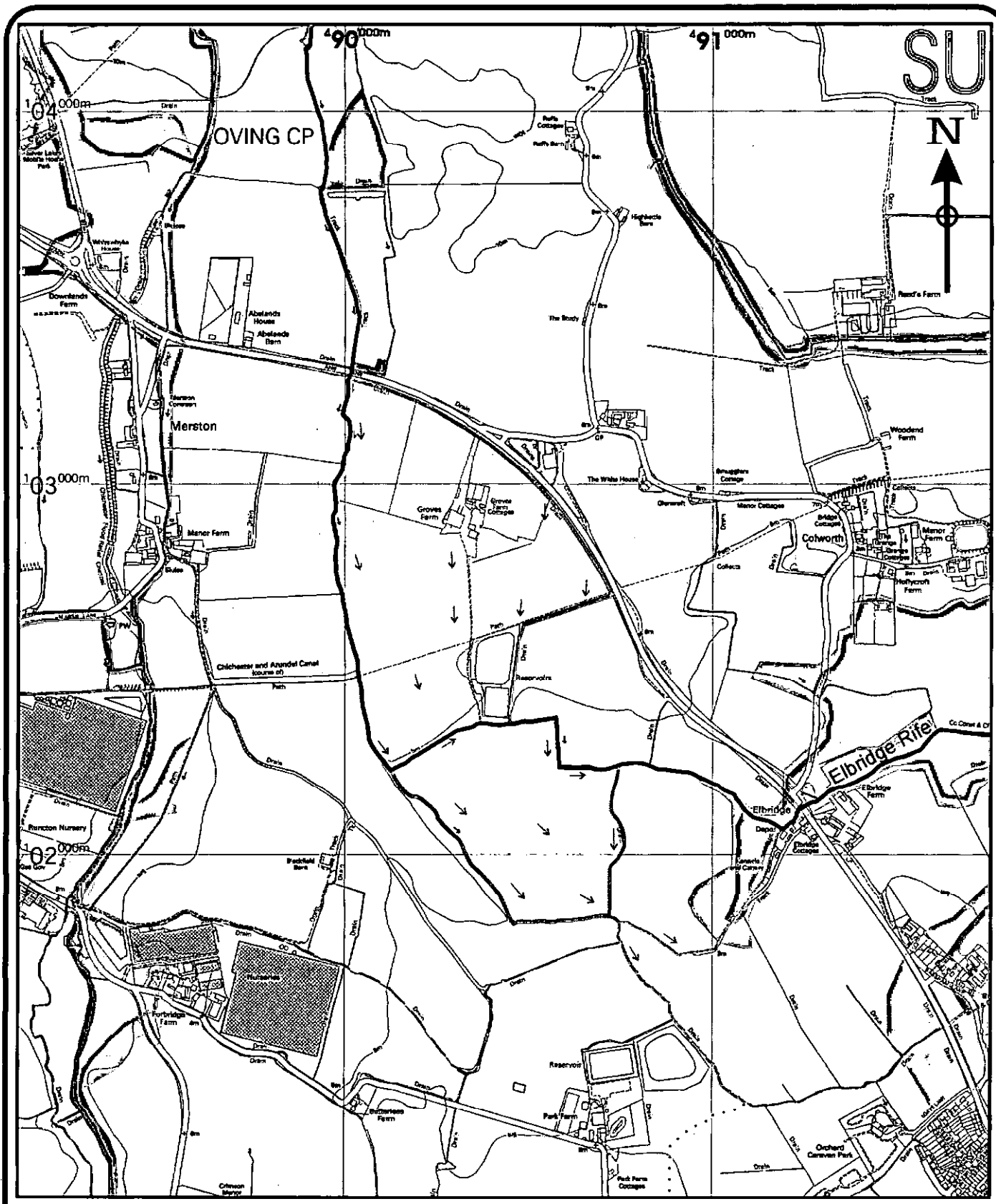
Based upon Ordnance Survey topographic mapping, the field area has been considered as one single catchment area, which is shown on Figures 1 and 2.

The planning application is for a 18ha of polytunnels. Figure 2 shows the area of polytunnel development, together with the direction of overland runoff and drainage directions associated with the polytunnels. The polytunnel area illustrated in Figure 2 forms the basis of the quantitative assessment of runoff from the site.

It is important to recognise that the hydrological characteristics of the polytunnel growing system is characterised by rural hydrology and not urban hydrology. While the polytunnels themselves form a high runoff cover, the drainage from the site is controlled by the processes at ground level, which is generally grassed, or vegetated soil, with or without artificial channels. This results in an overall low runoff velocity system. This is different from an urban setting, where development generally leads to high runoff surfaces, with drainage controlled by pipes, resulting in high runoff velocities.

When soft fruits are grown in the ground, the drainage from the polytunnels is achieved by a series of vegetated/grass lined, straw lined or Mypex lined channels that run along the line of the polytunnel leg stands. The line of the leg stands, are commonly referred to as "leg rows". The leg row channels will have flow restrictors in the form of dams placed at regular intervals along them. The overall result in the leg row channels is to increase the resistance to flow and therefore, reduce flow velocities. With flow restrictors in place, the leg row channels also provide storage.

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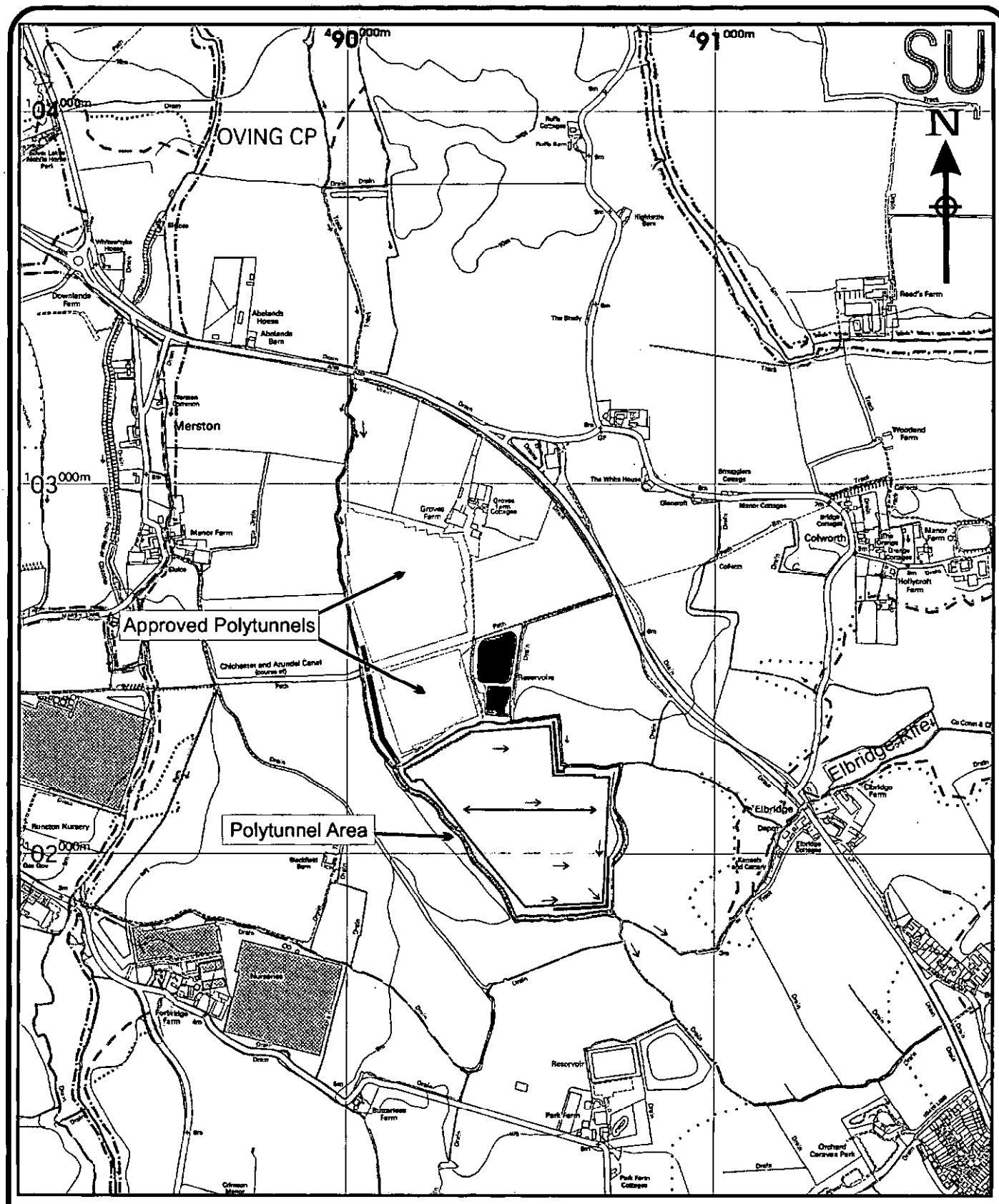
- Land Boundary and Rainfall Runoff Catchment of Groves Farm
- EA Flood Risk Zone [Extreme Event - Flood Zone 2]
- Drainage
- 55m — Topographic Contours
- EA Flood Risk Zone [Flood Zone 3]
- Natural Runoff pathways

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Scale 1 : 10 000 at A3

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Ref: P:/Groves Farm(5934)\ Dog Kennel FRA\Fig 1.cdr Date: 12/12/08	**Dog Kennel, Groves Farm - FRA**
Figure 1	Land Coverage, EA Floodrisk Boundary and Natural Catchment Divides



LEGEND

- Land Boundary and Rainfall Runoff Catchment of Groves Farm
- Polytunnels
- EA Flood Risk Zone [Extreme Event - Flood Zone 2]
- EA Flood Risk Zone [Flood Zone 3]
- Row of Alder Trees
- Polytunnels Orientation
- Reservoir
- Storage Pond
- Drainage
- 55m — Topographic Contours
- Natural and Polytunnel Induced Runoff Pathways
- Channel Flow

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Ref: P:/Groves Farm(5934)\ Dog Kennel FRA\Fig 2.cdr Date: 22/07/08	**Dog Kennel, Groves Farm - FRA**
Figure 2	Polytunnel Placement, Orientation and Farm Drainage Pathways

The net result is to reduce the flow velocities and runoff rate of the overall polytunnel area, when compared to simple open channels. The "in the ground" growing concept is summarised schematically on Figure 3. In essence the polytunnel growing system produces a series of drainage routes spaced 8m apart, which act as retention zones, seepage zones, and velocity reduction zones. Therefore, the leg row channels become swales, however, the principal difference between rural development and an urban development is that the ratio of impermeable area to swale is generally greater and more favourable than that provided in urban developments.

This conceptualisation is important, as the drainage system following the establishment of the polytunnels is an agricultural drainage system and not an urban drainage system. It is therefore important that the analysis approach and technique reflects this. The polytunnel development represents one land use type. If polytunnels were not present then the land would still be farmed and this would need to be productive. Therefore the alternative land would be for the growing of lettuce, small grain crops or potatoes'.

3.2 Proposed Polytunnel Layout

Figure 2 shows the proposed location and layout of the polytunnels on the farm based on site plans provided by Douglas Briggs Partnership.

The farm catchment area within which the polytunnels are located extends to approximately 68ha of which the planning application polytunnels represent 18ha. These polytunnels are located within Dog Kennel Field, at the southern end of the Groves Farm land boundary and rainfall runoff catchment, labelled polytunnel area.

The polytunnels will only be covered/sheeted for some of the year between February and November and will not be covered in winter and when strong winds are forecast. Therefore, the polytunnels will not be sheeted for the winter months when fields are generally at field capacity and precipitation surpasses potential evapotranspiration and infiltration to ground. In these conditions, the fields will operate hydrologically as if there were no "development"

3.3 Proposed Polytunnel Orientation and Drainage

The polytunnel orientations at Dog Kennel Field are illustrated in Figures 2 and 4. Drainage from the covered polytunnels is in two stages. Initially, rainfall hits the polytunnels and 100% is assumed to instantaneously run off to the ground surface before accumulating in each of the leg rows channels.

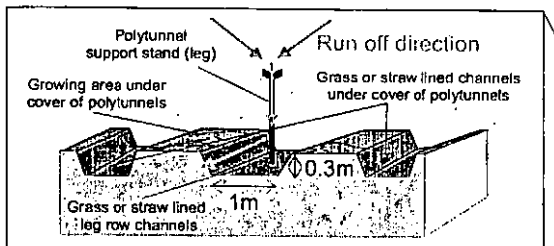
During rainfall events the leg row channel storage comprising storage within the grass and/or straw and/or flow restrictors as well as storage related to micro-topography, will be filled, and then flow will be initiated parallel to the tunnel orientation.

North of the polytunnel area runoff will flow east to the end of the leg row channels via flow restrictors and will be dispersed by a 2m grassed buffer strip (Figure 4). From the grassed buffer strip the runoff is conveyed as overland flow through a buffer strip of wildflower meadow/pasture into Long Term Storage Area 1. The flow will leave the storage area via a throttle pipe at 2l/s/ha and will flow over an energy dissipater. The flow will enter the Elbridge Rife on the north east side of the polytunnels and flow east.

South of Long Term Storage Area 1, runoff will flow east to the end of the leg row channels via flow restrictors and will be dispersed by a 2m grassed buffer strip (Figure 4). From the grassed buffer strip the runoff is conveyed through a buffer strip of pasture as overland flow to a drainage channel. Run off is then conveyed south as

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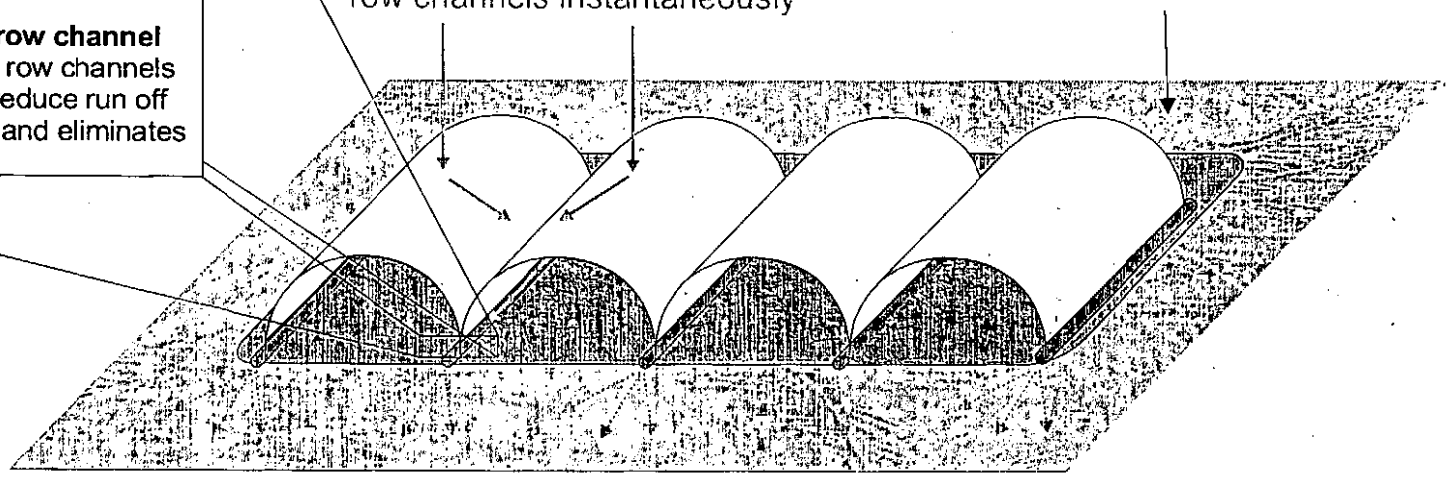


Cross-section of leg row channel
Grass or straw lined leg row channels increase runoff depth, reduce run off velocity, provide storage and eliminates erosion

Rainfall

Rainfall lands on polytunnels and is assumed to enter the leg row channels instantaneously

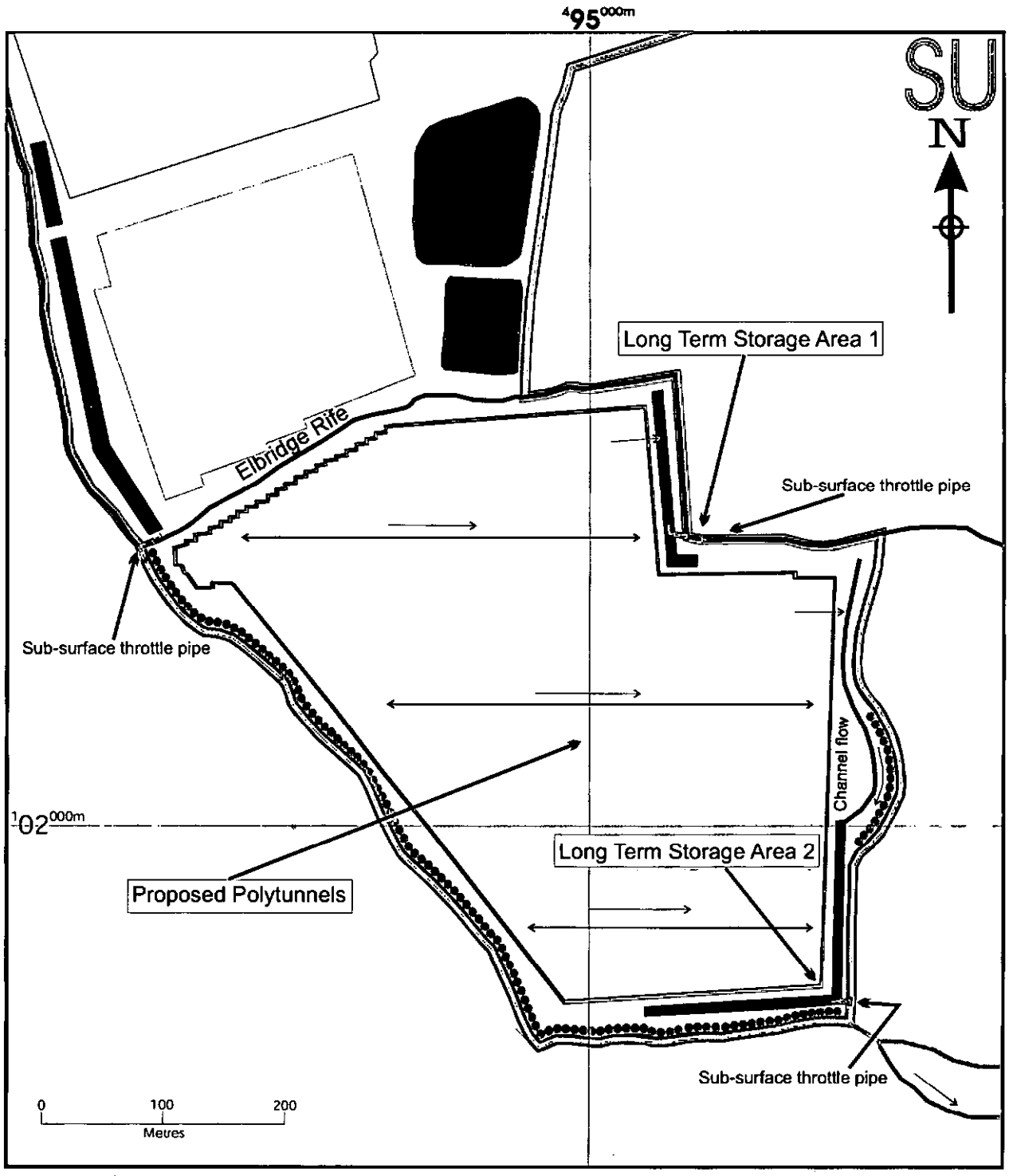
Primarily grassed or vegetated area surrounding polytunnels.



Runoff accumulating in leg row channels is dispersed by wide grassed buffer strips at the open end of the polytunnel and then flows as overland and channel flow into two storage areas. The flow will leave both storage areas via a throttle pipe at 2l/s/ha, and will flow over an energy dissipater. The flow will enter the Elbridge Rife from storage area 1 and flow leaving storage area 2 will enter a natural drainage ditch on the south side of the polytunnels and flow south. The drainage ditch then joins a series of rifes which are tributaries of the Aldingbourne Rife.

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Ref: P:\Groves Farm(5934)\ Dog kennel FRA\Figures\Fig3 Date: 12\12\08	**Dog kennel, Groves Farm - FRA**
Figure 3	Schematic Diagram of Polytunnel Runoff and Drainage for Soft Fruit Crops



LEGEND

- Land Boundary and Rainfall Runoff Catchment of Groves Farm
- 2m Grassed Headland
- Natural and Polytunnel Induced Runoff Pathways
- Polytunnels
- 300mm Pipe
- Throttle Pipe 2l/s/ha with Energy Dissipater
- Reservoir
- Storage Pond
- Drainage
- Row of Alder Trees
- Polytunnels Orientation

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Ref: P:/Groves Farm(5934)\ Dog Kennel FRA\Fig 4.cdr Date: 12/12/08	**Dog Kennel, Groves Farm - FRA**
Figure 4	Detailed Views of Polytunnel Placement, Orientation and Farm Drainage Pathways

channel flow into Long Term Storage Area 2. The flow will enter a natural drainage ditch on the south side of the polytunnels and flow south. The drainage ditch then joins a series of rifes which are tributaries of the Aldingbourne Rife.

3.4 Sediment Mobilisation

Gradients at the site are very low which results in low overland flow velocities. The use of grass and/or straw and/or Mypex and flow restrictors in the polytunnel leg row channels, together with wide grassed buffer strips and planted trees around the polytunnels, in Dog Kennel Field, will have a significant positive effect on further reducing the potential for soil erosion and sediment mobilisation.

Overland flow velocities >1cm/s have the potential to start mobilising soil particles and therefore initiate erosion; and velocities >10cm/s will almost certainly transport soil particles and initiate erosion, if the water is flowing over bare soil (Reading, 1986). By utilising the grass and/or straw and/or Mypex and flow restrictors, leg row channel velocities are reduced. By dispersing the flow over the heavily vegetated areas overland flow velocities are reduced. As a result, soil stability is greatly increased. Soil stability is increased further by the binding effects of the roots.

4 SEQUENTIAL TEST AND EXCEPTION TEST

The Sequential Test from PPS25 guides new development to areas at the lowest probability of flooding (Zone 1); the zones being listed in Table D.1.

When trying to identify potential areas for the polytunnel development, the proposed site was identified to be available and within Flood Zone 1 therefore meeting the criteria of the Sequential Test.

Table D.3 of PPS25 indicates that the Exception Test is not relevant to this development.

5 QUANTITATIVE DATA ANALYSIS

5.1 Approach

The approach detailed in Defra/Environment Agency document "Preliminary rainfall runoff management for developments. R&D Technical Report W5-074/A/TR/1 Revision C, re-published June 2007", has been undertaken for this investigation comprising the following elements:

- Determination of the greenfield runoff (GFR) for the 1, 30 and 100 year period events
- Calculation of the attenuation storage volumes for the 1 in 100 year (+20%) event
- Calculation of the long term storage volumes for the 1 in 100 year (+20%) event

Although the approach has been developed for urban developments it must be emphasised that the polytunnel drainage at Dog Kennel Field is an agricultural drainage issue and not an urban drainage issue.

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The analysis method used in this study is the same as that used elsewhere by JDIH as a standard approach to assess polytunnel drainage, which has been reviewed and accepted by the Environment Agency.

The accompanying CD presents an Excel work book (ref: Final - Initial storm design using EA-Defra Guidance – Dog Kennel Field.xls) presenting the calculations and a summary of the results are shown below.

The results from the analyses have then been used to develop and justify a simple rule for the sizing of storage per block of polytunnels. The methodology also incorporates a percentage increase to the 1 in 100 year storm event to accommodate climate change.

5.2 Greenfield Runoff

The GFR has been determined and is summarised in Table 1. This provides a peak Greenfield runoff rate of 3.20l/s/ha.

Table 1 GFR for IoH124 methodology.

Greenfield Runoff (GFR)		**peak rate (l/s/ha)**
Initial design (IoH124)	Q1yr	0.85
	Q30yr	2.38
	Q100yr	3.20

5.3 Attenuation Storage Volumes and Long Term Storage Volumes

The attenuation storage volumes have been calculated as runoff per ha of polytunnels. This is simply to allow easy conversion to volumes, for each polytunnel block. The polytunnels represent an impermeable cover, except for the leg rows, which represent 13% of the polytunnel area, giving a PIMP value of 87 (%).

The analysis essentially calculates the volume of water that is running off the development, which should be taken into account when designing attenuation storage. In the context of Dog Kennel Field, this has been taken to be the volume of water running off the polytunnel area (per ha) in a design storm. At this stage no account is taken of flow restrictors in the leg rows. Table 2 summarises the results.

The long term storage volumes have also been calculated from the same set of assumptions. This method is the storage that is required to account for additional runoff caused by the polytunnels in comparison to the volume generated in a "greenfield" scenario. This volume must be allowed to infiltrate or be kept in storage with the ability to be discharged at a rate of less than 2 l/s/ha.

Table 2 Attenuation and Long Term Storage volumes

Initial Design Attenuation Storage (PIMP = 87% for 18ha development)	
Atten. Vol1yr	3125 m^3 174 m^3/ha
Atten. Vol30yr	7214 m^3 401 m^3/ha
Atten. Vol100yr	10498 m^3 583 m^3/ha

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Long term storage volume	
(LTVol100yr6hr)	3962 m^3
(LTVol100yr6hr)	220 m^3/ha

5.4 Discussion

The methods used in this assessment have been developed for urban runoff settings. It is therefore important to place the results within the context of polytunnel development which by its very nature is rural. While the polytunnels themselves generate essentially 100% runoff, as soon as the water hits the ground, then soil surface processes such as infiltration and evapotranspiration will start to attenuate the runoff. The leg row channels become swales by incorporating methods to restrict and store flows. At the end of the polytunnels, discharge into and over headlands (grassed buffer strips) will further attenuate flow rate and volumes by resistance in the grass sward as well as the other processes.

The leg row "swales" generally provide a greater ratio for impermeable surface to swale for the polytunnel development than that of an urban development. Additionally, storage can be provided in the polytunnel leg row "swales" to allow standing water. This is often unacceptable in urban settings because of the human health and safety factor.

However, the combination of results demonstrates that runoff can occur from the polytunnels in excess of the GFR and that in line with EA policy that this runoff should be catered for.

5.5 Existing Water Storage

There is an existing water storage area in the form of two reservoirs, located north of the Dog Kennel Field. This is illustrated on Figures 2 and 3. Although this storage area can accommodate some of the runoff from the polytunnel area, it has not been specifically designed for runoff storage and attenuation, moreover it is used as a store for irrigation water.

This storage area is also located within the EA Flood Zone 1 and therefore, can cater for storage and attenuation of runoff from the polytunnel area for events up to or greater than the 1 in 100 year storm event.

There is storage also located in the form of two long term storage areas, located north of the Dog Kennel Field. The storage areas accommodate runoff from the approved polytunnel development (planning application 08/02777/FUL) (as storage ponds in Figure 2).

6 NEW WATER STORAGE

6.1 Proposed Runoff Storage

It is recognised that additional storage and attenuation of runoff for high magnitude events is required. The long term storage requirement for the polytunnel area has been calculated as $4000m^3$.

Storage will be available in the leg row channels as micro storage and in the existing reservoirs, however, these are recognised as additional storages and have not been included in calculations to accommodate the $4000m^3$ at this stage. The proposed long term storage will be accommodated by two long term storage areas outside of the polytunnel area.

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Long term storage area 1 will capture the initial flows from the northern section of the proposed polytunnel area (Figures 2 and 3). This will feed into the Elbridge Rife via a throttle pipe at 2l/s/ha and will flow over an energy dissipater.

Long term storage area 2 will capture flows from the southern section of the proposed polytunnel area (Figures 2 and 4). The flow will leave the storage area 2 via a throttle pipe at 2l/s/ha and will flow over an energy dissipater. The flow will enter a natural drainage ditch on the south side of the polytunnels and flow south. The drainage ditch then joins a series of rifes which are tributaries of the Aldingbourne Rife.

7 OTHER POTENTIAL SOURCES OF FLOODING.

7.1 Flooding from streams and rivers

The nearest tributary to the site lies in the EA Flood Zone 1 and therefore in the event of flooding, surface water flooding will be that associated with the EA Flood Zone 1. It is unlikely that river levels will be raised sufficient to induce flooding of the polytunnel areas.

7.2 Flooding from the sea

Not applicable.

7.3 Flooding from groundwater

Groundwater levels at the site are thought to be high, however, any groundwater flooding will be associated with the flooding of surface water courses. The nearest tributary to the site lies in the EA Flood Zone 1 and therefore it is unlikely that groundwater will be raised sufficient to induce flooding of the polytunnel areas.

7.4 Sewers and road drainage

The site is a rural, agricultural development and as such there are no sewer systems or road drainage associated with the polytunnels areas.

The eastern boundary of the site is bounded by an A road, the A259. It is assumed that part of the road drainage for the A259 will be directed to the Aldingbourne Rife that flows south adjacent to the site. It is also assumed that the drainage network for this road has been appropriately sized and designed for storm events and will not impact on the EA Flood Zone 1. Therefore, it is considered that due to the nature of both the proposed polytunnel development and the road drainage network that neither will affect nor be affected by the other.

7.5 Reservoirs and canals

There are two reservoirs within the site boundary at Dog Kennel Field which are used as a store for irrigation water. It is unlikely that reservoir levels will be raised sufficient to induce flooding of the polytunnel areas. It is also assumed that the reservoirs have been appropriately sized and designed for storm events and will not impact on the EA Flood Zone 1.

There are no canals up gradient of site boundary.

8 ENVIRONMENT AGENCY CONSENTS

There is no requirement for a land drainage or flood defence consent.

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9 DRY ACCESS ROUTES

Based on the location of the site in Flood Zone 1, a site dry access route during the 1 in 100 year +20% event will always be available.

10 DRY ISLANDS

Not Applicable

11 CONCLUSIONS

This assessment has demonstrated that the polytunnel development at Dog Kennel Field will not have a detrimental impact on drainage and flooding providing storage is provided for in the proposed storage areas.

It is important that the drainage system is actively managed, to reduce flow velocities in the leg row "swales" and to distribute drainage over grassed areas.

Based on Defra/Environment Agency document "Preliminary rainfall runoff management for developments, R&D Technical Report W5-074/A/TR/1 Revision C. Long Term Storage calculations; the required additional storage requirement for polytunnel area is 220m^3/ha. It has been shown that this storage requirement can be accommodated within the long term storage areas 1 and 2.

Under guidelines laid out in PPS25, the polytunnel development has been classified (in Table D.2 of PPS25) as "less vulnerable" and the development is considered appropriate (in Table D.3 in PPS25) for Flood Zone 1. With the current and recommended water management systems at the site, these polytunnels will remain operational and safe during times of flood; will result in no net loss of floodplain storage; will not impede water flows and will not increase the flood risk elsewhere.

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Water Resource Specialist

Lee Clarke MSc FGS
Senior Hydrologist

James Dodds MSc CGeol FGS
Director, Water Management Specialist

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