Historic England

Surrey

Building Stones of England

The Building Stones of England

England's rich architectural heritage owes much to the great variety of stones used in buildings and other structures. The building stones commonly reflect the local geology, imparting local distinctiveness to historic towns, villages and rural landscapes.

Historic England and the British Geological Survey (BGS), working with local geologists and historic buildings experts, have compiled the Building Stones Database for England to identify important building stones, where they came from and potential alternative sources for repairs and new construction.

Drawing on this research, plus BGS publications and fieldwork, guides like this one have been produced for each English county. The guides are aimed at mineral planners, building conservation advisers, architects and surveyors, and those assessing townscapes and countryside character. The guides will also be of interest if you want to find out more about local buildings, natural history, and landscapes.

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Front cover: St Michael's Church, Betchworth. Chalk, Reigate Stone, Bath Stone. © Trinity Mirror / Mirrorpix / Alamy Stock Photo.

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HistoricEngland.org.uk/advice/technical-advice/

How to Use this Guide

Each guide describes the local building stones in their geological timescale order, starting with the oldest layers through to the youngest. The guide ends with examples of other notable building stones from other parts of England and further afield.

Geological time periods, groups, formations and building stones

Each building stone is listed under the relevant geological timescale, group and formation. A formation may be divided into members and where relevant these are referenced in individual building stone sections.

Middle Jurassic
↑— geological time period
Inferior Oolite Group, Lincolnshire Limestone Formation
↑— geological group ↑— geological formation
Lincolnshire Limestone
↑— building stone (alternative or local name)

Bedrock geology map and stratigraphic table

To help you with the geology of the area, there is a bedrock geology map and a stratigraphic table which shows the layers of rocks and the associated building stones in this geological timescale, group, formation order.

Page numbers for each building stone are included in the stratigraphic table for ease of reference. The page numbers are inverted to correspond with the geological age order.

Contents list

If you click on the page number for a building stone in the Contents list, you will go straight to the relevant section in the guide.

Building stone sources and building examples

A companion spreadsheet to this guide provides:

- More examples of buildings. Information is included on building type, date, architectural style, building stone source, and listed/ scheduled status
- A list of known (active and ceased) building stone sources such as quarries, mines, pits and delphs
- Additional information on building stones including lithology, grain size, sedimentary structures, key identification features, and notes on failure/weathering, and use.

The Building Stone GIS map allows you to search the Building Stones Database for England for:

- A building stone type in an area
- Details on individual mapped buildings or stone sources
- Potential sources of building stone sources within a given proximity of a stone building or area
- Buildings or stone sources in individual mineral planning authority area.

Further Reading, Online Resources and Contacts

The guide includes geological and building stone references for the area. A separate guide is provided on general Further Reading, Online Resources and Contacts.

Glossary

The guides include many geological terms. A separate Glossary explaining these terms is provided to be used alongside the guides.

The guides use the BGS lexicon of named rock units.

Mineral and local planning authorities

This guide covers the Surrey County Council mineral planning authority area and the local planning authority areas of Spelthorne, Runnymede, Surrey Heath, Woking, Elmbridge, Guildford, Waverley, Mole Valley, Epsom and Ewell, Reigate and Banstead, and Tandridge.

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1 Introduction

The geology of Surrey comprises sedimentary strata laid down during the Cretaceous, Palaeogene-Neogene (Tertiary) and Quaternary periods of geological time. The succession becomes younger north-westwards across the county.

The oldest exposed strata, represented by sandstones, siltstones and mudstones assigned to the Lower Cretaceous Tunbridge Wells Sand Formation, the Wadhurst Clay Formation and the Ashdown Formation, occur in the far south-eastern corner of Surrey, between Shipley Bridge, Lingfield, Felbridge and Dormansland. To the north, and stretching right across southern Surrey between Haslemere and the county border with Kent (encompassing the towns of Cranleigh, Ewhurst, Coldharbour, Capel, Charlwood, Earlswood and Horley), lies the outcrop of the Weald Clay Formation. This comprises mainly mudstones, with subordinate siltstones, shelly limestones (the Paludina Limestones) and occasional clay ironstones.

Stratigraphically overlying the Weald Clay Formation, and extending in a broad west–east trending belt throughout central Surrey, is a succession of calcareous and glauconitic sandstones (greensands), ironstones, mudstones and limestones assigned to the Lower Greensand and Selborne groups. These are, in turn, overlain by an Upper Cretaceous sequence of impure chalks and chalk with flints belonging to the Grey Chalk and White Chalk subgroups, respectively. North of a line stretching approximately from Farnham via Guildford and Leatherhead to Epsom, the north-western part of Surrey comprises Palaeogene to Quaternary-aged rocks and sediments. These are assigned to the Lambeth, Thames and Bracklesham groups. In the northern part of the county, principally in the area encompassing Stanwell, Egham, Walton-on-Thames, Woking and Esher, these sediments are largely concealed by a variety of essentially unconsolidated river terrace and alluvial deposits laid down during Pleistocene and Holocene times.

The Lower Cretaceous succession has been an important source of indigenous building stone in Surrey. The yellow-brown sandstones from the Lower Greensand Group were quarried for local use around Godalming, and at Hurtmore (working material known as Bargate Stone), Witley and Hurtwood. Bargate Stone is one of the most widely employed building stones within Surrey. Dark, purplish-black ironstone (carstone) occurring within the Folkestone Formation was also a former source of local building stone around Farnham. Ironstone has been used for various building purposes since at least the Iron Age. The last remaining quarry in the Lower Greensand Group producing sandstone for building was located at Hurtwood (Pitch

Hill), near Cranleigh, but it is now closed. At Russ Hill and Charlwood, on the southern boundary of the county near Gatwick, Lower Cretaceous limestones from the Weald Clay Formation (known as Bethersden Marble or Charlwood Stone) were worked. However, these were mainly employed for internal decorative use.

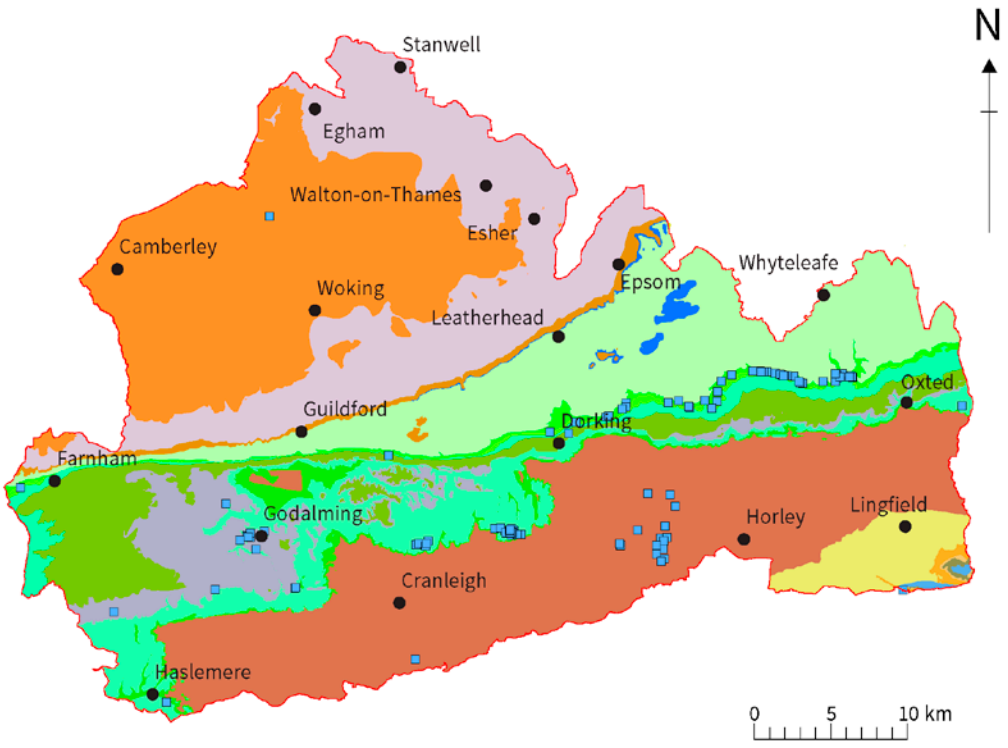
Some of the most important building stone quarries in Surrey were formerly those in the Reigate–Gatton–Chaldon area. These produced a distinctive siliceous sandstone from the Upper Greensand Formation known as Reigate Stone (also called Merstham Stone and Gatton Stone). The Upper Cretaceous Chalk succession yielded a small amount of flint for local building purposes, and younger superficial deposits were often widely exploited for Sarsen stones, Quaternary Flint and chert pebbles and cobbles. There are no building stone quarries currently operating or consented in Surrey.

Stratigraphic Table

Geological timescale	Groups		Formations	Building stones	Page
Quaternary	Great Britain Superficial Deposits Supergroup	variously subdivided	variously subdivided	Quaternary Flint (Field Flint, River Terrace Gravel Flint) Chert pebbles and cobbles Sarsen Stone (Greywethers, Silcrete) Ironpan Conglomerate (Conglomerate, Puddingstone, Ferricrete)	52 51 49 46
	Bracklesham Group		Camberley Sand Formation		
			Windlesham Formation		
			Bagshot Formation		
	Thames Group		London Clay Formation		
	Lambeth Group		Woolwich and Reading Beds		
	Montrose Group		Thanet Formation		
Upper Cretaceous	Chalk Group	White Chalk Subgroup	Upper Chalk, Middle Chalk	Chalk Quarry Flint (Fresh Flint)	45 44
		Grey Chalk Subgroup	Lower Chalk		
Lower Cretaceous	Selborne Group		Upper Greensand Formation	Upper Greensand Sandstone Reigate Stone (Merstham Stone, Gatton Stone, Chaldon Stone, Godstone Stone, Firestone, Hearthstone)	43 41
			Gault Formation		
	Lower Greensand Group		Folkestone Formation	Ironstone (Carstone)	39
			Sandgate Formation	Bargate Stone (Bargate Sandstone)	36
			Hythe Formation	Holmbury Hill Sandstone (Leith Hill Stone, Hurtwood Stone)	34
			Atherfield Clay Formation		
	Wealden Group		Weald Clay Formation	Sussex Marble (Paludina Limestone, Periwinkle Stone, Bethersden Marble, Charlwood Stone, Petworth Marble, Laughton Stone) Wealden Sandstone	33 31
			Tunbridge Wells Sand Formation	Tunbridge Wells Sandstone, Ardingly Sandstone	30
			Wadhurst Clay Formation, Ashdown Formation		

Building stones in geological order from the oldest through to the youngest layers.

Bedrock Geology Map



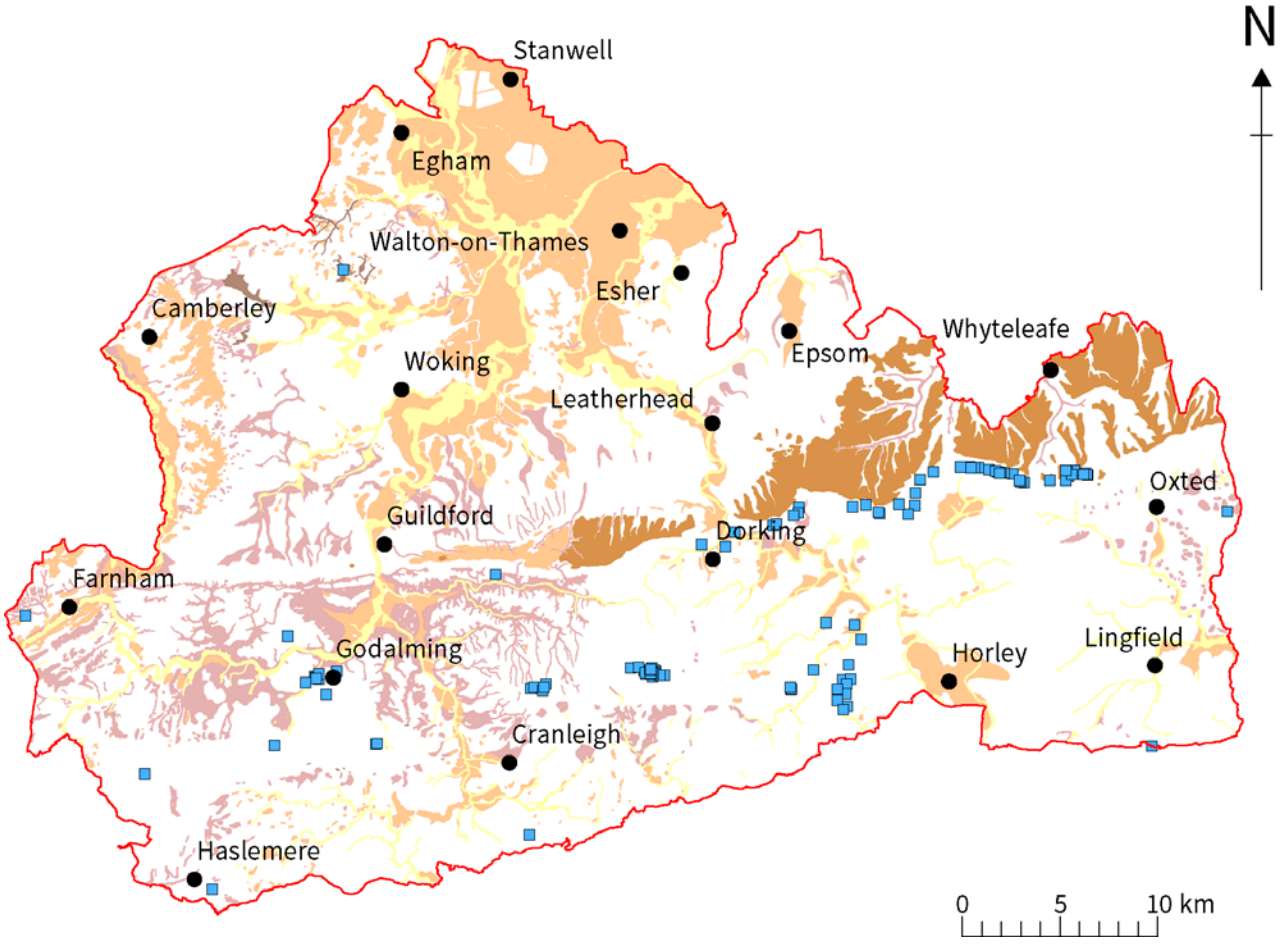
Key

Building stone sources

Bedrock geology

- Bracklesham Group — sand, silt and clay
- Thames Group (including London Clay Formation) — gravel, sand, silt and clay
- Lambeth Group — clay, silt and sand
- Thanet Formation — sand
- White Chalk Subgroup — chalk
- Grey Chalk Subgroup — chalk
- Upper Greensand Formation — calcareous sandstone
- Gault Formation — mudstone
- Folkestone Formation — sandstone
- Hythe Formation — sandstone and limestone
- Athertfield Clay Formation — mudstone
- Weald Clay Formation — clay, ironstone, limestone, sandstone and mudstone
- Upper Tunbridge Wells Sand — mudstone and sandstone
- Lower Tunbridge Wells Sand — mudstone and sandstone
- Ardingley Sandstone Member — sandstone
- Wadhurst Clay Formation — mudstone
- Ashdown Formation — sandstone and siltstone

Superficial Geology Map



Key

- Building stone sources

Superficial geology

- Alluvium — clay, silt, sand, gravel and peat
- River Terrace Deposits — clay, silt, sand and gravel
- Head — clay, silt, sand and gravel
- Peat — peat
- Clay-With-Flints Formation — clay, silt, sand and gravel

2 The Use of Stone in Surrey's Buildings

Surrey has 6,590 listed buildings, including 105 Grade I and 322 Grade II*. They range from graveyard monuments and garden walls to the post-modernist Legal and General House, Tadworth. There are 200 conservation areas in the county.

Surrey was and remains well wooded. The poor quality of much of its soils, the heathlands in the north-west, the chalk scarp of the North Downs and the dense woodlands of the Downs dip slope and of the Weald restricted agricultural production. Substantial parts of the county were economically impoverished. Throughout the medieval and early modern periods, vernacular buildings were predominantly timber framed. An extensive brick and tile industry developed from the 16th century, with the materials coming to dominate vernacular construction. However, the county had significant building stone resources, although they were not of particularly good quality. In the north-west of the county, Quaternary Flint, chert pebbles and cobbles, ironpan conglomerate and Sarsen stones were frequently used in medieval churches. Chalk from the North Downs was quarried in many locations, but it was generally used for marl for agricultural improvement. It was also employed internally in medieval churches close to the sources and occasionally further afield, including at Stoke D'Abernon, Wisley and Godalming. At times, chalk was used externally for dressings, such as at Waverley Abbey near Farnham and Loseley Park near Guildford; it is also found in the base to the 11th-century keep at Guildford Castle.

Flint was used from the Roman period onwards. Field, quarry and river terrace flints were employed depending on availability. Flint was used as facing to at least two-thirds of Surrey's medieval churches, particularly north of the chalk ridge of the North Downs. In the 19th century, it was favoured for re-facing and in the construction of extensions and new churches in the area. Most surviving flint domestic buildings date from the 18th and 19th centuries, reflecting the increased availability of the material as a by-product to the chalk marl industry. Flint was used particularly in the east, close to the chalk downs, and nearly always with brick dressings.

In the Weald of the south and south-east of the county, considerable use was made of local Reigate Stone and Upper Greensand Sandstone. Lower Greensand Holmbury Hill Sandstone was employed in the village of Holmbury St Mary. Wealden Sandstone was used at Ewhurst, Charlwood and Outwood, for example. Sussex Marble and Tunbridge Wells Sandstone were employed occasionally in the far south-east of the county. Examples of the

use of Sussex Marble include The Dolphin public house and the Church of St Michael at Betchworth and Tigbourne Court, Wormley.

In the south-west of the county, Lower Greensand Bargate Stone was employed extensively for churches, alongside some use of ironstone (carstone). Brick was generally used for dressings. There was a revival in the use of Bargate Stone in the late 19th and early 20th centuries, particularly in Arts and Crafts Movement houses.

Galleting is commonly found in buildings where the local stone is difficult to work as regular blocks. Stone chips are inserted into thicker masonry joints, sometimes decoratively. The stone chips are often ironstone but flint chips are also used as galletting in flint buildings.

Historical context

Until the Dissolution of the Monasteries in the 16th century, religious communities had a significant influence on the landscape, the economy and the extraction and use of building stone. There were probably 10 post-Conquest monasteries in the county. The two most significant were Chertsey Abbey, which became one of the largest and most influential monasteries in England, and Waverley Abbey, which was the first Cistercian abbey to be built in England. Monastic influence reached its peak in the 14th century during the tenure of Abbot Rutherwyk at Chertsey. The abbey was responsible for building and rebuilding many churches, including at Cranleigh, Egham, Godalming, Shere and Tatsfield, and for constructing roads, bridges, mills, barns and granges. Several stone bridges of the period survive across the River Wey, including those at Eashing, Elstead and Tilford Green.

There are 206 listed churches in Surrey; 64 churches were recorded in the Domesday Book. Most pre-Reformation churches were initially small and developed piecemeal over the centuries. The long history of alteration, extension, rebuilding and repair of such churches means they frequently exhibit a range of stones of different origins and periods. In most areas of the

Figure 1: Waverley Abbey, Farnham. Chalk, carstone, Quaternary Flint and Bargate Stone.

county, these churches are the most significant stone-built structures. Some 50 medieval towers remain.

Numerous Saxon churches were rebuilt after the Norman Conquest in 1066. In the later 12th century, many churches were enlarged by the addition of aisles and the rebuilding of their arcades, such as at Chobham and Walton-on-Thames. A number of towers were added in local materials, at Cobham and Limpsfield, for example. Changes to religious practices and beliefs in the 14th century led to the extension of several chancels, such as St Mary's at Guildford and St Mary's at Stoke D'Abernon. Occasionally, new towers were built, including at Chiddingfold, Chipstead and Wonersh.

After the Norman Conquest, those higher up the social hierarchy built castles and manors to defend the realm and demonstrate their authority. Early castles included the royal castle of Guildford, Farnham Castle (the home of the Bishops of Winchester) and Reigate Castle (the home of the de Warenne family).

Figure 2: Guildford Castle tower keep. Bargate Stone and Quarry Flint, with chalk and Upper Greensand Sandstone quoins and a chalk plinth. Repairs include Bargate Stone, flint and carstone.

Surrey became an important extractive and manufacturing area such as pottery, glass making, iron forges and furnaces, and armanents from the later medieval period onwards. Quarries around Godstone and Merstham provided stone for new buildings.

The county did not develop the very wealthy merchant class that funded the rebuilding of churches in the 15th century elsewhere in England. In fact, there are few 15th-century churches in Surrey, the best being at Lingfield. A small number of towers were rebuilt, though, including at Chobham, Farnham, Leatherhead, Reigate and West Molesey. Furthermore, very few churches were built or rebuilt in the late medieval period. A rare example is St George's Church at Esher (mid-16th century). Nearly all post-Reformation new work was constructed in brick.

The Dissolution of the Monasteries resulted in the fragmentation of monastic estates and their transfer to secular landowners. Most of the buildings were demolished and cannibalised for their building materials. The proximity of Surrey to London led to royalty and their courtiers building mansions in the county. Many were of brick, such as Sutton Place, a Tudor manor house near Guildford. Nonsuch Palace near Ewell, Henry VIII's favourite building, was built with a chalk and flint ground floor and timber frame above. It was demolished in 1682–88. Loseley Park, built for Sir William More in 1562–68, was the first house in the county with the 'H' or 'E'-shaped plan that became characteristic of the period. Bargate Stone from Waverley Abbey was reused at Loseley, and stone from Chertsey Abbey was re-employed at Hampton Court.

Figure 3: Loseley Park, Guildford. Bargate Stone with chalk dressings.

Competing demands for timber for iron and glass making and for shipbuilding led to a shortage in the early 17th century. Stone became more extensively used for building where it was locally available. Timber frame had become obsolete by the end of the 17th century, largely replaced by brick. At the end of the 18th century, imported Baltic softwood was used to build light-framed houses and other buildings clad in weatherboard, or occasionally lath and plaster.

London continued to grow during the 18th century and its demands on Surrey for food and other supplies continued. Before the end of the 18th century, threshing barns were often the only farm building. Most Surrey barns date from the 17th and 18th centuries, and only about one per cent are constructed of stone. The materials used include Bargate Stone, Greensand Sandstone, Quarry Flint and Quaternary Flint. In the Weald, Horsham Stone slate was occasionally employed. Post-18th century, with improvements in the transportation network, Welsh Slate started to be used on farm buildings.

Figure 4: Barns, Hydestile Farm, Hambledon. Bargate Stone with brick dressings.

Until the late 18th century, the road network of the county was very poor. The increased demand by London for goods made in Surrey necessitated better methods of transport. One of the country's first canal systems, the Wey Navigation, opened in 1653, followed by the Godalming Navigation in 1760 and the Basingstoke Canal in 1788, providing access to London via the Thames. From 1685, the Turnpike Trust competed to improve roads between London, the major towns and the south coast, so that by 1820 a virtually new road system had been created. Partly as a result of this road network, in the late 17th and early 18th centuries, Surrey began to attract fashionable society members looking for places of retreat. The landscapes of many estates were extensively redesigned as parks, gardens and arboreta, and farms.

The Grand Surrey Iron Railway, opened 1803, ran from Croydon to the Thames at Wandsworth. In 1805, it was extended by the Croydon, Merstham and Godstone Railway over the North Downs. The railway transported Reigate Stone, chalk and lime from the Jolliffe and Banks quarries at Merstham for use in London.

From the 1840s, the establishment of a network of railways across the county (serving the south coast ports and resorts, Exeter and the West Country) and the linking of freight routes (around the west of London to railways serving the north of England) enabled the importation of an increasing range of building stones and slates. The construction of a suburban railway network facilitated the development of commuting and the rapid expansion of London across much of the north and north-east of the historic county.

The population increase in the county caused by the expansion of London in the 19th century led to the need for many new churches. In 1826, there were 155 churches and 19 chapels in the current Surrey area; by 1965, there

were 263. Most were constructed prior to 1870. New parishes were created, including St Paul's, Addlestone. Nearly all Surrey's medieval churches were restored, and many were enlarged. Many significant Victorian architects were responsible for restoring, rebuilding and constructing new churches, including William Burges, Augustus Pugin, Henry Woodyer, Sir George Gilbert Scott, George Edmund Street and John Loughborough Pearson. A wide range of stones was used, including imported stones such as Bath Stone and Kentish Rag, along with various sandstones, marbles and serpentine.

In the 19th century, religious worship was starting to become more varied in Surrey, with an increasing mix of different cultures and faiths. The oldest mosque in Britain, the Shah Jahan Mosque in Woking, was opened in 1889. It is constructed of dressed, uncoursed Bargate Stone with Bath Stone dressings.

Figure 5: Shah Jahan Mosque, Woking. Bargate Stone with Bath Stone dressings.

Few churches were built in the 20th century. Examples include St Mary's Church at Pixham, where Sir Edwin Lutyens used chalk with tiles and sandstone patterning. W D Caröe worked in the north-west of the county, designing St Paul's Church at Camberley, St Mary of Bethany Church at Woking and St John the Baptist Church at West Byfleet. St Mary's Church at Burgh Heath was built in flint chequerwork. In the 1930s, a stone west tower was added to St Paul's Church at Woldingham by Sir Herbert Baker, with East Anglian-style flint flushwork. The county's most significant new religious building, Guildford Cathedral, was built in brick between 1933 and 1961.

The improvements in transportation throughout the 19th century largely brought Surrey's farming role to an end. Existing towns such as Guildford and Farnham grew rapidly and new towns were created, including Redhill and Woking. Settlements in the north and east of the county were subsumed into Greater London. The Green Belt around London, established following the Town and Country Planning Act of 1947, prevented excessive suburbanisation close to London, but transferred development pressure further west and south. The transformation of Surrey continued into the 20th century with the creation of the M25 orbital motorway, the M3 and the M23, as well as the building of both Gatwick and Heathrow airports on either side of the county.

Surrey style

In the late 19th century, Surrey was briefly at the forefront of European architectural design. The architecture of the Arts and Crafts Movement was heavily influenced by the vernacular of Surrey and the materials it used. Architects such as Sir Edwin Lutyens developed their early architectural practice, particularly in the west of the county. Here, easy access by rail to Westminster and the City of London led to the area being colonised by businessmen intent on playing the role of 'country gent'. Numbers of large and medium-sized, late 19th-century houses were built in and near settlements such as Haslemere, Hindhead, Godalming, Cranleigh, Ewhurst, Puttenham, Guildford, Abinger and Holmbury St Mary. The style became highly influential across the country, and also in Europe and the USA. Surrey probably has more houses of the period than any other English county.

Architects favoured the use of local materials, particularly Bargate Stone, which was readily available from the Godalming area, and Horsham Stone slate for roofing, although the latter was already in short supply by this time, and it was stripped off vernacular buildings to roof the new architect-designed country houses. Architects often delighted in the use of stone patterning and ornamentation. Sir Edwin Lutyens designed and remodelled a wide range of buildings, most famously the Orchards in Bramley, Ruckman's Farm House at Okewood Hill, Tigbourne Court in Wormley and Munstead Wood in Busbridge. He forged a partnership with the gardener Gertrude Jekyll, who laid out the gardens to complement the houses using a similar range of materials. A significant number of well-known architects also built in the area, including Norman Shaw, M H Baillie Scott, Charles Harrison Townsend, Philip Powell, Ernest Newton, Hugh Thackeray Turner, C F A Voysey and Philip Webb, along with many other less well-known practitioners. Wycliffe Buildings in Guildford, by Thackeray Turner, is a rare example of a complex of Arts and Crafts Movement residential flats. They are built of coursed and snecked Bargate Stone.

Figure 6: Tigbourne Court, Wormley. Bargate Stone with brick quoins and horizontal tile bands.

National Character Areas (NCAs)

Local landscape character and the combination of history, cultural and economic activity, geodiversity and biodiversity have been mapped for the whole of England and National Character Areas (NCA) defined (see Further reading). For each NCA there is a profile document which describes the natural and cultural features that shape the landscapes, how the landscapes have changed over time, the current key drivers for ongoing change, and a broad analysis of each area's characteristics and ecosystem services. The profiles include notes on local vernacular and building materials which are expanded in the following section on the nine NCAs covered by this guide:

NCA 114 Thames Basin Lowlands
NCA 115 Thames Valley
NCA 119 North Downs
NCA 120 Wealden Greensand
NCA 121 Low Weald
NCA 122 High Weald
NCA 129 Thames Basin Heaths
NCA 130 Hampshire Downs

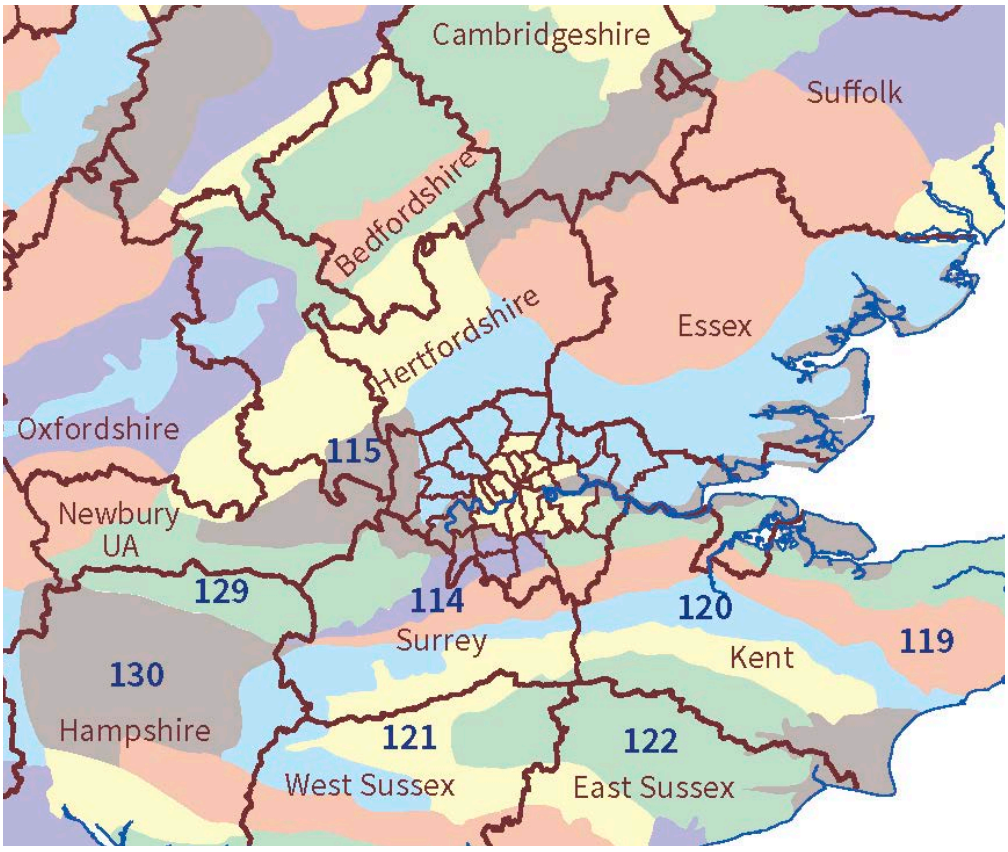


Figure 7: Map showing the National Character Areas (and the NCA numbers).

Thames Basin Lowlands

The Thames Basin Lowlands NCA forms a low-lying plain within the London Basin. It stretches from the London suburbs of South Norwood in the east to Hale on the Surrey-Hampshire border in the west.

To the north-east, the NCA incorporates parts of Greater London and its outer suburbs, such as Epsom, Ewell and Esher. Further south and west, the settlements of Hale, Weybourne, Guildford (north), Ash, Leatherhead, Stoke D'Abernon, Cobham and Chobham lie within the area.

In the north-east, the NCA is well wooded with areas of wood pasture common, such as Ashtead Common. Here, 20th-century suburban development is extensive. To the south-west, the NCA supports a small-scale farmed landscape, dissected by the meandering river valleys of the Wey and Mole.

The area became densely settled in the medieval period, with a varied settlement pattern of isolated farmsteads and houses, hamlets and small villages. Hunting forests and estate parks with grand houses were established, including Henry VIII's Nonsuch Palace at Ewell. The royal forest of Windsor extended to Chobham. Much of the area was owned by abbeys, such as Chertsey and Westminster.

Timber frame was the dominant form of construction for vernacular houses in the medieval period. Local flint was used extensively in medieval churches. Dressings were often originally of chalk, but these deteriorated frequently and were replaced with a variety of imported limestones. In churches, particularly in the north-west of the area, other materials were sometimes used, including ironpan conglomerates at All Saints' Church at Ockham and St George's Church at Esher, for example, and ironstone in the 15th-century tower at St Andrew's Church at Cobham. This last shows one of the most northerly uses of Horsham Stone slate slabs for roofing in the county.

Most of the area's churches were heavily restored and altered or rebuilt in the 19th century. Flint was often used to re-face the buildings. The Church of St Mary at Stoke D'Abernon is one of the very few seignorial churches to have survived from the Saxon period: the south wall dates from the 7th century. It is constructed largely of flint, but was extensively restored in the 19th century and partly re-faced in flint and a mix of other materials, including chalk, ironpan conglomerate and various sandstones. The Church of SS Mary and Nicholas at Leatherhead is built mostly of Quaternary Flint, with dressings of Lincolnshire limestone. It was re-faced in the 19th century and the north transept has a Horsham Stone slate roof.

From the 16th century, the region became a popular recreational area and retreat from London. Epsom became one of the first spa towns in England in 1711. Country houses, generally built of brick, and landscaped parks were constructed, including at Claremont just outside Esher. At East Horsley, the Earl of Lovelace re-faced Horsley Towers (originally designed by Charles Barry in 1820–9) in flint and brick and built sizeable extensions in flint rubble and

Figure 8: St Mary's Church, Stoke D'Abernon. Quaternary Flint.

brick, including cloisters, a chapel and a large tower between 1847 and 1860. Many cottages, houses and farms on the estate and in East Horsley village were built in flint and brick. A series of 15 flint and brick bridges were constructed to facilitate riding through the woods and the extraction of timber on the estate.

During the 18th century, villages such as Cobham, Esher, Ripley and Send grew up along what is now the A3, providing stopping points for coaches as they travelled between London and Portsmouth. The development of the railway network in the 19th century encouraged commuting to London. The pricing strategy of the railway company was aimed at commuters from the managerial classes rather than the working class. Many larger detached and semi-detached town and suburban houses were built. In Guildford, for example, Bargate Stone was often used for such buildings. Railway electrification in the 1920s encouraged further development of estates of large detached houses, particularly around settlements such as Esher, Cobham, Guildford, Oxshott and Leatherhead. The construction of the M25 in the late 20th century led to continuing development pressure.

Thames Valley

A small area of the Thames Valley NCA falls within north-west Surrey. It includes the settlements of Staines, Sunbury, Shepperton, Littleton and Laleham on the north bank of the River Thames, and Walton-on-Thames,

Thames Ditton and East and West Molesey on the south bank. Former areas of Surrey that now form part of Greater London, such as Kingston-upon-Thames, Richmond and Kew, lie within this NCA.

The Thames has always formed an important transport route and played a significant part in the county's history. In the Roman period, it was bridged at Pontes (Staines), which lay on the main road between Londinium (London) and the west via Calleva Atrebatum (Silchester, Hampshire). The fifth and current Staines bridge, constructed in granite by George Rennie, opened in 1832.

In the medieval period, the Thames was greatly modified to allow easier navigation, causing the tide to extend much further upstream than was natural. The river was tidal as far as Staines before Teddington Lock was built in 1810–12. The rich soils of the flood plain supported thriving agriculture and considerable settlement. Medieval churches of the area were built of a variety of local materials. For example, the Church of St Mary Magdalene at Littleton is constructed of chalk and ironpan conglomerate, with a brick tower and clerestory. St Mary's Church at Walton-on-Thames has a tower of flint, chalk and ironpan conglomerate, with various sandstones and limestones. The Church of St Nicholas at Shepperton is a rare example of a church rebuilt in the 17th century. It is constructed largely of flint rubble, with sandstone and flint chequerwork in the south wall. The tower was built of brick in 1710.

After the construction of Richmond Palace and Hampton Court Palace in the 16th century, many aristocratic families built great houses along the

Figure 9: St Mary's Church, Walton-on-Thames. Flint with stone dressings, and a brick clerestory.

river. The trend continued through the 18th and early 19th centuries. In the 18th century, the area attracted the most influential thinkers, poets, artists and landscape designers of the day. The river and other parts of the area became centres of interest, with villas, ornamental parks and residential development. Many mansions were created, including Ashley Park, Sunbury Court and Laleham Abbey. Most were built of brick.

Railways came to the area in the 1840s. The London and South Western Railway's Windsor branch, passing through Staines from Richmond, was opened in 1846, and Chertsey and Hampton Court were reached in 1849. The Staines line was extended to Wokingham in 1856. The Shepperton branch from Strawberry Hill via Sunbury opened in 1864. Development took place rapidly, with the historic villages becoming enveloped in new housing, nearly all built of brick. Large areas of the flood plain were built on. Heathrow Airport developed just to the north of the NCA.

Gravels have been extracted from the flood plain since the Middle Ages, and extensive extraction continues today. A substantial number of reservoirs were built to serve London from the 1850s, with construction continuing into the 20th century. Examples include the Staines Reservoirs (1901), and the Queen Elizabeth II Reservoir, Walton-on-Thames in Berkshire (1962).

North Downs

The North Downs form a long chalk escarpment extending from the Hog's Back in Surrey to the White Cliffs of Dover in Kent. The steep-sided escarpment faces south, with the extensively wooded dip slope, containing areas of heathland, extending northwards from the escarpment.

The North Downs NCA is generally sparsely populated. To the west, the settlement pattern is characterised by small nucleated villages, such as Puttenham, Seale and Wanborough, located on the spring line at the base of the escarpment, and scattered farmsteads on the dip slope. The Rivers Wey and Mole drain through valleys dissecting the downs from the Wealden Greensand in the south to the Thames in the north. Major settlements, such as Guildford, Dorking and Leatherhead, developed at the openings to the gaps but with the exception of Guildford largely lie outside the NCA. Small settlements such as Westhumble and Mickleham lie on the valley sides of the Mole gap. To the east, 19th and 20th-century suburban development has been extensive. Downland villages such as Walton-on-the-Hill, Tadworth and Banstead have coalesced. Similarly, valley bottom settlements such as Chipstead and Coulsdon (now Greater London) and Caterham and Worlingham have expanded dramatically. In the far east, the hilltop villages of Woldingham and Tatsfield retain more of their rural character.

Timber framing was the traditional building form, with thatch for roofing, although plain clay tiles from the Weald have largely replaced thatch. Flint, chalk, brick, timber and tiles were also employed. Wealden bricks were widely used from the later 17th century, sometimes for dressings and quoins to flint structures.

Chalk has been dug out of the downs from small quarries, pits and shafts for at least 2,000 years, principally to improve claylands, making them easier to plough. The Industrial Revolution and the construction of railways add: 'in the 19th century led to industrial-scale chalk quarrying, with extensive quarries near Betchworth and Oxted, for example. Use was made of chalk in medieval churches close to the escarpment. St Lawrence's Church at Caterham is built of chalk rubble with some ashlar and chalk dressings, with a brick east wall rebuilt in 1790. At Seale, to the far west of the NCA, various 18th and 19th-century buildings are built of chalk with Bargate Stone and ironstone. The village's Church of St Laurence was rebuilt in chalk and Upper Greensand Sandstone, with a central tower in Bargate Stone.

Between Brockham in the west and Godstone in the east, Reigate Stone was extensively mined and quarried from the Upper Greensand outcrop that passes through the parishes of Betchworth, Buckland, Reigate, Gatton, Merstham, Chaldon and Bletchingley. More than 40 entrances to underground Reigate Stone quarries have been identified, and there are more than 16km of underground tunnels. The stone was widely exported in the medieval period. Some use of the stone was made in many Surrey churches across the Weald, on the North Downs and beyond. St Katharine's Church at Merstham is of Reigate Stone (Merstham Stone), with some chalk and a Horsham Stone slate roof. All Saints Church at Warlingham was heavily restored in the 19th century in flint, with Reigate Stone dressings.

On the dip slope and in the valleys, flint was used more frequently. The Church of St Michael and All Angels at Mickleham is largely of flint with some chalk. Unusually, the Norbury chapel has flint flushwork and chequerwork with Reigate Stone.

Figure 10: Church of St Michael and All Saints, Mickleham. Flint and Reigate Stone.

In the 19th century, flint was used, in particular, for buildings from cottages to churches, largely reflecting its ready availability as a by-product of the chalk extraction and lime industries. St Martin's Church at Dorking is of coursed knapped flint, with ashlar quoins and dressings and a Welsh Slate roof. St Paul's Church at Dorking and the lodge and chapel buildings of Dorking's Reigate Road cemetery are also built of flint. The nave of St Mary the Virgin's Church at Headley is built of coursed flint cobbles. The fine Denbies estate Church of St Barnabas at Ranmore Common, the associated school and the rectory were all designed by Sir George Gilbert for George Cubitt, the first Lord Ashcombe. In 2017, flint was utilised to build the church hall of St John the Evangelist at Redhill, as an addition to James Knowle's knapped flint-faced church of 1842–3.

Flint was used for many cottages and houses in the 18th and 19th centuries from Redhill to Hindhead and Haslemere. Brick was usually employed for the quoins and dressings. Flint is still used in modern buildings, including the large entrance tower and restaurant at the Denbies Wine Estate, Dorking, which is faced in flint and brick.

Figure 11: Church of St Barnabas, Ranmore Common. Quaternary Flint cobble.

To the eastern end of the North Downs, some sandstones were used. The Church of St Mary the Virgin at Tatsfield has an 11th-century nave built of a dark sandstone with flint. The dressings were originally Reigate Stone, which is still prevalent in the chancel interior.

The advent of the railways enabled the easier transportation of materials. The Church of St John the Baptist at Puttenham was re-clad in Bargate Stone by Henry Woodyer, with some Bath Stone replacing earlier chalk dressings. The Arts and Crafts Church of Jesus Christ and the Wisdom of God at Lower Kingswood by Sidney Barnsley is constructed of brick with Ham Hill Stone. The interior exhibits a Roman and Byzantine influence and is richly decorated in reused Roman marbles, including African and Carrara marbles. The capitals are 4th to 6th century, reused from Byzantine buildings such as the Church of St John at Ephesus.

Wealden Greensand

The Wealden Greensand runs across Surrey parallel with and to the south of the North Downs, from the border with Kent near Oxted in the east to the Hampshire Downs NCA near Farnham in the west. The area is characterised by scarp and dip slope topography, with outcrops of Upper Greensand, Gault Clay and Lower Greensand. The Greensand forms escarpments rising to Leith Hill, the highest point in Surrey. The area remains well wooded, with areas of heathland particularly in the west. The settlement pattern is dominated by dispersed farmsteads, hamlets and nucleated villages, such as Puttenham, Shere, Gomshall, Haslemere, Holmbury St Mary, Betchworth, Bletchingley, Godstone, Limpsfield and Oxted. There are several market towns, including Farnham, Godalming, Dorking and Reigate.

Waverley Abbey near Farnham was a significant landowner in the west of the area. There were other monastic establishments in Guildford, and further east are the priories of Reigate and Tandridge. In the medieval period, the area became nationally important for iron making, using local ironstone and timber for charcoal for smelting.

Timber frame was the predominant form of vernacular construction until the 17th century. In the west of the area, Bargate Stone was extracted near Godalming from at least the 12th century. It is used in more than 250 listed buildings in the county and more widely. It was the preferred stone for use in local medieval churches, including Godalming Parish Church and the Church of St James at Shere. Often, it is found used with a range of other stones, such as ironstone, chalk, Caen Stone and various sandstones.

In the 19th and early 20th centuries, there was a significant revival in the use of Bargate Stone for new churches, including the Church of St Edmund King and Martyr at Godalming and the Church of St Christopher at Haslemere. It was also employed for Charterhouse School and by architects of the Arts and Crafts Movement for houses in the area.

Ironstone was extracted from the Lower Greensand and was used particularly around Farnham in the west and Limpsfield in the east. St Peter's Church at Limpsfield is built of ironstone and Wealden Group sandstone, with Horsham Stone slate roofs. The Church of St Mary the Virgin at Buckland, between Dorking and Reigate, is built of rough coursed ironstone and Bargate Stone. Ironstone was often used for galleting (particularly of Bargate Stone) in the wider area.

Reigate Stone has also been extracted in the area from the Upper Greensand Formation, between Brockham and Godstone in the east. The Church of St Mary Magdalene at Reigate was largely built of Reigate Stone, but it was extensively re-faced in Bath Stone by Sir George Gilbert Scott Jr after it deteriorated. Several buildings and walls in Reigate are built of local stone, including Sunningdale, a two-storey villa in London Road.

Figure 12: Sunningdale, London Road, Reigate. Reigate Stone.

Chalk was extracted from the North Downs immediately to the north of the NCA and used for agricultural improvement and lime as well as for internal mass walling. Quarries at Mickleham were worked for a more durable form of chalk, which was suitable for windows and external dressings, seen in the external carved stonework at Betchworth Castle. Chalk was also used occasionally as a building stone, for example with Bargate Stone, ironstone and Caen Stone at St James' Church at Shere. Christ Church at Brockham was built of chalk in 1847 by Benjamin Ferrey. The material was given by Sir Benjamin Brodie of Broome Park, Betchworth, whose estate extended to the top of Box Hill and included Betchworth and Brockham quarries. In 1883, the church was in need of restoration due to the perishable nature of the chalk; much of the material was replaced with Bath Stone.

Figure 13: Church of St James, Shere. Carstone, ironpan conglomerate, Quaternary Flint, Caen Stone and Lincolnshire limestone.

Figure 14: Christ Church, Brockham. Reigate Stone with chalk dressings, much replaced with Bath Stone.

St Andrew's Church at Farnham is of chalk and Greensand Sandstone, with repairs to the tower and some dressings in imported red sandstone (Hollington Stone) and ironstone.

Horsham Stone slate was used extensively for roofing in the NCA, particularly for churches, including St James' at Abinger, St James' at Shere, St John the Evangelist's at Wotton, St Michael's at Betchworth and St Peter's at Limpsfield, as well as in several villages such as Abinger and Dorking.

G E Street's last church at Holmbury St Mary was built at his expense in local Holmbury Hill Sandstone with Bath Stone dressings.

Figure 15: St Andrew's Church, Farnham. Chalk rubble; tower of chalk with Upper Greensand Sandstone and Hollington Stone.

Low Weald

The Low Weald occupies much of southern Surrey to its border with Sussex. It is an extensively wooded, broad, low-lying clay vale. Small towns and villages, including Chiddingfold, Dunsfold, Cranleigh and Ewhurst in the west and Newdigate, Charlwood, Horley, Lingfield and Dormansland in the east, are characteristic. Isolated farmsteads, often occupying ancient sites, are common. They are generally associated with a landscape of small and irregular fields. In the late 19th and 20th centuries, villages close to major transport routes that cross the area, such as the M23, expanded considerably. Gatwick Airport lies immediately across the county boundary near Horley.

The underlying geology provided materials for industries, including iron working and brick and glass making. The Wealden iron industry of the area was significant for more than 2,000 years.

Until the 18th century, buildings were predominantly timber framed. Later buildings are often weatherboarded, and barns clad with weatherboarding are a feature of the area. Local brick, often with tile hanging, predominates from the 18th century. Horsham Stone slate roofing was used extensively as a roofing material.

A variety of building stones were employed in the area's medieval churches. In the west, ironpan conglomerate was used with ironstone at the Church of St Nicolas at Cranleigh, one of the few 14th-century decorated churches in Surrey. Bargate Stone with ironstone galleting was employed for the Church of St Mary and All Saints at Dunsfold. This church was described by William Morris as 'The most beautiful country church in all England.' Some Sarsen stones, iron conglomerate and Greensand Sandstone, as well as a range of limestone dressings, are also present.

Wealden Sandstone was used further east in St Bartholomew's Church at Burstow, for example, unusually with Reigate Stone dressings. The fine Norman church of SS Peter and Paul at Ewhurst employs Wealden Sandstone. The 15th-century west porch and doorway is of chalk. Moorhouse Farm House, Limpsfield, has a rare group of barns and cottages built of Wealden Sandstone, with brick dressings and slate roof. Stone manors are relatively common on the Sussex border. For example, Smallfield Place at Burstow is built of Wealden Stone ashlar.

The Church of SS Peter and Paul at Lingfield is built of Tunbridge Wells Sandstone. It has a 14th-century tower, and the remainder of the building was rebuilt in the 15th century—this is the only late medieval rebuilding in Surrey. St Peter's Church at Newdigate exhibits a variety of stones, including Sussex Marble, Bargate Stone and Reigate Stone, all sourced from within 10km of its site.

Horsham Stone slate roofing was used in many villages, such as Capel, Chiddingfold, Cranleigh, Ewhurst, Horley, Newdigate and Ockley, and in rural buildings such as Smallfield Place near Horley.

Long Copse, Ewhurst, is an example of an Arts and Crafts house in the area. It is built of Bargate Stone blocks and rubblestone, with a thatch and part Horsham Stone slate roof.

Figure 16: Church of St Mary and All Saints, Dunsfold. Bargate Stone with some ironpan conglomerate and Upper Greensand Sandstone and ironstone galleting.

High Weald

The High Weald NCA encompasses the ridged and faulted sandstone core of the Kent and Sussex Weald. A very small part of Surrey, south of Lingfield and close to East Grinstead, West Sussex, lies within the NCA. The settlements of Felbridge and Dormans Park and part of the parish of Dormansland are within the NCA.

The Weald was the premier iron-producing district of England during the Roman occupation, and again in the 16th century. In the mid-19th century, the opening of railways brought about considerable building and the growth of country houses and estates.

Timber-framed buildings were dominant until the 18th century, and Horsham Stone slate was often employed for the roofing of timber structures.

Wealden Sandstone was the most frequently used stone of the area. The walls to the moat and garden house of Starborough Castle, Dormansland, are of Wealden Stone. The garden house was constructed on older foundations, reusing materials from the castle in 1754. The stone walls of the moat survive to just above ground level. Greathed Manor, a large country house built near Dormansland after the opening of the railways, was designed by Robert Kerr for the Spender-Clay family. It is constructed of coursed Wealden Sandstone with ashlar dressings, and slate roofs of varying types. St John the Divine's Church at Felbridge, designed by William White, is built of Wealden Sandstone quarried less than a kilometre away at Cooper's Wood, Woodcock Hill.

Deerpark and Felbridge Copse were a pair of service buildings originally built as kennels and stables by Sir Edwin Lutyens. The accompanying main house was never built. Deerpark was designed in the style of a classical temple and both buildings were later converted to dwellings. Built of sandstone blocks, they feature hipped Horsham Stone slate roofs and sandstone chimney stacks.

Figure 17: St John the Divine's Church, Felbridge, East Grinstead. Wealden Sandstone.

Thames Basin Heaths

The Thames Basin Heaths NCA stretches westwards from Walton-on-Thames to the countryside around Newbury in Berkshire.

Vestiges of the Norman royal hunting forests of Bagshot and Windsor, which covered much of the north of the area, remain. Chertsey Abbey significantly influenced this part of Surrey throughout the medieval period. Until the 18th century, the commons and heathshere constituted one of the largest and most continuous areas of lowland heathland in England. In the east, residential development influenced by the proximity of London has been significant since the 18th century. The NCA includes the extensive settlements of the lower reaches of the Rivers Mole, Ember and Way that lie within the green belt, such as Walton-on-Thames, Weybridge, Byfleet, Chertsey and Chobham. West of the green belt, the settlement pattern is a mix of scattered hamlets, farmsteads and houses interspersed with villages, many of medieval origin. Many smaller settlements developed around commons from the 16th century onwards.

Timber frame was dominant historically. By the 18th and 19th centuries, most buildings were constructed using locally produced brick and tile. Earlier timber frames were often encased or fronted with brick. The churches of the area exhibit a range of locally sourced building materials. The majority have been heavily restored and often re-faced. In the east of the area, St Mary's Church at Walton-on-Thames is mainly faced in knapped flint with stone dressings, with occasional chalk and ironpan conglomerate. The later north aisle is of brick. The Church of St Lawrence at Chobham has a Sarsen stones tower with ironpan conglomerate and Sarsen stone chequerwork to the south aisle, and a Horsham Stone slate eaves course.

In the west, ironpan conglomerate was used frequently with flint and other materials in churches such as St Mary's at Byfleet and St Peter's at Old Woking, where coursed Sarsen stone and ironstone were also employed. The Church of St Nicholas at Pyrford is built of ironpan conglomerate with ironstone and chalk. The 15th-century buttresses are constructed of Sarsen stones. The Church of St Michael and All Angels at Pirbright was rebuilt in 1783 and is a rare example of a Georgian church. The tower is of local coursed Sarsen stones, ironstone chips are used for galleting, and there are some ironstone blocks. The nave is of brick on a galleted stone base, and there is some use of chalk internally. St Mary the Virgin's Church at Worplesdon, in the far south-west of the area, has a Wealden Sandstone 15th-century clerestory. Most of the church is built of roughly coursed flint with ironstone.

The growth in population of the area led to the rebuilding and extension of many existing churches and also the construction of new churches. The improved transportation network allowed the use of a wider range of materials from more distant sources. Woking developed as a result of the opening of the London and Southampton Railway in 1838. The Church of St Peter with All Saints at Chertsey was largely rebuilt in 1887 by John Loughborough Pearson in Sarsen stones ashlar with Bath Stone dressings. The west tower (13th century) is built of flint with ironpan conglomerate, Sarsen stones and chalk.

Figure 18: St Mary's Church, Byfleet. Bargate Stone, ironpan conglomerate and flint.

Flint was used for both re-facing and new work. At the Church of St Mary Magdalen at Ripley, the chancel is of ironpan conglomerate, with a Caen Stone string course, and the nave is of flint. St John the Baptist's Church at West Byfleet, by W D Caröe, made use of chert pebbles and cobbles, knapped flint with random stone blocks and stone dressings.

Several churches were built of Kentish Ragstone, including the Church of SS Simon and Jude at Englefield Green and the adjacent Greek Orthodox Church of St Andrew the Apostle, both by E B Lamb. They have limestone dressings and bands of ornamental brick and slate roofs. The Church of St John the Baptist at Woking by Sir George Gilbert Scott is also built of Kentish Ragstone with Bath Stone dressings.

St Peter's Church at Hersham, by John Loughborough Pearson, is constructed in Bargate Stone with Bath Stone dressings. Bargate Stone was also used for the extension of some churches in the 19th century. St Mary the Virgin's Church at Horsell was enlarged in 1890 with a new chancel in Bargate Stone. A baptistry in the same material was added in 1921.

A further consequence of the area's proximity and easy access to London was the establishment of civic amenities, such as cemeteries, sanatoria, hospitals and colleges. Brookwood Cemetery (also known as the London Necropolis), the largest in the UK, was established next to the London and South Western Railway mainline in 1859. It was created to ease the growing problem of overcrowding within inner London cemeteries. The cemetery has several stone structures, including the neo-classical Portland Stone columbarium mausoleum.

The very large Holloway Sanatorium in Virginia Water, and Royal Holloway College in Egham, one of the first women's colleges in England, are both constructed of brick with Portland Stone dressings.

Figure 19: Church of St Mary Magdalen, Ripley. Chancel built in ironpan conglomerate with a Caen stone string course. Chancel built in flint.

Figure 20: Royal Holloway College, Egham. Brick with Portland Stone dressings and banding.

Hampshire Downs

A very small area of the Hampshire Downs NCA lies in the far west of the county, on the northern side of Farnham. It includes the west and northern part of the town and the hamlet of Dippenhall.

Timber frame and later brick were the main materials used in vernacular buildings in this part of the NCA. Chalk was employed for a range of buildings, including the chapels and lodge to West Street Cemetery, Farnham (which had Bath Stone dressings), occasional cottages and The Factory, Dippenhall. Bargate Stone was used for Farnham House Hotel (formerly Willey Park).

Farnham Castle lies within the Hampshire Downs NCA. It was founded in 1138 by Henry of Blois, Bishop of Winchester and brother of King Stephen, and it has been in almost continuous occupation since. During the medieval period, the diocese of Winchester was the richest in England and the castle was the home of its bishop for more than 800 years. Farnham Castle was rebuilt in the late 12th and early 13th centuries. The 12th-century, 23-sided shell keep is largely built of chalk, with extensive repairs in Upper Greensand Sandstone. It follows the shape of the original earth motte. To the south of the keep is an extensive range of buildings of various periods, dating from the 12th century onwards. Additions and alterations include an enlarged chapel in the 13th century, a brick tower in 1470–5, a further chapel, and stables in the 17th century. Much use was made of chalk, with brick repairs and dressings.

Figure 21: Curtain wall and keep, Farnham Castle. Chalk and Upper Greensand Sandstone.

3 Local Building Stones

Lower Cretaceous

Wealden Group, Tunbridge Wells Sand Formation

Ardingly Sandstone, Tunbridge Wells Sandstone

The outcrop of the Tunbridge Wells Sand Formation is confined to the far south-eastern corner of Surrey, encompassing Lingfield, Dormansland, Newchapel, Felcourt, Felbridge and Shipley Bridge. The formation comprises fine to medium-grained, pale or silvery grey to ochreous or buff-brown sandstones and siltstones, with darker coloured mudstones. Individual sandstones can be quite variable: some are thinly bedded or flaggy and exhibit parallel lamination or low-angle cross-bedding; others are more massive and display ripple marks. In overall terms, however, and in common with many other Wealden Group sandstones, the sandstones of the Tunbridge Wells Sand Formation tend to possess very similar lithological characteristics. Consequently, they cannot usually be distinguished from one another when seen *ex situ*, unless their exact provenance is known by other means. One exception to this is the Ardingly Sandstone, which mostly comprises silvery-grey, massive, fine-grained, well-sorted quartz sands and sandrock.

The Tunbridge Wells sandstones often exhibit a wide variety of textures and structures, including cross-bedding, ripple structures, slumped beds and sand-filled scours. Some blocks contain small carbon flecks (lignite), are iron stained and exhibit Liesegang banding. Fossil burrow structures and plant debris are common in many beds and they are often seen on the surface of quarried blocks.

Tunbridge Wells Sandstone is readily worked, and it is typically employed as dressed blocks in churches, prestigious houses and sections of wall in prominent locations. A good example of its use is the Grade I listed Church of SS Peter and Paul at Lingfield.

Figure 22: Church of SS Peter and Paul, Lingfield. Tunbridge Wells Sandstone with a Horsham Stone slate roof.

Wealden Group, Weald Clay Formation

Wealden Sandstone

The Weald Clay Formation crops out as a broad belt across southern Surrey, extending from near Haslemere in the west, via Cranleigh and Horley, to near Oxted in the east. The formation contains several sandstone units that form a series of low topographical ridges and have been quarried historically to a minor extent for building stone. However, these sandstones are all very similar lithologically, and unless their provenance is known from documentary evidence, it is very difficult to distinguish them and their sources once they are set within the fabric of a building. These Wealden sandstones are mainly fine grained (occasionally medium grained) and finely laminated and are often micaceous and flaggy. Individual sandstone units range in thickness from 1 to 5m. Their colour also varies, but they are typically buff to pale grey, or olive grey, weathering to an orange-brown or brown colour due to iron staining. They often exhibit Liesegang banding. The sandstones are composed of pale quartz sand, with scattered flakes of mica, and they are cemented with minor amounts of calcite, clay minerals and iron oxides. Many of the sandstones show 50 to 100mm-thick cross-bedded units, with varied ripple structures being commonly seen in the upper part of each bed and in individual blocks in walls. Occasional scour structures are also present.

Wealden Sandstone was worked and employed in a similar fashion to Tunbridge Wells Sandstone and distinguishing between these sandstone types in southern Surrey is not easy. However, blocks of Wealden Sandstone tend to be thinner, more rectangular and less regularly cut. A good example of the use of Wealden Sandstone is the Church of SS Peter and St Paul at Ewhurst.

Figure 23: Church of SS Peter and Paul, Ewhurst. Wealden Sandstone blocks and rubblestone with occasional blocks of ironstone (carstone); Horsham Stone slate roof.

Figure 24: Church of SS Peter and Paul, Ewhurst. Wealden Sandstone.

Sussex Marble (Paludina Limestone, Periwinkle Stone, Bethersden Marble, Charlwood Stone, Petworth Marble, Laughton Stone)

Sussex Marble is a freshwater limestone occurring in the upper part of the Weald Clay Formation in southern Surrey. The beds are typically 150 to 300mm in thickness, but may be considerably thicker, occasionally reaching up to 700mm. The limestone is usually light grey or buff in colour, but varies to shades of blue or green depending on the presence of clay and iron minerals, which often become brownish upon weathering. Sussex Marble is readily identified by the presence of abundant fossil gastropod shells, *Viviparus*, which tend to be somewhat paler in colour than their matrix (they are whitish in section) and are commonly infilled with patches of transparent crystalline calcite.

In southern Surrey, Sussex Marble was worked historically in areas around Russ Hill and Charlwood. Although relatively hard when fresh, Sussex Marble weakens due to water penetration, which causes the rock to crumble and fail. Exterior memorial stones rarely last more than 100 years. Consequently, this limestone, which takes a good polish, has been used mainly for internal decorative and monumental features, such as altar tables, tombs and ledgers, fonts, columns and fireplaces. One of its occasional external uses was as paving and flagstones, exemplified by the pavements adjoining Abbot's Hospital in Guildford. It was also employed as paving in the Reigate, Horley and Charlwood areas, especially in churchyards and along other routes.

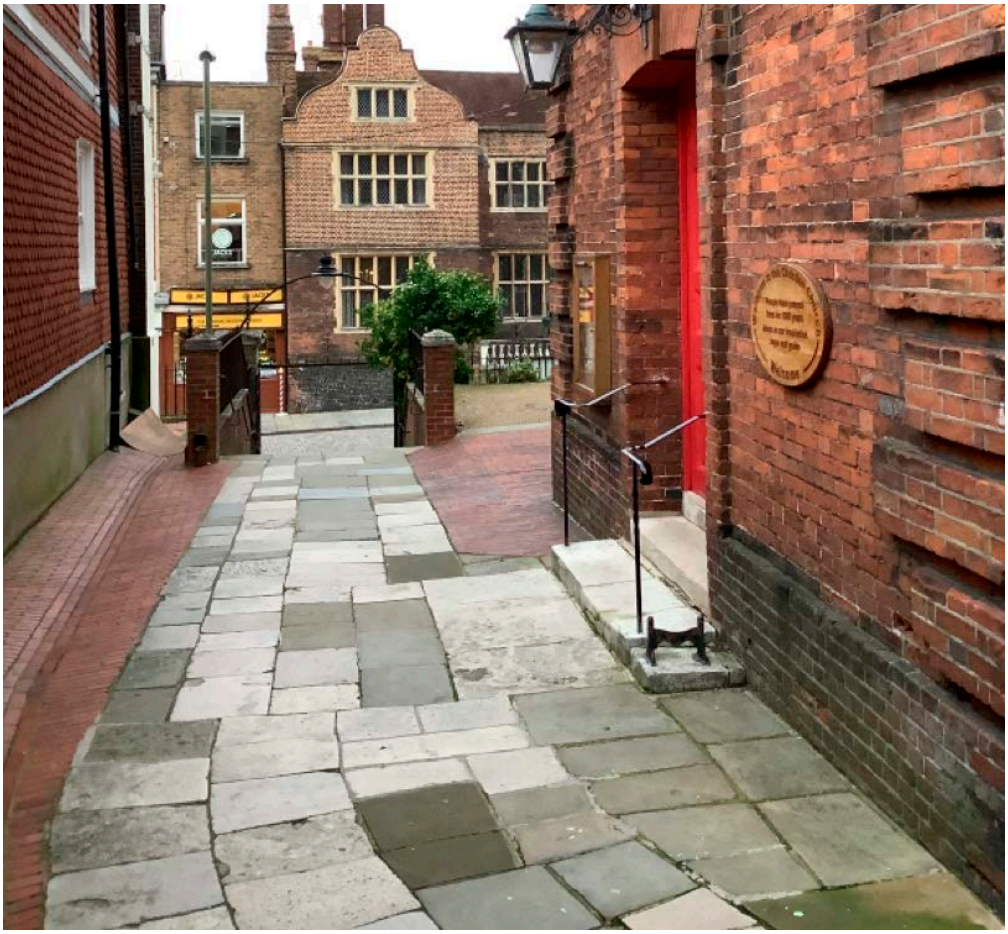


Figure 25: Flagstones, High Street, Guildford. Sussex Marble and York Stone.

Figure 26: Flagstone, High Street, Guildford. Sussex Marble.

Lower Greensand Group, Hythe Formation

Holmbury Hill Sandstone (Leith Hill Stone, Hurtwood Stone)

The Hythe Formation crops out as a band that extends right across Surrey, from Haslemere in the west to Oxted in the east. Its main occurrences are north of Haslemere and between Godalming and Dorking (especially near Holmbury and Abinger). Eastwards, between Dorking and Oxted, the outcrop area is relatively narrow.

The formation is highly variable and contains medium to coarse-grained sandstones and ferruginous sandstones, which range in colour from pale brown and yellowish-orange to olive or dark green, or pale to dark grey. They sometimes exhibit a bluish sheen. Individual sandstone units may be thinly bedded or more massive. Some contain hard, grey, cherty layers, while others are friable and striped with alternating paler quartz-rich and darker glauconite-rich bands. Many of the sandstones are highly bioturbated and contain fossil burrow or shelly structures; some are iron stained and display Liesegang banding. The more finely bedded units often exhibit sedimentary structures, including ripple marks and planar and trough cross-bedding on a variety of scales. The sediments are sometimes a vivid green colour when first quarried but change colour upon exposure to air.

Several varieties of Hythe Sandstone have been informally named after the villages near where they were quarried and where they were mainly used. In Surrey, one of the best-known varieties of Hythe Sandstone is Holmbury Hill Sandstone. As its name implies, this sandstone (and accompanying cherts) were quarried on Holmbury Hill. Traces of the extensive workings and pits can still be seen today, particularly in the area around the Iron Age hillfort. The church at Holmbury St Mary provides a particularly good example of the

use of local Holmbury Hill Sandstone. Elsewhere, sandstone from the Hythe Formation was formerly much used for buildings in the vicinity of Haslemere and Midhurst. Leith Hill Stone is very similar to Holmbury Hill Sandstone, but it is slightly more friable and has a tendency to be striped yellow and red. The last working stone quarry in the Hythe Formation was at Pitch Hill, just west of Holmbury Hill, and it extracted Hurtwood Stone. It had effectively closed by the turn of the century.

Figure 27: St Mary the Virgin Church, Holmbury St Mary. Holmbury Hill Sandstone with Bath Stone dressings.

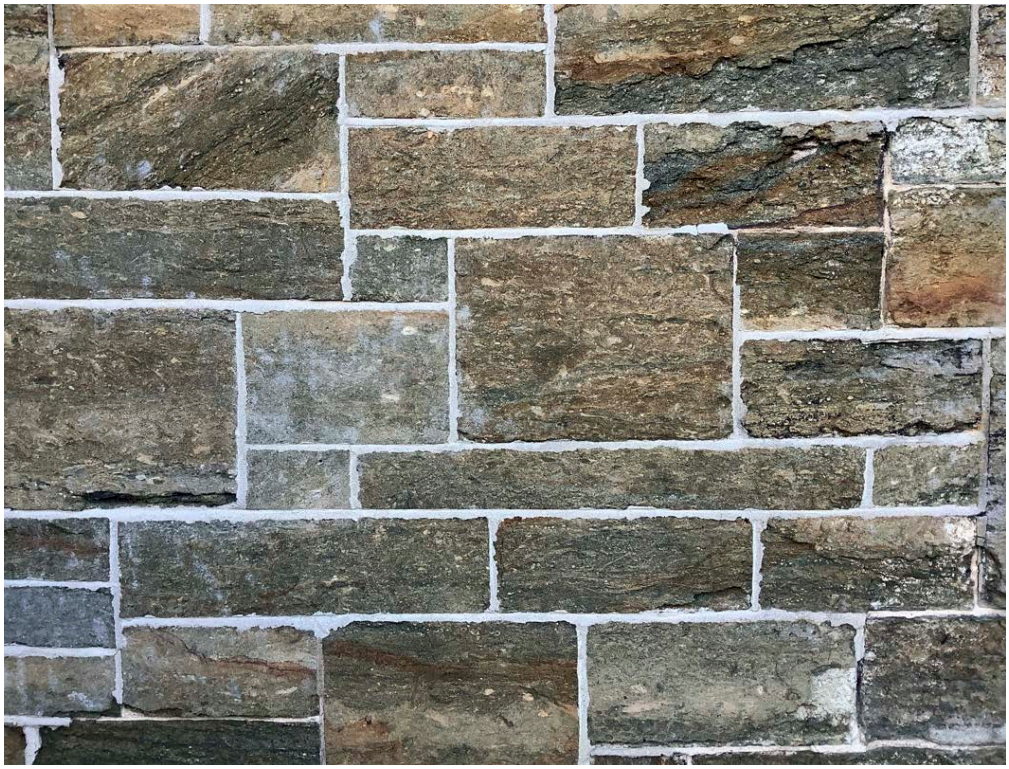


Figure 28: St Mary the Virgin Church, Holmbury St Mary. Holmbury Hill Sandstone.

Lower Greensand Group, Sandgate Formation

Bargate Stone (Bargate Sandstone)

Along with Quaternary Flint and Reigate Stone, Bargate Stone is probably the most common and widely used building stone in Surrey. The Bargate Sandstone Member occurs across the central-western part of the county in a band stretching from Liphook via Milford and Godalming (where the outcrop is at its widest) to Gomshall, Abinger Hammer and Cocks Farm, Abinger. Further east, the outcrop of the Sandgate Formation becomes much narrower and the Bargate Sandstone Member is absent.

The main lithology is a hard, medium-grained, rich, honey-brown-coloured calcareous sandstone, but varieties include dark fawn-brown or grey-green, glauconitic, often flaggy, calcareous sandstones and a pale brown, coarse-grained gritstone, which contains small (2 to 5mm diameter) sub-angular to rounded clasts of quartz, quartzite, flint, chert and sandstone.

Figure 29: Wycliffe Buildings, Portsmouth Road, Guildford. Bargate Stone.

The Bargate sandstones include massive and well-bedded types, the latter breaking into slabs 100 to 150mm thick, which can be easily used as brick-sized blocks. They also sometimes exhibit cross-bedding and/or honeycomb weathering textures. In places, the sandstones contain fossil burrows that are typically 5mm-wide cylindrical structures, each surrounded by a rim of glauconite grains.

Bargate Stone was formerly quarried for local use around Godalming and at Hurtmore and Whitley. The stone mainly occurred as large concretionary 'doggers', which were extracted by the quarrymen using crowbars, planks and leverage poles (a process known as 'jumping a stone'). The last working quarry of Bargate Stone in Surrey was Stockstone Quarry, just north of Hindhead; production ceased here in the early 1990s. Bargate Stone is encountered throughout Surrey but particularly fine examples of its use include the keep at Guildford Castle; the Shah Jahan Mosque, Woking; Tigbourne Court, Wormley; the Church of St Christopher, Haslemere; the Church of St Mary and All Saints, Dunsfold and the Wycliffe Buildings, Guildford.

Figure 30: Keep, Guildford Castle. Bargate Stone and Quarry Flint.

Figure 31: Church of St Christopher, Haslemere. Bargate Stone.

Figure 32: Church of St Christopher, Haslemere. Bargate Stone with ironstone galleting.

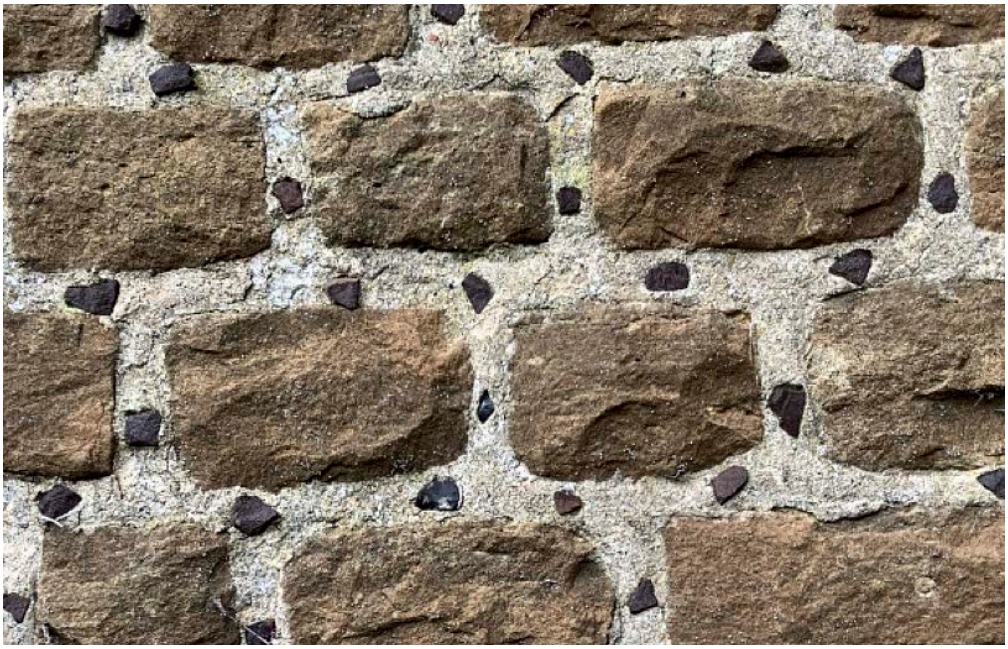


Figure 33: Quarry Hill House, Guildford. Bargate Stone.

Lower Greensand Group, Folkestone Formation

Ironstone (Carstone)

Ironstone (occasionally referred to as carstone in Surrey) crops out as a continuous band from just south of Farnham in the west, via Dorking, Reigate and Bletchingley, to Oxted and Limpsfield in the east. The outcrop is at its widest in western Surrey, in an area delineated by Farnham, Tilford, Thursley, Frensham and Lower Bourne. It is a medium to coarse-grained, ochreous to dark brown or reddish-black quartzose sandstone or gritstone, sometimes containing chert and quartz pebbles set within a dark purplish-black matrix of iron oxides and hydroxides. Ironstone occurs as irregularly shaped masses, thin layers and veins within the 'typical' sands that comprise the Folkestone Formation. Where it is massive, larger blocks of ironstone may exhibit cross-bedding structures and display Liesegang banding. The surfaces of blocks may also display a bluish sheen, created by coatings of iron oxide. Generally, ironstone is a hard, durable and tough rock that is resistant to weathering.

Ironstone is frequently encountered as a building stone in Surrey, especially in ecclesiastical buildings where it is usually found as isolated blocks or small clusters of blocks within wall fabrics. However, in those areas where it is better developed within the Folkestone Formation, ironstone tends to be quite extensively employed, especially in the Oxted area and in many of the older buildings and streets of Farnham. Particularly fine examples of its use include the Church of St Peter at Limpsfield and the ruins of Waverley Abbey. Ironstone is used occasionally as setts or cobbles (pitching), for example near the Church of St Mary at Guildford. Galleting is evident in the nave walls of the Church of St James at Shere, the Church of St Michael and All Angels at Pirbright, Little Leat in Godalming, and St Christopher's Church at Haslemere.

Figure 34: St Peter's Church, Limpsfield. Ironstone rubblestone; Horsham Stone slate nave roof.

Figure 35: Church of St Mary the Virgin, Buckland. Ironstone blocks.

Figure 36: Church of St James, Shere. Ironstone and Upper Greensand Sandstone with ironstone galleting.

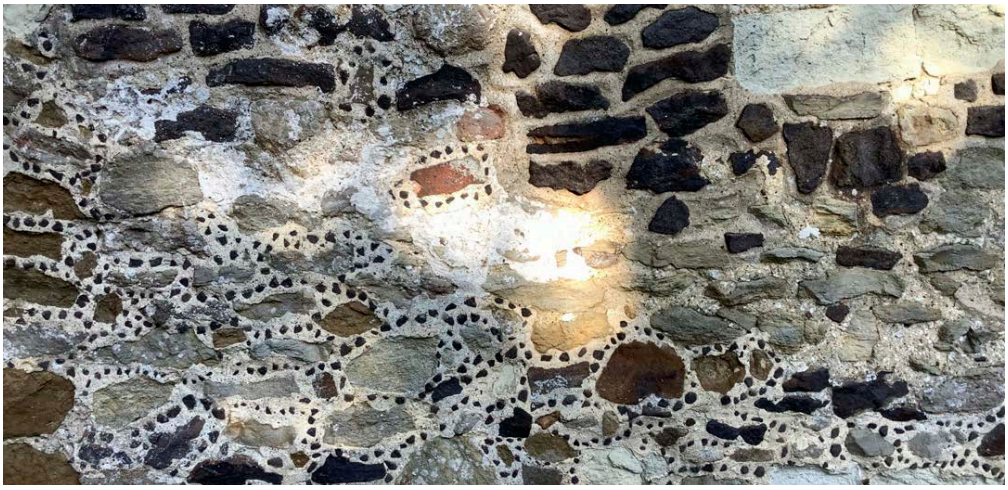


Figure 37: Church of St Mary the Virgin, Buckland. Ironstone.

Figure 38: Cobbles, Titsey Place, Titsey. Ironstone.

Selborne Group, Upper Greensand Formation

The Upper Greensand Formation crops out as a narrow band of strata across central Surrey, extending from west of Farnham, via Gatton Bottom and Merstham, to just north of Limpsfield on the county border with Kent. The Upper Greensand Formation comprises pale olive to pale grey, fine-grained sandstones, silty sandstones and sandstones that are frequently glauconitic and shelly.

Reigate Stone (Merstham Stone, Gatton Stone, Chaldon Stone, Godstone Stone, Firestone, Hearthstone)

Reigate Stone, and its locally named varieties, is a particular facies of the Upper Greensand Formation. The rock is a massive, pale grey to off-white calcareous siltstone with a sub-conchoidal fracture that weathers to a pleasant pale buff or cream colour. It is rarely fossiliferous. From a distance, weathered Reigate Stone can resemble chalk, but the latter powders easily when scratched. Reigate Stone is usually more durable, especially the forms that contain more chert and calcite cement. A more reliable way of distinguishing these stone types is that Reigate Stone often ‘sparkles’ in bright light due to the quartz grains it contains. Chalk lacks these grains.

All varieties of Reigate Stone have been widely employed for building purposes along its outcrop. Although much of the stone is a freestone, it is generally roughly dressed and laid to course, or used as rubblestone. Reigate Stone was once used extensively in the Reigate and Dorking areas (where, historically, it was known as Firestone) and it can be seen in many of the older buildings, including churches, farmhouses and barns. Soft Reigate Stone was used to whiten hearths and doorsteps (hence the name Hearthstone) during the 19th century. Gatton Stone is noticeably stronger than Reigate Stone, and, by the Victorian period, only Gatton Stone was used for quoins, arches and main walling.

Particularly good examples of the use of Reigate Stone can be seen in Reigate, including at Sunningdale villa on London Road. Merstham Stone is finely displayed in the Church of St Katharine and Wellhead Cottage, both in Merstham.

Reigate Stone was exported from the early medieval period. It was used in the Tower of London, Westminster Palace and Abbey, Hampton Court, Old London Bridge, in what is now Southwark Cathedral and Windsor Castle. In the early 19th century, large quantities of Reigate Stone were transported to London via the Surrey Iron Railway and Croydon Canal.

Figure 39: Church of St Katharine, Merstham. Reigate Stone and flint rubble. Horsham Stone slate roof on the nave.

Figure 40: Church of St Katharine, Merstham. Merstham Stone.

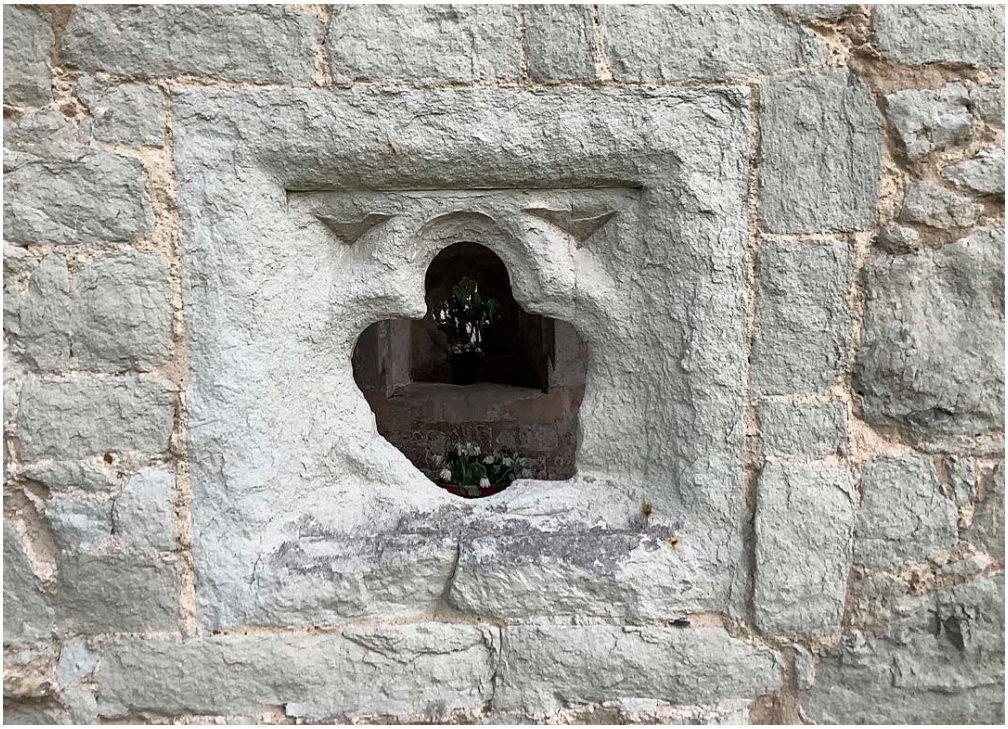


Figure 41: Wellhead Cottage, Merstham. Merstham Stone.

Upper Greensand Sandstone

Upper Greensand Sandstone is used for building purposes wherever it occurs, despite the fact that it has a tendency to weather readily and spall. It was formerly used extensively in the Farnham area: much of the stone employed for the walls and keep of Farnham Castle, the Church of St Andrew at Farnham and the Church of St Laurence at Seale was obtained from the Upper Greensand Formation.

Figure 42: Farnham Castle. Upper Greensand Sandstone.

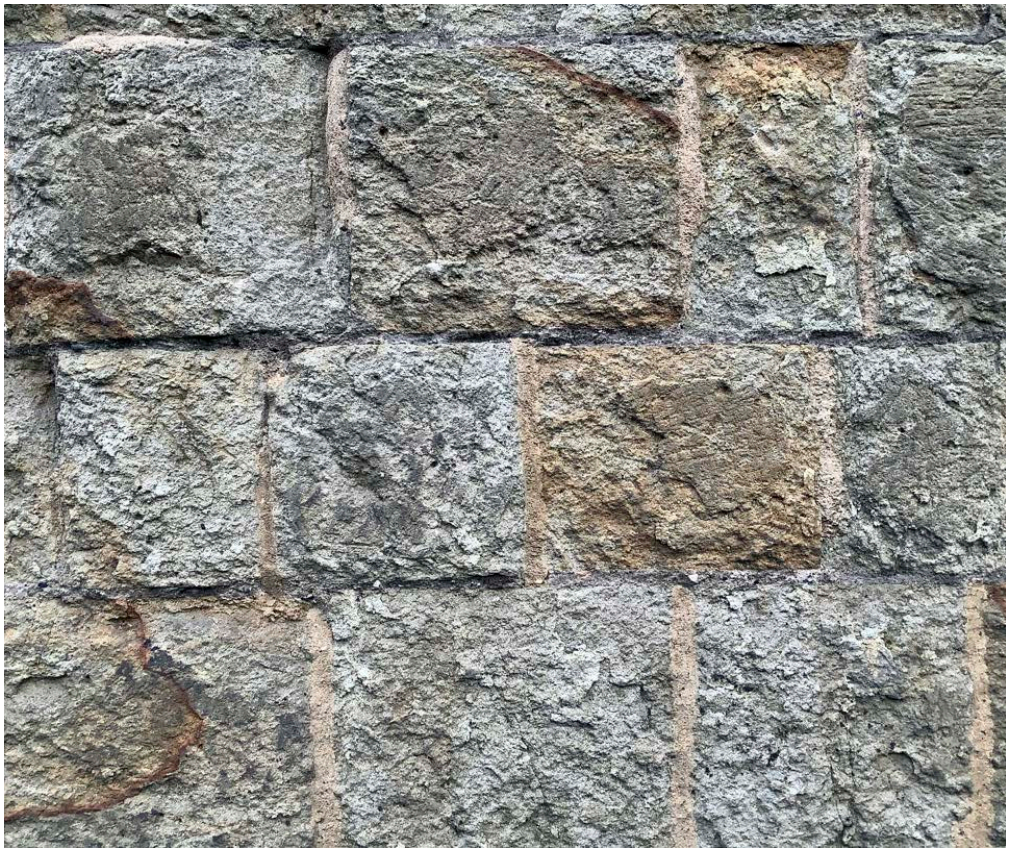


Figure 43: Church of St Laurence, Seale. Upper Greensand Sandstone and chalk; the tower is mainly Bargate Stone with Bath Stone dressings.

Upper Cretaceous

Chalk Group, White Chalk Subgroup

The white chalky limestones of the Upper Cretaceous White Chalk Subgroup occur in an easterly widening belt, extending from near Farnham in the west of the county, via Guildford and Leatherhead, to Whyteleafe on the eastern boundary.

Quarry Flint (Fresh Flint)

Quarry Flint occurs as bands or isolated nodules within the chalky limestone beds. It is an extremely fine-grained (cryptocrystalline) and hard form of silica containing microscopic quartz-crystal aggregates. Quarry Flint usually occurs as irregular-shaped nodules that are 100 to 200mm across, or as (sub-)rounded pebbles or cobbles. Occasionally, it is also found as weakly banded tabular sheets or layers up to 200mm thick. The colour is very distinctive: fresh nodules have a white outer cortex with a black or dark grey interior.

Quarry Flint breaks with a characteristic conchoidal fracture, producing razor-sharp fine edges. Flint nodules may contain cavities lined with translucent botryoidal chalcedony or small transparent quartz crystals. Some nodules contain well-preserved fossils, with echinoids, sponges, bivalves, burrow structures and, occasionally, belemnites. The Upper Cretaceous chalk succession in Surrey has yielded a small amount of flint for local building purposes. Where encountered, it is often seen in association with Quaternary Flint. It was employed in a variety of ways, including as knapped, faced, trimmed or cleaved-faced stone and sometimes in squared chequerwork. A fine example of its use can be seen in the walls of Guildford Castle keep.

Figure 44: Castle keep walls, Guildford Castle. Quarry Flint and Bargate Stone.

Chalk

Chalk is a white to very pale grey or pale buff, typically structureless, very fine-grained limestone, which in places contains fossil oysters (inoceramids) and echinoids. It is generally unsuitable for exterior masonry because repeated wetting and drying, coupled with frost action, causes the relatively soft rock to powder and disintegrate into small angular brash. Softer forms of the stone may show concave weathering away from mortar lines.

Chalk is not commonly employed as an external building stone in Surrey and, where it is, it is usually found in association with other stone types. Examples of its use include Waverley Abbey ruins, Guildford Castle keep and the tower of St Peter's Church at Old Woking. Occasionally, chalk dominates a built structure, with fine examples including the castle walls and Castle Arch in Guildford.

Figure 45: Castle Arch, Guildford Castle. Chalk with flint rubble.

Figure 46: Castle Arch wall, Guildford. Chalk.

Quaternary

Ironpan Conglomerate (Conglomerate, Puddingstone, Ferricrete)

Ironpan conglomerate is the name given here to a distinctive ironstone variety, blocks of which are frequently encountered in buildings (often churches) mainly in central and northern Surrey. The main rock type seen is a clast-supported conglomerate, comprising a dark purple-black-coloured, coarse-grained, iron-rich matrix in which pebbles of orange-brown chert or blackish Quaternary Flint are set. These pebbles are usually well rounded and vary in diameter from 20 to around 70mm. Typically, smaller sub-angular clasts or flakes of chert and flint are also present, sandwiched between the larger rounded pebbles. The clasts show no obvious preferred orientation. Superficially, some blocks of ironpan conglomerate resemble Hertfordshire Puddingstone, but they are readily distinguished by their overall darker colour and iron-rich matrix. These features contrast strongly with the much paler coloured Hertfordshire Puddingstone, with its light grey, siliceous matrix. Some blocks of ironpan conglomerate lack the larger rounded pebbles and instead contain smaller, sub-angular clasts (up to 20mm diameter) of chert, sandstone and (occasionally) flint, set within a purple-black iron-rich matrix. These blocks may be classed as matrix-supported breccio-conglomerates. Intermediates between these varieties of ironpan conglomerate also occur, sometimes even within the same block.

The stratigraphical origin of the ironpan conglomerate is not known. The stone has not been seen *in situ*, but a possible source horizon could lie within the Neogene/Quaternary superficial deposits. Alternatively, this stone could be derived from a ferricrete horizon within the late Palaeogene Bracklesham Group.

In older literature, ironpan conglomerate is often variously and inconsistently referred to as conglomerate, puddingstone or ferricrete. It is typically encountered as isolated, irregular blocks within church walls, and it is often associated with Quaternary Flint. Occasionally, it represents one of the main

constituents of a building and it may dominate the stone fabric of sections of individual walls. Particularly good examples of its use can be seen in the walls of churches in Cranleigh (Church of St Nicolas) and Old Woking (Church of St Peter).

Figure 47: Tower, Church of St Nicolas, Cranleigh. Ironpan conglomerate, ironstone and Bargate Stone with dressings of chalk, Bath Stone and Lincolnshire limestone.

Figure 48: Church of St Nicolas, Cranleigh. Ironpan conglomerate.

Figure 49: Church of St Peter, Old Woking. Quaternary Flint and ironpan conglomerate. Upper part of the tower is Sarsen stone.

Figure 50: Church of St Peter, Old Woking. Ironpan conglomerate with Quaternary Flint nodules.

Quaternary

Various groups, various formations

Sarsen Stone (Greywethers, Silcrete)

Sarsen stones are loose blocks of hard quartzitic sandstone that typically occur as rounded or elongate boulders, but sometimes as metre-scale slabs. They are pale grey to pale brown in colour, becoming distinctly creamy-buff or deep greyish-brown when weathered. They possess a very fine-grained, saccharoidal (sugary) texture, comprising sub-rounded quartz grains set within a silica matrix, which is visible on fractured surfaces. Sarsen stones are very hard and resistant to weathering. Their surfaces are often smooth and may occasionally show poorly defined bedding structures.

Sarsen stones were worked as a building stone in northern and north-western Surrey, and this was an important local industry historically. Sarsen stones were trimmed into paving setts, coping and building stones, and doorsteps. Fine examples of the use of squared and coursed Sarsen stones can be seen in the Church of St Michael and All Angels at Pirbright, and in the towers of the Church of St Peter at Old Woking and the Church of St Mary the Virgin at Worplesdon.

Figure 51: Church of St Michael and All Angels, Pirbright. Sarsen stone with Bath Stone and brick dressings.

Figure 52: Church of St Michael and All Angels, Pirbright. Sarsen stone and ironstone with ironstone galleting.

Figure 53: Tower, Church of St Mary the Virgin, Worplesdon. Sarsen stone.

Chert Pebbles and Cobbles

The Quaternary fluvio-glacial deposits of Surrey encompass a diverse range of poorly sorted, relatively soft and unconsolidated sediments, which have been exploited for construction materials on mostly a local scale. These deposits vary in composition, but they sometimes contain harder pebbles and cobbles of chert, which are mainly sub-rounded and orange-brown to brown coloured.

The use of chert pebbles and cobbles in Surrey walls is not especially common, but it is geographically quite widespread nonetheless. Where seen, such pebbles have often been used in conjunction with Quaternary Flint. Particularly fine examples include the walls of the Church of St John the Baptist at West Byfleet and the Church of St Mary the Virgin at Byfleet.

Figure 54: Church of St John the Baptist, West Byfleet. Quaternary Flint and chert with blocks and dressings of Lincolnshire limestone and Bath Stone.

Figure 55: Church of St John the Baptist, West Byfleet. Chert pebbles and cobbles with Quaternary Flint nodules.

Quaternary Flint (Field Flint, River Terrace Gravel Flint)

Quaternary Flint (along with Bargate Stone and Reigate Stone) probably represents one of the most extensively and commonly used building stones in Surrey. Quaternary Flint typically occurs as irregular-shaped nodules, which are found lying on the surfaces of fields or as pebbles within fluvio-glacial sands and gravels. The size of the nodules typically ranges from 100 to 300mm. The colour is variable: less weathered flint nodules or pebbles have a cream outer cortex with a darker coloured (greyish) interior; weathered flints, or those that have lain in soil or superficial deposits for a long period of time, may be variously discoloured or bleached, often with brown-stained interiors caused by the precipitation of iron hydroxides from percolating ferruginous waters. This weathered appearance helps distinguish Field Flint from the much fresher looking Quarry Flint.

A combination of hardness, durability and resistance to weathering has resulted in Quaternary Flint being much used as a building stone wherever deposits are (or were) present in Surrey. It was mainly employed as nodules or pebbles laid randomly or roughly to course, but occasionally as knapped, faced, trimmed or cleaved-faced stone in random or decorative arrangements. The stone was used extensively and can be seen in many churches, buildings and walls in towns and villages across the county. Particularly fine examples of its use can be seen in houses in East Horsley, the Church of SS Mary and Nicholas at Leatherhead, the Church of St Mary at Guildford, the Church of St Mary at Stoke D'Abernon, the Church of St Mary at Walton-on-Thames, the Church of St Mary Magdalen at Ripley and the Church of St Leonard at Chelsham.

Figure 56: St Nicholas and St Mary Church, Leatherhead. Quaternary Flint and Lincolnshire limestone.

Figure 57: Guildford Lodge and Gate, East Horsley. Quaternary Flint rubble with brick and terracotta dressings.

Figure 58: Guildford Lodge, East Horsley. Quaternary Flint and chert nodules.

Figure 59: St Mary's Church, Guildford. Flint and chalk.

4 Examples of Imported Building Stones

Although the Lower Cretaceous to Quaternary successions of Surrey have yielded a variety of indigenous building stones, these are in limited supply in some areas. Consequently, extensive use has been made of imported stones sourced from other parts of England, and indeed the UK.

One of the most unusual examples of stone importation into Surrey is the Temple of Augustus, Virginia Water. This is a reconstructed Roman ruin, transported to the UK from the city of Leptis Magna in modern-day Libya. It was a gift presented in 1816 from the local governor to the prince regent, later George IV. It included 22 granite columns, 15 marble columns and 10 capitals.

Sedimentary stone types

Upper Carboniferous

Millstone Grit Group, various formations

Millstone Grits, West Yorkshire

Hard, medium to coarse-grained sandstones, sometimes pebbly and feldspathic, with a distinctive granular appearance (arising from sugar-like, grey quartz grains) and occasional small flakes of white mica. It exists in various colours, ranging from pale grey to a buff-orange or pale brown colour, particularly when weathered. It typically displays lamination and cross-bedding structures, along with Liesegang banding. It is a very durable stone, with good abrasion resistance.

Figure 60: Town Bridge, Guildford. Millstone Grit.

Pennine Coal Measures Group, Pennine Lower Coal Measures Formation

Elland Flags (York Stone, Yorkshire Flags), West/South Yorkshire

Buff to pale grey or greenish-grey, typically fine-grained sandstones, which are often micaceous and laminated, but occasionally show small-scale cross-bedding features. York Stone usually weathers evenly but may separate along mica-rich horizons. It is little used as a building stone in Surrey, and is employed mainly as flagstones, paving stones or plinths.

Figure 61: Paving stones, St Mary's Church, Guildford. York Stone.

Permian

Zechstein Group, Cadeby Formation

Red Mansfield Sandstone, Nottinghamshire

A distinctive, pale red-brown, sandy dolostone or dolomitic sandstone that exhibits cross-lamination in some blocks. It has been employed very occasionally in Surrey as a facing or decorative stone.

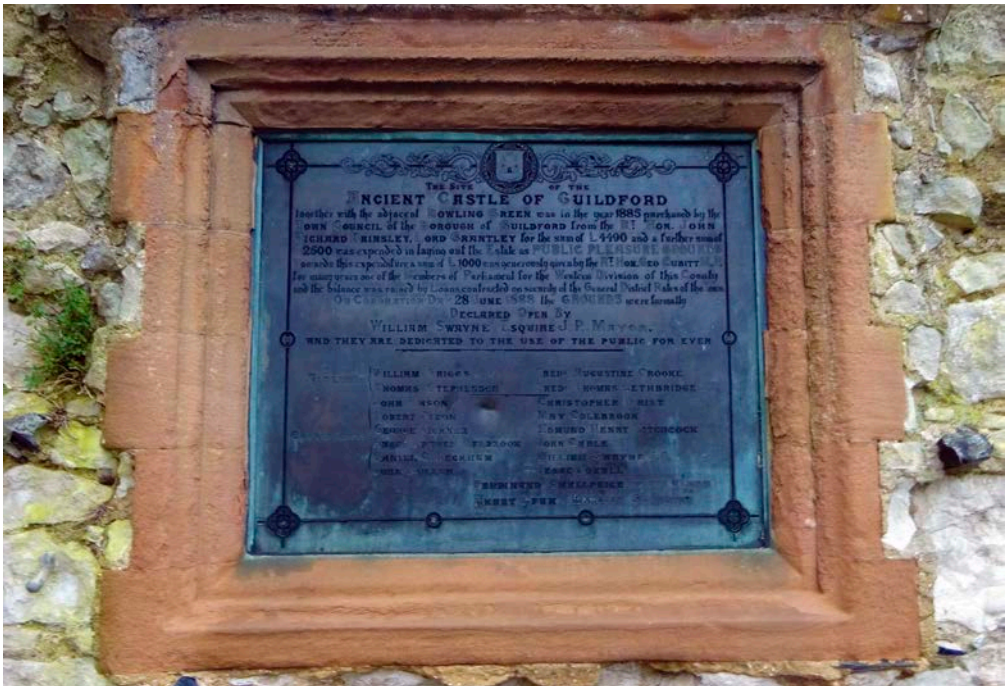


Figure 62: Plaque, Castle Street, Guildford. Decorative dressings of Mansfield Red Sandstone.

Triassic

Sherwood Sandstone Group, Hollington Formation

Hollington Stone, Staffordshire

A pale red or red-brown, fine to medium-grained sandstone that characteristically displays expressions of cross-bedding. These features are observed in many blocks seen in buildings. The stone has been employed only occasionally in Surrey, usually as dressings.

Figure 63: St Andrew's Church, Farnham. Window dressings of Hollington Stone and Bath Stone.

Jurassic

Lias Group, Bridport Sand Formation

Ham Hill Stone, Somerset

A coarse-grained, shelly limestone that is readily sawn and dressed. When freshly cut, the stone has a light golden yellowish-brown colour that darkens with age and weathering. The latter picks out the weaker, less well-cemented seams and cross-bedding features, which are characteristic of this sandy limestone. Relatively little employed in Surrey, the best examples of its use are provided by houses along Quarry Hill, Guildford, and the Church of the Wisdom of God at Lower Kingswood.

Figure 64: Door surround, 44 Quarry Street, Guildford. Ham Hill Stone.

Middle Jurassic

Inferior Oolite Group, Lincolnshire Limestone Formation

Lincolnshire limestones, Northamptonshire

A wide variety of Lincolnshire Limestones have been used in the county including Weldon Stone and King's Cliffe Stone. Lincolnshire limestone Formation incorporates a continuum of pale cream to pale grey-coloured limestones, which weather to shades of buff-yellow; textures may be ooidal and/or bioclastic. Cross-bedding features may or may not be displayed, and the stone is variably porous. Lincolnshire limestone has been employed throughout Surrey, primarily as dressings and for decorative work in ecclesiastical buildings.

Figure 65: St Nicholas and St Mary's Church, Leatherhead. Quaternary Flint with dressings of Lincolnshire limestone; the north transept has a Horsham Stone slate roof.

Ancaster Stone, Lincolnshire

A coarse-grained, creamy-white to pale yellow (occasionally weathering reddish), ooidal and bioclastic limestone, exhibiting cross-bedding structures that give rise to a distinctive ‘streaky bacon’ appearance. In Surrey, Ancaster Stone has been seldom used and is mainly encountered in the construction of ornate front portals of commercial buildings or as dressings in churches and chapels.

Figure 66: Pillars and surrounds, 133–135 High Street, Guildford. Ancaster Stone. First and second floor window dressings are Permo-Triassic red sandstones, including Hollington Stone.

Great Oolite Group, Chalfield Oolite Formation

Bath Stone, Bath, NE Somerset and possibly Corsham area, Wiltshire

A cream to buff-yellow, ooidal and variably bioclastic limestone (freestone). Bath Stone is used extensively throughout Surrey, especially in Victorian new-build and church refurbishment schemes, as ashlar and window and door mouldings, in particular. A noteworthy example of its use as ashlar is the tower of St Mary’s Church at Reigate.

Figure 67: St Mary’s Church, Reigate. Restored using Bath Stone.

Calcaire de Caen Formation

Caen Stone, Normandy, France

An off-white to pale creamy-yellow-coloured limestone with a fine-grained texture and few large bioclasts. It may exhibit spalling, and individual blocks of Caen Stone may also show uneven weathering. It has been employed only occasionally in Surrey, mainly in ecclesiastical buildings or fortifications dating to Norman times. However, it is also encountered in important domestic Tudor houses, such as Reigate Priory (windows) and Nonsuch Palace, Ewell.

Upper Jurassic

Portland Group, Portland Stone Formation

Portland Stone, Isle of Portland, Dorset

A near-white or very pale-coloured limestone that (in its 'basebed' guise at least) is typically a fine and even-grained freestone. It has seen widespread use across Surrey since the 18th century, especially in urban areas in carved form. It has been used for monuments, war memorials, gravestones, fountains and columns. Portland Stone is also employed as a high-quality walling stone, notably in civil, administrative and financial buildings.

Figure 68: Tunsgate Arch, High Street, Guildford. Portland Stone.

Lower Cretaceous

Purbeck Group

Purbeck Limestone, Isle of Purbeck, Dorset

A dark grey-green, shelly limestone, often containing pale-coloured sections of fossil oysters and other shells. It is mainly used for internal ornamental work but has been employed occasionally for external paving and walling.

Figure 69: Flagstones and steps, Holy Trinity Church, Guildford. Purbeck Limestone dressings.

Wealden Group

Horsham Stone (Horsham Stone slate), West Sussex

A honey-brown to brown-grey-coloured, calcareous sandstone, some beds of which readily cleave into 20 to 30mm-thick slabs that are ideal for use as roofing slates and flagstones. It exhibits few structures apart from fine laminations and occasional broad amplitude ripple marks. In Surrey, it has been most frequently used as a roofing slate on churches and lych gates,

and as a paving flagstone. Thicker slabs were used for floors, especially in the Ewhurst area. One of its most attractive uses is in the form of thinner ripplestone paving slabs, which were employed across southern Surrey in churchyards and old houses.

Figure 70: Paving slabs, Dormer Cottage, Stan Hill, Charlwood. Horsham Stone.

Figure 71: St John the Evangelist Church, Wotton. Bargate Stone with Firestone and Bath Stone dressings. Horsham Stone slate roof.

Figure 72: Lych gate roof, Church of St James, Shere. Horsham Stone slate roof.

Lower Greensand Group, Hythe Formation

Kentish Ragstone (Ragstone), Kent

A medium to coarse-grained, pale greenish-grey or pale brown limestone that contains greater or lesser amounts of quartz, glauconite and fossil shell debris. Kentish Ragstone has been employed occasionally in Surrey, and usually for the walling of ecclesiastical buildings, such as the churches at Englefield Green and Tatsfield. It may be found as dressed (typically rock-faced) tabular blocks or forming irregular random rubblestone patterns.

Figure 73: St Jude's United Church, Englefield Green. Kentish Ragstone with Bath Stone dressings.

Igneous and metamorphic stone types

Neoproterozoic to Early Permian

Granite, various sources, including Cornwall and Devon

A coarse-grained igneous rock, usually pale grey or pink in colour, comprising an interlocking network of grey quartz and white or pink feldspar crystals. The latter can exist as distinctly larger, well-formed crystals termed phenocrysts. Darker iron-bearing and magnesium-bearing minerals and glinting flakes of mica are also usually present in greater or lesser amounts. Granite is very durable and various types have been employed in Surrey. It can be seen used decoratively in finely dressed and polished guises or employed as a facing stone in association with buildings such as banks and offices. Granite has been used in the construction of bridges, and as paving setts, kerbs and memorial stones.

Figure 74: War memorial, Guildford Railway Station. Peterhead Granite and Portland Stone.

Figure 75: Staines Bridge, Staines. Ashlar granite blocks and corbels.

Ordovician

Mountsorrel and South Leicestershire Diorite Complexes

Mountsorrel Granodiorite, Leicestershire

Variously coloured, medium to coarse-grained igneous rocks, comprising a network of interlocking crystals of quartz (typically pale grey coloured) and feldspar (often white or pinkish-red coloured), together with greater or lesser amounts of ferromagnesian minerals (black or dark green coloured). A range of granodiorites and diorites from several sources have been employed in Surrey for various purposes, including ornamental stonework. These stones are durable and hard-wearing and have commonly been used for paving setts and kerbs.

Figure 76: Paving setts outside the Angel Hotel, High Street, Guildford. Granodiorite.

Various groups, various formations

Roofing slates (including Welsh Slate, Westmorland Slate)

Several different types of metamorphic slate are known to have been imported into and used in Surrey for roofing purposes. Welsh Slate, for example, was employed in many of the county's villages and towns. Good examples can be seen in Guildford. Other types of metamorphic roofing slate used in Surrey include Westmorland Slate from Cumbria.

Figure 77: 19 Quarry Street, Guildford. Welsh Slate porch roof.

Figure 78: Greyfriars, Wanborough. Westmorland Slate roof.

5 Further Reading

The Further Reading, Online Resources and Contacts guide provides general references on:

- Geology, building stones and mineral planning
- Historic building conservation, architecture and landscape.

There is also a separate glossary of geological terms.

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University of Oxford and Historic Royal Palaces 2023 *Reigate Stone. London's Lost Masonry* website https://www.reigatestone.org.uk/

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Figures

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