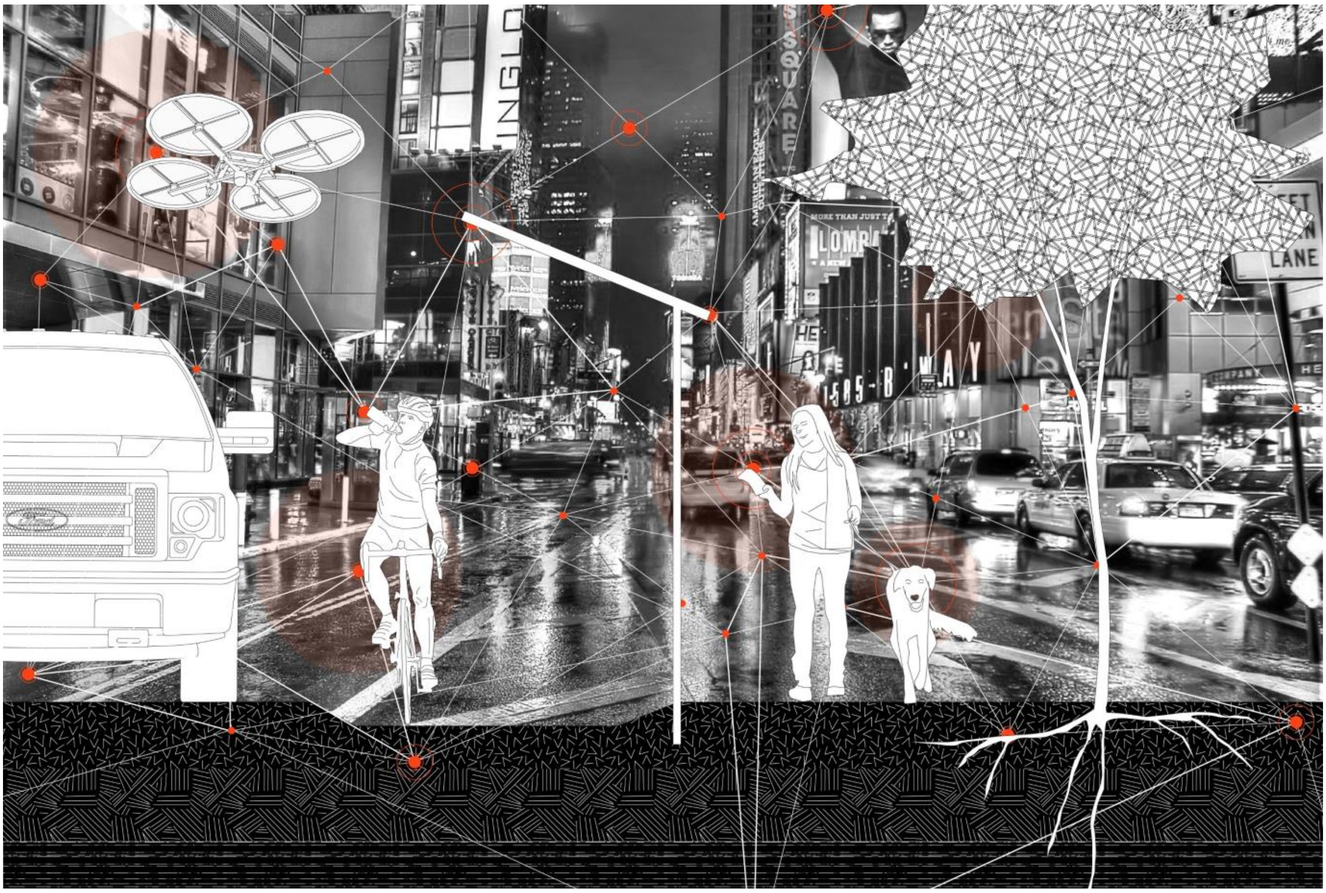
Technical Information Note | 22/02

Drones in Landscape Practice (2nd ed.)



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Unmanned Aerial Vehicles (UAVs)

Landscape Institute
Inspiring great places

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1.1 Acknowledgements

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The Association of Remotely Piloted Aircraft Systems UK (ARPAS-UK)

LI Technical Committee and LI Digital Practice Group

LI Members subscribed to the Visualisation discussion group on Talking Landscape (now replaced by LI Connect)

1.2 Foreword

This document covers drone operations and their uses for deployment in UK airspace. Although some detail is included for cautionary reasons, this document is not guidance and the information provided is accurate as of the time of publication. Please note that regulations are regularly updated. Please refer to Table 1 for the latest information, updates and legislative amendments.

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2 Drone terms and categories

2.1 Purpose

Drones or Unmanned Aerial Vehicles (UAVs) can be deployed and controlled by a variety of systems, with direct application to landscape and urban landscape practice and planning. Drones provide new survey possibilities and operate in a 'hover space' between human scales of landscape observation and low-flying light aircraft, usually between 10m–120m. Drones can therefore provide 'near range' visual information amongst other sensory data sets. They represent a powerful, cost-efficient design tool for sites, and client and public consultation, by providing new perspectives on the spatial layout, landscape and urban landscape conditions, as well as data capture.

(UAVs) are just one example of new landscape sensing technologies that recent design scholarship has identified as potentially transformative of landscape representation, modelling and design techniques.

Brett Milligan, University of California

2.2 Terms

'Drones' is a universal generic term for a fixed wing or multi-rotor vehicle. Standard terms are:

- *Remote Piloted Aircraft Systems (RPAS) (preferred term by drone pilots)*
- *Unmanned Aerial Vehicles (UAVs) (preferred term by drone pilots)*
- *Small Unmanned Aerial System (SUAS)*
- *Small Unmanned Aircraft (SUA) (UK legal term)*
- *Unmanned Aircraft Systems (UAS) (entirety of a system and preferred term the CAA) and*
- *Unmanned Aircraft (UA).*

These terms refer to aerial vehicles operating with various degrees of autonomy. The operation of these vehicles requires the pilot to understand the flight system, which varies in complexity. Most civilian and consumer drones refer to four rotor blade drones and a camera. They are technically known as remote controlled rotary gyroscopically stabilised quadcopters, which have gimbals that provide a stable platform for a high definition (HD) camera or sensor. Commercial drones navigate, position plot and return home using global navigation satellite systems (GNSS) and global positioning systems (GPS). The remote controller, or transmitter, is called a ground control station (GCS). GCS can be complex systems, sophisticated pieces of software/hardware that communicate with the UAV via a transmitter. Modern GCSs display real-time data on the UAVs performance and position and can serve as a 'virtual cockpit'. The different types of UAV include:

- *Multi-rotary vehicles that have between 4–8 rotors, quadcopter, hexacopter and octacopter.*
- *Fixed wing drones that can carry heavier payloads but are not able to hover in fixed positions. Fixed wing craft require runways or take off strips and can travel for longer distances, travel at higher speeds and survey greater distances +/- 1km².*

- *Hybrid models called tilt wing craft or vertical take-off and landing (VTOL) which trade off the two benefits of faster speeds/distances and maintaining fixed stable positions.*
- *Kite Aerial Photography (KP), tethered drones and dirigibles, or airships, that can also be used to survey landscapes and urban environments.*

The public typically relates to aerial vehicles as drones, UK legislation refers to SUAs and training organisations use the term UAVs and RPAS. The Civil Aviation Authority (CAA) use the term UAS and pilots are called operators. The CAA has produced a master glossary of definitions and abbreviations for reference.

The primary guidance for the operation of unmanned aircraft systems within the UK is CAP 722: *Unmanned Aircraft System Operations in UK Airspace*, by the CAA.

2.3 Categories of operation

The Air Navigation Order 2016 (ANO) is a legal statutory instrument which covers civil aviation in the UK and governs the legal requirements of drone flights. There are three categories of regulation for the operation of unmanned aerial vehicles in the UK; Open, Specific and the Certified category.

Open category

In the UK, you must register with the CAA before flying most drones or model aircraft outdoors. This involves a theory test for a flyer ID, and individuals and organisations must register any drone or model aircraft for an operator ID. For commercial operations, third-party insurance must be in place in accordance with EC Regulation 785/2004 (Insurance requirements for air carriers and aircraft operators). These general requirements are set up for drone use and are known as Open category operations. This category is split into three areas as follows:

- *A1 drones weighing less than 250g can be flown over people, but not crowds, for a short time – but not intentionally.*
- *A2 drones must maintain a 30m degree of separation from people, the operator must pass the CAA theory exam and have gained general practical experience. The training course is called Certificate of Competency (A2 CofC) and is valid for five years before renewal.*
- *A3 drones must stay at least 50m horizontally away from people and 150m meters horizontally away from parks, industrial and built-up areas.*

CAA permission is now required for commercial drone work and commercial drone operations need to be conducted in what the CAA call a Specific category that requires permission.

Specific category

Specific category operations require authorisation by the CAA and appropriate risk assessments, for example, for flying over an urban area. The Permission for Commercial Operation (PfCO) has been replaced by the Specific category as of 31 December 2020. The General Visual Line of Sight Certificate (GVC), introduced on 1 January 2021, allows operation in the Specific category to fly drones up to 25kg. GVC-approved remote pilot assessment organisations, or recognised assessment entities (RAE), can be viewed on the CAA website. Additional permissions may be required. For example, aerial filming in London is subject to several permissions. These permissions could include NATS/local air traffic control services (ATC), the Port of London Authority (PLA), Metropolitan Police, Protection Command (formerly Diplomatic Protection unit). In all cases, landowners' permission(s) must be obtained, as well as a GVC and third-party insurance. Insurance must be EC Regulation 785/2004 compliant. The insurance must be in the name of the applicant, not just the name of the pilot (unless the pilot is the applicant), or the trading name. For example, for companies, the insurance must include the full name of the company including Ltd/Limited/PLC as appropriate.

Certified category

The Certified category is a new area in development by the CAA which will have the equivalent regulations of manned aviation. Whichever the category of operation, operating safely is the primary basis. Additional weight restrictions apply for operating drones over 25kg and these are set out in CAP 722, Annex B.

Public perceptions

There are public perception issues with drone safety and operations, and this can disrupt fieldwork or generate misunderstandings with clients. The CAA conducted a risk assessment on these issues in 2018 (CAP 1627). For client liaison regarding drone operations, NESTA Flying High: The future of drone technology in UK Cities has several executive summaries and blog entries regarding future directions and public perceptions. The Institution of Mechanical Engineers (IMechE) has also conducted public drone perception surveys.

Privacy

The Information Commissioner's Office (ICO) recommends responsible operation and the respect of privacy of others. The form of imagery and data acquired can be an important consideration in fieldwork.

2.4 Sources of information

The following list is not exhaustive, but links to the major regulatory and professional bodies relevant to drone applications and operations (see Table 1).

Table 1: Sources of information

Body or organisation	Website	Description and remit
CAA	Remotely piloted aircraft and drones | Civil Aviation Authority (caa.co.uk)	As the UK's aviation regulator, CAA ensure that the aviation industry meets the highest safety standards, that consumers have choice, value for money and are protected and treated fairly when they fly, through efficient use of airspace.
NATS	https://www.nats.aero/	National Air Traffic Service (NATS) provides air traffic navigation services to aircraft flying through UK controlled airspace and at numerous UK and international airports.
ARPAS-UK	https://www.arpas.uk/	The Association of Remotely Piloted

		Aircraft Systems UK (ARPAS-UK) is the only industry trade association and professional body focused on the UK drone community.
EASA	https://www.easa.europa.eu/	The European Union Aviation Safety Agency (EASA) is the centrepiece of the European Union's strategy for aviation safety. Its mission is to promote the highest common standards of safety and environmental protection in civil aviation.
BMFA	https://bmfa.org/	The British Model Flying Association (BMFA) is the National Governing Body for the sport of model flying. Its aims are to promote, protect, organise and encourage model flying within the UK.
FPV UK	https://fpvuk.org/	FPV UK is the UK association for radio control model and drone flying.
IMechE	https://www.imeche.org/	The Institution of Mechanical Engineers (IMechE) is a global community of mechanical engineers represented in over 140 countries. The Institution is the largest

		network of mechanical engineering knowledge, skill and opportunity in the world.
RTPI	RTPI | Planning Enforcement Handbook for England	The Royal Town Planning Institute (RTPI) publish the Planning Enforcement Handbook for England. Section 1.3 is on use of drone surveillance for planning enforcement.
RAS	https://www.aerosociety.com/	The Royal Aeronautical Society (RAS) is the world's only professional body dedicated to the aerospace community. They work to further the advancement of aeronautical art, science and engineering around the world.
Historic England	https://historicengland.org.uk/research/methods/airborne-remote-sensing/drones/	Historic England uses airborne remote sensing methods to identify, record, illustrate and monitor the condition of a wide variety of heritage assets. The archaeological use of aerial photography transforms our knowledge of archaeological landscapes.

RICS	https://www.rics.org/uk/upholding-professional-standards/sector-standards/land/earth-observation-and-aerial-surveys-6th-edition-global-guidance-note/	The Royal Institution of Chartered Surveyors (RICS) recently published a global guidance note on Earth observation and aerial surveys (6th edition). The guidance note is intended for use by land, sea, engineering and environmental professionals who are acting in an advisory capacity, by survey-knowledgeable clients who specify their own surveys and by earth observation and aerial survey specialists.

3 Drone uses, requirements and operations

3.1 Drone uses

Drones may be used at remote locations for a range of applications, such as:

- *to survey sites*
- *to monitor construction phases*
- *for inspection and maintenance and*
- *for vegetation monitoring.*

Drones have an important role in heritage gardens and historic landscapes. They may also have a value for rapid survey of phenomena such as flooding or infrastructure inspection. The various areas of use of drones are a testimony to its industry growth. Drones are used to map areas to create a series of still orthographic images (see Figure 1) which are then processed post-flight and stitched together, detecting identical points, to create a 3D point cloud from which orthomosaics, are taken. Orthomosaics are mosaics of multiple aerial images that together form a dataset. This data can be used in building information modelling (BIM) workflows and can be used as a basis for cut and fill calculations and grading, amongst many other computational processes (Cureton, 2020). Drones may also be used to gain an aerial perspective of a site for a client, to make a documentary video of the area or to provide preliminary information for a design brief.

Figure 1. Alex Gwilliam, videographer, Bottoms Reservoir constructed by John Frederick Bateman 1865–1877, Longdendale Chain, North Derbyshire

Image courtesy of ©Alex Gwilliam, 2021

3.2 Drone requirements

A commercial drone pilot is expected to hold:

- *flight planning material*
- *landowner's permissions*
- *pilot logs*
- *site assessments*
- *aircraft records and maintenance logs*
- *insurance.*

Drones in commercial civilian operations follow the guidance that they must always remain in view, or visual line of site (VLOS), always maintain manual piloting capability in case of GPS signal loss and have a flight log and safety operations manual. The CAA has produced The Drone and Model Aircraft Code to support its legislation for the public and recreational flyers, including the below acrostic:

- ***D****on't fly near airports or airfields*
- ***R****emember to stay below 400ft (120m)*
- ***O****bserve your drone at all times – stay 150ft (50m) away from people and property*
- ***N****ever fly near aircraft*
- ***E****njoy responsibly.*

Pilots should know about their unmanned system, as well as its full functionality. The pre-flight planning stage involves numerous processes, including:

- *checking the unmanned system's deployment is legal prior to operation*
- *consulting aeronautical maps*
- *engaging in inspection and safety checks of equipment*
- *desk-based site and risk assessment.*

The pilot should record the areas of operation and mitigate any risks. They should check the class of airspace they operate in and gather permissions if necessary. They must also document local aerodromes and air spaces in case the vehicle suffers a loss of control. The distance considered is generally ten nautical miles from the area of operation.

There are five classes of airspace in the UK which determine the flight rules:

- *Controlled – A, C, D, E.*
- *Uncontrolled – G.*

Drones can fly in controlled airspace (class A, C, D, E), although notification to the air traffic control (ATC) unit is recommended. See NATS for definitions of airspace. Certain areas of UK airspace contain dangerous areas, prohibited zones or are restricted areas. These may be areas where there are aerodromes, glider sites or high-intensity transmitters, or areas of military activity. Drones may also have in built software 'geo-fences' preventing the device from entering these airspaces.

A Notice to Airmen (NOTAM) or Notice to Aviators is generally not required for VLOS operations due to the small scale, duration and operating limitations of VLOS flights. The potential need for NOTAM action does have to form part of the operator's risk assessment process, particularly above 400ft (120m), outside of controlled airspace, or when several unmanned aircraft will be operating together or as a swarm.

Drone flights require landowner permission where the drone takes off and lands. Councils, parishes and park spaces may have bylaws for drone usage, and operators are expected to check these in pre-flight phases. National Trust and Crown Estates also have strict guidelines (mainly referring to the requirement of a fee for commercial aerial work). Other landowners, such as Network Rail, require notification to its air operations team (see Operating drones close to or over the railway).

The process diagram below (Figure 2) describes the drone systems, payloads (the weight a drone can carry), flights and CAA-specific category flights, drone derived data and indicative applications of drones in landscape practice. There are many variations to the list depending on the site, client needs, technical skills and digital workflows present within the company or organisation. This diagram is intended to be used as a visual prompt for practices to map against capabilities and scope of services.

Figure 2. Process diagram

Image courtesy of Paul Cureton

3.3 Operation principles

A landscape practice may wish to have a pilot operator as a sub-contracted element of their work portfolio. This allows the pilot to receive commissioned work when both firms tendered on the same project. In this case, the arrangement would allow practices to maintain confidentiality and avoid a conflict of interest. This structure also follows best practice to Rule 10 of the Landscape Institute's Code of Practice (2021). The Association of Remotely Piloted Aircraft Systems UK (ARPAS-UK) has a list of its members which have met specific category operations and are CAA approved.

To operate in the Visual Line of Sight (VLOS), the pilot must maintain direct unaided visual contact to monitor flight paths and avoid collisions. Operating a drone outside of the VLOS risks collision, as the pilot only has the mounted camera frontal view, and obstacle avoidance sensors will not necessarily detect cables or small objects. Beyond the Visual Line of Sight (BVLOS) applications require additional permissions and, in 2021, CAA began piloting the concept in the UK.

A drone pilot may require a spotter and may be required to access construction sites. A spotter can be used for extended VLOS, although they will need additional training and specific consent from the CAA. Site access should be accommodated in all pre-flight plans, pre-construction meetings and must comply with the latest Construction (Design and Management) (CDM) Regulations. The drone pilot's site assessment and risk assessment form (risk register) should be shared with the nominated principal designer, and/or principal contractor. A drone pilot, as part of a landscape practice, may also need to be accounted for under Lone Worker legislation cited under the Health and Safety at Work Act 1974 and the Management of Health and Safety at Work Regulations 1999 and policies of practice.

Any accidents, crashes or injuries that occur must have Mandatory Occurrence Reports (MORs). This is a system not for attributing liability, but for the reinforcement of safety of drone operations. An example of an MOR could be a bird strike, loss of control or structural damage. There is a legal duty to report these issues.

3.4 Case study one

Figure 3. A drone captured aerial view revealing the setting and scale of 'Capability' Brown's landscape surrounding Berrington Hall, Herefordshire. The house was designed and built by Brown's son-in-law, Henry Holland, between 1778–1781 for London banker Robert Harley

Image courtesy of ©National Trust/Mike Calnan (see www.topographica.co.uk).

Drones are also useful for before and after comparisons of major restorations or for recording seasonal changes

via time-lapse sequences, as well as repeatable fixed point photo monitoring of tree growth following major storms, or deer herd head counts in parkland.

Mike Calnan, Historic Gardens Review, Issue 41, 2020.

3.5 Drone photogrammetry

The National Trust, like many other conservation organisations, is adopting drone technology to help it better understand and manage properties in its care (see Figure 3). Applications have included 3D models of built structure and archaeology to help plan conservation works. Drone 2D mapping has been used to record change, such as inland flooding or coastal erosion, soil health and the spread of plant disease. Occasionally, more detailed close-range drone-based LiDAR surveys have been justified for archaeology and other purposes. The National Trust used drones extensively for its in-house created photographic and video contributions to the UK's 2016 Capability Brown Tercentenary Festival. This gave a wider online audience the chance to see the full extent of his landscapes as Brown may have envisaged them (see one of a number of aerial videos and the National Trust's, Capability Brown Landscape).

Photogrammetry is the process of measuring, recording and interpreting photographs to create a spatial model, and this section introduces some of the principles and workflows of drone photogrammetry. Drone photogrammetry mapping is one the most common applications in landscape practice, second to media and site photography. However, the quality and accuracy of data is dependent on both the hardware being used and the expertise of pilots in their approaches and strategies to fieldwork. For further information, refer to the RICS Earth observation and aerial surveys 6th edition global Guidance Note.

It is important in pre-flight planning and procurement of drone services to envisage the expected outcome, for example:

- *are 2D maps required?*
- *are multiple flights across various seasons needed or is the site inaccessible apart from drone flight?*
- *what resolution would clients like the model to be?*
- *what is the spatial extent of the study? Typically, it is 10–100ha per survey (Duffy et al, 2020, p.14).*

A drone using a range of software can execute a waymarked path. Commonly, a drone flight can be automated in a grid pattern to create a 2D georeferenced map. The drone flight will gather orthophotos, a hybrid between maps and aerial photographs. They have been corrected for geometrical distortion and have been registered and matched to a coordinate system. The images are combined, and any colour differences are merged.

Photogrammetry is a cost-effective way of gathering spatial data. Using a ground sampling distance calculator will determine the altitude of the drone for survey and the required resolution. The closer to the ground, the more pixels of the area e.g., 2cm/pixel. When mapping vegetation, an image resolution higher than 10cm/pixel follows best practice. The level of detail (LOD) is a subjective task, as clients may demand a LOD higher than required, or the LOD may be insufficient for more detailed site design in later phases. Some drones have Real-Time Kinematic (RTK) modules which can provide higher accuracy precision mapping.

High relative accuracy can be achieved without Ground Control Points

(GCPs) by flying low with high overlap and strong oblique coverage if necessary.

Adam Carp, The Complete Guide to Professional Mapping with DroneDeploy, p.8.

A 3D map will require multiple grid patterns overlaid, or an overlaid linear area or corridor. The drone camera will need both nadir imagery, where the camera faces directly beneath the drone at the time of the exposure, and oblique imagery, where imagery is captured approximately at a 45-degree angle to the ground surface. Oblique photography at lower altitudes will improve the quality of the model. The further the images overlap, the further the quality of the final model to a point. Vegetation mapping requires increased overlap. Images can have front or side overlap and are mosaiced or overlapped to create an orthomosaic map. Flight patterns may also need to be adjusted depending on elevation. Elevation shift can result in loss of quality, and it is important to maintain ground distance.

Pilots might wish to consider temporal resolution, the time elapsed between each survey flight, which can cause issues in data. Multiple surveys, when combined for larger sites, may vary substantially depending on weather systems and site accessibility.

Once drone images are gathered from a site, there is a phase of post-processing using structure from motion (SfM), a photogrammetric range imaging technique for estimating 3D structures from 2D photos. Using various software platforms, this creates a 3D ‘reality’ environment mesh and point cloud. Example file formats include GeoTIFF, KML, STL, OBJ, DXF, FBX, SKP. Identical points between each image are found, and these are called key points. The more overlaps in the photographs, the more 3D key points can be established. The flight pattern, some ground control points and the range of angles for imagery and whether they are oblique or plan will also influence the quality of the output.

This process of SfM is called ‘reality capture’ and is geographically referenced. Geo-referenced models can be improved by using ground control points placed on site. However, certain shiny, reflective and transparent surfaces can cause holes in the generated 3D mesh output and model which creates voids. This requires additional editing, modelling and correction. Dense tree canopies and homogenous surfaces also cause considerable issues. Semantic segmentation algorithms are used to link each pixel in an image to a class label and, during processing, may remove people, cars and moving elements, though this subject to various software capabilities.

Common software platforms include:

- *Esri Drone Deploy*
- *Pix4D*
- *ContextCapture*
- *Global Mapper*
- *Agisoft Metashape and*
- *DJI Terra.*

This list is not exhaustive and there are a range of open-source and commercial software platforms that can integrate with geographic information systems (GIS) and parametric modelling programs.

The range of outputs resulting from a drone survey include:

- *a digital surface model (DSM)*
- *digital terrain model (DTM)*
- *contour lines*
- *classified point cloud*
- *orthomosaic*
- *contour point cloud*
- *3D mesh*
- *vector or*
- *thermal map.*

BIM workflows

Once a site model has been processed, designers may use the photogrammetric model to 'design in' or measure and execute parametric volumes, shapes and components. Therefore, drone derived surveys can be used in pre-construction site surveys and repeated as part of monitoring of construction phases and 'As Built' construction documentation.

3.6 Case study two

Figure 4. Construction Phase Aerials, 2017 (top) and 2020 (bottom), Barton Park, Development, Oxford, Tree Frontiers

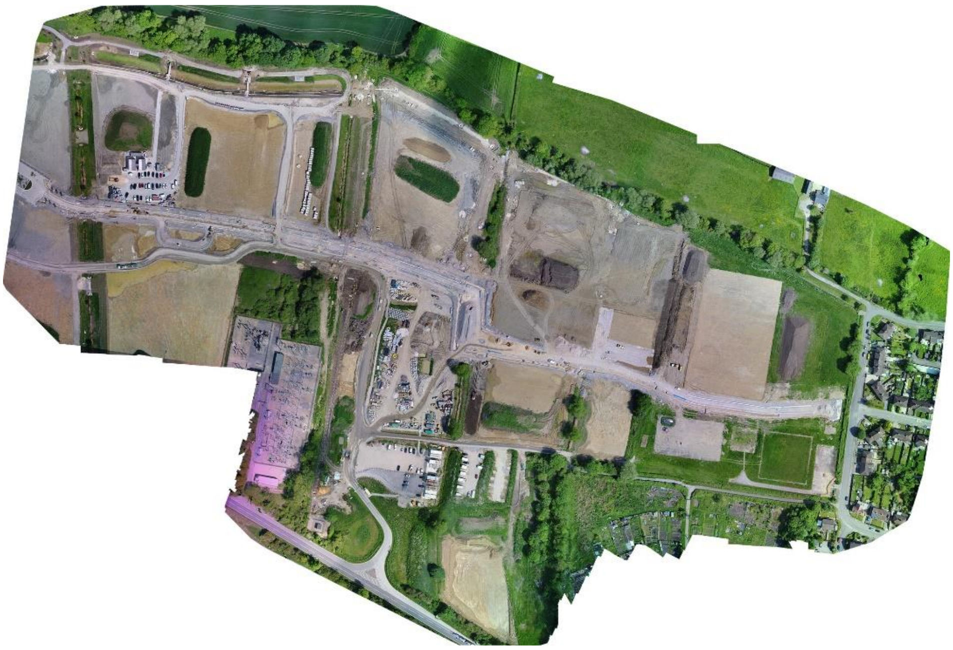

Image courtesy of @Tree Frontiers

Drones used on construction sites can provide a huge array of information, assisting everyone involved in the project in monitoring progression as well as post-development marketing. Barton Park is a development scheme on the outskirts of Oxford, providing 800 new homes with a mix of land uses.

The use of drones was adopted early in the project to assist in the design and planning stages of the development. Once planning consent was obtained, the continued use of drones to capture aerial footage allowed the project team to monitor all stages (see Figure 4).

Still images assisted in monitoring health and safety compliance on site.

Nick Bolton, Case Interview, 2021.

As Nick Bolton explains, the use of images assisted in monitoring health and safety compliance on site. By using drones, the client team could understand the progression of construction without the need for multiple site visits. The local authority team used the images provided to ensure compliance with planning conditions and, as the project progressed, changes in the land use and the translation from vision to reality became clear.

3.7 Drone Artificial Intelligence (AI) and Machine Learning (ML)

Drone AI is an emerging area in academic research, but with increasing commercial applications integrated within various software platforms, or as stand-alone services. Drone AI operates on-demand during flight and in cloud-based systems. The range of AI is highly diverse. Computer vision and machine learning can be used to analyse crowds in parks, for person or animal detection, for object and street furniture identification and for defect detection e.g., dieback in forests due to drought or viral infection. Computer vision is a field of AI for the high-level understanding of digital media for automation. Drone computer vision is AI autonomous navigation and flight through an environment, as well as hazard detection. Machine learning are algorithms that classify, cluster, train and count to mimic human intelligence. For example, in the Picterra project (see Figure 5), pavement cracks are detected by using a drone survey, including the labelling and classification of the images and training of the algorithms to detect defects. Deep learning is part of the family structure of machine learning. Artificial (deep) neural networks act like a brain and allow an algorithm to ‘learn’ from large amounts of data and to make subtle improvements. Therefore, deep neural networks (DNN) for monitoring wildlife and habitats is an emerging area of research (Hamilton et al, 2020).

Figure 5. Picterra, Geospatial AI, Pavement defect detection, 2021

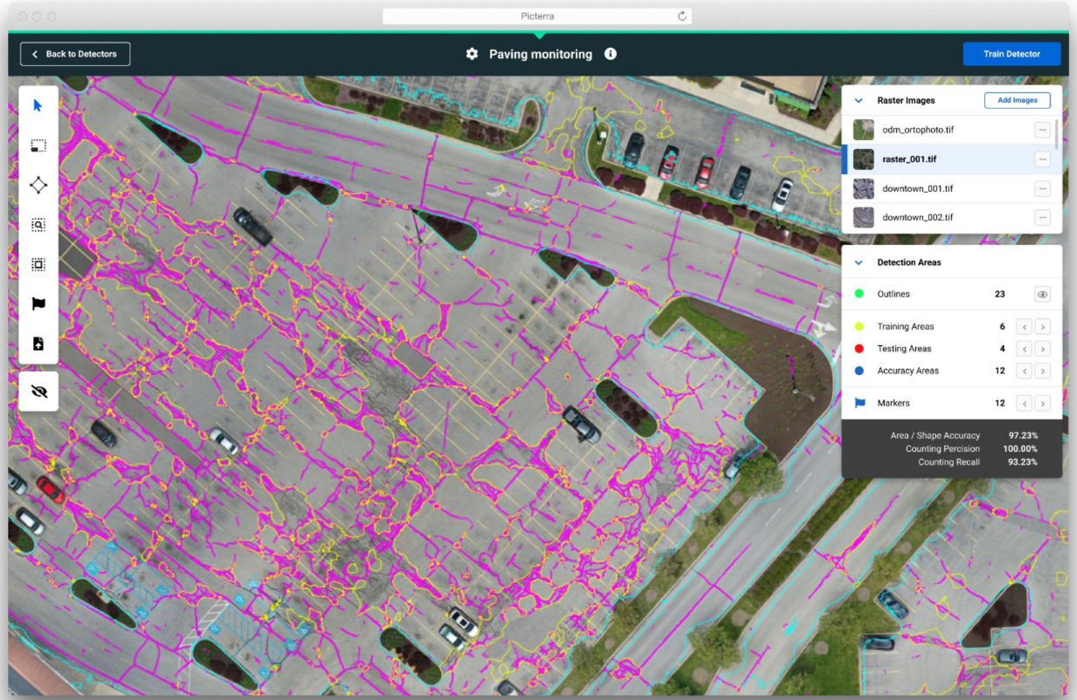

Image courtesy of @Picterra

Drone AI may be used for analysis of street furniture and maintenance, species identification and classification. Semantic classification is a growing area of geospatial data analysis based on 3D airborne data, in this case drones, and the ISPRS Benchmark is a useful basis for consultation (Kölle et al, 2021). For contemporary and future-based landscape architecture, drone AI and ML will provide cost-effective capabilities for automated advanced flight, spatial analysis, monitoring and inspection. The age of automated and improved 'data driven' decisions will radically change the industry.

3.8 Future of drones

The developing mapping and survey capability enabled through the use of drones in the 'hover space' provides 'reality' models and multispectral images of the process of environmental change, construction phases and/or our interaction with place. Multispectral imaging provides image information in the spectral and spatial domain. This is one of the prime areas of drone deployment. Drone flights can help with CDM and compliance, accessing hazardous areas and sequencing construction phases. Various drone pilot projects are currently taking place, as well as discussions of the operation frameworks and legislation for further integration in UK airspace. These pilots include the use of drones for planting and reforestation, coordinating drones and ground-based robots for surveys and inspection, and the establishment of drone logistics and drone flight corridors amongst others. Drones are already commonly used in ecological fieldwork and conservation (2020). In the approved roadmap, *European ATM Master Plan: Roadmap for the safe integration of drones into all classes of airspace* (SESAR, 2018), the drive for innovation is clear in terms of accommodating UAS technology in the airspace, and this is a shared UK objective.

Drones will be part of our future. Rapid changes in drone technology hold enormous promise for the future use of airspace and aviation at large as the digital transformation expands skyward. This requires a step-change in the way airspace is managed. Essentially, there will be a move from several thousand conventional aircraft in the sky every day to potentially hundreds of thousands of highly connected and automated aerial vehicles, offering advanced data-driven services and operating everywhere, including in cities (SESAR, 2018 p.3).

Much of this activity is already happening and landscape architecture has a rich opportunity to deploy, pioneer and deliver projects using drones and drone sensing technology, alongside other technologies, to transform places and environments.

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