Department for Environment Food & Rural Affairs

DARWIN INITIATIVE

Foreign & Commonwealth Office

Funded by UK Government

# Darwin Plus:
# Overseas Territories Environment and Climate Fund

# Final Report

***Important note*** *To be completed with reference to the Reporting Guidance Notes for Project Leaders:*

*it is expected that this report will be a maximum of 20 pages in length, excluding annexes*

## Darwin Project Information

| | |
|---|---|
| Project reference | DPLUS051 |
| Project title | Water Security and Sustainable Cloud Forest Restoration on St Helena |
| Territory(ies) | Saint Helena |
| Contract holder Institution | Saint Helena Government |
| Partner institutions | Connect Saint Helena, Arctium, Centre for Ecology and Hydrology |
| Grant value | £123,356 |
| Start/end date of project | April 2016 to September 2018 |
| Project leader name | Derek Henry |
| Project website/Twitter/blog etc. | www.arctium.co.uk/dplus051-water-security/ |
| Report author(s) and date | Ben Sansom, Derek Henry – January 2019 |

## 1 Project Overview

St Helena has experienced unpredictable weather in recent years, which has led to two droughts in the past five years. The island has a very high dependency on rainfall to replenish water supplies. With the planned increase in eco-tourism, water demand is expected to rise, whilst climate change is likely to further impact on weather patterns.

The 20-Year Water Resource Masterplan outlines development and management of island water resources to provide security of supply and enable resilience to climate change. The preferred development approach is through rainwater harvesting.

Improving mist capture in the Peaks through restoring endemic cloud forest would increase available water resources and provide more cloud forest habitat for at-risk endemic plants and invertebrates.

The project was designed to provide sub-catchment scale water balances to confirm the relationship between cloud forest, mist capture and impact of invasive species on water supply. Outcomes will support development of a cloud forest restoration plan.

Two sub-catchments in the Peaks cloud forest, located within the centre of the island, were identified for their current habitat distribution and significance to island water supply; Grapevine Gut (mainly invasive species) and Wells Gut (partially endemic species). A third sub-catchment on the south-east side of the Peaks was also identified for climate monitoring to compare micro-climates on opposite sides of the Peaks.

The project was designed to benefit the population of St Helena and endemic plants and animals. The outcomes of the project will be used to support the development of a more secure and sustainable water supply through cloud forest management and restoration, which in turn will increase habitat for endangered species.

A project location plan is presented in Figure 1.1 and Figure 1.2.

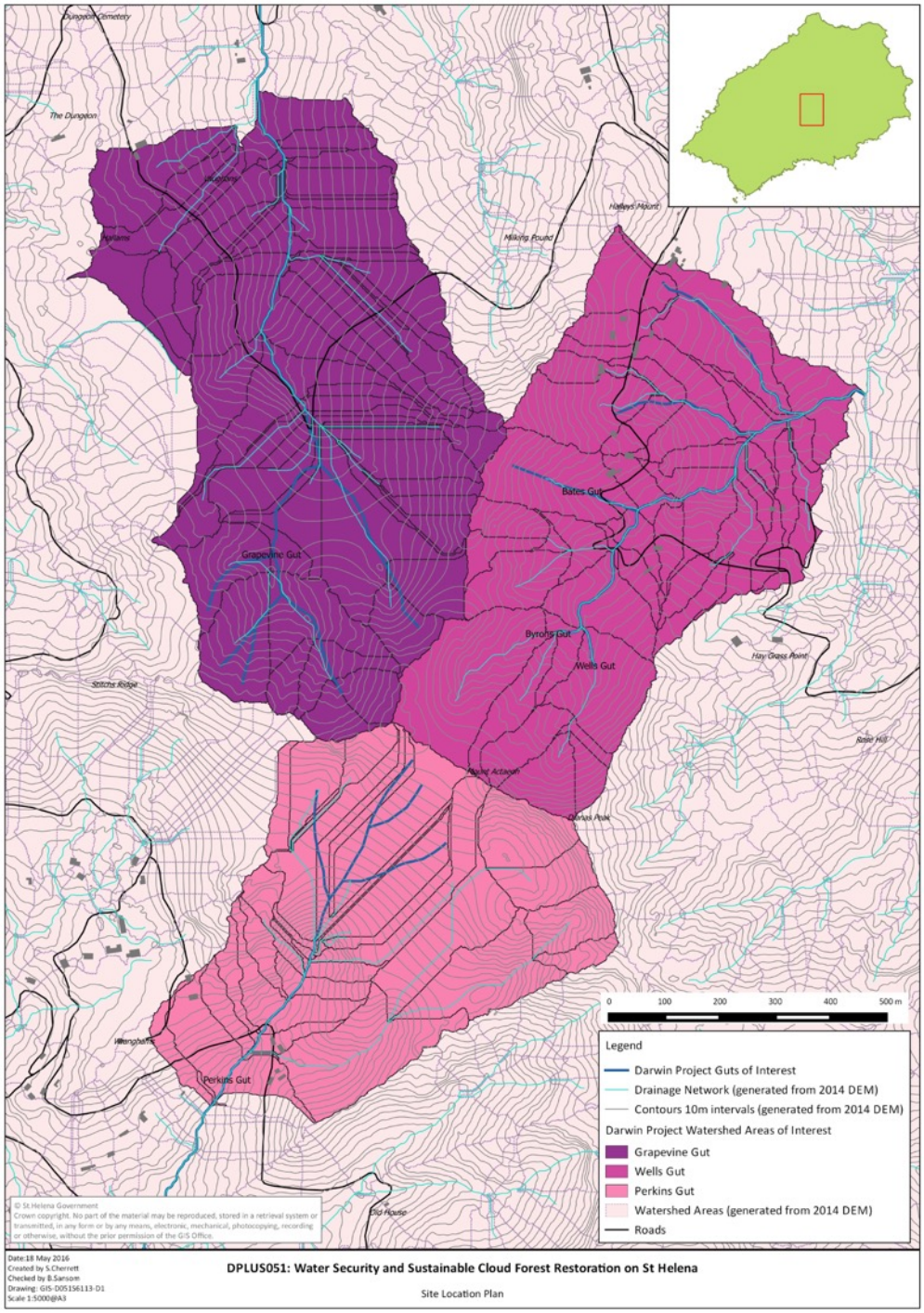
**Figure 1.1: St Helena**


## 2 Project Stakeholders/Partners

All stakeholders were involved in the project planning process, as the project is borne out of Connect Saint Helena's (Connect) 20-Year Water Resource Masterplan and Saint Helena Governments (SHG) responsibility for leading environmental management and protection on the island. The Centre for Ecology and Hydrology (CEH) provided technical knowledge supporting the selection and location of monitoring locations and ongoing interpretation of data. Arctium provided project management support and co-ordinated, installation of monitoring equipment, training and field survey support amongst project tasks.

During the project Connect needed to limit staff involvement due to the need to focus attention on post drought operations (2016 to 2017 drought). As a consequence, the majority of project communication has been between the remainder of the project partners. The reduction in Connects manpower resulted in some data collection periods being missed due to other support staff being on annual leave, delaying the download of data from the study. Project funded monitoring continued until June 2018, however additional rainfall and mist data was collected in December 2018 when the team attended the RSPB sponsored Peaks Management Plan workshop (Annex 6). These data will be used to update the project report in early 2019 as part of a continued commitment to evaluate the Peaks climate after the Darwin Plus funded work finished in September 2018.

**Figure 1.2: Site Location**




Project stakeholders have been in regular contact throughout the project via email and Skype to discuss staff resources, data collection progress, troubleshooting field equipment issues and project budgets.

Staff movements were a challenge on island, however the project team managed to retain a core island monitoring staff resource, despite staff moving from their original project employer. The drought of 2016/17 was a concern due to the long period of dry weather at the start of the project, however the extreme rainfall event in February 2017 provided an opportunity to evaluate how the sub-catchments responded to high intensity rainfall after a prolonged period of dry weather (see project report Sections 13 to 17, 19 and 20).

Despite the remoteness of the monitoring locations and relatively small number of people who access the study area, some of the data loggers in Grapevine Gut and Wells Gut were removed from their monitoring locations. An investigation by the DPLUS051 monitoring team concluded

that data loggers at SW02WG and SW02GVG were removed without consent, which resulted in gaps within the monitoring data. It is regrettable that this occurred and had an impact on some of the data sets. All monitoring locations had been selected to ensure there was limited opportunity for tampering of equipment and signs were posted at each monitoring location explaining the purpose of the equipment and providing project team contact details. Having a more frequent monitoring data collection programme may have limited the data losses and identified the cause of the logger removal. This was primarily down to the availability of local staff and changes in staff resourcing due to the drought.

Providing water resource monitoring training to staff from Connect and the Environmental Management Division (EMD) of Saint Helena Government (SHG) has been beneficial, with skills retained on the island. Members of EMD also promoted the project to the island's residents during the Nature Day outreach programme in March 2017 (DPLUS051 Annual Report 2017) and the St Helena Environment Conference 2018 where delegates were told about the project during field trips to the Peaks.

The project team also reported to the island Governments Environment and Natural Resources Committee (ENRC) on an annual basis (ENRC Agenda and Minutes 16/11/17 – no agenda or minutes available for 2016 meeting. Each presentation enabled the project team to emphasise the importance of understanding the islands water resources and how they link up with endeavours to start an eco-tourism economy and protect/restore the habitat of the islands endemic land-based biodiversity. These meetings have had a lasting impact which were confirmed during discussions with members of ENRC during the Deputy Governors reception in December 2018.

# 3 Project Achievements

## 3.1 Outputs

The project logframe outputs and report sections (evidence of outcomes) can be found in the project report (DPLUS051 Water Security and Cloud Forest Restoration on St Helena). Table 3.1 outlines each output with measurable indicator and identifies the project report section where evidence for each output can be found.

**Table 3.1: Project Logframe Outputs and Report Sections (evidence)**

| Logframe Outputs | Measurable Indicators | Report Sections |
|---|---|---|
| **Outcome:**<br>Demonstrate that restoring the cloud forest will increase harvested rainfall and meet the islands water demand, whilst improving climate change resiliency and significantly increase habitats for endemic plants and invertebrates. | 0.1 Desk study.<br>0.2 Collection of microclimate data.<br>0.3 Botanical survey of each sub-catchment.<br>0.4 Water balance.<br>0.5 Reporting and outline cloud forest restoration plan. | Section 1-20 |
| **1**. Desk Study - to collate archive data. | 1.1 Visit Kew and CEH in the UK to collate desk-based data.<br>1.2 Desk based assessment of ANRD archive in the Scotland library on Saint Helena.<br>1.3 Desk study report. | 2 Saint Helena<br>3 Tropical Montane Cloud Forests<br>4 Climate<br>5 Mist Capture and Rainfall Harvesting<br>6 The Ecology of St Helena<br>7 Geology<br>8 Soil |

| Logframe Outputs | Measurable Indicators | Report Sections |
|---|---|---|
| | | 9 Water Resources<br>16 Climate Change Assessment<br>18 Ecosystems Services Assessment |
| **2**. Baseline Field Assessment | 2.1 Completion of botanical surveys.<br>2.2 Completion of remote sensing/aerial surveys.<br>2.3 Water features survey | 10 Water Features Survey<br>11 Remote Sensing<br>12 Vegetation Survey<br>Also, see flight Operation Manual and Flight Plans (provided separately from this report). |
| **3**. Environmental Monitoring | 3.1 Installation of hydrology and hydrogeology monitoring locations.<br>3.2 Installation of meteorological monitoring equipment and relative humidity loggers in both sub-catchments.<br>3.3 Collection of meteorology data in the sub-catchments and a control catchment.<br>3.4 Monthly and quarterly monitoring of surface water and groundwater levels and flows and meteorological/micro-climate data. | 13 Monitoring Network<br>Also, see DPLUS051 Monitoring Network Manual v1.1 (provided separately from this report).<br>14 Monitoring Data<br>Includes description of monitoring record and interpretation of field data. |
| **4**. Interpretation of Data | 4.1 Calculation of water balances from collated water level, flow, meteorological and botanical survey data.<br>4.2 Interpretation of water balances – identify trends and/or relationships between micro-climate, vegetative cover and ground conditions. | 14 Monitoring Data Interpretation<br>Interpretation of field data.<br>15 Sub-Catchment Water Balance<br>16 Climate Change Assessment<br>19 Increasing Mist as Rainfall for Public Water Supply<br>20 Conclusions and Recommendations |
| **5.** Reporting | 5.1 Collation of all desk based and field data.<br>5.2 Interpretation of data and desk-based data and reporting of an outline restoration plan. | 17 Outline Cloud Forest Restoration Plan<br>18 Ecosystems Services Assessment<br>19 Increasing Mist as Rainfall for Public Water Supply<br>20 Conclusions and Recommendations |

The project achieved all outputs (see project report DPLUS051 Water Security and Cloud Forest Restoration on St Helena). A study of this kind had not been completed in the study area before and as a consequence the baseline conditions were that no climate or water balance data had been collected within the study area, nor had an eco-services assessment of the study are been completed in the past. The project was also the first of its kind on the island to use remote sensing data collected by a drone – most notable the project obtained the first commercial permit to fly a drone on the island within the new airport restricted fly zone (see permits as evidence). The project report provides evidence of the data collected and completion of each output as identified in Table 3.1.

The problems encountered had been identified within the project log-frame assumptions and are summarised below:

- **Travel to the island** – airport opening delays (Indicators: 2 – Collection of micro-climate data, 4 – Water balance). Equipment could not be shipped to the island in sufficient time to complete 12 months monitoring due to delays opening St Helena airport for commercial flights. The project programme and budget were amended in the October 2016 change request so that equipment could be sent to the island via ship (RMS Saint Helena) and to account for additional staff travel time to the island. Overall the project programme was extended by 6 months to enable sufficient time to collect a minimum 12 months data and complete the project report. The airport opened in time for the 2017 field team to fly back to the UK at the end of the 2017 monitoring visit. See DPLUS051 HYR1 2016 and DPLUS051 Annual Report April 2018;
- **Procurement of equipment** (Indicators: 2 – Collection of micro-climate data, 3 – Botanical survey; 4 – Water balance)**.** The majority of equipment was purchased through the SHG procurement team. The SHG procurement department had problems with a supplier procuring the DJI Phantom 4 drone which came to light 1 week before the baseline monitoring was going to start. The drone was to be used to create a digital map of the study area, to determine the percent coverage of each candidate catchment with endemic and invasive plant species. An identical drone was hired with the permission of Darwin Plus so that the work could be completed in time. The project drone was procured in early 2017 and shipped to the island in time for commencement of the November 2017 field work. See DPLUS051 HYR1 2016; and
- **Equipment reliability** (Indicators: 2 – Collection of micro-climate data, 4 – Water balance). All the automatic weather stations, a single rain gauge, barometric logger, surface water logger and two soil moisture loggers failed to operate correctly during the project. Spare parts were shipped to the island to repair equipment, however problems with the weather stations, rain gauge and soil moisture loggers persisted. See DPLUS051 Annual Report April 2018.

An additional problem/risk related to site security had not been identified in the log-frame (Indicators: 2 – Collection of micro-climate data, 4 – Water balance). Some of the monitoring equipment was removed from its monitoring location by unknown actors. See Section 2 of this report for details and DPLUS051 Annual Report April 2018.

### 3.2 Outcome

The project achieved the desired outcome. Evidence and indicators can be found in the project report (DPLUS051 Water Security and Cloud Forest Restoration on St Helena). Gaps in data due to equipment reliability issues were filled by built-in redundancy measures where some data sets were duplicated by other instrumentation, or through hind casting/forecasting data. The drought of 2016 to 2017 prevented the collection of climate data for a “normal” year but afforded an opportunity to monitor how the sub-catchments behaved during an extreme event (something which will be more common on the island due to climate change – see project report Section 16). Interpretation of this extreme event data is presented in Section 14.8 of the project report.

An additional outcome and deliverable from the project will be to assist SHNT and the SHG Conservation team in the drafting of an Operations Manual and supporting documentation to support a Permission to Fly application with Air Safety Support International. A template Operation Manual is provided as evidence (project report Appendix E). A follow up meeting was help with the EMD Conservation Officer in December 2018 as part of the RSPB workshop (Annex 6) to agree a drafting of the operation manual for approval by SHG before submission to ASSI in early 2019 for approval.

### 3.3 Long-term strategic outcome(s)

See Annex 6 for details regarding change, decision making and impacts.

The link between water supply for public consumption and habitat restoration had not been made on the island before and the project outcomes have provided an opportunity to link conservation with a basic human need.

The project has demonstrated that restoration of the cloud forest on St Helena not only brings opportunities for improving the islands water supply, but also provides an opportunity to significantly enhance the islands international reputation for nature conservation. Cloud forest restoration would also support efforts to develop an eco-tourism economy by providing evidence of the island's connection with its rich natural resource and desire to be climate change resilient.

Costs of restoring cloud forest indicate that bringing additional water to the island through improvements in mist capture is initially more expensive than the costs of water storage infrastructure. However, ongoing costs would be negligible compared to the value of creating additional habitat and an increased source of water. Planning for these costs will require a change in thinking across Government, the private sector and society.

A key issue to overcome is that water is seen as a free commodity, with only the costs of abstraction, storage, treatment and distribution being considered. This has to change. If water is seen as a product, then the cost of production (mist capture through habitat restoration) also needs to be accounted for. Mist capture is a means of increasing the production of water in a sustainable way. The calculation of the cost/benefits to society of securing habitat for 1/3 of the UK's endemic biodiversity is almost impossible.

A long-term positive change will depend upon the outcomes of a funding application to the UK Government for restoring habitat within the Peaks National Conservation Area (Annex 6). However positive dialogue is ongoing with Connect Saint Helena to enable the link between habitat restoration activities and catchment management activities in order to deliver water to the island population through mist capture (as identified as a goal within the 20-year Water Resource Masterplan).

## 4 Sustainability and Legacy

See Annex 6 for post project impact and legacy. The project has started a new conversation on island about ecosystem services and how water supply and conservation objectives can be mutually beneficial.

The majority of staff who supported the project and received training are still working on the island for SHG, Connect or the Saint Helena National Trust. Climate monitoring equipment is being refurbished and will be used by the climate team within SHG's Agriculture and Natural Resource Directorate. Additional spare parts were delivered during December 2018, donated by Arctium. Water monitoring equipment will be incorporated by Connect into a catchment monitoring network, including the study area. Water level and flow data will continue to be collected by Connect. Two sets of rain gauges and mist loggers have been kept on Dianas Peak and in Grapevine Gut to collect a long-term climate record for the study area. Data was downloaded in December 2018 with the equipment and data now being managed by EMD staff working in the Peaks with the support of the ANRD climate team.

Staff from the Centre for Ecology and Hydrology (CEH) and Arctium continue to donate time, supporting staff on island with climate and water resource data collection and interpretation.

## 5 Lessons learned

See Section 3.1 for what didn't work well.

As this project and CEH have found (in previous cloud forest projects on St Helena), the islands climate can be aggressive and damage field equipment installed to collect climate data. The project team procured equipment from suppliers well known for supporting research projects in challenging locations. However, on presentation of evidence the equipment suppliers confirmed they had not seen such quick deterioration of electronics and data cables. As a consequence, our recommendation would be to use a conductive lubricant within all data cable connections to remove any humid air between cable connections and to frequently check cables and connections for damage. The most reliable equipment was the iButton temperature and humidity loggers which were in sealed units and did not have any moving parts or cables. We would also recommend including a maintenance package in equipment procurement if transportation links enable quick transportation of equipment to the supplier for regular servicing. For more remote areas, using the simplest equipment may provide the most robust/reliable data.

If mobile phone networks are available, costing in a 3G data plan for data loggers will save time and save data. Remote access to loggers in real-time will enable problems to be identified quickly and solutions implemented to limit equipment down-time.

Maintenance of paths and monitoring equipment locations can be a challenge where vegetation grows quickly. There is a trade-off with equipment location, accessibility and safety which cannot be underestimated. The long-term location of monitoring equipment may need to be in a sub-optimal location to enable easy access and low-cost maintenance. The DPLUS051 monitoring locations were in higher maintenance locations in three areas, which enabled the collection of good quality data for the project but were not ideal for long term monitoring.

Procuring scientific equipment through government procurement teams can be challenging, especially where fewer than 3 suppliers are available to give quotes for specialist equipment. More time should be included within project planning phases to ensure that the selection of specialist equipment via an externally funding route can be communicated to fit within a broader internal procurement process. Additional time should also be included to chase up internal procurement teams to ensure that the suppliers they are communicating with are actually going to order and deliver the equipment.

### 5.1 Monitoring and evaluation

This has been covered in earlier sections. Also see project report DPLUS051 Water Security and Cloud Forest Restoration on St Helena, DPLUS051 HYR1 2016, DPLUS051 HYR2 2017, DPLUS051 Annual Report April 2017, and DPLUS051 Annual Report April 2018.

CEH provided external evaluation support for the duration of the project, via email, telephone calls, Skype and a meeting at the CEH office in Scotland. Feedback from Darwin Plus evaluation of project reports was also used to refine parts of the project and report.

### 5.2 Actions taken in response to annual report reviews

The project report was amended to include an ecosystems services assessment and increase communications with the teams.

## 6 Darwin Identity

The Darwin Initiative logo has prominence on the SHG website and Arctium project web pages. It has also been used in presentations that Arctium have made in the UK regarding Saint Helena's environment. The project report and outline will be permanently shown on the SHG website in January 2019. Project data will be held on the SAERI South Atlantic GIS from spring 2019.

An article on the project was published in the Darwin Plus newsletter of January 2017 (www.darwininitiative.org.uk/publications/newsletter).

The project was promoted during the March 2017 nature day in island.

During the project, the island based project team promoted the project during 2 field trips to the Peaks with visiting conference delegates who attended the inaugural St Helena Environment Conference.

Mike Jervois also took 8 private groups into the Peaks during the year to show them the islands endemic flora and fauna and discussed the project, the Darwin Plus initiative and demonstrated monitoring equipment.

The project was also promoted at Groundsure "lunch and learn" presentation in February and June 2018.

The project was promoted at the Ardingly College career fair in May 2017 when the Project Manager gave a talk about careers in conservation and environment.

An opportunity to promote the project at the RBG Kew Science Fair at Wakehurst Place in July 2018 was withdrawn due to oversubscription. It is hoped that the project outcomes can be promoted at the 2019 Science Fair.

The project team will continue to promote the project once the report is complete through the publication of research papers and conferences. CEH will be leading this initiative with the support of SHG, Connect and Arctium.

The project was a key component of the December 2018 Peaks NCA Management Plan workshop sponsored by the RSPB (see Annex 6). The project will be a corner stone of a planned cloud forest restoration funding initiative supported by the RSPB in 2019 and will receive wider coverage.

SHG, Connect, CEH and Arctium are exploring further publicity for the project now that it has been completed as the outcomes can be used to support similar work on other OT's and in small island communities.

# 7 Finance and administration

## 7.1 Project expenditure

| **Project spend (indicative) in this financial year** | **2018/19 Grant (£)** | **2018/19 Total actual D+ Costs (£)** | **Variance %** | **Comments (please explain significant variances)** |
|---|---|---|---|---|
| Staff costs | | | | |
| Consultancy costs | | | | |
| Overhead Costs | | | | |
| Others (Please specify) | | | | |
| **TOTAL** | | | | |

| **Staff employed (Name and position)** | **Cost (£)** |
|---|---|
| Ben Sansom | |
| Dr Alan Gray | |
| **TOTAL** | |

| **Consultancy – description of breakdown of costs** | **Other items – cost (£)** |
|---|---|
| Paul Cherrett | |
| **TOTAL** | |

## 7.2 Additional funds or in-kind contributions secured

| **Source of funding for project lifetime** | **Total (£)** |
|---|---|
| CEH soil moisture loggers and mist capture equipment | |
| Connect Saint Helena diver barometric loggers and water level logger | |
| Connect Saint Helena staff time to support project planning and implementation. | |
| Overhead Costs - Connect Saint Helena | |
| Operating Costs - Connect Saint Helena | |
| Travel & Subsistence Costs - Connect Saint Helena | |
| **TOTAL** | |

Funding post project is pending the drafting of the Peaks NCA Management Plan and drafting of a funding application (with costs) to the UK Government. See Annex 6.

### 7.3 Value for Money

The cost of the project has been justified as it has unlocked a serious debate about ecosystems services on the island, provided evidence to support catchment management through habitat restoration to deliver additional water to the island and provides evidence to support a significant long-term funding application for cloud forest restoration on St Helena.

The matched funding contributed by project partners and use of equipment and data associated with other ongoing Darwin projects (DPLUS020, DPLUS029) ensured excellent value for money against total project costs. The external partners bring experiences and best practices from elsewhere to ensure St. Helena can adopt world-leading approaches to climate change adaptation and water resource management. Areas of cross-Darwin project support comprised:

- Accommodation – support from DPLUS039;
- Data sharing – remote sensing, meteorological, mapping (DPLUS051, DPLUS052, DPLUS025 and DPLUS040);
- Field surveys – access to remote areas in Wells Gut and Grapevine Gut, identification of water features in the sub-catchments during vegetation surveys (DPLUS029).

# Annex 1

Project's original (or most recently approved) logframe (if your project has a logframe), including indicators, means of verification and assumptions. N.B. Insert your full logframe. If your logframe has changed since your application and was approved by a Change Request the newest approved version should be inserted here, otherwise insert the logframe from your application. If your application's logframe is presented in a different format in your application, please transpose into the below template. Please feel free to contact Darwin-Projects@ltsi.co.uk if you have any questions regarding this.

| Project summary | Measurable Indicators | Means of verification | Important Assumptions |
|---|---|---|---|
| **Impact:**<br>Climate change and increasing population are managed effectively to enable a sustainable water supply and restoration of the fragile cloud forest habitat. | | | |
| **Outcome:**<br>Demonstrate that restoring the cloud forest will increase harvested rainfall and meet the islands water demand, whilst improving climate change resiliency and significantly increase habitats for endemic plants and invertebrates. | 0.1 Desk study.<br>0.2 Collection of microclimate data.<br>0.3 Botanical survey of each sub-catchment.<br>0.4 Water balance.<br>0.5 Reporting and outline cloud forest restoration plan. | 0.1 Completion of desk study and reporting of outcomes.<br>0.2 Field collection and interpretation of meteorological data.<br>0.3 Field data collection and interpretation of botanical data.<br>0.4 Field data collection and interpretation of hydrology, hydrogeology, meteorological and botanical data to calculate balances.<br>0.5 Reporting of restoration plan in final project report. | Access is made available to literature archives and data sources.<br>Topography is accessible.<br>Equipment can be shipped to island in good time to allow a minimum 12 months data collection.<br>Equipment performs reliably to collect remote datasets.<br>Procurement process enable the timely purchase of project equipment. |
| **Outputs:**<br>**1**. Desk Study - to collate archive data. | 1.4 Visit Kew and CEH in the UK to collate desk based data.<br>1.5 Desk based assessment of ANRD archive in the Scotland library on Saint Helena.<br>1.6 Desk study report. | 1.1 Collated reports and data sets from Kew and CEH.<br>1.2 Collated reports data sets from ARND library.<br>1.3 Completion of desk study report. | Reports and data sets are available to assess a baseline and determine key mechanisms for cloud forest rainfall harvesting. |
| 2. Baseline Field Assessment | 2.1 Completion of botanical surveys.<br>2.2 Completion of remote sensing/aerial surveys. | 2.1 Drafting of maps, GIS layers, reporting of field activities. | Topography allows access by foot into each sub-catchment to verify aerial survey data. |

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|---|---|---|---|
| | 2.3 Water features survey | 2.2 Drafting of maps, video and photos of aerial surveys.<br>2.3 Water features survey report. | Drone performs well and does not suffer technical problems.<br>Remote sensing data is available from SHG and other identified open source data providers (NASA, SMAP). |
| **3**. Environmental Monitoring | 3.1 Installation of hydrology and hydrogeology monitoring locations.<br>3.2 Installation of meteorological monitoring equipment and relative humidity loggers in both sub-catchments.<br>3.3 Collection of meteorology data in the sub-catchments and a control catchment.<br>3.4 Monthly and quarterly monitoring of surface water and groundwater levels and flows and meteorological/micro-climate data. | 3.1 and 3.2 Monitoring location maps and data sheets.<br>3.3 and 3.4 Maps, spreadsheets and associated charts showing data collected. | Topography allows access to monitoring locations by foot.<br>Equipment is procured and shipped to Saint Helena in time to meet project programme.<br>All equipment performs well and does not suffer technical problems.<br>Remote monitoring equipment does not suffer power loss (trickle charge batteries via solar PV).<br>Pressure transducer calibration does not drift. |
| **4**. Interpretation of Data | 4.1 Calculation of water balances from collated water level, flow, meteorological and botanical survey data.<br>4.2 Interpretation of water balances – identify trends and/or relationships between micro-climate, vegetative cover and ground conditions. | 4.1 Reporting of sub-catchment hydrology, hydrogeology, meteorology and botanical survey data.<br>4.2 Reporting of sub-catchment water balances and interpretation of the relationships/trends. | Sufficient data can be collected to calculate a water balance.<br>Meteorological data and vegetation survey are of sufficient resolution to differentiate between sub-catchments. |
| **5.** Reporting | 5.1 Collation of all desk based and field data. | 5.1 Draft final report.<br>5.2 Final section of draft final report. Outline cloud forest restoration plan to | All data and reporting is completed within the 24 month project programme. |

| | | | |
|---|---|---|---|
| | 5.2 Interpretation of data and desk based data and reporting of an outline cloud forest restoration plan. | support water supply and terrestrial conservation objectives. | Sufficient data and identification of trends/relationships to draft an outline restoration plan. |
| **Activities** (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1) | | | |
| 1.1, 1.2 and 1.3 contribute to Output 1. Output 1 is required to evaluate existing information and data associated with cloud forest rainfall harvesting on Saint Helena.<br><br>2.1, 2.2 and 2.3 contribute to Output 2. Output 2 is required to confirm the coverage of endemic and invasive species in each sub-catchment, define each sub-catchment through mapping and the digital terrain model and complete a survey of the sub-catchments hydrological and hydrogeological features.<br><br>3.1, 3.2, 3.3 and 3.4 contribute to Output 3. Output 3 is required for the collection of micro-climate and water resource data sets.<br><br>4.1 and 4.2 contribute to Output 4. Output 4 is required to quantify each water balance and determine differences between each sub-catchment quantify any differences in micro-climate between the sub-catchments and interpret the trends/relationships.<br><br>5.1 and 5.2 contributes to Output 5. Output 5 is the main project report and provides an outline restoration plan for the cloud forest to support water supply and terrestrial conservation objectives. | | | |

# Annex 2 Report of progress and achievements against final project logframe for the life of the project

| Project summary | Measurable Indicators | Progress and Achievements for the life of the project |
|---|---|---|
| **Impact**:<br>Climate change and increasing population are managed effectively to enable a sustainable water supply and restoration of the fragile cloud forest habitat. | | The project identified that 60% of the study area precipitation was derived from mist capture rather than direct rainfall. The sub-catchment with the highest surface water flows may be due to the larger proportion of endemic cloud forest vegetation and higher proportion of peaty subsoil beneath the endemic cloud forest, holding back rainfall runoff, reducing direct recharge to aquifers, and releasing water in a slower less “flashy” flow. The native cloud forest canopy of St Helena is structurally more complex than the other vegetation types. As canopy ‘roughness’ increases mist capture, it is not unreasonable to assume that restoration of cloud forest will increase mist capture and hence water supply whilst also safeguarding and increasing the biodiversity of the restored areas.<br><br>Encouraging a larger area of cloud forest and developing a richer peaty subsoil in the Peaks will help even out the islands yearly water supply by slowing rainfall runoff and releasing water in a slower less “flashy” flow.<br><br>The 20-Year Water Resource Masterplan outlines a preferred water supply development approach through rainwater harvesting (mist capture). The study has shown that mist is a significant source of water for the island and is the dominant source of water during the summer months. Mist capture/rainwater harvesting should be used to improve the reliability of the island’s water supply.<br><br>Mist capture provides an opportunity of increasing the amount of water that reaches the island throughout the year, whilst also improving a significant source of rare biodiversity and habitat. There are identifiable benefits for drinking water, food production, ecotourism, public health and mitigating the effects of climate change.<br><br>The cost of water relationship with cloud forest restoration enables a staged restoration programme to be implemented based upon water demand and water resource planning, spreading the costs of restoration to the 690mASL contour. |

| | | |
|---|---|---|
| | | Restoration of the cloud forest not only brings opportunities for improving the islands water supply, but also provides an opportunity to significantly enhance the islands international reputation for nature conservation. Cloud forest restoration would also support efforts to develop an eco-tourism economy by providing evidence of the island's connection with its rich natural resource and desire to be climate change resilient.<br><br>Costs of restoring cloud forest indicate that bringing additional water to the island through improvements in mist capture is initially more expensive than the costs of water storage infrastructure. Planning for these costs will require a change in thinking across Government, the private sector and society.<br><br>Water is seen as a free commodity, with only the costs of abstraction, storage, treatment and distribution being considered. This has to change. If water is seen as a product, then the cost of production also needs to be accounted for. Mist capture is a means of increasing the production of water in a sustainable way. The calculation of the cost/benefits to society of securing habitat for 1/3 of the UK's endemic biodiversity is almost impossible.<br><br>See project report Executive Summary. |
| **Outcome**<br><br>Demonstrate that restoring the cloud forest will increase harvested rainfall and meet the islands water demand, whilst improving climate change resiliency and significantly increase habitats for endemic plants and invertebrates. | 1.0 Desk study.<br><br>2.0 Collection of micro-climate data.<br><br>3.0 Botanical survey of each sub-catchment.<br><br>4.0 Water balance.<br><br>5.0 Reporting and outline cloud forest restoration plan. | The project achieved its objectives to provide evidence that mist is a significant source of water for the island and restoration of endemic cloud forest habitat will provide benefits for a sustainable water supply and provide additional habitat to secure much of the island's endemic biodiversity.<br><br>See project report for evidence. |
| **Output 1**. Desk Study | 1.1 Complete desk study | See project report Sections 2, 3, 4, 5, 6, 7, 8, 9, 16 and 20. |

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| **Output 2**. Baseline Field Assessment | 2.1 Completion of botanical surveys.<br>2.2 Completion of remote sensing/aerial surveys. | See project report Sections 10, 11 and 12. See also project report Appendix D, Appendix E and Appendix F. |
| Activity 2.1. Completion of botanical surveys. | | See project report Section 12. |
| Activity 2.2. Completion of remote sensing/aerial surveys. | | See project report Section 11. |
| **Output 3.** Environmental Monitoring | 3.1 Installation of Blue Siren flow logger.<br>3.3 Collection of meteorology data in the sub-catchments and a control catchment.<br>3.4 Monthly and quarterly monitoring of surface water and groundwater levels and flows and meteorological/micro-climate data. | See project report Sections 13 and 14. |
| Activity 3.1. Installation of Blue Siren flow logger. | | See project report Sections 13 and 14. |
| Activity 3.3. Collection of meteorology data in the sub-catchments and a control catchment. | | See project report Sections 13 and 14. |
| Activity 3.4. Monthly and quarterly monitoring of surface water and groundwater levels and flows and meteorological/micro-climate data. | | See project report Sections 13 and 14. |
| **Output 4.** Interpretation of Data | 4.1 Calculation of water balances from collated water level, flow, meteorological and botanical survey data.<br>4.2 Interpretation of water balances – identify trends and/or relationships between micro-climate, vegetative cover and ground conditions. | See project report Sections 14, 15, 16, 19 and 20. |

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| Activity 4.1. Calculation of water balances from collated water level, flow, meteorological and botanical survey data. | | See project report Sections 14, 15, 16, 19 and 20. |
| Activity 4.2. Interpretation of water balances – identify trends and/or relationships between micro-climate, vegetative cover and ground conditions. | | See project report Sections 14, 15, 16, 19 and 20. |
| **Output 5.** Reporting | 5.1 Collation of all desk based and field data.<br>5.2 Interpretation of data and desk-based data and reporting of an outline cloud forest restoration plan. | See project report Sections 1-20. |
| Activity 5.1. Collation of all desk based and field data. | | See report Sections 1-13. |
| Activity 5.2. Interpretation of data and desk-based data and reporting of an outline cloud forest restoration plan. | | See report Sections 14-20. |

# Annex 3 Standard Measures

| Code | Description | Totals (plus additional detail as required) |
|---|---|---|
| **Training Measures** | | |
| 1 | Number of (i) students from the UKOTs; and (ii) other students to receive training (including PhD, masters and other training and receiving a qualification or certificate) | |
| 2 | Number of (i) people in UKOTs; and (ii) other people receiving other forms of long-term (>1yr) training not leading to formal qualification | |
| 3a | Number of (i) people in UKOTs; and (ii) other people receiving other forms of short-term education/training (i.e. not categories 1-5 above) | |
| 3b | Number of training weeks (i) in UKOTs; (ii) outside UKOTs not leading to formal qualification | |
| 4 | Number of types of training materials produced. Were these materials made available for use by UKOTs? | 2 – Arrangements are being made to share resources now the project has ended. |
| 5 | Number of UKOT citizens who have increased capacity to manage natural resources as a result of the project | 8 |
| **Research Measures** | | |
| 9 | Number of species/habitat management plans/ strategies (or action plans) produced for/by Governments, public authorities or other implementing agencies in the UKOTs | |
| 10 | Number of formal documents produced to assist work in UKOTs related to species identification, classification and recording. | |
| 11a | Number of papers published or accepted for publication in peer reviewed journals written by (i) UKOT authors; and (ii) other authors | |
| 11b | Number of papers published or accepted for publication elsewhere written by (i) UKOT authors; and (ii) other authors | |
| 12b | Number of computer-based databases enhanced (containing species/genetic information). Were these databases made available for use by UKOTs? | |
| 13a | Number of species reference collections established. Were these collections handed over to UKOTs? | |

| Code | Description | Totals (plus additional detail as required) |
|---|---|---|
| 13b | Number of species reference collections enhanced. Were these collections handed over to UKOTs? | |
| **Dissemination Measures** | | |
| 14a | Number of conferences/seminars/workshops/stakeholder meetings organised to present/disseminate findings from UKOT's Darwin project work | |
| 14b | Number of conferences/seminars/ workshops/stakeholder meetings attended at which findings from the Darwin Plus project work will be presented/ disseminated | At least 1? |
| **Physical Measures** | | |
| 20 | Estimated value (£s) of physical assets handed over to UKOT(s) | |
| 21 | Number of permanent educational/training/research facilities or organisation established in UKOTs | |
| 22 | Number of permanent field plots established in UKOTs | |
| 23 | Value of resources raised from other sources (e.g., in addition to Darwin funding) for project work | |

# Annex 4 Publications

| Type * (e.g. journals, manual, CDs) | Detail (title, author, year) | Nationality of lead author | Nationality of institution of lead author | Gender of lead author | Publishers (name, city) | Available from (e.g. weblink, contact address, annex etc) |
|---|---|---|---|---|---|---|
| Newsletter | Darwin Initiative Newsletter January 2017 | UK | UK | Male | Darwin Initiative | http://www.darwininitiative.org.uk/publications/newsletter |
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# Annex 5 Darwin Contacts

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| **Ref No** | DPLUS051 |
| **Project Title** | Water Security and Sustainable Cloud Forest Restoration on St Helena |
| | |
| **Project Leader Details** | |
| Name | Derek Henry |
| Role within Darwin Project | Project Leader |
| Address | |
| Phone | |
| Fax/Skype | |
| Email | |
| **Partner 1** | |
| Name | Benedict Sansom |
| Organisation | Arctium Ltd |
| Role within Darwin Project | Project Manager – Water and Environment Consultant |
| Address | |
| Fax/Skype | |
| Email | |
| **Partner 2** | |
| Name | Alan Gray |
| Organisation | Centre for Ecology and Hydrology |
| Role within Darwin Project | Technical Advisor and Plant Ecologist |
| Address | |
| Fax/Skype | |
| Email | |
| **Partner 3** | |
| Name | Barry Hubbard |
| Organisation | Connect Saint Helena |
| Role within Darwin Project | CEO of Connect and Project Support |
| Address | |
| Fax/Skype | |
| Email | |

## Checklist for submission

| | Check |
|---|---|
| **Is the report less than 10MB?** If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line. | N |
| **Is your report more than 10MB?** If so, please discuss with Darwin-Projects@ltsi.co.uk about the best way to deliver the report, putting the project number in the Subject line. | Y |
| **Have you included means of verification?** You need not submit every project document, but the main outputs and a selection of the others would strengthen the report. | Y |
| **Do you have hard copies of material you want to submit with the report?** If so, please make this clear in the covering email and ensure all material is marked with the project number. | N |
| Have you involved your partners in preparation of the report and named the main contributors | Y |
| Have you completed the Project Expenditure table fully? | Y |
| Do not include claim forms or other communications with this report. | |