Positioning Systems

CASE STUDY | TERRAFORMATION

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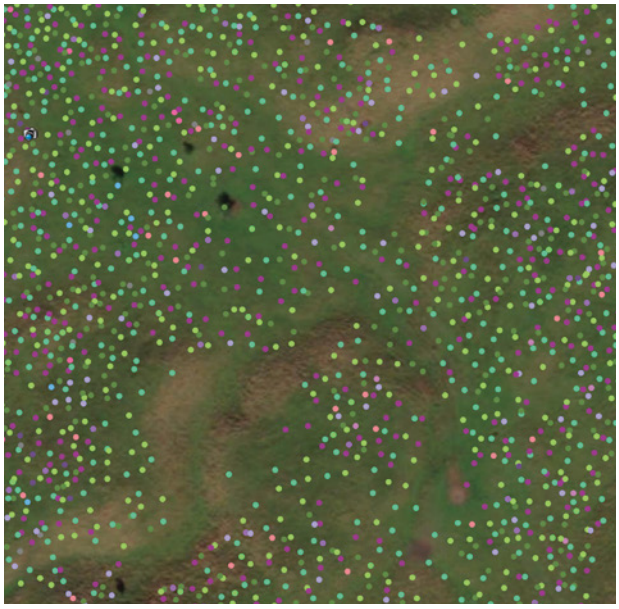


Terraformation Restoration Technician Aka Rodriguez-Herring collects the location of a newly planted tree using the Eos Arrow 100+™ GNSS receiver paired with Esri's ArcGIS® Field Maps.

Customer
Terraformation

Industry
Conservation

Challenge
Terraformation sequesters atmospheric carbon via reforestation. To retain partner and investor support, they needed a way to prove success.

Solution
Eos Arrow 100+™ GNSS receiver, ArcGIS® Field Maps, ArcGIS Online, ArcGIS Dashboards

Results
Terraformation can track individual plant success and share powerful data and geospatial visuals to stakeholders.

Terraformation: Combatting Climate Change with Accurate Accountability

Warming temperatures, rising sea levels, and a multitude of environmental issues are visibly changing the world around us. How can one person, or even a group of people, begin to find a solution?

Yishan Wong, who founded the Hawaiian forest restoration startup Terraformation in 2017, believes reversing course starts with going back to basics: trees.

"We believe that forest restoration is one of the most effective and immediately scalable solutions that we have for fighting climate change," Wong said.

According to Terraformation's website, Wong's research showed that "native forest restoration outperforms any other known method of carbon capture by nearly an order of magnitude." Trees naturally capture and store carbon and, most importantly, are accessible throughout the world. Out of all the ways to combat carbon emissions, Wong found that native reforestation carried the lowest cost and risk.

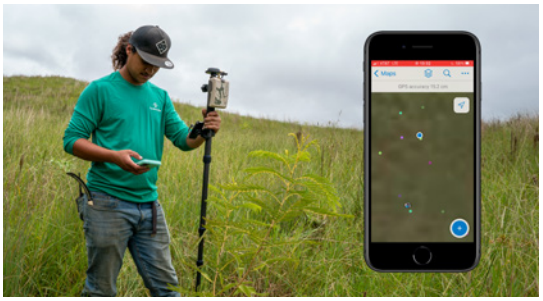
Their goal was to launch a proof-of-concept at certain sites in Hawai'i, with the objective of scaling it in conjunction with partners globally.

"We help projects all over the world to develop nurseries, to develop seed banks, and to have the software that they need to manage and to monitor their projects, and to grow and establish healthy forests," said Jill Wagner, Director of Hawai'i Island Seed Bank and consultant to Terraformation.

From Seedlings to Forest: A Process of Patience

Once an area of land is identified for reforestation, the team determines which native plants are suitable. Next, they collect native seeds of these species from the field and bring them back to the nursery. There, the seeds are germinated as well as stored in seed banks for future generations.

Once germinated, the seedlings are placed outside to get used to the environment and become "hardened" for the conditions they will experience naturally in the field. After this, Terraformation field technicians plant the hardened plants at reforestation sites. Technicians revisit each plant over the years to ensure survival. This process takes patience and commitment. On average, Wagner says, it takes about 10 years to re-establish healthy, native forests. It also takes technology.



"I can't emphasize enough the ease of [the Arrow 100+], of how it pairs with Esri's Field Maps app. You have the mapping interface combined with the ability to collect data. Having that dual functionality, that is really powerful."

— Brian Tucker, GIS Specialist, Terraformation

Terraformation Restoration Technician Aka Rodriguez-Herring updates the status of an acacia koa tree using the Eos Arrow 100+ GNSS receiver paired with Esri's ArcGIS Field Maps.

The Need for High Accuracy: Tracking a Native Forest Pattern

Forest restoration isn't as easy as just planting neat rows of seedlings. In nature, plants don't grow in grids of identically spaced rows of species. So, to mimic how a native ecosystem could have organically grown, Terraformation plants in intentionally irregular formations. A *mamaki* plant might be planted in one spot with an *acacia koa* tree a half meter away, and so on until the entire parcel is reforested. These plants together will grow into a healthy and diverse ecosystem that mimics a natural one.

But this planting strategy makes it harder to record and revisit each seedling over time. You can't, for instance, revisit a grid of all the *mamaki*. So, Terraformation turned to digital maps, which allow them to map, track, revisit, and monitor each plant individually. This provides needed data to show partners and investors that the plants are thriving after being planted.

"Because spacing can be a meter or a meter and a half apart, high accuracy is really important to ensure the long-term tracking and monitoring of these plants," said Brian Tucker, Geospatial Information System (GIS) Specialist at Terraformation.

The Solution: High-Accuracy GNSS and GIS

To track these plants with high accuracy, Terraformation sought out global navigation satellite system (GNSS) and GIS technologies. After trying a legacy GNSS receiver that could not meet their needs for consistent accuracy and reliability, Terraformation started using an Arrow 100+™ GNSS receiver alongside Esri's ArcGIS® Field Maps.

The Arrow 100+ provides submeter accuracy using WAAS differential corrections, without any need for a paid subscription. The receiver is paired via Bluetooth® to iPhones, which collect spatial information via the ArcGIS Field Maps data collection app. This combined technology allows restoration crews to map plants in real-time with high accuracy.

With ArcGIS Field Maps, the field crews can collect not only the exact location of the plant, but also specific information on the species type, the health of the plant, and even photos to help future crews navigate back to the specific point in the future. This information is submitted in real time to an ArcGIS Online map, which provides valuable analytical features. When viewing the map back in the office, team members can see the species distribution sorted by color. By clicking on the individual points, they can gain insight into the details of each plant.

The data is also gathered into an ArcGIS Dashboard, where viewers can see a summary of the number of plants planted, alongside the species distribution, to track the overall process of the restoration site.

"People love to just see the numbers and see the impact going on," Tucker said. "And if they check in to the dashboard monthly, and see the numbers rise — it's pretty powerful."

Accountability: An Essential Piece of the Puzzle

The highly accurate ArcGIS Online maps serve a second purpose, one that is essential to Terraformation's bigger mission: to secure more funding that can be used to sustain the project and, most importantly, scale.

"One of the really important missing pieces to reforestation is accountability," said Wong. "Ideally, you want full accountability because you can really track the data for science. You can know exactly how much carbon is being sequestered."

With irrefutable data pointing to how many healthy plants Terraformation has restored, and therefore information about how much carbon can be sequestered, Terraformation can provide a compelling argument for organizations capable of providing financial support.

Looking Ahead: A Collective Goal

Terraformation intends these sites in Hawai'i to serve as proof of concept that this process can be done across the globe. In leading by example, Terraformation hopes to show others a simple path toward bettering the environment.

Wong recognizes not everyone will participate in the ambitious goal of global reforestation. But he and the Terraformation team believe this goal is not only worth striving toward, but also within reach.

"Local communities are the protectors of the forest," said Wagner. "And we want to leave the next generation with a resource, and with healthy forests. Everyone should be involved in this."