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| **Project Period** | 07/01/2011 - 12/31/2012 |
| **Award Amount** | $64,167.00 |
| **Matching Contributions** | $64,325.00 |
| **Project Location Description (from Proposal)** | Along the seaward boundary of the Pu'u Kukui Watershed Preserve within the West Maui Mountains Watershed Partnership, Maui Hawaii. |

**Project Summary (from Proposal)**

Finish a 0.6 mile portion of a 1.8 mile ungulate fence to mitigate disturbance to soils in upland watershed areas. Project will protect downstream priority coral ecosystems from harmful runoff and sedimentation.

**Summary of Accomplishments**

All work has been completed as proposed in our 2011 NFWF grant. The two principle deliverables of completing a 0.6 miles section of ungulate proof fence and completing an N-SPECT model for the Honolua Watershed has been achieved. The 0.6 mile portion of the total 1.8 mile fence is a critical link in protecting the integrity of the watershed and will help to prevent ungulate disturbance to the forest understory once all the ungulates are removed from within the fenced area. The N-SPECT model has also given us an impression of how important ungulate removal from the mauka watershed may be to improving water quality. Results of the model indicate that the headwaters of the Honolua Watershed above the completed fence line, are responsible for a significant portion of whole watershed sediment export (possibly 37 to 77%). Upper watershed areas experience more rainfall and contribute more overall to the water quality of the watershed. The headwaters will also respond the fastest and with greatest benefit to conservation efforts.

**Lessons Learned**

The lessons learned while achieving the deliverables are numerous. The first meaningful lesson includes the utility of fence building collaboration. Building eight foot tall ungulate-proof fence in rugged terrain is always a challenge. We have been fortunate to benefit from the knowledge of not only our experienced crew, but also the crew of the Pu'u Kukui Watershed Preserve. Working collaboratively on this project can be difficult when scheduling crews, helicopter time and material loads; however we have learned that we are much more efficient when working as a team on such a large fencing projects and that different construction techniques are learned and enhanced along the way.

Landscape modeling was a new endeavor for us and collaborating with an outside consultant was required. Fitting ungulate ground disturbance behavior into a model adequately and with enough scenarios to illuminate different ecosystem responses was interesting. Fortunately the model reinforced our assertions that ungulates were significant contributors to increased sedimentation in the stream system but the magnitude of this level was more than expected. Peer review will hopefully support our findings and yield greater understanding of the results.

In addition, and outside the scope of this grant but part of the matching grant with the Hawaii Department of health, we have been adapting water quality monitoring techniques to Hawaii's natural setting. We have learned how to properly inst

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| Conservation Activities | Fence - meters built |
| Progress Measures | Other (Meters built) |
| Value at Grant Completion | $39/foot |
| Conservation Activities | Ungulate Monitoring |
| Progress Measures | Other (Acres of disturbed area) |
| Value at Grant Completion | 0 |
| Conservation Activities | Acres of Land Protected by Fence |
| Progress Measures | Other (Acres of Land protected from ungulates above fence) |
| Value at Grant Completion | 6300 |
| Conservation Activities | Ungulate Monitoring |
| Progress Measures | Other (Acres of bare soil within transects) |
| Value at Grant Completion | 0 |
| Conservation Activities | Priority Invasive Weed Monitoring |
| Progress Measures | Other (Presence/absence priority weeds along monitoring transects) |
| Value at Grant Completion | range comparison for future |
| Conservation Activities | Compile datasets for NSPECT model |
| Progress Measures | Other (Variety of background GIS data available for NSPECT model) |
| Value at Grant Completion | at least 3-4 GIS layers in correct format |
| Conservation Activities | Implement Water Qualitymonitoring in upper Honolua stream |
| Progress Measures | Other (Completed dataset of water quality for the stream for pre and post fence installation) |
| Value at Grant Completion | full dataset of water quality indicators |

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| Conservation Outcome(s) | Decrease in sedimentation of Honolua Stream |
| Conservation Indicator Metric(s) | Sedimentation rate in streams/rivers (mg/cm2/day) |
| Baseline Metric Value | pending DOH grant |
| Metric Value at Grant Completion | yet to be determined |
| Long-term Goal Metric Value | Reduction yet to be determined |
| Year in which Long Term Metric Value is Anticipated | 2012 |
| Conservation Outcome(s) | Reduced Total Nitrogen levels in stream, post fence installation |
| Conservation Indicator Metric(s) | Nitrogen levels in streams/rivers (mg/L) |
| Baseline Metric Value | pending DOH grant |
| Metric Value at Grant Completion | yet to be determined |
| Long-term Goal Metric Value | yet to be determined |
| Year in which Long Term Metric Value is Anticipated | 2012 |
| Conservation Outcome(s) | Reduced Total Phosphorus in stream, post fence installation |
| Conservation Indicator Metric(s) | Phosphorus levels in streams/rivers (mg/L) |
| Baseline Metric Value | pending DOH grant |
| Metric Value at Grant Completion | yet to be determined |
| Long-term Goal Metric Value | yet to be determined |
| Year in which Long Term Metric Value is Anticipated | 2012 |
| Conservation Outcome(s) MLCD | Decreased turbidity in upland streams that empty into Honolua/Mokuleia |
| Conservation Indicator Metric(s) | Other (Nephelometric Turbidity Units) |
| Baseline Metric Value | pending DOH grant |
| Metric Value at Grant Completion | yet to be determined |
| Long-term Goal Metric Value | yet to be determined |
| Year in which Long Term Metric Value is Anticipated | 2012 |
| Conservation Outcome(s) | Implement WMMWP management plan |
| Conservation Indicator Metric(s) | # activities from management plan being implemented |
| Baseline Metric Value | 5 |
| Metric Value at Grant Completion | 6 |
| Long-term Goal Metric Value | 6 |
| Year in which Long Term Metric | 2012 |

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| Value is Anticipated | |
| Conservation Outcome(s) | Implement PKW management Plan |
| Conservation Indicator Metric(s) | # activities from management plan being implemented |
| Baseline Metric Value | 2 |
| Metric Value at Grant Completion | 3 |
| Long-term Goal Metric Value | 3 |
| Year in which Long Term Metric Value is Anticipated | 2012 |
| Conservation Outcome(s) | Recovery of native forested upland watershed from ungulate disturbance |
| Conservation Indicator Metric(s) | Other (# of Photopoints showing recovery) |
| Baseline Metric Value | 0 |
| Metric Value at Grant Completion | 3 |
| Long-term Goal Metric Value | 3 |
| Year in which Long Term Metric Value is Anticipated | 2012 |
| Conservation Outcome(s) | Reduced ungulate disturbance in transects |
| Conservation Indicator Metric(s) | Other (Acres of disturbance and bare soil along ungulate transect) |
| Baseline Metric Value | pending |
| Metric Value at Grant Completion | 0-2 acres |
| Long-term Goal Metric Value | 0 |
| Year in which Long Term Metric Value is Anticipated | 2017 |
| Conservation Outcome(s) | Reduce ungulate intrusion into project area |
| Conservation Indicator Metric(s) | Other (Reduction of animals removed over time/ per year) |
| Baseline Metric Value | Pending yr 1 removal |
| Metric Value at Grant Completion | 15-20 |
| Long-term Goal Metric Value | 0 |
| Year in which Long Term Metric Value is Anticipated | 2017 |

**Final Programmatic Report Narrative**

**Instructions:** Save this document on your computer and complete the narrative in the format provided. The final narrative should not exceed ten (10) pages; do not delete the text provided below. Once complete, upload this document into the on-line final programmatic report task as instructed.

**1. Summary of Accomplishments**

The West Maui Mountains Watershed Partnership and the Pu'u Kukui Watershed Preserve staff completed the required phase of the fence building project to protect the upland watershed areas from the threat of feral ungulates. The actions to be completed were to build 0.6 miles of eight foot tall game fence, complete baseline monitoring and run an NSPECT model to predict the benefits of removing feral ungulate disturbance from the watershed and improvements to water quality.

**2. Project Activities & Outcomes**

**Activities**

- Describe the primary activities conducted during this grant and explain any discrepancies between the activities conducted from those that were proposed.

**Activity 1. Fence Construction:**

The 8-foot high, 0.6 mile phase of boundary fence of the Pu'u Kukui Preserve has been completed (Figure 1, p.5). This was a collaborative effort between the staff of the West Maui Mountains Watershed Partnership (WMMWP) and the Pu'u Kukui Watershed (PKW). This fence stretches across the Honolua and Honokohau drainages and protects nearly 6,300 acres of upland watershed lands. A pre-construction fence line survey was conducted to ensure the absence of any rare species. The fence is an 8-foot bezenol coated steel "hog wire". On extremely steep terrain, a 4-foot high bezenol hog wire was used with a 4-foot plastic "deer mesh" above it, creating an 8-foot high fence. Rappelling was necessary on some of these slopes. An apron of 32-inch hog wire was also installed to prevent ungulates from digging under the fence. This section is a portion of a 1.8 mile boundary fence of which the remainder is in progress and funded by the Department of Health. Outside of the scope of this grant, this fence will be inspected and maintained by PKW staff and funding. Ungulate and weed control will also continue and be supported by other funds.

Photos: In Progress (left) and Completed (right) 8 foot ungulate fence (apron yet to be installed).

Photos: Brushed fence line of a steep slope where a 4-foot fence and plastic mesh were used to make an 8 foot fence.

**Activity 2. Terrestrial Monitoring:**

Six baseline photo point / vegetation plots, three above (internal) and three below (external) the fence, were created (Figure 1, p.4) and will be repeated to depict the amount of disturbance and changes in composition of the vegetation regenerated (See photos below) within a four-meter circular plot. The Pohakupule 2 plots were the only ones containing ungulate disturbance. The internal photo had 2% old disturbance (> 2 weeks old), while the external photo had 8% old sign and 2% new disturbance (<2 weeks old).

Kaluanui External photo point

Kaluanui Internal photo point

Pohakupule 2 External

Pohakupule 2 Internal

Pohakupule 3 External

Pohakupule 3 Internal

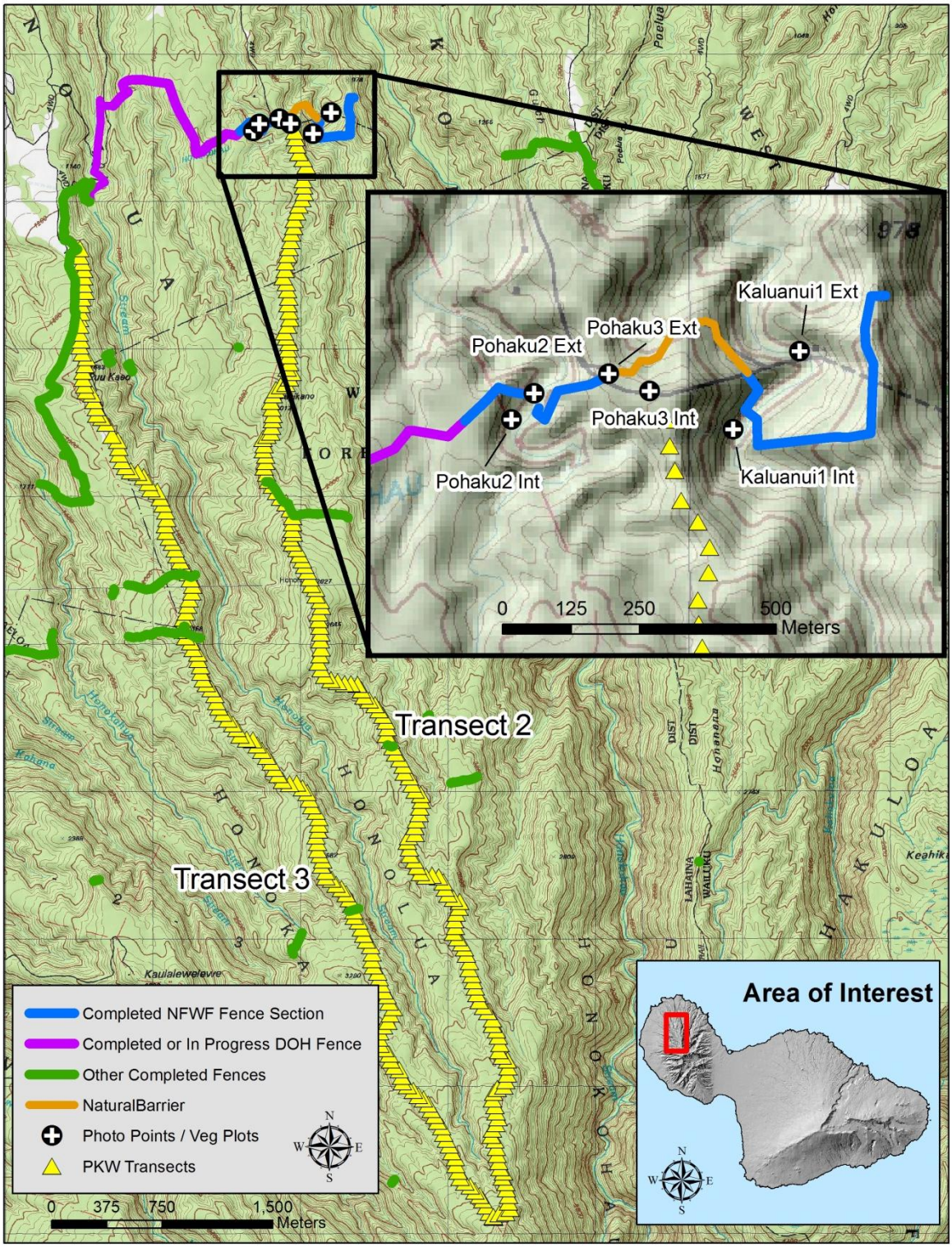
The two existing PKW transects running mauka to makai (Figure 1, p.4) along the north and south rims of this project area were read for a baseline survey of ungulate sign and presence of weeds. These transects consist of 187 and 167 stations measuring 5X50 meters each. Old ungulate disturbance was found on eleven of the 187 stations on Transect 2. The average disturbance along the transect was 0.13%. No sign was found on Transect 3. Although this data shows little or no disturbance, it is important to note that there is pig sign in the area, just not specifically on the transects. Ungulate sign will be recorded annually and weeds are recorded every two years, and these can be compared to the pre-fence data to assess spread or management success.

We have been also monitoring the water quality in Honolua with funding from the Department of Health, however our baseline data is not available yet.

**Activity 3: NSPECT Model:**

The final deliverable is an NSPECT model. Please see attached report.

**Figure 1**. Fence Construction and Terrestrial Monitoring. The 8-foot high 0.6 mile ungulate boundary fence has been completed (in blue) along with the natural boundary (in orange) between sections. The DOH funded fence is shown in purple and other fences in green. The six photo point / vegetation plots are shown by the white crosses. The two existing PKW transects are shown by yellow triangles.



**Outcomes**

- Describe progress towards achieving the project outcomes as proposed. and briefly explain any discrepancies between your results compared to what was anticipated.
- Provide any further information (such as unexpected outcomes) important for understanding project activities and outcome results.

The intention of this grant has been fully fulfilled with the creation of the fence, the baseline documentation and the NSPECT model seems to support our intuitive understanding of the relationship between the ungulate disturbance and water quality. The full impact of the completed work will only be realized once the ungulates are removed from above the fence, the ecosystem stabilized and water quality is shown to have a long lasting improvement.

**3. Lessons Learned**

Describe the key lessons learned from this project, such as the least and most effective conservation practices or notable aspects of the project's methods, monitoring, or results. How could other conservation organizations adapt similar strategies to build upon some of these key lessons about what worked best and what did not?

The lessons learned to date are limited, but meaningful. The first issue to make sure that the baseline data and monitoring methods are installed for years prior to fencing a closed system. Animal impacts can fluctuate greatly within areas where the population is nomadic and the monitoring must be long enough to catch seasonal changes or longer to be truly robust.

Also, the fence itself must be constructed in ways which are effective but flexible in terms of how it integrates into the environment. In is recommended that groups make sure to think through and know the installation methods well ahead of time so that you can effectively work the fence into the environment with the least amount on challengers. Installers should expect minor changes in design when working in remote areas.

The NSPECT Model is a great exercise and seems to be proving our previous assumptions but its confidence should be tested with peer review. We have heard that the model, like many, may have limitations in its applicability to Hawaiian Ecosystems. We are hopeful that peer review will reinforce our confidence.

**4. Dissemination**

Briefly identify any dissemination of project results and/or lessons learned to external audiences, such as the public or other conservation organizations. Specifically outline any management uptake and/or actions resulting from the project and describe the direct impacts of any capacity building activities.

The NSPECT model will be disseminated for peer review once the landowner has finished a review. The greater water quality monitoring study (part of a parallel Dept of Health grant) will be shared with other Watershed Partnerships and other interested parties, including University of Hawaii, the Dept. of Land and Natural Resources as well as the West Maui Ridge to Reef program.

**5. Project Documents**

Include in your final programmatic report, via the Uploads section of this task, the following:

- 2-10 representative photos from the project. Photos need to have a minimum resolution of 300 dpi;
- Report publications, Power Point (or other) presentations, GIS data, brochures, videos, outreach tools, press releases, media coverage;
- Any project deliverables per the terms of your grant agreement.

***POSTING OF FINAL REPORT:*** *This report and attached project documents may be shared by the Foundation and any Funding Source for the Project via their respective websites. In the event that the Recipient intends to claim that its final report or project documents contains material that does not have to be posted on such websites because it is protected from disclosure by statutory or regulatory provisions, the Recipient shall clearly mark all such potentially protected materials as "PROTECTED" and provide an explanation and complete citation to the statutory or regulatory source for such protection.*