



USAID
FROM THE AMERICAN PEOPLE

CANOPY WALKWAY INSPECTION, MAINTENANCE AND TRAINING

FINAL REPORT



December 2012

This publication was produced for review by the United States Agency for International Development. It was prepared by Greenheart Canopy Walkway Ltd.

CANOPY WALKWAY INSPECTION, MAINTENANCE AND TRAINING

FINAL REPORT

Program Title: Strengthening Sustainable Ecotourism in and around Nyungwe National Park

Sponsoring USAID Office: USAID/Rwanda, Office of Economic Growth

Contract Number: AID-696-C-10-00002

Contractor: Development Alternatives Inc. (DAI)

Date of Publication: December 19, 2012

Author: Greenheart Canopy Walkway Ltd.

Cover photo: Adjusting nets on the Canopy Walkway, photo by Greenheart Canopy Walkway Ltd.

The authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

Greenheart Canopy Walkway Company Ltd.

2526 West 14th Ave.,
Vancouver,
B.C., Canada V6K2W7

Project Maintenance Report Greenheart Canopy Walkway Nyungwe, Rwanda

The Greenheart Canopy walkway was designed and built in Nyungwe National Park as part of an overall biodiversity conservation strategy. The goal of the walkway is to create a “draw card” attraction to promote eco-tourism while providing conservation based employment and education. The canopy walkway consists of an entrance tower and two main observation towers with three suspension bridge spans and a truss bridge. The walkway is an aluminum design with steel tower bases and a micropile anchor system.

The walkway provides excellent views and access to the upper canopy while also offering expansive views of Nyungwe National Park. The canopy walkway was built in 2010 and opened to the public in October of that year. Greenheart has not been involved in the project since completing construction in Aug. 2010.

In October of 2012 two Greenheart canopy walkway technicians returned to Nyungwe at the request of DAI to inspect and carry out standard maintenance on the Greenheart canopy walkway system installed at Nyungwe National Park in Rwanda in 2009/10. The Greenheart technicians also provided training to the Rwandan maintenance staff with a focus on carrying out daily inspections and preventative maintenance. The training was “hands on” and the Rwandan staff worked alongside the Greenheart technicians to carry out maintenance and inspection of the walkway

During the inspection and maintenance all of the towers had the bolts checked, re-tightened and marked – support beams and floor plates were checked and adjusted - cable saddles were checked and adjusted. The bridges were adjusted and set level, safety nets were checked and the technicians replaced net attachment points that were showing fatigue. The Catenary cable clamps were inspected, tightened and marked. All the backstays/anchors were visually checked and marked. The foundations for the truss bridge were inspected and all tower bases were found to be level. The welds on the bridge were inspected. Several beams were replaced and extensive time was set on leveling the bridges.

It was also noted that no clear documentation was available and that no record of the annual engineering inspection was available. The canopy walkway system designed for Nyungwe and used in forests around the world is subject to constant motion and is designed as a lightweight weather resistant system suitable remote installation and operation. A key to the long life of these systems and safe operation is daily inspection and preventative maintenance. Daily inspection to ensure all components are safe and

secure and like all moving systems wear and tear is expected but can be limited by ensuring the system is properly adjusted.

Key findings and repairs made during this inspection and maintenance trip were completed within the time allotted.

The majority of items adjusted or repaired appeared to be the result of a failure to tighten or maintain original settings for bridge cable hangers and set bridge levels. The bridge connections to the tower had suffered damage due to this misalignment as the forces had been transferred to the support brackets for the bridge planks. The bridge saddles and tower bolts were loose and it appears that regular checks and maintenance on the tower had not been conducted.

One area that requires further attention is the stabilization of the soil and control of water flow around and under the tower bases. There are signs of erosion and exposure of the tower footings. It is recommended that the tower footings be re-set and poured and ground cover or geo-fabric be added to the base area to limit erosion.

It would appear that access to equipment and tools is an issue for the maintenance crew along with supervision and support for daily inspections and ongoing maintenance. It is recommended that one of the senior (on site staff) be responsible for ensuring daily reports are completed and that ongoing adjustments are carried out to maintain bridge levels and safety. Tools required for climbing and maintenance should be kept on site and each staff member responsible for climbing should be issued their own set of climbing gear.

An inspection procedure was provided during the original installation and staff currently employed by the Park were part of the original installation crew. These staff are dedicated and would benefit from clear direction and verified procedures.

A system checklist is included and to ensure completion and the ongoing safe maintenance and use of the walkway a audited reporting system should be established. Further support and consultation with the field/maintenance staff should also be carried out to ensure they have the tools, material and support necessary to carry out their duties.

SYSTEM CHECKLIST

SIGNOFF: _____

DATE: _____

	OPERATIONS	INSTRUCTION	
	COMPONENT INSPECTIONS		✓
	Operator to sign off & date this checklist as part of a continuous log for the facility.	Daily checks should be done as a walk-through before allowing public access. Look for anything abnormal or part of a continuous log not to standard. Increase inspection frequency if warranted. Check off the following:	
1.	Weather/storm - check high wind or electrical storm conditions	Get weather report. Assess any unsafe weather forecasted. Decide on opening or be prepared for a swift shutdown. [Wind speed > 25 km/h or threat of lightning strikes] Wind Speed = _____ Lightening Probability = (Yor N) _____ [Wind speed > 25 km/h / Threat of lightning strikes?] _____	
2.	Capacity: - Bridges - Platform - Truss Bridge	Check ongoing: 12 adults [should be reduced if motion is too erratic] 16 adults 16 adults	_____
3.	Clearance for Walkway Access	Check for: 1. Build-up of leaves or slippery substances on branches, walkways, and any enclosure platforms. 2. Good condition of all net guards.	_____ _____
4.	Coordinate with others	At shift change, hand-over and review checklist with person going off-shift. Note any deviations or problems.	_____
5.	Hazard trees	Check: 1. Potentially hazardous trees within striking proximity of walkway and determine any changes since previous inspection. 2. All adjacent trees for high or extreme risk conditions.	_____ _____
6.	Maintain Cantenary Cables	Check for: 1. Damage, duress, fraying twines,	_____

	OPERATIONS	INSTRUCTION	
	COMPONENT INSPECTIONS		✓
		<p>corrosion.</p> <p>2. Slack cables (indicate non-equalized load sharing or slippage of fittings or anchors).</p> <p>3. Horizontal bolt cable clamps (horizontal hold hangers indicates proper load sharing).</p> <p>4. Slippage or unwrapping of end, pre-formed cable eyes.</p>	<p>_____</p> <p>_____</p> <p>_____</p>
7.	Hangers	<p>Check for:</p> <p>1. Cable for duress, fraying, corrosion, slackness.</p> <p>2. Slippage on cable clamps.</p>	<p>_____</p> <p>_____</p>
8.	Fittings: cable clamps hand rail grip cables thimble eyes bolts	<p>Check for:</p> <p>1. Signs of duress (overstress), loose bolts, abrasion, corrosion, slippage of splices, cables, clamps, hanger clamp. thimble eyes</p> <p>2. Tightness and orientation of cables. bolts</p> <p>3. Any bending of plates, shackles, bolts.</p> <p>4. Dislodgement of thimbles</p> <p>(Circle only fittings that do not pass inspection)</p>	<p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
9.		<p>Check for:</p> <p>1. Cracks in suspension plates or aluminum members.</p> <p>2. Security of railings and nets.</p> <p>3. Cracks in welds, gussets and members .</p>	<p>_____</p> <p>_____</p> <p>_____</p>
10.	Deck/Walkway Grating "Shur-Grip" Aluminum	<p>Check for:</p> <p>1. Signs of wear, distortion, bearing failure at joints and bolts.</p> <p>2. Cracks in welds or main members.</p>	<p>_____</p> <p>_____</p>

	OPERATIONS	INSTRUCTION	
	COMPONENT INSPECTIONS		✓
		3. Tripping and slipping hazards.	_____
11.	Anchors & Backstays	Check for: 1. Ground heave at anchor locations (indicating pull-out initiated). 2. Proper cable connection and equalizer orientation. 3. Corrosion on rod & cable. Check after wind storm and heavy rain	_____ _____ _____
12.	Guard Netting and Rope Handrail	Check for: 1. UV deterioration, record progress (1 to 10). 2. Secure connections to hangers and platform. (Record findings in inspection log book. Add photographic documentation. Check for lightening strikes.)	_____ _____
13.	Overall Inspection	Thorough inspection including hazard tree assessment. Report to Greenheart's Engineer. Include: deficiency list and parts replacement recommendation and Owner action commitment	
14.	References	Call GreenHeart Conservation Co. engineer for assistance in parts ID, assessment or consultation.	

APPENDIX A: POWERPOINT PRESENTATION



The Park staff selected to participate in the inspection and maintenance were involved in “hands on” training in the use of power tools, tensioning equipment, cable wraps and inspection procedures.

All inspection and maintenance requirements were reviewed with the staff in an effort to ensure that ongoing inspection and basic maintenance would be carried out.

Use of technical climbing gear and safety procedures were reviewed and an emphasis was placed on proper and safe procedures for climbing and working at height.

The local staff performed each task under supervision and would benefit from ongoing guidance and instruction. It was noted that the annual engineering inspections have not taken place since opening in October 2010.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

Greenheart Canopy Walkway Technicians
Juarez da Silva
Luis da Sousa

Nyungwe National Park Staff

- 1 - Gakuru Zacharie
- 2 - Dushimimana Jules Cesar
- 3 - Munyeshyaka Jean de Dieu
- 4 - Rwandema Gabriel
- 5 - Ntegamaherezo Faustin
- 6 - Ntibarikure Assiel



Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca



Tower bases were checked to
verify level and all bolts were
tightened.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca



Each tower was climbed,
inspected and bolts tightened.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca



All saddle bolts were inspected
and tightened.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

ENTRANCE BRIDGE



The bridge connection for the entrance bridge to the tower was moved from the concrete pad to the tower beam.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

ENTRANCE BRIDGE



Working cable for bridge one was inspected and tensioned.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

ENTRANCE BRIDGE



Hanger cables were checked,
adjusted and tightened.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

ENTRANCE BRIDGE



The entrance bridge was aligned
and nets adjusted.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

ENTRANCE BRIDGE



Bridge cables for bridge #1 were checked and new buffer pad installed.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

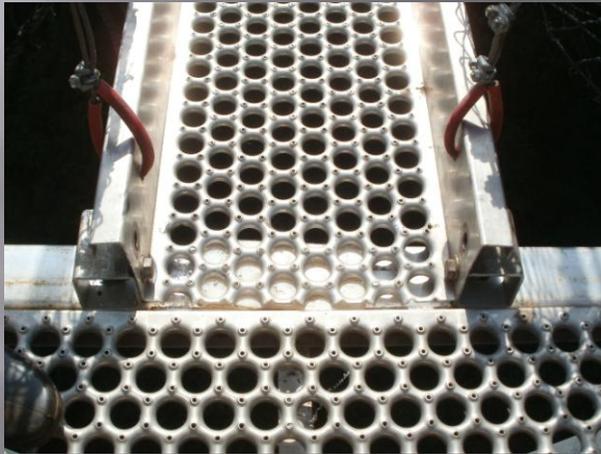
TOWER # 1



The beam and connection for the bridge to tower #1 were replaced with a new beam.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 1



New beam in place.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 1



The tower base nuts were checked and
tightened.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 1



Bolts were checked and tightened.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 1



Several of the handrails on tower 1 were loose and required re-drilling and new screws.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 1 TO BRIDGE 2



The bridge connection for tower #1 to bridge 2 was replaced and a new beam installed.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 1 TO BRIDGE 2



The first bridge section on bridge 2 was replaced.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 1 TO BRIDGE 2



Bridge saddles were checked and adjusted.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

BRIDGE 2 AND CENTER SPAN



Adjusted and tensioned safety cable
for bridge #2.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

BRIDGE 2 AND CENTER SPAN



Hanger cables for bridge number 2 were checked and the bridge aligned.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

BRIDGE 2 AND CENTER SPAN



Nets were removed, inspected and re-set after bridge alignment.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

BRIDGE 2 AND CENTER SPAN



Bridge level was set and nets re-set.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 2



Some of the bolts securing the
handrails on tower 2 were replaced.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 2



Stairs on tower #2 inspected and adjusted.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 2



Tower #2 based was checked and bolts tightened.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 2



Tower #2 structure was inspected and bolts tightened.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TOWER # 2



Soil erosion was found under all of the bases of tower number 2. It was recommended that new footings be set and poured. The tower remains level and the local maintenance crew were advised to carry out this procedure.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

TRUSS BRIDGE



Conducted truss bridge inspection and re-installed tech screws to secure the decking.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca

DAILY INSPECTION REPORT

1. **Components to be checked (daily * weekly#)**
2. BackStays* Tower Bases *
3. Net & Clips * Saddles # Saddles Spigot #
4. Bridge Connections * Bolts & Connector Plate # Bridge Level *
5. Bridge Section & Bolts * Platform Handrails Type 1-2-3-4-5-6 *
6. Hanger Hanger Cables * Main Catenary Cable 7/8" #
7. Plank Clamps *
8. Trees around the Tower and BackStays # - potential hazards

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca



RECOMMENDATIONS

- Ensure daily/weekly inspections are completed and necessary maintenance is carried out on a regular basis with sign off by a qualified supervisor and documentation filed;
- Ensure annual engineering inspections are conducted and documented; and
- Provide ongoing monitoring and support for the local maintenance team by carrying out inspection reviews, equipment checks, and producing quality control reports.

Greenheart Canopy Walkway
Company Ltd. 2012 www.greenheart.ca