Smithsonian Institution

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Reviewing Mitigation Hierarchy Implementation

Challenges of Quantifying the Mitigation Hierarchy: Case Study PERU LNG

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Florence, Italy
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PERU LNG

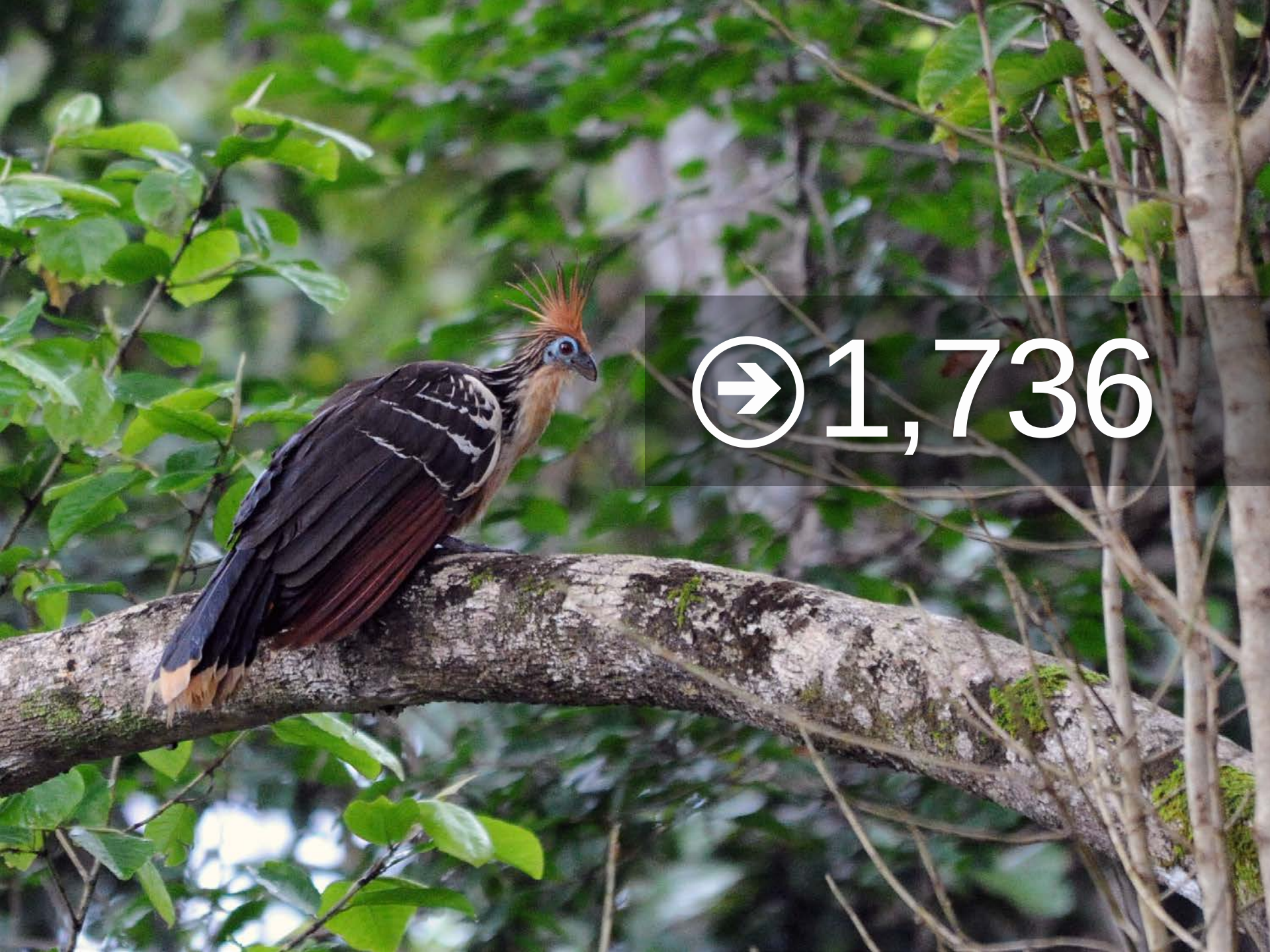
- 408 km 34” pipeline
- One LNG Plant: process train, two LNG storage tanks, and a marine export terminal

PERU LNG


PERÚ


25,000


2,000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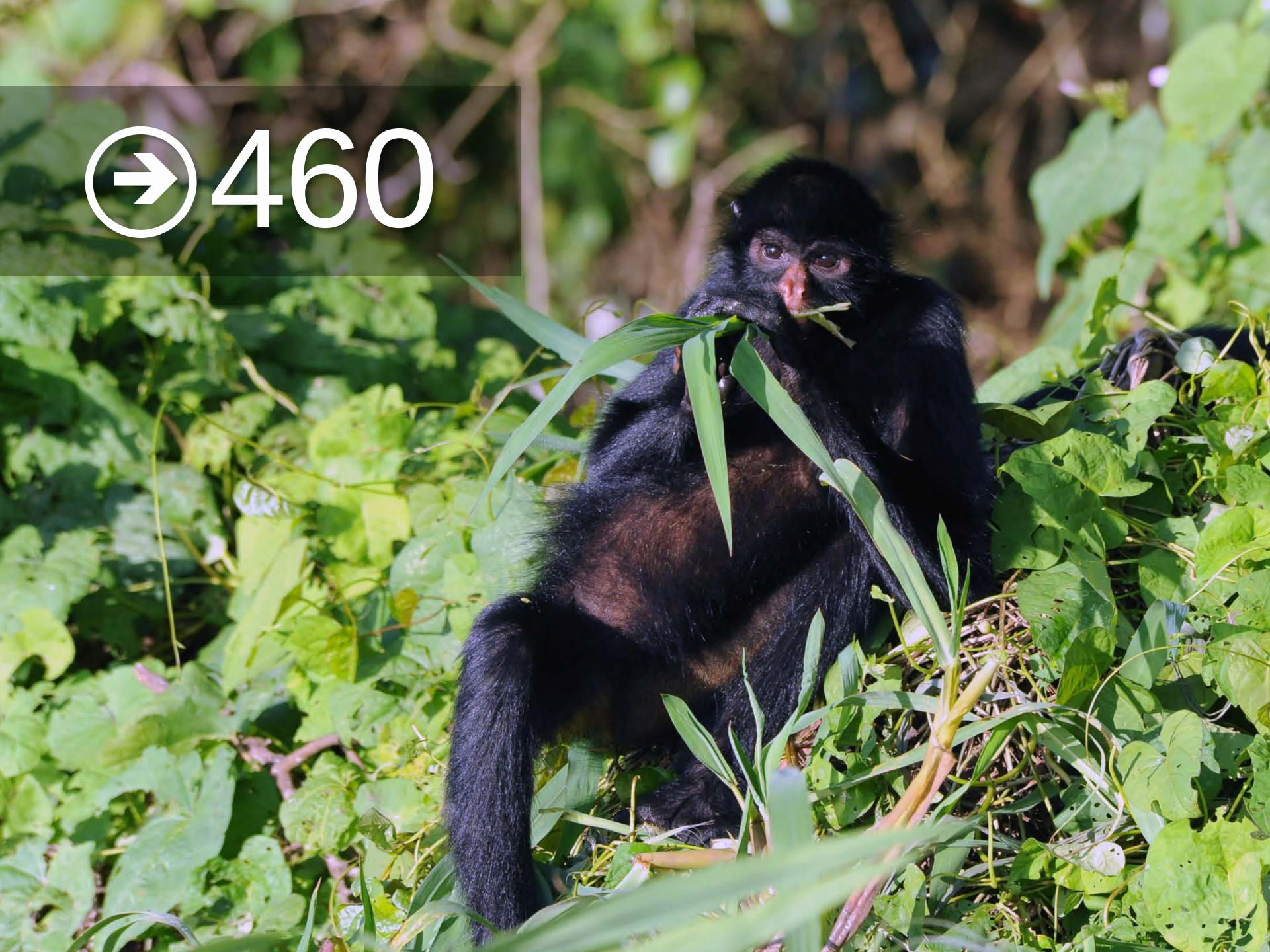
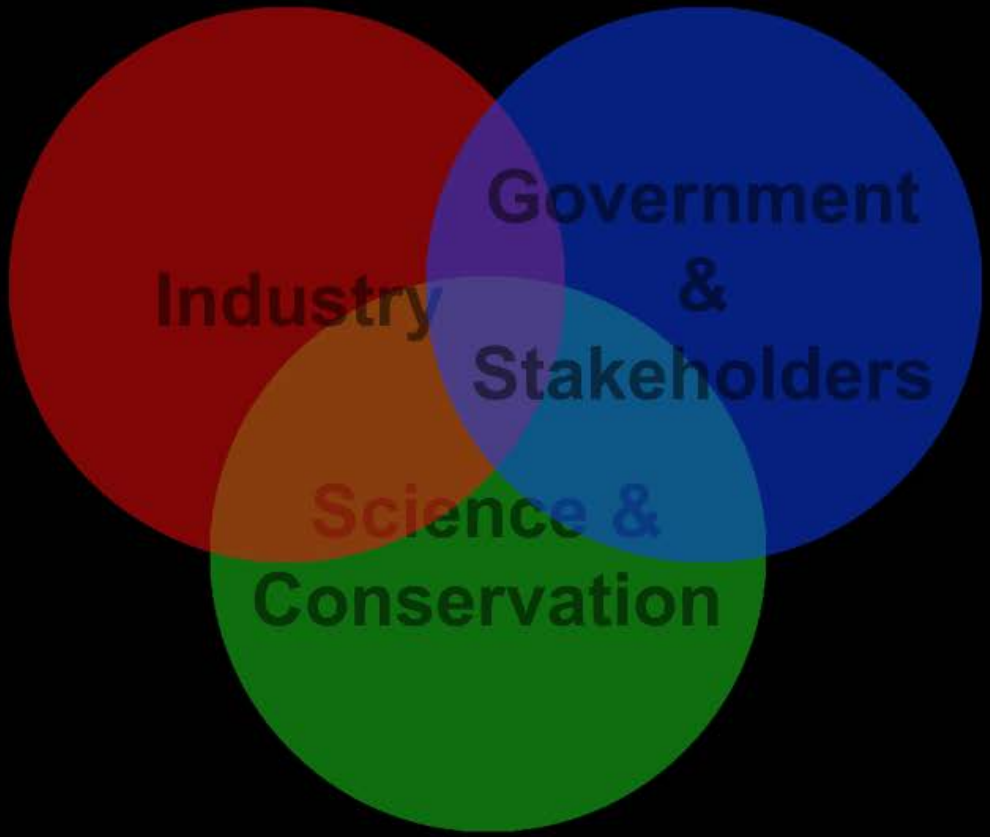

460


332


365

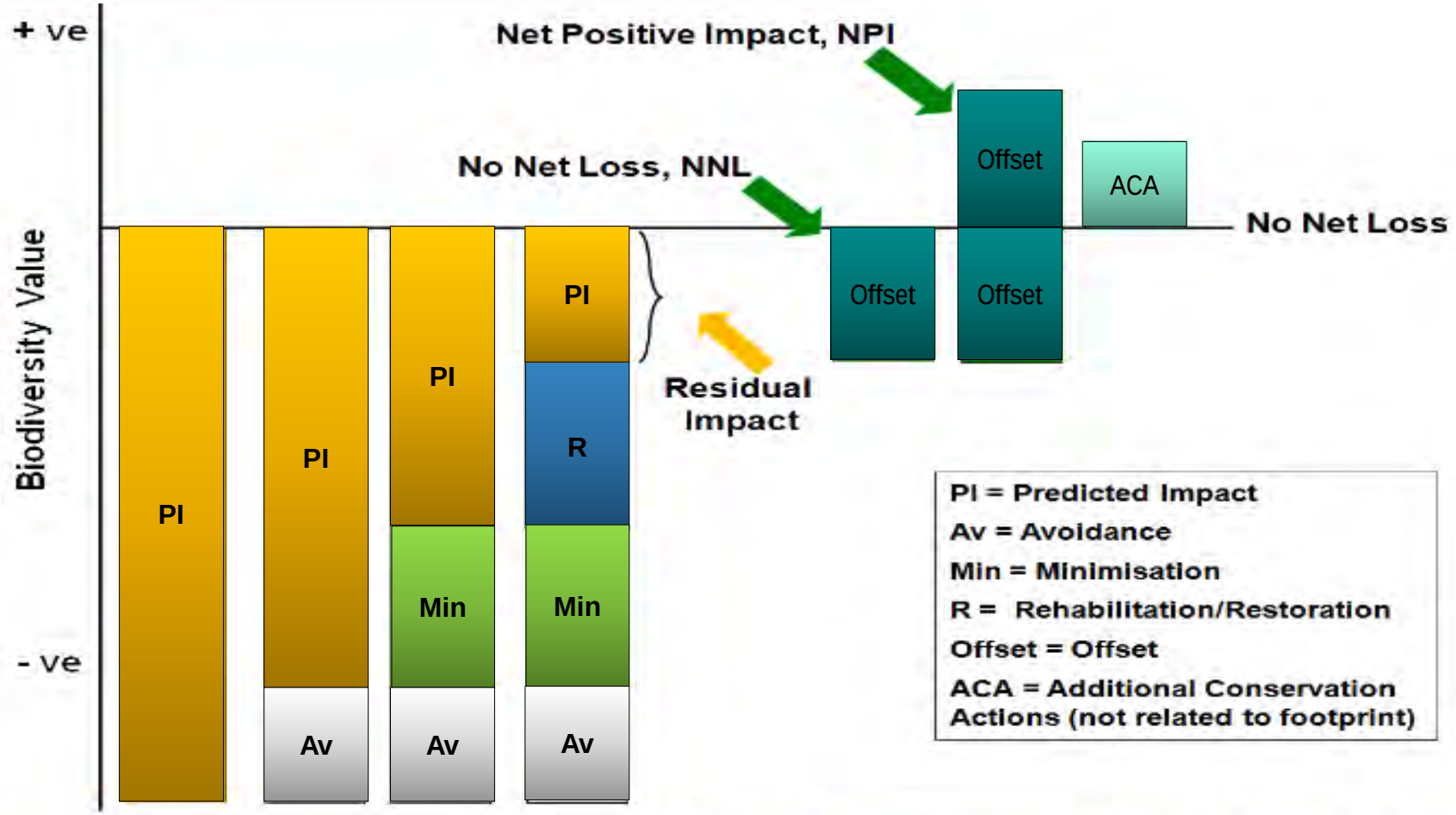
Challenge: How to build & run a mega project in a mega diverse environment?

CONSERVATION & SUSTAINABLE DEVELOPMENT



The Basis…..

The Mitigation Hierarchy



Source: UNDP 2002, EBI 2005, Rio Tinto & BBOP 2009

PERU LNG Pipeline Biodiversity Action Plan

PROYECTO PERU LNG Melchorita

Evaluation of Alternative Pipeline Routes

Several routes were selected, reviewed and analyzed considering different variables such as the pipeline integrity, stability, and safety, archaeological, social and environmental aspects.

The route selection process included experts in the fields of engineering, construction, archaeology, and ecology.

Environmental and Social Impact Assessment (ESIA)

A 4 to 7km wide corridor, along the entire 408 kilometers of the pipeline route, was studied for development of the ESIA and included collection of baseline information and identification of potential impacts associated with construction of the pipeline.

Ecological Field Survey (EFS)

Based on the data collected in the ESIA and further data collected within a 50 meter pipeline corridor, the Right of Way (RoW) was broken down into 14 Ecological Landscape Units (ELUs). Within each ELU endangered and threatened species of flora and fauna were then identified and registered.

Ecological Management Plans (EMPs) and Ecological Action Plan (EAPs)

Three regional EMPs were developed to address PERU LNG's environmental commitments and manage mitigation measures specifically related to ecological issues whilst considering possible impacts of pipeline construction in each region.

Based on the 14 Ecological Landscape Units identified, 14 Ecological Action Plans (EAP) were developed. Each EAP identifies the appropriate mitigation measures to be implemented by PERU LNG, such as the translocation or the taking of plant cuttings for use during reinstatement. Special emphasis has been placed on endangered plant species within the 25 meter corridor.

Biorestoration Management Plan

Development of a biorestoration and revegetation plan for all the areas and habitats affected by the construction of the pipeline RoW, and associated sites affected by the Project. Specific objectives of this plan include avoiding soil erosion, ensuring pipeline integrity, and safeguarding ecologically sensitive habitats, such as water bodies and wetlands against sedimentation processes.

Camelid Management Plan

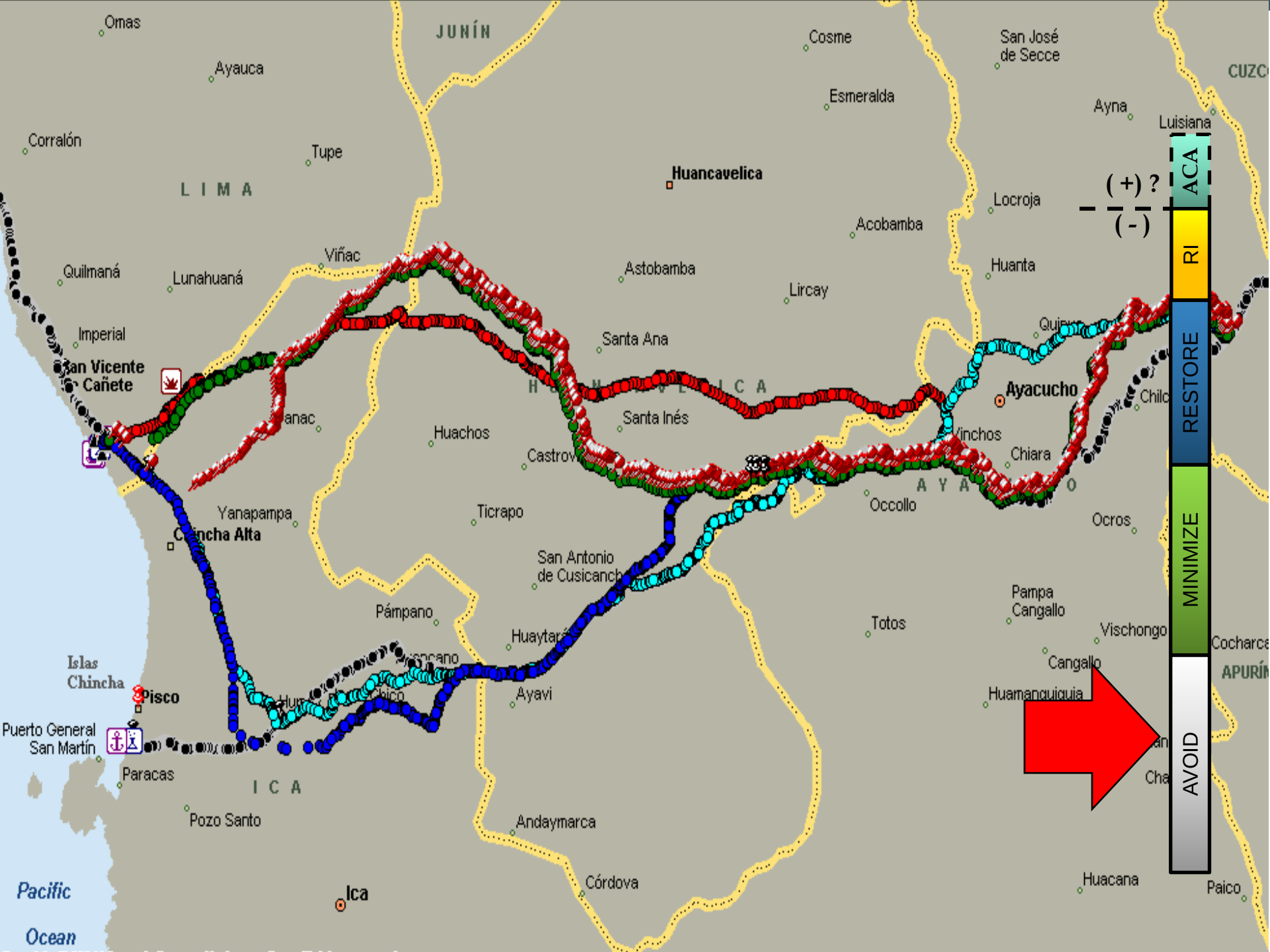
Includes development of environmental and social management methods to identify and mitigate potential impacts on camelid populations within the pipeline area.

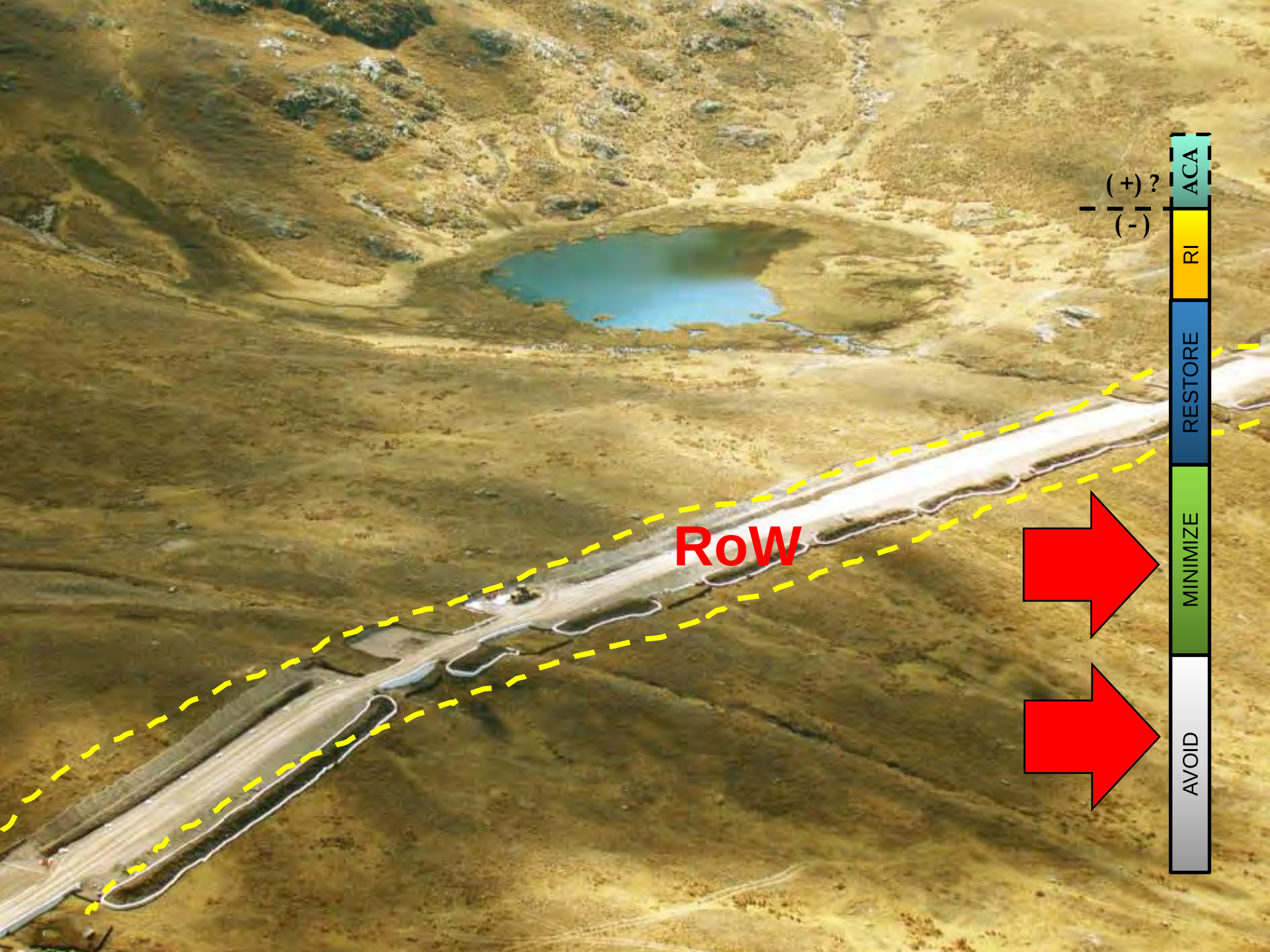
Biodiversity Monitoring Program

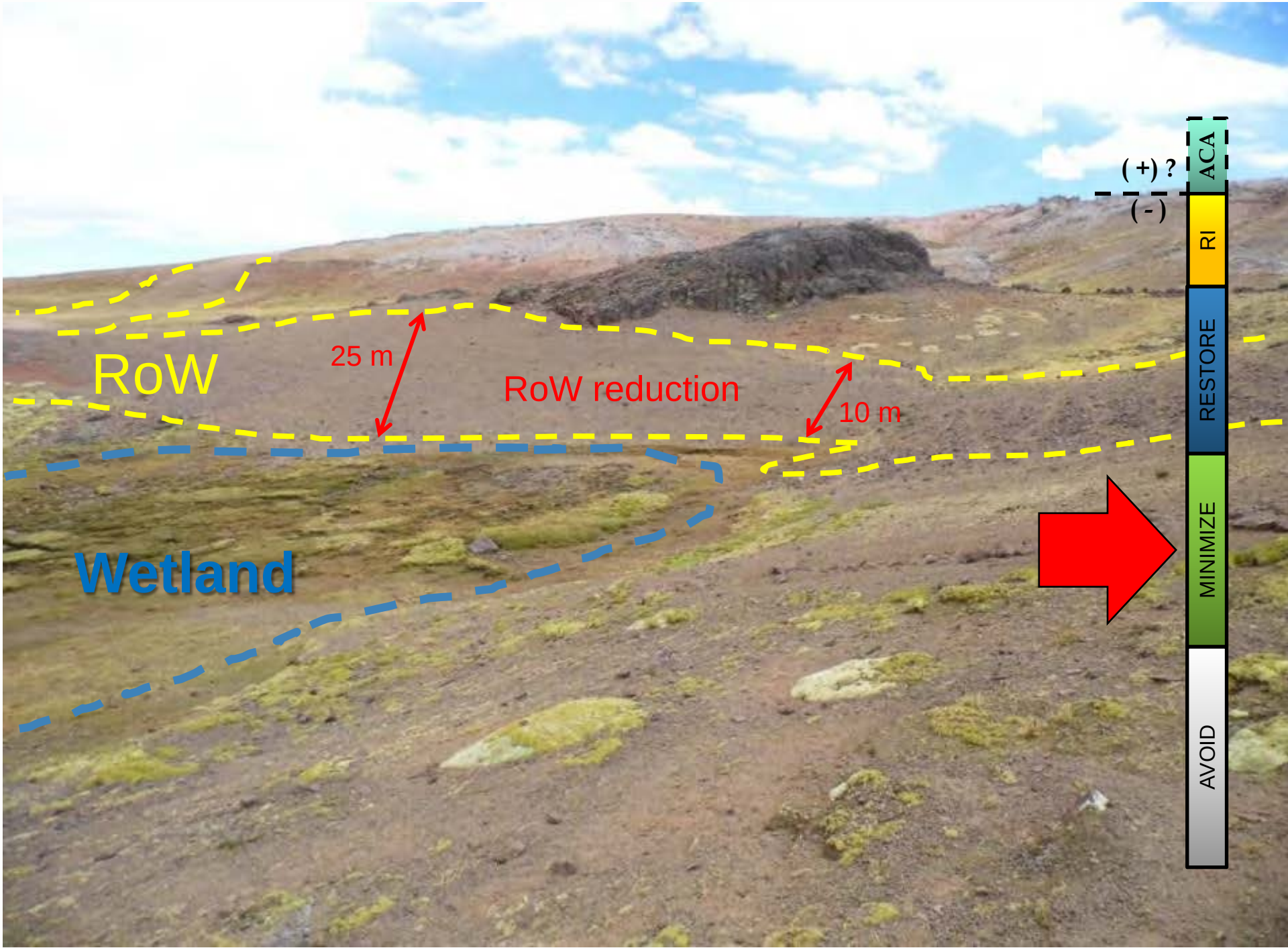
Development of a monitoring program for flora, fauna, and physical habitat key indicators along the 408 kilometers of the RoW. The Smithsonian Institution is technically leading this Program and partnering with Peruvian specialists for its successful implementation.

Environmental Investment Plan

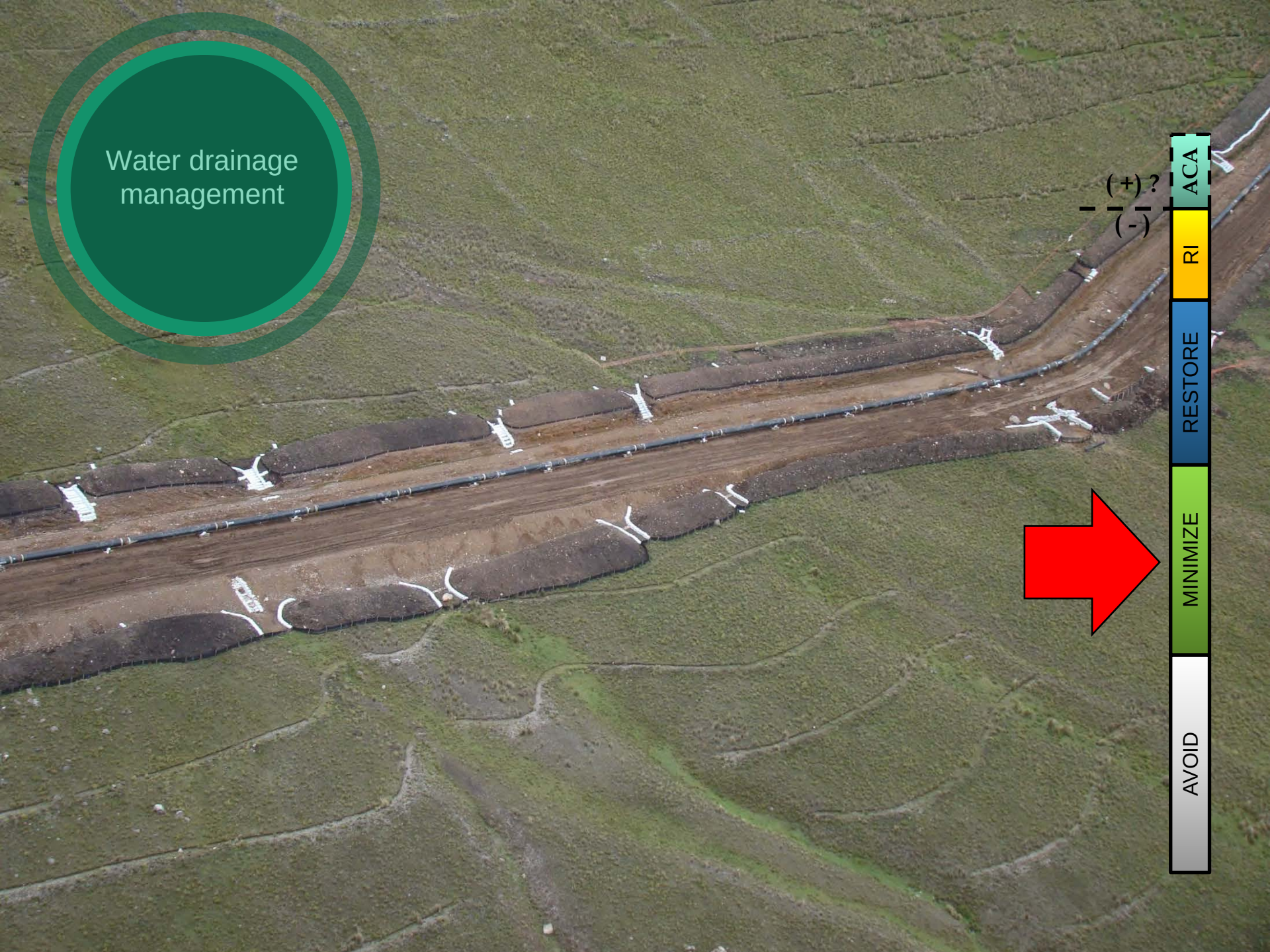
Throughout all biodiversity activities conducted so far, there are a number of areas where PERU LNG has identified opportunities for investment. One example is the camelid husbandry. Opportunities for investment may be identified in the Biodiversity Monitoring Program and may be considered for Environmental and Community investment programs.


Omas
JUNÍN
Cosme
San José de Secce
Ayauca
Esmeralda
Ayna
Luisiana
Corralón
Tupe
LIMA
Huancavelica
Locroja
(+) ?
ACA
(-)
Acobamba
Viñac
Astobamba
Huanta
Quilmaná
Lunahuaná
Lircay
RI
Imperial
Santa Ana
RESTORE
San Vicente de Cañete
Ayacucho
Huachos
Santa Inés
Chiara
Yanapampa
Ticrapo
Occollo
Ocros
Chincha Alta
San Antonio de Cusicancha
MINIMIZE
Pámpano
Pampa Cangallo
Totos
Huaytara
Vischongo
Islas Chincha
Ayavi
Cangallo
Pisco
Huamanquiquia
AVOID
Puerto General San Martín
Paracas
ICA
Pozo Santo
Andaymarca
Pacific
Ocean
Ica
Córdova
Huacana
Paico


RoW
(+) ?
(-)
ACA
RI
RESTORE
MINIMIZE
AVOID


RoW
25 m
RoW reduction
10 m
Wetland
(+) ?
(-)
ACA
RI
RESTORE
MINIMIZE
AVOID


Avoiding sensitive habitats
(+) ?
(-)
ACA
RI
RESTORE
MINIMIZE
AVOID


Water drainage management
(+) ?
(-)
ACA
RI
RESTORE
MINIMIZE
AVOID


Short-term goal
erosion control
(+) ?
(-)
ACA
RI
RESTORE
MINIMIZE
AVOID

Revegetation of the RoW

(+) ?
(-)

ACA
RI
RESTORE
MINIMIZE
AVOID

Biorestoration Program


(+) ?
(-)
ACA
RI
RESTORE
MINIMIZE
AVOID
Biodiversity Monitoring and Assessment Program (BMAP)


Biodiversity Monitoring and Assessment Program (BMAP)
(+) ?
(-)
ACA
RI
RESTORE
MINIMIZE
AVOID

Conservation Initiatives

Torobamba River Valley

- ✓ *Eriotheca sp.* (Pati) Forest
- ✓ Extension: 375 Ha
- ✓ No regeneration in > 10 years

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Methods:

- Avoidance: Comparison of original vs final micro-routing
- Minimization: reduction of width and micro-routing: Satellite images and Google Earth
- Restoration by bio-restoration program: restoration indices every 500m along RoW
- Habitat diversity, abundance, and ecosystem function: BMAP bio-restoration data: ELUs 1-11 from 2010-2014
- Spatial information and Vegetation cover: Satellite Imagery 2010-2014 and GIS polygons interpretation of RoW

Methods: Metrics

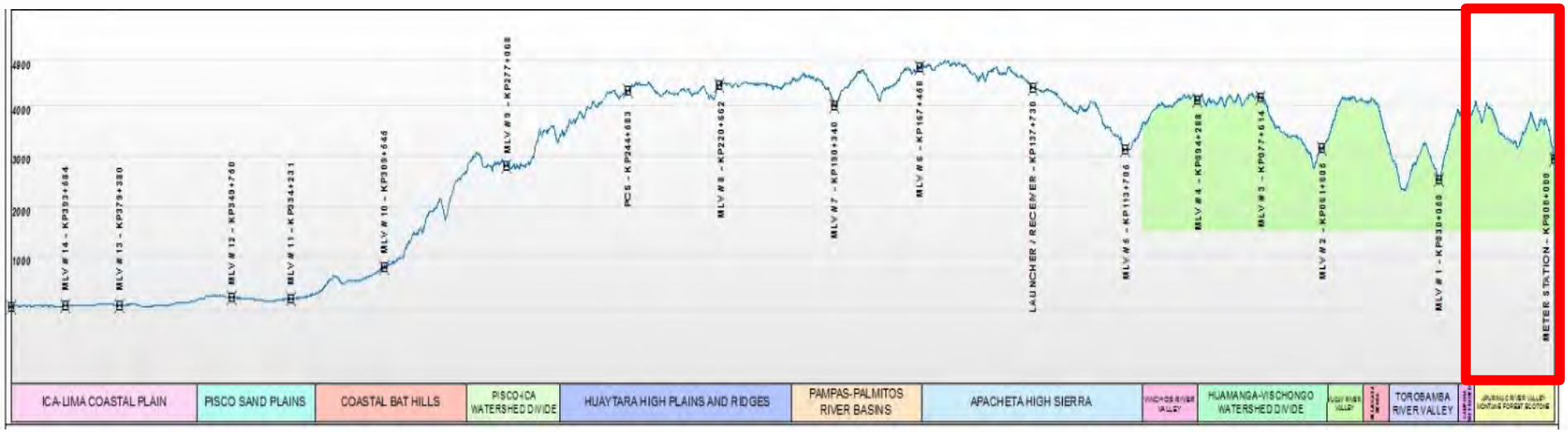
- Habitat area: 25m wide x 408km length
- Quality Hectares: habitat area times assigned Biodiversity and Ecosystems Significance (BES) value
- BES value range from lowest (1) to highest (5) importance
- Restoration indices were calculated with controls every 500m along RoW, using vegetation cover and sp richness


2
3
BES values
5
5

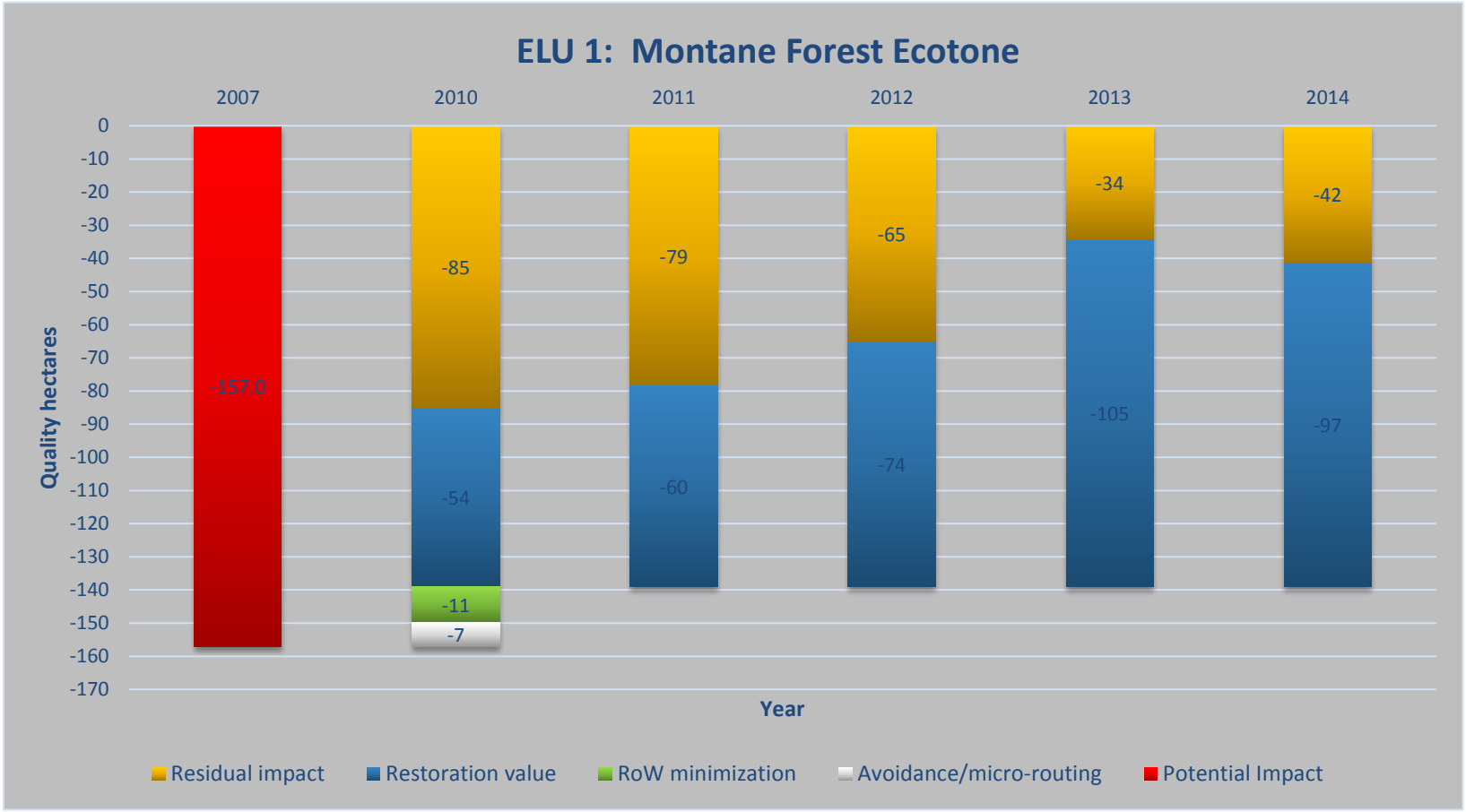
Results

ELU 1: Montane Forest Ecotone

- Habitats: High elevation montane forests, shrub habitat, tussock and sward-forming grasslands, and peat bog wetland.
- KP 0+00 KP 20+511; altitude 2966 m - 4066 m
- BES value of 5



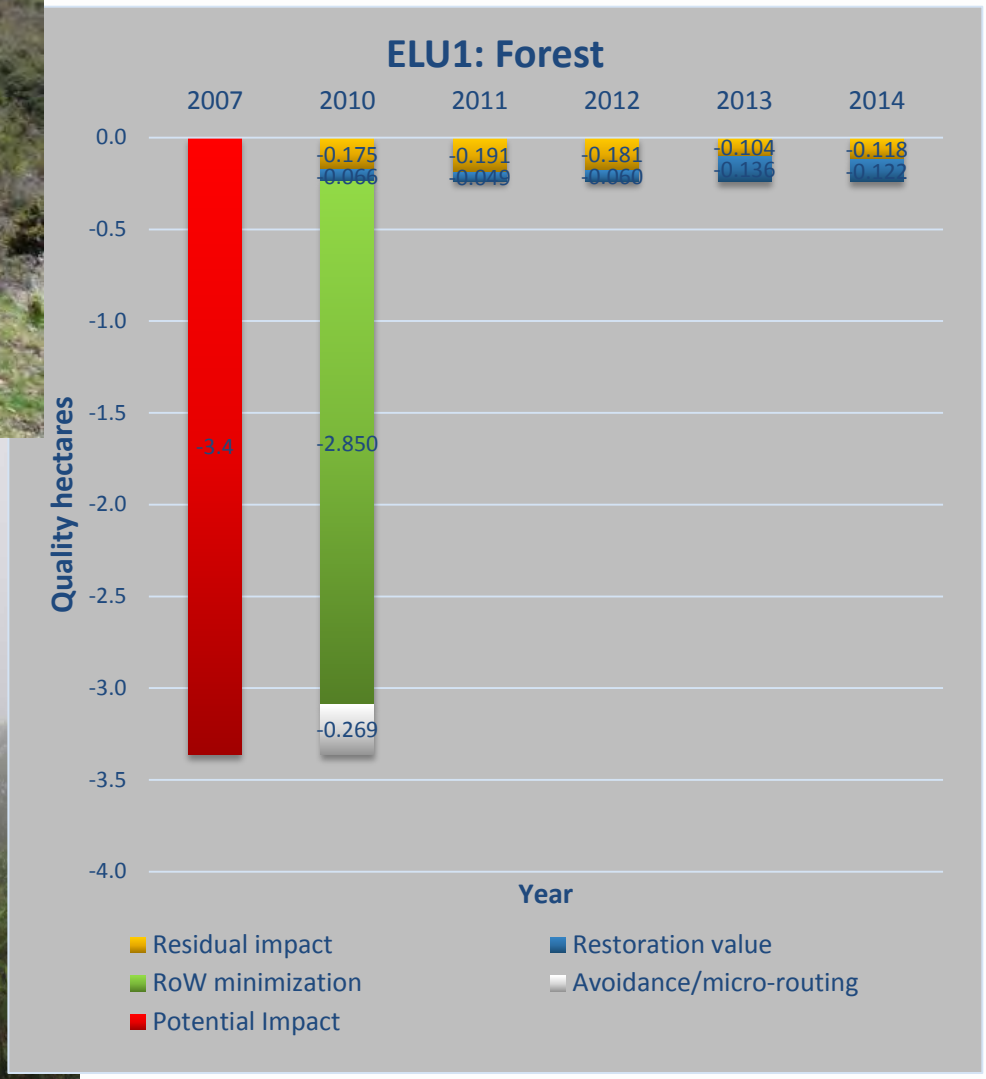
Results


ELU 1: Montane Forest Ecotone
2007
2010
2011
2012
2013
2014
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
Quality hectares
-157.0
-85
-54
-11
-7
-79
-60
-65
-74
-34
-105
-42
-97
Year
Residual impact
Restoration value
RoW minimization
Avoidance/micro-routing
Potential Impact

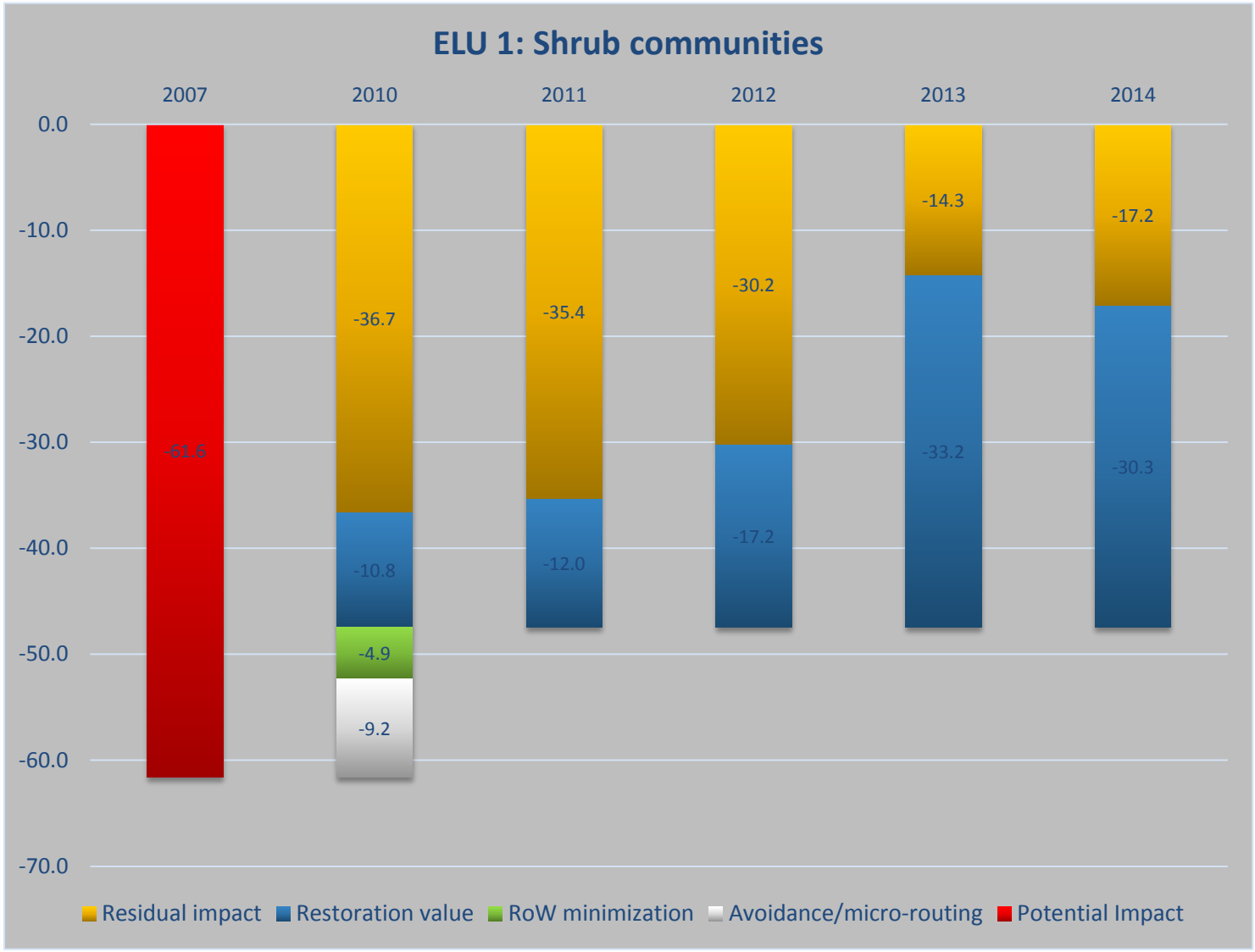
Results


2011

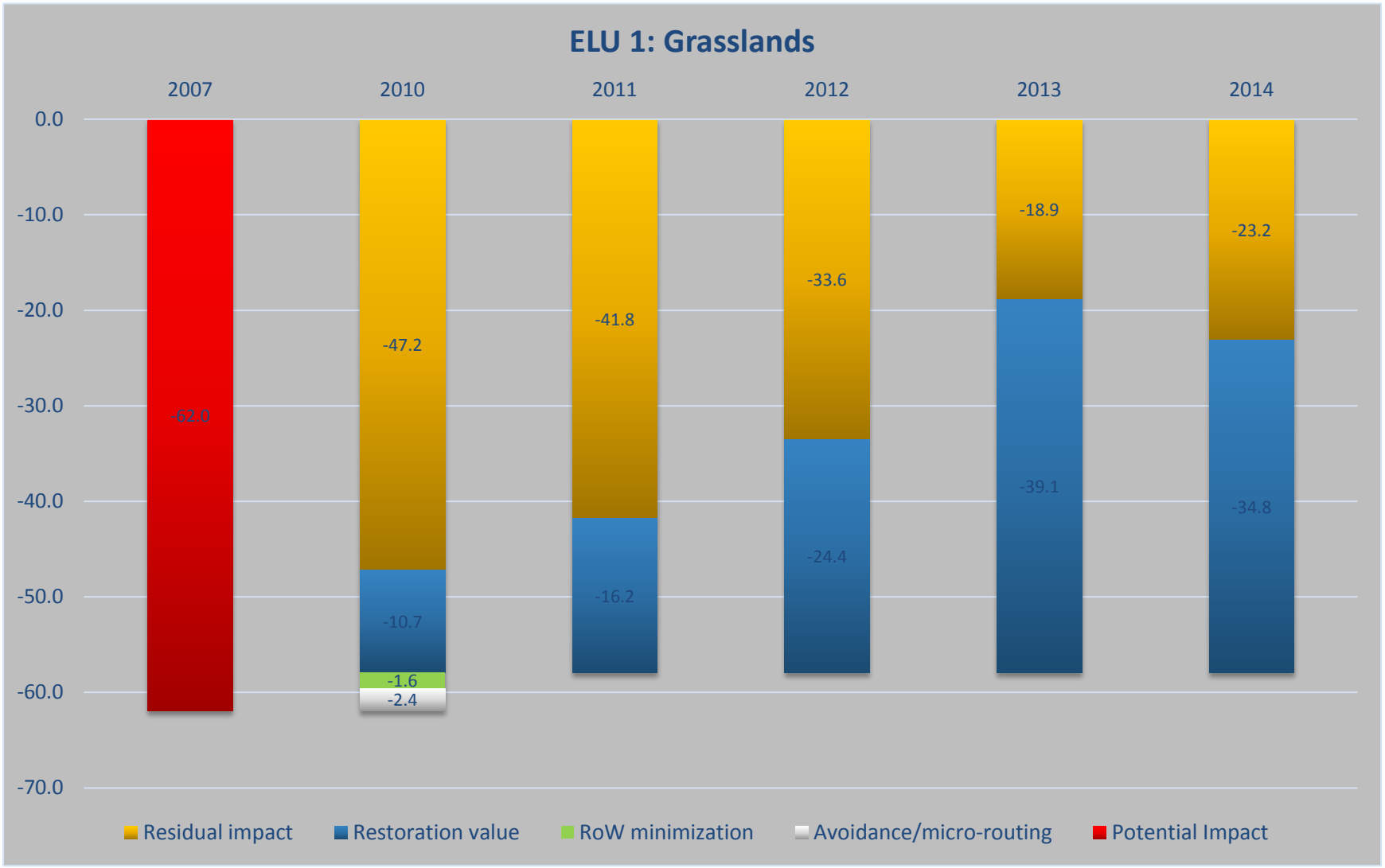

2014


ELU1: Forest
2007
2010
2011
2012
2013
2014
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-0.175
-0.066
-0.191
-0.049
-0.181
-0.060
-0.104
-0.136
-0.118
-0.122
-3.4
-2.850
-0.269
Quality hectares
Year
Residual impact
RoW minimization
Potential Impact
Restoration value
Avoidance/micro-routing

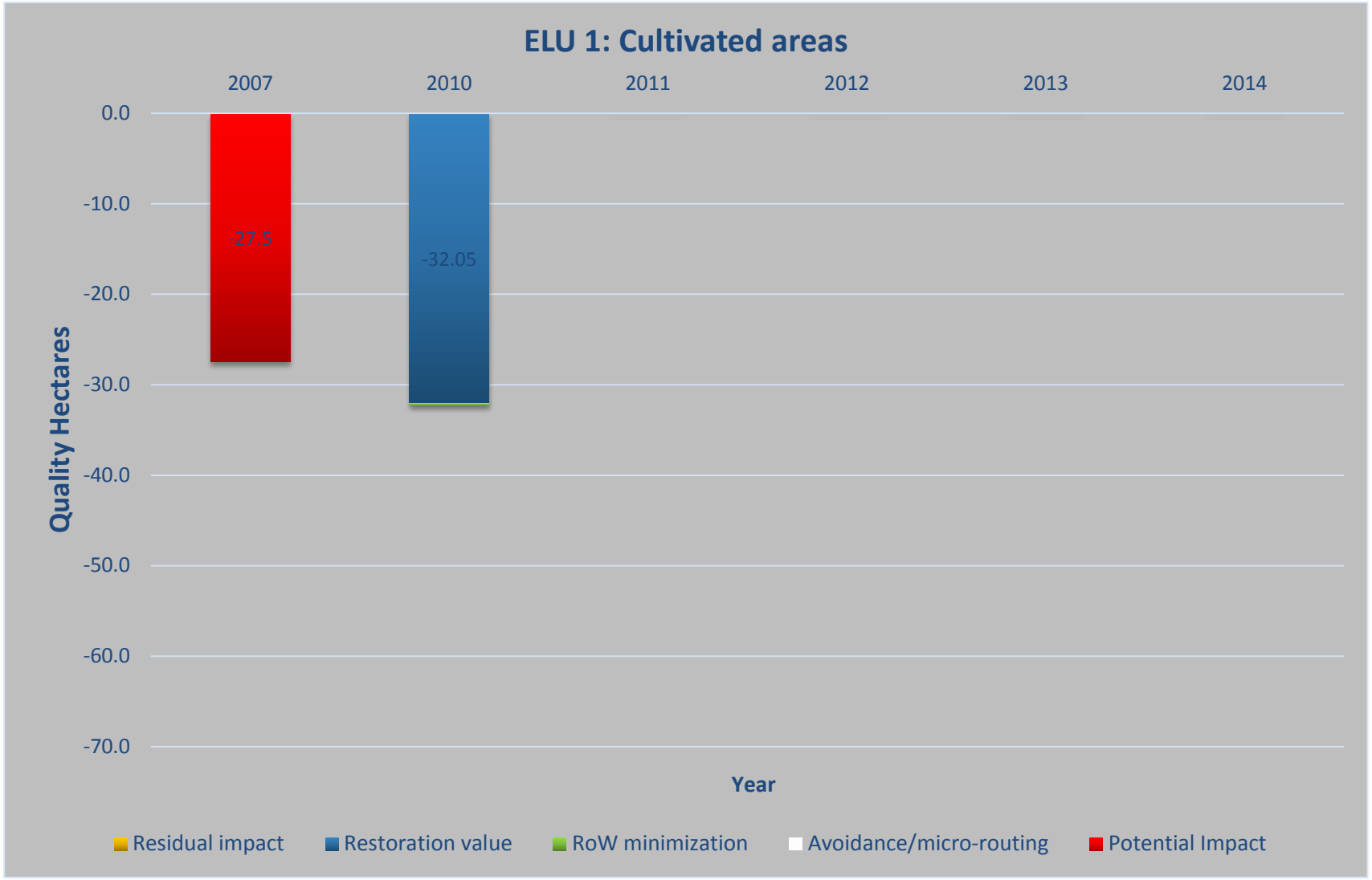
Results


ELU 1: Shrub communities
2007
2010
2011
2012
2013
2014
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-61.6
-36.7
-10.8
-4.9
-9.2
-35.4
-12.0
-30.2
-17.2
-14.3
-33.2
-17.2
-30.3
Residual impact
Restoration value
RoW minimization
Avoidance/micro-routing
Potential Impact

Results


ELU 1: Grasslands
2007
2010
2011
2012
2013
2014
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-62.0
-47.2
-10.7
-1.6
-2.4
-41.8
-16.2
-33.6
-24.4
-18.9
-39.1
-23.2
-34.8
Residual impact
Restoration value
RoW minimization
Avoidance/micro-routing
Potential Impact

Results


ELU 1: Cultivated areas
2007
2010
2011
2012
2013
2014
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Quality Hectares
-27.5
-32.05
Year
Residual impact
Restoration value
RoW minimization
Avoidance/micro-routing
Potential Impact

Results

- High BES habitats (forest and wetland) < quality hectares impacted
- High avoidance and minimization efforts for High altitude BES habitats
- Sensitive habitats such as *Tillandsia* spp. in coastal desert areas were avoided
- Medium BES habitats (grasslands) are most impacted by the RoW Restoration
- High restoration efforts in medium BES habitats
- Restoration challenging in high altitude and cold temperatures
- Bio-restoration reduced residual impacts followed by minimization
- Residual impacts are greatest for the central, high Andean and western slopes
- Eastern Andes more resilient due to greater precipitation and lower elevations
- High Andean and western slope ELUs have highest

Conclusions

- Mitigation Hierarchy is quantifiable for pipeline/linear infrastructure projects

- Quantification of Mitigation Hierarchy challenges:
  - Record keeping and criteria adoption for project planning phase
  - The same Spatial and Temporal data
  - Satellite images, ground verification, and strong/standardized BMAP data

- Data from impacted and non-impacted control areas for time sequence comparisons

- Criteria to assess the Biodiversity Value:
  - Habitat characteristics/classification
  - Endemism
  - Rare, threatened and endangered species
  - Value for local communities
  - Ecosystem services provided

Conclusions

5. Forecasting toward ‘no net loss’:
   a. Trends toward ‘no net loss’ goal
   b. Assess the effectiveness of mitigation and restoration efforts
   c. Assess impacted areas current and future conditions
   d. Helps to better understand the impact and plan restoration response
   e. Adequately manage resources: time, crews, research, budget needs, etc.
   f. Improves adaptive management planning process focused on lessons learned

6. Mitigation Hierarchy quantification fosters a well-informed and cost-effective decision making process


CAMBIO CLIMATICO
PROTÉGETE DE LA RADIACIÓN SOLAR
GOBIERNO REGIONAL
DE AYACUCHO
THANKS