

MHV – Environmental Overview

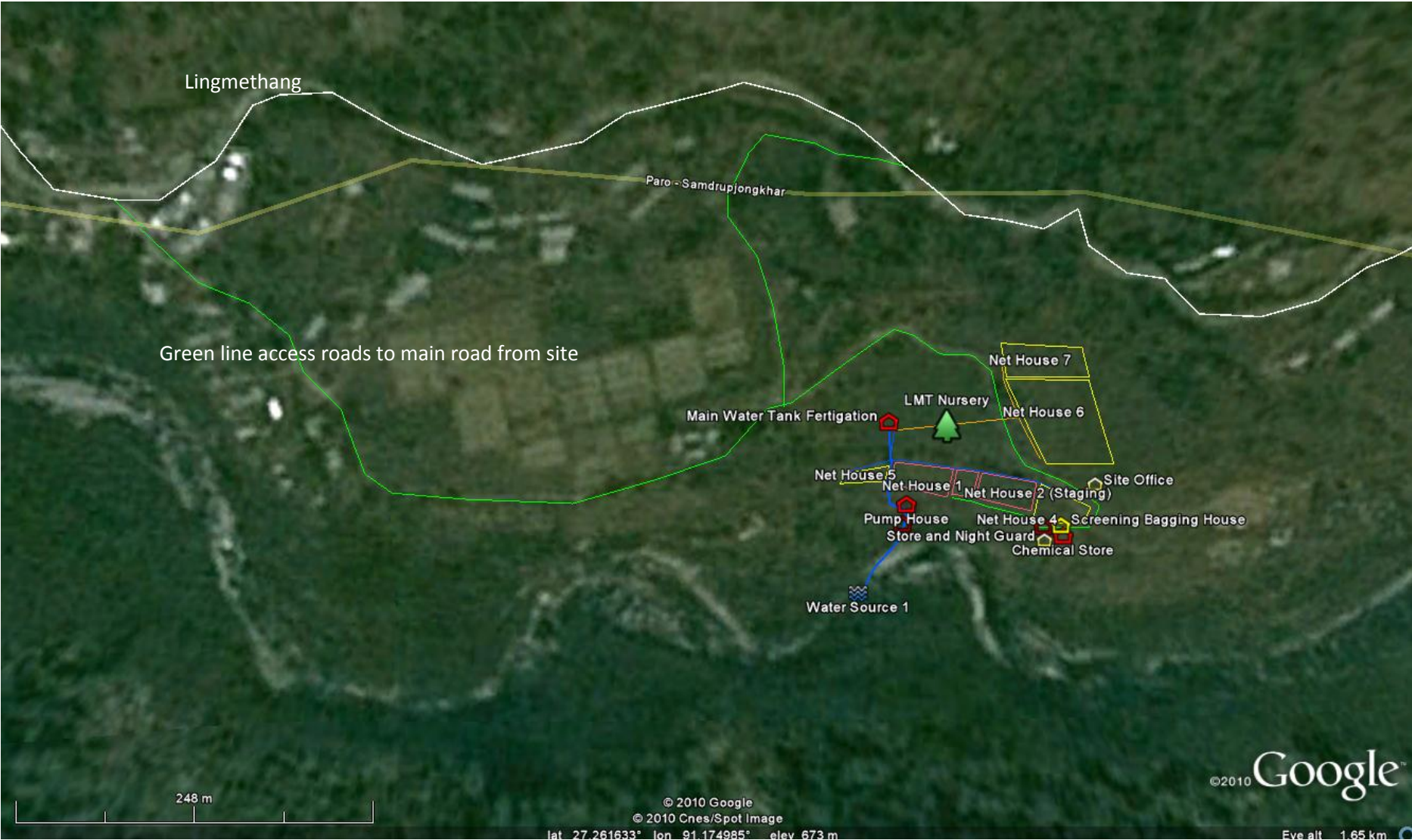
1. ENVIRONMENTAL IMPACT

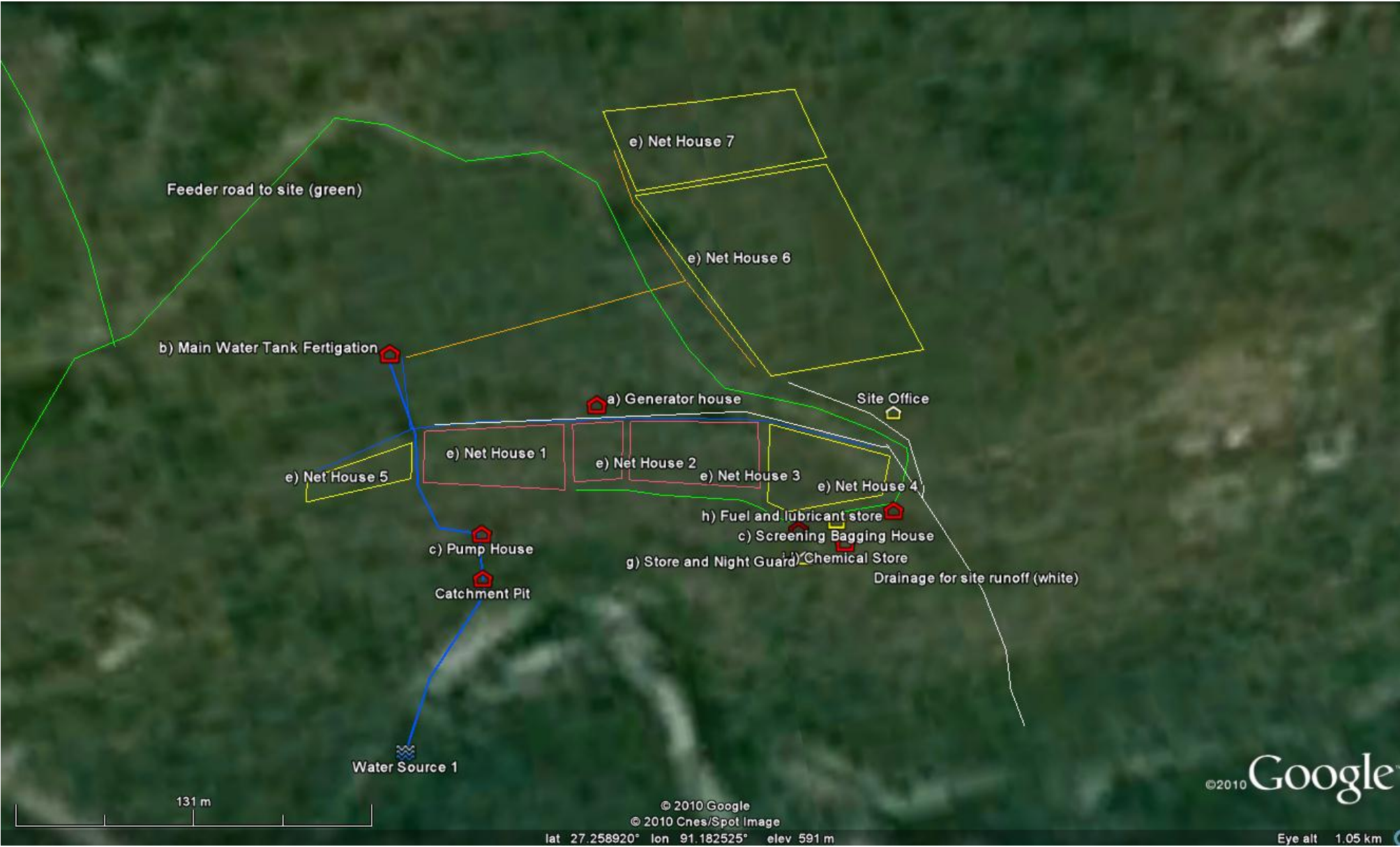
a. Location plans

- Nursery

The Lingmethang nursery site, leased from the RNR Research Sub-Centre at Lingmethang, is presented in the maps below.







The site was selected in conjunction with the MoAF based on its suitability for the construction of a tree nursery. These factors are relatively gentle slopes (max 10 degrees), access to year round water sources, road access to the main Thimphu/Mongar highway, and its current zoning for agricultural use by RNR. The site is entirely bounded by agricultural research centre land.

- Orchards

Trees will be planted by interested farmers on their own fallow land or on fallow/degraded land allocated for community forests by farmer groups. All land used for plantings will have the land classification and title confirmed by the relevant government agencies. Approximately 22-25,000 acres will be planted at altitudes between 1800 and 2800m on degraded or fallow land concentrated initially in the Eastern Provinces and Central Provinces of Bhutan (See Figure xx) and close to the existing road network. These land types are approved by the relevant Government agencies for planting hazelnuts. The scattered nature of plantings over a wide area will result in a light footprint, an increase in forest area, and a reduction in fallow or degraded land.

- Factory

Site selection for the processing facility is still at the pre-feasibility stage and a report showing the location will be provided for approval as an addendum.

b. Establishment

- Nursery

Construction at the Lingmethang nursery site commenced in October 2009 and is expected to be completed by October 2010. Net houses 1 through 5 have already been completed and terracing work has commenced for Net Houses 6 and 7 (See maps above).

- Orchards

Demonstration planting of two acres at three sites (Khangma, Rangshikar, and Yonphula) was carried out in September 2010. Further plantings will be

carried out in the wet seasons from 2011 to 2015 until 10 million trees have been established.

- **Factory**

Building and construction of the factory is expected to commence at the end of 2012 and be completed and commissioned before the first harvest in August 2013. Site selection for the processing facility is still at the pre-feasibility stage and a more detailed construction schedule will be provided for approval as an addendum once engineering studies are complete.

c. Design and operation

- **Nursery**

- 1) List of structures
- 2) Net houses – Spanish industrial-style wire frame with a height of 2 to 2.5m.
- 3) Catchment pit – 15m³ temporary river bank pit.
- 4) Pump House – 1 story 3.5m height.
- 5) Fertigation tanks – 2 x 1m³ tanks with roof.
- 6) Main water tank – 1 x 50m³ sunken tank with roof
- 7) Store house 1 story 3m height.
- 8) Fuel and lubricant store - 1 story 3.5m height
- 9) Pesticide storage and washing station – 1 story 3.5m height
- 10) Office - 1 story 3.5 m height
- 11) Roofed medium storage and mixing station – 1 story 3.5m height
- 12) Generator house – 1 story 3m height

All poles, sand, flat stones, and boulders harvested locally with appropriate permits. All aggregate timber and cement are sourced from approved local suppliers. Wires, agro-net, plastics, irrigation piping, motors, and pumps are sourced from India.

Analysis of Potential Environmental Impacts

Pollution Source Number	Pollution Source	Daily Periods of Operation	Type of Pollution	Risk of Occurrence	Severity of impact if occurs	Management Measure
a.	Diesel generator	Power cuts c.100hrs a year	Noise, Used lubricants, Emissions	Certain	Insignificant due to few hours of operation and no settlements to disturb.	Silencer and within a purpose built generator house. Used lubricants collected and used as paint for preserving poles
b.	Main water tank 11hp electric pump	8 hrs a day every day	Noise	Certain	Insignificant. Lack of settlements to disturb within small radius of disturbed area.	Housing around pump.
c.	Pump house pump 15hp electric pump	4 hrs a day every day	Noise	Certain	Insignificant. Lack of settlements to disturb within small radius of disturbed area.	Housing around pump.
d.	Medium mixing station – 2 hp motor	8 hrs Mon to Saturday	Noise	Certain	Insignificant. Lack of settlements to disturb within small radius of disturbed area.	Housing around pump.
e.	Net house light bulbs	2.5 hrs for each net house every night October to March. c.30000 60W bulbs	Light, waste incandescent bulbs	Certain	Insignificant Lights have reflectors which ensure that light is directed efficiently downwards	None
f.	Drainage channel for runoff from net houses and fertigation tank	Peak runoff during irrigation or rains.	Nutrients and chemicals in runoff	Certain	Minor compared to other agricultural uses of land. Fertigation concentrations volumes are very low designed for regular low concentration applications to small plants (low requirement) in bags. Very low volumes of pesticides required as in net houses which prevent insect entry and wind drift	Drainage pit for cleaning fertigation tank and sprayer washing area. Plants are irrigated so that run-off and waste is minimal. 95% of fertigation water is absorbed by medium and bags are not overwatered. Plants are sprayed by hand on plants following GAP standards

Pollution Source Number	Pollution Source	Daily Periods of Operation	Type of Pollution	Risk of Occurrence	Severity of impact if occurs	Management Measure
					minimized.	(EUREPGAP, GLOBALGAP). Water quality testing of runoff water.
g.	Grey water from staff showers and septic tank	Peak flows during daylight working 07:00 to 18:00	Nutrients and chemicals in runoff and risk of spillages from septic tank	Low	Minor. Small volumes from 70 workers washing and sewage needs.	International standard and properly sized septic tank to prevent discharges. Drainage pit for overflow from septic tanks and grey water. Adequate buffer zones to prevent spillages draining into the river. Water quality testing of runoff water.
h.	Diesel and lubricant store	Store accessed once a day.	Risk of spillage of oils and explosion	Low	Serious if explosion occurs. Injury to staff and members of the public. Minor for spillages of low volumes	Separate fuel store with adequate buffer zone and proper signage and ventilation. Health and Safety training for staff implemented as part of GAP and ISO9001 compliance systems.
i.	Fertilizer Store	Store accessed once a day	Risk of spillage of fertilizers contamination of soils and water.	Very Low	Minor due to type of material.	Separate store with adequate buffer zone and proper signage and ventilation. Health and Safety training for staff implemented as part of GAP and ISO9001 compliance systems.
j.	Pesticides Store	Store accessed once to twice a week	Risk of spillage of pesticides and contamination of soils and water.	Very Low	Serious if enters water courses	Separate store with adequate buffer zone and proper signage and ventilation. Health and Safety training for staff implemented as part of

Pollution Source Number	Pollution Source	Daily Periods of Operation	Type of Pollution	Risk of Occurrence	Severity of impact if occurs	Management Measure
						GAP and ISO9001 compliance systems.
k.	Vehicles on site. Farm truck, Tractor and Front Loader	8 hrs Mon to Saturday	Noise, Used lubricants, Emissions, Accident Risk	Noise and Used Lubricants are certain. Accident risk is moderate	Moderate for accident risk. Insignificant for Noise due to low number of vehicles. Emissions more than offset by plantings	Health and Safety training for vehicle operators as part of GAP and ISO9001 compliance systems. Drivers certified to use vehicles. Used lubricants collected and used as paint for preserving poles
l.	Haulage	1-2 trucks per day May to August	Noise, Nuisance, Accident Risk, Emissions	Low	Minor due to low number of trucks per day	Haulage sub-contractors audited by MHV to ensure compliance with health and safety standards

a) Raw Materials

Raw Materials Consumed	Source of supply, and seasonal availability	Annual Use	Total Quantity	Pollution Risks	Management Measures
1. Hazelnut tissue culture plantlets	Available Year Round – Sourced from China	1 million to 3 million	14 million	None. Hazelnut is indigenous to Bhutan and non-GMO.	
2. Sawdust – Planting Medium Mix	Available Year-Round – Recycled waste material from sawmills	200 to 700 m3	3000 m3	None. Productive use of a waste material.	
3. Top Soil – Planting Medium Mix	Available Year-Round – harvested from approved local sources	116 to 348 m3	1500 m3	Insignificant.	Sustainably harvested (thin layer) and quantities are small.
4. Planting Bags	Available Year-Round – Purchase in India	1 to 3 million	14 million	Moderate. Aesthetic and fauna strangulation/poisoning once sent to farmer	Collection program by MHV of planting bags from fields
5. Fertilizers and Pesticides	Available Year-Round - Purchase from Bhutan NPPC	1 to 3t of fertilizers and 20 to 40kg of pesticides	13t of fertilizers and 200 kg of pesticides	Serious. Health and safety risks to workers Minor soil and water quality spillage risks.	Separate stores with adequate buffer zone and proper signage and ventilation. Health and Safety training for staff implemented as part of GAP and ISO9001 compliance systems.

Raw Materials Consumed	Source of supply, and seasonal availability	Annual Use	Total Quantity	Pollution Risks	Management Measures
6. Fuel and lubricants	Available Year-Round	6,500 litres to 15,000	60,000 litres	Minor. Soil and water quality risk from spillages. Serious health and safety risks to workers.	Separate stores with adequate buffer zone and proper signage and ventilation. Health and Safety training for staff implemented as part of GAP and ISO9001 compliance systems. Used lubricants collected and used as paint for preserving poles.
7. Electric Power	Available Year-Round through BPC and Company's back-up generator	222,000 kWh	1,1 million kWh	Serious health and safety risks to workers	Proper signage and enclosures for electrical installations. Occupational Health and Safety training for staff implemented as part of GAP and ISO9001 compliance systems.
8. Water	Available Year-Round from river and RNR tributary supply	18,250 m3 to 54,750 m3	182,500 m3	Insignificant. Abstraction rates 50m3 to 100 m3 per day. Insignificant compared to average river flows of >100 m3/s	

d) Other than those identified under c) above, there are no operational failures or accidents liable to cause significantly increased pollution.

e) Nursery will operate 7 days a week with main day shift from 06:00 to 18:00. A smaller night shift will manage house lighting from 18:00 to 06:00 from October to March. Operation of main pollution equipment is indicated in Table below.

f) Nursery is planned to operate until 2015 or until such time as the Company no longer requires the facilities. Facilities will then be handed over to the Research Centre to operate and use for research purposes.

- Orchards

Orchards are the direct responsibility of the farmer. MHV provides training, materials, extension advice and carries out monitoring of farmer performance to ensure that the crop is grown to meet GAP, EUREPGAP and GLOBALGAP standards of safety, sustainability, and traceability.

Pollution Source Number	Pollution Source	Periods of Operation	Type of Pollution	Risk Of Occurrence	Severity of Impact	Management Measure
a.	Planting of trees	May to August	Soil Erosion,	Certain	Minor erosion immediately after planting	Conservation planting method
b.	Plastic planting bags and mulching discs used for planting	May to August	Plastic waste. Aesthetic and fauna strangulation/poisoning	Certain	Moderate aesthetic impairment and fauna mortality	Collection program of planting bags and mulching sheets after year 2 for re-export
c.	Fertilizer use	0 to 2 times a year.	Runoff from fertilized orchards	Certain	Minor. Low volumes compared to other crops	Erosion and runoff will decrease as orchard matures

Pollution Source Number	Pollution Source	Periods of Operation	Type of Pollution	Risk Of Occurrence	Severity of Impact	Management Measure
d.	Pesticide use	Very low intensity. Moving to organic. Possibly 1 application per year	Runoff or wind drift from pesticide applications. Health and safety of farmers.	Certain	Serious	Health and Safety training for farmers. All applied in compliance with GAP, EUREPGAP, GLOBALGAP. Extension advice and monitoring program. All pesticides provided by the Company from NPPC.
e.	Haulage	2-4 trucks per day May to August, 1 truck per day September to March	Noise, Nuisance, Accident Risk	Low	Serious if accidents occur.	Haulage sub-contractors audited by MHV to ensure compliance with health and safety standards.

Raw Material Used	Source of supply, and seasonal availability	Annual Consumption	Total	Pollution Risks	Management Measure
1. Hazelnut Saplings	Nursery May to August	1 to 3 million	13 million	None. Hazelnut is indigenous to Bhutan and is non-GMO.	None
2. Mulching Discs and planting bags	Available Year-Round – Purchase in India	1 to 3 million	13 million	Serious. Aesthetic and Moderate fauna strangulation/poisoning risks	MHV collection and recycling program of planting bags and mulching sheets after year 2.

Raw Material Used	Source of supply, and seasonal availability	Annual Consumption	Total	Pollution Risks	Management Measure
3. Fertilizers and Pesticides	Available Year-Round - Purchase from Bhutan NPPC and local fertilizer suppliers.	Fertilizers 40 to 120t Limited use of pesticides when required. Moving to organic production	50 years of production	Moderate. health and safety risks to farmers. Minor. Soil, water and pollution from runoff or drift	Health and Safety training for farmers. All applied in compliance with GAP, EUREPGAP, GLOBALGAP. Extension advice and monitoring program. All pesticides provided by the Company from NPPC. Fertilizer application rates and methods advised by Company to prevent excessive fertilizer use.

- **Factory**

Site selection for the processing facility is still at the pre-feasibility stage and a report outlining design and operation will be provided for approval as an addendum. Factory in full production will be collecting and processing 40,000 MT of nuts sourced from local farmers.

d. Cleaner production

Low impact technologies and environmental protection measures are presented in the tables describing pollution risks, wastes, and raw materials for nursery and orchards.

Factory cleaner production technologies will be presented as an addendum once designs are finalized.

e. Pollution

- Nursery

None of the pollution sources are significant enough to require detailed emissions calculations.

- Orchards

None of the pollution sources are significant enough to require detailed emissions calculations.

- Factory

Factory emissions will be presented as an addendum once designs are finalized.

f. Waste etc.

- Nursery

Waste	Annual quantities of waste	Method of Disposal	Site of Disposal	Waste stored at site
Fluorescent tubes 32W 4 ft tubes	10	Disposed in waste pit	On site dry hazardous waste disposal pit.	Disposal site clearly marked and registered with authorities. Site selected with adequate buffer zones to prevent drainage into water courses.
Incandescent bulbs 60W	200 to 500	Disposed in waste pit	On site dry hazardous waste disposal pit.	Disposal site clearly marked and registered with authorities. Site selected with adequate buffer zones to prevent

Waste	Annual quantities of waste	Method of Disposal	Site of Disposal	Waste stored at site
				drainage into water courses.
Used pesticide containers plastic	40 to 160 containers	Washed 3 x with water and then disposed in dry hazardous waste pit	On site dry hazardous waste disposal pit.	Disposal site clearly marked and registered with authorities. Site selected with adequate buffer zones to prevent drainage into water courses.
Used lubricants	20-40 litres	Preservative painted on poles	Pole surfaces	Yes coated on poles
Rotten poles (3-5 years for softer poles) and timber	From year 3 50 to 100 poles and 10m ³	Firewood	Worker homes	No
Agro nets and plastic (3 year lifespan)	From year 3 1500 m ² per year	Recycled	Plastic recycling plant to be selected (with plastic bags and mulching discs)	No
Waste wires	10-30 kg	Recycled	Metal recycling contractor to be selected	No
Batteries AA, AAA	100 batteries	Disposed in waste pit	On site dry hazardous waste disposal pit.	Disposal site clearly marked and registered with authorities. Site selected with adequate buffer zones to prevent drainage into water courses.

Waste	Annual quantities of waste	Method of Disposal	Site of Disposal	Waste stored at site
Sewage	10 m3	Approved septic tank contractor	Sewage plant or other approved government site	Residual waste at end of project 10 m3 decompose on site

- Orchards

Waste	Annual quantities of waste	Method of Disposal	Site of Disposal	Waste stored at site
Used pesticide containers plastic	40 to 160 containers	Washed 3 x with water and then disposed in dry hazardous waste pit	On site dry hazardous waste disposal pit.	Disposal site clearly marked and registered with authorities. Site selected with adequate buffer zones to prevent drainage into water courses.
Planting bags and mulching discs (3 year lifespan)	1 to 3 million bags 2011 to 2015 and 1-3 million mulching discs from 2013 to 2017	Recycled	Plastic recycling plant to be selected	Collected and stored at nursery site prior to recycling.

- Factory

Site selection and design of the processing facility is still at the pre-feasibility stage. A description of wastes will be attached as an addendum once designs have progressed to feasibility stage.

g. Pollution control measures

- Nursery

- a) No specific cleaning measures are used other than soap and water.
- b) Pumps and motors are housed in separate specific structures. Site has 4 electric motors in separate buildings and 1x 80kVA generator again in a separate noise reducing housing.
- c) MHV is implementing a preventative maintenance program to identify faults prior to catastrophic failures and ensure that equipment operates efficiently. Ampere load and vibration testing is performed for all motors and pumps. Circuit boards and cabling is monitored with IR cameras to detect shorts and fire hazards

- Orchards

Not applicable

- Factory

Site selection and design of the processing facility is still at the pre-feasibility stage. Pollution control measures will be attached as an addendum once designs have progressed to feasibility stage.

h. In-site control

Terms governing establishment and operation of the plant have yet to be established. MHV is however already adhering to international social and environmental best practices and is implementing an ISO compliant quality management system to document the process and are ready if any specific terms are established or required.

i. Information for the safety evaluation of industrial activities involving major hazards

- Nursery

No major hazards are present at the nursery site.

- Orchards

No major hazards are present in orchards

- Factory

Site selection and design of the processing facility is still at the pre-feasibility stage. Safety evaluation will be attached as an addendum once designs have progressed to feasibility stage.

j. Information on occupational health and safety measures

- Nursery

MHV is already implementing best practice OHS training of its nursery staff in line with GAP, EUREPGAP, GLOBALGAP and Bhutanese standards.

Use of proper protective equipment is mandatory and included in employment contracts.

MHV will perform a full hazards (mechanical, chemical and physiosocial), risks and outcomes assessment of their nursery operations.

The Company is implementing an ISO9001 quality management system to document and record its OHS training and programs and track OHS key performance indicators.

- Orchards

MHV will provide training, materials, extension advice and carry out monitoring of farmer performance to ensure that the crop is grown to meet GAP, EUREPGAP and GLOBAL standards to ensure farmer health and safety. New technologies of GPS tracking and geo-tagging will be used to ensure that works are carried out in a transparent and auditable manner.

The Company is implementing an ISO9001 quality management system to document and record the performance of its outreach, extension and monitoring systems.

- Factory

Site selection for the processing facility is still at the pre-feasibility stage. OHS is an attached as an addendum at the feasibility stage.

k. Information on the cultural and heritage resources

- Nursery

No cultural or heritage sites are located on the site.

- Orchards

All planted on farmers or farmer groups titled fallow or degraded land. No cultural or heritage sites are located on any of the planting sites

- Factory

Site selection for the processing facility is still at the pre-feasibility stage. An assessment of any cultural and heritage sites affected will be attached as an addendum at the feasibility stage.

l. Information on the results of the public consultation program and the concerned people

Nursery

There has been a constant feedback loop and engagement with all key stakeholders especially MoAF and the RNR centre during the selection and development of the nursery which has been leased at no charge by RNR to MHV. In addition, a monthly progress report is presented to MoAF detailing progress on the site.

Orchards

To further ensure that MHV's approach was conceived in accordance with local circumstances and needs, the Company has invested significant time and resources in frequent public consultative meetings with farmer communities throughout Bhutan. Over 40 outreach meeting have been conducted with geog leaderships and farmers to date.

Moreover, MHV's close partnership with all levels of the MoAF, including the leadership and front-line field staff, provides great expertise and manpower during outreach work and ensures that there has been a constant feedback loop and engagement with all key stakeholders.

The tenets of MHV's outreach operations are effective training, constant communication, and collaboration with communities.

MHV's outreach team works with local government officials, MoAF staff, and influential villagers to organize meetings to introduce the Company and hazelnuts to potential growers to:

- Explain contract in detail to ensure clear understanding, then complete grower registration;
- Assess land suitability;
- Provide training through local language materials, videos, and field staff; and
- Promote the Hazelnut Project through media interviews and community influencers.

Factory

Site selection for the processing facility is still at the pre-feasibility stage. Public consultation with all stakeholders will be carried out at the feasibility stage.

m. Benefits to the ecosystem

Hazelnut is an ecologically friendly crop and will have positive impacts on the country's bio-diversity. The Project would begin with little chemical intervention and later aim to fully move towards an organic method of farming. This is in-line with the government's policy of going organic. Hazelnut orchards will assist in the preservation of forests and reduce deforestation for firewood as the matured shoots can be cut for fuelwood. Hazelnut trees will have to be regularly pruned to cut off the older shoots every year from

the seventh year onwards. With almost 500 trees in an acre, pruned shoots could provide for one to one and half tons of fuelwood.

Hazelnut orchards will have positive impact on soil conservation. Soil erosion can be prevented and the organic matter of soil can increase from leaf, wood, and catkins droppings. About 69 percent of the country's population reside in rural areas which are highly susceptible to landslides, soil run-off, and seasonal floods. In certain pockets, intensive land use has caused soil erosion, landslides, and forest degradation, resulting in depletion of soil fertility and overall land degradation. A very clear example of such a situation has been observed in Radhi. The ecosystem services seem disturbed through events of land degradation, which includes loss of top soils, landslides, and flash floods. These events are triggered largely by removal of vegetative cover through deforestation, over-grazing, poor management of agricultural land and water resources, and construction of infrastructure to meet the demands of growing population. While only less than eight percent of the total land is arable, 70 percent of it falls under dry land and on an average a household is cultivating less than two hectares of land to feed the family. The MoAF has taken several initiatives to combat land degradation and is preparing a National Action Plan for land management and the large scale orchards of hazelnut perfectly fits within this plan.

Commercial orchards of hazelnut in fallow and degraded land are bound to have a positive impact on the environment. Firstly, fallow and waste land would be planted which would otherwise remain barren for a number of years. The concept is to reforest barren and fallow areas that would not only keep the surroundings clean and conserve soil but also to generate yearly income for the farming communities and add to the aesthetic beauty of the place.

In a span of about 10 years, 25,000 acres of Bhutan's mountainsides will be dark green, resplendent with 10 million hazelnuts trees, having been transformed from erosion-prone, deforested slopes. MHV will have established close collaborative relationships with local

communities, having provided trees, training, and support programs to ensure productive orchards.

The orchards of hazelnut would bring about these positive environmental impacts:

- Increase in vegetation cover through orchards, soil conservation, and controlled erosion and landslides;
- Conservation and protection of watershed; and
- Decreased pressure on open forest grazing, thereby leading to improved cattle breeding and management.