“OYU TOLGOI” LLC
“UPDATES TO GUNII HOOLOI WATER SUPPLY PIPELINE PROJECT”

SUPPLEMENTARY DETAILED ENVIRONMENTAL IMPACT ASSESSMENT
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One. General description about the project

1.1. Project name

A project to “Updates to Gunii Hooloi water supply pipeline” extended from Gunii Hooloi groundwater resource area to the Oyu Tolgoi copper and gold deposit area.

1.2. Location

Total of 82.2 km long water transmission pipeline which is extended along Gunii Hooloi groundwater resource and Oyu Tolgoi copper and gold deposit area is located in Bayan, Gaviluud and Javkhlant bags of Khanbogd soum, Umnugovi aimag.

1.3. Project proponent

Project proponent: Oyu Tolgoi LLC
State registration number: 9019006110
Registration number: 2657457

1.4. Project implementation reasoning and documents

- During the construction of pipeline to supply water from Gunii Hooloi groundwater resource for the Oyu Tolgoi project’s demands, young saxaul forest called “Khar Zag” was detected (Figure 1). Therefore, Oyu Tolgoi LLC developed a new construction route in order to reach its duty and primes to have minimum adverse environmental impact and submitted the relevant design layout to the Ministry of Nature, Environment and Tourism by following recommendation number 6/4597 received from the MNET in 2011 (Oyu Tolgoi LLC’s document (7717/Env) about conducting General Environmental Impact Assessment submitted to the MNET’s Department of Environment and Natural Resources in November 17, 2011).

- It is concluded that amendments are required to the environmental impact assessment report for the project to construct pipeline to supply water for Oyu Tolgoi project from Gunii Hooloi groundwater resource based on the General Environmental Impact
Assessment conclusions reflected in 6/5432 document of the MNET in December 20, 2011.

- During paleontology study along the first cluster (CTP #1 station’s PB07) of the plant water supply conducted in November 2011, paleontological finding was discovered (figure 2). Therefore, changes have been made to the first cluster according to recommendations given by (Ph.D) Kh. Tsogtbaatar, senior science expert of the Academy of Science’s Paleontological Center, on moving the cluster excavation route for plant water supply CTP #1 station and PB07 cluster from the layer containing paleontological findings and make minor changes to the current design mapping which is in adherence to Mongolian Law on Cultural Heritage Protection’s Article 17.10 stating that it is obligatory to preserve cultural and historical heritages.

Although the General Environmental Impact Assessment conclusions of the MNET did not reflect paleontological heritage issues, but the report includes detailed information. This report was prepared according to General Environmental Impact Assessment conclusions reflected in the MNET’s document 6/5432 as of December 20, 2011; detailed environmental impact assessment guideline and schedule; and conclusions form the paleontological findings exploration conducted in November 2011.
Supplementary Detailed Environmental Impact Assessment Report for Project on “Updates to Gunii Hooloi Water Supply Pipeline”

Figure 1. Update to the second cluster of water transmission pipeline
Figure 2. Update to the first cluster of the water transmission pipeline
1.5. Construction process for the water supply pipeline

The Oyu Tolgoi project water demand will be supplied from Gunii Hooloi groundwater resource. Construction of 82.2 km water pumping pipeline, 35 kW electricity transmission lines, total of 28 production (wells) and 5 standby bores, and centers with water accumulation and dislodging pumps will be completed in two phases. The pipeline construction has started in 2011 and currently the process has reached the first cluster (nearest or fifth cluster to OT site), which enabled water consumption from five wells. The construction is 51 % complete as of December 2012. This includes:

- Regarding the first construction phase, construction of 40 km improved road, 35 kW electricity transmission line, water transmission pipeline until 5th cluster, monitoring wells along the pipeline, and water reserve facility with 400 thousand m³ capacity were completed. Currently reclamation is being implemented for the destroyed land impacted from the construction of these facilities.

- Regarding the second construction phase:
  - Completion of the construction of 35 kW electricity transmission line and improved road of all clusters (until the end of the first cluster)
  - Completion of construction and pump installation for all wells of fifth cluster and signature of water consumption contract according the Water Authority and Khanbogd soum governor’s resolution.
  - Construction of the fourth cluster well is in progress.
  - Pump installation for the fourth cluster wells is in progress.
  - Pump installation for the third cluster wells is in progress.
  - Construction of water transmission pipeline until the second cluster (installation to the ground) is in progress.
  - Completion of drilling for the first and second clusters’ wells. Installation of chimney pipe for groundwater pumping is in progress.
Figure 3. Pipeline to transmit Gunii Hooloi groundwater

Figure 4. First well of fifth cluster in Gunii Hooloi
Figure 5. Electricity transmission line and road along Gunii Hooloi water transmission pipeline

Figure 6. Lagoon
1.6. Project potential

The maximum of 785 l/sec for the project demand will be transferred through water transmission pipeline and the pipeline is capable of transmitting the maximum of 900 l/sec water according to its design. The project water supply system including 238 production and 5 standby bores, 4 reserve wells, emergency water storage pond with 400,000 m$^3$ capacity, break pump pipeline, 35 kW electricity transmission line, and gravel paved road for maintenance service will occupy 1030 ha areas.

1.7. Accomplished works within amendments to the DEIA on the water supply pipeline

This report was prepared according to General Environmental Impact Assessment conclusions reflected in the MNET’s document 6/5432 as of December 20, 2011 and detailed environmental impact assessment guidelines and schedules.

In 2009, Eco Trade LLC has developed Detailed Environmental Impact Assessment for the project to supply water for Oyu Tolgoi project from Gunii Hooloi groundwater resource. Therefore, this report only considers the second cluster where “Khar Zag” young saxaul forest is located and the first cluster (from northwestern side) where paleontological findings were found and their surrounding environmental properties.

The supplementary report for the water supply pipeline was prepared on the basis of field study materials by Nature Friendly LLC conducted in February 2012 and results and materials of the previous reports related with the project.

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1 Detailed Environmental Impact Assessment on “Water supply pipeline project to supply water for Oyu Tolgoi
2 Amendments to the (2005) detailed environmental impact assessment report on Gunii Hooloi’s groundwater resource for Oyu Tolgoi project” developed by JEMP LLC in 2010
1.8. Project implementing area’s current environmental baseline conditions

This part includes photos taken during the environmental field study in February 2012.

Figure 7. Current condition of the water supply pipeline area, February 2012
Two. Environmental impacts and assessment

2.1. Water consideration

2.1.1. Impact to ground and surface water caused by changes to the water transmission pipeline

There is no permanent flow surface water point at the water supply pipeline area, however temporary surface flows and small marsh areas form during precipitation fall. These streams include Kharganat, Ukhaa Zag, Bayan Sukhain, Baga Bulag, and Ikh Bulag Rivers. Water transmission pipeline’s main impact on the ground and surface water is that it crosses temporary flow channels caused by precipitation fall. Table 1 shows the location of temporary flow channels location.

Table 2. Temporary flow channels crossed by water transmission pipeline

<table>
<thead>
<tr>
<th>No</th>
<th>X</th>
<th>Y</th>
<th>Width of river, m</th>
<th>Depth of river, m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>684593.994</td>
<td>4802415.324</td>
<td>4</td>
<td>0.7</td>
</tr>
<tr>
<td>2</td>
<td>684463.878</td>
<td>4802349.669</td>
<td>3.5</td>
<td>1.6</td>
</tr>
<tr>
<td>3</td>
<td>682838.630</td>
<td>4801525.596</td>
<td>7</td>
<td>1.6</td>
</tr>
<tr>
<td>4</td>
<td>682511.317</td>
<td>4801359.447</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>682183.173</td>
<td>4801193.298</td>
<td>6.5</td>
<td>1.2</td>
</tr>
<tr>
<td>6</td>
<td>682088.468</td>
<td>4801145.115</td>
<td>8</td>
<td>1.8</td>
</tr>
<tr>
<td>7</td>
<td>679174.215</td>
<td>4799365.659</td>
<td>200</td>
<td>0.75</td>
</tr>
<tr>
<td>8</td>
<td>677082.387</td>
<td>4797888.741</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>673879.209</td>
<td>4795504.285</td>
<td>350</td>
<td>1.5</td>
</tr>
<tr>
<td>10</td>
<td>670058.292</td>
<td>4791178.007</td>
<td>85</td>
<td>3.2</td>
</tr>
<tr>
<td>11</td>
<td>850376.614</td>
<td>4770619.372</td>
<td>150</td>
<td>0.75</td>
</tr>
<tr>
<td>12</td>
<td>650082.471</td>
<td>4769301.011</td>
<td>15</td>
<td>1.2</td>
</tr>
</tbody>
</table>

The following table shows potential impacts on ground and surface water caused by construction of water transmission pipeline and prevention, mitigation measures, recommendations.

Table 1. Potential impact assessment on ground and surface water caused by construction of water transmission pipeline

<table>
<thead>
<tr>
<th>№</th>
<th>Potential impacts</th>
<th>Recommendations to prevent and eliminate potential impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Potential subsurface ground water pollution by construction materials’ substances’ wash through precipitation or flood water during construction of pipelines</td>
<td>Adjust environment for the construction material storage and transportation without any pollution sources</td>
</tr>
<tr>
<td>2</td>
<td>It is potential to change the location of temporary flow streams and channels.</td>
<td>Reflect the construction of crossroads and channels for allowing flow pass at the surface water flowing intersections</td>
</tr>
<tr>
<td>3</td>
<td>It might have potential impacts on animals and</td>
<td></td>
</tr>
</tbody>
</table>
### Potential impacts and Recommendations

<table>
<thead>
<tr>
<th>№</th>
<th>Potential impacts</th>
<th>Recommendations to prevent and eliminate potential impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>plants fed by temporary flow streams channels</td>
<td>in the construction design and plan for pipeline</td>
</tr>
<tr>
<td></td>
<td>If any damages occur to water reserve pond or pipelines, ground water might spill inefficently and cause flood.</td>
<td>Construction of flood water prevention channels and trenches along the areas containing main pressurized pipelines, maintenance road, water reserve pond, and emergency water pond.</td>
</tr>
</tbody>
</table>

Potential impacts on ground and surface water caused by using the ground water reserve for Oyu Tolgoi copper and gold deposit extraction and production plant process are detailed in Eco Trade LLC’s DEIA on “Project to use Galbryn Gobi and Gunii Hooloi groundwater resource for Oyu Tolgoi project” in 2005 and JEMP LLC’s amendments to potential environmental impact assessment report for using Gunii Hooloi groundwater resource for Oyu Tolgoi project in 2005.

### 2.2. Soil considerations

This chapter shows detailed information about identification of areas for extraction of construction materials required for the construction of water transmission pipeline, extraction volume, and reclamation details.

#### 2.2.1. Construction materials extraction

Construction materials required for the construction of water transmission pipelines will be mined from the local permitted quarries and technical contouring and rehabilitation will be conducted after completion of the pipelines.

#### 2.2.2. Soil properties

Two separate water transmission pipelines (1741 m + 1810 m), one heads to the center of the central water transmission pipeline’s second cluster extending from Gunii Hooloi to Oyu Tolgoi processing plant and the other heads to the central cluster of GHO2-BB06 and GHO2-PB07 ground wells drilled in the north an south east, meet young saxaul forest in its 3551 m route. Therefore, the plan was changed to surround this piece of land with saxaul forest. This strip land is dominated by **semi-desert light brown soil** which is identified by its stable land surface, soil forming minerals type, its depth, sand cover, vegetation cover, soil types such as ordinary, sandy and loose consistent soil classified by particle structures (Figure 8).
Supplementary Detailed Environmental Impact Assessment Report for “Updates to Gunii Hooloi Water Supply Pipeline” project

Figure 8. Soil cover distribution
Based on these soil types distribution, morphological formations, and physical and chemical study results, the soil was defined.

**Semi desert brown soil** is mainly comprised of sandy particles similar to light clayish and located along the areas connecting groundwater wells GHO2-PB06 and GH02-PB07 of the water transmitting pipelines which surround the saxaul forest and led to the second cluster; areas encompassing western of the GH02 – PB07 groundwater well extending from the saxaul forest to the second cluster and Oyu Tolgoi deposit’s central water transmission pipeline (Figure 9), and relatively elevated land higher than filling materials quarry (Figure 10) for the north western road use starting from the GHO2-PB06 ground well. This type of soil distributed around saxaul forest and vast valley with Kharmag hills and sometimes it distributed in mixture with sand cover soil in some parts. The morphological structure records and physical and chemical study for the semi-desert brown soil is shown below.

**Soil Profile OT12(3)-05**  
Sandy brown soil similar to light clayish (Figure 11). Central pipeline area constructed to pipe water to Oyu Tolgoi deposit near water reserve second cluster. It has relative elevation of 970 m. Soil forming minerals is comprised of gravely sand with historic proluvium layered structure located on red moraine of the third era. Almost 60-70% of the soil surface is comprised of sand. If hydrochloric acid is poured on the soil, spurting occurs.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0 – 28(36)</td>
<td>It is dry, pale grey brown colored, firm consistent, contains plant roots, light clayish sand, bright in transmission color, and uneven in transmission margin.</td>
</tr>
<tr>
<td>Bc</td>
<td>28(36) – 70</td>
<td>Pale brown colored, firm consistent, light clayish, extreme in transmission color, wavy margins, and contains pale colored carbonate accumulations.</td>
</tr>
<tr>
<td>C1</td>
<td>70 – 110</td>
<td>Grey brown colored, contains various types of structures such as loose obtuse pebble, dominant in sand composition, and bright in transmission color.</td>
</tr>
<tr>
<td>C2</td>
<td>110 – 150(160)</td>
<td>Uneven stripped carbonate layers, great amount of loose obtuse pebble, firm consistent, sandy, bright in transmission color, and wavy margins.</td>
</tr>
<tr>
<td>C3</td>
<td>150(160) – 190</td>
<td>Grayish yellow colored, medium and tiny particle sand dominant, low in pebble content, and bright in transmission color.</td>
</tr>
<tr>
<td>C4</td>
<td>190 – 225</td>
<td>Dominant in dark grey hued large particled sand, pebble layer with Loose obtuse, extreme in transmission color, and flat in transmission margin.</td>
</tr>
<tr>
<td>D</td>
<td>225 – 260</td>
<td>Bright colored carbonate containing stained accumulation and redish brown colored particles.</td>
</tr>
</tbody>
</table>
Soil morphological structure recording and soil particles’ laboratory study results show that the fertile soil layer is comprised of multi-particle sand fractions (1-0.05 mm) 78.5-80.4%. This indicates that physical clay (<0.01 mm) number indicator is sandy soil similar to light clay (19.1-19.5%). However, soil forming minerals (prollevium layered structured gravelly
sand) moraine contains low clay content (4.9-11.2%) according to its physical content and there are whitish grey stains with high carbonate clay within the red brown colored sandy moraine located 225 cm beneath the above. Regarding its soil chemical feature, the soil’s fertile layer has low humus content (0.29-0.35%), low in mobile fertile substances in plants (P₂O₅ and K₂O), even layers above the ground moraine, low in carbonate, and even reaction for all layers, high alkaline (pH 8.82-9.57).

Figure 11. Filling material quarry with grey brown soil near GHO2- PBO6 groundwater area

Figure 12. Sandy brown colored soil of the second cluster surrounding the saxaul forest
Table 2. Main physical and chemical feature of the soil

<table>
<thead>
<tr>
<th>Depth of soil stratum, cm</th>
<th>Mechanic particles, % (Particle size, mm)</th>
<th>Humus, %</th>
<th>CO₂ %</th>
<th>pH</th>
<th>Mobile nutritious substance, mg/100 gr soil</th>
<th>P₂O₅</th>
<th>K₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-0.25</td>
<td>0.25-0.05</td>
<td>0.05-0.01</td>
<td>0.01-0.005</td>
<td>0.005-0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>A 0 - 10</td>
<td>16.6</td>
<td>63.8</td>
<td>0.5</td>
<td>6.7</td>
<td>4.8</td>
<td>7.5</td>
<td>19.1</td>
</tr>
<tr>
<td>A 18 - 28</td>
<td>18.2</td>
<td>60.3</td>
<td>2.0</td>
<td>5.9</td>
<td>4.3</td>
<td>9.3</td>
<td>19.5</td>
</tr>
<tr>
<td>B₄ 40 - 50</td>
<td>18.6</td>
<td>56.8</td>
<td>1.1</td>
<td>4.8</td>
<td>7.1</td>
<td>11.6</td>
<td>23.5</td>
</tr>
<tr>
<td>C₁ 80 - 90</td>
<td>58.4</td>
<td>30.2</td>
<td>1.3</td>
<td>2.1</td>
<td>1.0</td>
<td>7.0</td>
<td>10.1</td>
</tr>
<tr>
<td>C₁ 1.7 - 1.8</td>
<td>45.2</td>
<td>43.4</td>
<td>0.2</td>
<td>3.6</td>
<td>2.3</td>
<td>5.4</td>
<td>11.2</td>
</tr>
<tr>
<td>C₂ 2.0 - 2.1</td>
<td>79.2</td>
<td>7.7</td>
<td>8.3</td>
<td>0.2</td>
<td>1.7</td>
<td>3.0</td>
<td>4.9</td>
</tr>
<tr>
<td>D 2.4 - 2.5</td>
<td>16.6</td>
<td>20.6</td>
<td>43.5</td>
<td>10.0</td>
<td>3.4</td>
<td>5.9</td>
<td>19.3</td>
</tr>
<tr>
<td>Carbonate strains</td>
<td>8.8</td>
<td>26.3</td>
<td>11.8</td>
<td>7.4</td>
<td>16.3</td>
<td>29.3</td>
<td>53.0</td>
</tr>
<tr>
<td>Profile 12(3) - 05, Sandy grey brown soil similar to light clay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Profile 12(3) - 06, Sandy brown soil (Figure 13). Kharmag hilly area located near the saxaul forest and GH02-PB06 groundwater well of the second water accumulating cluster. Its relative elevation is 9701 m. The soil formation moraine is proluvium layered structured pebbly sand. If hydrochloric acid is poured, all layers might react by spurting.

A0- 20(27) cm Pale brown colored, dry, contains roots along the Kharmag bushes, small pebble rocks (15-20% layer volume), loose consistent sand, and bright in transmission color.

B₄ 20(27)-44 cm More bright colored than the top layer, dry, contains unevenly distributed thin roots, scarce pebble stones, firm consistent sandy, bright in transmission color, and uneven transmission margin.

B₄ C44 - 70 cm Pale grey brown colored, some parts are grey yellow colored, contains 30-40% pebble stones with multi-sized obtuse pebbles, firm consistent sandy, and bright in transmission color.

C₄ 70 - 100 cm Contains bright white colored, carbonate filling materials, contains pebble stones similar to the above layer, layered, firm consistent, and sandy.
Figure 13. Water transmission pipeline’s Kharmag hilly area with sandy brown soil

Figure 14. Profile of semi-desert sandy brown soil
According to soil particle study results, sand fraction with various particles (1-0.05 mm) occupies the majority (72.7-86.4%) until 44 cm, and it is only 7.6-9.4% according to its physical clayish numerical indicator and this type of soil belongs to “consistent sand” classification. Kharmagyn hill’s top layer soil is low in carbonate and humus content (0.17-0.19%), however humus carbonate content increases beneath 50 cm to 2.7-4.8% and its reaction condition (9pH 8.02-8.71) is determined by interval number from (alkaline to extremely alkaline intervals). This sandy soil has low content of mobile nutritious substances contained in plants.

2.2.3. Soil ecological and economic assessment

In order to conduct soil ecological and economic assessment, it follows Methodology to environmental damage assessment and compensation (2010) which uses soil layers dominant in the area, humus layer thickness, particle content, humus amount, stone and carbonate content, and soil consistence detonation as main indicators. Construction of channels with deep excavated trenches occupies total of 4.2 km strip area which includes the areas connecting groundwater wells GHO2-PB06 and GH02-PB07 of the water transmitting pipelines which surround the saxaul forest and led to the second water accumulation cluster; areas encompassing western of the GH02 – PB07 groundwater well extending from the saxaul forest. It is estimated that average of 10 m wide area or 4.20 hectares will be subject to soil degradation and damage including topsoil areas oppressed by temporary dirt stockpiling along the two sides of the trench for later reclamation and areas under technical influence. According to soil recordings and analysis, 0.55 he strip areas will be soil removed along its trench margins (1.3 m) and 20 cm of topsoil removal is possible. This topsoil or upper layer soil will be used for reclamation purpose after construction of the pipelines and trench burying. Based on the collected materials and laboratory analysis conclusions conducted in the soil samplings, which conforms to the above-mentioned methodology, the following table shows commonly distributed soil features for the water transmission pipeline’s strip area.
Supplementary Detailed Environmental Impact Assessment Report for
“Updates to Gunii Hooloi Water Supply Pipeline” project

Table 3. Soil features

<table>
<thead>
<tr>
<th>Soil</th>
<th>Soil layer</th>
<th>Thickness, cm</th>
<th>Rock particles, %</th>
<th>Particle structure</th>
<th>CaCO3, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy, greyish brown</td>
<td>A</td>
<td>28</td>
<td>10</td>
<td>Sandy</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>Bk</td>
<td>42</td>
<td>10</td>
<td></td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>40</td>
<td>25</td>
<td></td>
<td>3.6</td>
</tr>
<tr>
<td>Sandy brown</td>
<td>A</td>
<td>20</td>
<td>15</td>
<td>Sandy</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>Bk</td>
<td>24</td>
<td>10</td>
<td></td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>BkC</td>
<td>26</td>
<td>40</td>
<td></td>
<td>6.1</td>
</tr>
</tbody>
</table>

Table 4. Soil humus reserve

<table>
<thead>
<tr>
<th>Soil</th>
<th>Soil layer</th>
<th>Thickness, cm</th>
<th>Humus,%</th>
<th>Volume, g/cm³</th>
<th>Humus reserve, t/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy</td>
<td>A</td>
<td>20</td>
<td>0.32</td>
<td>1.5</td>
<td>9.6</td>
</tr>
<tr>
<td>Sandy brown</td>
<td>A</td>
<td>10</td>
<td>0.17</td>
<td>1.6</td>
<td>2.7</td>
</tr>
</tbody>
</table>

In order to conduct ecological and economic assessment of soil, the soil humus reserve was estimated by considering water transmission pipeline area’s humus portion, fertile layer consistence, fertile layer thickness of the greyish brown soil distributed along 4.20 ha area with sandy structure similar to light clay as the main background indicators. Estimation of soil humus reserve concludes that multiplier correction factor for the soil varies differently depending on the soil classifications. This correction coefficient is 1.0 for greyish brown soil. Although the assessment methodology manual does not contain correction coefficient for sand soil classification, but we select 0.6 coefficients considering structural component of the soil properties in the book.

In order to produce soil ecological and economic assessment, geographic factors and soil properties correction coefficient are used and these coefficient are concluded with each soil type. Fertile layer of the sandy brown soil is thin in humus amount and comprised of loose sand. Therefore correction coefficient is considered only for comparing it to sandy and greyish brown colored soil.

Table 5. Correction factor for geographic factors

<table>
<thead>
<tr>
<th>Soil</th>
<th>Slope</th>
<th>Trench consistence</th>
<th>Vegetation cover</th>
<th>Micro cover</th>
<th>Sand cover</th>
<th>Soil moisture</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy greyish brown</td>
<td>1</td>
<td>1</td>
<td>0.7</td>
<td>1</td>
<td>0.9</td>
<td>0.3</td>
<td>0.82</td>
</tr>
<tr>
<td>Sandy brown</td>
<td>1</td>
<td>1</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.3</td>
<td>0.83</td>
</tr>
</tbody>
</table>
Table 6. Correction factor for soil properties

<table>
<thead>
<tr>
<th>Soil</th>
<th>Soil rock particles</th>
<th>Particle structure</th>
<th>Salinity</th>
<th>Carbonate detecting depth</th>
<th>Movable potassium</th>
<th>Reaction condition</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy greyish brown</td>
<td>0.9</td>
<td>0.8</td>
<td>0.9</td>
<td>0.5</td>
<td>1</td>
<td>0.8</td>
<td>0.82</td>
</tr>
<tr>
<td>Sandy brown</td>
<td>0.9</td>
<td>0.6</td>
<td>1</td>
<td>0.7</td>
<td>1</td>
<td>0.9</td>
<td>0.85</td>
</tr>
</tbody>
</table>

According to humus reserve assessment methodology which was based on potential fertile layer thickness and multiplied by geographic and soil properties, the ecological and economic assessment of the impacted soil caused by construction of water water transmission pipeline concludes that 27.2 tons of humus substance loss will occur at 4.2 ha areas which equals to 7.507 million tugrug for the total area by multiplying the baseline price for one kg humus (276 tugrug as of 2010). This is shown in the following table and the result is correlated with low amount of humus reserve for the region.

Table 7. Ecological and economic assessment along the changed water transmission pipeline

<table>
<thead>
<tr>
<th>Soil</th>
<th>Destroy rate</th>
<th>Area to be destroyed, ha</th>
<th>Humus reserve loss, tons</th>
<th>Humus reserve loss (corrected), tons</th>
<th>Assessment, thousand tugrug</th>
<th>1 ha soil value, thousand tugrug</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy, greyish brown</td>
<td>Medium</td>
<td>3.65</td>
<td>35.0</td>
<td>23.6</td>
<td>65136</td>
<td>1784</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>0.55</td>
<td>5.3</td>
<td>3.6</td>
<td>9936</td>
<td>1806</td>
</tr>
<tr>
<td>Amount</td>
<td></td>
<td>4.20</td>
<td>27.2</td>
<td>75072</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.2.4. Reclamation work

Reclamation for the water transmission pipeline will adhere to the following standards and norms.

Table 8. Reclamation standard and norm

<table>
<thead>
<tr>
<th>№</th>
<th>Standard name</th>
<th>Note</th>
<th>About</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reclamation for the degraded land. Terminologies and definitions.</td>
<td>MNS 5914:2008</td>
<td>The purpose is to have terms and terminologies related with degraded land reclamation issues caused by industrial operations</td>
</tr>
<tr>
<td>2</td>
<td>Degraded land classification according to mining operation</td>
<td>MNS 5915:2008</td>
<td>It refers to develop and conduct reclamation plan for degraded land from mining activities.</td>
</tr>
<tr>
<td>3</td>
<td>Fertile soil stripping and storing during earthwork</td>
<td>MNS 5916:2008</td>
<td>It belongs to fertile soil stripping and storing during mining, construction, and earthwork and development of industrial and mining economic baselines and projects.</td>
</tr>
<tr>
<td>4</td>
<td>Degraded land reclamation caused by minerals operation. General technical requirement.</td>
<td>MNS 5917:2008</td>
<td>It belongs to the completion of reclamation work during the extraction and exploration of minerals.</td>
</tr>
<tr>
<td>5</td>
<td>Rehabilitation of degraded land. General technical requirement.</td>
<td>MNS 5918:2008</td>
<td>Define the general requirement to rehabilitate the degraded land.</td>
</tr>
</tbody>
</table>

Reclamation guidelines for using the destroyed land

Due to the land soil properties, reclamation for agricultural and saxaul forest favor is most efficient for both reclamation and reclaimed land use purpose for degraded land impacted by construction of water transmission pipeline. This part includes measures for this type of reclamation.

**Technical reclamation:** Technical reclamation activities include removing equipment and tools located at the land for reclamation, clear the land through cleaning the wastes, conduct contouring for the alcove and concave areas, holes, areas where construction used to be and prepare the land for the future operational purpose.

**Area for reclamation:** Water transmission central pipeline from Gunii Hooloi groundwater resource to Oyu Tolgoi licensed area is 82.2 km long. The preliminary study concludes that 153.8 ha areas will be impacted by the construction of the water supply pipeline. This 152.8 ha areas include lagoon area, main and branch water transmission pipeline area, and
maintenance road. Reclamation for these areas differs according to the previous land use types and the following table shows the relevant reclamation works.

**Biological reclamation:** Firstly, annual plant seeds will be planted and then perennial plant seeds will be planted. The following recommendations are proper for the biological reclamation activities:

- Biological reclamation will be conducted by relevant specialized agencies and experts.
- Preparation of trenches or holes for planting perennial plants.
- In addition to local plant reserve, select local plant with strong growth speed for the main reclamation plant seeds.
- Pastureland perennial plants are most appropriate for reclaiming the degraded land because perennial plants roots have good development and adjust to the environment which are the main difference form other plants. It is important for distributing roots along the land surface.

**Table 9. Plant species and trees to be used for reclamation according to natural regions and zonings**

<table>
<thead>
<tr>
<th>Geographical zones</th>
<th>Main plants, perennial Gramineae</th>
<th>Cape plant (yealing, non-perennial)</th>
<th>Trees</th>
<th>Bushes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desert region</td>
<td>Desert steppe</td>
<td>Elymus Wheatgrass Feather grass Lenensis Daagansuul</td>
<td>Alfalfa Clover Caragana</td>
<td>Oat Budargana Colza Sudan grass Chenopodium</td>
</tr>
<tr>
<td>Desert region</td>
<td>Steppe desert Real desert</td>
<td>Stipa, grassy plant</td>
<td>Caragana</td>
<td>Budargana Chenopodium</td>
</tr>
</tbody>
</table>

- Sample various types of fertilizer in various conditions in order to improve soil fertility, make biological reclamation efficient with soil specialist’s support, and select the most efficient method for reclamation work.
Plantation of seeds at the reclamation area requires manual or technical work. During manual planting, it is important to distribute the seeds evenly and bury them after seeds are developed. Regarding technical plantation, it is important not to exceed the depth of the seed placement more than 3 cm and select the plantation line in the local horizontal wind direction. If the plant roots, clusters, or branches are used for the plantation, a method for trenches and holes preparation is used and direction of these trenches and holes should be located along the the crosscutting wind and stream flow.

After planting, it is important to water the plants for the reclamation area until they became capable of growing independently. Watering is used to balance the soil moisture for the initial reclamation years depending on the land slope and contouring.

The main requirement for biological reclamation is to improve the reclamation similar to former natural vegetation cover. In order to do this, the vegetation type used for the reclamation purpose must meet the vegetation cover formation within 50 km radius of the territory.

Saxaul tree is the only tree which forms forest in Gobi and desert region. Saxaul is a beneficial plant which prevents soil degradation and balances sand movement. The local saxaul magnolia is proper for reclamation work.

**Magnolia seed preparation**

- Saxaul magnolia is proper for gathering from mid October to November.
- Fabric should be carpeted surrounding the saxaul tree leafstalk and magnolia should be collected by vibrating or shaking by hand or rod without damaging or cutting tree branches.
- Label the bag containing magnolia with the location and date collected.
- It is proper to engage local community for the magnolia seed collecting work.
- 15-16% net seeds will be gathered by the above mentioned seed collection method.
- Magnoglia will be spread 10-15 cm thick in shady area and dry them in the wind until no moist can be felt if they are clasped.
- Dried seeds will be bagged by 10-15 kg which will be thwacked prior to being removed from the fan.
- Seeds split off from the fan will be sieved. If the sieved seeds have any other components, then it will be ladled up and poured back on 1 m high shelter to remove the wings through wind blow.

 Seed storage
- Stored seeds are required to be cleaned.
- One year stored seeds will be dried without moisture and bagged in plastic bag and stored in shaded area.
- Seeds to be stored 2-3 years will be dried until they are left with 3.5-5.5% moisture and stored in jarred bottle.
- Label the seed bags with locations and dates which are going to be stored.

 Soil development
- The area for saxaul seed plantation must have light, loose consistent, and sandy soil.
- The area for saxaul seed plantation will be cultivated 25-30 cm deep and will be developed through manual tools or harrowed.

 Seed planting period
Seeds can be planted from mid April to May 10 for desert region and from end of April to mid May for steppe region.

 Seed planting norm
- First class seeds will be planted with 3 gram for one meter long line (laboratory intergrowth will be more than 75%)
- The second class seeds will be planted with 4.5 gram (laboratory intergrowth is 65-75%)
- The seeds will be planted in 0.5-1.0 m.

 Watering norm
- Seeds planted and placed shallow in soil must be watered gently by sprinkler. Saxaul seed shell will soften and stretched within 36 hours. If seeds which have become softened and stretched are dried out, then they became incapable of spurting therefore it is important not to dry their surface until they are fully spurted. If spurting starts, then the watering can be delayed by day.
- 7 days from seed plantation to seed germination.
- 4-5 days from germination to growth start.
- 8-10 days from active growth to stabilization.

**Methodology**

- The planted saxaul must be fenced 4-5 years in order to be protected from cattle. During their growth period, weeds must be destroyed 2-3 times and soil scarifying must be conducted. The planted saxaul must be protected from cattle during its initial 4-5 years.

**Figure 15. Scheme for forestation through saxaul seeds in Gobi desert region**

Monitor for the reclamation: Reclamation work will be conducted timely once the construction of the water transmission pipeline starts. Also reclamation results’ monitoring will be conducted at the same time. Oyu Tolgoi LLC will conduct technical and biological reclamation after its operation at the land and return the land to the local community.

General requirements for the reclamation results
- The reclaimed vegetation cover of the reclaimed land must equal to 60% of the area’s vegetation cover.
- Reclaimed land’s vegetation cover’s animal species must equal to 30% of the area’s species general structure.
- If weed plant covering percentage of the reclaimed land reaches 25% then the reclaimed land can be left for natural growth.
- After the completion of reclamation, monitoring must be conducted for 5 years period. Monitoring must be conducted 2.5 years at the monitoring sites which can be extended up to 6-10 years if necessary.

**2.2.4. Environmentally friendly measures and its costs estimation to dispose waste related with vehicles, techniques, domestic liquids and solid waste without polluting the soil during the construction of new water supply pipeline techniques and technologies**

The following table shows measures and recommendations to eliminate and mitigate potential impacts from soil pollution caused by lubricant and flammable wastes and domestic liquid and solid wastes during the construction of water supply techniques and technologies.

<table>
<thead>
<tr>
<th>Potential impacts</th>
<th>Measures to mitigate and eliminate adverse impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential soil pollution caused by dropping trashes such as paper, food wastes,</td>
<td>- Conduct collecting, classifying, and transporting solid wastes activities according to Law on “Industrial and</td>
</tr>
<tr>
<td>and plastic bags, glasses from temporary employees camp and temporary works.</td>
<td>Domestic Wastes”</td>
</tr>
<tr>
<td></td>
<td>- Classify, place, and label waste bins where it is possible to conduct waste classification at the most</td>
</tr>
<tr>
<td></td>
<td>appropriate area for waste disposal on the pipeline maintenance route.</td>
</tr>
<tr>
<td></td>
<td>- Hazardous wastes</td>
</tr>
<tr>
<td></td>
<td>- Second raw material /tree, plastic, glass cans/</td>
</tr>
<tr>
<td></td>
<td>- Food residuals etc</td>
</tr>
<tr>
<td></td>
<td>- Establish waste disposal areas along the pipelines</td>
</tr>
<tr>
<td></td>
<td>- Provide waste bags to the temporary employees and give guidelines and recommendations to warn not to</td>
</tr>
<tr>
<td></td>
<td>dispose wastes in open area.</td>
</tr>
<tr>
<td>Soil pollution for the temporary waste disposal site during construction work</td>
<td>Constant cleaning for waste disposed soil and conduct reclamation measures.</td>
</tr>
<tr>
<td>Insect persisting and disease contamination caused by lack of disinfection and</td>
<td>- Conduct disinfection and decontamination at the waste disposal sites on regular basis, store the waste</td>
</tr>
<tr>
<td>decontamination at waste disposal sites and lack of waste</td>
<td>within special purpose containers, and dispose it on the planned site.</td>
</tr>
<tr>
<td></td>
<td>- Adhere to the relevant health and hygiene</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>disposal on time</th>
<th>requirements and standards</th>
</tr>
</thead>
</table>
| Environmental pollution caused by waste blow or spill during waste transportation and disposal at the waste site. | - Transport and dispose the waste according to the waste site capacity and space.  
- Transport the waste with sealed truck and cover the truck if it is open.  
- Construct fences and protection surrounding the central waste disposal site. Wastes must be gathered together to decrease its territory on regular basis.  
- Conduct monitoring on waste disposal and seed opportunities to eliminate and reused wastes. |

| Potential soil pollution caused by formation of hazardous substances such as old tires, cleaning substances, oils and lubricating materials used for the equipment during the construction of water transmission pipeline. | Oil and lubricating containers, cleaning substances, iron residuals, and tools such as tires must be gathered together to be disposed to the central waste disposal site. |

| Potential soil pollution caused by lube and lubricating materials spill form machines and equipment. | - Inspection, maintenance for the equipment and tools must be conducted at the dedicated sites on regular basis during the construction.  
- Prioritize to take maintenance and inspection services from the settled areas and ensure technical safety.  
- Conduct training and provide guidelines for the employees who work closely with the techniques about measure to be taken during lube and lubricating materials spill |

The following table shows measures to dispose wastes without environmental damage and its required budget.

**Table 11. Costs to eliminate and minimize waste during the construction of pipelines**

<table>
<thead>
<tr>
<th>№</th>
<th>Planned activities</th>
<th>Period</th>
<th>Costs, tugrug</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Classify and dispose the wastes</td>
<td>Constant</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Assemble the wastes to be disposed at the central waste disposing site</td>
<td>7 days</td>
<td>100 000</td>
</tr>
<tr>
<td>3</td>
<td>Bury and incinerate the wastes</td>
<td>Month</td>
<td>50 000</td>
</tr>
<tr>
<td>4</td>
<td>Conduct decontamination for the waste sites</td>
<td>14 days</td>
<td>50 000</td>
</tr>
<tr>
<td>5</td>
<td>Protect and fence the temporary waste storage sites in order to prevent wastes to spread by wind effect</td>
<td>Monthly</td>
<td>20 000</td>
</tr>
</tbody>
</table>
2.3. Plants and saxaul forest considerations

2.3.1. Defining plant species and distribution of subject or potential project influence, identify whether they are categorized as rare or extremely rare, take measures to protect and transplant if they are to be influenced, and plant the costs related

Vegetation population is Hillock Anabasis L desert

Here the vegetation cover is 20 cm and its height is 12 cm which makes the ground with color green in summer. Last year (2010)’s summer was great with yearling Aristida heymanii growth. Aristida heymanii sedge remained a lot, which makes the land color greyish during chilly seasons. Lots of sinus of yielding plants formed last year. This area’s vegetation cover becomes perfect pastureland for cattle, chamois, and wild horses. Bushes and bushy plants along the new pipeline route:

1. Haloxylon ammodendron
2. Convolvulus fruticosa
3. Brachanthemum gobicum
4. Artemisia xerophytica
5. Oxytropis aciphylla
6. Anabasis brevifolia
7. Ajania achilloides

Perennial grassy plants:

1. Cleistogenes soongarica
2. Allium mongolicum
3. Allium polyrrhizum
4. Scorzonera divaricata
5. Dontostemon sinilis
6. Piganium nigellastrum
7. Convolvulus ammanii

Yielding species plant:

1. Aristida heymannii
2. Bassia dasyphylla
3. Halogeton glomeratus
4. Salsola pestefera
5. Salsola collina
6. Artemisia scoparia
7. Erodium tibetanum
8. Corispermum mongolica
9. Euphorbia humifisa
10. Eragrostis minor
11. Trebulus terestis
12. Ennopogon borialis were registered during the study.

Common distribution of rare plants:
1. Oxytropis aciphylla and
2. Brachanthenum gobicum grow.

2.3.2. Conduct detailed study and analysis on distribution, regrowth, and protection of saxaul forest which is newly grown or under project influence

The project adopted its initial design, which is to pump water from saxaul forest, and Gunii Hooloi to Oyu Tolgoi project and the second water accumulation center which is capable of pumping water from its four directions. Pipeline GHO2-PBO7 in the east direction crossed total of 3551 m areas including 1820 m saxaul forest and GHO2-PB06 pipeline’s 1741 m areas. Therefore decision to encircle the saxaul forest by connecting the above wells was made in order to protect the saxaul forest.

It passes through 203 m area encircling the saxaul forest which connects the two ends’ lines, line GHO2-PB07 (697436mE/4808530mN) in the eastern direction and line GHO2-PB06 (696004mE/4813515mN) in the north eastern. We conducted study for counting and study for 25 * 4 m area and the results show that there are 45 young individual along 100 m² area.

If we consider that the average width of the area crossed by water and electric transmission lines is 8 m then total of 731 saxaul individual will be influenced in the east part. Total of 12784 young saxaul trees would have been influenced if the project implements its first
initial design to place the lines in straight direction. As a result of choosing the second design, total of 12053 young saxaul trees which is 17.5 times more than the actually impacted saxaul were saved. Thousands of young saxaul trees from Nariin zag Saxaul Forest were saved because of complying with the local community’s comments and laws. The following pictures show areas with and without saxaul forest according to study conducted as of February 2012.

Figure 16. Valley without saxaul forest, Feb 2012

Figure 17. Valley with young saxaul forest
2.3.3. Ecological and economic assessment of saxaul forest

We conducted study for counting and study for 25 * 4 m area and the results show that there are 45 young individual along 100 m² area near the second water collection center for the water transmission pipeline from Gunii Hooloi groundwater resource to Oyu Tolgoi project.

If we consider that the average width of the area crossed by water and electric transmission lines is 8 m then total of 731 saxaul individual will be influenced in the east wing. Total of 12784 young saxaul trees would have been influenced if the project implements its first initial designing to place the lines in straight direction. As a result of choosing the second design, total of 12053 young saxaul trees which is 17.5 times more than the actually impacted saxaul were saved.³

Ecological and economic assessment for these 12784 young saxaul individuals occupy 2.8409 ha area is:

If we consider that the saxaul forest belongs to the first zone of forest fee, 0.7 m³ and 1m³ saxaul trees value is 90000 tugrug for 1 he areas which is based on forest taxation’s average indication:

\[
2.8409 \text{ha} \times 3210 + 2.8409 \times 0.7 \text{m}^3 \times 90000 = 9119.29 + 178976.7 = 188095.99 = 188.1 \text{thousand tugrug.}
\]

2.4. Climate considerations

2.4.1. Identify the meteorological changes to the environment and its potential impacts on the normal operations of the project and water pipeline techniques

Climate and meteorological conditions and changes of the area planned for water transmission pipeline construction were studied by on using information from Umnugovi aimag Meteorological and Environmental Monitoring Center, data from Khanbogd soum agricultural and meteorological station (three times per day), temperature and precipitation perennial observation between 1979-2010 in order to define meteorological changes. Graphics, diagrams, and recordings were developed as a result.

³Assessment: OT LLC, Plant specialist J. Sanjid
Khanbogd soum climate

**Sunlight:** The average monthly sunray sum is 224 – 240 hours in winter and 320 – 330 hours in summer based on considering the sunlight balance between 43 and 45 of the northern latitude. The annual average is 3200 – 3400 hours. The daily average is 7.2 – 8.2 hours during winter and 9.8 – 10.1 hours during summer. The highest solar radiation of 5000 – 5500 mJ/m² in the horizontal direction and 3500 – 3600 mJ/m² in direct way occur in May. Daily incoming sunlight is 190 mJ/m² during December and 650 – 690 mJ/m² during May and June.

**Atmospheric temperature:** Temperature fluctuation is high during winter and summer season, which has evident annual and daily process too. Average atmospheric temperature is 7.5°C in Khanbogd soum during 1979 – 2010 (Figure 18). The following table shows average annual temperature process. The maximum atmospheric temperature is in July (24.9°C) and the minimum value is in January (11.5°C).

![Figure 18. Annual average temperature process 1979-2010](image)

The Figure 19 shows perennial atmospheric temperature changes.
Atmospheric temperature between 1979 and 2010 shows increasing trend. The coldest is 5.9°C in 1984 and 9.2°C in 2007. The Figure 19 shows the lowest value in blackish green color and the maximum value in red color.

Soil temperature:
Average annual temperature for the top soil layer is +8.8°C which decreases only during winter months. The average soil temperature is – 3.6°C and -13.2°C during November and February and + 0.3°C and 29°C during March and December (G. Namkhajantsan, 2002). The soil surface layer reaches +65°C during hot summer months. The minimum soil surface temperature reaches - 37°C during winter days with snow cover. Soil freezing is common during November and March. The average seasonal freezing occurs during November and March. The average freezing depth and period are different during cold winter months. The average depth of seasonal freezing:
- Clayish soil 1.5 m
- Sandy soil 1.9 m
- Gravely soil 2.2 m
Freezing depth varies according to moisture content but it does not exceed 2 m.
Atmospheric humidity and precipitation:

This region belongs to dry and warm region with low precipitation fall and its relative atmospheric moisture is less than 40%. Nearly 10 days in winter and more than 10 days in summer has less than 30% relative atmospheric moisture. During 1979 – 2010 average, Khanbogd soum received 64.1 mm precipitation. The maximum precipitation value (27.2 mm) occurs in August and the minimum value (0.9 mm) occurs in December. The figure 20 shows annual precipitation distribution.

Figure 20. Annual precipitation distribution, 1979-2010

Annual total amount of precipitation has increasing trend between 1979 and 2010. In 1982, the minimum precipitation fall (38.1 mm) occured in 1982 and the maximum precipitation of 194.3 mm occurred in 2003. The figure 21 shows the higests values in red and the lowest values in black green color.
Wind regime:
The wind direction is north and northwest similar to other parts of the country. The average wind speed is 4.2 m/sec. The wind speed exceeds its average value during March – May and November – December. Figure 22 shows annual wind process.

Figure 21. Perennial precipitation changes

Figure 22. Annual wind process
30 -40 days have more than 15 m/sec wind, 70-90 days have windstorm, and less than 5 days have snowstorm. The highest wind speed reached 40 m/sec. Similar to other parts of the country; spring months experience the highest wind velocity. During the construction and utilization of water transmission pipeline, there will be no impact on climate. However, the following potential impacts occur caused by climatic factors:

Table 12. Potential impacts caused by construction and use of water transmission pipeline resulting from climatic factors

<table>
<thead>
<tr>
<th>Potential impacts</th>
<th>Recommendations to mitigate and eliminate potential impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the climatic factors were erroneously calculated during the construction of facilities, it will impact the future activities and the system will not work to its full capacity. This leads to erosion and damage.</td>
<td>- Reflect climate factors on the engineering infrastructure.</td>
</tr>
<tr>
<td></td>
<td>- Conduct constant monitoring on climate factors, prevent risks, use aimag and soum meteorological stations and guardians perennial data, and cooperate together.</td>
</tr>
<tr>
<td>Potential delay on the planned schedule caused by disturbance on the construction of water transmission pipeline resulting from atmospheric temperature fluctuations and climate danger</td>
<td>Reflect considerations of idleness and difficulties caused by climate factors’</td>
</tr>
<tr>
<td>Dust arousal during spring earthwork might influence on employees health at workplace.</td>
<td>- Avoid from earthwork during spring (dusty) season.</td>
</tr>
<tr>
<td></td>
<td>- Provide occupational safety clothes and equipment to employees.</td>
</tr>
<tr>
<td>Potential formation of damage or crack for roads before their due date caused by high temperature fluctuations such as condensing during winter and extending during summer.</td>
<td>Conduct small scale meteorological measures along water transmission pipeline.</td>
</tr>
<tr>
<td>Facilities quality degrades earlier than the schedule date and loss of normal operation due to sudden climate disasters</td>
<td>- Consider climate factors when calculating the lifespan of the facility</td>
</tr>
<tr>
<td></td>
<td>- Conduct constant monitoring on the normal operation of the facility</td>
</tr>
<tr>
<td></td>
<td>- Conduct maintenance according to the plan.</td>
</tr>
<tr>
<td>Potential damage and degradation of the equipment due to sudden climate disasters.</td>
<td>Take measures to prevent climate disasters</td>
</tr>
</tbody>
</table>
2.5. Cultural heritage considerations

Paleontological finding was found in the direction of trench digging along the first cluster of the plant water supply during paleontological study in November, 2011 (CTP #1 station’s PB07). Paleontological exploration for 2-4 km area along the two sides of the pipeline was conducted during the field study. The exploration was quite detailed especially in areas where dinosaur eggs and paleontological findings were previously discovered. All exposed items were thoroughly checked.

Figure 23. Study process along the water transmission pipeline

The northern border area of the water transmission pipeline form Gunii Hooloi or the first cluster (GH01) and some of its bores areas belong to protection zone for Paleontological immobile heritage area. This area used to be called Urulbe well of Tserdiin Bayanshiree age. Paleontological discovery territory belongs to historical and cultural heritage under

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4Paleontological study report for the infrastructure area of Oyu Tolgoi project, Science Academy, Paleontological Center, 2011
Mongolian state protection. The Urulbe finding belongs to list of historical and cultural immobile heritage\(^5\) according to Government resolution number 175 in 2008. Therefore, changes have been made to the first cluster according to recommendations given by (Ph.D) Kh. Tsogtbaatar, senior science expert of the Academy of Science’s Paleontological Center, on moving the cluster excavation route for plant water supply CTP #1 station and PB07 cluster from the layer containing paleontological findings and make minor changes to the current design mapping which is in adherence to Mongolian Law on Cultural Heritage Protection’s Article 17.10 stating that it is obligatory to preserve cultural and historical heritages.

**Urulbe well – paleontological finding site**

This discovered site was first discovered by Mongolian and Soviet Russian cooperative paleontological expedition which worked during 1970-1980 and detected numerous interesting discoveries. Since then, Japanese-Mongolian cooperative expedition conducted study during 1993, 2003, 2004 and 2010 and discovered ancient representatives of carnivore dinosaur: Alectrosaur, Garudimimus and vegetarian: lizard – hizoraud, shelled dinosaur, dinosaur eggs, and ancient crocodile. The construction of the third radio communication tower along the water transmission pipeline is in progress. Its area for base was covered with modern moraine and it is concluded no historical findings were discovered.

2.6. Social and economic considerations

2.6.1. Identify adverse and positive social and economic impacts from the project

Umnugovi aimag has the largest territory among Mongolian 21 aimags. Regarding its administrative unit, there are 15 soums and 53 bags. Khanbogd soum of Umnugovi aimag has the third largest territory among other 15 soums (15.2 thousand km\(^2\)). According to 2010 population census, 3522 individuals were counted which is the third largest for the aimag level.
Population: Urban population influx is increasing from the countryside because of low living standards and high unemployment in the countryside, whereas population increased in Umnugoviaimag’s Khanbogd soum during 2004 and 2010 (Figure 24). This could be related with rapid mining development in local and soum levels leading to positive impacts on family’s livelihood.

Figure 24. Khanbogd soum population, 2004-2010

Khanbogd soum population was 2577 as of 2004, which continuously increased to 3522 until 2010, which shows increase of 945 individual within six years.

Population age: According to 2010 population census, the highest number of people was aged between 21 and 24 representing 105 individual from each age. Figure 25 shows age classification grouped by four age gaps.
According to this age classification, people aged 20-24 occupy almost 13% of the total population which is the highest number and people aged between 15 and 29 are the most dominant. Figure 17 illustrates people aged between 20 and 24 in red color.

**Population location and gender ratio:** Total of 3522 individuals were registered in the soum in 2010. Males outnumber the females by four fold. Out of these 3522 individuals, 2067 which is 59% live in the countryside and 1455 or 41% live in the soum center.

**Family and location:** Soum population increased during 2004 and 2010 which led to increase in families’ cattle number.
Supplementary Detailed Environmental Impact Assessment Report for “Updates to Gunii Hooloi Water Supply Pipeline” project

Figure 26. Family number

The Figure shows that 627 families were counted as of 2004. Since then, the number increased to reach 1112 families in 2010.

**Families location**: Out of 1112 families registered in 2010, 473 families or 43% of the total families live in the soum center and the remaining 57% or 639 families live in the countryside.

**Herder, herder families, and their number**: The following figure shows the statistical number of herder families and families with cattle in Khanbogd soum during 2008 and 2010.

Figure 27. Number of families with cattle and herders

It is clear from the figure that families with cattle fluctuate around 669-667 during 2008 and 2010. The number of herder families was 496 in 2008, which dropped until 480 in 2010. Herders older than 16 years old were 865 in 2009, which increased by 17 to reach 882 in 2010. Out of these 882 herders, 407 were female herders.

**Cattle husbandry**: Cattle husbandry is the main income resource for local community.
At the end of 2010 cattle census, 96084 cattle were recorded for the soum level in 2009, which was decreased by 20199 than the previous year. The cattle increased ever since to reach 116283 at the end of 2009. However, the number was 96084 in 2010, which is less by 96084 of the cattle in 2009.

**Agriculture:** Statistic information on prepared hay and manual forage during 2006 and 2010 was considered.

Total of 190 tons of manual forage was prepared in 2006 however the number decreased ever since. In 2010, no manual forage was prepared. The prepared forage fluctuates around 41-427 tons based on information between 2006 and 2010. In 2010 the prepared hay reached 66.4 tons.

**2.6.2. Social and economic impacts**

The following table shows identification of potential adverse and positive impacts caused by the construction and utilization of water transmission pipeline and measures to eliminate, mitigate, and prevent from adverse impacts.
### Table 13. Measures to eliminate and mitigate potential adverse social and economic impacts caused by construction of water transmission pipeline

<table>
<thead>
<tr>
<th>Potential impacts</th>
<th>Measures to eliminate and mitigate adverse impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive impact</strong></td>
<td></td>
</tr>
<tr>
<td>Oyu Tolgoi project is a state level project, which will improve national economy and increase employment opportunities, which led to numerous families’ livelihood improvement. Construction of water transmission pipeline, supporting sub infrastructure issue for the project’s water supply, it can be concluded that the construction will have positive impacts on the state, local economy, employment, and livelihood increase.</td>
<td></td>
</tr>
<tr>
<td><strong>Negative impact</strong></td>
<td></td>
</tr>
<tr>
<td>Potential disturbance to the family living near water transmission pipeline caused by increased population, formation of noise and dust, truck noise resulting from the construction of water transmission pipeline</td>
<td>- Compensate the families to be potentially impacted by project and take measures to help them relocate.</td>
</tr>
<tr>
<td></td>
<td>- Make the vehicles adhere to road planned, which will limit the soil erosion in minimum possible level.</td>
</tr>
<tr>
<td>Potential grievance and protest from the local community during the construction and utilization of water transmission pipeline.</td>
<td>- Receive the comments and grievances from the local community and try to solve the issue within minimum possible period and explain the situation thoroughly if the issue is difficult to be solved.</td>
</tr>
<tr>
<td></td>
<td>- Conduct open and transparent information sharing with the local administration and public about the work completed and planned.</td>
</tr>
<tr>
<td>Potential loss of pastureland since the project implementing area covers the cattle pastureland</td>
<td>Conduct reclamation for areas degraded or eroded during construction</td>
</tr>
</tbody>
</table>
Three. Environmental protection plan and environmental monitoring program

3.1. Amendment to the project Environmental protection plan

Table 15.1 of the Detailed Environmental Impact Assessment for project to supply Oyu Tolgoi project’s water demand from Gunii Hooloi groundwater resource prepared by Eco Trade LLC in 2009 shows details about Environmental protection plan and Environmental monitoring program for the Oyu Tolgoi project’s water supply. Therefore, because of changes being made to the first and second clusters for the water transmission pipelines, the following measures will be taken.

Organization of environmental management trainings and seminars

The project to supply Oyu Tolgoi water demand from Gunii Hooloi groundwater resource strictly adheres to principles of being responsible in environmental management and report about its mining operations, environmental plans, and its implementation to the local community and governmental organizations. Project environmental management should pay attention to the following issues during all stages of project implementation:

- Prevent from air and soil pollution;
- Water management (reserve, groundwater, polluted water);
- Waste management;
- Saxaul forest protection management
- Reclamation management
- Lube and lubricating materials storage management
- Protection of historical and cultural heritages.

In order to implement integrated environmental policy, Oyu Tolgoi LLC identified its mission, rights, duties and responsibilities, developed its official system, adheres to certain management policies which evaluates and monitors results, successes, and shortcomings of the work.

It is important to engage the project employees in trainings on how to handle the environment properly and implement this practice in order to implement the above mentioned management program.
3.2. Amendment to the project Environmental monitoring program

Table 16.1 of the Detailed Environmental Impact Assessment Report on the project to supply Oyu Tolgoi water demand from Gunii Hooloi groundwater resource, developed by Eco Trade LLC in 2009 shows detailed information and guideline about conducting observation, measurement, and monitoring on certain frequency and location basis in order to identify, eliminate, and mitigate any adverse environmental impact resulting from the project implementation. Therefore, because of changes being made to the first and second clusters for the water transmission pipelines, the following measures will be taken.

Table 14. Environmental monitoring program for the water transmission pipeline (by on year)

<table>
<thead>
<tr>
<th>Indicators to be monitored</th>
<th>Location</th>
<th>Frequency</th>
<th>Law, policy, standard</th>
<th>Expenditure, tugrug</th>
</tr>
</thead>
</table>
| Plants                    | - Groundwater well road and auxiliary road  
- Pipeline channels and linking parts  
- Pump stations and water accumulating water reserve ponds  
- Near the artificial lake  
- Near the electricity, fire protection, and measuring equipment, and protection fences  
- Near the saxaul forest | Conduct study once a year | - Field study recording, measure, photo, biomass, and sampling etc  
- Comparison and conclusion with the number of saxaul individuals conducted in 2012 | 2 000 000 |
| Cultural and historical heritages  
- Its intactness  
- Protection and labeling | - Monitor the intactness of paleontological and archeological heritages located at the project area. | 3 month | Visit the area containing cultural and historical findings once every 2-3 months and check and monitor their intactness, and protect them from outside impacts | 50 000 |
| Wastes                    | - Groundwater well road and auxiliary road  
- Pipelines and connecting parts  
- Pumping stations and Spring and summer | Field note, surveys, observation, photo confirmation | 100 000 |
## Indicators to be monitored

<table>
<thead>
<tr>
<th>Indicators to be monitored</th>
<th>Location</th>
<th>Frequency</th>
<th>Law, policy, standard</th>
<th>Expenditure, tugrug</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>water reserve ponds &lt;br&gt;- Near the water reserve &lt;br&gt;- Near the electricity, fire protection, and measuring equipment, and protection fences &lt;br&gt;- Waste disposal site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Society</td>
<td>Families located along the pipeline route &lt;br&gt;- Local administration &lt;br&gt;- Soum center residents &lt;br&gt;- Other companies employees and administrations</td>
<td>Once every two years</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 000 000</td>
</tr>
<tr>
<td>Reclamation</td>
<td>All reclaimed areas &lt;br&gt;- Monitor newly formed erosions and degradations caused from the project operations</td>
<td>Once every year</td>
<td></td>
<td>3 000 000</td>
</tr>
</tbody>
</table>

**Total** 7 million 150 thousand
Conclusion

This Supplementary Detailed Environmental Impact Assessment Report entitled “Making changes to water supply pipeline route” developed by Nature Friendly LLC – Environmental impact assessment company reflects amendments to be made to the “Detailed Environmental Impact Assessment for the project to construct pipelines to supply water demands for Oyu Tolgoi project from Gunii Hooloi groundwater resource” developed by Eco Trade LLC and approved by the MNET in 2009.

This amendments consider identification of potential impacts on soil, vegetation cover, and cultural heritages caused by first and second clusters of the water supply pipeline of Oyu Tolgoi project and recommendations on measures to eliminate and mitigate such adverse impacts,. Environmental protection plan and Environmental monitoring program reflected in the report will be implemented in as part of the OT project’s integrated program. Implementation of the Environmental protection plan and environmental monitoring program will be integrated to OT project’s integrated annual reporting and will be reviewed by the relevant governmental offices. Potential environmental impact assessment for the project is only limited to the areas of the first and second clusters where changes to Gunii Hooloi pipelines took place. Also, considerations related with the ground surface and air quality were not assessed again since the previous reports discussed them in great detail.
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9. DEIA on project to use Gunii Hooloi groundwater resource for Oyu Tolgoi project developed by JEMP LLC in 2010.