Overview of Human and Natural Resource Impacts of the Oyu Tolgoi Project

- Consequences to herders, their livestock, traditional nomadic lifestyle;
- Consequences to water supplies and grazing land;
- Lack of waste rock and tailings management plans and associated reclamation plans and financial assurance;
- Opportunities to increase waste water recovery and reuse at the tailings; and
- Impacts of proposed underground block cave mining.

Invited Presentation to:

Mongolian Parliament Standing Committee on the Environment

by

Paul Robinson
Research Director
Southwest Research and Information Center
Albuquerque, New Mexico USA 87106
sricpaul@earthlink.net

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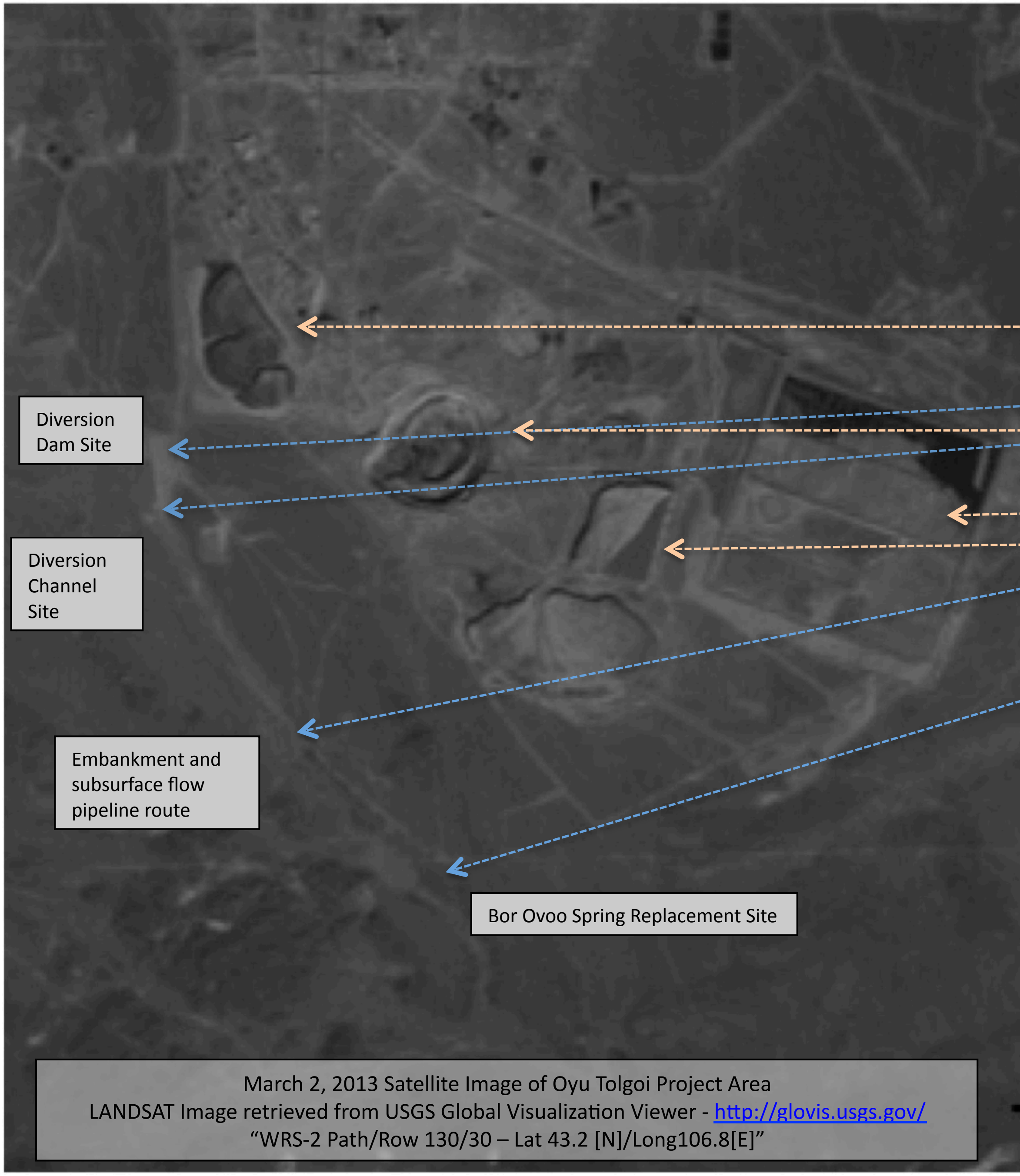
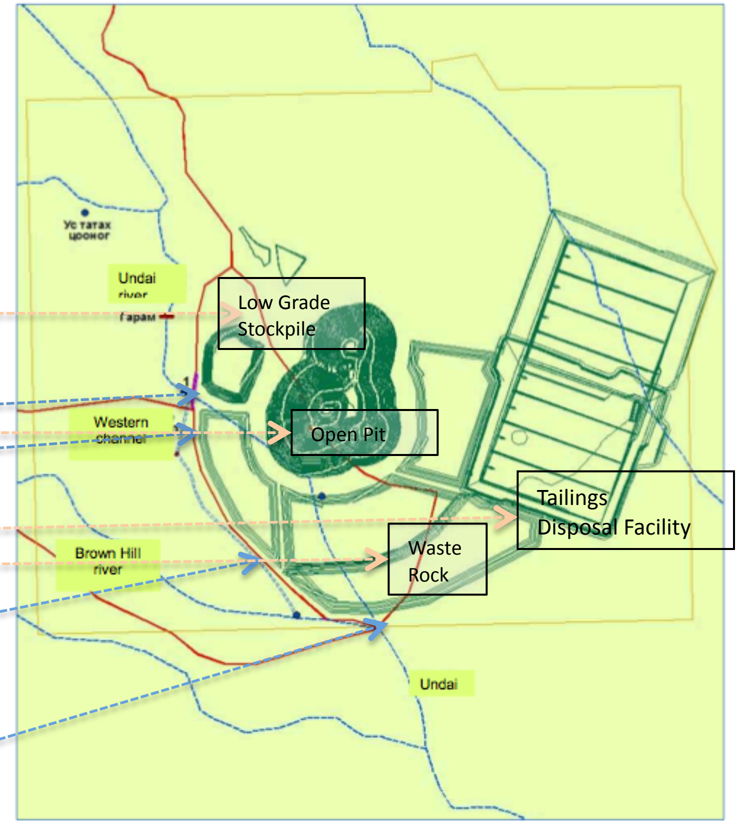
Camels hoping for water from a well used for decades by the herders before the soil water aquifer that sustained the well was punctured and drained by poorly constructed monitoring wells above the Gunii Hooloi Groundwater extraction area

Oyu Tolgoi Mine
Satellite Image from August 9, 2013

Waste from the open pit mine being dumped on a waste rock disposal pile August 13, 2013
– Open pit operations and copper processing not affected by deferral of underground work



March 2, 2013 Satellite Image of Oyu Tolgoi Project Area
LANDSAT Image retrieved from USGS Global Visualization Viewer - http://glovis.usgs.gov/
"WRS-2 Path/Row 130/30 – Lat 43.2 [N]/Long106.8[E]"



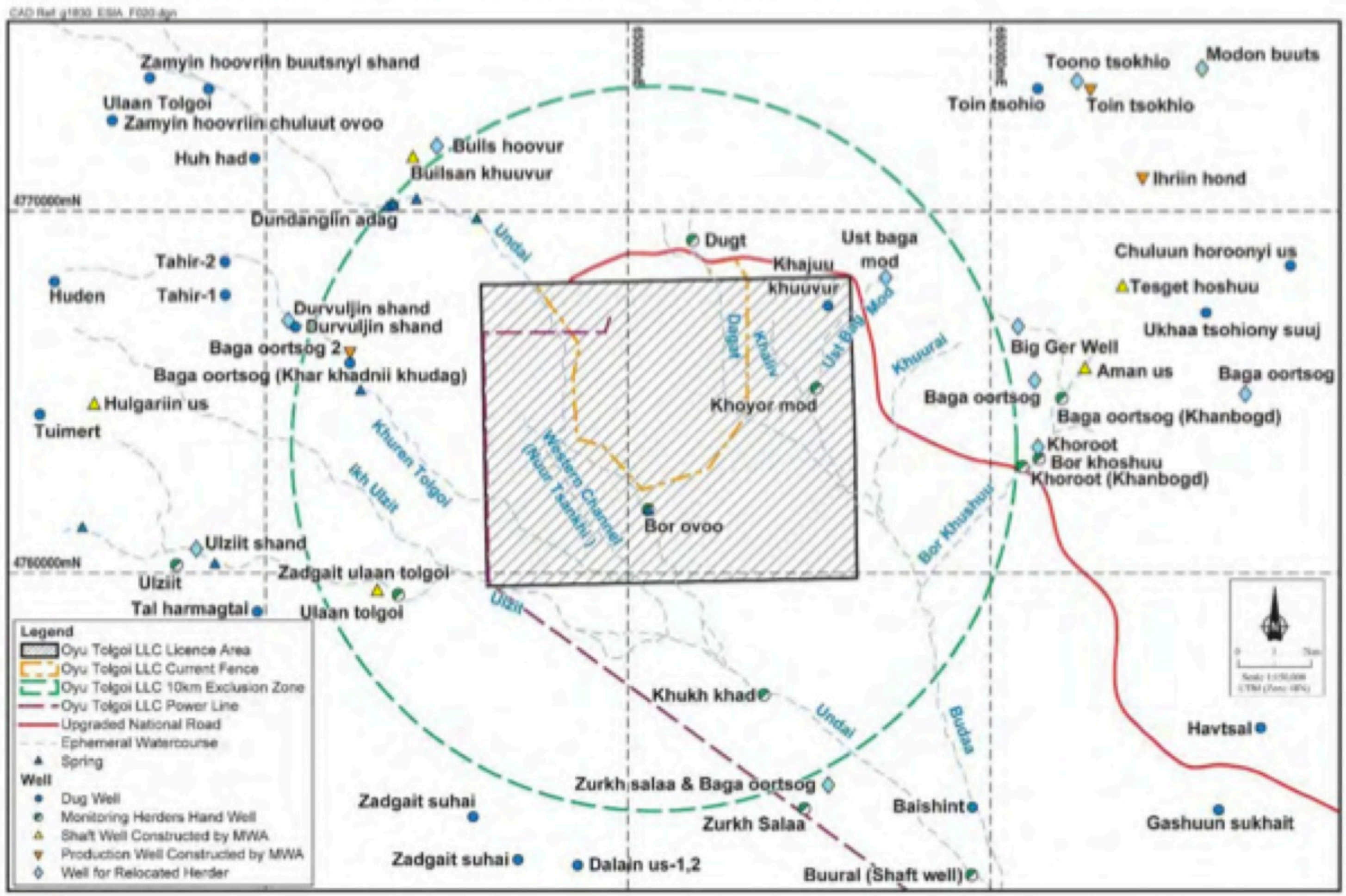
Note: 1- Dam

FIGURE 44. UNDAI RIVER WATERCOURSES AROUND OT PROJECT AREA

Oyu Tolgoi Project Area development as of March 2, 2013 showing mine facilities, construction at site of Undai Diversion Dam and Channel and alignment of subsurface flow channel.

For scale, the square tailings disposal facility approximately 2 km x 2km.

Figure 6.2: Ephemeral Watercourses, Springs and Wells around the Oyu Tolgoi Licence Area



Herder born at Bor Ovoo and his son looking at rust-stained water currently being provided by OT at proposed Bor Ovoo Spring replacement site

Livestock of family that lived at and used Bor Ovoo Spring to which they will never be able to return

Figure 6.1: Undai Flowing at Bor Ovoo location following Rainfall Higher up the Catchment

Wild Ass near OT fenceline

Figure 6.22: Bor Ovoo Spring Located on the Southern Part of the Oyu Tolgoi Mine Licence Area

Herder born at Bor Ovoo Spring said the spring was used regular by 10 – 20 families and their livestock but was only water available in early winter – into January - and was used by 50 - 100 families and their livestock as well as wild animals.

Water from pipes inside OT fence flowing toward Proposed Bor Ovoo Spring replacement site

Water at proposed Bor Ovoo Spring appears to soak into ground completely within 200 meters of pipes from which it flows

“The cascading well” is one of the six improperly constructed monitoring that wells that has drained the soil water decades old wells into top Gunii Hooloi deep aquifer; none of which have been repaired to prevent continued draining of soil water to the deep aquifer

Decades old livestock water well where the soil water level has dropped significantly due to the lowering of the water level in the soil water aquifer due to faulty and unrepaired monitoring wells nearby

Oyu Tolgoi's ESIA says

"Typical Borehole Design – ESIA Water Resources Management Plan p. 32 of 48

"The design of boreholes in the Gunnii Hooloi and elsewhere has evolved over the life of the Project such that the permitted design is more protective of the shallow groundwater aquifers present in the basin. A typical well design (GH05-PB01) is presented below. Pertinent points being:

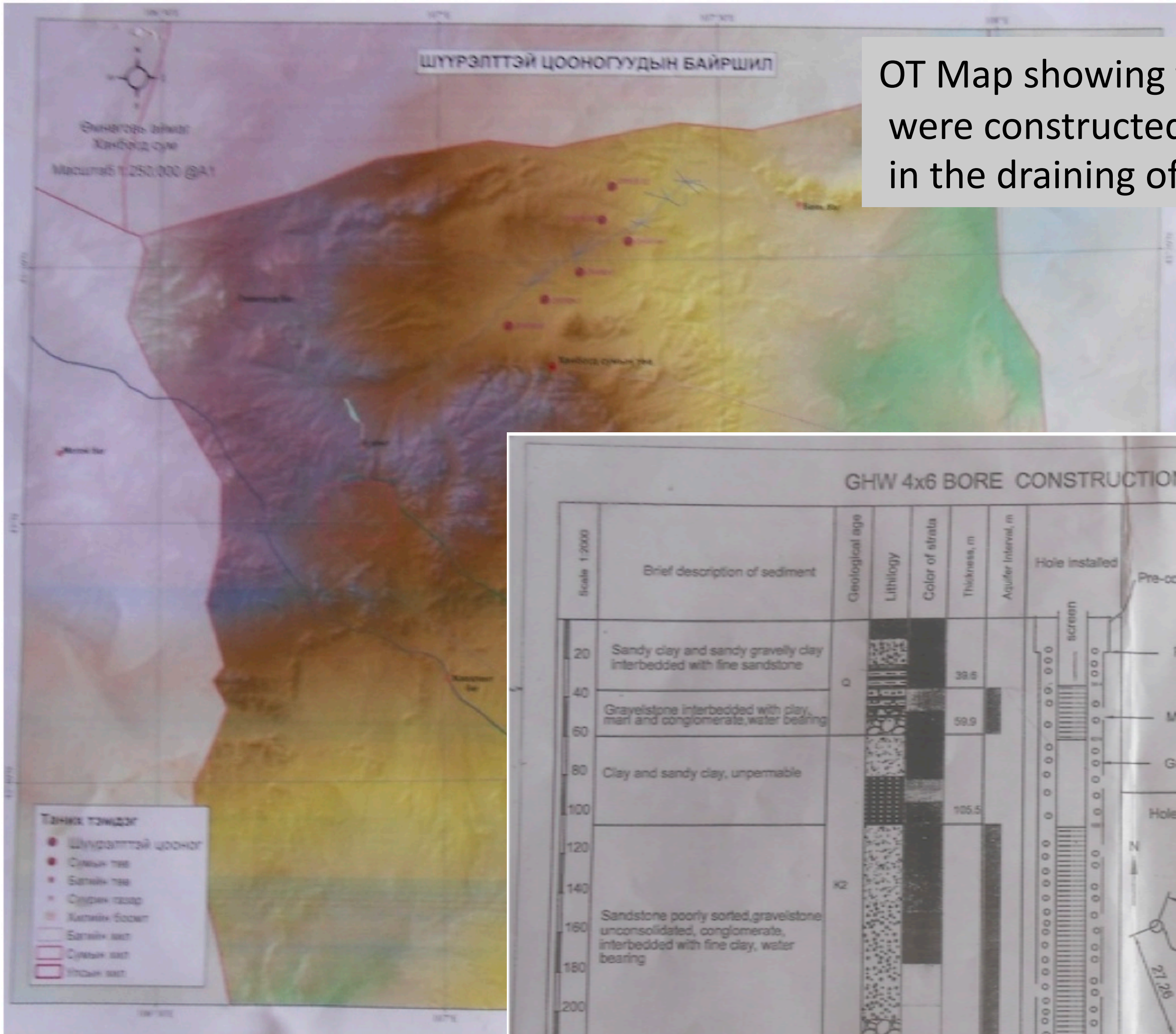
1.Surface seal around the borehole to prevent any infiltration from the surface into the annulus.

2.Solid casing from surface down to the aquifer unit.

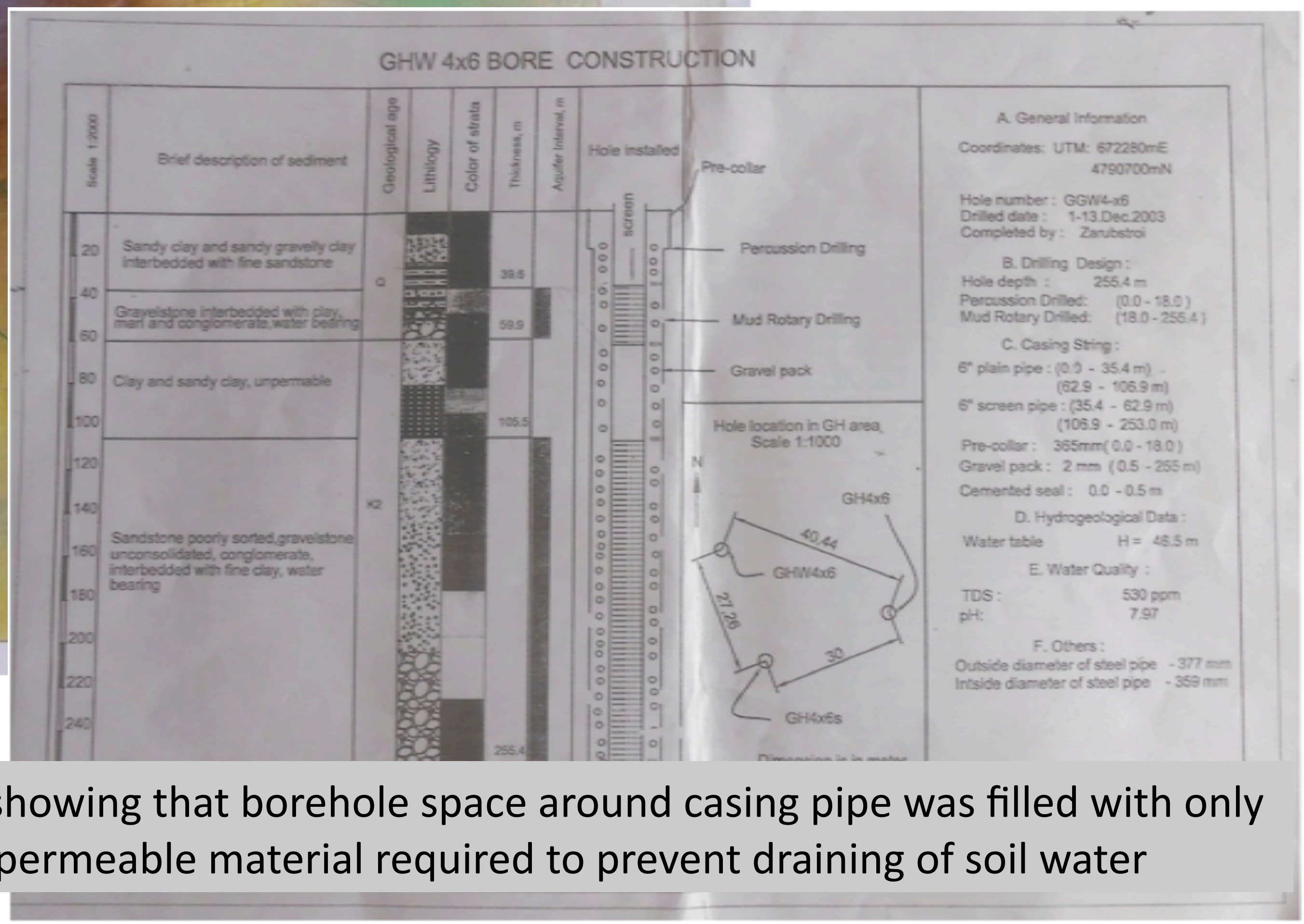
3. **<u>Upper sections of the well bore grouted with impermeable material (bentonite or similar) to ensure that any surface or shallow aquifers units in the borehole are sealed and cannot flow into the annulus</u>**.

4.Gravel pack around the casing and screen through the aquifer section. This design will be adapted as required to reflect the local hydrogeology; however the key principle of preventing flows between hydraulically distinct shallow and deep aquifer horizons will be maintained in all designs."

ACTUALLY OT acknowledges that its contractors failed to include "**<u>grouted with impermeable material (bentonite or similar) to ensure that any surface or shallow aquifers units in the borehole are sealed and cannot flow into the annulus</u>**" in 6 of 10 monitoring wells resulting in the surface and shallow aquifers being drained of water which flowed in down into the deeper aquifer. None of the erroneously constructed wells have been repaired and the damage to the soil water aquifer continues. Other traditionally used wells show dropping water levels as the effect of the drainage of the soil water aquifer spreads



OT Map showing the 6 wells it acknowledges were constructed incorrectly resulting in the draining of the soil water aquifer

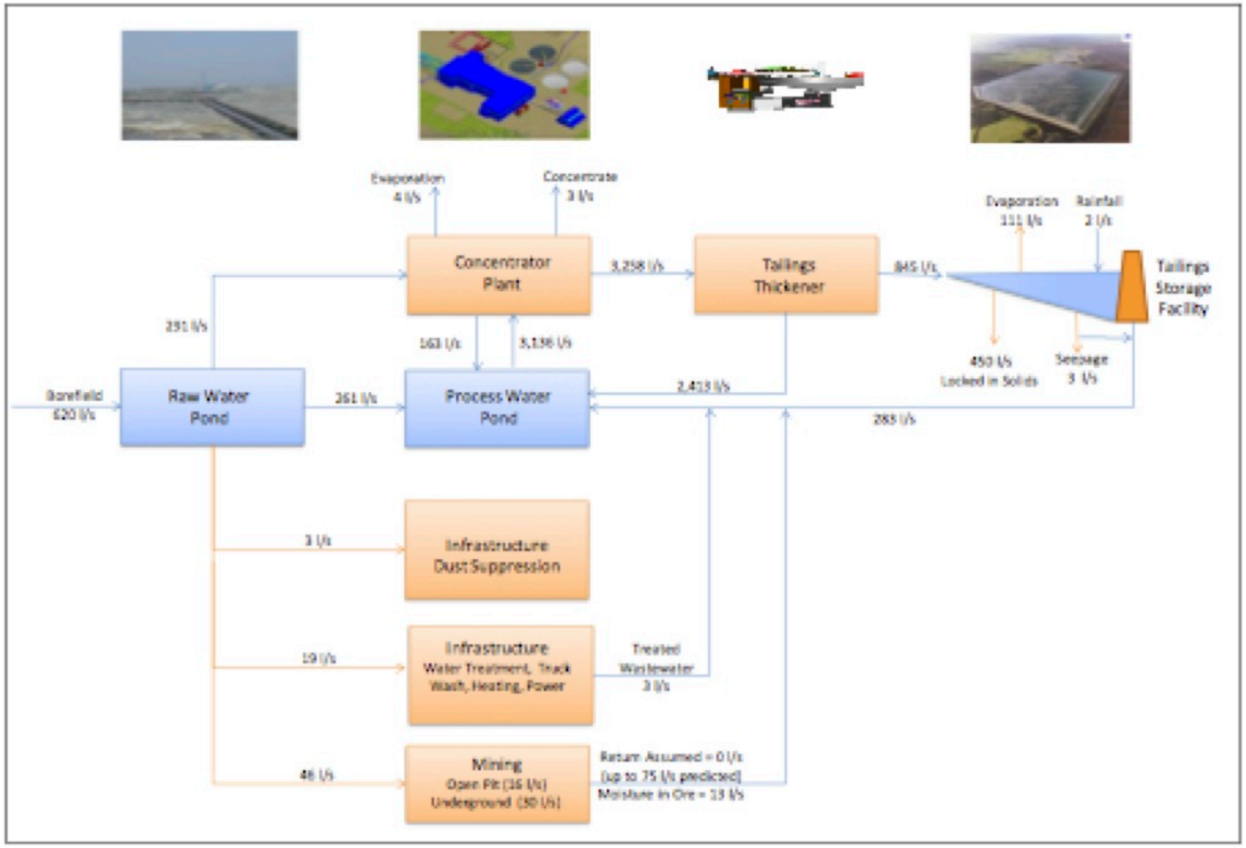


OT well completion record showing that borehole space around casing pipe was filled with only gravel pack without any impermeable material required to prevent draining of soil water

Camels waiting at decades old
Watering well now dry as a result of
draining of soil water due to
erroneous monitoring well construction
That has yet to be repaired

Camels reacting to people
approaching well hoping
for water to be filled into
their drinking trough

Figure 4.16: Water Balance 100,000tpd case



Note: Values in litres per second

Oyu Tolgoi estimates 561 l/s of water will be lost by evaporation at the tailings site (111 l/s) or locked in tailings (450 l/s)

“The average water demand during the initial years of 100,000 tpd mine production is predicted to be 696 L/s [if there is] no water recovery from the underground or open pit mines.”
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This water is potentially recoverable by paste or dry tailings disposal and represents up to 80% of the water needed from the Gunii Hooloi groundwater extraction zone

The March 2013 Oyu Tolgoi Technical Report states,
"In 2005, Golder Associates completed an alternative TSF design with central discharge of a tailings paste thickened to densities as high as 70% solids. The capital and operating costs, and operational complexities, of a paste tailings system were found to be high compared to those associated with conventionally thickened tailings, and the reduction of water consumption by using paste was small. Therefore, this option was not pursued further. "

In its February 2013 Tailings Brief, Oyu Tolgoi states,
In 2006/2007 when Oyu Tolgoi was planning its tailings storage facility, further reducing the water content to 20% through the use of dry stack technology was not identified as a realistic option. Even a middle ground option, so called 'paste tailings' (containing 22-24% water), was not found to be justified due to the complexity and high costs that would be required at an operation on the scale of OT.

In sharp contrast to those conclusions, Oyu Tolgoi's 2006 Mining and Processing EIA finds: "The combined use of high-compression thickeners to increase the deposition density of tailings and of decant towers to reduce the size of the tailings pond area has the potential to reduce make-up water requirements and thereby reduce the water demand form the Gunii Hooloi well field. These water saving opportunities increase the rate of recirculation of process water and investigations are continuing as to the feasibility and cost implications" states in Section 2.4 Project Alternatives.

Since 2006-7 when Oyu Tolgoi's tailings facility design was developed, the use of high-density thickened, paste and dry-stack tailings disposal tailings systems at large mines has grown rapidly.

Existing large-scale mine operations as large or larger than Oyu Tolgoi that use high-density thickened tailings, paste or dry stack technology include: Chuquicamata, Chile – 230,000 tons per day; Quebrada Honda, Peru – 147,000 tons per day and Esperanza, Chile – 95,000 tons per day

Perceived and realized benefit of High-Density Thickened, Paste and Dry Stack Tailings management include both reduced operating cost and potentially large reductions in water use

Table I

Perceived benefits of P&TT, after Tacey and Ruse (2006), with suggested gradings

Feature	Economic/engineering benefits	Environmental/social benefits	Grade
1. Similar capital cost and reduced operating cost compared with wet disposal	Overall economic benefit	Less resources applied to end of pipe and less corrective action	B
2. Costs accrued during operations	Reduced requirement for bonds and provisioning	Costs met by operator, no long-term y liability to communit	B
3. Increased deposit strength	Reduced risk of facility failure	Avoids offsite environmental and safety impacts	C
4. Decreased land footprint by at least doubling practical stacking height	Reduced land purchase cost	Reduced sterilization of productive land, reduced clearing	D
5. Decreased demand for borrow materials for construction	Less transport and construction	Reduced clearing for borrow materials, reduced greenhouse gas production in construction	A
6. Reduced risk of leachate seepage	Better leachate and reagent recovery	Reduced risk of ground- and surface water contamination	B
7. Reduces or eliminates ponding and low-strength mud deposits	Increased surface accessibility	Reduced injury to fauna, increased operator safety	B
8. Prompt creation of firm, convex draining surface at completion	Early creation of trafficable surface	Progressive or more rapid rehabilitation	C
9. Earlier, better surface leaching and drainage	Early leaching of toxicants from surface	More rapid establishment of vegetation, reduced duration of dust generation	D
10. Potentially large reductions in water use	Reduced need for water collection and supply facilities, pumping energy savings	Reduced footprint from water collection structures or impacts from diversion or abstraction	A
11. Reduced potential for liquefaction	Deposit remains firm and will not flow	Reduced offsite environmental and safety impacts	D
12. Potentially reduced heating, lower water demand	Reduced energy use, cost savings	Lower greenhouse gas emissions	C
13. Reduced reagent requirements	Potential operating cost savings	Reduced pollution risk	C

Source: Fourie 2012 “**Perceived and realized benefits of paste and thickened tailings for surface deposition,**” by A.B. Fourie, in The Journal of The Southern African Institute of Mining and Metallurgy, Volume 112, November 2012 , available at: http://www.saimm.co.za/journal-papers

Field Test of Thickened Tailings Technology at Minera Esperanza, Chile

The Esperanza TSF was commissioned in late 2010, with SRK acting as technical advisors. The facility was designed to store a maximum of 750 million tonnes of copper tailings [produced at 95,000 ton per day].

Source: - http://www.srk.cl/es/node/2375

Waste Rock Management Plan "Intentionally Omitted" from ESIA

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"Preliminary environmental test work has shown that some open pit waste, mainly in the central pit, is potentially acid forming (PAF), but that a significant proportion of waste also has an acid neutralizing potential….

"Design work on the waste rock dump is ongoing and further information on how the Project will ensure that the design, construction, operation and closure of the WRD incorporates good international practice and meets applicable Mongolian standards and IFC and EBRD requirements to mitigate potential impacts is set out in *Chapter D9: Waste Rock Management Plan."*

"SECTION D: ENVIRONMENTAL AND SOCIAL CONSTRUCTION MANAGEMENT PLANS
CHAPTER D9: WASTE ROCK MANAGEMENT PLAN
This section is intentionally omitted and will be included with the operations- phase management plans which will be prepared in due course."

No reclamation plan was provide for waste rock in the ESIA either, only conceptual goals, though waste is the largest volume of material being generated at the open pit mine and that will be left at the site after mining ceases.

Oyu Tolgoi Intentionally Omitted its Tailings Management Plan from the ESIA

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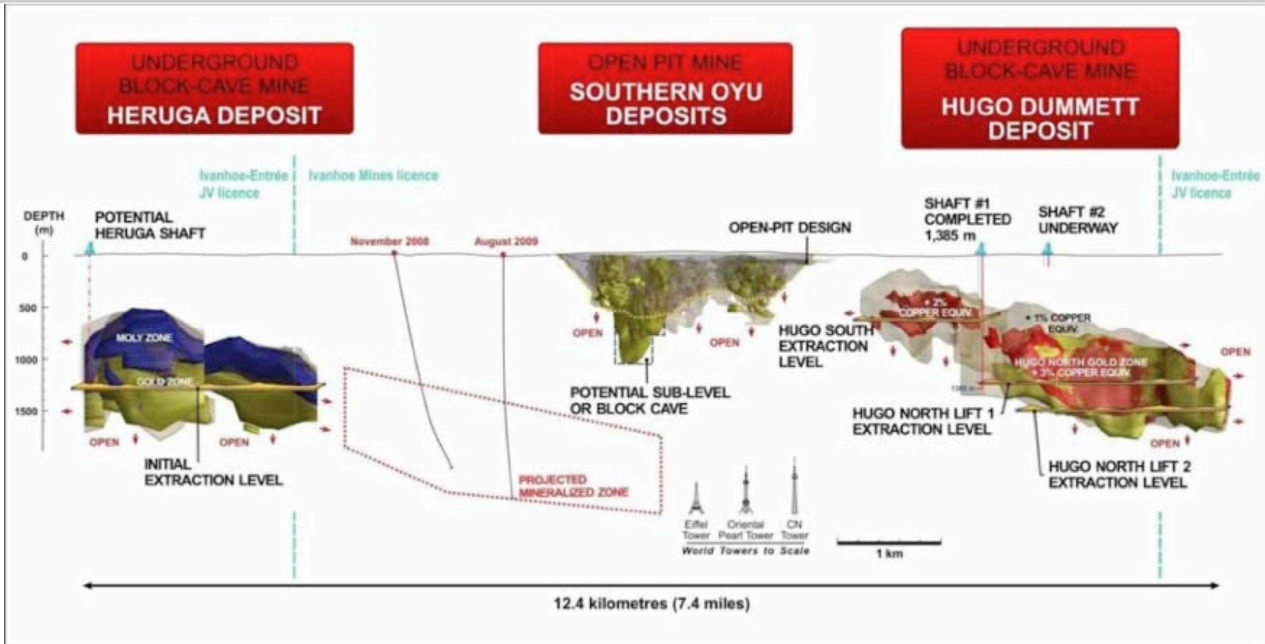
"An Independent Tailings Review Board (ITRB) has been established in accordance with IFC Performance Standard 4 to provide independent review and oversight of TSF design and operational management. The ITRB will:

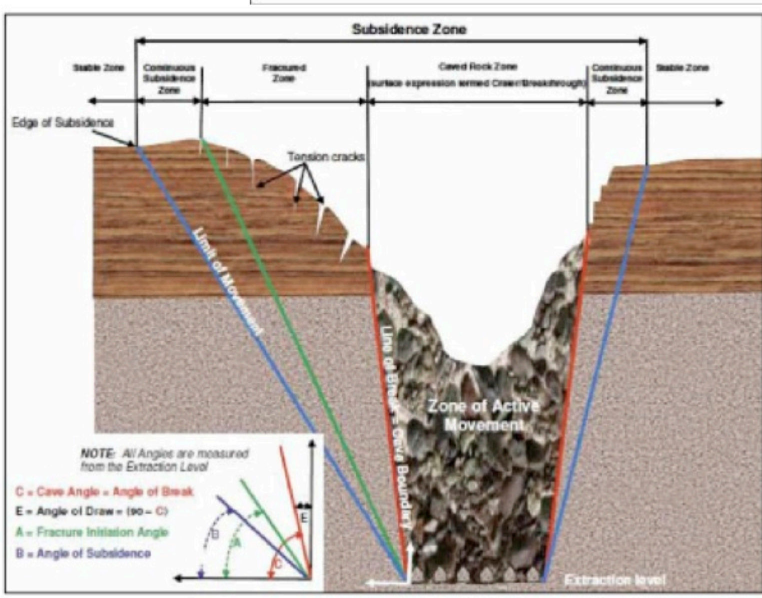
- Review TSF design and operational monitoring during construction and the initial phase of construction;
- Ensure that TSF design, construction and operation is undertaken in accordance with good international industry practice;
- Review the final TSF designs prior to financial close of project financing; and
- Review the final TSF construction as part of the Physical Facilities Completion Certificate for project financing."

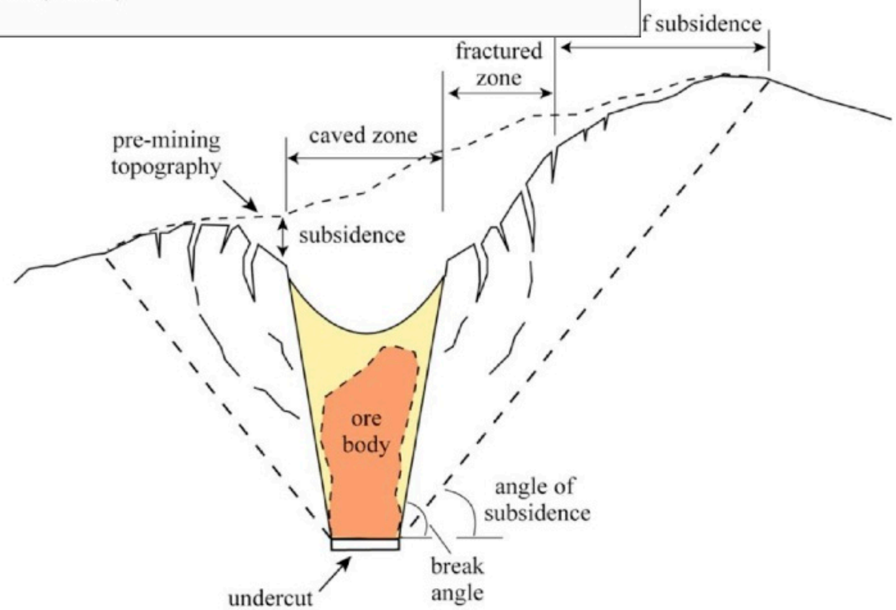
"SECTION D: ENVIRONMENTAL AND SOCIAL CONSTRUCITON MANAGEMENT PLANS
CHAPTER D10: TAILINGS MANAGEMENT PLAN
This section is intentionally omitted and will be included with the operations- phase management plans which will be prepared in due course."

No reclamation plan was provided for the tailings disposal site, though tailings are the second largest volume of waste material to be left at the site after mining ceases

Areas of Underground Mining using Block Cave Mining proposed at Oyu Tolgoi and illustrations showing surface collapse and subsidence zone associated with that mining method







Extent of Collapse and Subsidence Zone projected above proposed Hugo North underground mine using Block Caving Mining Method

Figure 23.8.8
Subsidence Area

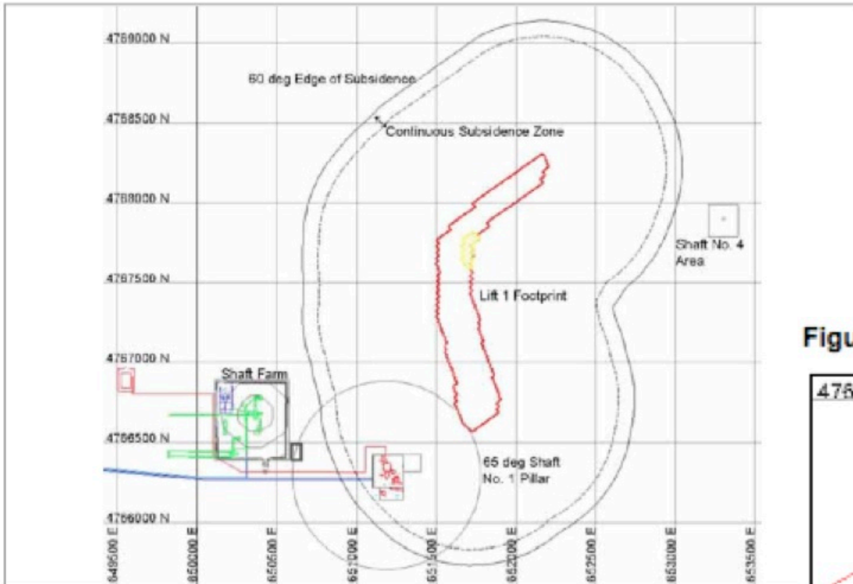
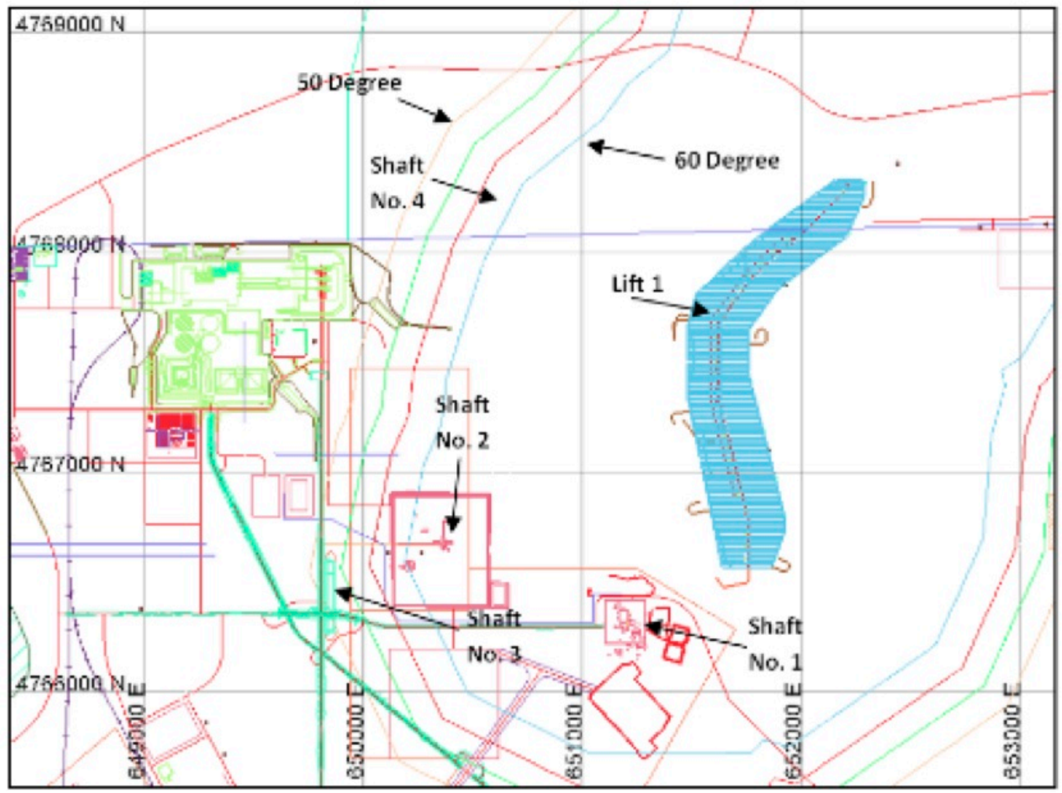


Figure 16.33 Projected Subsidence Area



Grid on map above is 1 kilometer x 1 kilometer

Collapse Zone Project to be
- 3 km x 0.5 km

"Continuous Subsidence Zone Projected to be – 6 km x 3 km

Bayarglaa

Thank you for your time and attention to this critical important matter.