

TECHNICAL SUMMARY – REMEDIATION OF HIGH PRIORITY HOTSPOTS IN WESTERN BALKANS

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COUNTRY : MONTENEGRO

SITE: Mojkovac: Abandoned metal mining complex

ENVIRONMENTAL/HUMAN HEALTH PROBLEM

There is a concern that the abandoned tailings dam adjacent to the town of Mojkovac is impacting on the human and environmental health both from the metals present in the tailings dam and from sewerage pollution which has also been diverted into the dam. This is both from the effects from the mining and sewerage impacts from overflow or leaching from the dam as well as impacts on people who continue to use dam recreationally and for fishing.

INTERVENTION & WORKS

The planned works will involve draining of the dam, stabilise the tailings sludge with lime, fill the rest **of the tailing dam to a final grade (i.e. a usable surface) and to leave a temporary 'water proof' barrier** until a second tender process is conducted to construct the final cap elements (ie drainage layer – gravel in pipe works system, 1 metre earth layer and grass finish). This stabilizing, cap and containment approach aims to both prevent the tailings being an ongoing source of metal contamination to the Tara River and to rehabilitate the tailing dam to permit a productive public use of the area.

BASELINE AND EXISTING INFORMATION

There is considerable baseline data available from the various studies that have been for this site. The studies cover the sediment and water quality above the mine site, the water and sediment/tailings quality within the tailings dam (TMI) and the sediment and water quality of a smaller river that also merges with the Tara. This information in many cases covers a number of years of monitoring. There is limited information on the metal load of a fish within the TMI.

In general the information shows that the current water contamination from sewerage and mine tailings, while exceeding some drinking water and ecological thresholds, is not high and would likely meet acceptable limits through dilution with river water on release. While the tailings do contain considerable quantities of toxic metals they are considerably lower than tailings found elsewhere in the Balkans. In its present condition the TMI appears to be having little adverse effect on the Tara with the exception of sewerage contamination. Studies on heavy metal contributions from the Rudnica may be a more significant source of heavy metals found in the Tara River than the TMI.

SITE VISIT - 11 March 2008

"The Tailings Dam (TMI)"

Inspection of the tailings dam revealed it to be almost full with approx 1 metre of freeboard remaining. It is present on the edge of the Tara River with the town of Mojkovac on the heights behind it. The dam itself seemed to be heavily vegetated with thick reeds projecting from the bank approximately ½ to 1/3 of the dam width into the centre. The dam walls were well clear of the Tara River and it appeared to be of a height would only be inundated in a major flood event. The plan for capping and containing the dam has been prepared by the faculty of Civil Engineering, University of

Montenegro and has now been advertised for tender. While the plan contains the general mechanisms required for such works it is apparent that performance criteria has been independently derived by the University rather than following international guidelines which represent best practice cap, contain, and monitoring practices. For instance the performance of the temporary 'water proof' barrier which would consist of 30cm of lime treated tailings has also not been determined in accordance with the standardized international methodologies and would be unlikely to meet the 'best practice' performance requirements (ie usually 10^{-7} metres per second).

"The Stabilisation Works"

The site adjacent to the tailings dam contained equipment used by one potential tender candidate for a pilot treatment of the tailings. The site adjacent to the tailings dam contained a stockpile of excavated tailings grey in colour, holding an angle of repose <5 degrees and containing mixed pebbles, a batch mixer utilising a hopper based system that would mix reagents and tailings through and auger type mixer, power supply, security fence and a short conveyer to discharge the mixed then deposited onto short conveyer. The final equipment used for mixing will depend on the outcomes of the tender and may vary from that present on the site. The University requirements for the stabilization will only require treatment of the tailings with lime to a final expected strength of 45kpa **unconfined compressive strength. It should be noted this does not meet the general "best practice"** requirements for solidifying/stabilizing wastes were the typical hardness required would be 450kpa which would require the addition of cement or other pozzolanic substances and would involve specific leachate tests to determine if the treatment prevents metals from leaching out.

RECOMMENDATIONS

While a best practice approach for the cap and containment of the TMI and stabilization/solidification has not been followed in accordance with appropriate international guidelines the information on the comparatively low levels of metals present in the tailings dam water, the volume of material required to be treated (ie 500 000m³) compared to the budget to undertake such activities (approx 4million euro) **provide some justification on taking a 'risk management' approach that should deliver much** higher levels of human and environmental health protection than currently exists. Though it is strongly recommended those works yet to commence that the following performance monitoring is introduced for the most critical elements such as:

- Adaptation of standard barrier system construction quality assurance (COA) integrity monitoring techniques for the TMI;
- Field testing the permeability of the temporary cap and whether the treated tailings can meet and sustain the required performance through treatment and placement trials;
- Consideration on the maintenance and monitoring program of the final drainage layer and drainage pipe construction;
- Introduction of containment site monitoring program in line with standard monitoring of engineered barrier performance to detect infiltrating water and to monitor water quality between the containment area and the Tara River;
- Consideration to stabilizing the tailings to a higher performance level.