

Also, as part of the water management system and the ultimate plan to rehabilitate the site, some of the tailings from the tailings dam were transferred to Pit 1 when this pit was brought on line as a tailings repository.

The tailings corridor pipework currently handles the following streams:

- Tailings from the mill to Pit 1 (two lines – A&B)
- Process water return from either the tailings dam or Pit 1
- Process water transfer from Pit 1 to the tailings dam
- Process water/tailings transfer from the tailings dam to Pit 1 although there is currently no transfer of tailings
- Tailings corridor run off water from the tailings corridor sump ultimately to RP2.

An overview water management pictorial drawing no 05-P-8004 which includes these services is included in appendix B. The appendix B schematic also identifies a number of redundant lines from earlier tailings/water management operations at the site. Redundant lines are discussed in section 4.5 of this report.

The tailings corridor system overview layout is shown on water management layout drawing no 1253-05-A0014 and included in appendix C.

2.2 Design and operating philosophy

Accepting the primary objective of carrying the services listed in section 2.1 above, the principal design and operating criteria applied to the tailings corridor is that it forms part of the Restricted Release Zone (RRZ) for the site Water Management System (WMS).

The RRZ has been defined in terms of those areas affected by mining and milling operations where ‘material’ >0.02 per cent uranium dry weight is exposed. Accordingly the tailings corridor, which carries water and material from affected areas, is included in the RRZ.

Rainfall within the RRZ and resulting runoff must be managed within the RRZ unless the Supervising Authority grants special approval. It is noted that, as of 9 January 2000, water management objectives are being focused toward water quality targets for all waters rather than the previous objectives that sought to primarily manage surface waters in the context of its site origin. This shift in emphasis does not, however, appear to diminish in any way the design and operating criteria which must be applied to the tailings corridor.

The objectives and operation of the WMS are covered in the ERA Ranger ‘Water Management System Operation Manual’ .

3 Review of design

3.1 Original design

The key features of the original design are briefly described below under the following three headings:

- Corridor design
- Tailings and process water pumping and piping system
- Environmental

3.1.1 Corridor design

The tailings corridor, as constructed, was approximately 16 m wide and ran for approximately 2.5 km from the tailings pumping facility at the mill to the tailings dam, passing to the south side of ore body Pit 1. It comprised 300 mm minimum compacted fill covered with selected earth fill base compacted to 95% relative dry density (modified) with a 300 mm layer of earth-rockfill on top.

Typical cross section details from the original design are shown in drawing no 1253-04-T0039 included in appendix D. In section, from south to north, it comprised an embankment, a 6 m wide vehicle access way, a pipe track, an open drain and a further embankment. The corridor south side embankment formed the southern limit of the RRZ.

The design incorporated a number of culverts passing under the corridor carrying various runoff flows.

The corridor longitudinal profile was such that it had high points at the mill and tailings dam ends and drained by gravity flow to a mid point where a drainage collection sump was located. The sump contents were automatically pumped to RP3.

3.1.2 Tailings and process water pumping and piping system

The original corridor process and tailings water piping system design comprised two tailings lines bringing tailings to the tailings dam and a single process water return line from the dam. Support for these pipelines was provided via concrete supports at 6 m intervals along the corridor pipe track.

The original tailings lines were carbon steel rubber lined with jointing via victualic couplings. Design operating pressure was 1800 kPa.

The original process water line was ERW carbon steel unlined with jointing also via victualic couplings. Design operation pressure was 700 kPa.

Flexibility provision for curved installation (they follow the tailings corridor route) and for thermal expansion and contraction on the tailings and process water lines was provided via the victualic couplings. Another reason for using victualic joints was that leaks do not spray radially from the joints thereby reducing the likelihood of leakage spray reaching outside the corridor. Flange guards need to be fitted to flanged joints to prevent this.

3.1.3 Environmental

As already stated, the tailings corridor and associated pipework and sump were designed as part of the RRZ. Hence, any corridor runoffs or corridor pipe leakages were to be managed under the WMS and not present a risk to the environment.

Clearances provided from the pipe runs to the embankments which formed the boundaries of the corridor ensured a practical minimisation of the risk of any occurring pipe leaks resulting in tailings or return process water being spilt outside of the corridor.

Whilst the full specification of corridor ground preparation has not been sighted during the review, it is assumed for the moment that the grading and permeability specification will have ensured that any seepage of tailings/process water into the environment would be insignificant. Further comment on this is provided later in the report.

3.2 Summary of changes since the original design and construction and additional details

The significant changes which have occurred since the original design and construction are as follows:

1. The rubber lined pipework used in the original tailings lines design and construction provided very poor service life. It initially failed due to a manufacturing fault. The replacement rubber lined pipes failed due to a leakage around the seals and subsequent corrosion of the steel. Replacement polyurethane lined lines failed due to incompatibility with components in the tailings. Ultimately a polyethylene lining was adopted and continues to be successful.
2. The original unlined process water line provided very poor service life. This unlined pipework has been replaced with internal epoxy painted pipework.
3. A number of pipe runs have been either added, removed or changed as required by ongoing mine development operations. The current changes relative to the original design are as follows:
 - The tailings lines now run only as far as Pit 1. Tailings line A leaves the corridor at a point to the south east of Pit 1 and runs towards the pit in a dedicated branch corridor formed by a trench and draining to Pit 1. This line passes through a culvert under the pit perimeter road on route to the pit.

Tailings line B leaves the corridor at a point on the south side of Pit 1 and runs towards the pit in branch corridor formed by earth bunds either side. The redundant tailings pipework associated with these diversions has been removed because it was needed for the A line branch. The surplus pipe has been stockpiled.
 - A process water return line branch from Pit 1 has been installed and connected into the original process water return line from the tailings dam. This branch runs from the pit to the tailings corridor in the same branch corridor as tailings line B.
 - Two off 500 mm diameter polyethylene lines have been added to transfer tailings dredged from the tailings dam to Pit 1 and return water from Pit 1 to the dam. These two lines run ,between the tailings dam and the Pit 1, in the open drain inside the tailings corridor.
4. An additional culvert underneath the main corridor has been added to carry run off from the south waste rock dump across to the corridor wetland filters. Another has been constructed under the A line branch to drain areas otherwise isolated by this extension.
5. Water collected in the tailings corridor collection sump is now directed via one only sump pump and a 110 mm diameter polyethylene pipe running along the corridor back to the mill and via underground storm water drains to RP2. The pumping system is manually started after storm events. The standing procedure is that the operator inspects the full length of the pipeline corridor for leaks prior to the commencement of pumping to RP2. The sump is provided with a gravity overflow to No. 1 pit
6. In the event of an accidental spillage of tailings from the corridor pipework which contaminates the sump water, the water would be returned to the RP3 process water system subject to a quality check.
7. A 150 mm welded steel line runs part way along the corridor. It transfers ground water from bore MBL to flood irrigation to prevent it entering Pit 1.

8. Regrading of the corridor has taken place on a regular basis as required to maintain the surface and road drainage.

To the north of the corridor, except for the last approximately 0.75 km at the tailings dam end, is a sediment control zone (catchment #11 referenced in the WMS operation manual). For the above mentioned last 0.75 km, the corridor is bordered on the north side by the south waste rock dump/capped area (catchment # 11A referenced in the WMS operation manual).

3.3 Current suitability of key aspects and of the original design

An overview review of the original design has been undertaken and it has been found to be appropriate to the design and operating criteria which prevailed at the time of the original design subject to the following comments. It is also considered to be appropriate for the current design and operating requirements, again subject to the following comments.

1. The 500 mm polyethylene pipes, located as they are in the corridor drain, raise the following concerns:
 - They do not have sufficient clearance between them and the corridor north side embankment to provide reasonably reliable protection against discharge of process water into the catchment areas (11A and part of 11) in the event of a leak in one of these lines. In order to overcome this, consideration should be given to appropriately increasing the width of the corridor on its north side between the Pit 1 branch corridor and the tailings dam.
 - The drainage capacity of the ditch could be impeded by the pipes. This should be reviewed and the adequacy of the drainage confirmed if it is intended to leave the pipes in the drain.
 - Thermal movement of the HDPE lines in the ditch could lead to progressive erosion and degeneration of the trench. General maintenance of the trench is also made more difficult by the presence of these pipes. Again, these aspects should be examined further if it is intended to leave the pipes in the drain.

The foregoing concerns and their potential solutions are interrelated. They should be studied together to ensure that any alternative widening and HDPE pipe routing/support scheme considered addresses all three issues as appropriate.

2. As noted above, a complete specification for the particle grading and overall impermeability of the corridor cover has not been sighted during this investigation. This specification should be obtained and reviewed to confirm its appropriateness.
3. As for the main corridor, a full particle grading and impermeability specification for the branch corridors should be obtained and reviewed.
4. A recent corridor pipe leakage incident resulted in process water contamination of wetland filters. It is believed that this occurred due to leakage through the corridor floor at the additional culvert installed for the south waste rock run off subsequent to the original design. This suggests that the cover provided above the culvert at this location was suspect. All locations where the original corridor specification has been significantly altered should be reviewed to check whether the cover provided is still adequate. It is understood that remedial action in respect of this suspected leakage path has included the provision of a concrete cover slab in the trench over the location of the culvert. The design of this modification should be reviewed to confirm that it is properly keyed and will not result in an undermining of the slab by storm flow in the drain.

5. Details of the recently installed overflow pipe from the corridor sump to Pit 1 were not sighted during the review. These should be obtained and checked to ensure that adequate overflow capacity is available in the event of the design storm event.

4 Review of existing system and current operating, maintenance and development regimes and responsibilities

4.1 Current inspection, operating, maintenance and development regimes and responsibilities

The overall operating, maintenance and development regime for the tailings corridor is governed by the ERA Ranger general authorisation to operate and the requirements relevant to the tailings corridor are covered, in either specific or general terms, in the WMS operation manual.

The departments within ERA who are directly responsible for aspects of the corridor operation, maintenance and development and their specific responsibilities are as follows:

Department	Responsibilities
Mill (Operations)	<ul style="list-style-type: none"> • Operation of tailings and return process water supply lines • Inspection of tailings corridor and pipe lines a minimum of 3 and preferably 4 times per shift • Inspection of corridor lines for leaks after storm events prior to pumping of tailings corridor sump contents to RP2 • Management of dams and ponds
Mill (Maintenance)	<ul style="list-style-type: none"> • Maintenance of tailings pipelines • Maintenance of balance of corridor pipework • General maintenance of tailings corridor
Engineering Services (Mechanical Workshops)	<ul style="list-style-type: none"> • Maintenance of the process water return line • Maintenance of the Water Management System (WMS)
Engineering Services (Engineering Technical Services)	<ul style="list-style-type: none"> • Maintenance of drawing records • Provision of engineering support, when requested, for facility upgrades or modifications
Environment Safety & Health	<ul style="list-style-type: none"> • Overall supervision of tailings corridor operations and development to ensure compliance with the WMS requirements • Conceptual and strategic input for the design of any modifications to the corridor or its associated pipework/ equipment • Liaison with and reporting to the Office of the Supervising Scientist