

# Design of an HDPE-lined platinum tailings facility in South Africa



Linda Spies

13 February 2020



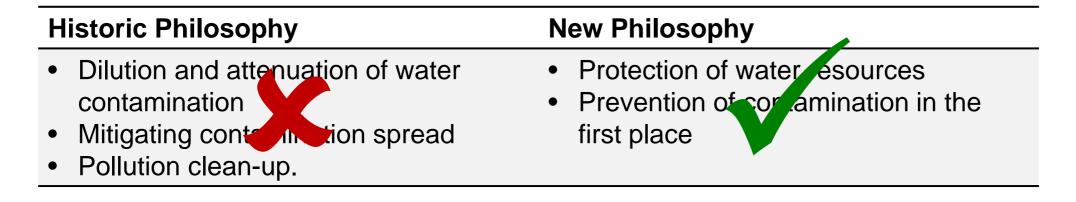
# Key message of this presentation:

Although there are many environmental benefits to the inclusion of a liner in a tailings dam, this does increase the **complexity** of the design, construction and operation of the tailings dam.



In South Africa

DWS's philosophy has changed in the past 20 years



NEMA Regulations (632, 634, 635 & 636) administered by the DWS

→ Waste Acceptance Criteria for Disposal to Landfill applies to all waste, including tailings

Waste Acceptance Criteria for Disposal to Landfill

#### Marula platinum tailings

Waste Type	Landfill Disposal Requirements
Type 0 Waste	The disposal of Type 0 waste to landfill is <b>not allowed</b> . The waste must be treated and re-assessed in terms of the Norms and Standards for Assessment of Waste for Landfill Disposal.
Type 1 Waste	Type 1 waste may only be disposed of at a <b>Class A</b> landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a <b>Hh</b> / <b>HH landfill</b> as specified in the Minimum Requirements for Waste Disposal by Landfill (2 <sup>nd</sup> Ed., Department of Water Affairs and Forestry, 1998).
Type 2 Waste	Type 2 waste may only be disposed of at a <b>Class B</b> landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a <b>GLB+ landfill</b> as specified in the Minimum Requirements for Waste Disposal by Landfill (2 <sup>ed</sup> Ed., DWAF, 1998).
Type 3 Waste	Type 3 waste may only be disposed of at a <b>Class C</b> landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a <b>GLB+ landfill</b> as specified in the Minimum Requirements for Waste Disposal by Landfill (2 <sup>nd</sup> Ed., DWAF, 1998).
Type 4 Waste	Type 4 waste may only be disposed of at a Class D landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a <b>GLB- landfill</b> as specified in the Minimum Requirements for Waste Disposal by Landfill (2 <sup>nd</sup> Ed., DWAF, 1998).

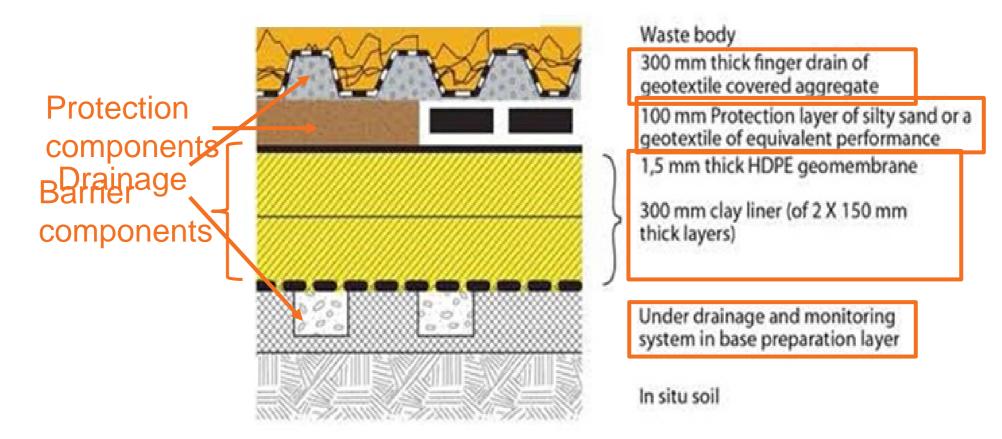
	Type 3 waste may only be disposed of at a Class C andfill designed in accordance
	with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of
Type 3 Waste	these Norms and Standards, may be disposed of at a landfill site designed in
	accordance with the requirements for a GLB+ landfill as specified in the Minimum
	Requirements for Waste Disposal by Landfill (2 <sup>nd</sup> Ed., DWAF, 1998).

Type 3 waste requires a Class C landfill barrier system

#### OR

a barrier of equivalent performance

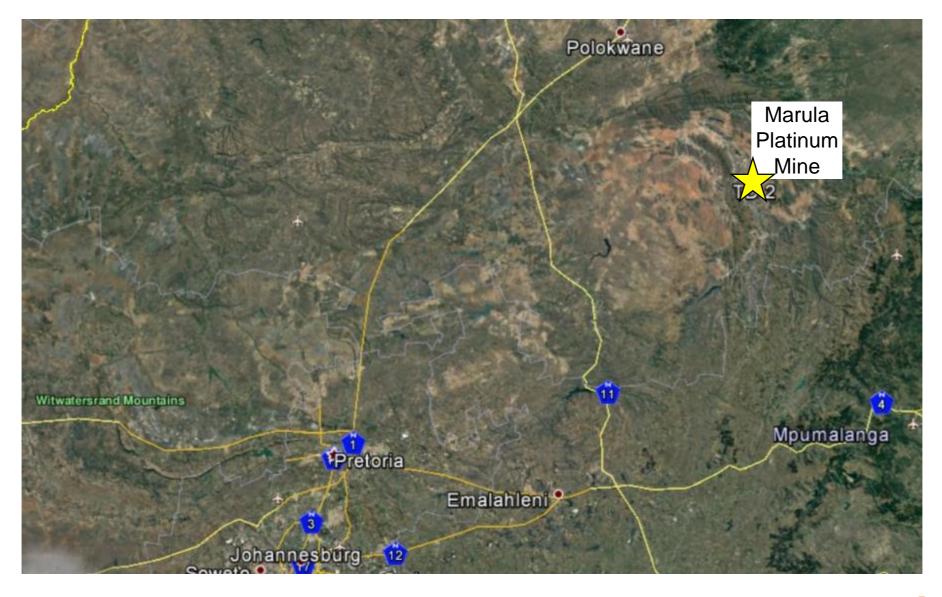
Core components of a Class C landfill barrier system



# Case study

Marula Tailings Dam 2

### Marula Tailings Dam 2



#### Marula Tailings Dam 2



#### **TD 2 Statistics**

Footprint:77 HaMax height:47 mDesign life:20 yrsTailings received from same plant<br/>as existing TD 1Elevated nitrate (NO3) levels

03

# Design challenges

Drainage Stability Others

## Drainage

#### Purpose

Above-liner drains

- Draw down the phreatic surface
- Reduce head on the liner → reduce seepage gradient
- Reduce liquefaction potential of tailings

#### **Under-liner drains**

- Mitigate against construction issues
- Provide leakage detection layer
- Drain seepage from existing TD 1

#### **Additional challenges**

- Protection from stormwater damage
- Protection from blinding from fine tailings

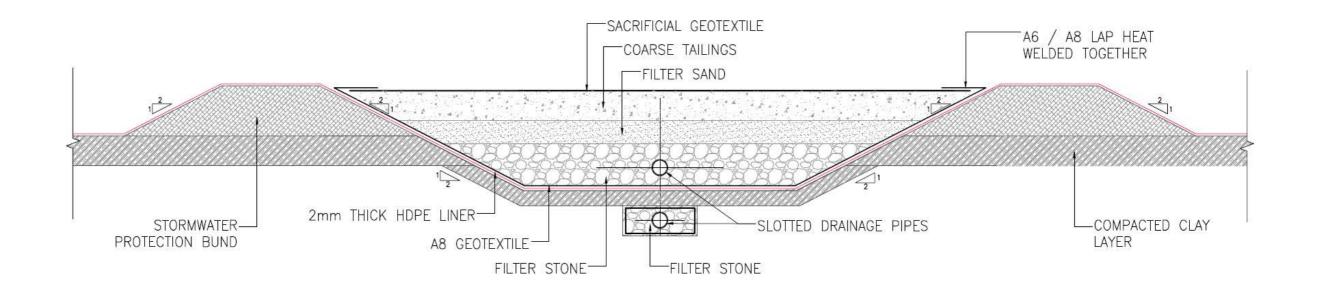






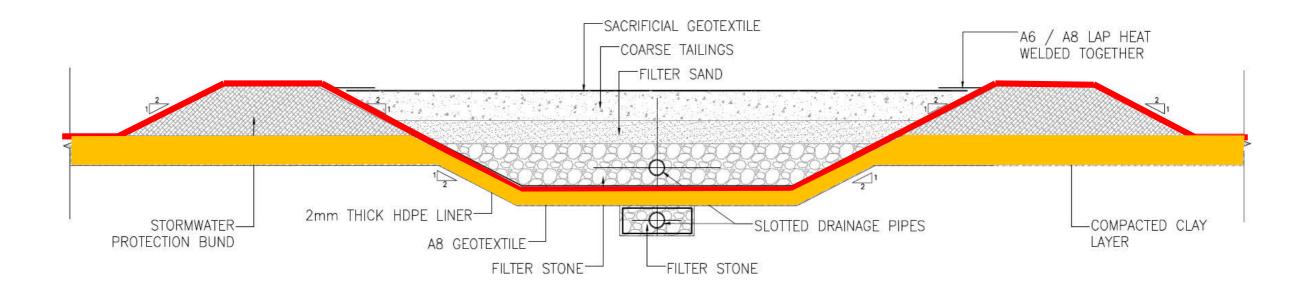


#### Section through a typical drain





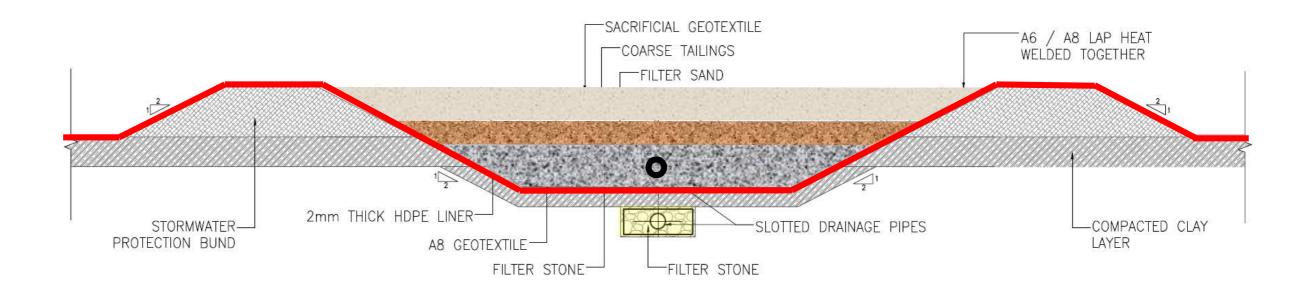
#### Section through a typical drain



#### **Barrier components**



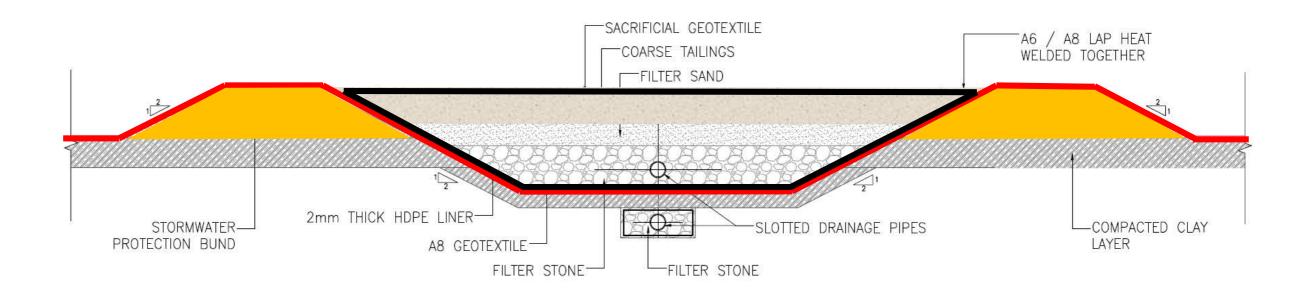
#### Section through a typical drain



#### Drainage components



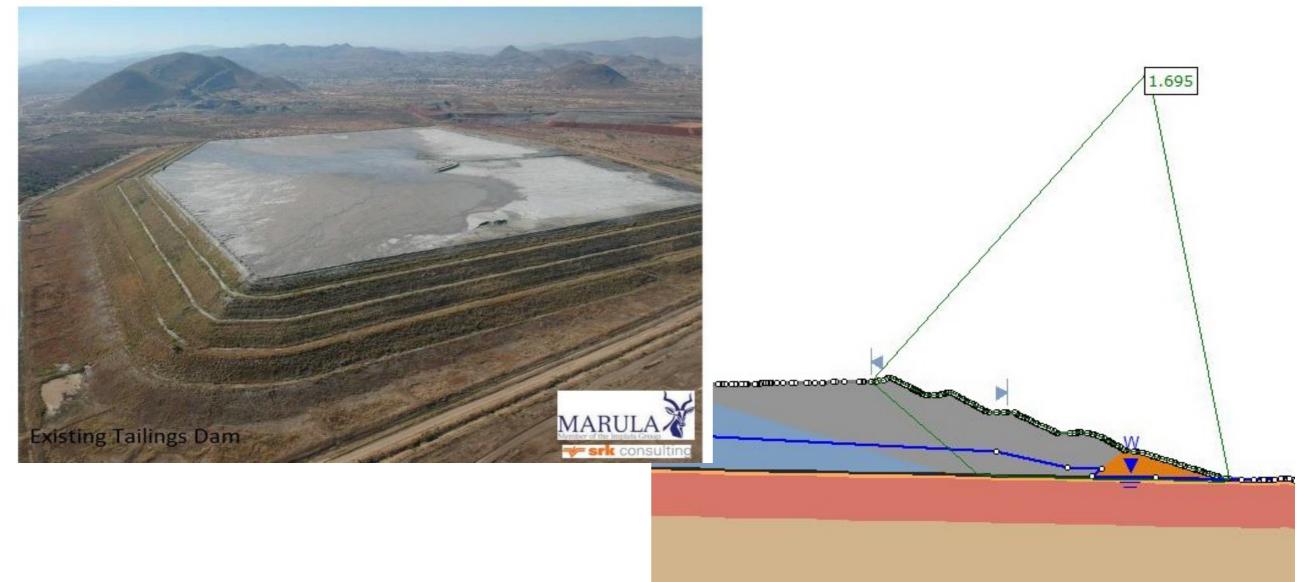
#### Section through a typical drain



#### **Protection components**



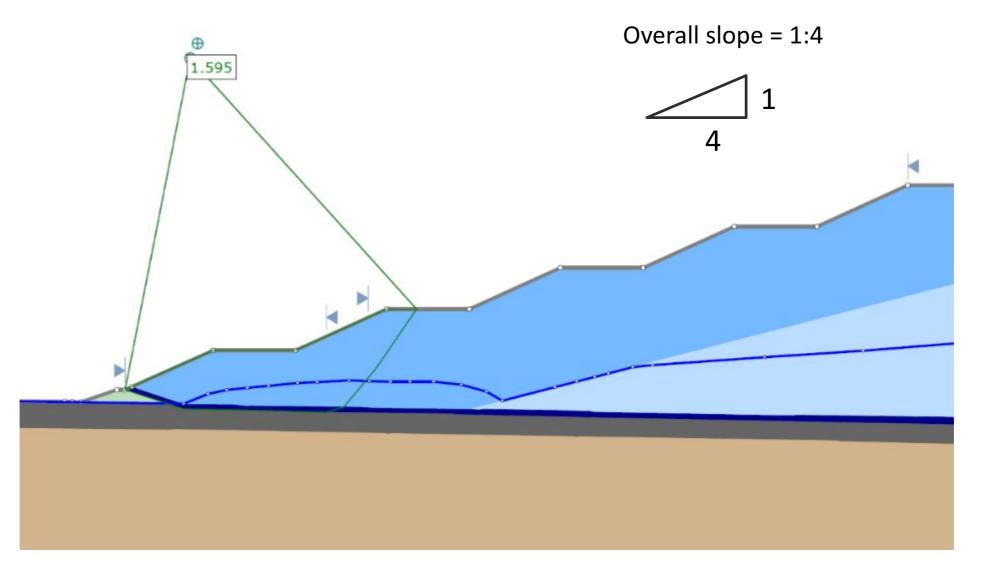
## Stability



# Stability

	Existing TD 1	New TD 2
	Unlined	Lined
Weakest layer	Underlying soil Φ = 21°	Liner interface $\Phi = 16^{\circ}$
Outer slope	1:3	1:4
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# Stability



### Stability – determination of interface shear strength



### Stability – determination of interface shear strength



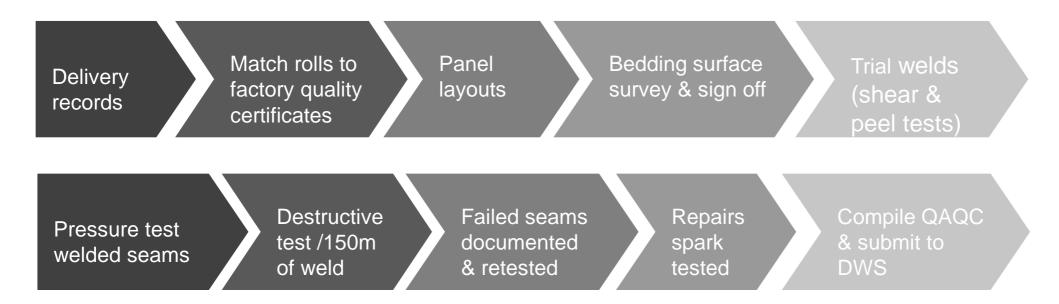
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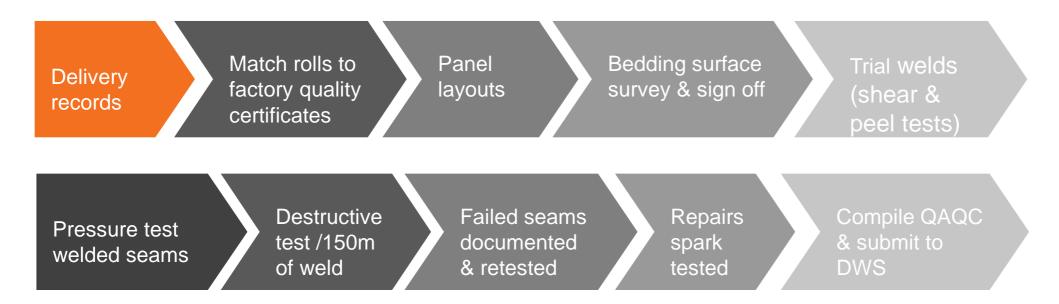
# **Construction challenges**

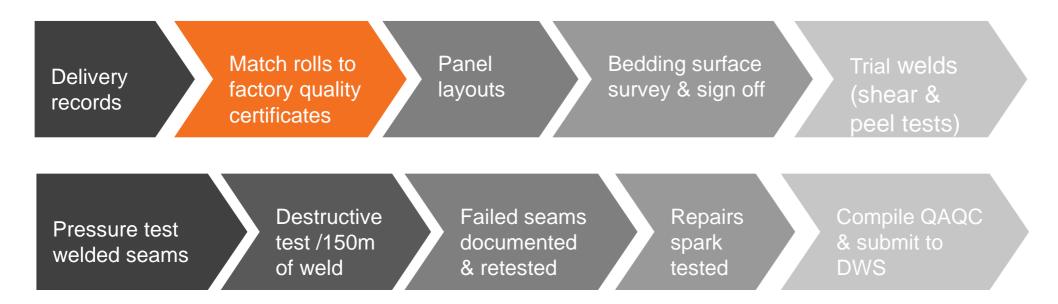
52 km of drainage pipes 700,000 m<sup>2</sup> of liner = 1,100 rolls 220 km of liner welds

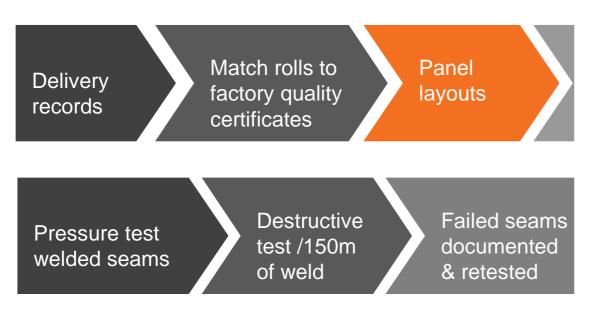
To ensure the tailings dam succeeds to limit seepage, it needs to be constructed to the highest standard

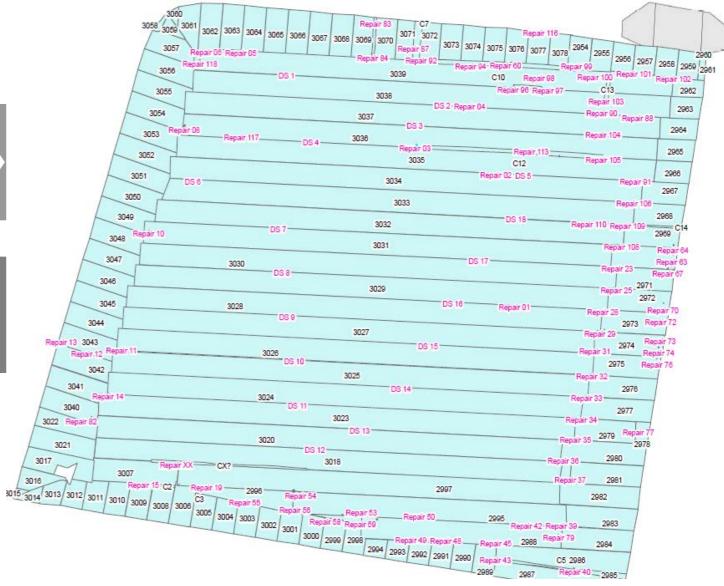


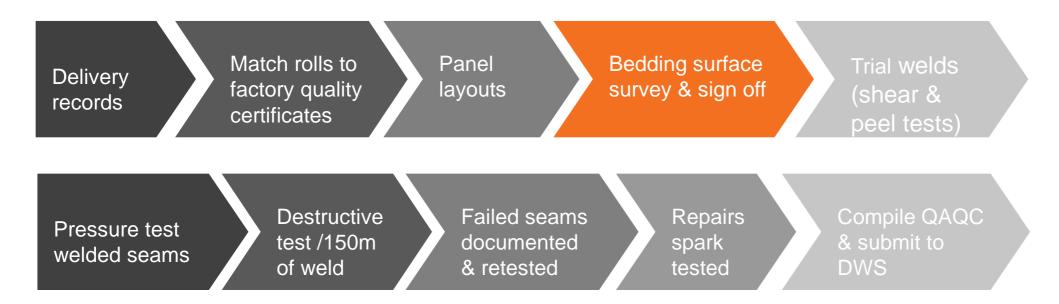










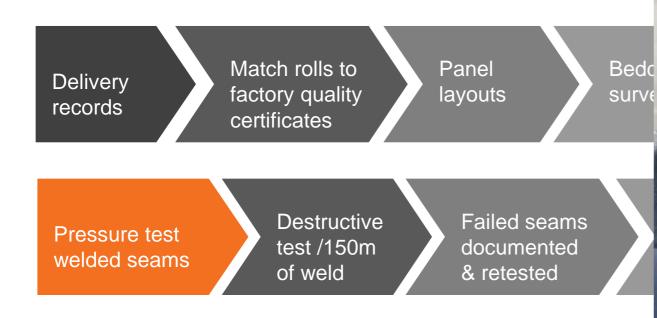


Quality control & assurance for liner

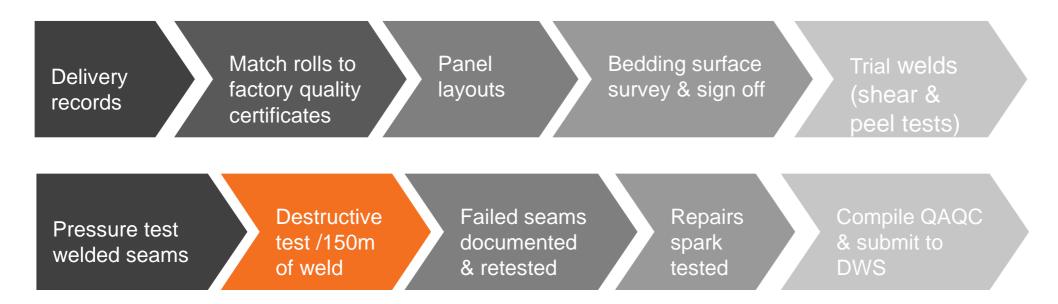


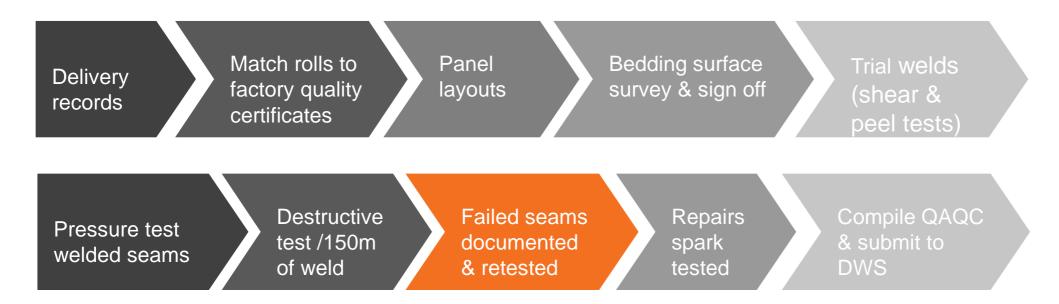
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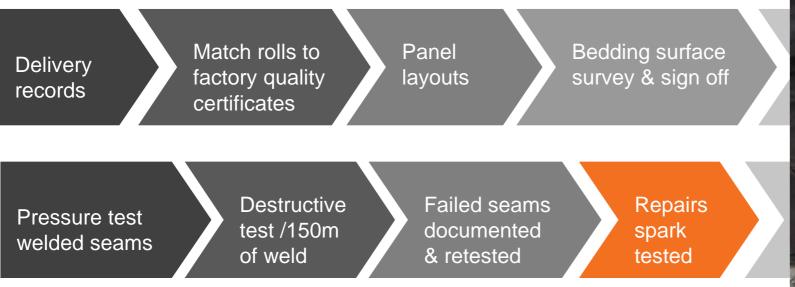
Quality control & assurance for liner



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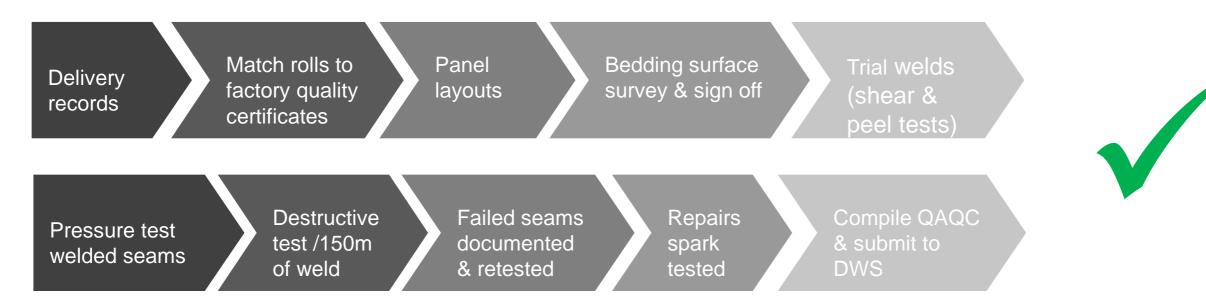


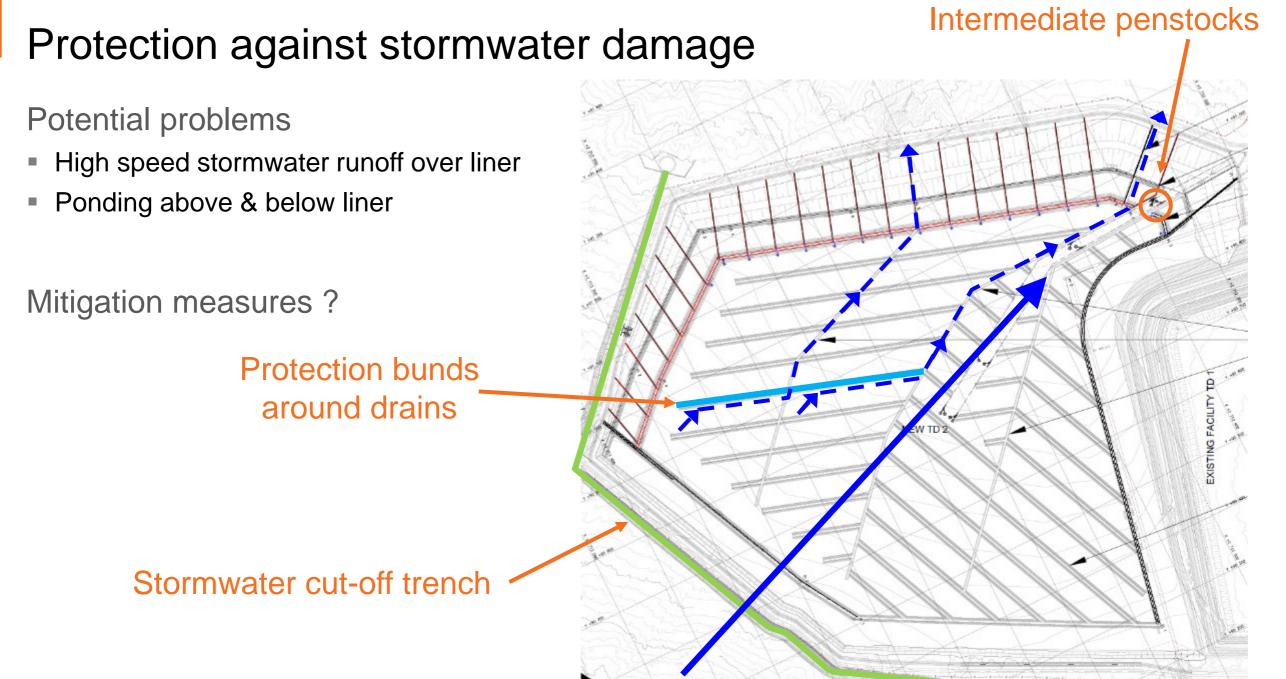
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PROJECT NAME: <u>Strg-isf &amp; Rwd In</u> Pre Panel Layout	RT DATE: <u>24 /09/2019</u> Mando PROJECT NO: <u>FR 8156</u> <b>DATE</b> 24/09/19	GF MATERIA ROLL NUMBER 471 459 471 459 471 459 471 459 471 459 471 459 471 459 471 459 471 459 471 443 471 443 471 443 471 443 471 443	RID REFER L DESCRIF PANEL NUMBER 3075 3068 3065 305 305 305 305 305 305 305 30	PTION: 11. PANEL LENGTH 13m 13m 13m 13m 13m 13m 13m 13m	PANEL G   WIDTH A   7m 7m	Sracoth L SROSS SREA A 9/100 9/100 9/100 9/100 9/100 9/100 9/100 9/100 9/100 9/100 9/100 1/200 1/200 1/200 1/200 1/200 22.500 2600 2600		& subm		C				
PROJECT NAME: <u>Strg-isf &amp; Rwd In</u> Pre Panel Layout	RT DATE: <u>24 /09/2019</u> Mando PROJECT NO: <u>FR 8156</u> <b>DATE</b> 24/09/19	GF MATERIA ROLL NUMBER 471 459 471 459 471 459 471 459 471 459 471 459 471 459 471 459 471 459 471 443 471 443 471 443 471 443 471 443 471 443 471 443 471 443	RID REFER L DESCRIF PANEL NUMBER 3075 3067 3065 305 305 305 305 305 305 305 30	PTION: 11. PANEL LENGTH 1.3m 1.4m 1.4m 1.6m 1.6m 1.6m 1.7m 1.6m 1.7m 1.6m 1.7m 1.6m 1.7m 1.6m 1.7m 1.6m 1.7m 1.7m 1.6m 1.7m 1.7m 1.6m 1.7m 1.7m 1.7m 1.6m 1.7m 1.8m 1.7m 1.7m 1.8m 1.7m 1.8m 1.7m 1.8m 1.7m 1.8m	PANEL G   WIDTH A   7m 7m   7m	Srapoth L SROSS SREA A 9/m 9/m 9/m 9/m 9/m 9/m 9/m 9/m		& subm		C				
PROJECT NAME: <u>Strg-isf &amp; Rwd In</u> Pre Panel Layout	RT DATE: <u>24 /09/2019</u> Mando PROJECT NO: <u>FR 8156</u> <b>DATE</b> 24/09/19	GF MATERIA ROLL NUMBER 471 459 471 459 471 459 471 459 471 459 471 459 471 459 471 459 471 459 471 443 471 443 471 443 471 443 471 443	RID REFER L DESCRIF PANEL NUMBER 3075 3068 3065 3066 3065 305 305 305 305 305 305 305 30	PTION: 11. PANEL LENGTH 13m 13m 13m 13m 13m 13m 13m 13m	PANEL G   WIDTH A   7m 7m   7m	Sracoth L SROSS SREA A 9/100 9/100 9/100 9/100 9/100 9/100 9/100 9/100 9/100 9/100 9/100 1/200 1/200 1/200 1/200 1/200 22.500 2600 2600		& subm		C				

SAIMM Tailings Storage Conterence 2020

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## Protection against stormwater damage



# Other challenges

Trafficking over liner

Concurrent construction of liner and drains

Storage of materials

Commissioning



## In conclusion:

Although there are many environmental benefits to the inclusion of a liner in a tailings dam, this does increase the **complexity** of the design, construction and operation of the tailings dam.