

In the event of flooding, the safety of your people should always be your number one priority.

- ✓ **Be particularly careful crossing flooded roads. While the water levels may not be hazardous, they can conceal other hazards. Water over the roads may have cause potholes, washouts or exposed rocks.**
- ✓ **Ensure that adequate manpower needs are addressed: Each location should have ample training and appropriate resources available to do the jobs needed.**
- ✓ **Remember PPE if involved in the clean-up: gloves, boots (waterproof if possible). Be careful of any cuts as the potential for infection is high; remember antiseptic cream and tetanus shots.**

Here are 10 tips to help your mine return to normal operations quickly safely.

1. **Each location in question will require a good visual assessment:** On the ground and at the location itself to determine specific issues and steps for corrective actions. What may be a concern at location/site X may be a non-factor at location/site Y. All sites that have been affected by this will need to understand that doing a good assessment for each location in question will, to a larger degree, determine the time frame in which sites can be back to full operation and production and loss of financial enumerations as such. A complete visual assessment will ensure that human safety is the top priority and employees are not at risk.
2. **Equipment may be fully submerged and require a full recovery to include a major flush of all systems:** Ensure that locations will have a clean and readily available work shop facility to begin equipment service. Make sure provisions are in place to document and track conditions of each asset/component for any potential warranty/insurance payable issues, as well as to accurately monitor conditions going forward; think of this as starting from ground zero. Most locations should have a contingency plan in place that may address things of this nature already; if that is the case refer to that plan as there is no reason to rewrite processes which are already in place.
3. **Do a thorough examination of your current Bulk Oil Supply storage facilities:** If these are contaminated, this oil should be removed, tanks flushed and any corrective actions needed to address source of entry and the damage. Do not place new oils into an already contaminated source. Follow the same guidelines with all bulk delivery trucks. Ensure that your new bulk oils which are arriving are at acceptable levels as this recent flooding, and other similar disasters, can be far reaching and may have affected the bulk oils/fuels from vendors as well. Do visual checks of oil condition and any onsite testing as you are able to do. Sample all oils and fuels and expedite samples to your testing labs.
4. **Establish a Mission Criticality and Priority List of which equipment/assets/components will need to be addressed first:** This may require that all engines have oil/filter changes regardless once conditions of bulk oil have been identified and determined as usable. Ensure that oil samples are taken after drain so that necessary condition monitoring can move forward. Other components' oils may be able to wait until a later date; this should be a case by case basis. Closely monitor the results of the next series of oil samples as there can and will be residual contamination in the samples of record and/or lingering effects as such.
5. **Ensure that your warehouse facility has adequate inventory of filters and breathers:** Do not allow short cuts to be abused just for the sake of getting equipment into operation. Using contaminated, old or wrong inventory can be just as destructive as not doing anything at all.
6. **Maintain your work shop facilities:** Ensure that additional contamination does not result from sloppy work environments. It is easy to get complacent during times like this. If you have access to usable water source, wash down equipment thoroughly, as cleaning allows for inspections and leak identifications.
7. **Be vigilant in OEM oil/filter change intervals at this point:** Depending on asset/ mission criticality, consider 1/2 normal intervals until conditions determine otherwise. This is equally as important for kidney loop filtration on components which were previously serviced in this way and not solely on a condition based schedule.

8. **Aggressively monitor your fuel sources, as water, algae and microbes will be present:** These conditions will plug filters both in delivery applications and in-service equipment. Biological growth—bacteria, fungi, mold—is likely due to the presence of water in the fuel. Condensation and poor storage practices are often the cause. As water is heavier than fuel, it settles to the bottom of storage tanks and becomes an immediate breeding ground for microbial growth. For locations that use a large amount of biodiesels, this fuel source has a shelf life of typically around 6 months. This can be reduced depending on many factors/variables.
9. **The effects of water are dramatic:** This should be a concern that takes top priority to ascertain as well as aggressively and immediately address. Failure due to water contamination may be catastrophic, but it takes time to fully come to fruition. Components and systems do have built-in tolerance, but keeping oil as dry and free of contamination as possible should be the top priority second only to human safety. Multiply the affects from abrasive wear to lubricated systems as dirt may be included in the equation as well.
- Shorter component life due to rust and corrosion: Water attacks iron and steel surfaces to produce iron oxides. Water teams up with acid in the oil and will corrode ferrous and nonferrous metals alike. Rust particles are abrasive and get ground up in the system where the associated metallurgical wear elements can serve as a catalyst which increases the process at an exponential rate. Abrasion exposes fresh metal which corrodes more easily in the presence of even lower concentrations of water and acid.
10. **Water etching/erosion and vaporous cavitation:** Water etching can be found on bearing surfaces and raceways. It is primarily caused by the generation of hydrogen sulfide and sulfuric acid from water-induced lubricant degradation with vaporous cavitation. If the vapor pressure of water is reached in the low-pressure regions of a machine, such as the suction line of a pump or the pre-load region of a journal bearing, the vapor bubbles expand. Should the vapor bubbles be subsequently exposed to sudden high pressure, such as in a pump or the load zone of a journal bearing, the water vapor bubbles quickly contract (implode) and simultaneously condense back to the liquid phase. The water droplet impacts a small area of the machine's surface with significant force in the form of a needle-like micro-jet, which causes localized surface fatigue and erosion. Water contamination also increases the oil's ability to entrain air, thus increasing gaseous cavitation.
- Hydrogen embrittlement: Hydrogen embrittlement occurs when water invades microscopic cracks in metal surfaces. Under extreme pressure, water decomposes into its components and releases hydrogen. This explosive force causes the cracks to become wider and deeper, leading to spalling.
 - Oxidation of bearing babbitt (material)
 - Wear caused by loss of oil film or hard water deposits: Rolling element bearings and the pitch line of a gear tooth are protected because oil viscosity increases as pressure increases. Water does not possess this property. Its viscosity remains constant (or drops slightly) as pressure increases. As a result, water contamination increases the likelihood of contact fatigue (spalling failure).
 - The effects of water on lubricating oil can be equally as harmful:
 - Accelerates oxidation of the oil;
 - Depletes oxidation inhibitors and demulsifiers;
 - May cause some additives to precipitate;
 - Causes ZDDP anti-wear additive to destabilize over 180°F;
 - Competes with polar additives for metal surfaces.



If you have questions regarding the above tips or need further support, please contact Liam Gannaway, Australian Operations Manager, at lgannaway@dingo.com. **Our Condition Intelligence experts are ready and available to help.**