



TECHNICAL WHITE PAPER

WASHPLANT SELECTION BASED ON MINING METHOD





Alluvial / Placer gold washplants are selected based on various factors, including the deposit type and most suitable mining method. This whitepaper outlines some of the most common mining methods around the world and explains the washplant options for each method. Simplified diagrams illustrate material handling examples, but are not intended to be accurate or complete.

Macon has developed a comprehensive lineup of gold washplants and support equipment - including grizzly feeders, stacker conveyors, water pumps, power generators and concentrate cleanup systems – suitable for many different ground conditions and mining methods. Focus has long been on mobile mining and processing methods, reducing fuel consumption and emissions.

Since geological features of a deposit are given, mining and processing methods have to adapt. The most suitable washplant option will depend on the ground conditions, mine layout and most elegant tailings deposition and reclamation concept.



Deposits are generally classified as deep or shallow deposits, depending on the depth of overburden, considering 10m (30ft) as the boundary between deep and shallow deposits. Gravel type, clay content and groundwater levels may differ.

Washplants can be skid mounted, tracked or floating on pontoons, depending on the ground conditions, mining method and level of mobility required. Skid mounted washplants, depending on their size and weight, require heavy enough excavators or dozers to maneuver them.

WASHPLANT SPECIFICATIONS

	CLASS	300	350	400	500	600/700
PROCESSING CAPACITY	T/H	50-75	100	100-180	200-330	300-450
WATER REQUIREMENT	GPM	1,100	1,500	2,200	2,900	3,600
RECOMMENDED GENERATOR	KVA	30	30	50-100	100	100
WEIGHT	POUNDS	19,000	13,500	35,000	70,000	95,000
TOWING EQUIPMENT REQUIREMENT	EXCAVATOR DOZER	20 TON D6	20 TON D6	30 TON D7	40 TON D9	50 TON D10

1. Deep Deposits

Alluvial deposits with overburden depths of 10m (30ft) or more are considered deep, typically requiring multiple benches for overburden removal. The stripping ratio may be 10:1 for example if 20m (60ft) of overburden need to be removed to access 2m (6ft) of alluvial gravels. Deep deposits are mined in “pits” and sometimes host multiple mineralized layers with barren gravel or clay layers in between.

1.1. Deep Gravel Deposits

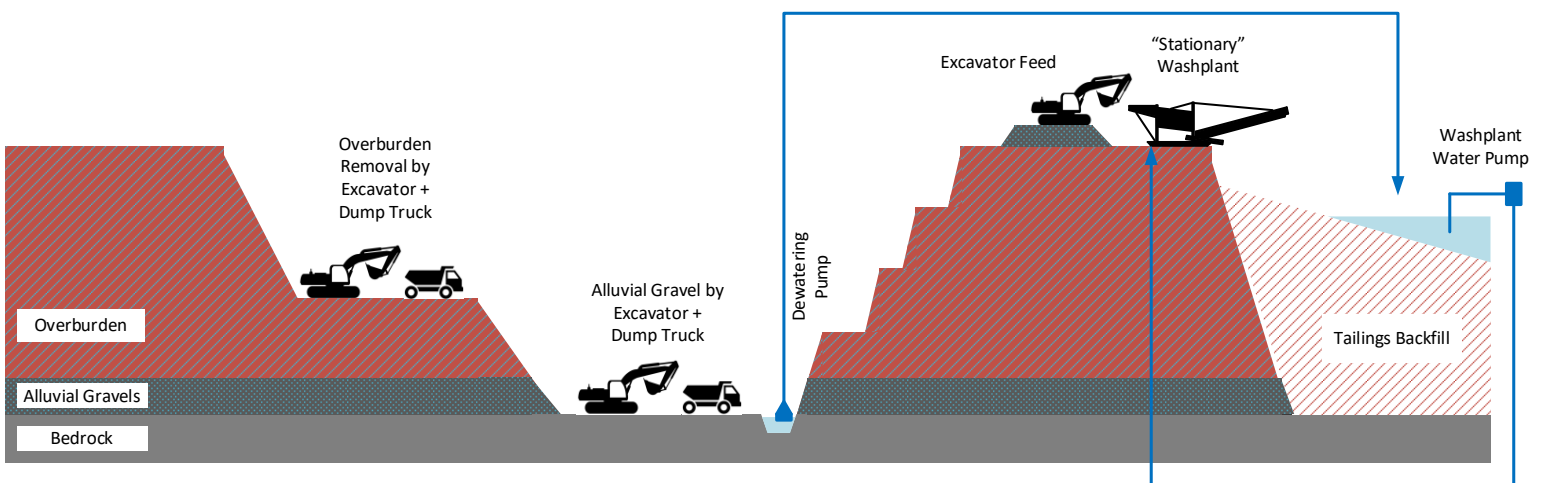
Deep gravel deposits consist of well-draining overburden with rock-gravel-sand components and only minor clay. Overburden may be removed from several benches simultaneously. Solid roads allow for the utilization of wheeled haul trucks. Alluvial gravels are hauled to a high plateau where the washplant is situated and from where tailings can flow downhill into large volume impoundments. Due to the flexibility that comes with trucking and the large tailings capacity, washplant relocation is infrequent (i.e. once per year), classifying as a stationary washplant setup. Pumps are used to dewater the deep pit and to supply clean process water to the washplant. Although hauling overburden and alluvial gravels by truck is fuel intensive, this mining and processing method is widely used due to its operational flexibility.

Best washplant options:

- 400-600 class shaker deck (SD) or trommel (T) Washplant

Best feeder options:

- Attached wash-hopper or drag-chain Feeder (excavator feed) OR
- Separate Grizzly Feeder (GF) (front end loader feed)



1.2. Deep Clay Deposits

Common in West Africa, deposits are covered by a clay-rich overburden, requiring mobile equipment to be track mounted. Therefore, material is handled exclusively by excavator. The mining sequence consists of a series of individual pits that follow the alluvial channel. Deposits may contain some coarse gold while significant value can be in the very fine (<100 micron) size fractions, justifying the installation of equipment specifically designed for very fine gold.

Excavators (30 ton class) feed alluvial gravels directly onto a skid mounted washplant placed on bedrock within the pit. Tailings from the washplant are pumped to a secondary fine gold recovery module. Slurry pumping is an efficient means of transporting material, scrubbing (clay breakup by pump impeller) and pit dewatering (groundwater).

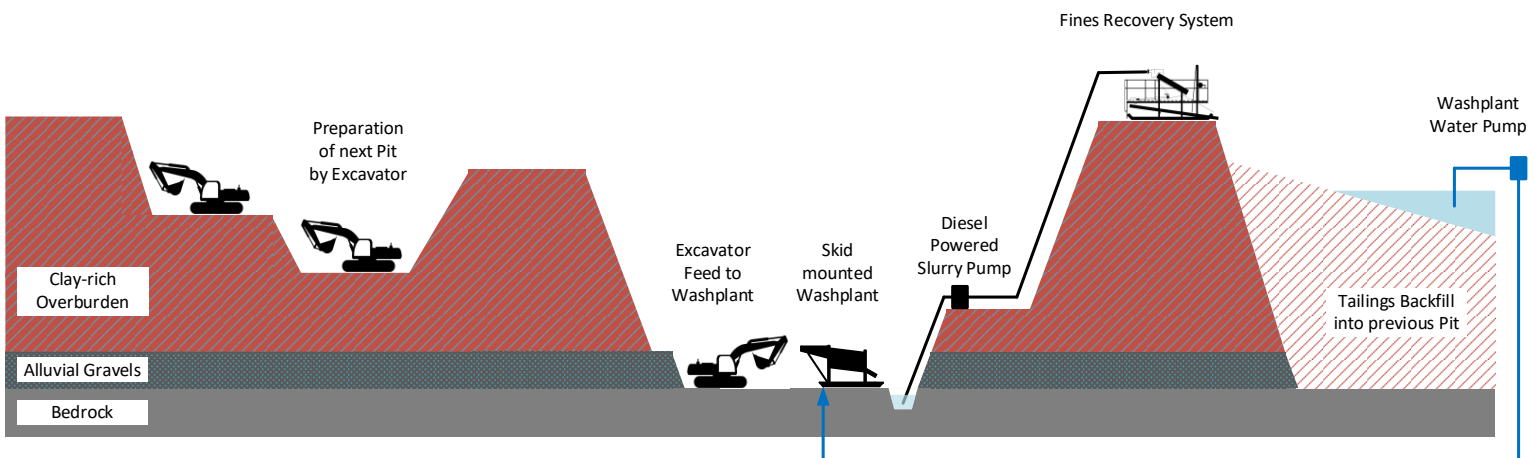
The washplant is kept in close proximity to the excavator, requiring frequent (weekly) relocation within the pit. Since access ramps to the pits are steep and clay-rich overburden making the maneuvering of equipment difficult, washplants need to be skid mounted and of light yet robust design.

Best washplant options:

- 350-400 class shaker deck (SD) or trommel (T) Washplant
- Fine Gold Recovery Module (FRS)

Best feeder options:

- Attached wash-hopper (excavator feed)



2. Shallow Deposits

Alluvial deposits with overburden depths of 10m (30ft) or less are considered shallow. The stripping ratio may be 3:1 for example if 3m (10ft) of overburden need to be removed to access 1m (3ft) of alluvial gravels. Shallow deposits allow for large scale lateral mining “cuts” to be opened.

2.1. Shallow Dry Excavation (Semi-Mobile)

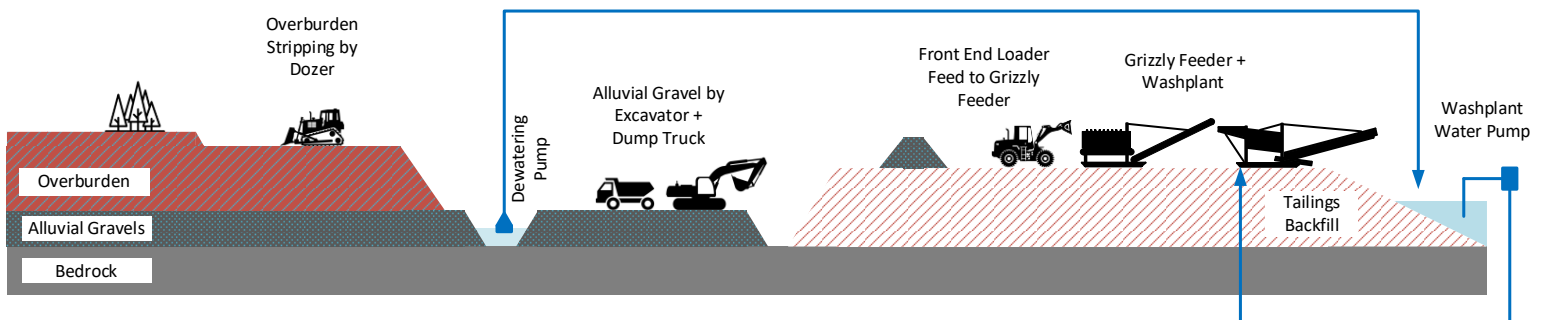
Stripping is done by dozer and sometimes using hydraulic monitoring where overburden is frozen and of high organic matter. Alluvial gravels are excavated and hauled to a pad where the washplant is located. Trucking provides high flexibility, allowing to shift between mining areas or haul alluvial gravels from multiple directions to one large washplant. Grizzly Feeders are popular where gravels are well-washed and with minimum clay content, providing highly consistent feed to the washplant. Since the tailings impoundment is shallow, tailings re-handling can be minimized if the washplant is moved frequently along the edge of the developing tailings impoundment (i.e. every two weeks). The washplant is preferably positioned just outside the active mining cut, hence minimizing fuel consumption related to material hauling. Please refer to Macon’s Case Study on “Emissions comparison between mobile and stationary washplant concepts in placer gold mining” for more information.

Best washplant options:

- 400-600 class shaker deck (SD) Washplant

Best feeder options:

- Attached drag-chain Feeder (excavator feed) OR
- Grizzly Feeder (GF) (front end loader feed)



2.2. Shallow Dry Excavation (Mobile)

Even in relatively shallow deposits, overburden stripping and hauling is the dominant expense in an alluvial (placer) mining operation. The utilization of mobile (track mounted) conveyor belts can reduce haulage and fuel consumption. Gavel type overburden, without clay or large boulders, is excavated and loaded directly to a conveyor belt for stacking outside the cut. Multiple stacking conveyors may be arranged in series to gain higher elevation. Dozers are used to level out the piles generated by the stacker and re-apply the topsoil layer.

The exposed alluvial gravels are mined by excavator directly feeding a highly mobile, track mounted washplant. Since excavator and washplant must remain in close proximity at all times, with gravel in reach of the excavator bucket, both units need to move frequently (i.e. 30m (100 ') every 4 hours). A track driven washplant is equipped with onboard diesel-hydraulic power and can be maneuvered from a wired remote control. Trommel washplants are particularly suited since all components (including the trommel drive) can be hydraulic powered.

An attached drag-chain feed hopper allows the excavator operator to dump a full bucket and provides steady feed to the washplant, while the operator is excavating more material.

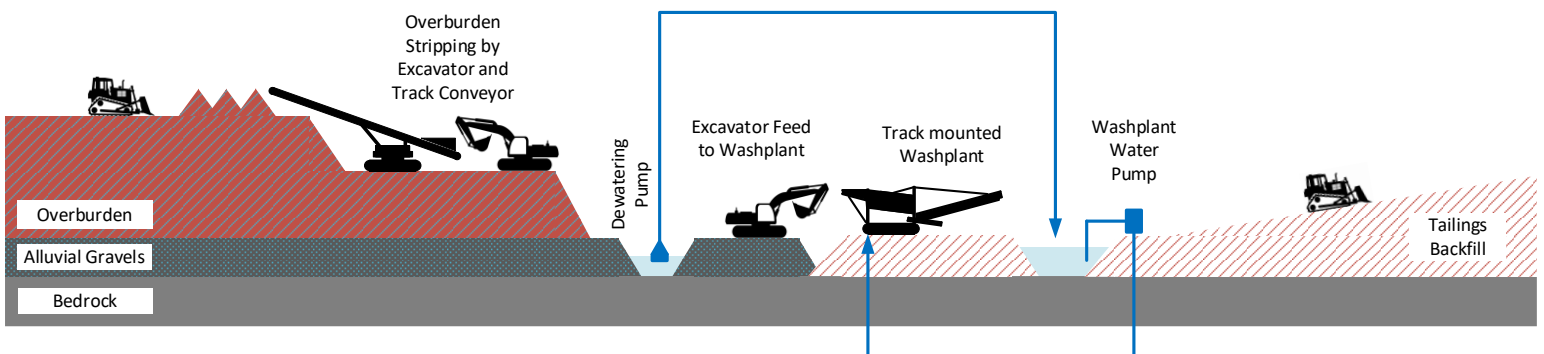
Water supply lines come in modular sections for fast dis-/re-connect. Floating de-watering pumps are a good option to remove groundwater from the active cut.

Best washplant options:

- Track mounted 500-700 class trommel (T) Washplant

Best feeder options:

- Attached wash-hopper (excavator feed) OR
- Attached drag-chain Feeder (excavator feed)



2.3. Shallow Wet Excavation

Common in New Zealand and South America, and applicable where groundwater levels are high, bedrock is even, predictable and within the excavators reach, wet excavation of the alluvial gravel layer can be considered.

Wet excavation comes with the difficulty of requiring a very experienced excavator operator, since there is no visual reference of the underwater excavation. If bedrock is uneven or ground contains large boulders, extraction of the alluvial layer may be incomplete. This method is not recommended where gold is concentrated directly at bedrock, but rather where distributed over multiple feet above bedrock.

Overburden is stripped by dozers until the alluvial gravel layer is exposed along a narrow, flooded cut. A floating washplant, mounted on pontoons, and positioned via cable winches, is fed by a land based excavator. Tailings and oversize are discharged in the opposite direction and stacked above groundwater elevation.

Floating washplants are equipped with onboard power generator and water pump and require no levelling, making it an extremely mobile and energy efficient solution.

Best washplant options:

- Pontoon mounted 400-600 class Trommel (T) or Shaker Deck (SD) Washplant

Best feeder options:

- Attached wash-hopper (excavator feed)

