

## Machine Demonstration Analysis and Preliminary Results

Geoff Coley<sup>36</sup>

In support of the HCR-CTRO symposium in April 2007, a machine demonstration was conducted. In this event 10 parallel test/demonstration lanes were prepared in the Skradin-area demonstration field. In each lane three fibreboards were placed in the manner described by CWA15044. Three additional decoy areas, or strips, were prepared so that the machine operators could not tell where the three boards were located. The manufacturers/operators were given an instruction about how to use their machines (see attachment below). The machines were timed on the outbound 50m lane, and they were timed on their turnaround. The fibreboards were set to be able to capture the outbound lane plus the intended 30cm overlap. In the end only nine machines were present to run the course.

Using this information plus the manufacturers' published working width, it was possible to present a snapshot of the digging capability of each machine and to extrapolate the time required to process a 100m x 100m area including working time and turnaround time. Of course it is possible that each of the machines could have been operated faster in order to improve the 1 ha processing time. It is also possible that slower operation might have resulted in better depth results. The MV-4 suffered some kind of breakdown part way through the run. The Hydrema MFV2500 working head was driven hard enough to bog down a couple times. The Samson 300 created such a cloud of dust that the operator could not see and had to stop briefly, and the machine had apparently been mistakenly set for a depth of 15cm instead of 20cm. The Minewolf was operated at a very high speed but the working head porpoised up and down throughout the run. Clearly each of the machines might have been able to achieve different or possibly better re-

sults had they been operated in a different manner. The limitation of this demonstration is that it provides just a single snapshot into the performance of each machine. There are many other important factors in the evaluation of a machine, including fuel consumption, spares needed, training, transportability, and maintenance.

Although most of the machines looked impressive from the viewing area, inspection of the lanes showed that some of them did not dig as deeply as they were capable. None of the depths achieved was very deep. This was not a function of the soil conditions as test team members have seen some of these machines dig deeper in harder soils. It appeared that some of the machine owners or the operators might not have taken the soil working portion of the day very seriously, with some of the test team wondering if some of them would have done a better job if they had been working a real minefield.

For the purposes of this discussion, the following definitions and conditions apply:

- Target Overlap: Machines were to create an outbound lane, turn around and then create a return lane having a 0.3m overlap with the outbound lane.
- 1 ha Processing Time: Using the time to process the 50m outbound lane, the time to turn around, the published working width of the machine and the 0.3m overlap, a time was calculated for the machine to complete a hypothetical 100m x 100m area.
- Centre Band: Assuming that lanes were to have a 0.3m overlap, the centre portion of the working width was calculated for each machine. For example, the Bozena-4 has a published width of 2.22m. With a 0.3m overlap shoulder on each side, this amounts to a centre band of 1.62m (2.22-0.3-0.3), or 73% over

<sup>36</sup> Defence R&D Canada - Suffield Ralston, AB, T0J 2N0 Canada, e: geoff.coley@drdc-rddc.gc.ca

the published working width. ROI, or Region of Interest is the same as Centre Band.

- Target mine: While no mines were used in the demonstration, a hypothetical round mine of diameter 5cm (similar to a PMA-2) was used for the purposes of calculations.
- Maximum Effective Depth: Based on the three fibreboards, this is the minimum depth at which a target mine might have been able to hide without being contacted by the machine. In this calculation the two 0.3m wide shoulder areas are disregarded and only the remaining centre band is considered since it is assumed that poor performance in the shoulders would be erased when the next lane is overlapped. MED for the full width is also

available.

- Penetration Efficiency (PE(20)): Based on the three fibreboards, this is the percentage of the lane that was successfully processed to the indicated depth (in this case, 20cm). For example, if PE(20)=92%, it suggests that the machine was able to process 92% of the lane to a depth of 20cm. Similar values are given for depths other than 20cm. Like MED, this considers only the centre band, although the full width data is available.

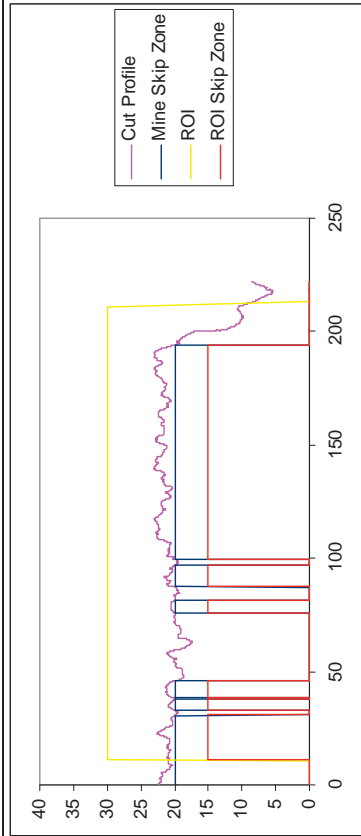
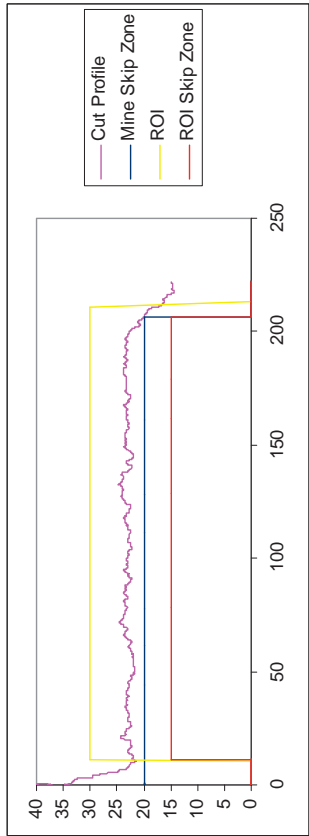
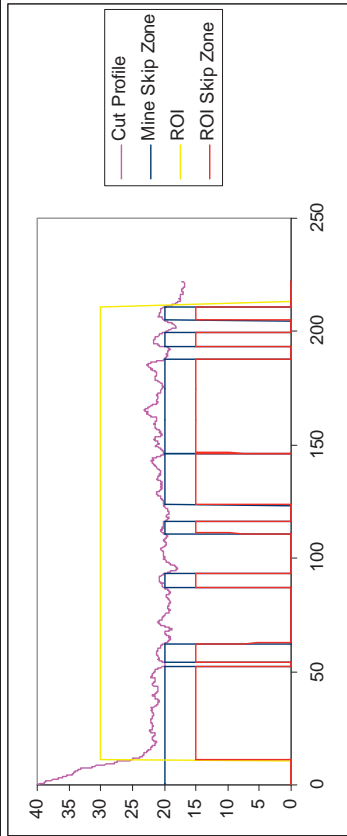
The summary of performance assuming a goal of 20cm depth is shown in Tables A1,A2 and A3. The results are presented in more detail in the appendices that follow.

| Table A1 – Performance Summary – Light Machines |      |                                |                              |                                  |
|---|------|--------------------------------|------------------------------|----------------------------------|
| Machine   | Lane | 1ha Processing<br>Time (hours) | MED<br>(centre band)<br>(cm) | PE(20cm)<br>(centre band)<br>(%) |
| Bozena-4  | L1   | 23.14                          | 16                           | 20%                              |
| MV-4  | L2   | 13.82                          | 0                            | 18%                              |

| Table A2 – Performance Summary – Heavy Machine |      |                                |                              |                                  |
|--|------|--------------------------------|------------------------------|----------------------------------|
| Machine  | Lane | 1ha Processing<br>Time (hours) | MED<br>(centre band)<br>(cm) | PE(20cm)<br>(centre band)<br>(%) |
| Minewolf                                       | T2   | 3.60                           | 10                           | 18%                              |

| Table A3 – Performance Summary – Medium Machines |      |                                |                              |                                  |
|--|------|--------------------------------|------------------------------|----------------------------------|
| Machine  | Lane | 1ha Processing<br>Time (hours) | MED<br>(centre band)<br>(cm) | PE(20cm)<br>(centre band)<br>(%) |
| RM-KA-02   | S1   | 7.28                           | 1                            | 17%                              |
| Samson-300                                       | S2   | 9.07                           | 8                            | 0%                               |
| Mini-Minewolf                                    | S3   | 10.77                          | 19                           | 90%                              |
| Bozena-5   | S4   | 11.31                          | 11                           | 85%                              |
| HydremaMFV2500                                   | S5   | 12.27                          | 7                            | 0%                               |
| MV-10  | S6   | 8.28                           | 9                            | 25%                              |

Appendix 1 – Bozena-4



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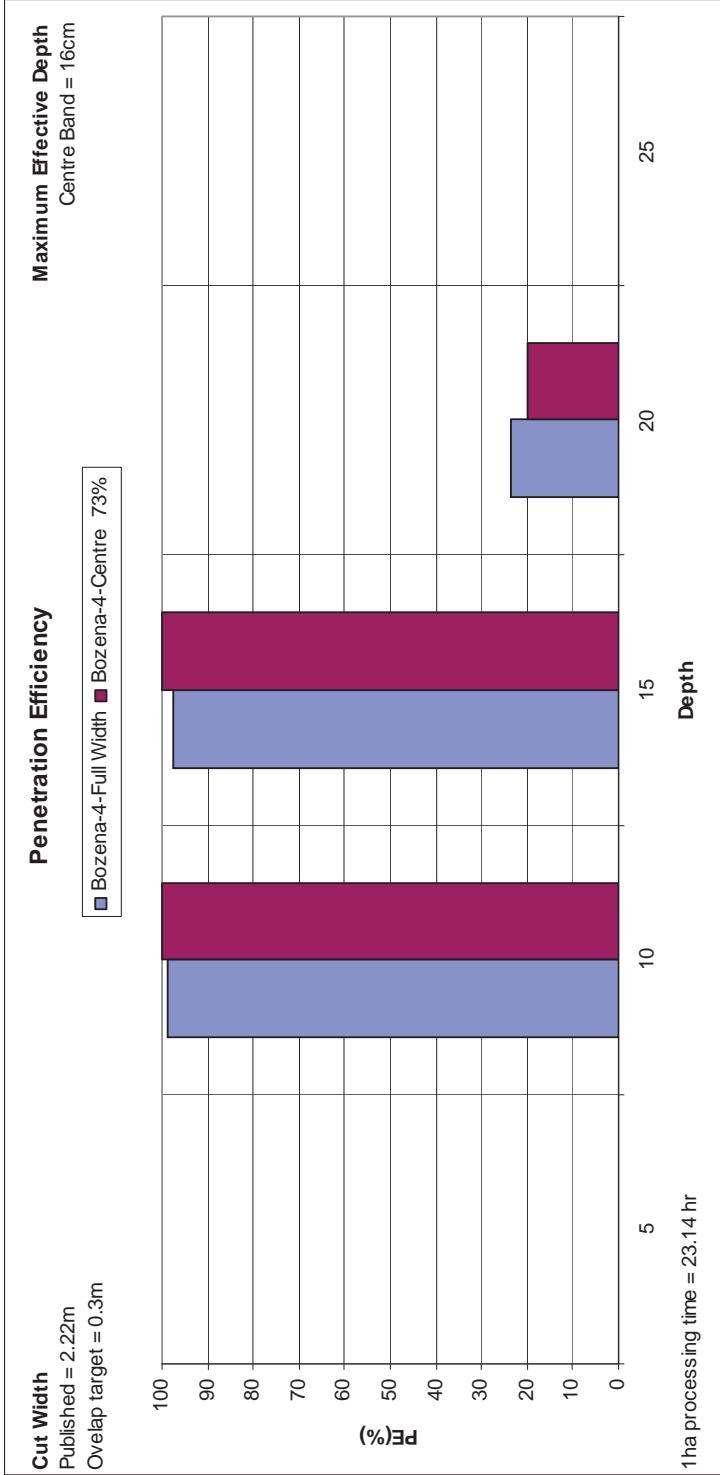
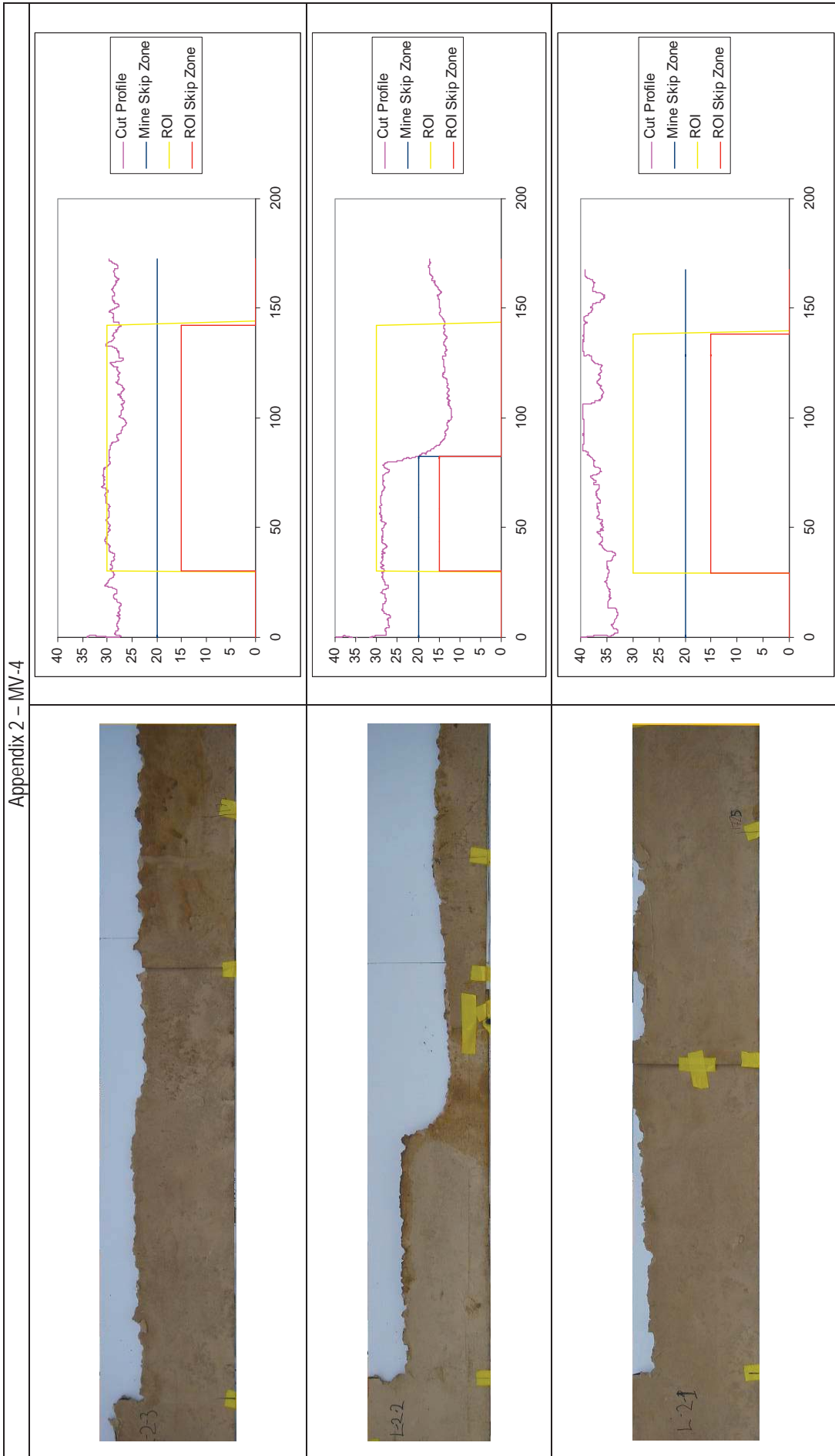


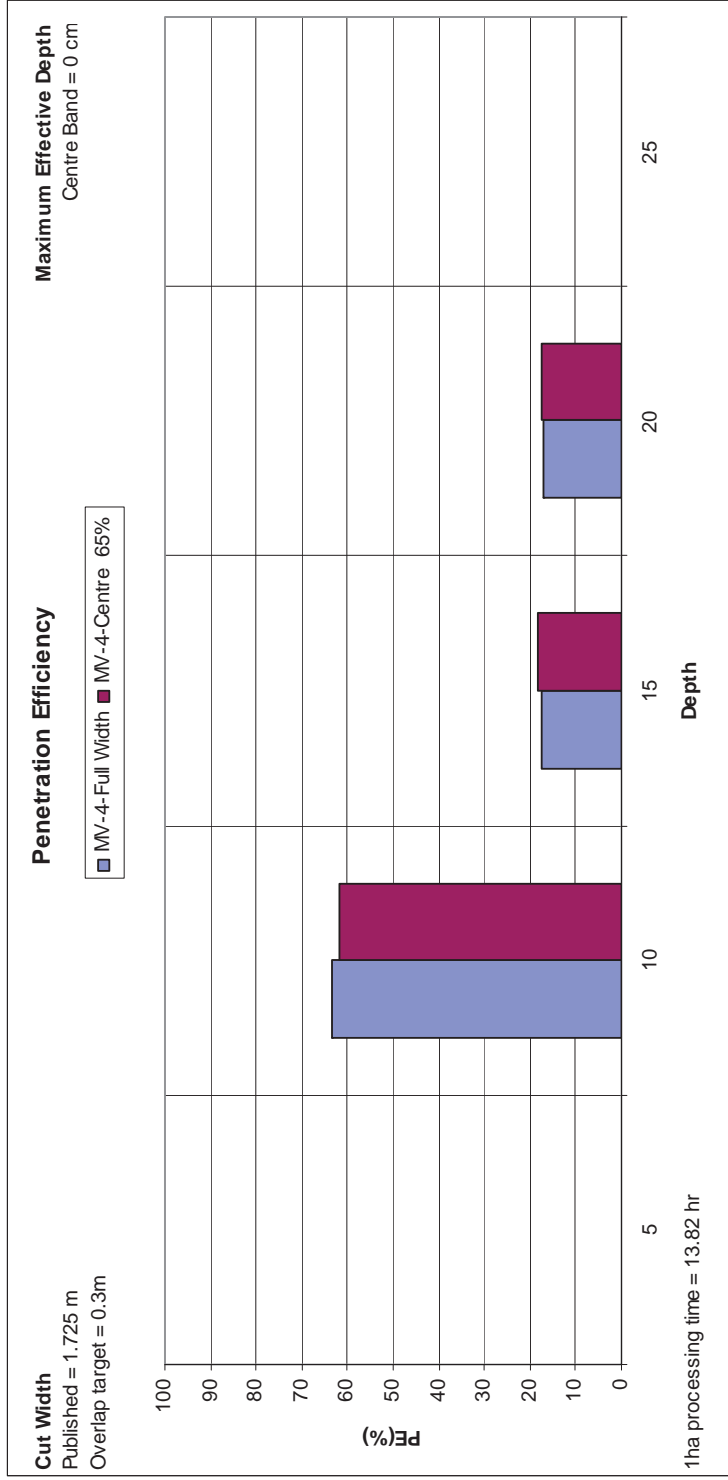
Photo not taken at symposium demonstration

- Dead crawl all the way through – appeared to have consistent speed control. Some evidence of soil wave suggesting that machine may have been under manual depth control.

Appendix 2 – MV-4

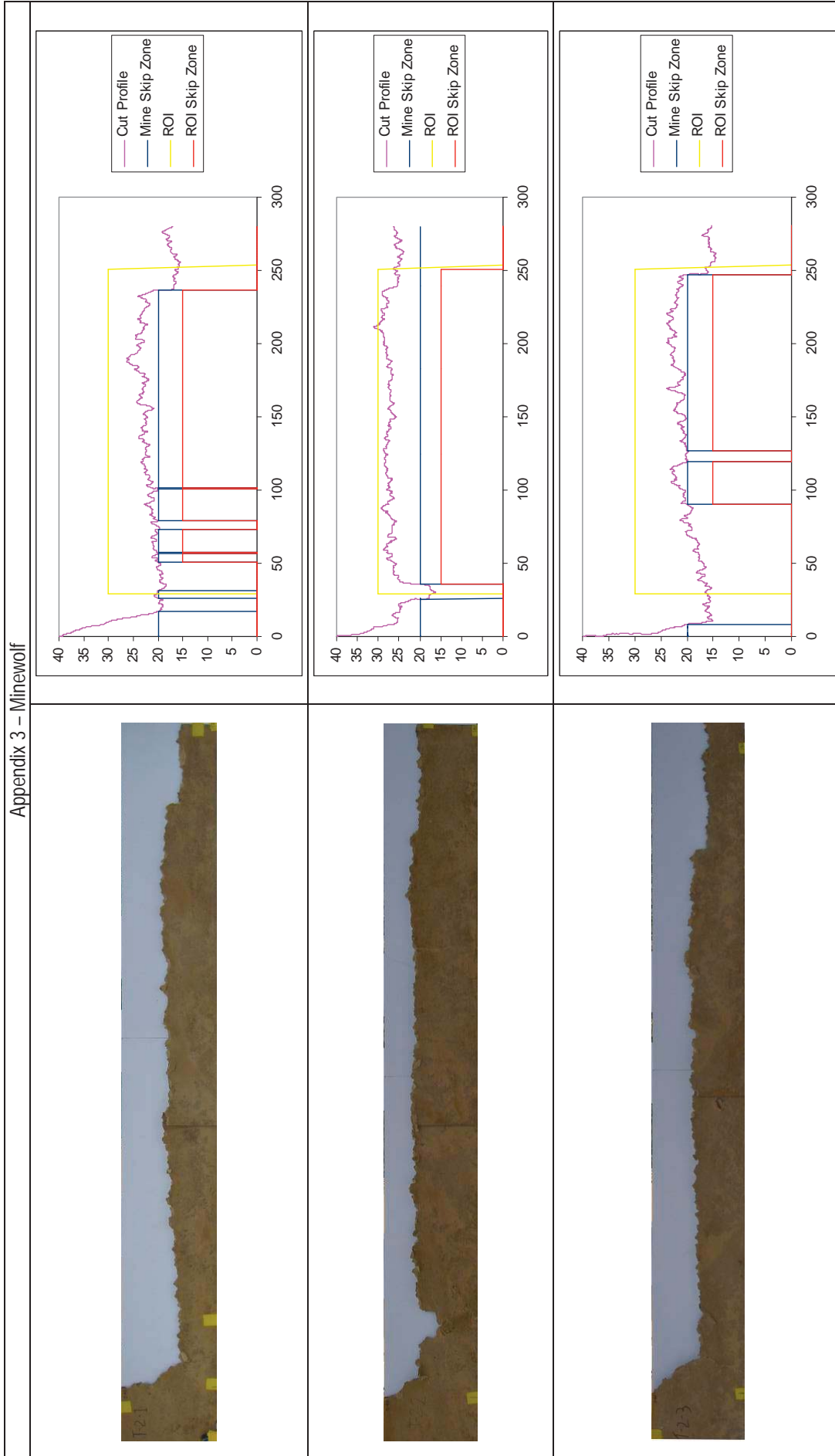


Appendix 2 – MV-4

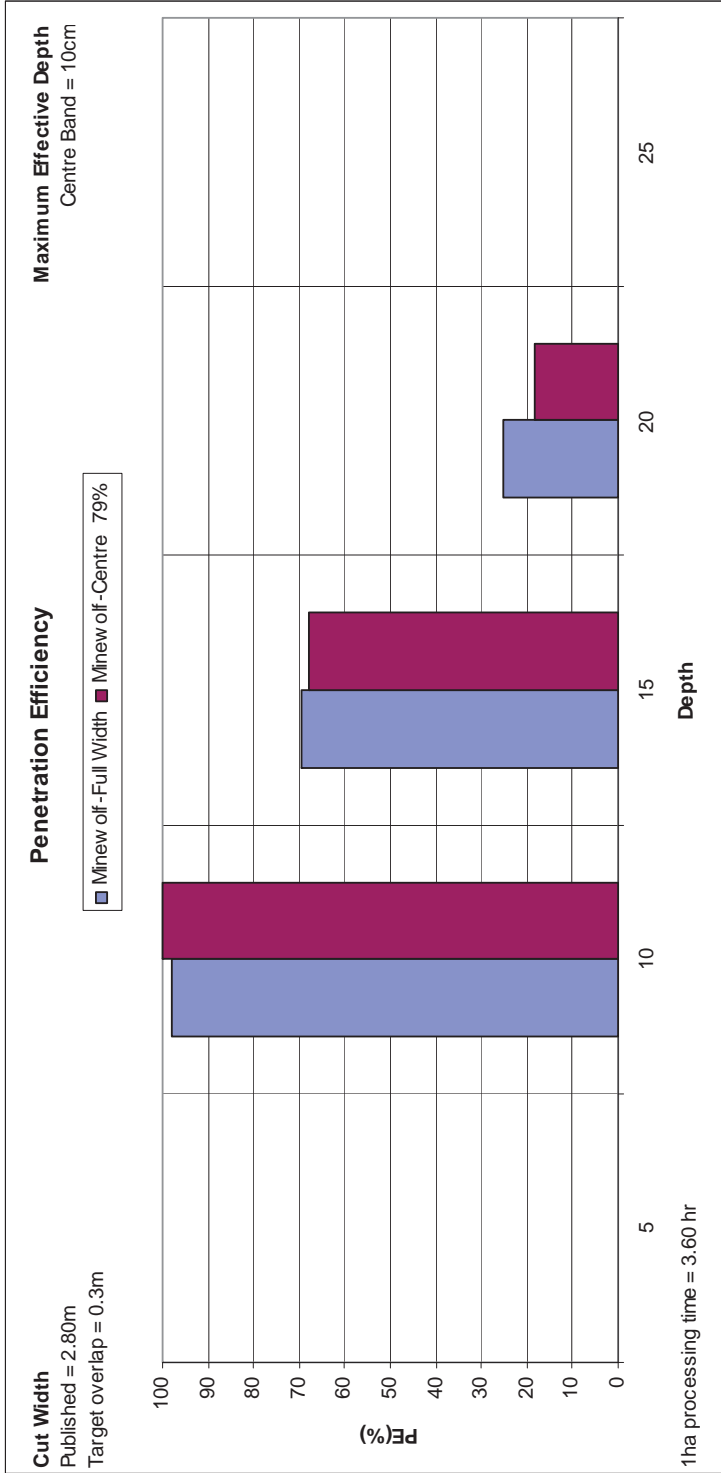


- Out of the gate very fast but slowed to a crawl, possibly stopping right at strip 2. Very erratic speed control – stop/start movement in some places. Erratic depth control throughout – flail head completely clear of the ground near strip 4. Appeared to stop near 4<sup>th</sup> strip. Quit working altogether part of the way back. Claimed equipment malfunction.

Appendix 3 – Minewolf

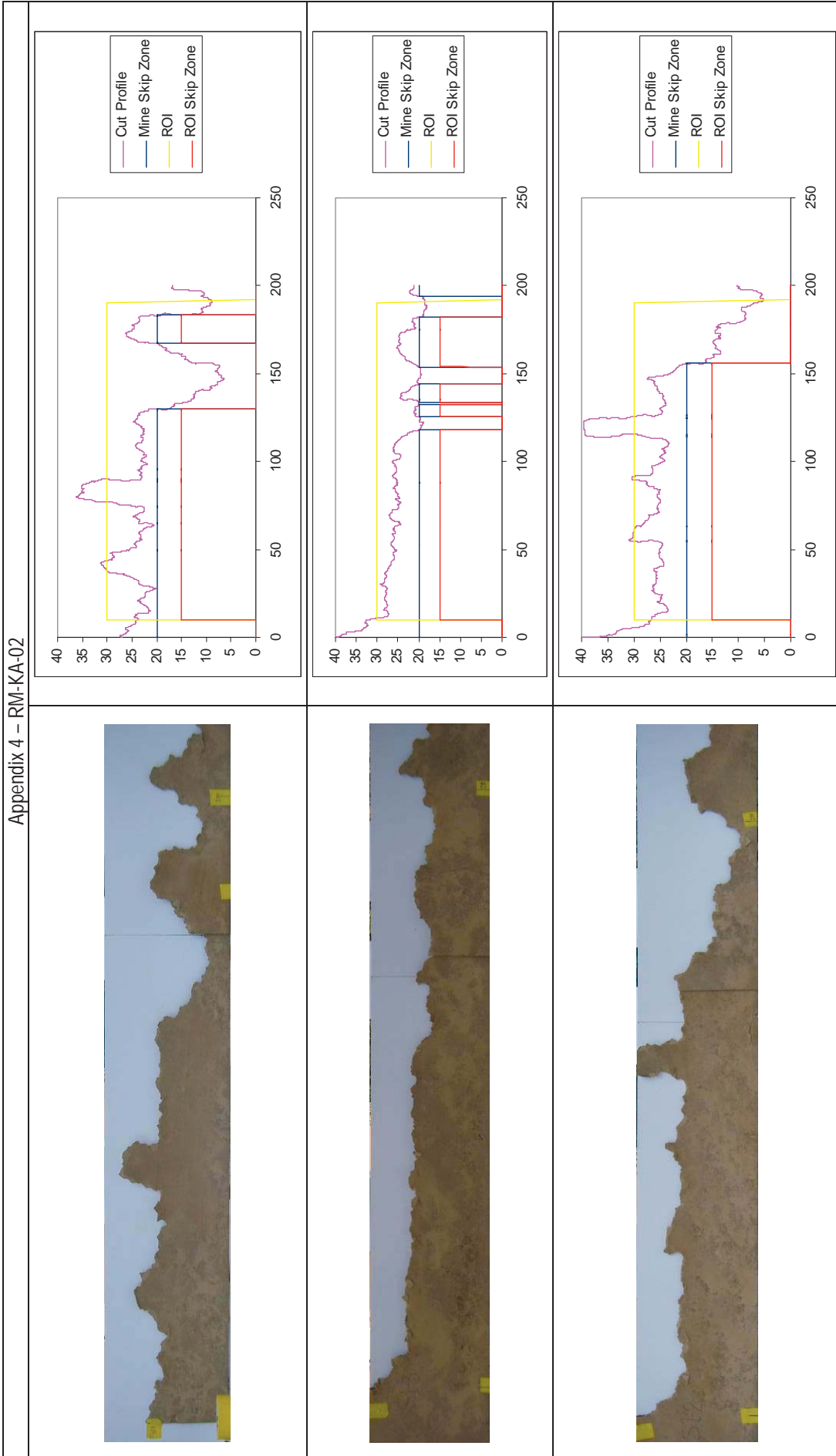


Appendix 3 – Minewolf

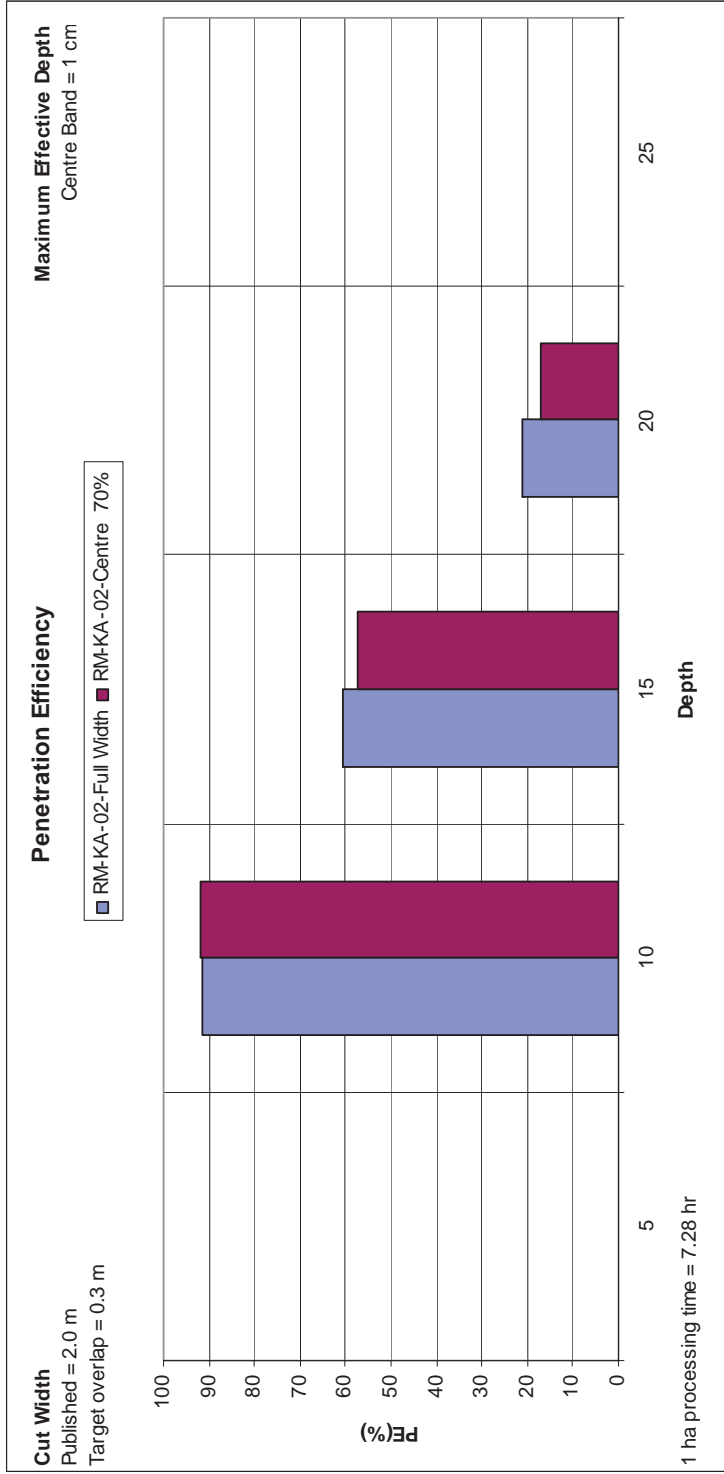


- Operated very fast and with erratic depth control. Very little dust cloud as soil is sliced, not pulverized. Throws a lot of debris under/behind machine. Speed consistent throughout. Tiller head porpoised its way through the test – operator control or a lag in the feedback?

Appendix 4 – RM-KA-02

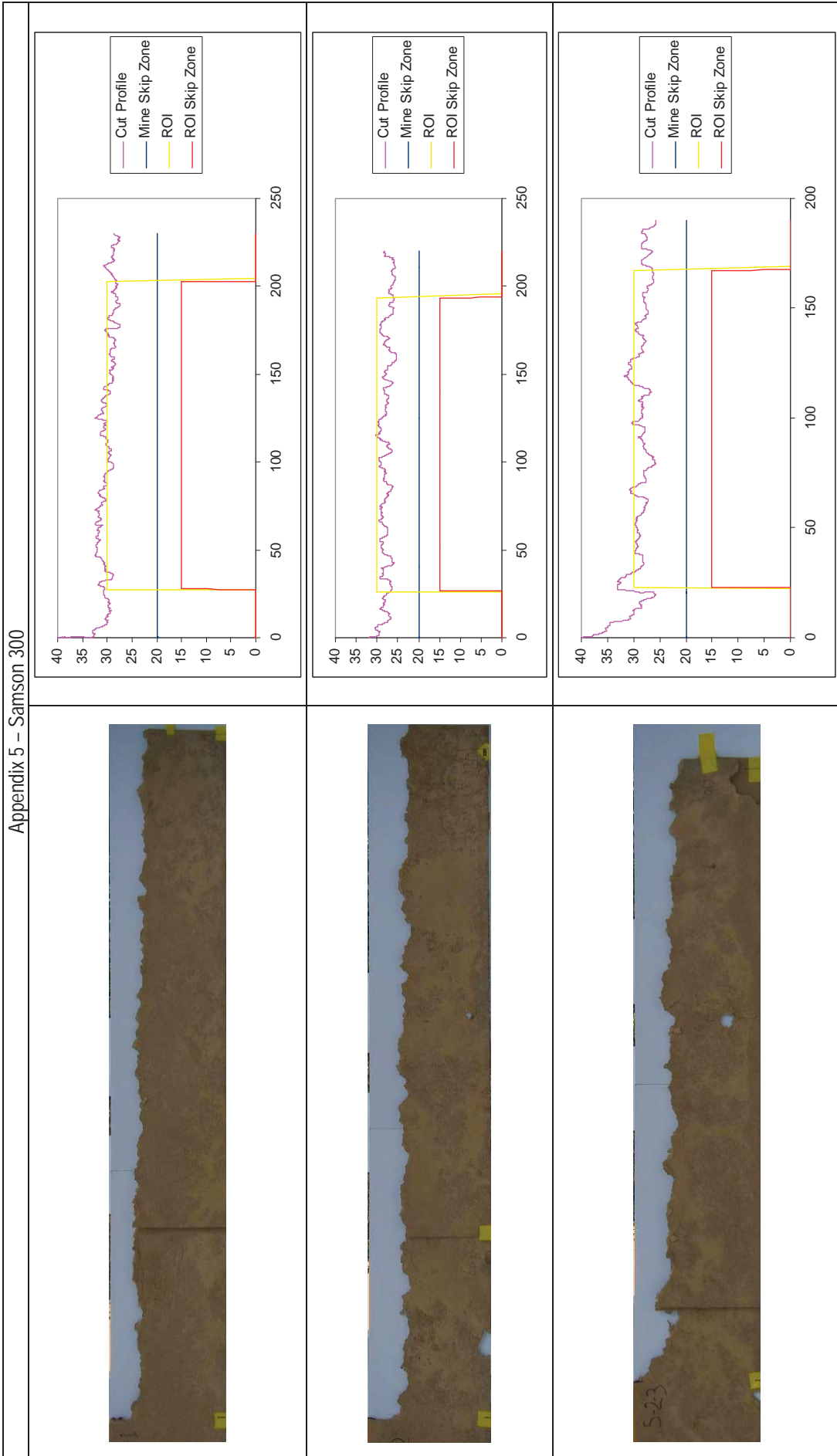


Appendix 4 – RM-KA-02

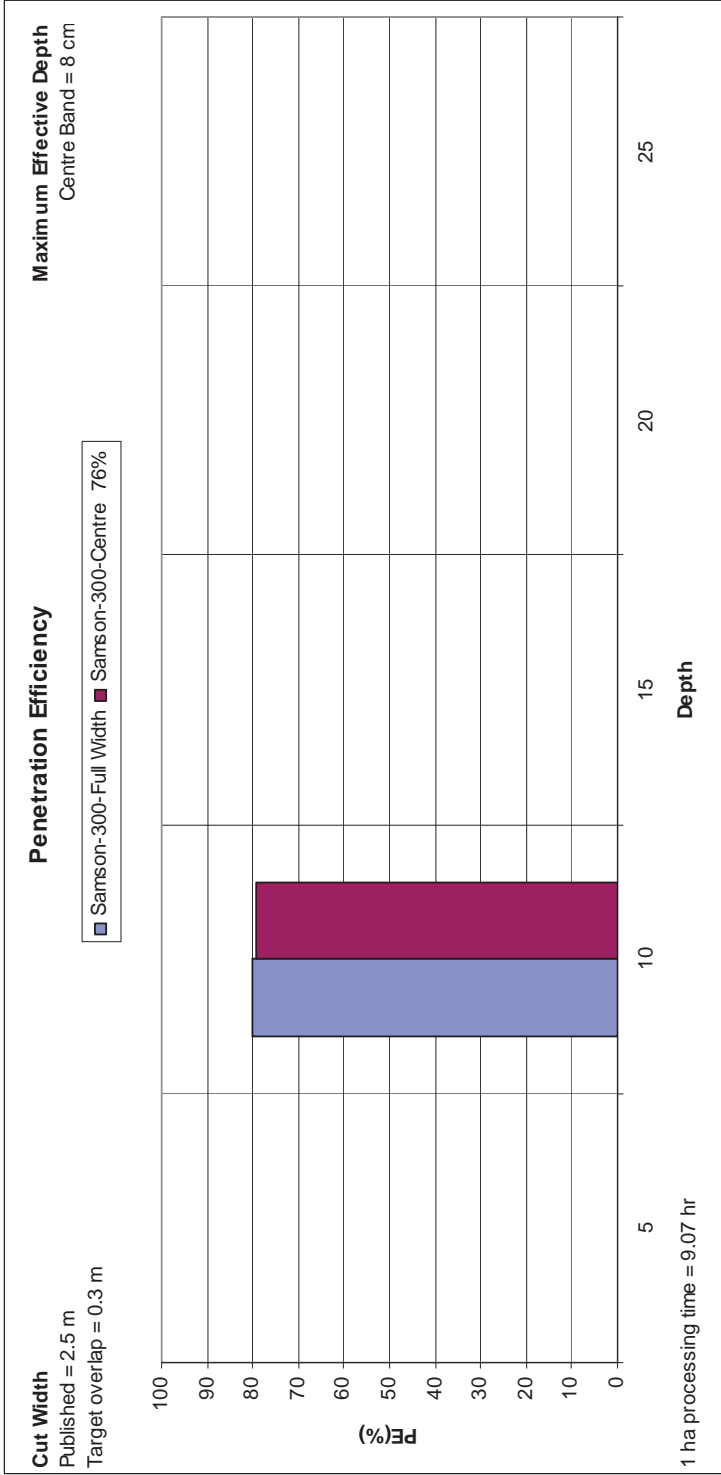


- RC operator wandered well into the test lane following the machine (far closer than the 50m requirement) until called back by official. (Was first machine to run so requirement may not have been clear to the operator.) Was forced to stop once on the return run because the visibility of the operator was obscured by a cloud of dust created by the operation of the Samson machine.

Appendix 5 – Samson 300

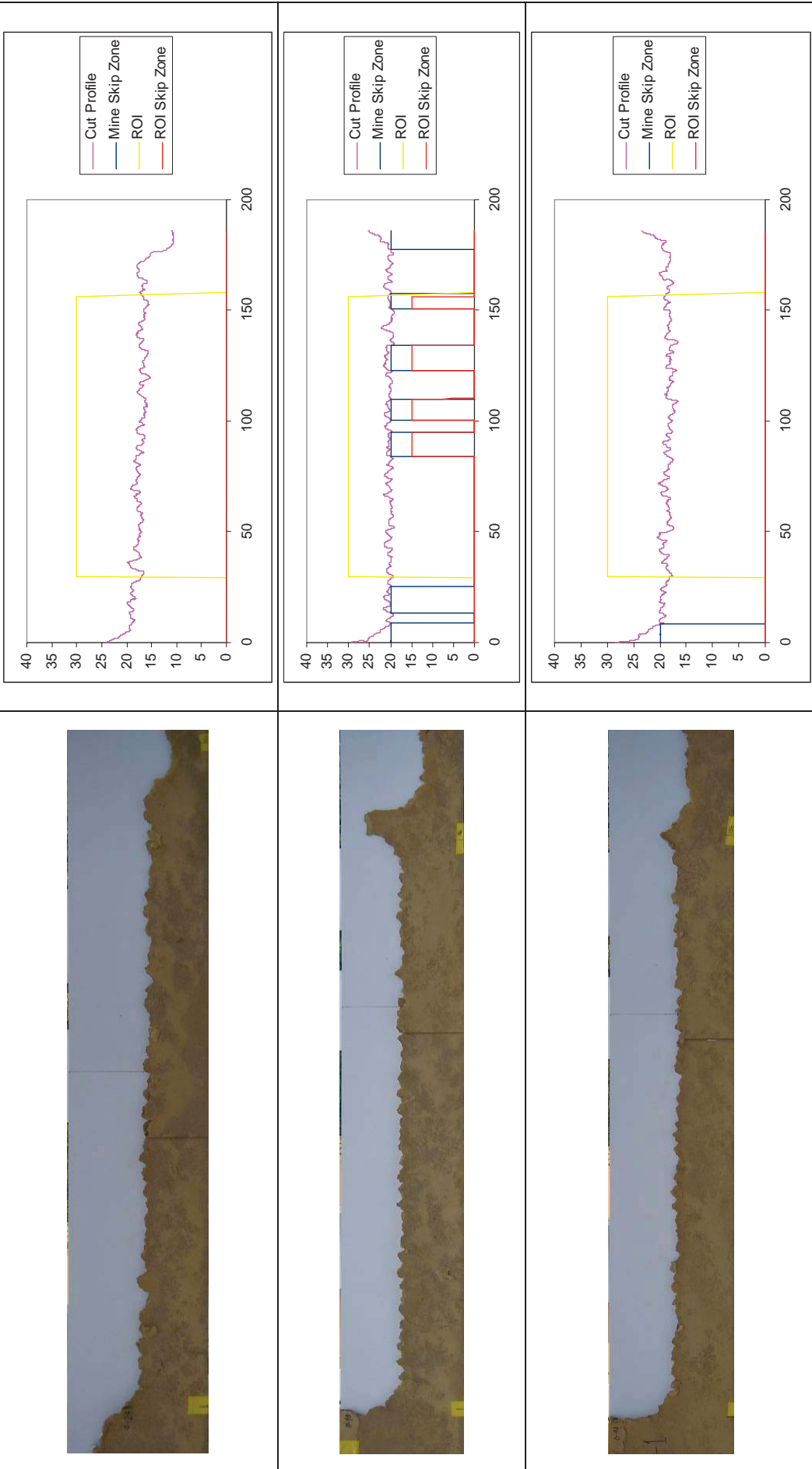


Appendix 5 – Samson 300

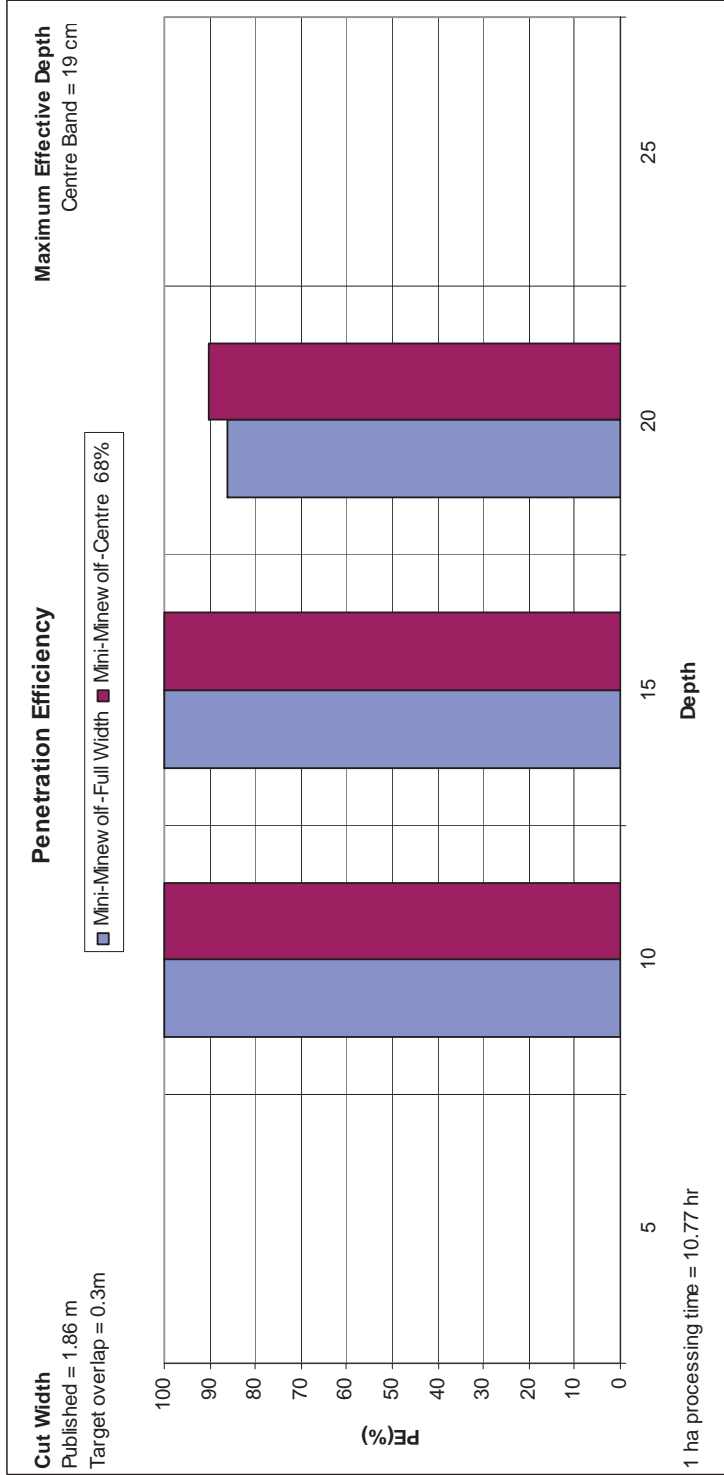


- Driver stopped briefly on return trip 3-4 times – probably a visibility issue. Huge dust cloud (partly caused by lack of shroud, partly because the machine worked to a shallow depth where the ground was dry). Apparently misunderstood requirement and thought depth of interest was only 15cm instead of 20cm.

Appendix 6 – Mini-Minewolf

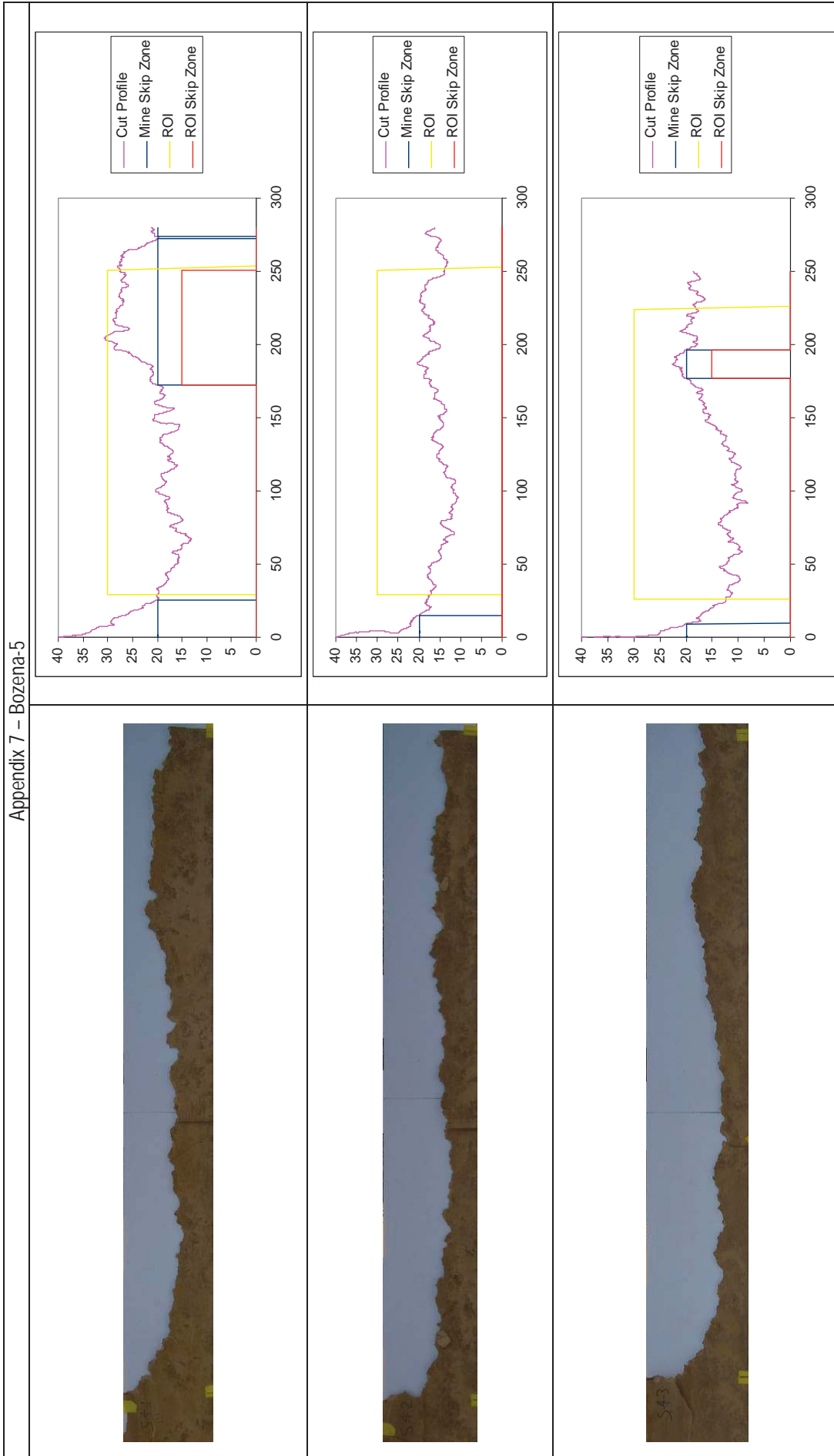


Appendix 6 – Mini-Minewolf

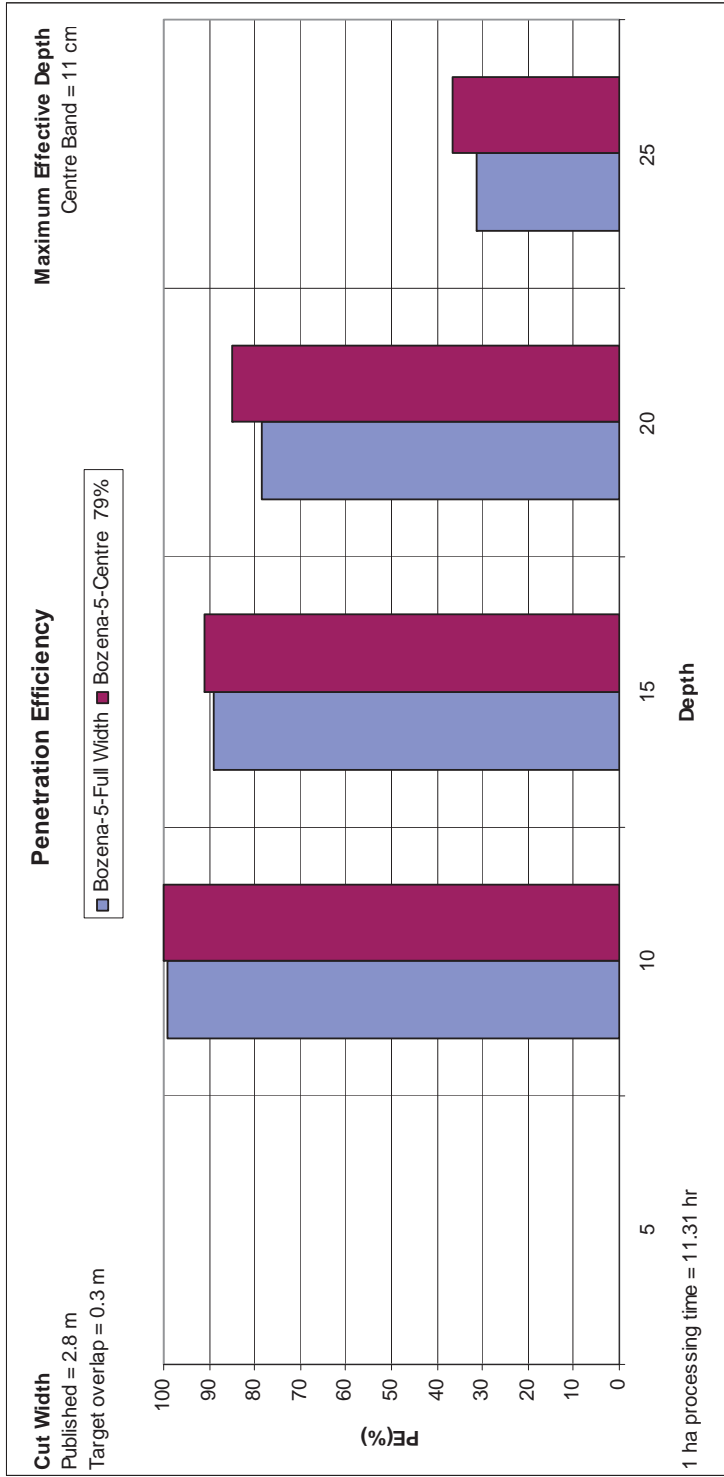


- Very little dust as soil is sliced, not pulverized. Soil only thrown a short distance ahead. From fibreboards, 30cm overlap not really achieved. Obviously a driver error issue not a machine performance issue.

Appendix 7 – Bozena-5

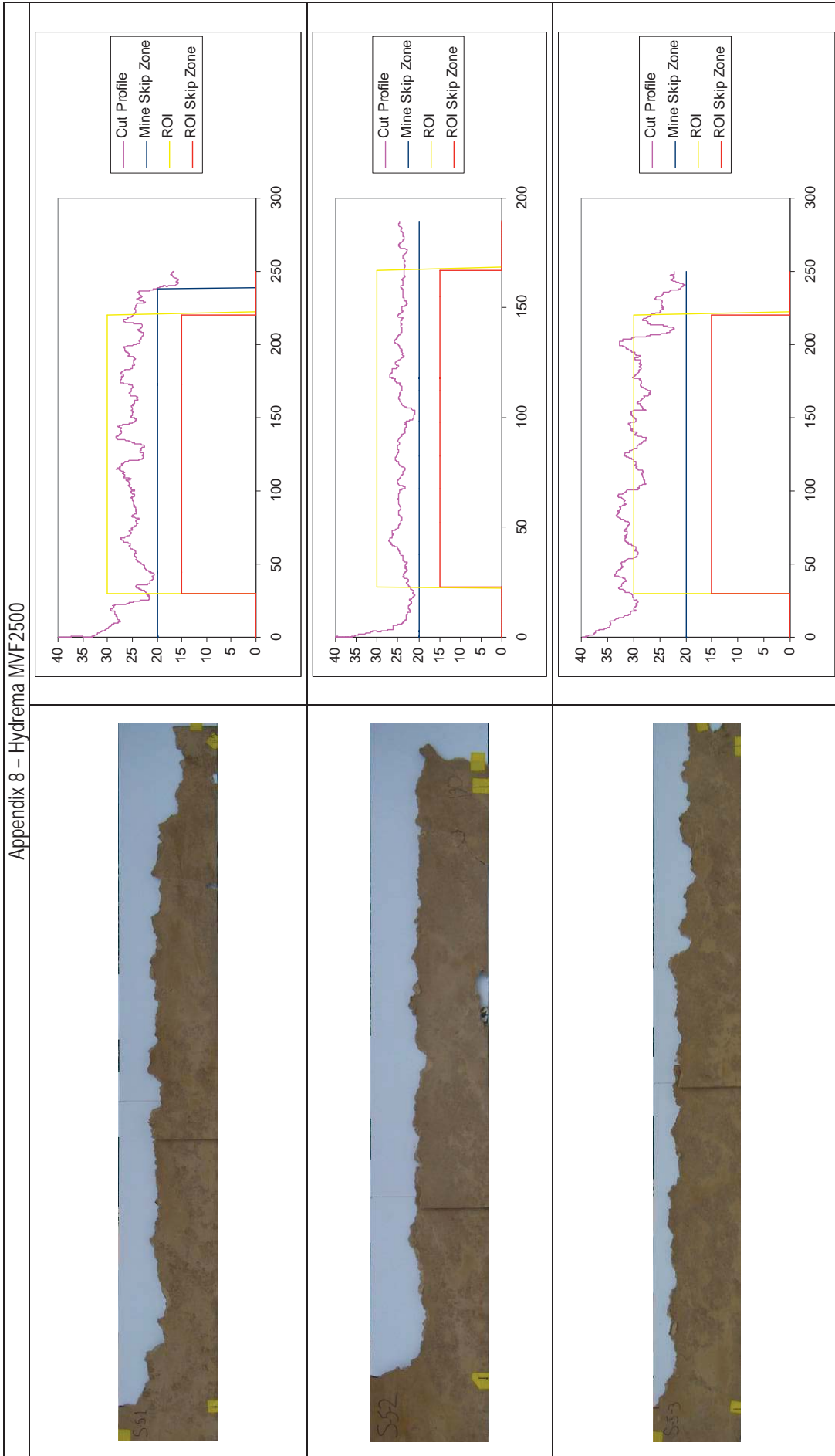


Appendix 7 – Bozena-5

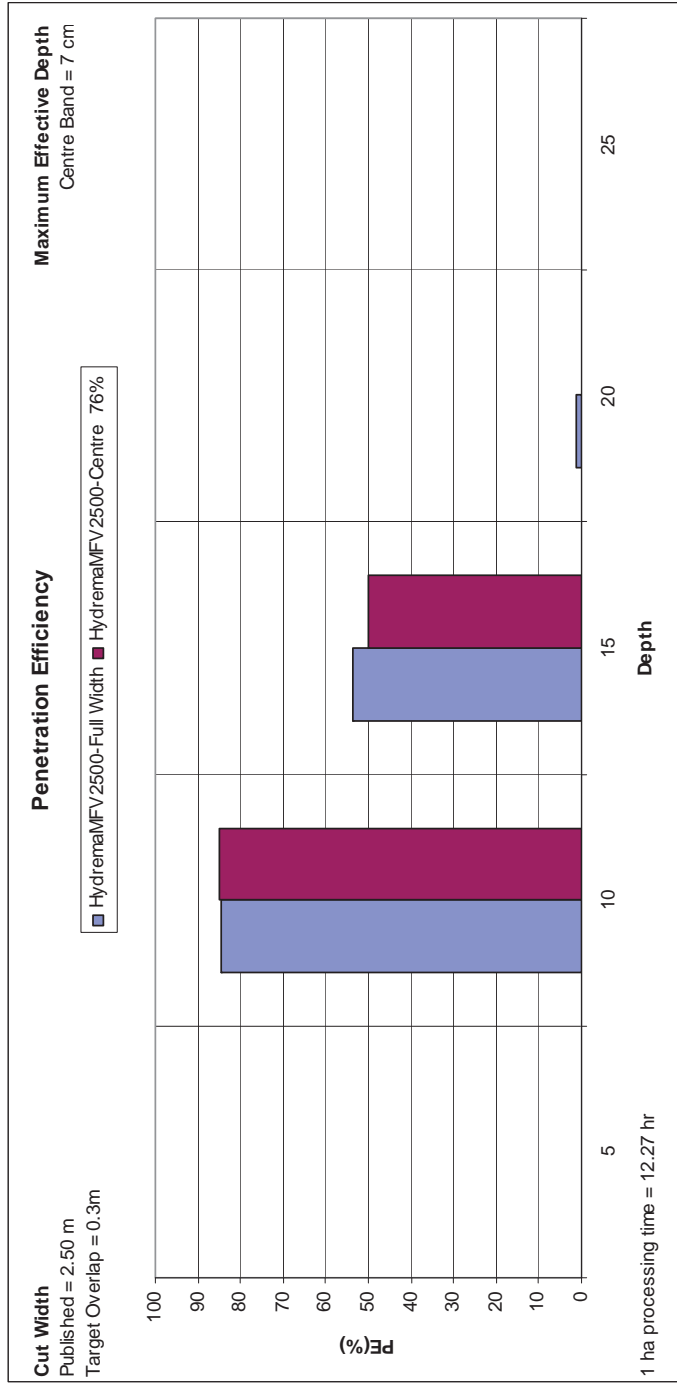


- Consistent speed control.

Appendix 8 – Hydrema MVF2500

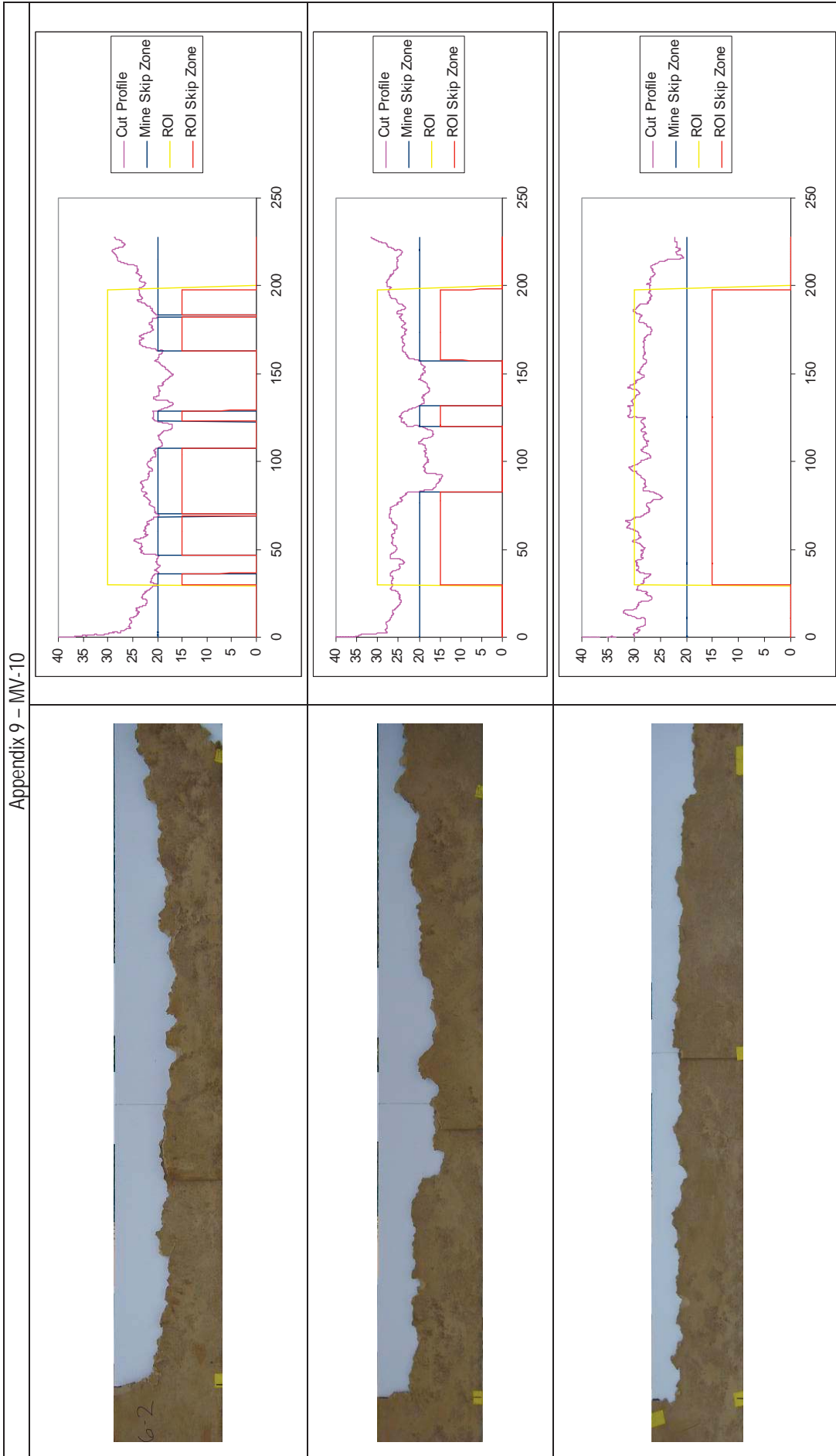


Appendix 8 – Hydrema MVF2500

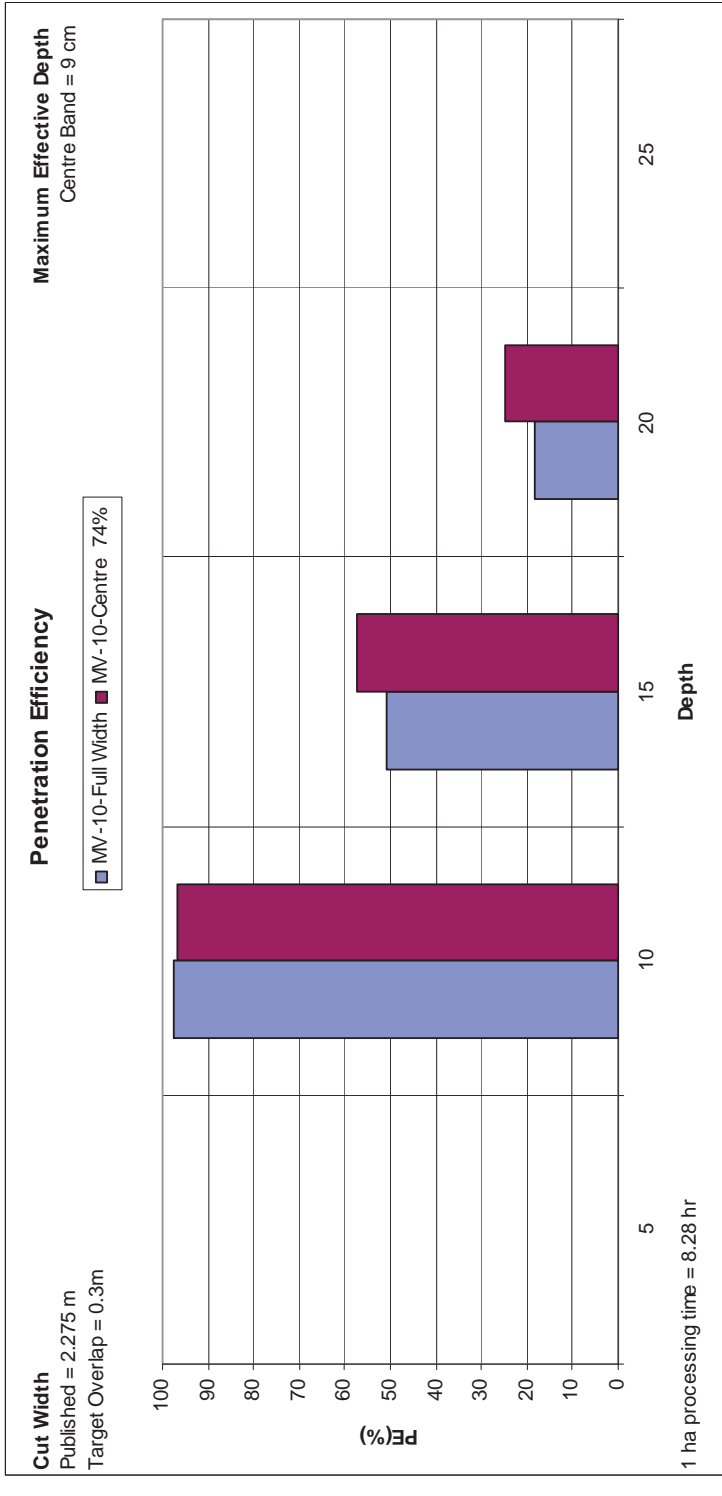


- Exact PE(20cm) and MED values may be slightly off since the middle fibreboard was hit so far across the board that only 190cm of the cut could be captured. The difference should be minor.
- Great variations in speed. Slowed visibly near board/decoy strips 1 and 2. Flail head stalled near strip 5. Machine stopped moving while trying to restart flail engine. Lots of smoke on restart of the flail engine. Happened again near strip 6. Slowed several times on return trip.

Appendix 9 – MV-10



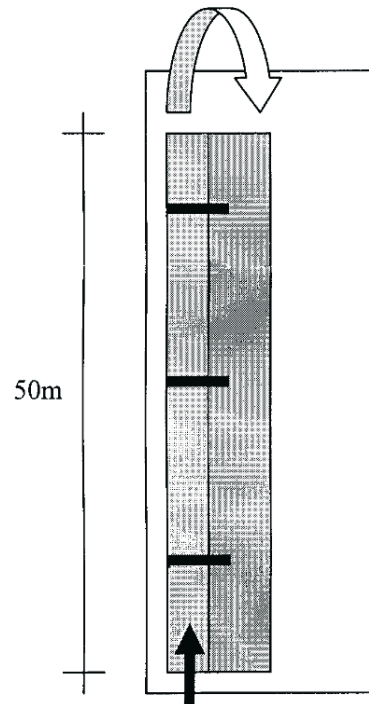
Appendix 9 – MV-10



- Head was lifted a couple times between the first and second fibreboard/decoy strips. Reasonably consistent speed throughout run but may have been a little slower on the return trip.

## INSTRUCTIONS FOR THE DEMINING MACHINES OPERATORS

### a) Layout of the test lane



### b) Activities of the machine operator

- Drive the machine to the line-up line. Machine will face the bleachers (spectators stand). The operator stands on the left side of the work tool.
- Upon signal – drive the machine from the line-up line to the start line, 3 m before the start line of the test lane.
- Upon signal – start the work tool, lower the work tool to the foreseen depth and start moving the machine.
- **Machine operates in 50 m test lane, at the end of lane lift the work tool, turn the machine around, set the overlap of soil treatment to 30 cm, lower the work tool and drive the machine back down the lane (50 m).**
- **Machine must operate in a continuous movement and constant soil treatment.**
- Time required of driving through the lane (outbound + turning + inbound), and depth of the soil treatment will be measured.
- If machine is operated from the cab, the operator will remain in the cab for the whole duration of operation (and will not leave the machine at any time, even

during the malfunction or stall of the machine), especially when on the test lane.

- If machine is remote control operated, the operator must wear protective equipment during operation, and stand at least 50 m behind the machine.
- Upon passing the finish line, drive the machine to the line-up line, turn off the engine, and stand next to the machine.

**c) Disqualification possibilities**

- Driving backward is not allowed
- Change of the speed is not allowed in the test lane
- It is not allowed to stall the machine, dig with the work tool on the spot, and then continue with operation
- If there is a malfunction of the machine or work tool during operation, the results will not be taken in account
- Operating outside foreseen lane or changing of direction is not allowed