

Concept of Dewatering at Hitech Industrial Estate

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on behalf of Sino-Thai Engineering and Construction Public Co., Ltd.

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Background

Sino-Thai Engineering and Construction Public Co., Ltd. was engaged by *Hitech Industrial Estate* to assist in the planning and management of the dewatering work. Sino-Thai has appointed *Seah Tian Ho*, the geotechnical engineer to provide assistance in the overall planning and inspection of dike condition during dewatering.

Hitech, with the assistance from the *Thai Royal Army*, had started repairing and strengthening the perimeter dike of the Hitech Industrial Estate immediately after section of the dike was breached in October. Most of the dike strengthening works have been completed on 10th November 2011, except for some small sections (at 7 locations) which may require further improvement as shown in Figure 1.

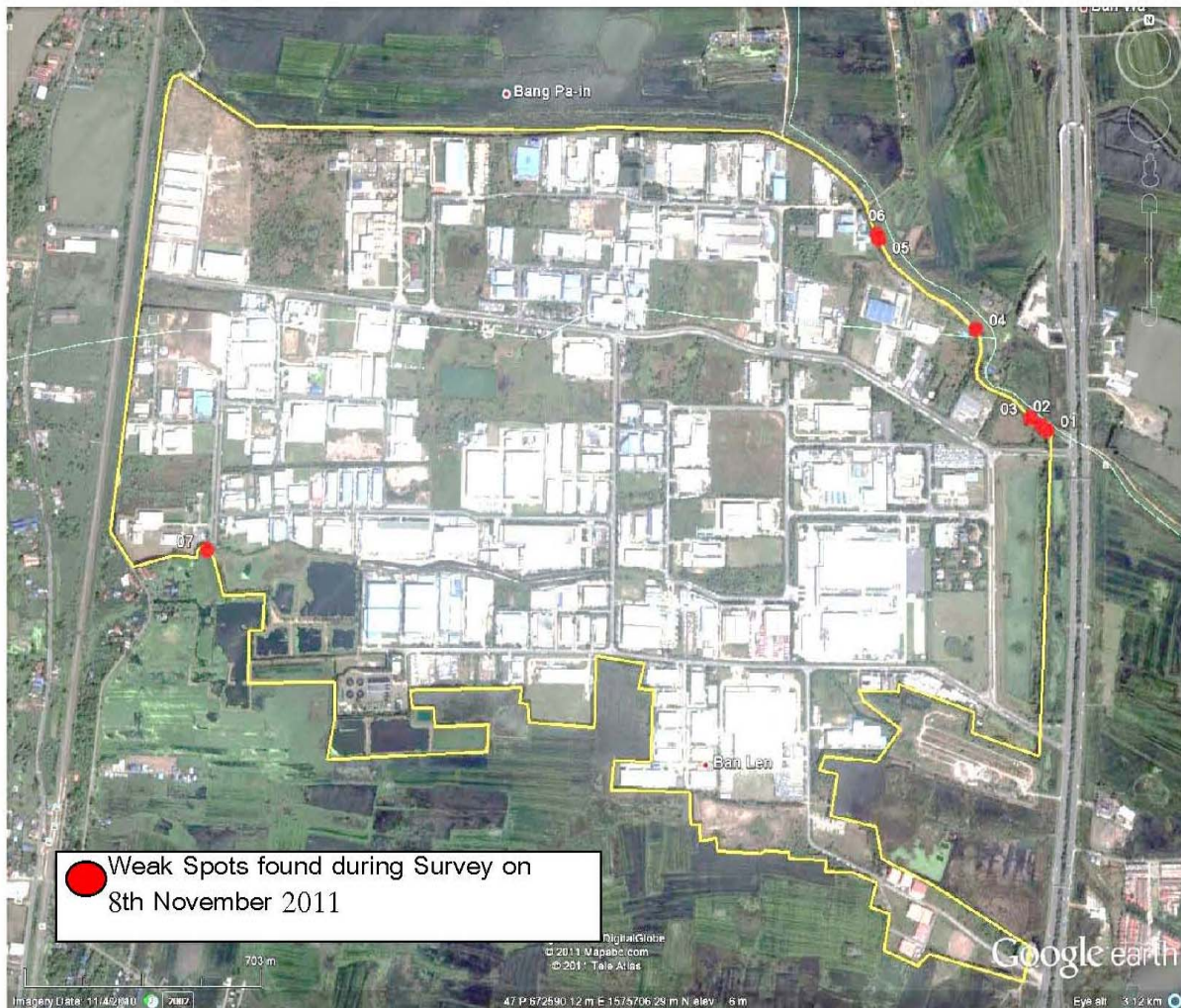


Figure 1 Locations of Weak Spots discovered on 8th November 2011 by Sino-Thai Team

Hitech had originally planned to start the dewatering of the estate on 11th November 2011 when the flood water has subsided to a level below +4.2 m MSL. The level of +4.2 m MSL was

based on the constructed dike level twenty years ago. But the permanent dike had settled by at least 40 cm to a level of +3.8 m MSL (accordingly to the earthwork contractor for the temporary topping of dike just before the dike breach). Based on the actual water retrieval records (water level measurement), the target water level of +4.2 m MSL can only be reached on 14th November 2011. The target date for traffic to enter the estate was planned on 25th November 2011 with 2 weeks of dewatering. Since the natural water retrieval is slower than expected, Hitech is considering delaying the traffic entry date according to the actual water retrieving data.

Between 11th and 14th of November 2011, Hitech will handle all other critical issues, including environmental concerns by the neighbouring villagers to the south of the industrial estate on the discharging of water. Hitech had approached the Government authority (Ministry of Environment) to verify the water quality within the estate. This verification is expected to start on 11th November 2011 and completed before 14th of November. In addition, there is a possibility that the discharged water may raise the flood water level to the south of the estate, affecting the villagers in the neighborhood if the rate of water flowing to the Chao Phraya River through the southwest watergate is less than expected. Hence, a public briefing is planned to clarify the water discharge program to the neighbouring villagers, ensuring that the villagers are well-informed on the discharge condition. Safety measures will be taken if the water level to the south of the estate rises during discharging.

It should be emphasized that the traffic can only be allowed to enter the estate when the condition is considered to be SAFE, and precautionary measures will be taken as well, such as evacuation plan shall be implemented in case of any unforeseeable breaching of dike during that period. In any case, Hitech will accelerate the dewatering work, by increasing the number of pumps etc., if the overall condition is favorable to ensure speedy recovery of the estate, reducing the down time suffered by the plant operators. **With this clear policy stated by Hitech, the concept of dewatering plan is prepared by Sino-Thai.**

This concept report outlines the inspection and monitoring program of the existing dike, the pumping capacity and schedule, the scenarios of drawdown (lowering of water level within the estate) versus time, the safe water levels (both within and outside the estate) for traffic entry and preliminary precautionary measures in case of dike breaching etc.

Preparation to be done by Hitech Industrial Estate

It is understood that the Hitech Team along with the Royal Thai Army have made or shall make the following preparation for the dewatering work:

1. **Repairing and strengthening of existing dike.** The Royal Thai Army had started repairing and strengthening of the existing dike immediately after the breaching of the first dike back in October. The technique of remedies include replacement of weak fill materials, placing of sand bags or big bags between installed wooden piles, raising of dike elevation by sand bags and clayey fill etc.. Additional strengthening will be done on those minor weak spots reported by Sino-Thai team on 10th November 2011, which will be expected to be completed by 14th November 2011.
2. **Preparation of water pumps.** The pumping operation will be handled by the Hitech team directly. The submersible pumps at the pump house (with location shown in Figure 2) have been repaired with new controllers, and trial runs have been conducted on those pumps during the last few days. Up to 9th November 2011, two (2) pumps (Pump Nos. 2 and 3) have been functioning properly, and two (2) other pumps are expected to work within the next days. One pump (No. 1) will probably require major repair which will not be completed in time for the dewatering work. Therefore, four (4) submersible pumps are expected to be in full operation by 14th November 2011. The total capacity of these

pumps will be $3 \text{ m}^3 \times 4$ numbers per second (totaling 12 m^3 per second). At the south-eastern corner of the estate, several small pumps (with pipe diameter of 8 inch) have been going through trial run since 9th November 2011. Two (2) mobile additional pumps with capacity of 1.5 to 2 m^3 per second are expected to be brought into the estate for dewatering work soon. With these pumps in place, the expected pumping rate will be around $800,000 \text{ m}^3$ per day with consideration of losses through dike leakage and loss time during pump maintenance. The Royal Thai Army in charge of dike strengthening work had suggested to Hitech that the pumping should only be conducted during day time because any dike breaching can easily be repaired with full workforce, therefore there may be a need to increase the number of pumps if the target date for traffic entry is set on 25th November 2011. It is suggested that the inside water level will be maintained by operating some of the mobile pumps at the south-eastern corner during the night to compensate for any leakage through the dike.

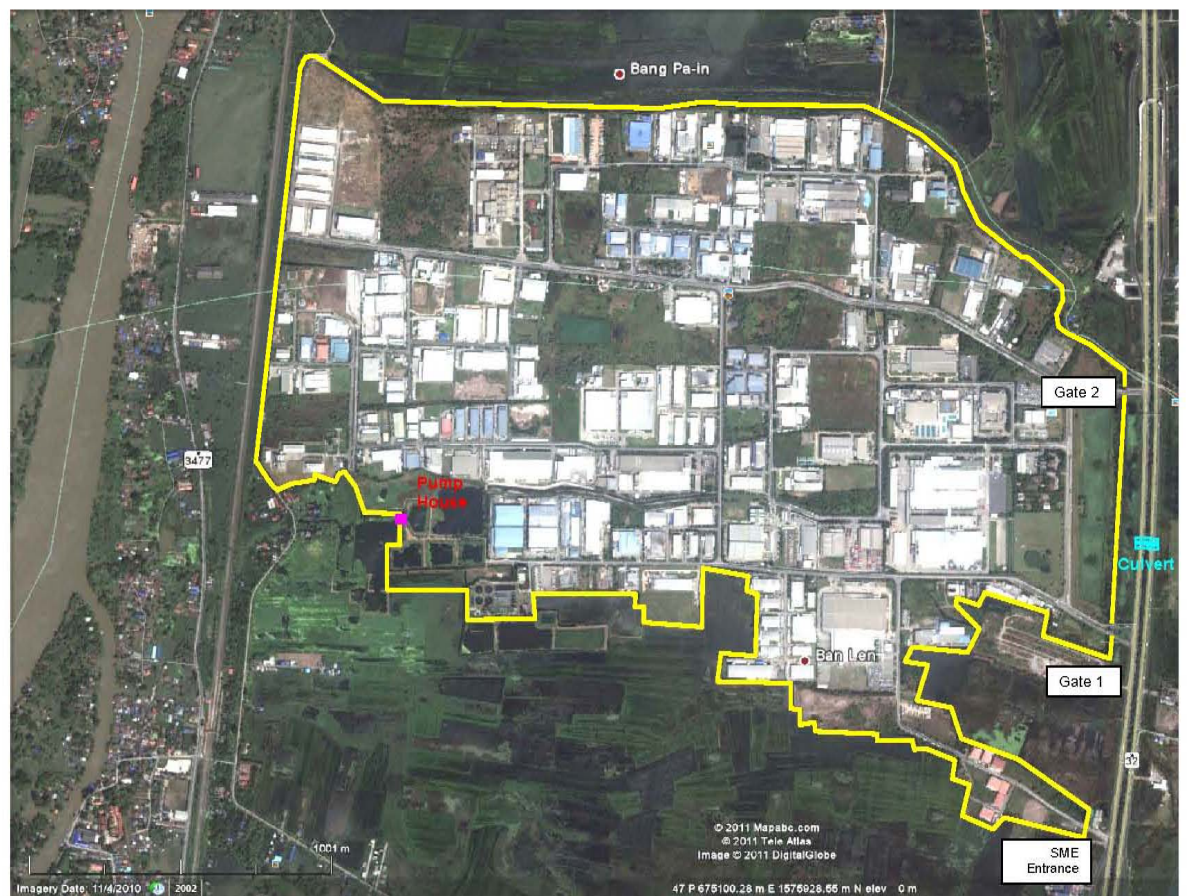


Figure 2 Location of Estate Pump House

3. **Water level monitoring.** The Royal Thai Army has conducted water level measurements on all four (4) sides of the perimeter dikes at least once a day. It is suggested that the frequency of monitoring should increase for better verification of the pumping capacity. If necessary, personnel may have to be stationed at some of the critical locations 24 hours a day. This monitoring is essential in any dike breaching, then immediate action can be taken.
4. **Dike condition monitoring during dewatering.** It is also vital to closely monitor the perimeter dike condition at all time during dewatering. It is understood that the Royal Thai Army will place a monitoring team to check the condition of the dike throughout the dewatering period. Again, any sign of dike breaching will be reported, and immediate

action will be taken. Sino-Thai team will participate in the daily dike inspection during the day (at least once a day).

5. **Machinery and material preparation for dike remedy.** In case of any dike failure, the Royal Thai Army should have the machinery (mainly excavators on pontoons) and necessary materials ready (such as sand bags, big bags, wooden piles etc.) for immediate repair. This issue has not been discussed in details among the involved parties (including the Royal Thai Army, Hitech and Sino-Thai).

Proposed Dewatering Concept

Apart from the necessary preparation required as described above, the involved parties should understand the basic concept of the dewatering work. The followings describe the main important issues:

1. **Outside water level or water retrieval level.** It is important to understand that the whole dewatering process depends greatly on the rate of water retrieval (rate of the reduction in the flood level). From the records of the past few days, the flood water had reduced by an average rate of 3 cm per day since 7th November 2011 as shown in Figure 3. To reach the safe level of +3.8 m MSL with the concept proposed by Hitech (based on the actual level of old permanent dike), then this level can only be reached by 27th November 2011 which will exceed the target date of 25th November 2011. If the rate of water retrieval decreases, then it is necessary to revise the traffic entry date. It should be emphasized that the selected outside water level of +3.8 m MSL before traffic entry is based on higher confident level on the old permanent dike without considering the new recent weak fill, which is an acceptable criterion as illustrated in Figure 4. Therefore, it is advisable to allow the traffic to enter the estate only after the outside water level has reached in this limit.

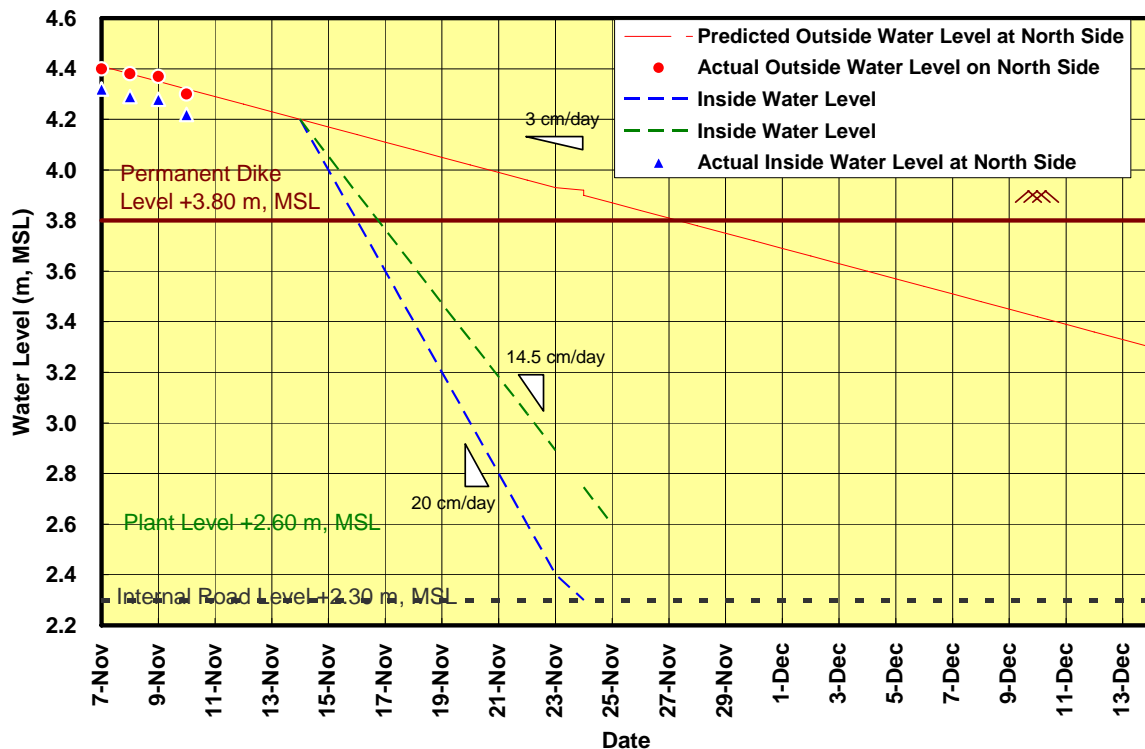


Figure 3 Assumed Water Levels during Dewatering

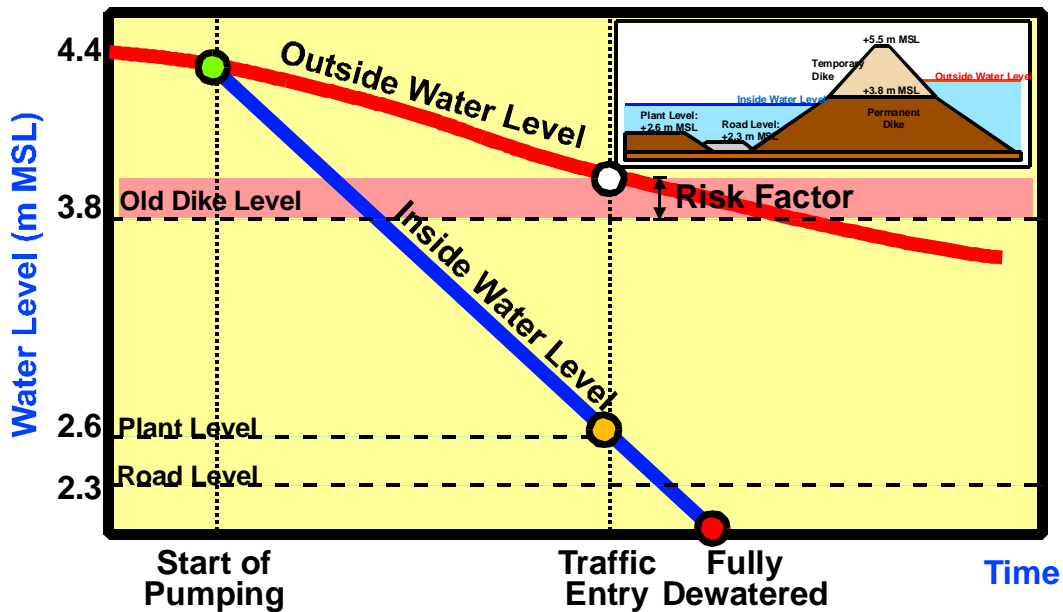


Figure 4 Risk of Dike Breaching if Outside Water Level is above +3.8 m MSL

2. **Inside water level for traffic entry.** For early entry of traffic to the estate, it is not necessary to wait until the inside water level has reached the road level of +2.3 m MSL (refer to Figure 5). In other words, if the water level is 30 cm above the road level which is passable by heavy vehicles, then the traffic should be allowed to enter the estate provided that the outside water is equal to or below +3.8 m MSL. A simplified drawdown (lowering of inside water level) versus time curve is presented in Figure 6. The graph presents two (2) water level time curves for inside and outer water level conditions. Ideally, the pumping within the inside estate should reach the target date of traffic entry at water level of +2.6 m MSL with the outside water level of no more than +3.8 m MSL. The risk involved will be minimum if this condition is achieved, but precautionary measures should still be provided in case of any unforeseeable problem.

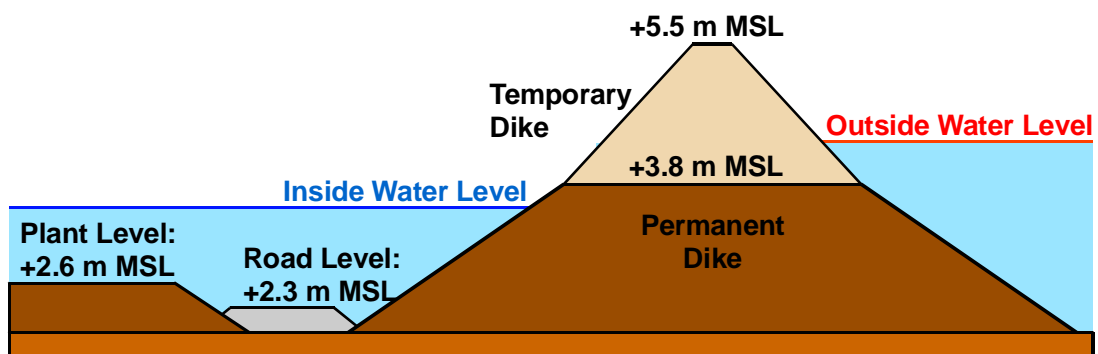


Figure 5 Levels of Plant and Road

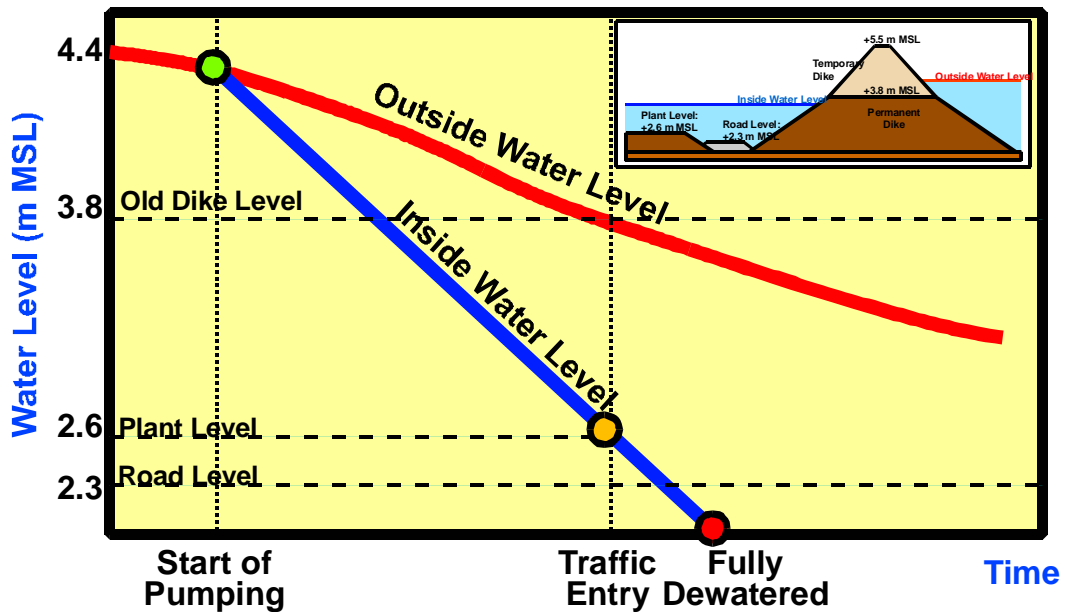


Figure 6 Ideal Condition of Drawdown

3. **Risk of dike breaching during pumping when outside water level is above +3.8 m MSL.** If pumping starts before the outside water level reaches +3.8m MSL, then there is a higher risk of dike breaching during pumping. The failure of dike will raise the inside water level to match the outside water level within a very short period with schematic shown in Figure 7. During repair of dike, the inside water level will equilibrate with the outside water level. Once the pumping has restarted, then the drawdown will continue. The consequence of the dike breaching with high outside water level is *considered minor* with minimum risk to safety, but there will be a loss in pumping time. Therefore, an early start in pumping is considered acceptable with some risk in time loss if the dike failed.

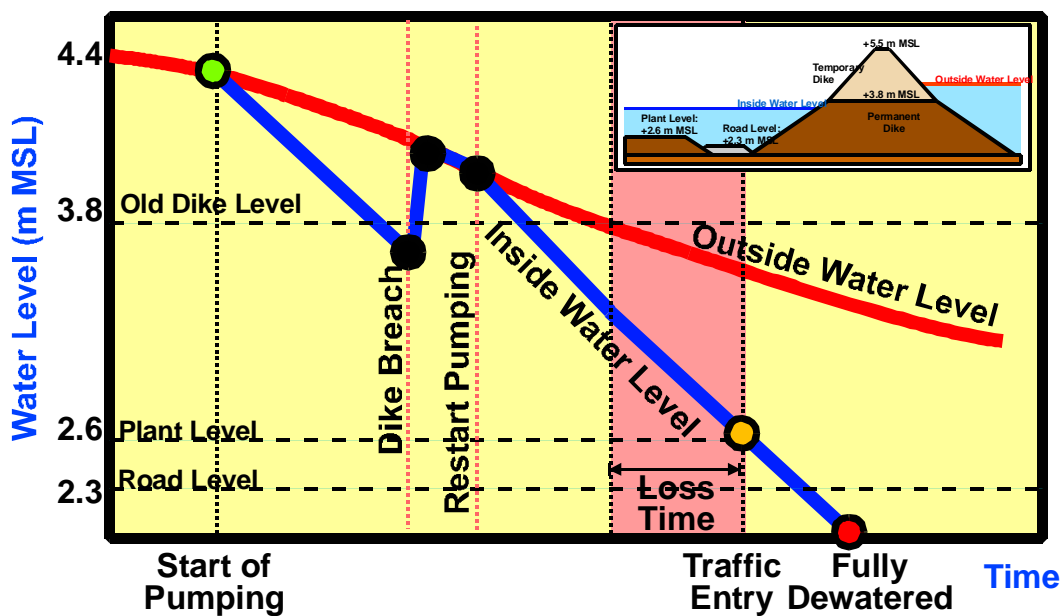


Figure 7 Water Level Condition during Dike Failure

4. **Expected condition of drawdown.** A linear water drawdown within the estate will not be unlikely due to leakage through the dike at the top section (new fill) and low hydraulic head for full flow when the water reaches lower level. Figure 8 shows the possible stages of dewatering. During the initial pumping, large leakage through the new fill is expected, then the lowering of water will be low. To meet a particular target date, it may be necessary to increase the pumps half way through the dewatering process. For the low head condition in Stage 3, it will be necessary to distribute the mobile pumps over the boundaries for shortest the drainage paths which shall be discussed in detail soon.

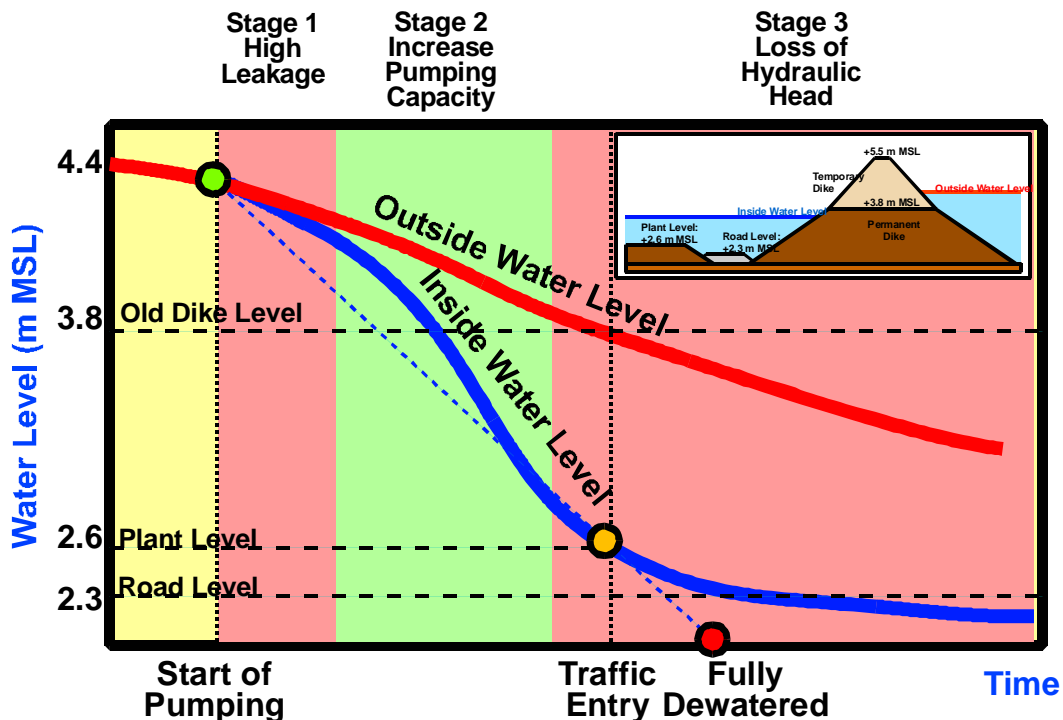


Figure 8 Expected Drawdown Time Curve

5. **Evacuation Plan.** Though the criteria for outside and inside water levels are specified, an evacuation plan or precautionary plan should be drawn out and implemented. The personnel entering the estate during the period when the outside water level is still at high level, should fully understand the evacuation plan. Hitech should work on this plan at this soonest so that those personnel have sufficient time to be briefed on the procedure.
6. **Closure of SME entrance culvert and Gate 1 entrance culvert.** It was suggested by Sino-Thai during the meeting on 7th November with involved parties that the culverts at SME and Gate 1 entrances should be blocked so that the maintenance of the some sections of the eastern dike can be omitted. This suggestion may require further discussion with the involved parties.