Suncor Steepbank Mine application second request for supplemental information.

Suncor inc.
Oil Sands Group
September 10, 1996

ATT: **Mr. Ken Banister**
AEUB
640 - 5th Avenue SW
Calgary AB T2P 3G4

Dear Mr. Banister

Re: Suncor Steepbank Mine Application
Second Request for Supplemental Information
Letter dated 1996-08-27

Your request has been reviewed and Suncor provides the clarification and additional information below following the points in your letter.

Q1. With the information that has been provided in the *Steepbank Mine Project Application* and the *Supplemental Information Response*, Suncor is confirming the following commitments:

Q1.a. Maintaining an average extraction recovery of 92.5 % recognizing:

- **different facies of ore will be processed;**
- **temperatures and slurry densities in the hydrotransport line will vary;**
- **process chemicals will be added at the extraction plant and not at the cyclofeeders;**
- **the design of any current or proposed equipment.**

A1.a. Commitment re-confirmed.

Q1.b. Providing adequate containment of slurried ore and tailings for multiple purges of the pipelines crossing the Athabasca River bridge without releases to the environment.

A1.b. Suncor is committed to the provision of adequate containment of slurried ore and tailings for multiple purges of pipelines crossing the bridge. Suncor would like to clarify information provided in the Application and Supplemental. We indicated that for spill purposes on the bridge there would be containment "pools" at either end of the bridge at the abutments. For the purposes of draining the entire line in the event of a complete shutdown, an "emergency pond" is provided at the hydrotransport complex as show on Figure C4.0-4 in the Application. For winter conditions the line would have to drained if the stoppage is greater than 4 hours.

Q1.d. Ensuring the stability of all overburden and tailings dumps including the Shipyard Lake overburden dump will meet the requirements of a 1:100 year flood.

A1.d. All dyke and dump structures have been sited above the 1:100 year ice flood contour (241 m ASL) with the exception of a portion of the relocated west dump. The west dump was relocated out of the Shipyard Lake area due to the sensitivity of the ecology of the wetlands.

An assessment by Golder Associates on the effect of the Athabasca River on the dump concluded: "The Athabasca River is not expected to cause erosion of the toe of the waste dump because the toe is located 200 m from the river bank. Any flow alongside the waste dump during extreme floods would result in slow velocities as a result of the hydraulic resistance provided by the dense vegetation and trees in this area. The face of the waste dump would also be protected by a vegetation cover which would be capable of handling short periods of inundation."

As stated in the supplemental document, the west dump will be designed to prevent erosion of the toe of the dump due to flooding events. This design will consider vegetation placement and rip-rap, if necessary, to meet design objectives.

All dyke and dumps designs will undergo a full geotechnical assessment, including foundation conditions, to assure geotechnical stability of the constructed structure. The final design will include the determination of side slope angle, berm (if any) placement, maximum height and material compaction requirements. A preliminary assessment, referred to in the Supplemental Document, indicated that there were no initial concerns with the placement of structures in the valley as outlined in the feasibility study.

In conclusion, although the west dump does fall within the 1:100 year flood plain, the intent of the IRP Guideline is met through the design considerations for the structure. All other structures and facilities are sited above the 241 m contour.

Q1.e. Achieving greater than 90 % capture of the mature fine tails using the CT process to enable dry landscape reclamation.

A1.e. Suncor is targeting 90 % capture; however, we require at least one year of operating experience to commit to this target..

Q1.f. Meeting the requirements in EUB Guide 55, *Storage Requirements for the Upstream Petroleum Industry*, for the storage of coke.

A1.f. See answer 4 below.

Q2. **In the Supplemental Request for Information, Suncor stated that 60 % of the fines were captured in the CT Trial. Provide physical and chemical characteristics of the material that was not captured in the CT trial, such as: particle size, clay content, specific volume. Provide the release water chemical data from the trial**

What information does Suncor have that shows that capture for greater than 90 % is achievable? Describe modifications that are required to ensure that greater than 90 % of fines material are captured.

What are the consequences of capturing less than 90 % of the fines (60 %, 70 %, 80 %) on the timing of the reclamation of Tar Island Dyke, Leases 86/17 and 25? Describe the need for, nature of design and location of additional tailings ponds and storage space.

Relate any consequences to: water quality, water management, public lands and reclamation if the CT process does not work as proposed. Also, identify how the predictions of effects, impacts, resource consumption, land use and mitigation plans in the EIA are altered. Present any further plans needed to address uncertainties through research and development, monitoring, reporting and public involvement.

A2. **1.0 Introduction**

Long term storage of fluid fine tailings has been accepted as a responsible reclamation strategy. However, it is clear that at the Suncor site that there is a lower overall risk if the fine tailings do not remain in a fluid state. In order to achieve this lower level of risk, Suncor's tailings R&D has focused on the following goals:

- reduce or eliminate the production of fine tailings from future operations,
- alter the fluid nature of existing fine tailings deposits,
- reduce the environmental impact of process affected waters,
- maintain the economic viability of the tailings operations.

After decades of R&D, the CT process appears to have the best chance of achieving these goals. Suncor's confidence in the process is based on work conducted jointly with its R&D partners which developed a fundamental understanding of the process and conducted extensive laboratory investigations. Pilot operations at both Suncor and Syncrude culminated in Suncor's five month Consolidated Tailings Commercial Trial which was completed May 1, 1996. The CT Trial has provided data in the following areas and which are discussed below:

- properties of the release water
- mechanisms affecting the capture of fines in the CT process
- actions to improve commercial scale fine capture.

2.0 Properties of CT Release Water

Approximately 7 million cubic yards (MCY) of CT were placed in Pond 5E during the Trial. At the end of the Trial a total of 2.64 MCY of clear, mineral free water had accumulated on the top of the deposit from the following sources:

Volume in Pond prior to Trial (runoff/dyke seepage)	0.50MCY
Volume from tailings line flushing	0.22
Volume from tailings sand discharged to pond	0.21
Volume dyke seepage during the Trial	0.21
Volume of precipitation during the Trial	0.34
Total non-CT water sources	1.48
Volume released from CT (2.64-1.48)	1.16MCY

The above indicates that about 45% of the surface water was expressed from CT. However, the majority of the water from non-CT sources was process-affected and would possess the chemical and toxicological characteristics of dyke seepage water. A detailed chemical analysis of the combined surface water is given in the attached Tables 2-1 through 2-3. Various measures of toxicity are also included (Tables 2-4 and 2-5). Additional measurements from the Syncrude Research laboratory are reported below.

Sample Date	Naphthenic acid (mg/l)	Microtox IC 50	Microtox IC 20
Dec 21/95	83	100	30
Mar 5/96	87	100	18
Mar 28/96	79	90	18
June 26 (surface)	64	100	36
June 26 (10' depth)	65	100	33
June 26 (19' depth)	66	100	35

The lack of turbidity and the "slightly toxic" classification of this water reflects a considerable improvement in quality with respect to the "acutely toxic" dyke seepage or tailings water and is consistent with results from pilot testing. The chemistry of the release water also approximates theoretical predictions made prior to the Trial. This provides the first stage of confirmation of the long range recycle water chemistry modelling which indicates that there should be no significant impact on extraction recovery.

3.0 Fines Capture

Suncor's confidence in achieving fines capture rates around the 90% level upon initial deposition is based on pilot plant experience at Suncor in 1993. Deposition rates of about 500-1000 usgpm were achieved without detectable segregation. This experience seems to have been confirmed by the Syncrude pilot test in 1995, which used deposition rates of about 2000 usgpm.

Suncor's Commercial Trial was the next opportunity to investigate CT deposition

performance where discharge rates varying between 10,000 to 15,000 usgpm were achieved to Pond 5E.

3.1 Commercial Trial Fines Capture

Figure 2-1 shows the sampling site location map in Pond 5E. Data for sites 6 and 11 are attached. These data indicate that the upper region of the profiles contain a low sand/fines ratio relative to the CT mixture of about 4.5 and the lower regions are enriched in sand. The conclusion is that there was some segregation in the deposit - ie. the sand was not retained in the CT mixture as per expectations. However, the data also show that clay as determined by the methylene blue test procedure is present within the lower regions of the deposit. The best estimate of fines capture rate in the lower region of the deposit is based on a comparison of the fines in the CT mixture and the fines in the upper region of the deposit. It is estimated that upper region contains 40% of the fines contained in CT when the CT process was operating according to specification. The capture rate in the lower region is the estimated to be 60%.

3.2 Comparison with Normal Tailings Pond Capture Rate

Although the capture rate obtained from the Commercial Trial was lower than the target of 90%, it is instructive to compare these rates with capture rates expected in normal tailings operation. Suncor's fines balance shows that of the 79% of the mined fines which enter the tailings pond, about 47% are captured and 32% form fine tailings. This produces a capture rate of about 59%. However, the most important mechanism in the capture rate deals with the reincorporation of fine tailings in the beaches built beneath the mud line. This reincorporation mechanism is only effective when the fine tailings layer dewaters to the point where some strength is available. In the case of a new pond where there is only recycle water or very dilute fine tailings, the recapture rate is probably less than half of this rate, in the 20% to 40% range. Therefore, the 60% capture rate obtained during the commercial trial represents a significant improvement and would likely result in a major reduction in fine tailings accumulation rate even if no further improvement was made.

3.3 Methods to Enhance CT Fines Capture

Although the Commercial Trial does represent an improvement in the capture of fines relative to a normal operation, it is desirable to identify the methods to improve the operation to take full advantage of the CT process. Figure 2-2 shows the basic composition relationships for CT (Scott, 1995). This figure is based on testing at the University of Alberta. Samples were mixed with various initial compositions and gypsum dosages. The samples were then placed in columns about 50 cm high and allowed to settle to determine whether segregation of the coarse and fine mineral particles would occur. It was found that there was a reasonably well defined boundary between the segregating and non-segregating behaviour, as shown in the figure.

Based on Figure 2-2, there are three parameters to examine: dosage of gypsum, sand to

fines composition and the solids content in the CT mixture. These will be considered below.

3.3.1 Gypsum Dosage

Based on extensive laboratory testing at the University of Alberta, the required gypsum dosage was identified as 900 grams of gypsum per cubic metre of CT mix. The 1993 Suncor CT pilot, which used acid/lime instead of gypsum, found a good correlation between lab and pilot segregation performance. However, experience at Syncrude using gypsum in their CT pilot indicated that this level may not be sufficient for full commercial operation. The gypsum metering systems for Suncor's Trial were adjusted such that dosage rates well in excess of the minimum target values were to be achieved. Reconciliation at the end of the test with the actual tonnage of gypsum measured by the plant gate weightometers indicates the actual dosages were for the entire Trial was 1180 grams per cubic metre of CT.

There were two gypsum addition systems used during the Trial. A Stanko system was used during late November, December and early January. The apparent dosage was 1403 grams per cubic metre of CT. This unit was replaced in early January with a Rocktec unit which indicated a dosage of about 1400 grams per cubic metre. However, upon reconciliation at the end of the Trial, it is clear that the actual average dosage rate was just 1005 grams per cubic metre of CT. The dosage level for this second portion of the Trial may have been insufficient for fully effective CT, because of scale up issues not detected in the laboratory testing.

Testing is currently in progress to identify the treatment level required using FGD gypsum. The initial characterization of this material is favourable with an mean particle size in the 80-100 micron range and a 90% gypsum concentration in the coarse particles. In addition, a vibratory testing device has been developed to quickly identify non-segregating behaviour which can be used in the plant environment to monitor the process.

3.3.2 Sand to fines Ratio

It is noted in Figure 2-2 that the sand/fines ratio is an important parameter in forming CT. The value of 4.5 was chosen for the Commercial Trial, although full commercial operation may use values as low as 3.5.

Selection of the course-sand-to-fine-mineral ratio (SFR) is driven by two objectives. The first objective is to produce a deposit which consolidates quickly, gains strength and allows surface reclamation to proceed. This is best accomplished at a SFR exceeding 6:1. The second objective is to reduce the existing inventory of fine tailings. Incorporation of the existing inventory of fine tailings into CT deposits can be done most economically prior to establishing a remote desanding operation, which could be as early as 2020. The current plan is to reduce the existing inventory of fine tailings by 2020 to 30 to 40 MCY (the ongoing volume required for the CT process). This plan requires a SFR of about 4:1.

The table below shows the summary data related to sand/fines ratio:

Measurement System	March	April
Interplant	4.60	4.57
Lab Analysis	4.19	4.68

It is clear from these data that in average terms an acceptable mixture was prepared for CT.

3.3.3 Solids Concentration in CT

The remaining critical parameter in formation of CT relates to the solids concentration in the mixture. It is clear in Figure 2-2 that there is a tendency for increased segregation at lower solids concentrations for constant sand/fines ratios. It is instructive to overlay the actual operating CT composition data on Figure 2-2. Figures 2-3 and 2-4 show that about 25% of the samples would plot in the non-segregating range for the March operation and about 7% for the April operation.

The % of samples which should have shown segregating behaviour does not seem to fully explain the 60% fines capture in Pond 5E, and it is suspected that a more subtle problem was encountered. From a fundamental view point, the primary effect of the chemical treatment is on the clay minerals. Treatment of the silt and sand size mineral grains would be effective only to the extent that they are incorporated in the basic structure of the clay mineral flocs. Oil sand "fines" are defined as particles of an apparent diameter less than 44 microns. This size range includes both clay minerals and non-clay mineral silt size particles (quartz, for example). It has been shown that the clay mineral/fines ratio is quite variable in the oilsand ore. The use of "fines" as the measured parameter was appropriate for the University of Alberta test program because blends on one fine tailings sample and one sand sample were used which eliminates variability in clay/fines ratio. However, for more general use the clay mineral concentration is the preferred parameter. Methylene blue adsorption test provides important information on the area of clay mineral surface which is available for reaction with calcium liberated from the gypsum.

Methylene blue tests were conducted on the fine tailings sample used for the testing shown in Figure 2-2. The data at the segregation boundary in Figure 2-2 were recomputed on a clay mineral basis as shown in Figure 2-5. It is clear that segregation behaviour is very closely associated with the clay mineral/water ratio, but relatively insensitive to clay mineral/sand ratio. The implication is that, for the range of sand/fines ratio's in which the process is to be applied, it is the viscous or strength properties of the clay mineral and water suspension which prevents segregation of the coarse grained material. This means that the CT process can be quite tolerant of the swings in sand and clay composition which will be unavoidable as ore composition in the mine is quite variable. However, the clay mineral/water ratio must always exceed a critical value or the suspension will be unable to prevent segregation of the coarse minerals.

The same CT composition data shown in Figure 2-2 for the month of April were recomputed and are plotted in Figure 2-6. If the CT mix design basis for clay mineral/water ratio was established as 0.1 (see Figure 2-5) then only about 50% of the samples would have demonstrated non-segregating behaviour. An additional test program is currently in progress to verify that 0.1 clay mineral/water ratio is the proper value, but early indication are confirming this value.

3.3.4 Determination of clay/water ratio required in the Fine Tailings Source Materials

The question remains as to what the composition of the fine tailings must be in terms of clay/water ratio in order to achieve a clay/water ratio of 0.1 in the CT mixture. Since most of the clay is coming from the fine tailings deposit, then the issue is how much dilution water is coming from other sources. This dilution water comes from the cyclone underflow where a consistent 70% solids was achieved. Additional water comes from the gypsum stream, the slurry pump seal water and other cleanup streams. Based on operating data it is estimated that when the other dilution streams are considered, the "effective" cyclone underflow concentration was about 63%. Figure 2-7 shows that at the Trial sand/fines ratio of 4.5/1, the fine tailings source must possess a clay/water ratio in excess of about 0.2 to form a non-segregating mixture.

Figure 2-8 shows a typical fine tailings profile at the location of the fine tailings pumps used in the Trial. It is clear that the 0.2 criteria was not met. The reason for this has been traced to recent beach building operations which displaced the more concentrated fine tailings away from the shore mounted pumping system. During the winter trial period it was not feasible to relocate the pumping system away from this area.

Figure 2-9 shows a typical profile from the mid-pond location which will be the site for the fine tailings pumps when operations resume in the fall of 1996. An analysis has shown that a sufficient supply of concentrated fine tailings exists within the pond to meet CT production requirements.

3.3.5 Summary of Actions to Enhance Fines Capture

In order to maximize the potential to achieve an improved fine capture when operations resume in the fall of 1996, Suncor has taken the following actions:

- The gypsum dosage has been raised from 900 gm/cubic metre to 1300 gm/cubic metre. This is consistent with Syncrude's experience. FGD gypsum will be used, and laboratory testing has shown that it is equally effective to the commercial gypsum used in the Trial.
- The fine tailings source location has been moved from the shore mounted location used in the Trial to a mid pond location with demonstrated reserves of fine tailings at sufficient clay concentration.
- Dilution of the CT mixture will be minimized during operation to maintain a clay/water ratio in the CT mixture exceeding 0.1.

- The deposition method has been changed from discharge from a single location to a spigotting system to reduce turbulence.
- The sand/fines ratio will be lowered from 4.5 to the 3.5-4.0 range.
- In-plant test procedures have been developed for the CT plant process operators to use to determine whether or not a suitable CT mixture is being produced in real time.

3.3.6 Other Opportunities to Enhance Fines Capture

The foregoing discussion has only considered fines capture on initial deposition. There is every reason to believe that the same very important mechanism of reincorporation of fines (discussed above for existing ponds) in future deposition will be effective in increasing capture rate. However, the magnitude of this mechanism must be determined from actual full scale operation.

If the overall capture rate does not reach target levels, it will be possible to recover the segregated fines layer, as is being done to recover fine tailings for CT production, and force reincorporation into future CT production. Also, it would be necessary to consider whether an alternative chemical treatment would improve performance.

4.0 Evaluation of Alternative Tailings Plans

Suncor intends to achieve a high fines capture rate in its CT process, and has identified several actions to further enhance capture. The attractiveness of the CT technology for the integrated Steepbank and Lease 86/17 mine and reclamation plans, as well as Suncor's confidence in the technology, provide strong incentive to continue to develop the technology until its promise is fulfilled.

Ultimately, and in the unlikely event that fines capture rates can not be improved to a satisfactory level, it will be necessary to revise the tailings plan to determine the best way to increase storage capacity. This would probably result in a significant economic penalty. However, Suncor believes that at this early stage, it is premature to undertake a major evaluation of a range of planning alternatives and the environmental consequences of each.

5.0 Monitoring and Reporting

Full commercial CT operation is scheduled to commence in October, 1996. Production will involve intense monitoring to determine performance. Progress reporting from this monitoring and any required follow up action can be made available informally on a relatively frequent basis, and more formally as part of annual reporting requirements.

Q3. Provide a revised tailings management schedule, including the necessary changes to the tailings process, that shows the remediation of Tar Island Dyke within the currently agreed upon schedule.

A3. **1.0 Background**

Until 1994, Suncor's tailings reclamation plan was based on the assumption that Suncor would complete mining of Leases 86/17 at the turn of the century and proceed with final reclamation of its site. The tailings plan consisted of transferring all fine tails to Pond 5 and infilling all other ponds except Pond 1a with sand. Pond 1a and Pond 5 would remain as a wet ponds. In-filling of Pond 1 would have been complete by 2002.

Although methods like Consolidated Tailings (composed of sand, fine tails and gypsum) were aggressively being studied, one of the major stumbling blocks was the lack of incoming sand to make Consolidated Tailings. With insufficient sand available to combine with the all of the fine tails, a CT tailings plan indicated that Suncor would be left with many wet ponds instead of just Ponds 5 and 1a.

However, in 1995 Suncor announced plans to develop the Steepbank Mine. An additional supply of sand would now be available. This combined with the gypsum from the newly commissioned FGD plant, provided all the building blocks for the Consolidated Tailings (CT) process. The reclamation of both Lease 86/17 and the Steepbank Mine to a dry landscape could be accomplished. The "wet pond" strategy could now be replaced with a much improved CT based dry reclamation plan.

This new CT based reclamation plan however affected schedules, in particular that of the reclamation of Pond 1.

2.0 Impacts of 2002 Schedule

The previously tailings plan, developed in 1993/1994, was based on the assumptions that all fine tails would be pumped to Pond 5 and the pumping of fine tails from each of the ponds, particularly Pond 1 could be done independent of the operation as a whole. Under this plan Pond 1 would be infilled by 2002 and fully reclaimed by 2005. The time required to complete the reclamation of Pond 1 was set at 5 years and the equipment designed around the system to insure that this schedule was met.

Fine tails are an integral part of the CT process. Therefore fine tails removal, particularly from Pond 1 can no longer be considered independent from Suncor's entire operation. Consolidated Tailings technology requires a supply of mature fine tails (MFT) pumped to Extraction and combined in specific proportions with cycloned sand and gypsum.

The Long Range Tailings Plan is now CT based and the reclamation of Pond 1 is coupled or "linked" closely with the rest of the ponds. A major goal of the tailings plan is to fully integrate CT into the operation, however regular tailings must still be produced because of sand dyke construction requirements for Dyke 8..

Pond 4 will be used for gypsum storage and Pond 5 for CT, leaving Pond 2/3 for recycle water, regular tailings (including cyclone overflow, a high fines "regular tailings") and fine tailings accumulation. As Pond 2/3 is the only pond that regular tailings can be

pumped into, Suncor must keep this pond in operation to maintain production. If the "consumption" of fine tails from Pond 2/3 is stopped to transfer fine tails from Pond 1, Pond 2/3 will quickly become overloaded. If Pond 2/3 becomes overloaded with fine tails the entire Suncor operation including the implementation of CT will be in jeopardy.

Figures 3-1 through 3-4 illustrate what would happen to the CT based reclamation plan if Suncor attempted to reclaim Pond 1 by 2002. This is discussed in more detail below:

Pond 1

In Figure 3-1 note that the MFT level is drawn down very rapidly and all MFT is removed by the year 2000. All MFT removed would be sent to extraction and used to produce CT which would be pumped to Pond 5. Pond 1 is in-filled with sand by the year 2002, again very rapidly, and is then ready for final reclamation activities. This meets the original Pond 1 reclamation schedule.

However because the CT based plan (unlike the original plan) is coupled to the rest of the operation this rapid draw down and in-filling of Pond 1 has an effect on Pond 2/3 and Pond 5.

Pond 2/3

For CT to succeed fine tails are required at specific rates tied to sand production. If Pond 1 is made the priority the balance of fines for CT would come from Pond 2/3. However, if we do not remove enough fine tails from Pond 2/3 overtopping of the pond will occur, as can be seen in Figure 3-2. To maintain the level of Pond 2/3 at the maximum fluid level of 363 metres additional fine tailings would have to be transferred from Pond 2/3 to Pond 5. It is estimated that 35 million cubic metres of fine tails would have to be transferred starting in 1997.

Pond 5

The transfer of fine tails from Pond 2/3 would have a significant impact on the quality of CT being placed into Pond 5 and the tailings plan overall. Figure 3-3 illustrates the changes in elevations of fluids in Pond 5. Impacts can be summarized as follows :

- Dyke construction may have to be accelerated, which would require more sand and overburden. We are short of both at present.
- The overall CT sand to fines ratio would go from a target of 4.0 to 3.0 or less.
- Consolidation of Pond 5 would be slowed considerably (20 % more fines would be going into the pond).
- The development of strength within the deposit to support a dry reclamation surface is seriously delayed. Strength depends on sand grain contact which only occurs after the fines are consolidated within the voids of the sand matrix. The more clay in the voids the longer time required to reach a significant strength.
- The release of water from Pond 5 is critical to the success of the CT plan and the placement of untreated fine tails into Pond 5 may contaminate the released water.
- Large slugs of fine tails could end up trapped in the CT, the released water or on the surface.

Summary - Impacts of 2002 Schedule

As illustrated in Figure 3-4, Pond 1 would be infilled by 2002 and reclaimed shortly after. Pond 5 would have some mixture of 3.0 to 4.0 sand to fines ratio CT, and Fine Tails and entrained bodies.

In summary Suncor would be jeopardizing the dry landscape reclamation of a 180 million cubic metre pond in order to accelerate the reclamation of a 23 million cubic metre pond. In essence Suncor believes that the dry reclamation landscape would not be achievable at a 3.0 to 1 (or less) sand to fines ratio, within the reclamation certification time frame.

3.0 Proposed Reclamation Schedule Benefits

Figure 3-5 through 3-8 illustrate the present CT implementation plan, that shows Pond 1 fine tails removed by 2006, the pond infilled by 2009 and fully reclaimed by 2010. This plan is fully integrated into the Suncor operation, and can be accomplished.

Figure 3-5 illustrates the draw down and reclamation of Pond 1. Although it is a slower drawdown than the original plan, it allows Suncor to keep Pond 2/3 in control and does not require any transfer of fine tails to Pond 5. The operation of Pond 5 is illustrated in Figure 3-6.

Figure 3-7 illustrates the steady controlled build-up of good quality CT in Pond 5, which should consolidate and produce a trafficable surface by 2020. Figure 3-8 illustrates the forecast outcome of this plan.

As previously stated in the Steepbank Application and Supplemental Information Response, Suncor will continue to pursue planning alternatives to accelerate Pond 1 reclamation relative to the 2009 time frame.

Q4. The *Storage Requirements for the Upstream Petroleum Industry*, EUB Guide G-55, states that an operator has until 31 October 2001 to adhere to the storage requirements for solid materials on bulk pads. The current coke pile does not meet these requirements. The proposal to reclaim the pile in place does not comply with this guide and the answer to Q4.33 does not address how Suncor will meet these requirements. What measures will Suncor undertake to meet the storage guidelines?

Provide the economic and technical justification to support Suncor's proposal to dispose (waste) the coke versus the continued storage of this resource.

What affect will the addition of coke have on: the CT process, fines capture, and CT release water chemistry?

A4. **1.0 Background**

The Suncor Coke Management Plan (March 1994 EUB approval) included relocation of the coke stockpile starting in 1999. The plan was to create a stockpile on the west facing slope of Waste Area 8. The capacity of the proposed in-pit stockpile would be sufficient for coke produced to the end of Lease 86/17 operations. The submission indicated that a modification may be required in the future should other leases be brought into production. The remaining capacity (as of August 1996) of the existing stockpile is approximately 1.5 million tonnes.

At planned rates of excess coke production, the remaining capacity of the existing stockpile will be exhausted in August 1999. Total stockpile capacity will be about 6 million tonnes. The continued operation of the Suncor upgrading facility through the development of the Steepbank Mine will result in the requirement to dispose of 15 million tonnes of coke during the next 25 years.

2.0 Economic Justification for Disposal of Coke

The continued storage of excess coke as a resource represents a significant on-going cost for handling and reclamation. The definition of excess coke as a resource at the Suncor site is questionable due to the fact that through 29 years of operation no market for this by-product has developed. Direct placement of future coke and relocation of the existing stockpile to an in-pit location would cost $ 85 million in handling costs alone. The costs of reclaiming the coke storage piles are not included in the cost estimate.

A study examining the feasibility of a coke slurry pumping system to handle the excess coke at Suncor was completed by Monenco AGRA in February 1996. The study concluded that a system to create a pumpable coke slurry would result in significant efficiencies in comparison to the existing trucking system. Costs of handling excess coke by slurry pumping may be 50% less than trucking. The coke slurry would be placed as a waste product with the consolidated tailings stream. The coke slurry disposal method has the added benefit of reducing air-borne dust generation due to reduced handling.

3.0 Coke Management Proposal

Suncor has proposed that if no economical use develops for coke, the current stockpile would be managed in place. A plan demonstrating that the stockpile meets the intent of EUB Guide G-55 (Storage Requirements for the Upstream Petroleum Industry) will be completed by the end of 1998. The alternative of removing the coke stockpile will be exercised should the plan not meet the intent of Guide G-55. Final reclamation of the coke stockpile will be addressed in conjunction with abandonment of the Suncor plant site.

The objective of Suncor's Coke Management Plan is to provide a cost effective, rational, method of excess coke disposal which addresses the conservation of resources and protects the environment. A summary of the priorities for the proposed management plan is as follows:

- Develop an economical use for this by-product.
- Until such market develops the existing stockpile would managed in place provided that an acceptable plan is developed. This could include long term reclamation of the stockpile.
- Once the capacity of the existing storage site is exhausted, provided that the coke remains unmarketable, excess coke will be disposed of by pumping it in a slurry form for inclusion in the consolidated tailings stream. Confirmation that consolidation of the ponds would not be impacted by the inclusion of coke will be made prior to implementation.
- The stockpile at the existing storage site would be disposed of by pumping it in a slurry form for inclusion in the consolidated tailings stream if a suitable long term plan can not be demonstrated.
- The maintenance of the existing stockpile would conserve a significant quantity of potential resource. Disposal with the consolidated tailings stream would cease if a market developed for the coke.

Results of groundwater monitoring, vegetation establishment trials, a coke leachate study, and a geomorphic assessment indicate that a plan to reclaim the coke pile at the existing storage site is achievable. A summary of points that demonstrate the viability of the existing site to meet the intent of Guide G-55 are as follows:

- Groundwater Monitoring

Sample analysis results from groundwater monitoring wells in the coke pile area show pH levels of 7 indicating that the coke is not acid generating. Low pH levels (2.8) were recorded in the southern area of the stockpile in 1993 prior to the removal of a sulphur stockpile. Groundwater pH levels improved to the current level within 2 years of the removal of the sulphur pile.

- Vegetation Establishment Trials

Suncor has hydro seeded test sections of the coke pile during 1994 and 1995 in an effort to establish a vegetation cover, aimed at reducing wind borne dust. The mitigation of air-borne dust and surface fires will be addressed through suitable soil capping and re-vegetation. A 1992 study on the susceptibility of Suncor coke to spontaneous combustion concluded that the risk is minimal; combustion incidents are a result of the placement of hot coke. The vegetative trials have been fairly successful in providing a cover on the areas where operations have been completed. In the spring of 1996 the area was seeded aerially along with an application of a nutrient supplement to aid in the establishment of a vegetative cover. The data obtained from the trials will assist with the development of long term reclamation plan.

- Coke Leachate Study

A 1996 coke leachate study conducted by HydroQual confirmed the lack of toxicity and leaching of inorganic chemicals that might be associated with coke. The reclamation plan will include a suitable capping of the stockpile to minimize water infiltration and

establish a vegetation cover. The low risk of toxicity or inorganic chemical leaching will be minimized by this cap.

- Athabasca River Geomorphic Assessment

A geomorphic assessment of the long term integrity of Suncor's existing and planned facilities, adjacent to the Athabasca River was completed by AGRA Earth and Environmental Limited in April 1996. The site of the coke storage facility is protected from the river by an extensive limestone outcrop; the river bank will not overtop during a 1:100 year flood event.

4.0 Coke Slurry Effect on CT

With respect to the storage of a coke slurry there has been no experimental data developed to directly address impact on the CT process. The first consideration in speculating on these questions would be the rate of addition of coke to CT. If it is assumed that the current coke inventory would be distributed within the CT deposits to be located in Ponds 5 and 6, (with future coke to be distributed within Ponds 7 and 8) then the mass of coke will only be in the order of 1% of the mass of CT.

The only way the coke could inhibit the CT process would be to adsorb the calcium in the CT mixture such that the calcium is not available to flocculate the clay particles, which is required to stabilize the CT clay/sand mixture. Coke particles do have a high internal surface area which may be effective in physically adsorbing certain types of molecules, particularly organics. However, they will not act as a significant sink for calcium ions. Therefore, there does not seem to be a mechanism through which coke could inhibit the reactions which stabilize the CT mixture, thereby reducing the rate of fines capture.

Coke does contain elevated levels of heavy metals which are concentrated in the coke from the recovered bitumen stream during processing. However, the pH of the CT mixture is above 7.5 and the mobility of these metals is therefore very low. Following initial dewatering, the CT deposit possesses a very low permeability which will lead to low leaching rates in the long term.

Because of its high internal surface area, coke is known to adsorb organic molecules. It has been demonstrated that the acute toxicity of tailings water can be reduced somewhat by passage through coke beds (see Table 5-1). Historically, coke filters have been used within Suncor's tailings dykes to control seepage without any known significant impact on seepage water quality. However, due to the low concentration of coke in CT it is not expected that there will be a significant impact on discharge water quality.

Q5. The report *Laboratory Studies on Trophic Effects and Fish Health* prepared by HydroQual Laboratories does not appear to address the issue of toxicity data and leaching of inorganic chemicals from coke. The report addressed the mixing of Tar Island Dyke wastewater and Athabasca River water. Provide the information that demonstrates that there is no toxicity or leaching of inorganic chemicals from the coke.

A5. The study of toxicity and leachates from coke is not in the referenced report. Our reference to these data was to a recent HydroQual lab study which is attached as Table 5-1.

I trust this information is satisfactory for the EUB to complete the review of our Application. Please contact the undersigned at 743-6892 or Don Klym at 743-6532 for any further discussion on the above information.

Yours truly

SUNCOR INC., OIL SANDS GROUP

Terry Bachynski
Director
Project Approvals

Attachments

K:\KLYM\ST\BEUBSU.SUR

CHEMEX Labs Alberta Inc.

Calgary : 2021 - 41st Avenue N.E., T2E 6P2. Telephone (403) 291-3077. FAX (403) 291-9468
Edmonton : 9331 - 48th Street, T6B 2R4. Telephone (403) 465-9877. FAX (403) 465-3007

Sample Description : POND 5
Sample Date & Time : 12-06-96 1040
Sampled By : TJH/DH
Sample Type : GROUND
Sample Received Date: June 12, 1996
Sample Station Code :

SUNCOR INC. OIL SANDS GROUP
ATTENTION : CHRIS FORDHAM
A008
GROUNDWATER
PROJ.#GROUNDWATER

Chemex Worksheet Number : 96-01579-7
Chemex Project Number : SUNC178-0501
Sample Access :
Sample Matrix : WATER
Report Date : July 3, 1996
Analysis Date : June 18, 1996

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	RESULTS	DETECTION LIMIT
Calcium - (ICP) Dissolved	20111L	mg/L	106.	0.01
Magnesium - (ICP) Dissolved	12111L	mg/L	25.6	0.01
Sodium - (ICP) Dissolved	11111L	mg/L	425.	0.01
Potassium -(ICP) Dissolved	19111L	mg/L	19.4	0.02
Chloride - Dissolved	17206L	mg/L	53.5	0.5
Sulphate - Dissolved	16306L	mg/L	659.	0.5
PP Alkalinity (as CaCO3)	10151L	mg/L	< 0.1	0.1
Total Alkalinity (as CaCO3)	10111L	mg/L	552.	0.5
pH	10301L	Units	7.99	0.01
Carbonate	06301L	mg/L	< 0.5	0.5
Bicarbonate	06201L	mg/L	673.	0.5
Total Hardness (as CaCO3)	10602L	mg/L	370.	0.5
Hydroxide	08501L	mg/L	< 0.5	0.5
Silicon - Dissolved (ICP)		mg/L	3.95	0.02
Fluoride	09105L	mg/L	4.00	0.05
Specific Conductance	02041L	uS/cm	2440.	0.02
Total Dissolved Solids	00201L	mg/L	1630.	1.
Total Ammonia Nitrogen	07505L	mg/L	10.3	0.01
Nitrite plus Nitrate Nitrogen as N	07110L	mg/L	0.018	0.003
Sulphur - (ICP) - Dissolved		mg/L	274.	0.2
Aluminum - Dissolved (ICP-AES)	13109L	mg/L	0.05	0.01
Barium - Dissolved (ICP-AES)	56109L	mg/L	0.20	0.01
Beryllium - Dissolved (ICP-AES)	04103L	mg/L	0.002	0.001
Boron - Dissolved (ICP-AES)	05111L	mg/L	3.12	0.01
Cadmium - Dissolved (ICP-MS)		mg/L	0.0028	0.0002
Chromium - Dissolved (ICP-AES)	24360L	mg/L	0.004	0.002
Cobalt - Dissolved (ICP-MS)		mg/L	0.0007	0.0003
Copper - Dissolved (ICP-AES)	29109L	mg/L	0.003	0.001
Iron - Dissolved (ICP-AES)	26109L	mg/L	< 0.01	0.01
Lead - Dissolved (ICP-MS)		mg/L	< 0.0003	0.0003
Lithium - Dissolved (ICP-AES)	03109L	mg/L	0.183	0.001
Manganese - Dissolved (ICP-AES)	25109L	mg/L	0.015	0.001
Molybdenum - Dissolved (ICP-AES)	42330L	mg/L	0.997	0.003

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SUNCOR INC. OIL SANDS GROUP
ATTENTION : CHRIS FORDHAM
A008
GROUNDWATER
PROJ.#GROUNDWATER

Sample Description : POND 5
Sample Date & Time : 12-06-96 1040
Sampled By : TJH/DH
Sample Type : GROUND
Sample Received Date: June 12, 1996
Sample Station Code :

Chemex Worksheet Number : 96-01579-7
Chemex Project Number : SUNC178-050
Sample Access :
Sample Matrix : WATER
Report Date : July 3, 199
Analysis Date : June 17, 199

PARAMETER DESCRIPTION	NAQUADAT CODE	UNITS	R F S U L T S		DETECTION LIMIT
Nickel - Dissolved (ICP-MS)		mg/L	<	0.0005	0.0005
Phosphorus - Dissolved (ICP-AES)	15450L	mg/L	<	0.1	0.1
Silver - Dissolved (ICP-MS)		mg/L		0.0002	0.0001
Strontium - Dissolved (ICP-AES)	38111L	mg/L		1.54	0.002
Titanium - Dissolved (ICP-AES)	22111D	mg/L	<	0.003	0.003
Uranium - Dissolved (ICP-MS)		mg/L		0.0070	0.0004
Vanadium - Dissolved (ICP-AES)	23330D	mg/L	<	0.002	0.002
Zinc - Dissolved (ICP-AES)	30501D	mg/L		0.008	0.001
Ion Balance		Balance		1.03	0.01

TABLE 2-2

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monton : 9331 - 48th Street, T6B 2R4, Telephone (403) 465-9877, FAX (403) 466-8332

SUNCOR INC. OIL SANDS GROUP
ATTENTION : CHRIS FORDHAM
A008
GROUNDWATER
PROJ.#GROUNDWATER

mple Description	: POND 5
mple Date & Time	: 12-06-96 1040
mpled By	: TJH/DH
mple Type	: GROUND
mple Received Date	: June 12, 1996
mple Station Code	:

Chemex Worksheet Number	: 96-01579-?
Chemex Project Number	: SUNC178-0501
Sample Access	:
Sample Matrix	: WATER
Report Date	: July 3, 1996
Analysis Date	: June 19, 1996

TOTAL EXTRACTABLE HYDROCARBONS METHOD MODIFIED ASTM D2887

COMPONENT	mg/L	BOILING RANGE
C 08	< 0.01	98.5 TO 125.7
C 09	< 0.01	125.8 TO 150.8
C 10	< 0.01	150.9 TO 174.2
C 11	< 0.01	174.3 TO 196.0
C 12	< 0.01	196.1 TO 216.0
C 13	< 0.01	216.1 TO 236.0
C 14	< 0.01	236.1 TO 253.0
C 15	< 0.01	253.1 TO 271.0
C 16	< 0.01	271.1 TO 287.0
C 17	< 0.01	287.1 TO 302.0
C 18	< 0.01	302.1 TO 317.0
C 19	< 0.01	317.1 TO 331.0
C 20	< 0.01	331.1 TO 344.0
C 21	< 0.01	344.1 TO 357.0
C 22	< 0.01	357.1 TO 366.0
C 23	< 0.01	366.1 TO 380.0
C 24	< 0.01	380.1 TO 391.0
C 25	< 0.01	391.1 TO 402.0
C 26	< 0.01	402.1 TO 412.0
C 27	< 0.01	412.1 TO 422.0
C 28	< 0.01	422.1 TO 432.0
C 29	< 0.01	432.1 TO 441.0
C 30	< 0.01	441.1 TO 449.0

TOTAL HYDROCARBONS C8-C10 N.D.
TOTAL HYDROCARBONS C11-C30 N.D.

verage molecular weight : N.D. AMU

per component : 0.01 mg/L

Results are reported in accordance with COME guidelines, "Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites, Volume I". All results are corrected for blank levels

Method detection level. - Calculated on the basis of the instrument detection level, the dilution used, and the weight of the sample.

Bracketed results are values below the reliable detection level, and are subject to reduced levels of confidence. The reliable detection level is twice the method detection level

Surrogate Recovery : 107% WATER surrogate limits : 62% - 136%

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Microtox Report

Project : SUNC178-0501-96-01579-7

Sample Data :

Company Name :	**Suncor Inc. Oil Sands Group**		
City :	**Fort McMurray, AB**		
Sample Description :	**Pond 5**		
Sampling Location :	**n/a**		
Sampling Method :	**Grab**		
Volume Obtained :	**250 mL**		
Sampled By :	**T.J.H. / D.H.**		
Sample Date :	**96 06 12**	*Time:*	**22:40**
Date Received :	**96 06 14**	*Time:*	**10:00**
Date of Assay :	**96 06 17**	*Time:*	**14:00**
Report Date :	**96 06 17**		
Storage Temp :	**4 ± 2 °C**		
Sample Prep:	**n/a**		

Test Data:

Appearance, Visual :	**Clear**		
Turbidity, Visual :	**None**		
Initial pH :	**7.6**		
Sample Dilution :	**Neat**		
IC50 (5min, 15°C) :	**96%**	*95% Confidence Interval :*	**83%<96%<110%**
IC20 (5min, 15°C) :	**17%**	*95% Confidence Interval :*	**16%<17%<19%**
IC50 (15min, 15°C) :	**99%**	*95% Confidence Interval :*	**83%<99%<120%**
IC20 (15min, 15°C) :	**16%**	*95% Confidence Interval :*	**14%<16%<17%**

Note: **Sample Is Considered Slightly Toxic.**

Results of Phenol Reference Test :

IC50 @ 5 min. :	**23.8 mg/L**
95 % Confidence Interval :	**16.6<23.8<27.8**
Method :	**Shewhart**
Date of Reference Bioassay :	**96 06 13**

Data
Verified By : M. A. Brown

Data & QA/QC
Reviewed By : M. A. Brown

CHEMEX Labs Alberta Inc.

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Microtox Report

Project : SUNC178-0501-96-01579-7

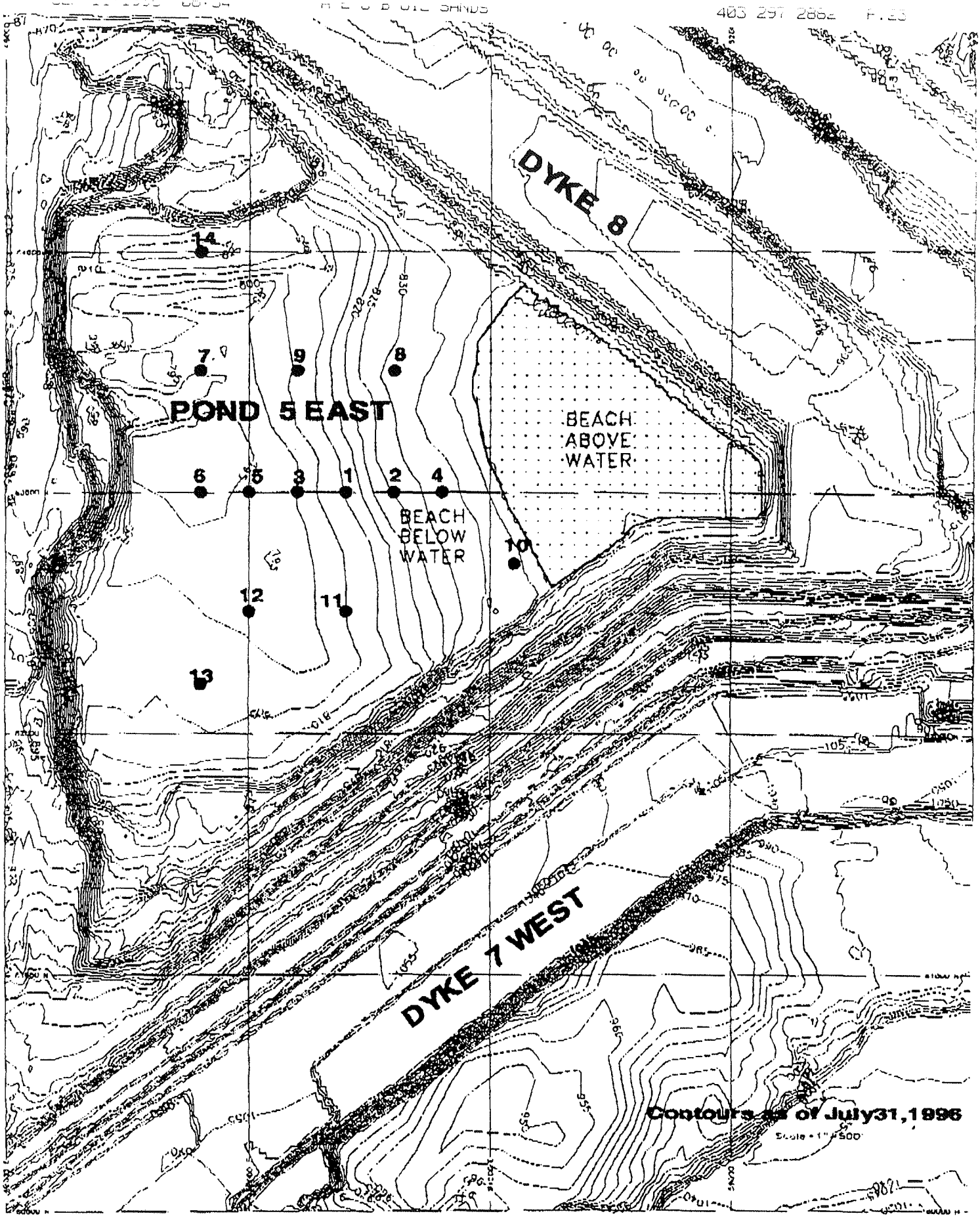
Test Information :

Type of Test :	15 min. Static Bioassay
Test Species :	*Vibrio fischeri* (Bioluminescent bacteria)
Source of Test Species :	MICROBICS Corporation
Reagent Lot # :	ACV003-2
Date Obtained :	96 06 01
Expiry Date :	97 10
Reagent Holding Temp :	< - 20°C
Test Protocol :	Environment Canada EPS 1/RM/24
Salinity Adjustment :	Osmotic Adjusting Solution
Analyzer Used :	MICROBICS Analyzer 2055 and refrigerated water bath
Calculation Method :	MICROBICS Data Reduction Software ver. 7.11

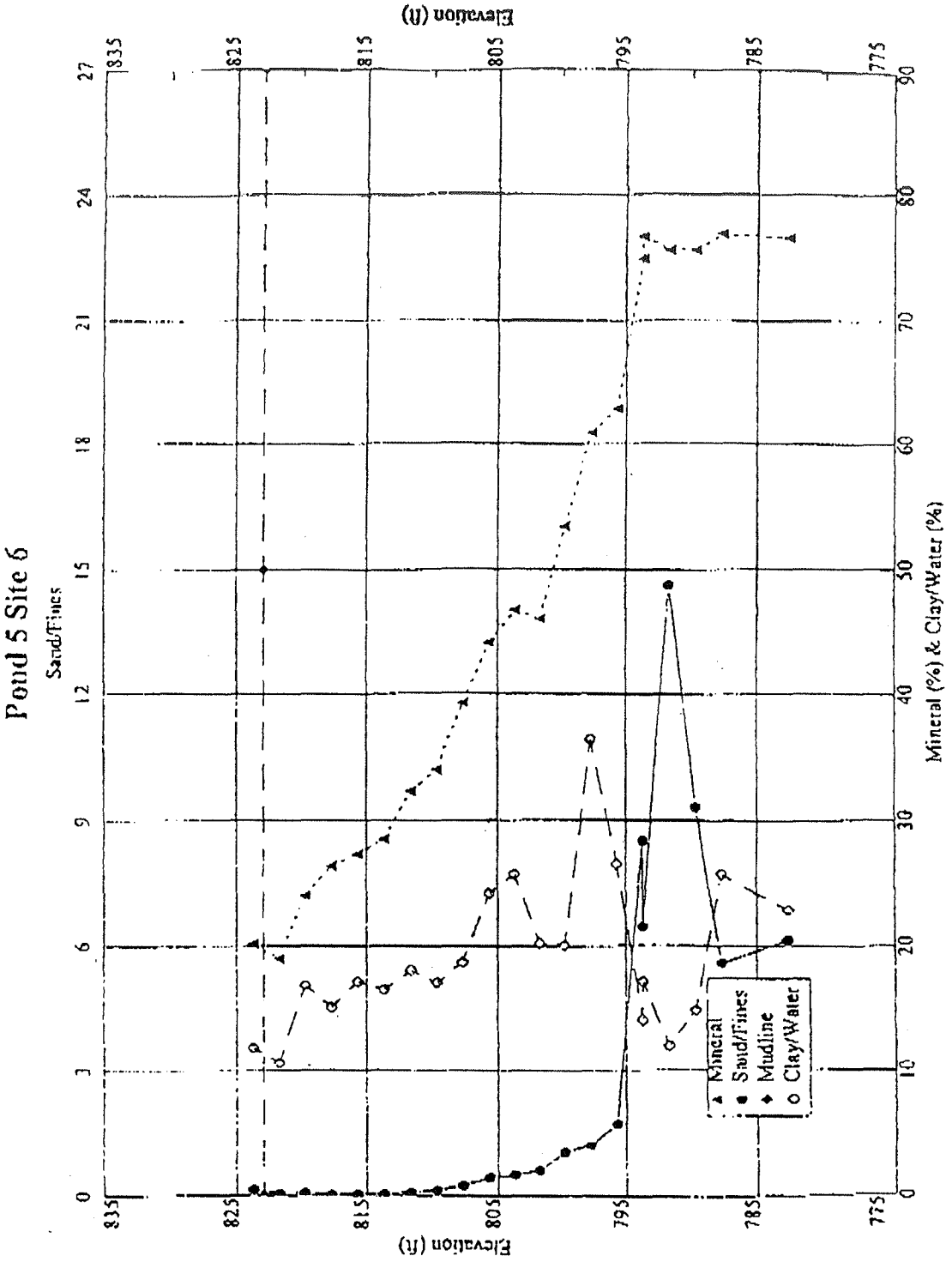
Data Table: Sample vs Light Emission at Time T

Time	Replicate Controls			Sample Concentration [% v/v]					
(min.)	1	2	3	2.6	5.1	10.2	20.5	40.9	81.8
T0	96	94	98	94	95	96	96	94	95
T5	108	107	113	110	108	104	99	82	64
T15	110	108	112	101	99	93	85	72	57
T30*									
T60*									

* If applicable

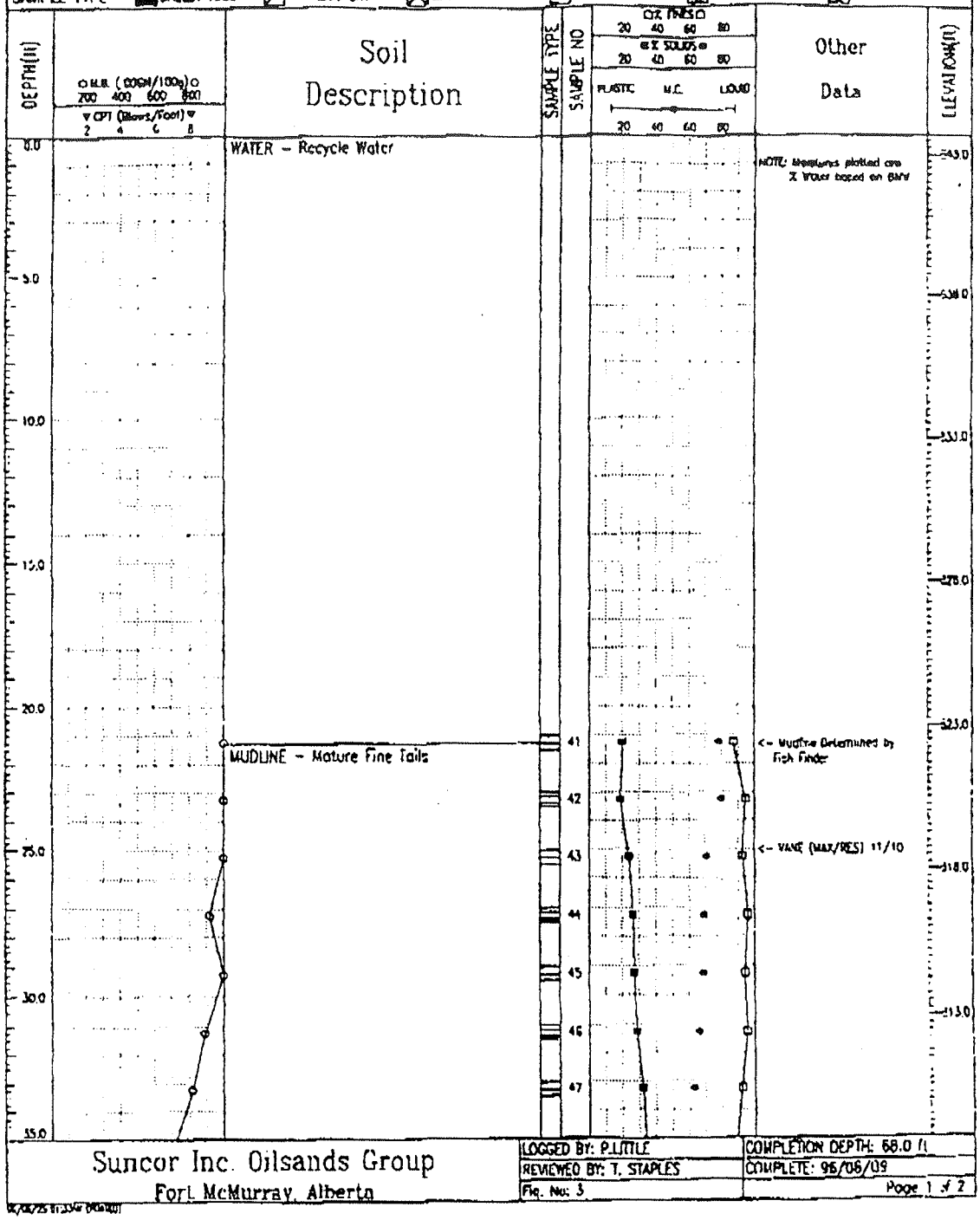


POND 5 EAST CT SAMPLE SITES


Pond 5 Site 6
Sand/Fines
Mineral (%) & Clay/Water (%)
Elevation (ft)
Elevation (ft)
Mineral
Sand/Fines
Mudline
Clay/Water

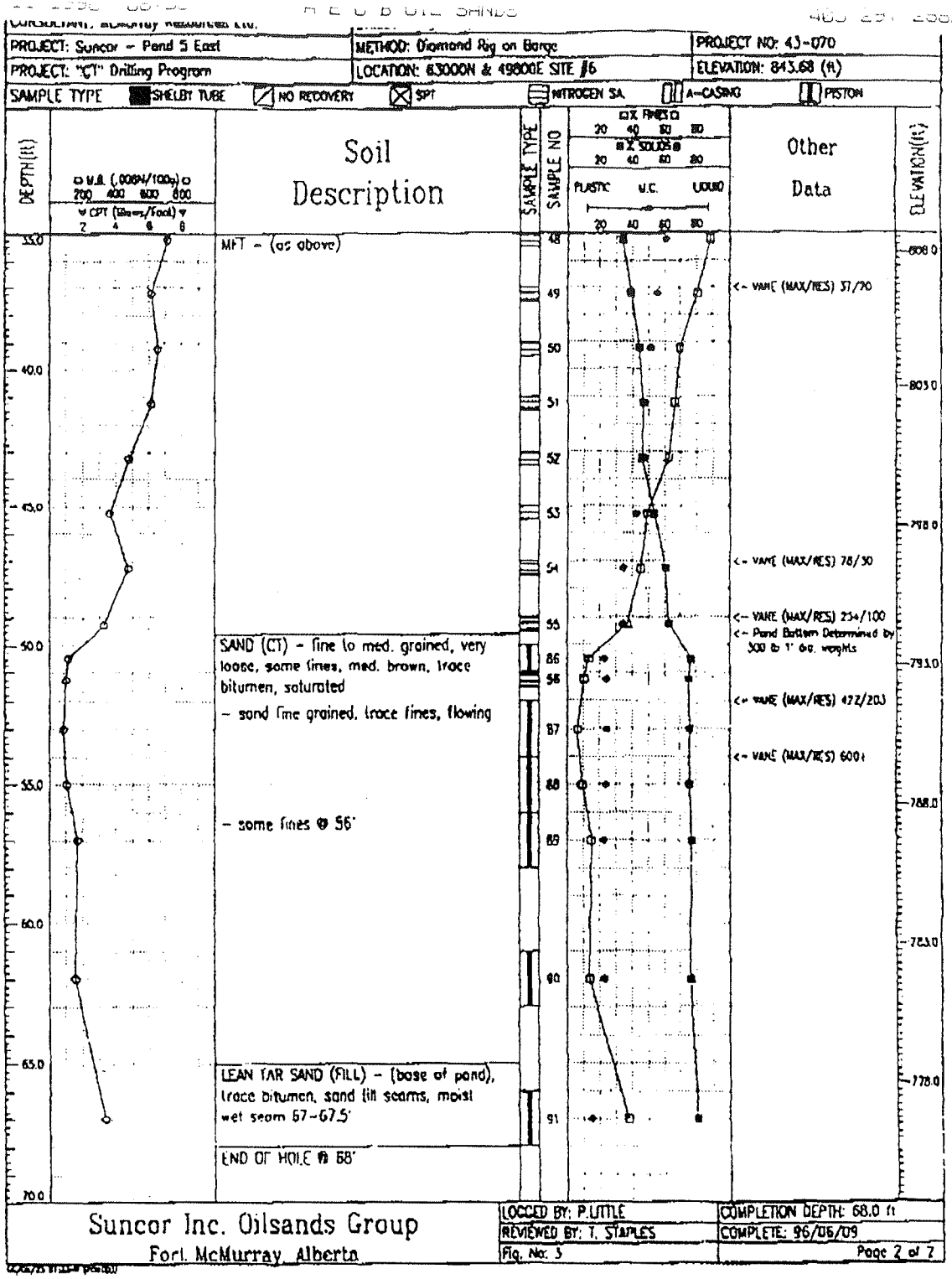
CONSULTANT: McMurray Resources Ltd.	DRILLER: Elgin Exploration Ltd.	TEST HOLE NO: PSS6
PROJECT: Suncor – Pond 5 East	METHOD: Diamond Rig on Barge	PROJECT NO: 43-070
PROJECT: "CT" Drilling Program	LOCATION: 6300ON & 4980OE SITE #6	ELEVATION: 843.68 (ft)

SAMPLE TYPE: SHELBY TUBE | NO RECOVERY | SPT | NITROGEN SA | A-CASING | PISTON



Suncor Inc. Oilsands Group
Fort McMurray, Alberta

LOGGED BY: P.LITTLE	COMPLETION DEPTH: 68.0 ft
REVIEWED BY: T. STAPLES	COMPLETE: 96/08/09
Fig. No: 3	Page 1 of 2


PROJECT: Suncor – Pond 5 East
METHOD: Diamond Rig on Barge
PROJECT NO: 43-070
PROJECT: "CT" Drilling Program
LOCATION: 63000N & 49800E SITE #6
ELEVATION: 843.68 (A)
SAMPLE TYPE
SHELBY TUBE
NO RECOVERY
SPT
NITROGEN SA
A-CASING
PISTON
DEPTH(ft)
SAMPLE TYPE
SAMPLE NO
Soil Description
Other Data
ELEVATION(ft)
MFT – (as above)
SAND (CT) – fine to med. grained, very loose, some fines, med. brown, trace bitumen, saturated
– sand fine grained, trace fines, flowing
– some fines @ 56'
LEAN TAR SAND (FILL) – (base of pond), trace bitumen, sand lit seams, moist wet seam 67–67.5'
END OF HOLE @ 68'
<– VANE (MAX/RES) 37/20
<– VANE (MAX/RES) 78/30
<– VANE (MAX/RES) 234/100
<– Pond Bottom Determined by 300 lb 1' dia. weights
<– VANE (MAX/RES) 472/203
<– VANE (MAX/RES) 600+
Suncor Inc. Oilsands Group
Fort. McMurray, Alberta
LOGGED BY: P.LITTLE
REVIEWED BY: T. STAPLES
Fig. No: 3
COMPLETION DEPTH: 68.0 ft
COMPLETE: 96/06/09
Page 2 of 7

MRRT

McMURRAY RESOURCES LTD.

Research & Testing)

PARTICLE SIZE ANALYSIS

CLIENT: Suncor Inc.	SAMPLED BY: MRRT	PROJECT NO: 43 - 070	
PROJECT: Pond 5 East - "C1" Drilling Program	CONTRACTOR: MRRT & Elgin Exploration	SAMPLED: 05/08/96	DATE TESTED: 06/11/96
DESCRIPTION (prev, perf, CT, LTS): CT	DEPTH (m): 50-52	SITE: SITE # 6	LOCATION: 63000N & 49800E
		TEST HOLE #: PSS6	SAMPLE #: 86

SIEVE ANALYSIS

(std) SIEVE	(mm)	WT. RETAINED	% RETAINED	% PASSING
4"	100.000			
3"	80.000			
2"	50.000			
1½"	40.000			
1"	25.000			
3/4"	20.000			
5/8"	16.000			
1/2"	12.500			
3/8"	10.000			
#4	5.000			
#10	2.000			
#16	1.000			100.0
#40	0.425		0.1	99.9
#80	0.250		4.5	95.5
#100	0.150		68.8	26.7
#200	0.075		12.3	14.4
#325	0.045		1.0	13.4

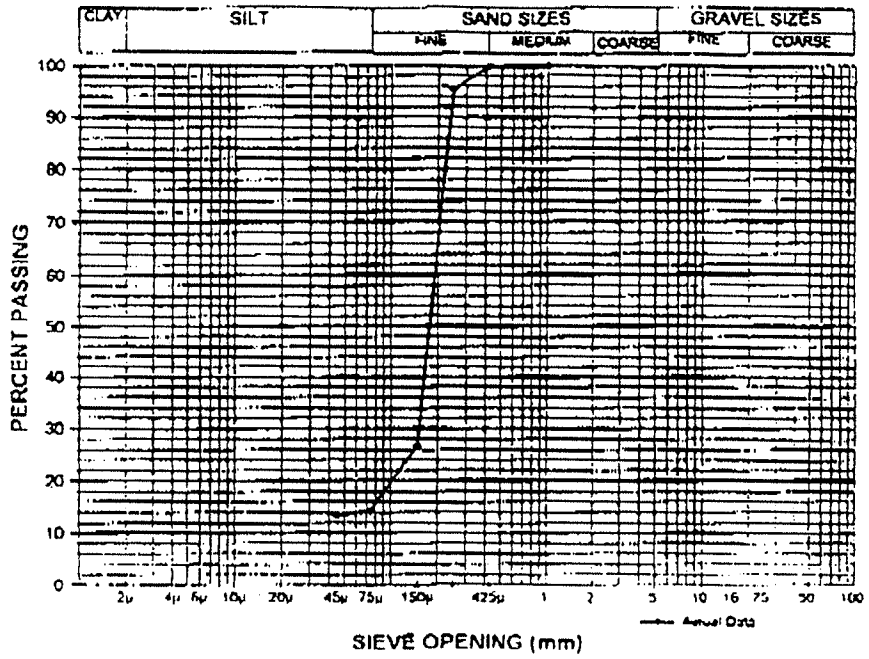
METHYLENE BLUE	
113	006N/100g
	% CLAY
	CLAY - WATER

HYDROMETER	
DIAMETER (µm)	% PASSING
30	
20	
10	
8	
6	
4	
2	

MINERAL COMPOSITION	
0.0%	GRAVEL
85.6%	SAND
13.4%	FINES <325

BITUMEN, MINERAL, WATER (%)	
BITUMEN	0.40
MINERAL	78.70
WATER	22.90
TOTAL	100.00

COMMENTS:



PER

MRRT

McMURRAY RESOURCES LTD.
(Research & Testing)

PARTICLE SIZE ANALYSIS

CLIENT	SAMPLED BY	PROJECT NO	
Suncor Inc.	MRRT	43 - 070	
PROJECT	CONTRACTOR	SAMPLED	DATE TESTED
Pond 5 East - "CT" Drilling Program	MRRY & Elgin Exploration	06/09/96	06/11/96
DESCRIPTION (RW, BPT, CT, LTS) / DEPTH (m)	DYE	LOCATION	TEST HOLE #	SAMPLE #
CT 54.56	SITE # 6	53000N & 49800E	PSS6	88

SIEVE ANALYSIS

(std) SIEVE (mm)		WT. RETAINED	% RETAINED	% PASSING
4"	100.000			
3"	80.000			
2"	50.000			
1½"	40.000			
1"	25.000			
¾"	20.000			
5/8"	16.000			
1/2"	12.500			
3/8"	10.000			
#4	5.000			
#10	2.000			
#18	1.000			100.0
#40	0.425		0.1	99.9
#60	0.250		7.0	92.9
#100	0.150		60.0	32.8
#200	0.075		11.6	21.2
#325	0.045		11.5	9.7

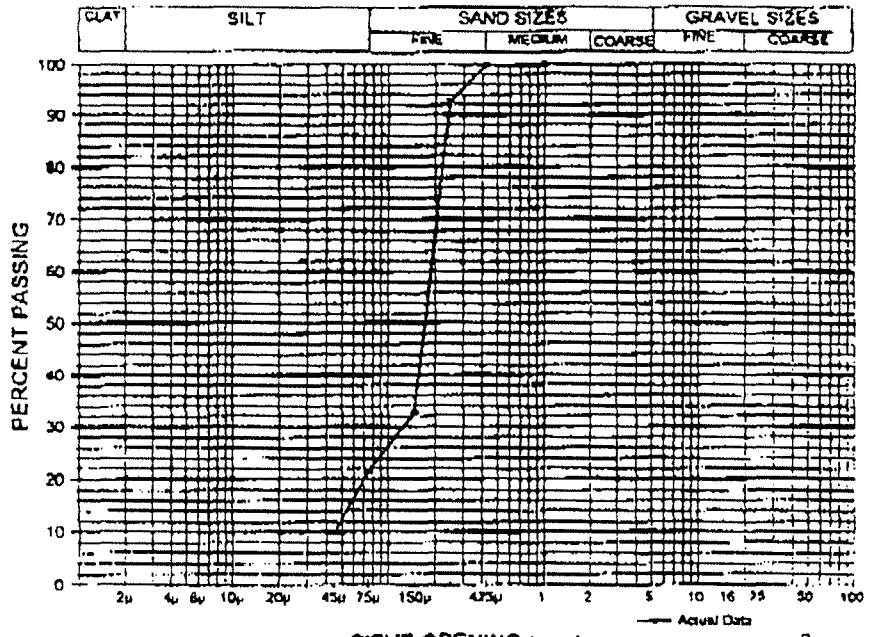
METHYLENE BLUE	
104	005N/100g
	% CLAY
	CLAY - WATER

HYDROMETER	
DIAMETER (µm)	% PASSING
30	
20	
10	
8	
6	
4	
2	

MINERAL COMPOSITION	
0.0%	GRAVEL
78.8%	SAND
9.7%	FINES <325

BITUMEN, MINERAL, WATER (%)	
BITUMEN	0.40
MINERAL	75.60
WATER	24.10
TOTAL	100.10

COMMENTS:



PER

MRRT

McMURRAY RESOURCES LTD.

Research & Testing

PARTICLE SIZE ANALYSIS

CLIENT: Suncor Inc.	SAMPLED BY: MRRT	PROJECT NO: 43 - 070	
PROJECT: Pond 5 East - "CT" Drilling Program	CONTRACTOR: MRRT & Elgin Exploration	SAMPLED: 06/09/96	DATE TESTED: 06/11/96
DESCRIPTION (BH, WPT, CT, ETC): CT	DEPTH (m): 61-63	SITE: SITE # 6	LOCATION: 63000N & 49800E
		TEST HOLE #: PSS6	SAMPLE #: 90

SIEVE ANALYSIS

(std) SIEVE	(mm)	WT. RETAINED	% RETAINED	% PASSING
4"	100.000			
3"	80.000			
2"	50.000			
1½"	40.000			
1"	25.000			
¾"	20.000			
⅝"	16.000			
½"	12.500			
⅜"	10.000			
#4	5.000			
#10	2.000			
#18	1.000			100.0
#40	0.425		0.1	100.0
#60	0.250		2.0	98.0
#100	0.150		43.3	54.7
#200	0.075		36.9	17.8
#325	0.045		3.8	14.0

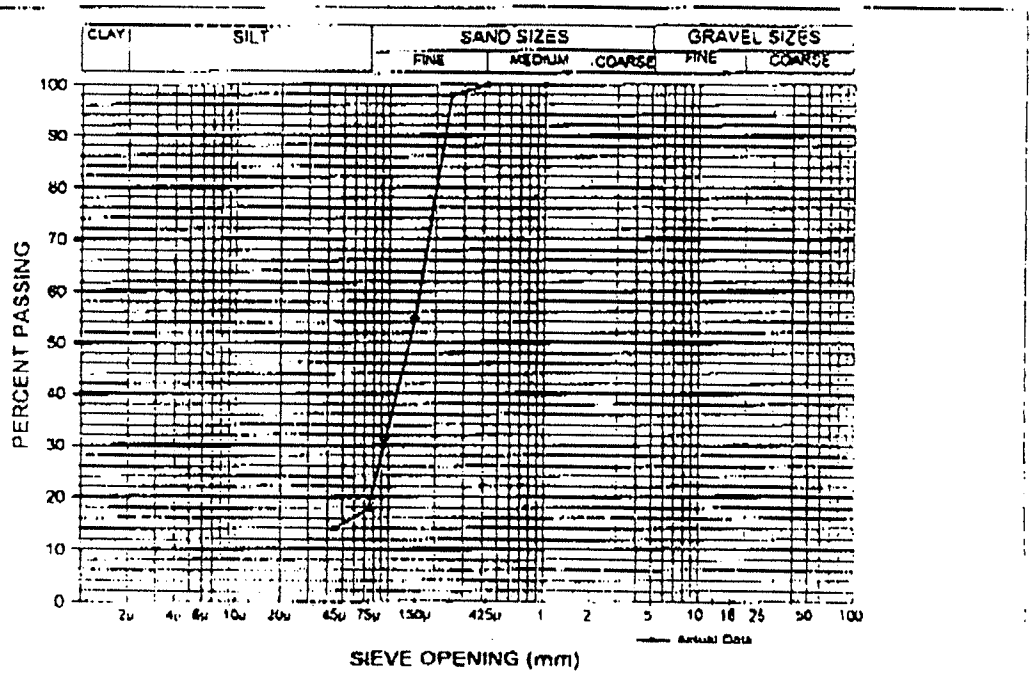
METHYLENE BLUE	
154	.006N/100g
	% CLAY
	CLAY - WATER

HYDROMETER	
DIAMETER (µm)	% PASSING
30	
20	
10	
8	
6	
4	
2	

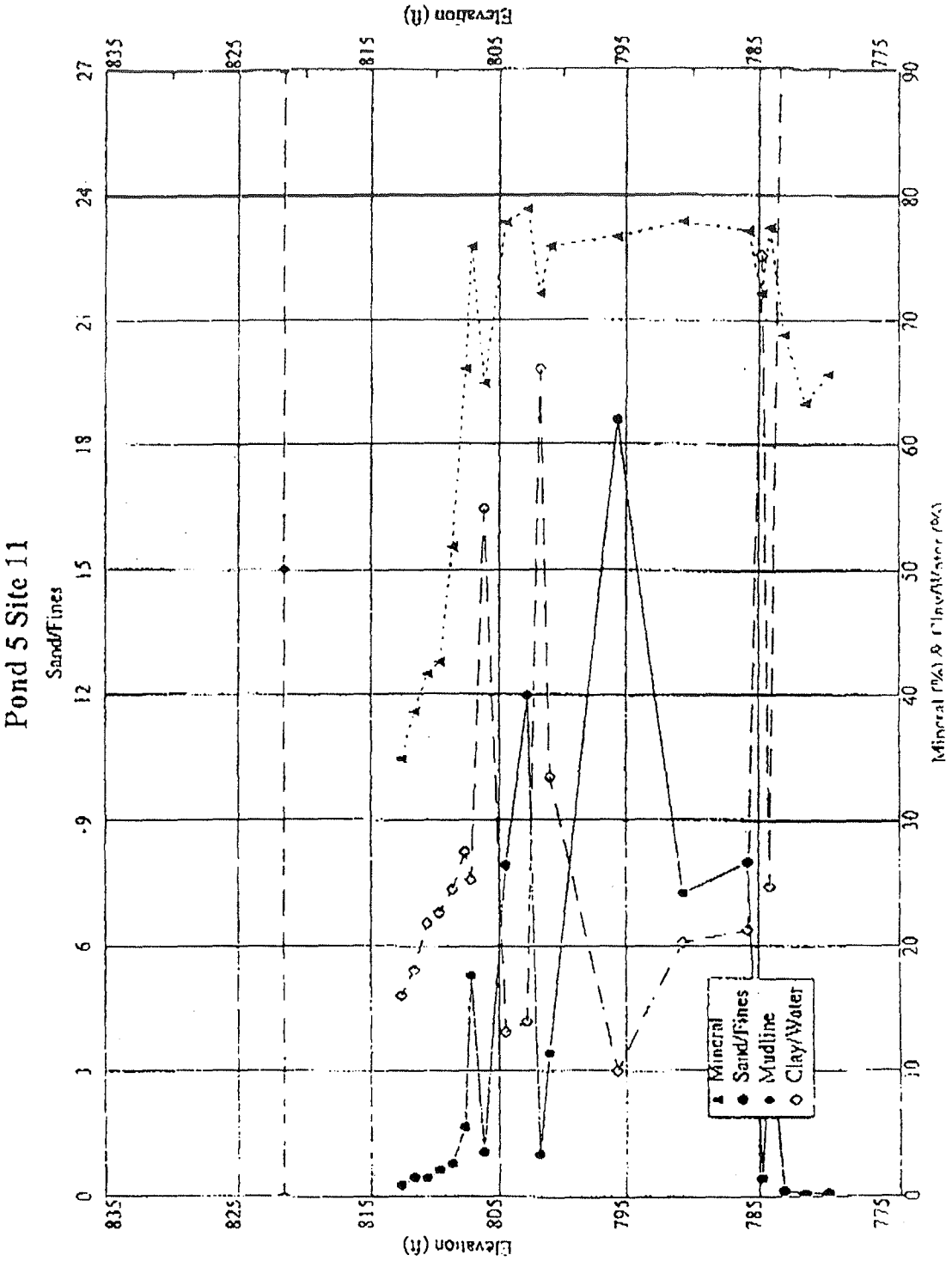
MINERAL COMPOSITION	
0.0%	GRAVEL
82.3%	SAND
14.0%	FINES <325

BITUMEN, MINERAL, WATER (%)	
BITUMEN	0.40
MINERAL	76.60
WATER	23.00
TOTAL	100.00

COMMENTS.



PER



SITE 11 DATA
SHEET 1

CONSULTANT: McMurray Resources Ltd. | DRILLER: Ugin Exploration Ltd. | PROJECT NO: 43-070

PROJECT: Suncor – Pond 5 East | METHOD: Diamond Rig on Barge | ELEVATION: 843.68 (ft)

PROJECT: "CT" Drilling Program | LOCATION: 62500N & 50400E SITE #11

SAMPLE TYPE: SHELBY TUBE | NO RECOVERY | SPT | NITROGEN SPL | A-CASING | PISTON

DEPTH (ft)	Undr. Shear Strength (kPa) / CPT (Rises/Foot)	Soil Description	SAMPLE TYPE	SAMPLE NO	Atterberg Limits / % Solids / Water Content	Other Data	ELEVATION (ft)
0.0		WATER – Recycle Water				NOTE: Moistures plotted are % Water based on Bulk	843.0
10.0							828.0
20.0							813.0
30.0							798.0
40.0							783.0
50.0							768.0
60.0		MUDLINE – Mature Fine Tails				<– Mudline Determined by Fish Finder	753.0
70.0		– fine to medium grained, trace fines					738.0
80.0				152		<– @ft 1.0 TEMP 15.8 C	723.0
				153		VANE (MAX/RES) 11/9	
84.0				154		<– VANE (MAX/RES) 15/10	

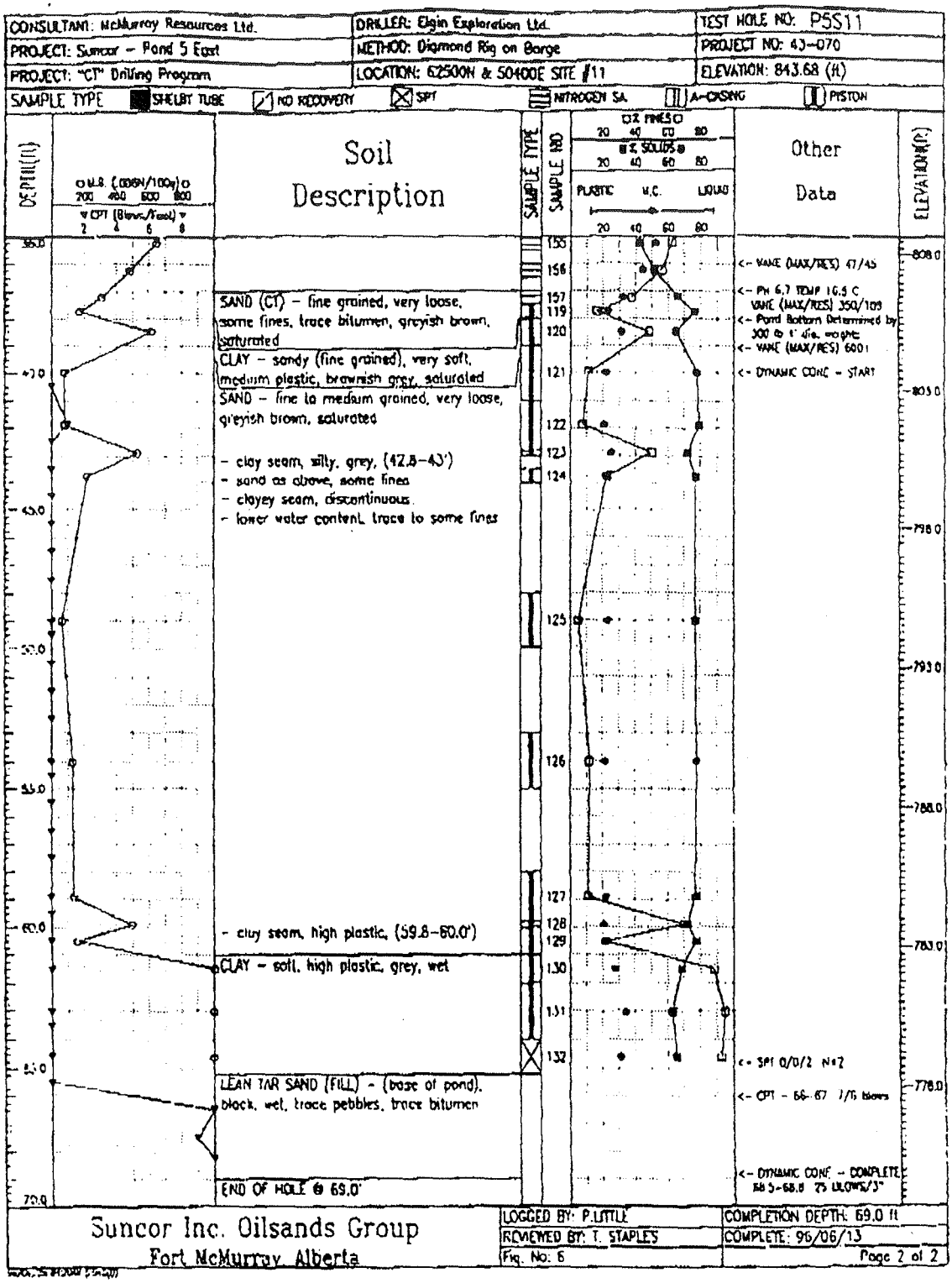
Suncor Inc. Oilsands Group
Fort McMurray, Alberta

LOGGED BY: P.LITTLE | COMPLETION DEPTH 69.0 ft

REVIEWED BY: T. STAPLES | COMPLETE: 96/06/13

Fig. No: 6 | Page 1 of 2

SITE 11 DATA
SHEET 2


CONSULTANT: McMurray Resources Ltd.
DRILLER: Elgin Exploration Ltd.
TEST HOLE NO: P5S11
PROJECT: Suncor - Pond 5 East
METHOD: Diamond Rig on Barge
PROJECT NO: 43-070
PROJECT: "CT" Drilling Program
LOCATION: 62500N & 50400E SITE #11
ELEVATION: 843.68 (ft)
SAMPLE TYPE
SHELBY TUBE
NO RECOVERY
SPT
NITROGEN SA.
A-CASING
PISTON
DEPTH(ft)
Soil Description
SAMPLE TYPE
SAMPLE NO
% FINES
% SOLIDS
PLASTIC
W.C.
LIQUID
Other Data
ELEVATION(ft)
SAND (CT) - fine grained, very loose, some fines, trace bitumen, greyish brown, saturated
CLAY - sandy (fine grained), very soft, medium plastic, brownish grey, saturated
SAND - fine to medium grained, very loose, greyish brown, saturated
- clay seam, silty, grey, (42.8-43')
- sand as above, some fines
- clayey seam, discontinuous.
- lower water content, trace to some fines
- clay seam, high plastic, (59.8-60.0')
CLAY - soft, high plastic, grey, wet
LEAN TAR SAND (FILL) - (base of pond), black, wet, trace pebbles, trace bitumen
END OF HOLE @ 69.0'
<- VANE (MAX/RES) 47/45
<- PH 6.7 TEMP 10.5 C
VANE (MAX/RES) 350/109
<- Pond Bottom Determined by 300 lb 1' dia. weight
<- VANE (MAX/RES) 6001
<- DYNAMIC CONE - START
<- SPT 0/0/2 N=2
<- CPT - 66-67 7/6 blows
<- DYNAMIC CONE - COMPLETE
Suncor Inc. Oilsands Group
Fort McMurray Alberta
LOGGED BY: P.LITTLE
REVIEWED BY: T. STAPLES
Fig. No: 6
COMPLETION DEPTH: 69.0 ft
COMPLETE: 96/06/13
Page 2 of 2

MRRT

McMURRAY RESOURCES LTD.

(Research & Testing)

PARTICLE SIZE ANALYSIS

CLIENT: Suncor Inc.	SAMPLED BY: MRRT	PROJECT NO: 43 - 070	
PROJECT: Pond 5 - Oiling Project	CONTRACTOR: MRRT & Elgin Exploration	SAMPLED: 06/13/96	DATE TESTED: 06/17/96
DESCRIPTION (MFT, CT, LTD): MFT	DEPTH (ft): 34	SITE: SITE 6 11	LOCATION: 62500N & 50400E
TEST HOLE #: P5S11	SAMPLE #: 154		

SIEVE ANALYSIS

(std) SIEVE (mm)		WT. RETAINED	% RETAINED	% PASSING
4"	100.000			
3"	80.000			
2"	50.000			
1½"	40.000			
1"	25.000			
3/4"	20.000			
5/8"	16.000			
1/2"	12.500			
3/8"	10.000			
#4	5.000			
#10	2.000			
#16	1.000			100.0
#40	0.425		0.0	100.0
#60	0.250		0.2	99.8
#100	0.150		3.1	96.7
#200	0.075		20.3	76.5
#325	0.045		5.6	70.9

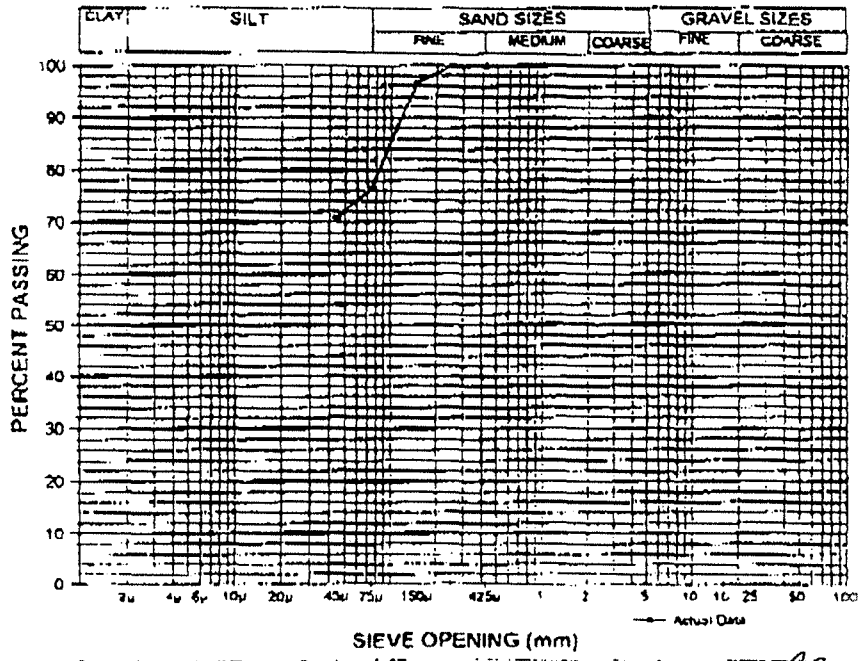
METHYLENE BLUE	
660	.000N/100g
	% CLAY
	CLAY - WATER

HYDROMETER	
DIAMETER (µm)	% PASSING
30	
20	
10	
8	
6	
4	
2	

MINERAL COMPOSITION	
0.0%	GRAVEL
29.5%	SAND
70.9%	FINES <325

BITUMEN, MINERAL, WATER (%)	
BITUMEN	3.70
MINERAL	41.80
WATER	54.50
TOTAL	99.50

COMMENTS:



PER

MRRT

McMURRAY RESOURCES LTD.

(Research & Testing)

PARTICLE SIZE ANALYSIS

CLIENT: Suncor Inc.	SAMPLED BY: MRRT	PROJECT NO: 43 - 070	
PROJECT: Pond 5 - Drilling Project	CONTRACTOR: MRRT & Elgin Exploration	SAMPLED: 06/13/96	DATE TESTED: 06/17/96
DESCRIPTION (SAND, SILT, CLAY, LTS): MFT	DEPTH (ft): 37	SITE: SITE # 11	LOCATION: 62500N & 50400E
TEST HOLE #: PSS11	SAMPLE #: 157		

SIEVE ANALYSIS

(std) SIEVE (mm)		WT. RETAINED	% RETAINED	% PASSING
4"	100.000			
3"	80.000			
2"	50.000			
1½"	40.000			
1"	25.000			
¾"	20.000			
⅝"	16.000			
½"	12.500			
⅜"	10.000			
#4	5.000			
#10	2.000			
#16	1.000			100.0
#40	0.425		0.2	99.8
#60	0.250		4.1	95.7
#100	0.150		29.8	65.9
#200	0.075		25.6	40.3
#325	0.045		2.7	37.6

METHYLENE BLUE

308	.008N/100g
	% CLAY
	CLAY - WATER

HYDROMETER

DIAMETER (µm)	% PASSING
30	
20	
10	
8	
6	
4	
2	

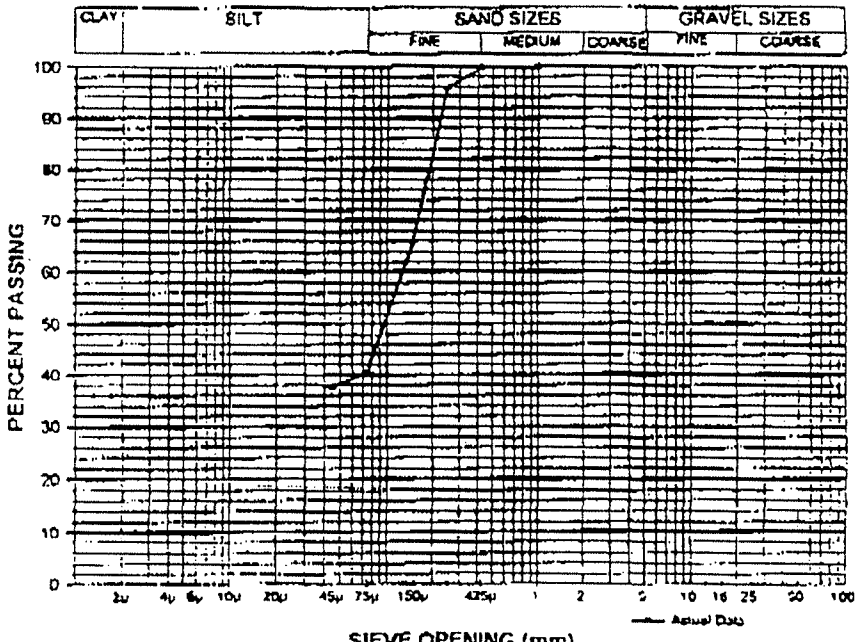
MINERAL COMPOSITION

0.0%	GRAVEL
59.7%	SAND
37.6%	FINES <325

BITUMEN, MINERAL, WATER (%)

BITUMEN	1.70
MINERAL	66.00
WATER	32.40
TOTAL	100.10

COMMENTS:



PER

MRRT
McMURRAY RESOURCES LTD.
(Research & Testing)

PARTICLE SIZE ANALYSIS

Suncor Inc	SAMPLED BY: MRRT	PROJECT NO: 43 - 070	
Pond 5 - Drilling Project	CONTRACTOR: MRRT & Elgin Exploration	SAMPLED: 06/12/96	DATE TESTED: 06/17/96
DESCRIPTION (FM, MFT, CT, LTS): CT	DEPTH (ft): 39.5-41	SITE: SITE # 11	LOCATION: 62500N & 50400E
		TEST HOLE #: P5S11	SAMPLE #: 121

SIEVE ANALYSIS

(std) SIEVE (mm)	WT. RETAINED	% RETAINED	% PASSING
4" 100.000			
3" 80.000			
2" 50.000			
1 1/2" 40.000			
1" 25.000			
3/4" 20.000			
5/8" 16.000			
1/2" 12.500			
3/8" 10.000			
#4 5.000			
#10 2.000			
#18 1.000			100.0
#40 0.425		1.3	98.7
#60 0.250		11.7	87.0
#100 0.150		53.6	33.3
#200 0.075		20.3	13.0
#325 0.045		1.8	11.2

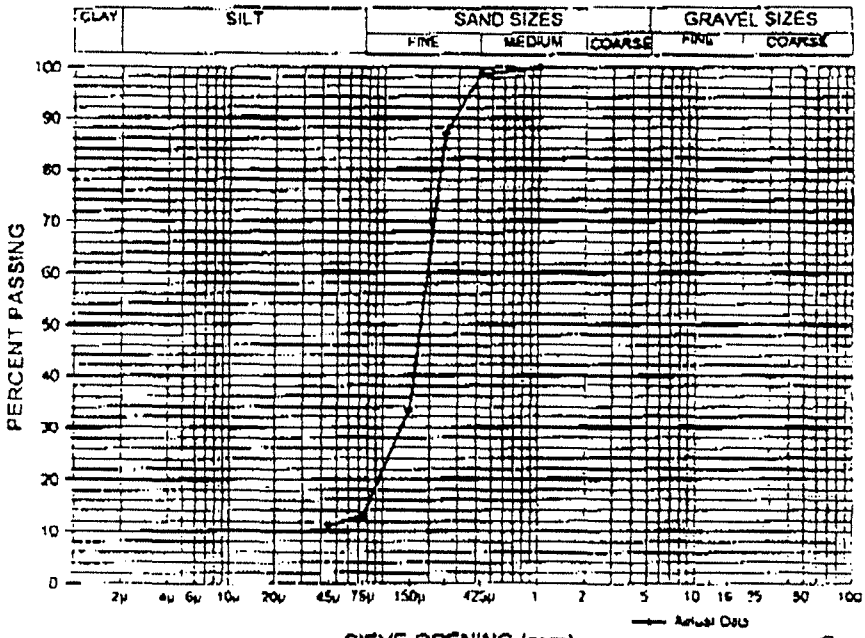
METHYLENE BLUE	
79	.006N/100g
	% CLAY
	CLAY - WATER

HYDROMETER	
DIAMETER (µm)	% PASSING
30	
20	
10	
8	
6	
4	
2	

MINERAL COMPOSITION	
0.0%	GRAVEL
87.0%	SAND
11.2%	FINES <325

BITUMEN, MINERAL, WATER (%)	
BITUMEN	0.40
MINERAL	77.80
WATER	21.80
TOTAL	100.00

COMMENTS:



PER

MRRT

McMURRAY RESOURCES LTD.
(Reserves & Testing)

PARTICLE SIZE ANALYSIS

CLIENT: Suncor Inc	SAMPLED BY: MRRT		PROJECT NO: 43 - 070
PROJECT: Pond 5 - Drilling Project	CONTRACTOR: MRRT & Elgin Exploration	SAMPLED: 06/12/96	DATE TESTED: 06/17/96
DESCRIPTION (RW, MFT, CT, LTS): CT	DEPTH (ft): 53-55	SITE: SITE # 11	LOCATION: 62500N & 50400E
		TEST HOLE #: P5S11	SAMPLE #: 126

SIEVE ANALYSIS

(Std) SIEVE	(mm)	WT. RETAINED	% RETAINED	% PASSING
4"	100.000			
3"	80.000			
2"	50.000			
1½"	40.000			
1"	25.000			
¾"	20.000			
⅝"	16.000			
½"	12.500			
⅜"	10.000			
#4	5.000			
#10	2.000			
#18	1.000			100.0
#40	0.425		0.3	99.7
#60	0.250		5.4	94.3
#100	0.150		51.9	42.4
#200	0.075		28.9	13.5
#325	0.045		1.4	12.1

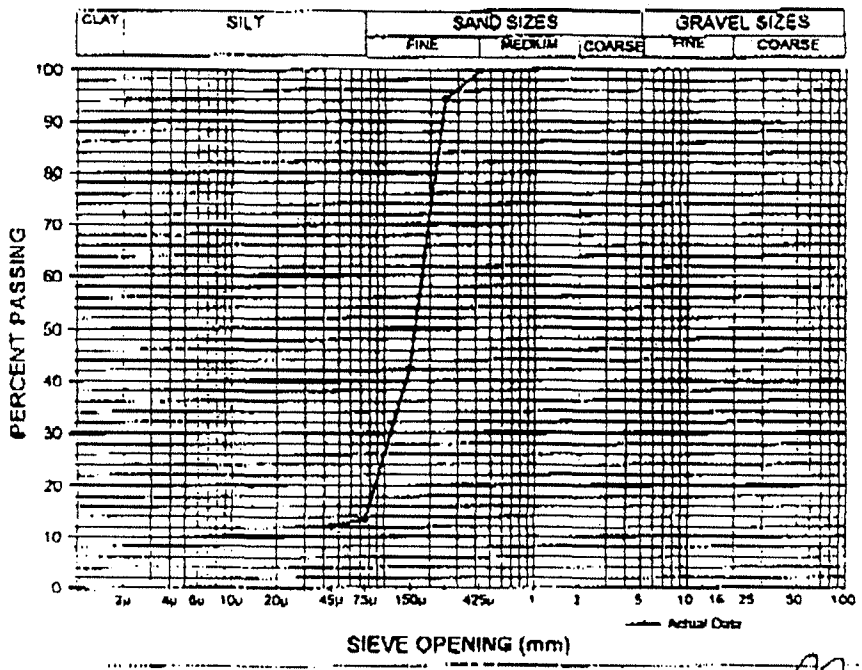
METHYLENE BLUE	
126	.008N/100g
	% CLAY
	CLAY . WATER

HYDROMETER	
DIAMETER (µm)	% PASSING
30	
20	
10	
8	
6	
4	
2	

MINERAL COMPOSITION	
0.0%	GRAVEL
86.5%	SAND
12.1%	FINES <325.

BITUMEN, MINERAL, WATER (%)	
BITUMEN	0.40
MINERAL	77.90
WATER	21.80
TOTAL	100.10

COMMENTS:



PER

MRRT
McMURRAY RESOURCES LTD.
(Research & Testing)

PARTICLE SIZE ANALYSIS

Suncor Inc	MRRT	43 - 070	
Pond 5 - Drilling Project	MRRT & Elgin Exploration	06/13/96	06/17/96
CT	60-61	SITE # 11	62500N & 50400E	P5S11	129

SIEVE ANALYSIS				
(std) SIEVE	(mm)	WT. RETAINED	% RETAINED	% PASSING
4"	100.000			
3"	80.000			
2"	50.000			
1½"	40.000			
1"	25.000			
¾"	20.000			
⅝"	16.000			
½"	12.500			
⅜"	10.000			
#4	5.000			
#10	2.000			
#18	1.000			100.0
#40	0.425		0.1	99.9
#60	0.250		4.2	95.7
#100	0.150		54.3	41.4
#200	0.075		14.9	26.5
#325	0.046		5.2	21.4

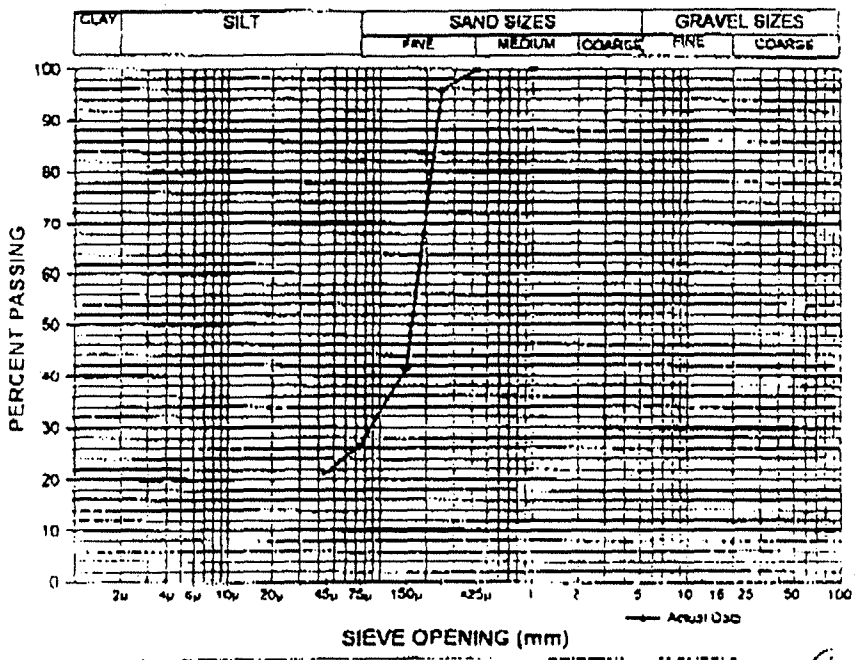
METHYLENE BLUE	
156	006M/100g
	% CLAY
	CLAY - WATER

HYDROMETER	
DIAMETER (µm)	% PASSING
30	
20	
10	
8	
6	
4	
2	

MINERAL COMPOSITION	
0.0%	GRAVEL
73.5%	SAND
21.4%	FINES - 325

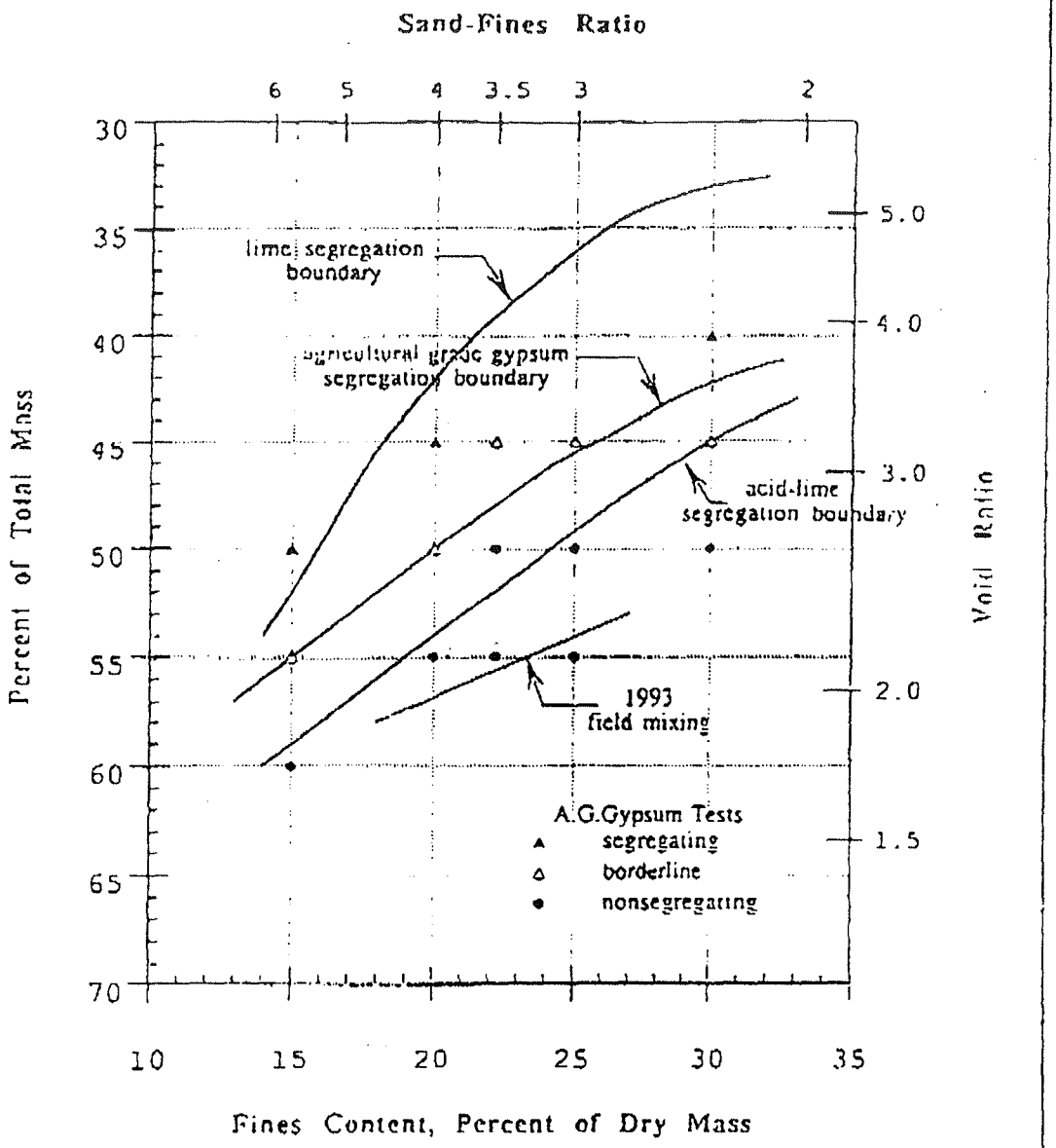
BITUMEN, MINERAL, WATER (%)	
BITUMEN	0.70
MINERAL	77.40
WATER	21.80
TOTAL	99.90

COMMENTS:



PER

SITE 11 DATA SHEET 8



Ref: U of A Test Results

AGRA
Earth & Environmental

SUNCOR INC. - OIL SAND GROUP
COMMERCIAL TRIAL PREDICTIONS

SUNCOR SEGREGATION TEST RESULTS FOR
600 ppm AGRICULTURAL GRADE GYPSUM

DATE APR./96 | MADE | CHKD. | JOB EG-07845 | FIGURE 1.1

FIGURE 2-2

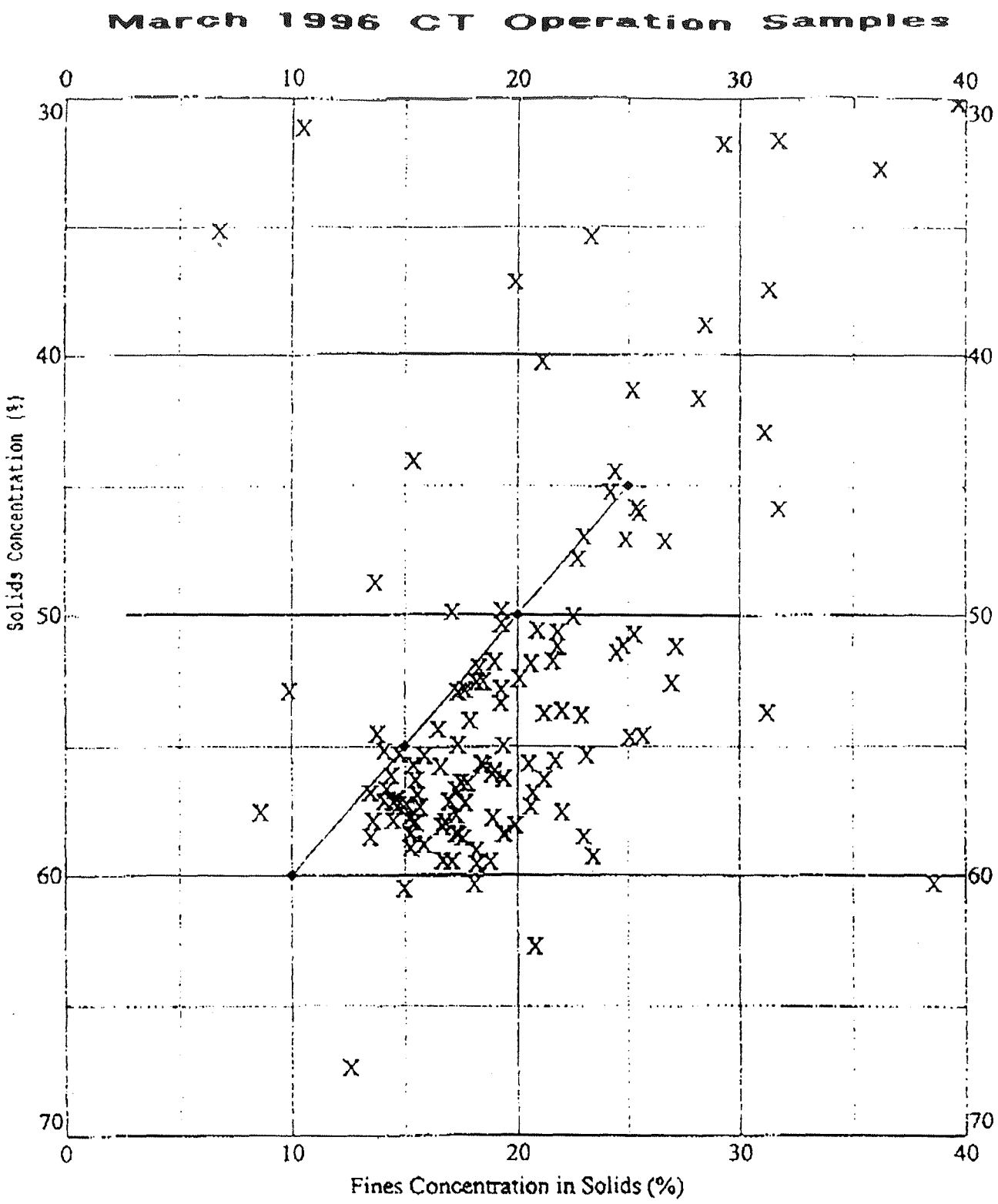

March 1996 CT Operation Samples
Solids Concentration (%)
Fines Concentration in Solids (%)
0
10
20
30
40
50
60
70

FIGURE 2-3

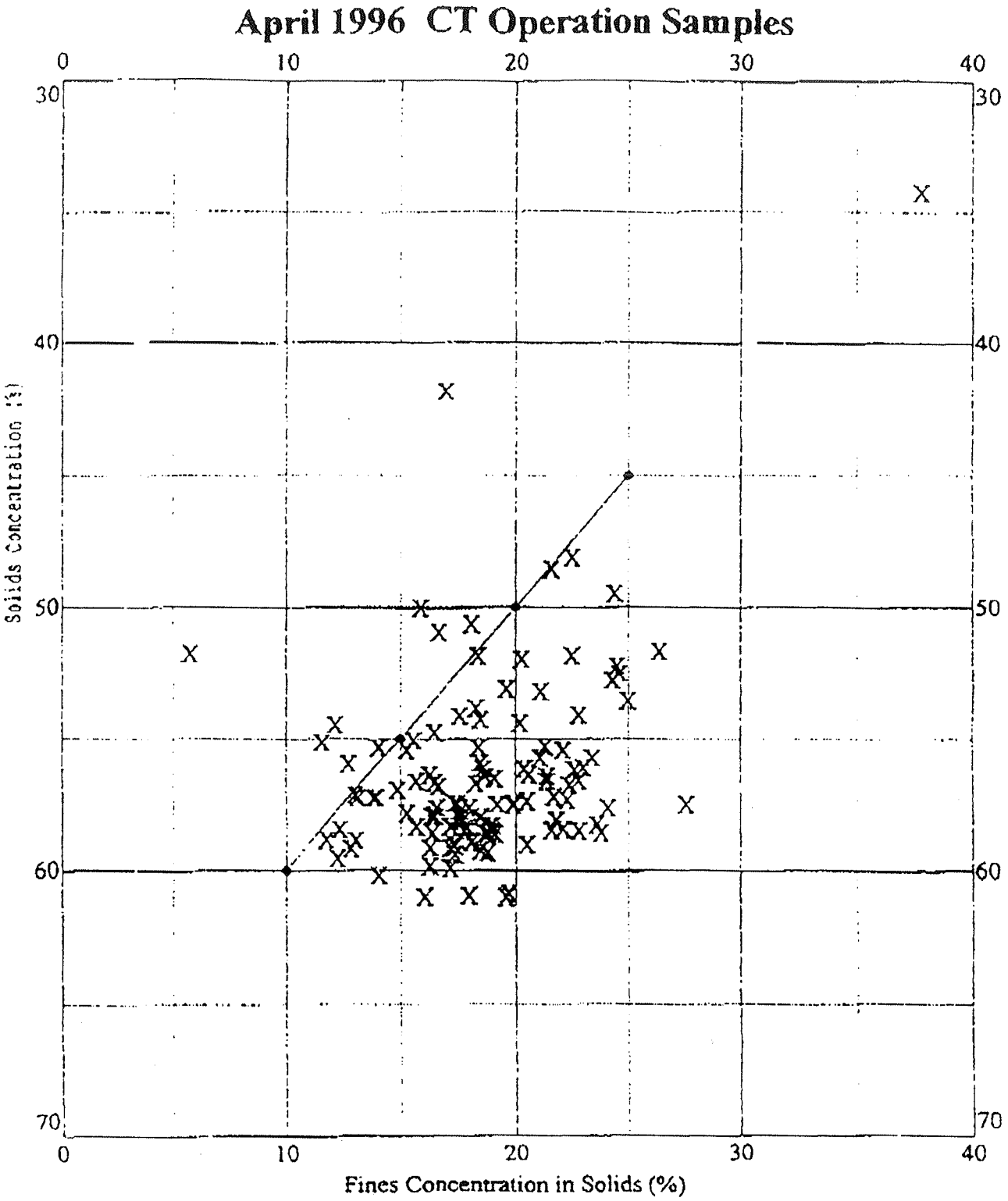

April 1996 CT Operation Samples
0
10
20
30
40
30
40
50
60
70
Solids Concentration (%)
Fines Concentration in Solids (%)

FIGURE 2-4

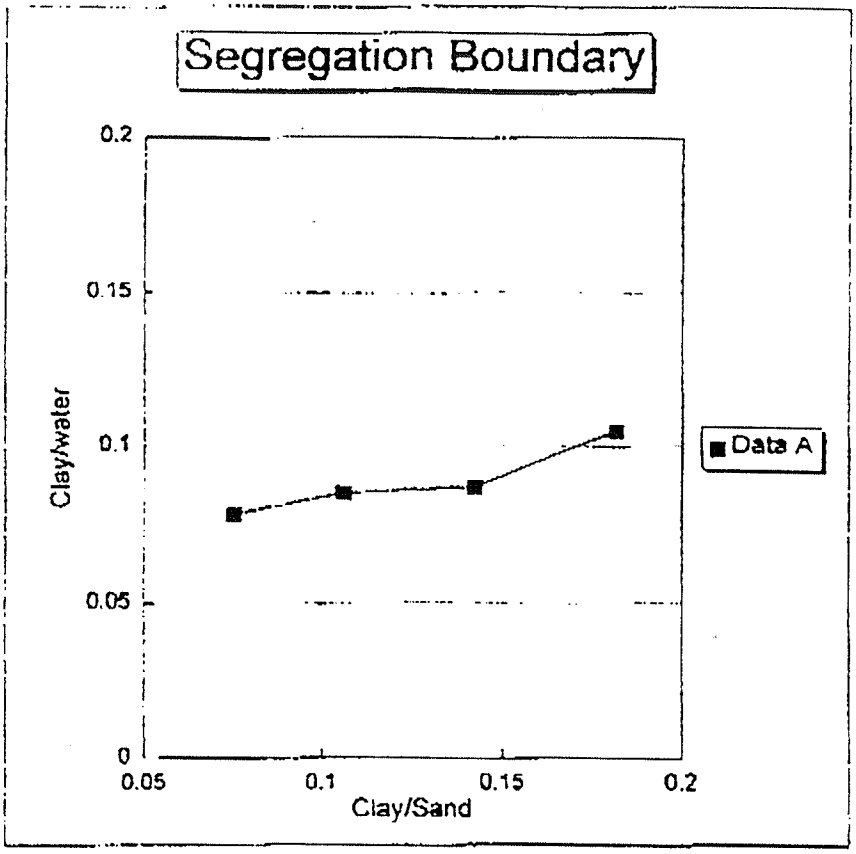

Segregation Boundary
0.2
0.15
0.1
0.05
0
Clay/water
0.05
0.1
0.15
0.2
Clay/Sand
Data A

FIGURE 2-5

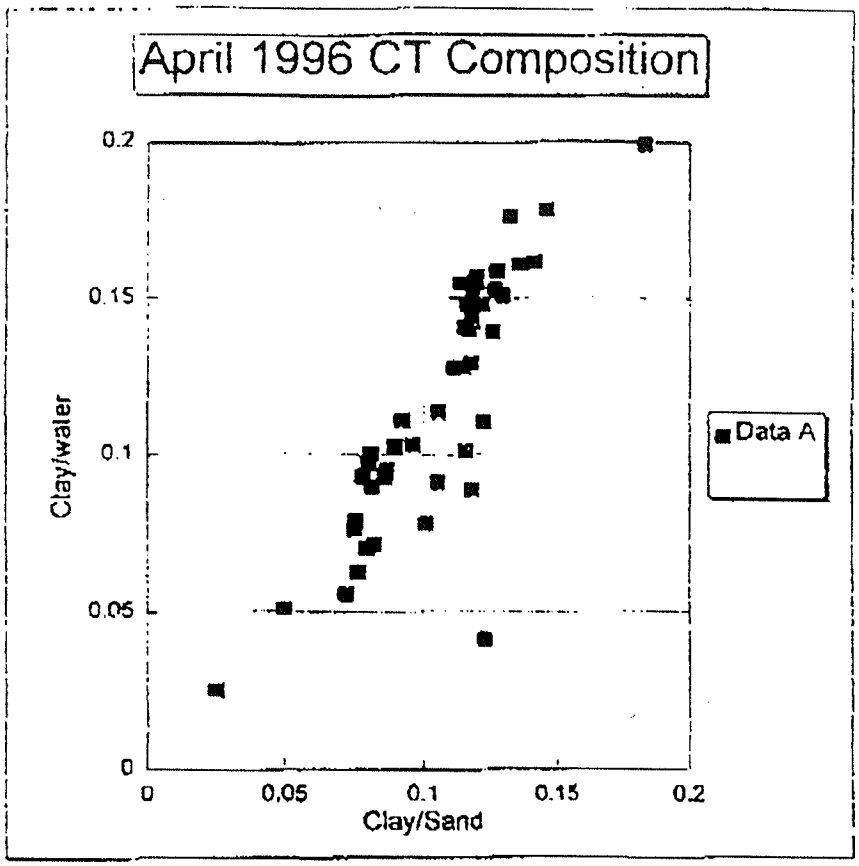

April 1996 CT Composition
0.2
0.15
0.1
0.05
0
Clay/water
0
0.05
0.1
0.15
0.2
Clay/Sand
Data A

FIGURE 2-6

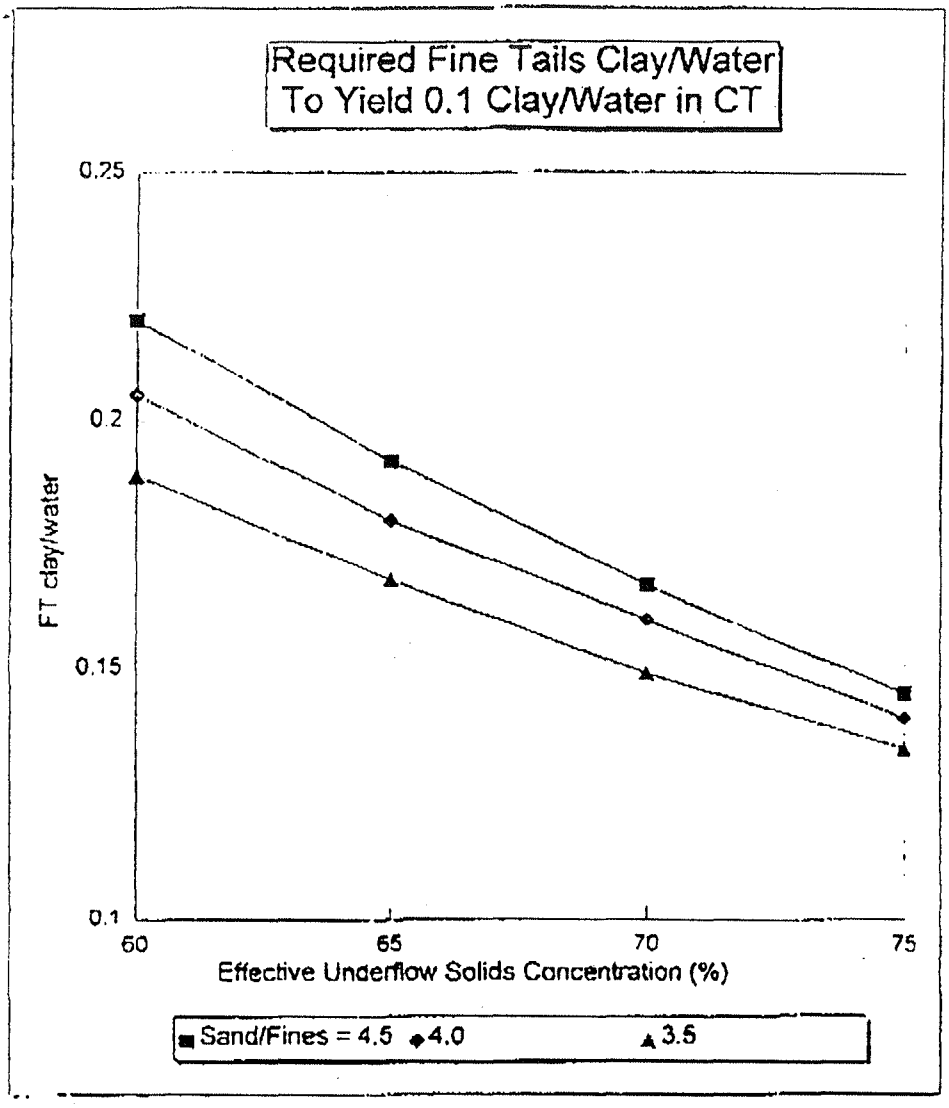

Required Fine Tails Clay/Water
To Yield 0.1 Clay/Water in CT
0.25
0.2
0.15
0.1
FT clay/water
60
65
70
75
Effective Underflow Solids Concentration (%)
Sand/Fines = 4.5
4.0
3.5

FIGURE 2-7

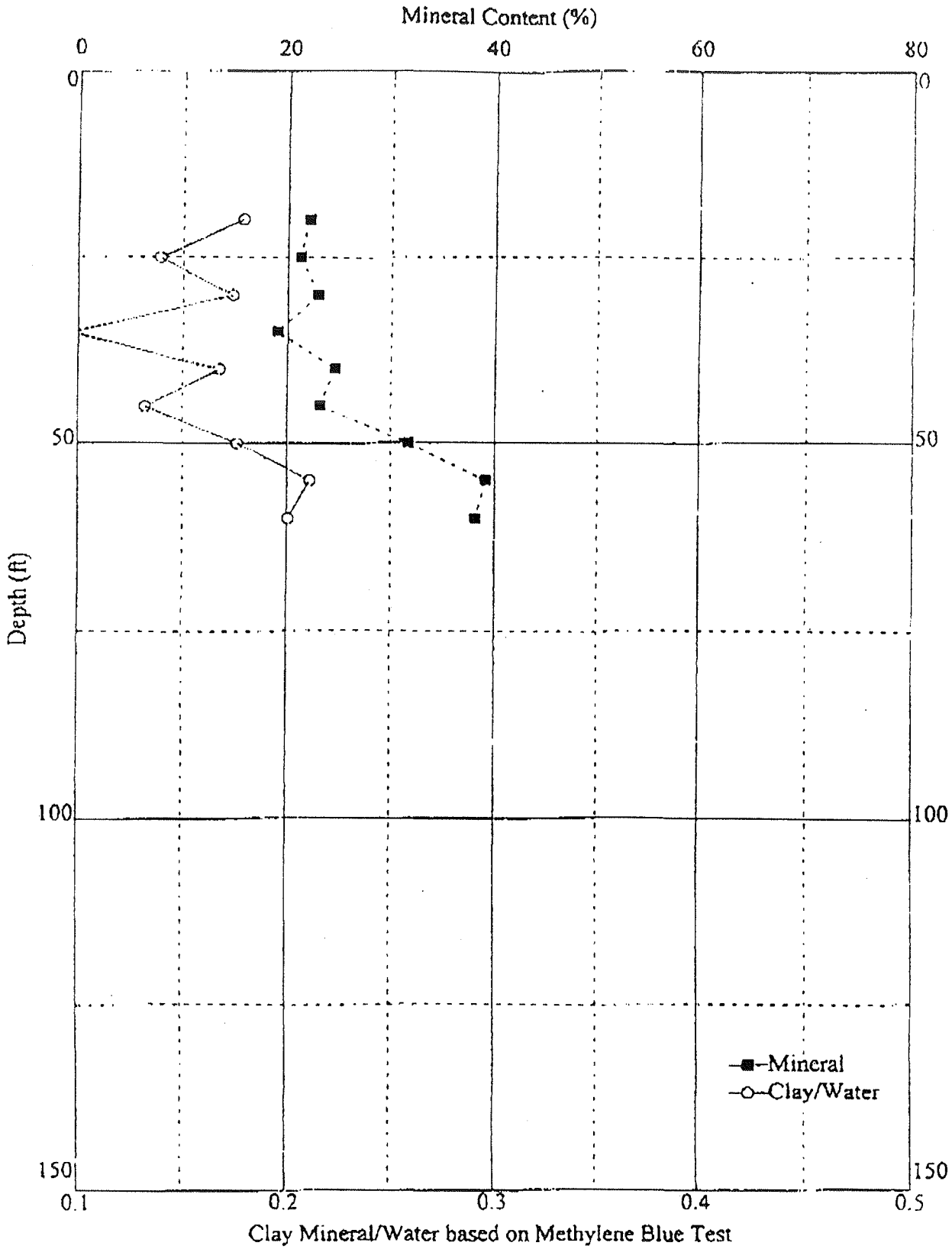

1996 -P2S2d3/27
Mineral Content (%)
0
20
40
60
80
Depth (ft)
50
100
150
0.1
0.2
0.3
0.4
0.5
Mineral
Clay/Water
Clay Mineral/Water based on Methylene Blue Test

FIGURE 2-8

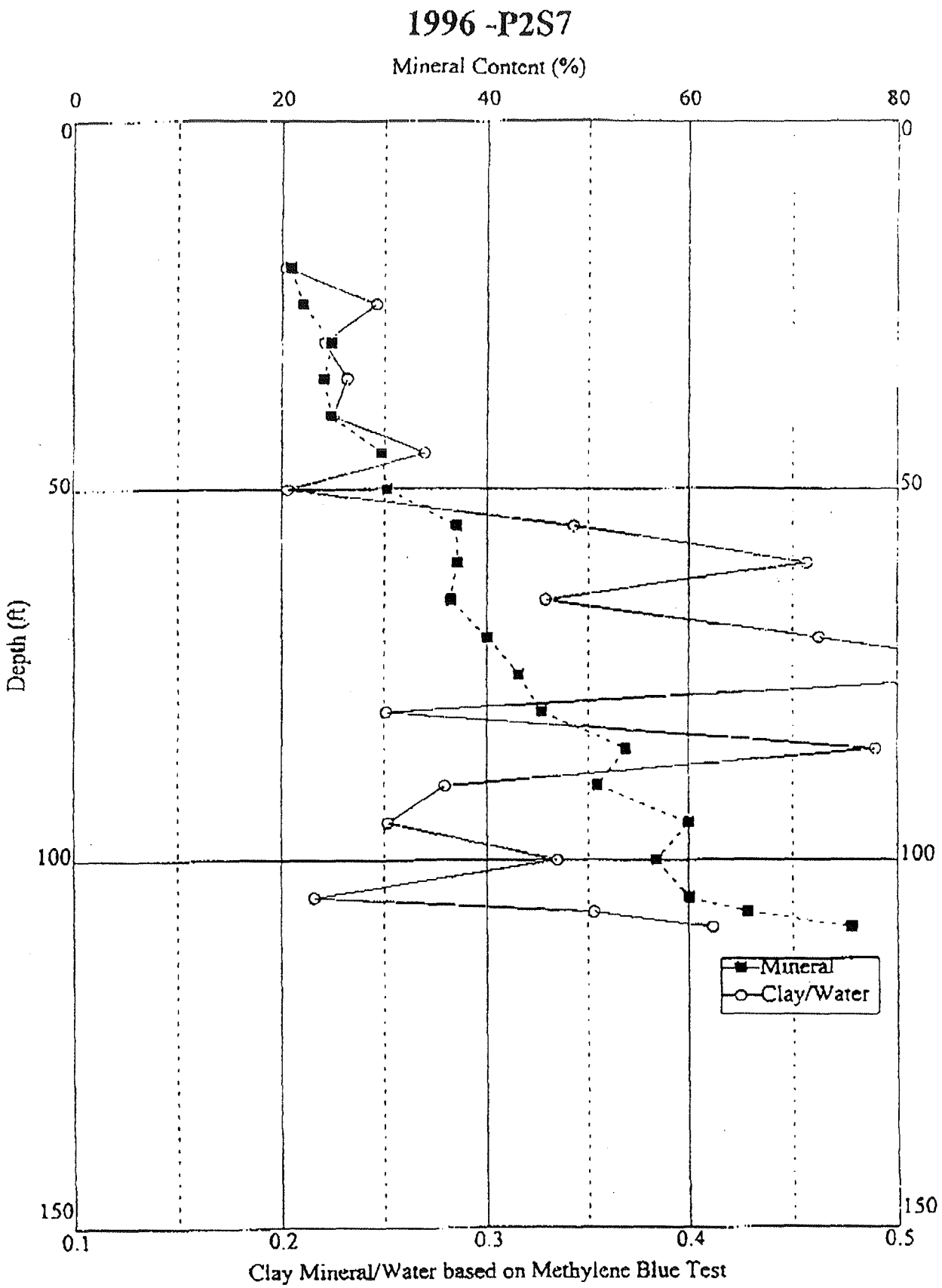

1996 -P2S7
Mineral Content (%)
0
20
40
60
80
Depth (ft)
50
100
150
0.1
0.2
0.3
0.4
0.5
Clay Mineral/Water based on Methylene Blue Test
Mineral
Clay/Water

FIGURE 2-9

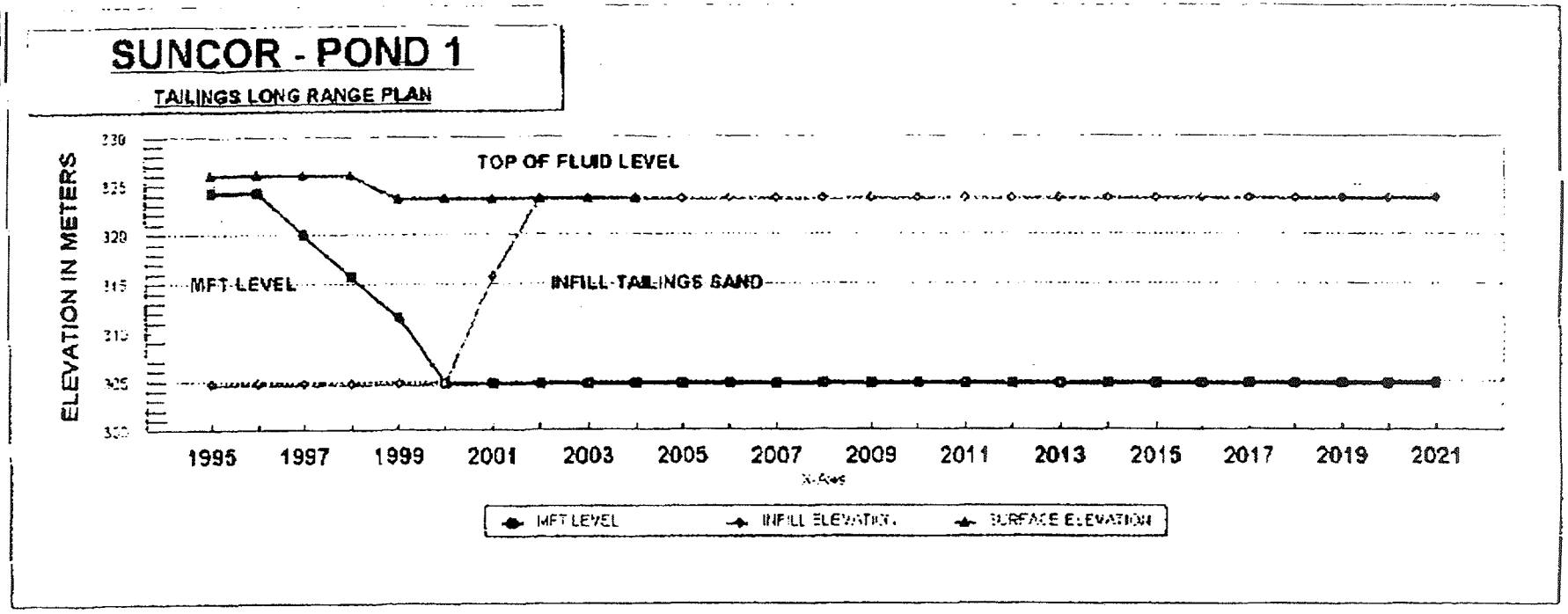


FIGURE 3-1 - OPTION 1 - RECLAMATION
AS PER ORIGINAL SCHEDULE

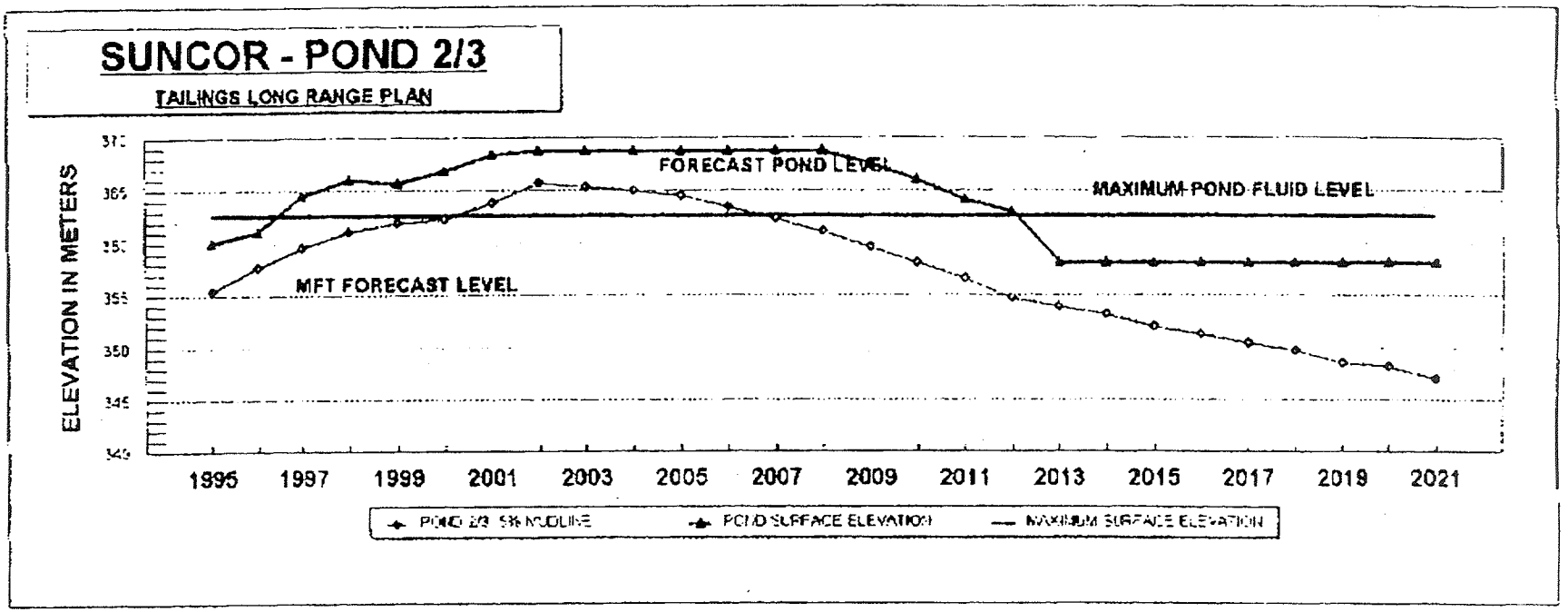


FIGURE 3-2 - OPTION 1 - RECLAMATION
AS PER ORIGINAL SCHEDULE

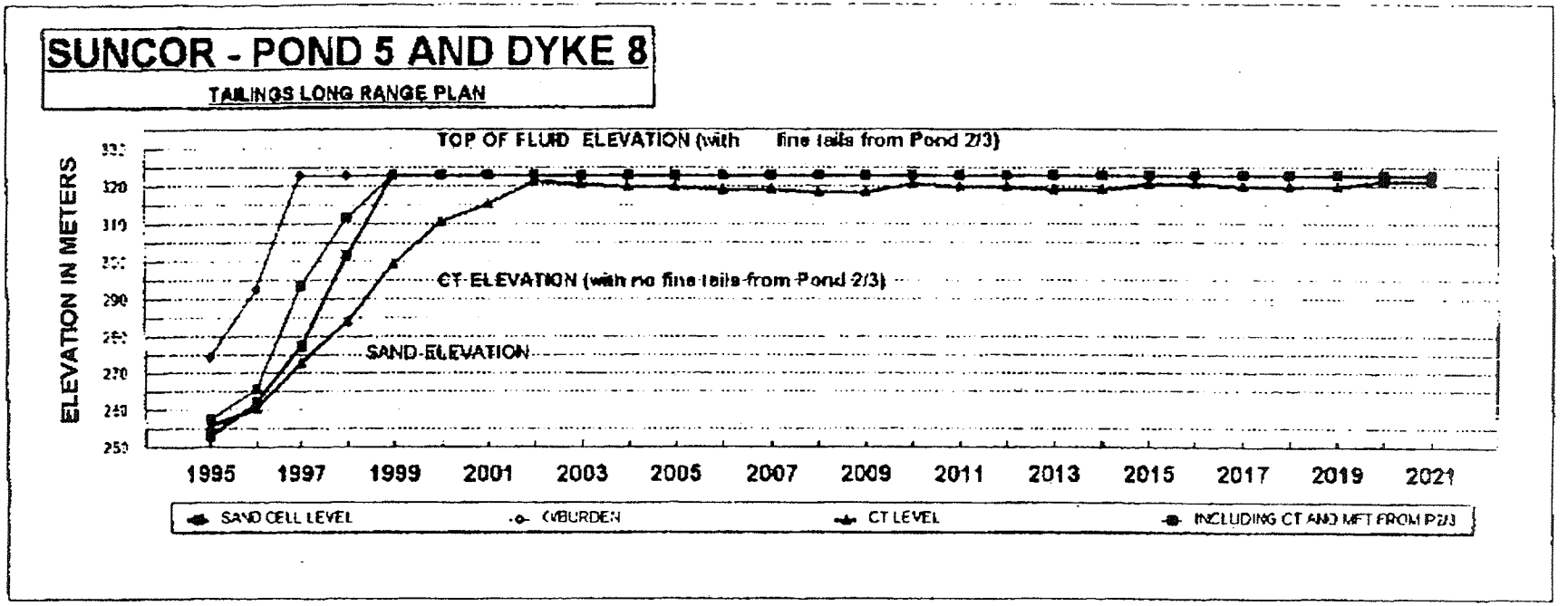
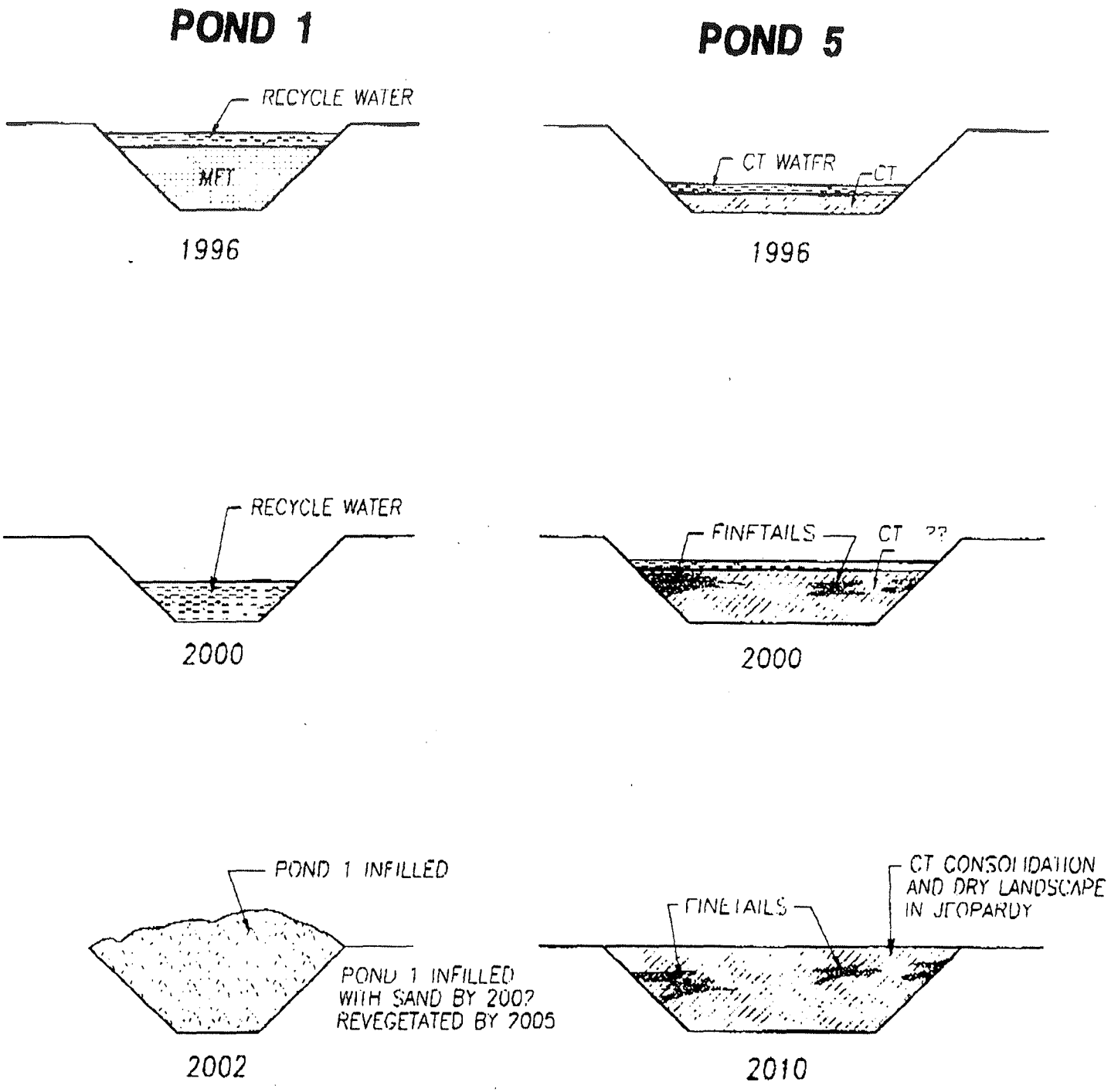


FIGURE 3-3 - OPTION 1 - RECLAMATION
AS PER ORIGINAL SCHEDULE



POND ONE RECLAMATION AS PER ORIGINAL SCHEDULE

FIGURE 3-4

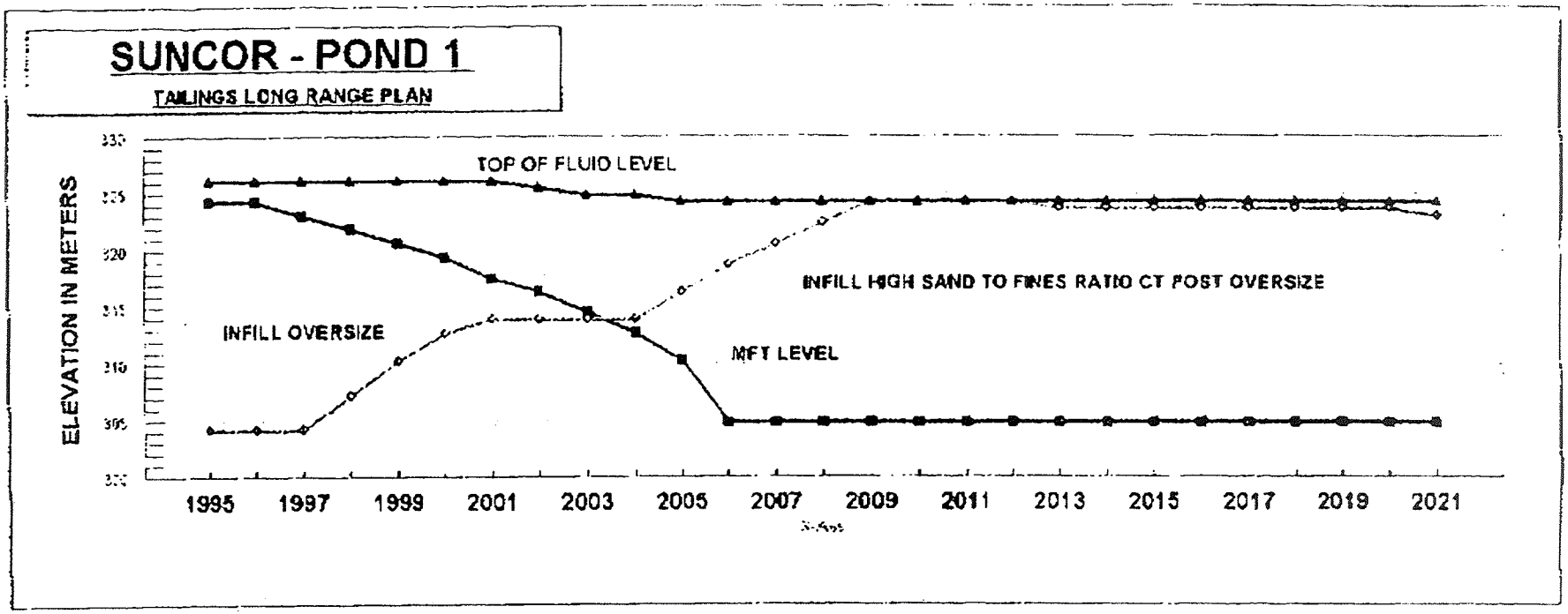


FIGURE 3-5 - OPTION 2
PRESENT OPERATIONAL PLAN

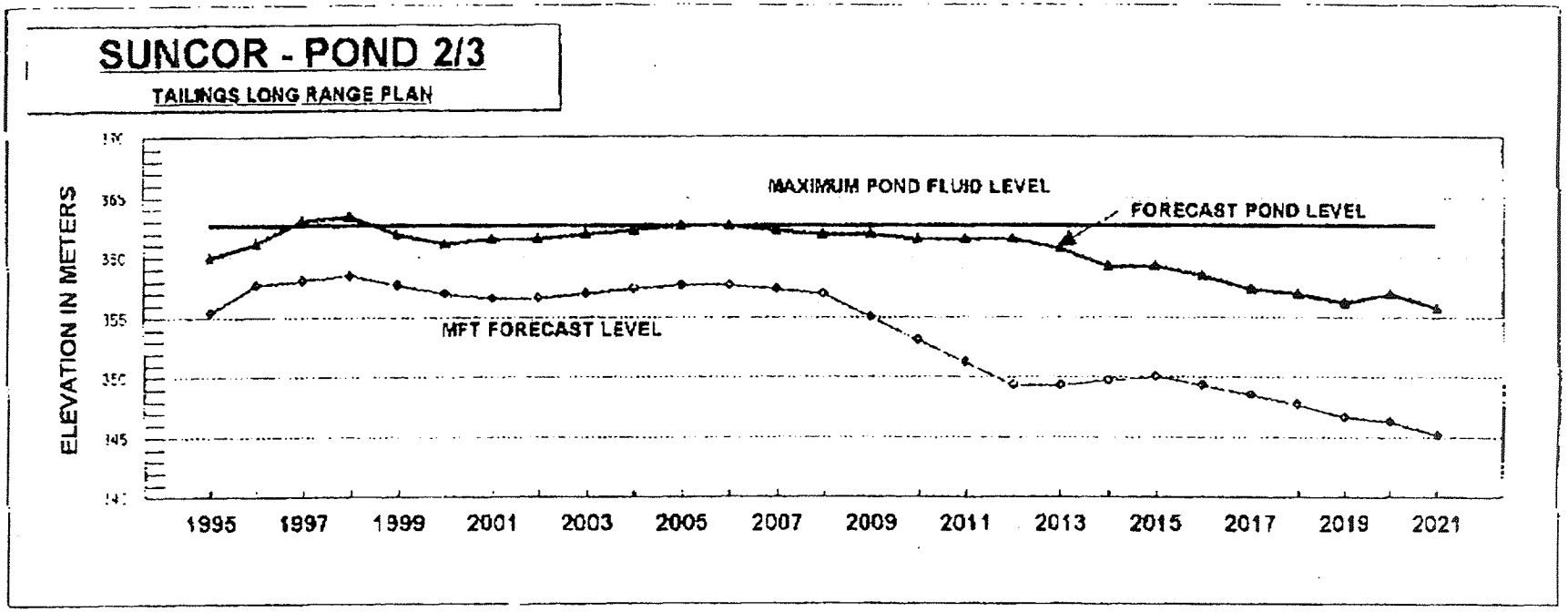


FIGURE 3-6 - OPTION 2
PRESENT OPERATIONAL PLAN

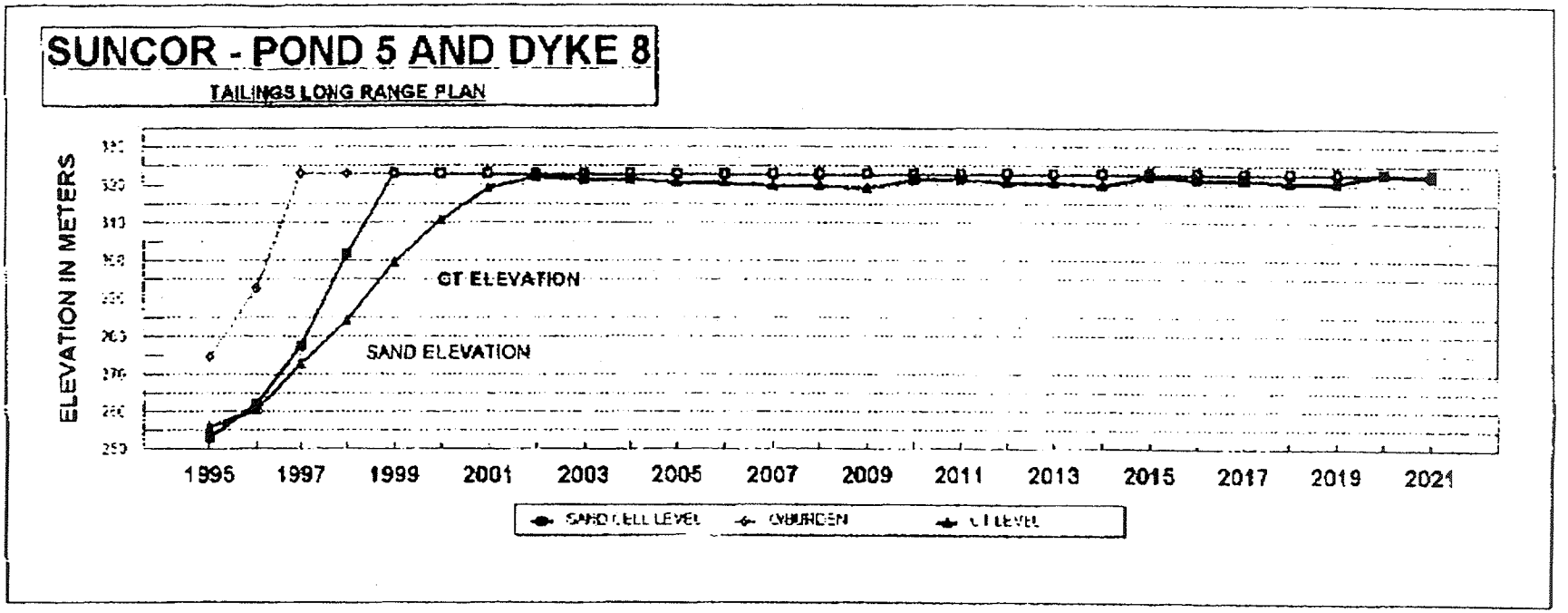
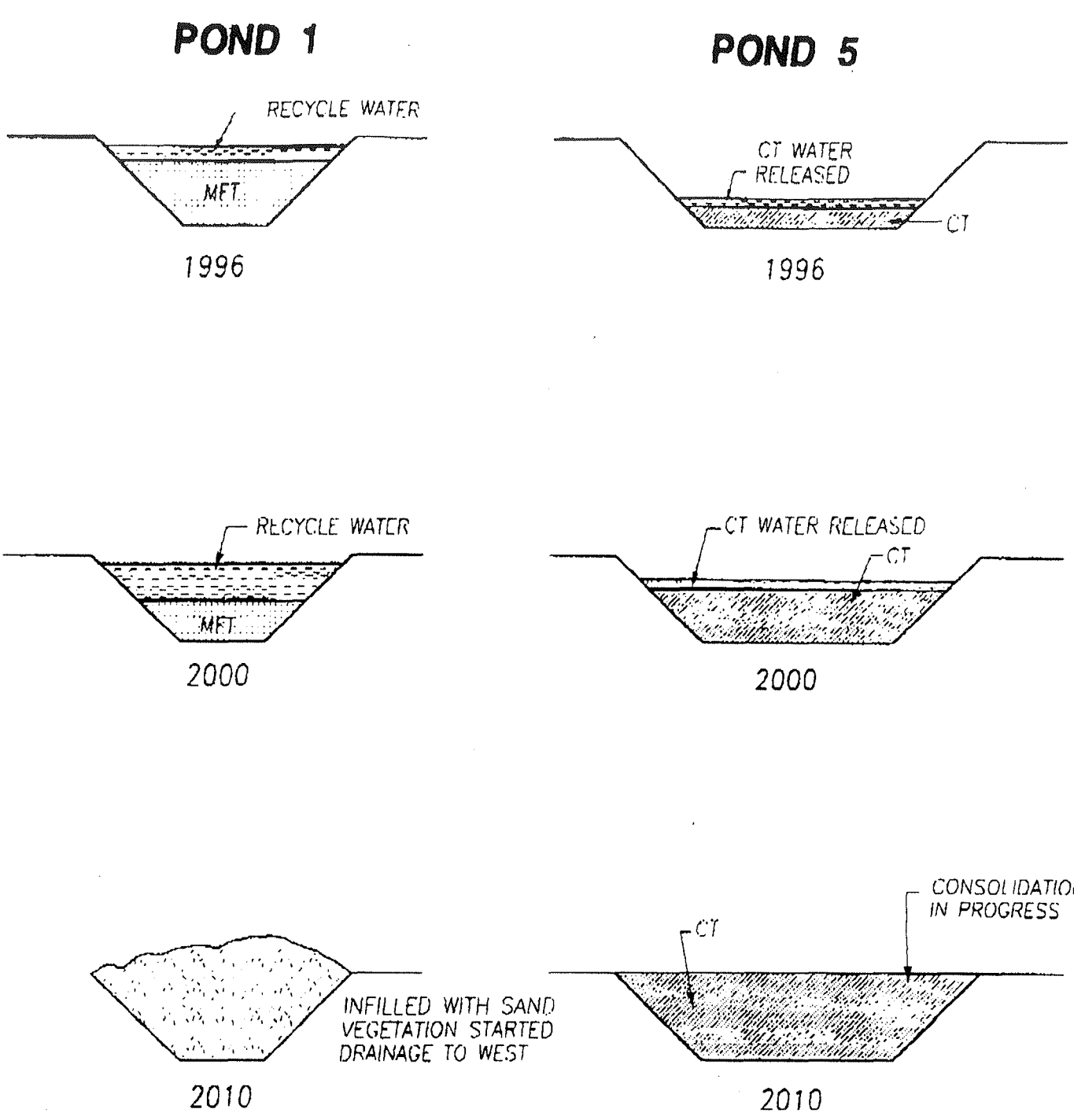


FIGURE 3-7 - OPTION 2
PRESENT OPERATIONAL PLAN



POND ONE RECLAMATION
AS PER CT IMPLEMENTATION SCHEDULE

FIGURE 3-8

March 1996 Suncor Coke Leachate Study

Parameter	Coke Solids	Coke Leached with Loon Lake Water		Coke Leached with TID Seepage Water			Coke Leached with Pond 5 (CT Release) Water		
		Water Before Leaching	Leachate	Water Before Leaching	Leachate		Water Before Leaching	Leachate	
					pH 7	pH 8.5		pH 7	pH 8.5
Sulphur	8200	10.4	15.1	161	15.1	153	9.5	10.2	10.3
Ammonia-N	<0.25	0.46	0.35	12.8	11.7	12.0	9.26	9.05	8.10
Total Organic Carbon	n/c	7	10	45	42	40	44	34	37
Silver	<1	<0.005	<0.005	<0.005	<0.005	<0.005	n/c	<0.005	<0.005
Aluminum	n/c	<0.01	<0.01	0.06	<0.01	0.01	N/c	<0.01	<0.01
Barium	7.1	0.107	0.113	0.142	0.168	0.098	n/c	0.060	0.035
Beryllium	<1	<0.002	<0.002	<0.002	<0.002	<0.002	n/c	<0.002	<0.002
Boron	n/c	<0.05	<0.05	2.15	<0.05	2.07	n/c	1.47	1.43
Calcium	n/c	84.3	83.3	74.3	72.9	36.0	n/c	20.7	14.1
Cadmium	<0.5	<0.001	<0.001	<0.001	<0.01	<0.001	n/c	<0.001	<0.001
Cobalt	5	<0.002	<0.002	<0.002	<0.002	<0.002	n/c	<0.002	<0.002
Chromium	4.3	<0.005	<0.005	<0.005	<0.005	<0.005	n/c	<0.005	<0.005
Copper	5	0.001	<0.001	0.003	<0.001	0.004	n/c	0.005	0.002
Iron	n/c	1.37	0.008	0.073	0.009	0.010	n/c	0.013	<0.005
Potassium	n/c	1.3	2.6	28.1	30.3	28.1	n/c	16.0	15.6
Magnesium	n/c	22.7	24.0	17.7	18.9	16.7	n/c	7.3	6.5
Manganese	n/c	0.640	0.420	0.056	0.051	0.009	n/c	0.051	0.009
Molybdenum	31	<0.005	<0.005	0.613	<0.005	0.586	n/c	0.008	0.009
Sodium	n/c	9	16	397	418	400	n/c	304	320
Nickel	304	0.004	0.007	0.020	0.016	0.013	n/c	0.011	0.005
Lead	<5	<0.005	<0.005	<0.005	<0.005	<0.005	n/c	<0.005	<0.005
Phosphorus	n/c	<0.05	<0.05	0.07	<0.05	0.11	n/c	0.05	<0.05
Silicon	n/c	4.6	4.7	3.3	3.6	3.4	n/c	5.5	5.6
Tin	<5	<0.05	<0.05	<0.05	<0.05	<0.05	n/c	<0.05	<0.05
Strontium	7	0.108	0.214	0.992	1.01	0.746	n/c	0.242	0.184
Titanium	n/c	<0.001	<0.001	<0.001	<0.001	<0.001	n/c	<0.001	<0.001
Thallium	<1	<0.05	<0.05	<0.05	<0.05	<0.05	n/c	<0.05	<0.05
Vanadium	824	<0.001	0.008	0.043	0.027	0.028	n/c	0.013	0.027
Zinc	10.7	0.026	0.026	0.032	0.032	0.034	n/c	0.018	0.022
Bacterial Luminescence (Screening Test)	n/c	122% of control	120% of control	52% of Control	64% of control	64% of control	42% of control	86% of control	85% of control

NOTE: analytical values in mg/L
n/c = not completed