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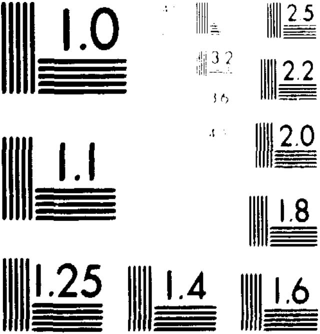

MICROCOPY RESOLUTION TEST CHART

10654

TANNERY - EFFLUENT TREATMENT PLANT.

G U Y A N A

(DP/GUY/79/007/ 11 - 55)

REPORT AND RECOMMENDATIONS.

PREPARED FOR GOVERNMENT OF GUYANA by

DAVID WINTERS

on behalf of:

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

May/June 1981

~~001005~~

002016

I SUMMARY

During a three week mission to Guyana the adviser analysed the existing situation and plans of the nascent tannery at New Amsterdam. Discussions were held with responsible officers of the relevant Ministries, Corporations and local authorities, and, based on the above, the adviser prepared an effluent treatment scheme suitable for this miniscule tannery being located in an urban area.

In essence the scheme provided for :-

A. Separation of tannery effluent flow into three streams

B. Specific treatment for the two streams with significant pollutants (chrome and lime/sulphide) in order to lessen their environmental impact

C. Equalization of all liquors

D. Sedimentation to remove the majority of Suspended Solids

E. Transportation of the above treated liquors by Tank/Trailer for discharge to the river

The scheme is detailed at Annex I

II BACKGROUND

David Winters (U.K.) was assigned a three week advisory mission to Guyana. His duties were to :-

A) Analyse the existing activities for recovery of chemicals and by-products and neutralizing of effluents generated by the processing of cattle skins to leather in the tannery;

B) Develop a scheme for a high level of recovery of chemicals and for the discharge of resulting effluents into the open drainage system;

C) Assist in engineering design and preparation of specifications for establishing tannery effluents recovery facilities;

D) Introduce a scheme of the environmental control including periodicity and specification of subjects to be checked.

He was attached to the Industrial Consultancy Unit of the Guyana State Corporation (GUYSTAC) and worked in close co-operation with the

/potential.....

potential management of the tannery (Leather Industries Limited), and with the Technical Specialist of the Ministry of Economic, Finance and Planning (who have responsibility for the pre-operational phase of the tannery project).

The adviser arrived at the Duty Station on the 16th May 1981 and returned home on the 4th June 1981. In the remaining one day of this assignment* the adviser sought, in the U.K. at the request of GUYSTAC, Technical Specifications and Quotations for several items needed for the scheme. In addition the adviser obtained several photocopies of detailed design drawings (see Annex III).

III FINDINGS

The adviser found that, given the urban location of the tannery project, it did not seem socially acceptable to discharge the effluent into the adjacent drainage channel, which then passed through residential locations. Accordingly the adviser proposed partial treatment of the effluent and subsequent tankering of the liquors for discharge into the river below the town of New Amsterdam (see details Annex I).

The adviser prepared a Technical Report, in Guyana, with two alternatives, this was discussed and further detailed with the relevant authorities. Due to the existing institutional framework, the number of departments and divisions of Ministries and parastatal bodies involved in the tannery project, and the fact that the consultant was not attached to the implementing authority, the fine detailing of an agreed scheme was not possible. However, sufficient data was given for the Guyana experts to proceed with final design.

The adviser feels that on balance Alternate A, Annex I, must be the most realistic/cost effective scheme.

Although outside his terms of reference the adviser was asked to give comments on all aspects of the tannery project, and these are given at Annex II

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* The adviser had anticipated having two days in the U.K. to assemble this material, but due to transportation delay this was reduced to one day only.

Technical Report

Tannery Operation - New Amsterdam - GUYANA

Prepared by:

DAVID WINTERS,
UNIDO Consultant,
Attached to Internal Consultancy Unit,
Guyana State Corporation.

Presented to:

(1) Executive Chairman,
Guystac Trading Group 11,

(2) Technical Specialist,
Ministry of Economic,
Finance & Planning,

(3) Mayor and Officials,
New Amsterdam Council.

May, 1981.

NEW AMSTERDAM

Effluent treatment Scheme - Leather Industries Ltd.
(referred to as the Tannery)

Chapter 1 - Background, Possible Strategies, Conclusions.

A. Background

The Tannery, now nearing completion is located in an urban area within a few hundred metres of a school and residential property. Given such location it seems evident that appropriate technology must be employed to ensure that no environmental nuisance disturbs the area.

The proposed Tannery thruput is minimal by international standards and it is not normal for such small units to practice effluent treatment. Small units are normally located in rural areas, where some degree of localised environmental degradation is acceptable. Given the miniscule size of the project it is economically impossible to consider immediately any serious recycling techniques as the capital cost and high level of technical supervision could not be justified. Such small Tanning units normally employ ponding or other low technology waste water treatment but due to the urban location selected for this project such crude systems, which often yield noxious odours, seem inappropriate.

Thus in the present situation there is little precedent to follow and a pragmatic approach is necessary.

B. Possible Strategies

There appear two possible alternate schemes and these may be outlined:-

(1) Alternate A

This is the strategy discussed with and "in principle" approved by the Mayor, M.O.H. and other officers of the Municipality, at an "on site" meeting on 20th May, 1981.

In essence the scheme involves:-

The Tannery effluent will be split into three streams:-

Lime/Sulphide

Chrome

Others

The potentially dangerous pollutants in the Lime/Sulphide and Chrome liquors will be removed by specialised treatment.

The majority of the suspended solids (S.S.) will be removed from all liquors*.

* Allowing for the fact that the S.S. mainly lime, are not toxic, and problems may be found in drying the sludge, it may be possible initially to postpone this process until a method of sludge drying is proven.

All liquors will be screened to remove solids (1/3" and larger).

The resultant treated liquor - free of serious toxins and with mininal suspended solids will be removed at regular intervals by tanker and discharged into the river below the town.

All solids separated out above will be buried at a suitable site.

Figures 1 and 11 overleaf show the proposed schematic layout of such treatment Unit.

2. Alternate B

The strategy employed would be to treat the effluent to acceptable standards so that it could be discharged to the adjacent surface water drainage canal. This would require the effluent to be reduced from its initial pollutant load of circa

1500	mg/L	$B.O.D._5$
2200	mg/L	Suspended solids

possibly levels of

50	mg/L	B.O.D.
60	mg/L	S.S.

could prove acceptable.

Schematic Outline - Alternate A

(detailed in Technical Note following) (1 cm square = 1 metre)

Scale 100:1

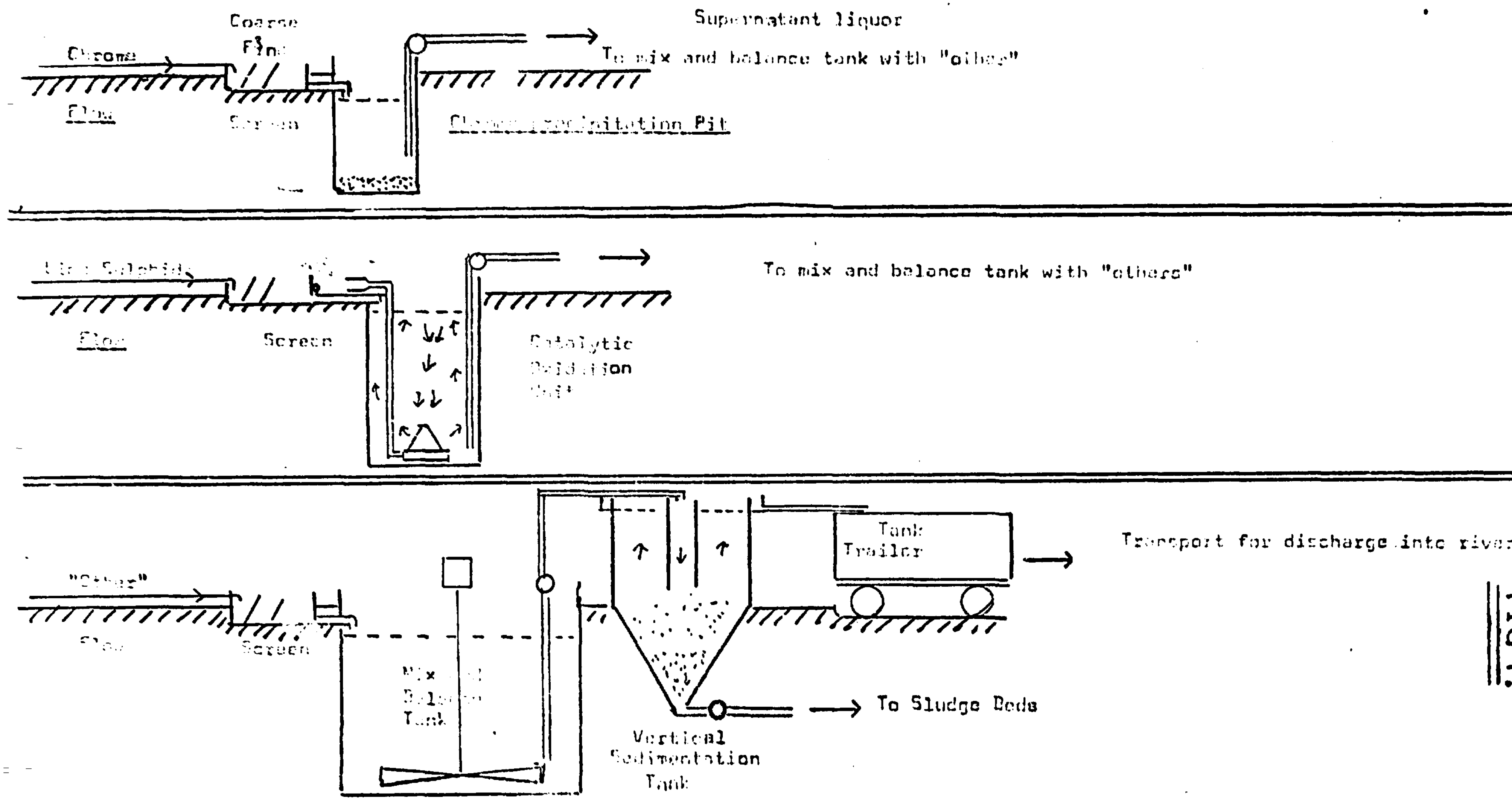


FIG 1.

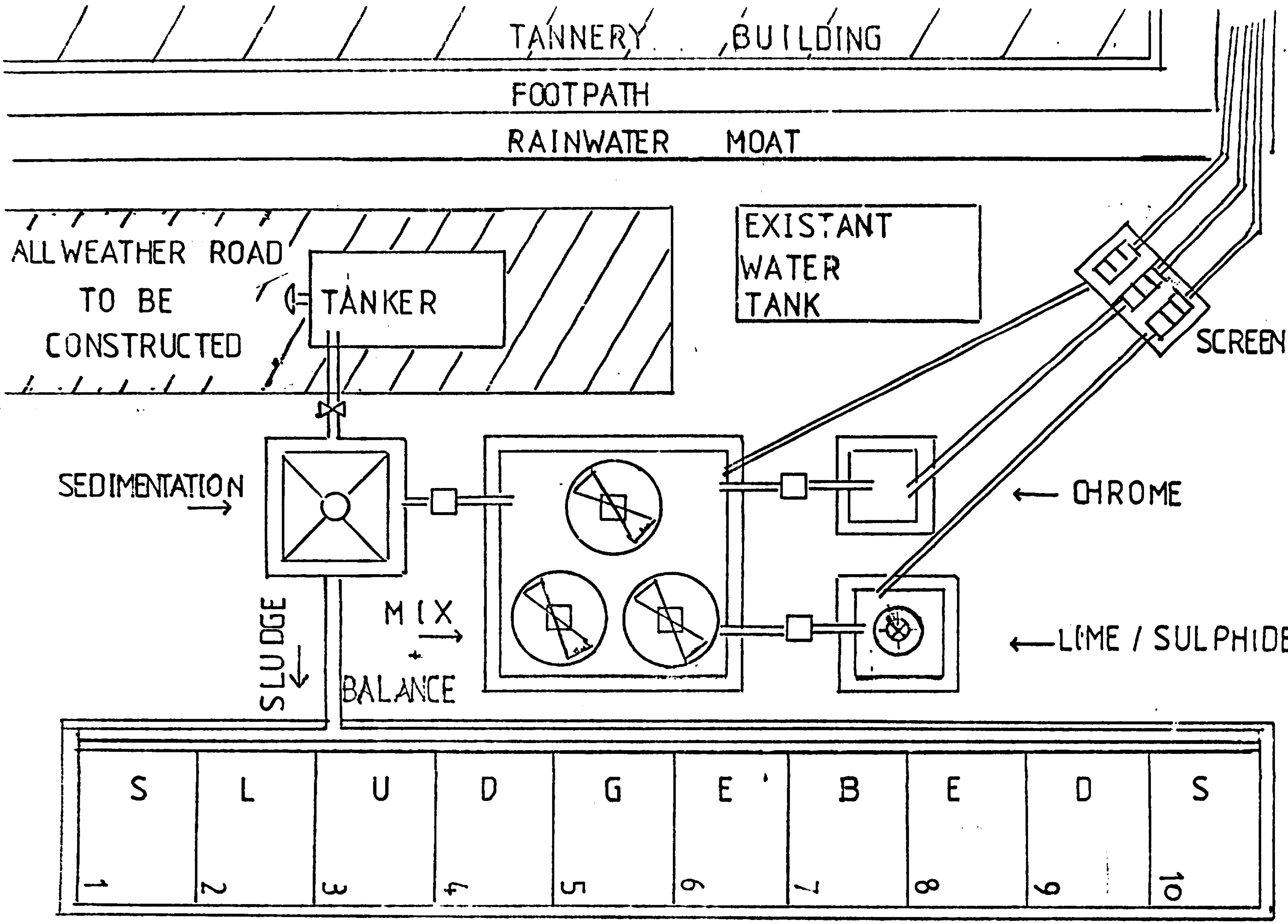
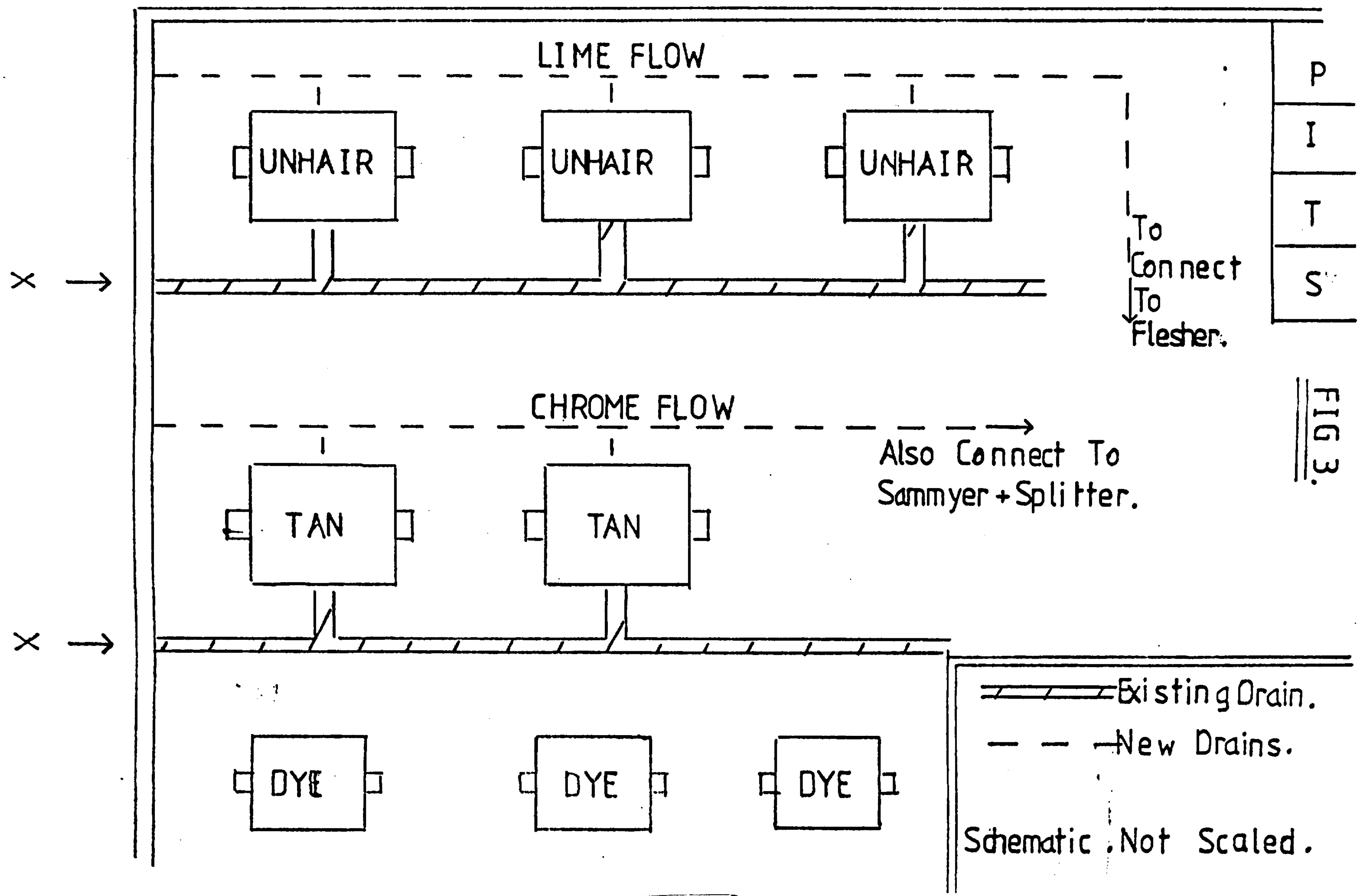

TANNERY BUILDING
FOOTPATH
RAINWATER MOAT
ALLWEATHER ROAD
TO BE
CONSTRUCTED
TANKER
EXISTANT
WATER
TANK
SCREENS
SEDIMENTATION
CHROME
MIX
+
BALANCE
LIME / SULPHIDE
SLUDGE
S L U D G E B E D S
1 2 3 4 5 6 7 8 9 10

FIG 2.

FIG 3 POSSIBLE NEW INTERNAL DRAINS TO SPLIT FLOWS



Given the location and the need to control capital expenditure the only feasible method to obtain such reduction of pollutant level would be by employing a Pasveer type oxidation ditch.

Although such Pasveer ditch was in earlier days reported capable of handling all untreated tannery wastes, recently it has become apparent that if no prior treatment is given poisoning occurs and the efficiency of the unit declines.

Therefore to avoid this occurance, Chrome and sulphide would need to be pretreated as in Alternate A.

The "other flow" would be completely replaced by the Pasveer ditch 2 - 3 days retention could prove effective and would require a working capacity of some 150 m^3 in the form of a closed circuit trapezoidal channel. The 1m deep channel could be 4m wide at the top, 2m wide at the base with 45° slope sides. The total circuit length would need to be 50m*.

20m long parallel trapezoidal channels separated by a 2 m island and connected at each end by max 5m radius semi circular channels.

See figure IV.

C. Conclusions

Although Prime Facae Alternate B appears suitable 2 possible problems may be posed:-

(i) It may be proved difficult to commission such oxidation ditch. As normally one "seeds" each unit with a tanker load of activated sludge from an existent unit. But in Guyana there is nowhere any activated sludge unit.

(ii) Disquiet might be felt by the local populace would feel that if the ditch were not correctly operated their environment may be degraded.

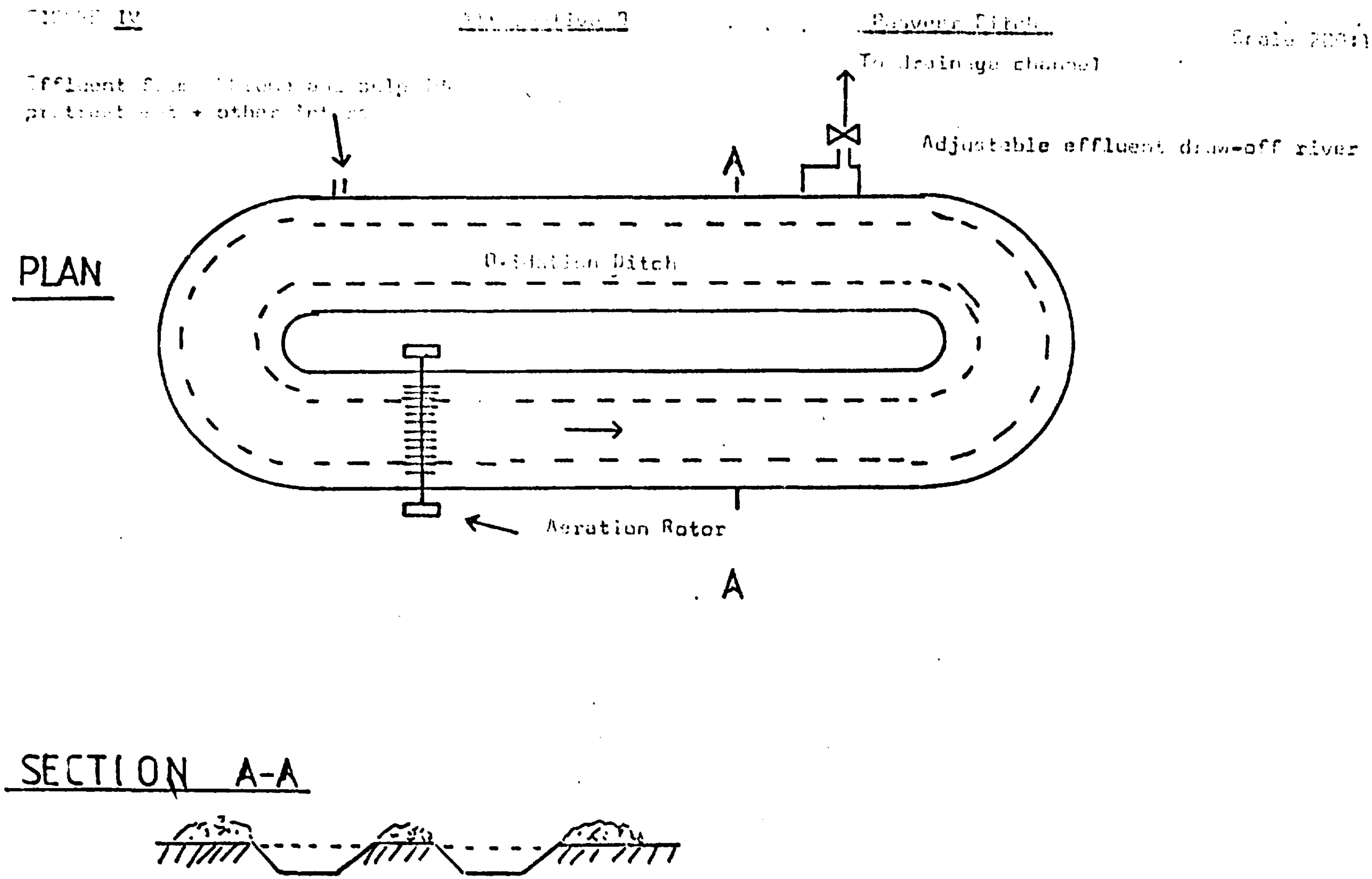

To drainage channel
Adjustable effluent draw-off river
A
PLAN
Aeration Rotor
A
SECTION A-A

FIG 4.

In such circumstances the Consultant has little hesitation in proposing and detailing Alternate A as most suitable for the New Amsterdam situation especially as such scheme already has "in principle" agreement of the local authority.

Chapter 11- Technical Specification/Costs

NOTE (1) C.E. = Consultant's crude estimate

NOTE (2) It is assumed for simplicity thruout this report that all concrete for the civil works is 1ft. (30 cms) thick - however the actual structures will need sizing by qualified civil/structural engineers.

NOTE (3) Simplistic cost calculations have been based on -

Excavation - 10 G$ Yd^3 (13 G$ m^3)

concrete - 350 G$ Yd^3 Laid (458 G$ m^3)

∴30 cm concrete wall (1ft) = 137 G$ m^2

APPROX

1 M^3	=	1.308 yd^3	All dimensions
1"	=	2.54 cm	internal

Alternate A.

1. Separation of Flow - Internal Drains

It is understood by all interested parties that for simplistic treatment of effluent it is desirable to separate the chrome and sulphide bearing liquors. (Toxic and Noxious).

Figure 111 shows the idealistic layout for much separation.

However it is appreciated that due to the nature of the existant concrete floor it may not be simple and economic to construct such new drainage network.

If the new drains are found too difficult/expensive to construct it should be possible at the 2 points marked X on Figure 111 to introduce a Y channel, controlled by a manually adjusted metal sluice where the separation of flow can be controlled.

(The separated liquors should be carried by 6 - 8" pipes (15 - 20 cm).

The major disadvantage of such system is that drums with dissimilar discharges would not be capable of simaltaneous discharge.

NB: a note elsewhere queries the efficiency of the existing drains -

the separation of flows should be detailed after the present drains are tested and their carrying capacity known.

Chrome Flow

(a) Screen A cast rod screen (1½" apertures - 4 cms) and a fine stainless screen (1/3" perforations - 0.8 cms) should be set at 45 into a sunken catchpit 1 yd long (0.9 m) 18" deep and wide (0.45 m). Flow should be by gravity. Cleansing by hand.

Possible cost

Rod screen	- G$ 100 (C.E.)
Perforated screen	- G$ 250 (C.E.)
Excavate (1.5 x 1.05 x .75) $1.2m^3$	- G$ 16
Concrete walls M^2 1.76	- G$ 240
Conc rete base M^2 1.58	- G$ 216
	G$ 822

(b) Chrome Ppt Pit

To hold the $3m^3$ envisaged daily, a pit of effective size 2m deep x 1.5m x 1.5m ($4.5M^3$) will be needed (surplus to allow for chrome hydroxide sump at base). The actual height of wall will be 3 m to ensure no entry of surface waters. A daily addition of an alkali, with plunging, followed by an overnight settlement will allow the virtual chrome free supernatant to be pumped off early next morning (before any drums are discharged.

Possible cost

	Hand plunger	- G$ 50 (C.E.)
	Pump (0.5 HP)	- G$ 500 (C.E.)
	Excavate (2.3 x 2.1 x 2.1x)10.1 m.	+ G$ 132
Base M	Base M^2 4.4	- G$ 604
	Base M^2 21.6	- G$ 2959
		- G$ 18,932

3. Lime Sulphide Flows

The technical requirements and alternatives are outlined later. To allow for the $12.6M^3$ anticipated if may be expedient to have a vessel effective depth 3m x 2m x 2m. (with safety wall 1m above).

Possible Cost

(a) Screen

Similar to chrome flow	-	G$	822	

(b) Catalytic Oxidation Tank

·erator	-	G$	10,200	
" (air freight)		G$	1,000	(C.E.)
Pump (2 Hp)		G$	1,500	
Excavate M^3 20.3			264	
Base M^2 6.76		G$	926	
Walls M^2 36.8		G$	5,042	
			18,932	

4. Other Flows

(a) Screen

Similar to chrome flow G$ 822

(b) Mis. & Balance Tank. To contain 1 day effluent would need to have effective depth 3m x 4.8m x 4.8m.

Float switches	-	G$	550	
Pump (1)*		G$	500	
Agitator/Stirer (2)**		G$	5000	(C.E.)
Excavate $87.5m^3$		G$	1137	
Concrete base M^2 29.2		G$	4000	
Concrete walls M^2 61.2		G$	8384	
			19,571	

* This pump must be capable of steady pumping at uniform rate over 24 hours (i.e $3m^3$/hr) to ensure efficient operation of subsequent sedimentation system. May be forced to employ overlarge pump governed by float switches and time clocks.

** To avoid sedimentation within this equalizing tank and subsequent clogging sufficient stirring power must be available. Slow rotating propellor devices (50/100 r.p.m.) of wide diameter may be employed (40 w per m^3 needed (i.e 2.88 KW). Diffused air (3 - 4 m^3/h per m^2 of tank) or surface aerators may be employed (cost: availability).

5. Sedimentation Tank

The options are between a horizontal or a verticle unit. The major characteristics of these 2 types:-

(a) Horizontal

Cheap and simple to design and erect but not foolproof in operation as if not emptied of sludge regularily becomes ineffective. If employed on this project it can be sized:-

With a forward pumping rate of $3m^3$/Hr for 24 Hrs/day require 6 hour retention i.e $18m^3$ volume. Advisable to have a pair (to allow cleaning etc.). Therefore 2 tanks at 9 m^3. With 2m effective depth each tank should be 1 m wide and 4.5 m long. OR

(b) Vertical

More difficult and expensive to design and erect but have the advantage that cannot be operated ineffectively. If the sledge is not removed (by sludge pump or gravity) the water cannot pass thru' the unit.

The size of the upper section may be calculated:- with an upflow rare of 0.5m/h require a tank area of $6m^2$. Thus a tank 2.5m x 2.5m x 2m effective depth should suffice with an appropriate 60^o sloped sludge hopper.

Possible cost:

Sedimentation tanks may be fabricated from concrete, steel or wood? The costing below assumes a verticle tank in concrete, partically sunk.

A detailed design drawing of a larger sedimentation tank is left with the competent Guyana Authority for ease in design.

Excavate say $6m^3$	- G$	78
Walls (square area) $20m^2$	G$	2740
" (Hopper) $10m^2$	G$	1370
	G$	4188

6. Sludge Drying Beds

Assuming $70m^3$/d effluent at 2,200 mg/L suspended solids, with a 70% removal in the sedimentation tank one may expect 154Kg/SS/day. If this is discharged at 5% solids it would suggest 3.1 M^3/ day slurry.

3.1 m^3/day of slurry placed on beds to a depth of 0.5m require a bed of $6.2M^2$. At Figure 2, a Sludge bed area of 87.5 m^2 is suggested, this is equal to nearly 3 weeks holding capacity and in most climatic conditions would prove sufficient to obtain caking However, the high humidity in Guyana may slow the drying process down.

Certainly any drying beds at the tannery site would need to be raised above the water table and suitable base drainage incorporated.

A detailed drawing of larger beds built elsewhere is handed to the competent Guyana Authority to assist design of the suggested units.

7. Summarised costs - Alternative A

	G$
Chrome Screen	- 822
Ppt Tank	4,245
Sulphide Screen	822
Oxidation Tank	18,932
Other Screen	822
Mis and Balance	19,571
Sedimentation	4,188
Mis pipes & valves	2,000

Total above items 51,402

+ 20% P & G total 61,682

Costing for three other items are not yet available -

Tank Trailer(s)

Sludge Drying Beds

Alteration to internal tannery drains

B. Alternate B

See Figure IV and Chapt 1

* The Consultant has not seen rotors of less than 2 metres width - if such smaller units were available the geometry could possibly be altered.

The spoil from the excavation would be utilized for the necessary 0.5m free-board.

Possible cost - In addition to Chrome and Sulphide Pretreatment Costs.

		G$
Rotor 2 metres	-	25,000
Adjustable weir		2,000 (C.E.)
Excavation $150m^3$		1,950
Concrete/liner $200m^2$	-	Not possible to cost until construction Technology agreed.

The normal loading of an oxidation ditch is 250 - 500 gms $B.O.D._5/m^3/day$.

In the present circumstance one may assume a total potential B.O.D. load of $70m^3$ x 1500 mg/L = 105 Kg/day.

However, deposition in "mix and balance tank", coupled with the oxidation of the Lime Sulphide liquor should effect a 30% reduction in B.O.D. to 73.5 Kg/day, i.e loading rate for the $150m^3$ of 490gm $B.O.D./M^3$/ day.

(As this process is unlikely to be installed no furthe date will be given.)

Chapter 111
Basic Data - Assumptions

. In the absence of a definitive, updated, feasibility study relating to the tannery project, it has been necessary to adopt certain basic parameters in order to prepare a realistic effluent treatment system. Most of the data was obtained at a meeting with the General Manager (Designate) on the 20th May, 1981.

1. Interoperational Hide Weights

It is understood that the hides will be a 50:50 mix of -

30 lbs D/S Hides which could represent 40/45 lbs in the Green State

and 20 lbs W/S " " " " 25 lbs in the Green State

Thus it may be envisaged that an average Green wt. of 35 lbs (16 Kg) could be realistic. This would be within 5% of "Limed Wt" (Normal basis on which early Tannery process is calculated).

The split/shoved wt. would be some 60% of "Limed Wt".

2. Water Usage

In the absence of a firm production schedule based on an indepth market study, it may be expedient to calculate water usage on the assumption that the major product will be corrected grain, chrome upper leather which process has a high water consumption.

Although initially, it is felt that 40 hides/day will be available for processing, the Consultant is instructed that provision shall be made for a thruput of 100 hides/day i.e 1600 Kg (1.6 mt.).

A summary of water usage based on the process the General Manager (Designate) expects to employ is

DAILY WATER CONSUMPTION

Process	%	Character	Base	Volume			Fl
Wash	300	Blood, Dirt etc Min. Chemicals	1600 Kg	4,800 L	=	$4.8M^3$	Ot
Soak/Lime	200	Dissolved Hair Lime Sulphide	1600 Kg	3,200 L	=	$3.2M^3$	Lime
Fleshing Machine	?	Dis. Hair Lime Sul. + Flesh	?			$1.0M^3$	"
Wash/Delime	300	Lime Remnants + weakly ocidic Ch.	1600 Kg	4,800 L	=	$4.8M^3$	Ot
Pickle/Tan	60	Acidic plus trivalent chrome salts	1600 Kg	960 L	=	$1.0M^3$	Ch
Wash, Neutralise retan, dye	930	Miscellaneous	960 Kg	8,928 L	=	$8.9M^3$	Ot
						$23.7M^3$	

Other Flow	$18.5M^3$
Lime Sulphide Flow	$4.2M^3$
Chrome Flow	$1.0M^3$

However, tannerise notoriously overuse water and it is not uncommon for actual usage to be double or treble specified process requirement. Typical medium water usage technology internationally is reckoned at 50 Litre/Kg salted hide (light salted european system). This could represent 45 Litre/Kg Green Hide, and for an inout of 100 Guyana hides would suggest daily water usage of $72M^3$. Alternate rule of thumb suggests $1ft^2$ of leather requires 7 gal water ∴ 100 hides x $25ft^2$ need 17,500 gals = $79M^3$.

Thus for safety it may be expedient to allow 3 times the specified process requirement.

Other Flow	$55.5M^3$	day
Lime/Sulphide flow	$12.6M^3$	day
Chrome flow	$3.0M^3$	day
Total daily usage	$71.1M^3$/	day

NB: It must be noted that the overspecifying in both inout and water usage may lead to operational difficulties if low hide inout and water economy are encountered.

3. Possible Sulphide content of Lime Liquors and its Oxidation.

It is assumed that the offering of Sodium Sulphide will be 2.5% on Lime Pelt Wt. i.e 40 Kg day technical No_2S - 62% Pure daily.

This represents some 10.2 Kg Pure Sulphide ($S^=$)

The oxidation reaction, employing catalyst and oxygen from air at ambient temparature does not proceed fully to the formation of a sulphate but the major product is a thiosulhate which decompores into sulphur and sulphite viz.

$$4S + 3O_2 \rightarrow 2S_2O_3 \rightarrow 2S + 2SO_3$$

Stoichimetrically 1Kg of Sulphide requires 0.75Kg Oxygen to satisfy the above reaction at N.T.P. 525 Litres of Oxygen are required for 1Kg Sulphide.

N.T.P. 2500 Litres of Air was required for 1Kg Sulphide.

Normal sulphide residue may be 30 - 40% of offering - however for design purposes one may allow 50% residual i.e 5Kg day Sulphide, needing 3.75 Oxygen.

B. Process Notes

(1) Catalyst

The rapid oxidation of Sulphide requires a catalyst. Managaneus Chloride or Sulphate are the recommended materials. ($Mn\ Cl_2$, $4H_2O$ Tech or $Mn\ SO_4$ $H2_2O$) and are relatively cheap. Normal concentration utilised is 50 - 100 mg/L Metalion. Full deatils of original process may be seen:-

Bailey A.D. Humphreys F.E.

"The removal of Sulphide from Lime Wastes by Aeration" - J.S.L.T.C. 1967 51, 154

(2) Aeration

Two acceptable methods exist and have been extensively utilised:-

(a) Aerators - Although capital intensive aerators (surface or submerged) require appreciably less maintenance. With the low level of oxygen required, 3.75 Kg, during a 3 Hr batch proess a 1KW mini aerator would be needed.

Oxygen transfer by aerator = approx 1.5 Kg/hr/KW.

May need to have larger aerator as usual minimum stock size is 2KW at cost of approx G$ 10,000 F.O.B. As weight of some 100 Kg is suitable for air freight.

Although aerators are more experience than the alternatives outlined below the Consultant believes such aerators may be more suitable for Guyana conditions.

b. Diffused Air

This employs relatively cheap, Rotary Vane Blowers, coupled to a series of diffusors. Sintered alumdun dome diffusors set at 1ft centres on the tank base and operated with each diffusor handling 1.2 cu ft/min was the original system. The sintered dome on these is removable for the frequent clearing needed.

A more recent innovation has been the employment of viberating valve diffusors which while less efficient need less maintenance and vertical rod and large hole diffusors with efficiency even lower (6%). Such systems also create appreciably noise. Given the limited volumes to treat, a 1 - 2 Hp motor should suffice.

3. Volume of Air required to Oxidine Sulphide:

The theoritical requirement of air may be calculated:-

1 Kg $S^{=}$ requires 2,500 Liters Air

∴ 5 Kg $S^{=}$ " 12,500 " "

If require batch oxidation of 3 - 6 hours require air 70 - 35 Litres /min ($2.4 - 1.2 ft^2/min$) (assuming 100% efficiency).

The efficiency of the oxidation process, employing diffused air is a function of depth of tank and bubble size:-

Small bubbles - less than 1.5 mm - may cause foam - over 10% efficient at 4m depth

∴ actual air required = 700 - 350 Litres/min

Medium bubbles - 1.5 - 3.0 mm (viberating valve), 6 - 8% efficient at 4m depth

∴ actual air required 1000 - 500 Litre/m

Large bubbles - over 5.0mm (large hole, vertical rod diffusors), 6% efficient at 4m deep, 1,160 - 581 Litre/min.

C - Operational Notes

1. General: The personal responsibility for operating and supervising the installed effluent treatment system must be clearly established (in writing).

In the absence of an agreed detailed treatment plant design, and an established production rhythm, no firm instructions may be given regarding timing, volumes and pump procedures. These may only be established following commissioning.

2. Chrome precipitation:

Lime or Sodium carbonate were originally utilised to precipitate chrome. Recently however it has been shown that Magesium Oxide produced a much denser and easily handled ppt of $Cr(OH)_3$.

A commercial precipitating agent is now available to isolate and recover chrome from tan drum effluent "Chromegin" (Can-Am-Sales Dept) claim "that a novel, dense basic chrome suplhate (highly olated - (Mol weight 824) x) precipitate is formed that settles readily, allowing for a commercially feasible simple decanting or filtration system". The precipitate is said to be easily reconverted to a 33% basic chrome liquor and effluents containing 0.1 ppm Cr are obtainable.

Following normal chrome tannage the float is discarded and transferred to the catchpit (draining from the "48 Hr Pile" and the sammying and splitting m/cs should also be similarily collected).

The used float is treated with sufficient precipitating agent, agitated by hand, allowed to settle for 12 hours following which a sample of liquor is tested by filtering, if virtually chrome free, the supernatant liquor may be gently pumped to the "mix and balance" tank.

At regular intervals, the chrome ppt must be pumped to a special drying bed. Initially it is suggested that such recovered chrome be stored in drums/poly bag.

When time permits it may be redissolved and used for split tannage. Once the Tannery production is established it may prove possible to redissolve the chrome hydoxcide ppt directly from the slurry state.

The amount of alkalie to employ for precipitation may initially be found by laboratory test giving additions to aliquat portions and filtering to assess insolublisation. Visual assessment of colour of filtrate could be sufficient.

Samples should be taken daily of untreated and treated liquors which should be inspected by the responsible technical officer who shall sign a bood kept for this purpose "that the supernatant liquor was visually chrome free".

The discharge pipe shall be some 0.6m (2 ft) above the base of the pit to ensure sufficient sump for the precipitate.

The periodicity of chrome precipitation will be governed by volume of production, if small thruput only, the activity may be carried out only once or twice weekly.

3. Catalytic Oxidation of Lime/Sulphide

The actual timing and technique will be dependant on equipment installed (see alternates outlined earlier). The general principle shall be:- The Lime Liquors, Water from fleshingm/c and if possible the 1st delime wash, shall be diverted to the oxidation unit, catalyst added, aeration commenced.

The initial oxidation procedures will be monitered by the laboratory, aeratic should continue until the $S^{=}$ level falls to 10 to 20 mg/L. The balance of : concentrati of catalyst: duration of aeration, must be analysed economically and technically to ensure that a practical batch oxidation time of from 3 - 6 hours is yielded.

Once the operational parameters (catalyst and duration) have been established it may be sufficient to monitor the processes by observing the colour change greyish green - yellow green - greyish white. It is essential that on completion of the oxidati a responsible staff member checks the liquor and attests so. In a book, "that the oxidation is complete", prior to pumping the treated liquor forward to the "mix and balance" tank.

This check is essential as if untreated lime/sulphide liquors are mixed with acid liquors, evolution of H_2S would occur which could be dangerous (even fatal) is enclosed space.

If employing dome diffusors and vulnerable systems it may be necessary to have air blowing into the system while filling with untreated liquor to avoid back flooding.

4. Mix and Balance Tank:

The flow into this tank will be spasmodic but the flow onward to the sedimentation unit must be controlled to as regular a rate as the volume of effluent justifies i.e if $70M^3$/day - will forward pump at $3M^3$/hr for 24 lbs. If lesser input the hourly flow rate must be proportionally reduced.

It is anticipated that the pump provided will be overcapacity, in such circumstances it must be adjusted via time switches, to pump the calculated volume, every ½ hour thruout the day, to ensure an even flow within the sedimentation unit.

The pumping will also be controlled by float switches. High level - 1ft from top of tank to activate pump (override time switch) if liquor reaches this level.

Low level - at mid height of tank, to stop pumping and ensure there will always be sufficient liquor present to equalise/neutralise the influent.

Ultimately, it is hoped this unit will be mechanically agitated (aerators or propellors) - if these are not provided 2 options are open.

(i) plunge frequently by hand to keep in suspension

(ii) allow sediment to settle in tank

but frequently use moving sludge pump with flat suction head to evacuate all depositions.

Sedimentation Tank:

Provided that the inflow is controlled a well designed unit should function relatively trouble free. Exit of supernatant liquors will be by gravity to tanker and should need no control provided sludge is withdrawn frequently.

In the event that $70m^3$ of effluent is generated daily one would expect some $3m^3$ of sludge slurry daily - (3 - 6% solids). This must be discharged (gravity or pump dependant on height of unit) to flow to distribution channel of drying beds. Volume of sludge discharged can be measured by fall in level of liquor in upper unit (at specified surface area of unit $3m^3$ would need a fall in level of 0.5m (1' 8").

If the mix and balance tank is not being continually agitated a lesser volume of sludge will be yielded in the sedimentation unit.

6. Sludge Beds.

Entry to the sludge beds will be controlled by individual manual sluice gates from the distribution channel.

The procedure will be:- sludge slurry will be run into Bed No. 1 until a height of 0.5m is obtained. (This may be 1 - 3 days slurry according to volume of effluent generated). When bed No. 1 is full (0.5m) - the sluice gate is closed and slurry run to bed no. 2 which is filled to depth of 0.5m. This process continues up the series until bed no. 10 is filled. Prior to this time bed no. 1 should have been dry and the dry cake removed ready for a new charge of slurry.

Under good conditions a firm cake of some 5cm depth (2") is yeilded which may be removed by hand - if poor drying conditions prevail a porridge consistency will be obtained which will heed to be removed by shovel.

Some sand may be removed from the bed each time sludge is cleared and it will need to be replaced regularily.

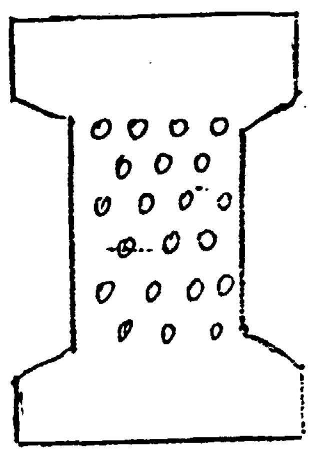
Annex 11

Some General Comments

The Consultant, in addition to his terms of reference was asked to offer comments/advice regarding the general operational problems and prospects for the Tannery now nearly ready for commissioning. Many items were discussed with the concerned parties and only the more specific problem areas are touched here.

It is self evident, and acknowledged by all, that the plant is somewhat over-specified for such a projected low level thru'put. This would ensure much higher "fixed charges" but given that the money has been invested it now remains to operate the unit as economically as is possible given the inbuilt constraints.

1. It may be that the internal drainage channels (to accept drum discharges) are not suitably constructed. (This may be checked by filling to axle level one or two of the lage drums with water and rotating the drum to allow instant discharge while watching the result.) One would normally recommend drain channels of at least 1 ft. (30cm) depth, with 2-5% fall. Additionally the wooden covers need to be shaped and perforated viz:



11. Consideration should be given to the possibility of binging up the drums. While empty and dry the wood is shrinking and may distort. It is normal to fill, and keep filled with water, drums as soon as they are erected. They would need to be turned regularily to avoid drying out of upper half.

III. There appears no provision to collect and retain the fleshings and water being produced and discharged at the fleshing machine. The fleshings must not be allowed to enter the waste water channels, (will cause blockage) It is normal to site the flesher near a wall, with an exit to an outside holding tank where the fleshings may be drained of water.

IV. It is surprising to find such a wall equipped tannery <u>without provision</u> for a boiler. The consultant does not feel that high quality dying/ retanning can be expected without some supply of hot water (calorifier). Additionally it appears a little risky to expect to achieve consistent drying employing natural air considering the high seasonal R.H. (possible need for steam). It may be that at an input of 40 Hides/day some crude heater could supply the necessary hot water for dying. If 100 Hides/day was ever attempted assistence would be necessary at the drying stage.

V. Although the plant has a hydraulic Press, it does not appear to have any printing plates. 4 - 6 of these plates are usually considered essential to mask natural defects (S/hand plates could be available).

VI. Some means of measuring the area of finished light leather must be purchased.

VII. Although one may operate a tannery without an analytical lab some control and measuring equipment is essential viz:

pH meter; pH papers; thermometers, measuring vessels, guages tec.,

VIII. There is need for transport equipment viz: Horses, Box Trucks, Pallets.

IX. It may be suggested that the shoving m/c is somewhat sophisticated for a tannery with such a low projected inout. Taking account of the lack of skilled tannery engineers available it could be that serviceability could be better assured if one of the older type double width machines were installed without automatic distance and grinding systems. Possibly the concerned authority could examine the possibility of selling the existent m/c while still new and purchasing a cheaper reconditioned m/c/ (should achieve a substantial paper profit due to inflation since original purchase).

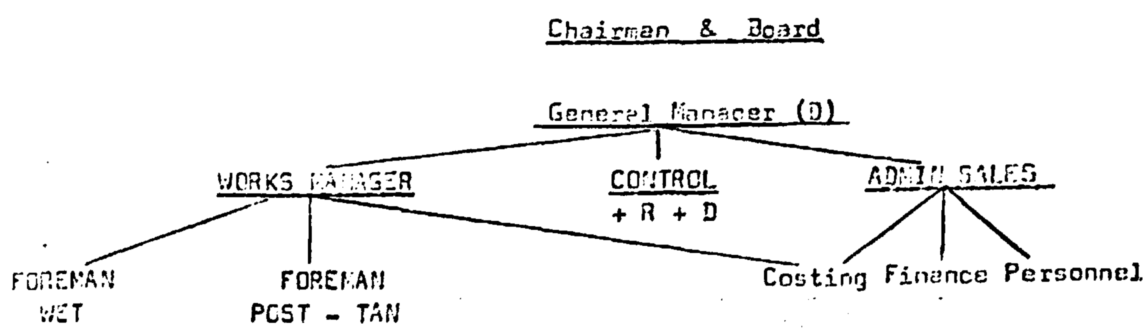
X. The undated report.

"Leathercraft Industries Limited"
"Tannery Operation"

Presented by -

Group Technical Co-ordinator
Guyana State Corporation

Outlines at Appendix 4(a) Page 15 a "proposed organisational chart". It may be that provision should be made for a Technical/Production/ Works Manager. The General Manager (designate) assistant is fully qualified for such post and it must be noted that the operation and control of the tannery will require such post. The consultant would feel a tannery organisation chart basically should read:-



ANNEX III

Items for D. Winters to obtain and submit to Guyana during the two days he will have in U.K. within his contract.

1. Copy of detailed design of Vertical Sedimentation Tank.
2. Copy of detailed design of Sludge drying beds.
3. Specification/quotes ref:-
   - a) Areators - floating and submerged.
   - b) Diffusion devices
   - c) Effluent pumps
   - d) Sludge pumps
4. Specification/quotes ref

   pH meter

   and small tannery control

   / measure items.
5. Availability/price of second-hand reconditioned
   - a) Leather area measuring devices
   - b) Embossing plates for Hydraulic Press (D.W. needs to know platten size).