OK TEDI MINING LIMITED

ENVIRONMENT DEPARTMENT

Sediment Transport Workshop
Tabubil, PNG
21-23 February 2000

Minutes

MINUTES OF THE SEDIMENT WORKSHOP HELD AT TABUBIL 21ST/22ND/23RD FEBRUARY 2000

1.0 ATTENDEES

OTML: Don Carroll (Chair), Arnold Moi, Monica Rau, Jat Tinkerame, Ken Voigt, Juan Jeffrey, Brian Foy, Brian Shepherd, Jon Glatthaar, Stuart Green, Vele Ila'ava, Bill Blenkhorn (day 2), Robin Moaina (day 2), BHP: Murray Hohnen, John Burgess, Bob Watts, Ian Wood, Mike Kennedy, INMET: Craig Ford, PNG Govt: Leo Kasa, PRG: Bill Dietrich, CONSULTANTS: Andrew Marshall, Yantao Cui, DREDECO: Hugo Shannen, (day 1) Gary Edwards (day 1).

2.0 APOLOGIES

Roger Higgins (OTML), Gary Parker (Uni of Minnesota).

3.0 RECONNAISSANCE TRIP: 21 FEB 2000

A reconnaissance trip was organised Monday afternoon, 21st Feb. The purpose of the trip was to view the southern dumps, the dieback areas, the dredge site and the sand/gravel bars in the Ok Tedi. General comments were that the extent of floodplain flooding was still widespread and that dieback had spread further into the Middle Fly (and was more discernible), but that good under-storey re-growth was evident around the dieback areas close to the Dredge. Most were impressed with the extent of the dredge site area. The visit to Hervey Creek revealed that increased erosion could be occurring from Hervey Creek. A sand/gravel bar was visited below Ningerum, where the following features were noted: iron staining, precipitated copper and gypsum salts and binding moss in patches of the most stabilised areas of the bar. The large extent of sand contained in the bar was also noted. Of most concern was the obvious segregation of the heavier minerals; pyrite and magnetite. This segregation was also evident from the stratification profiles of the various mineral layers below the surface. It was generally considered that the staining is a recent phenomenon. It was also assessed that the likely source of the bulk of the material is from the tailings stream. Some attendees commented that the character and pattern of the sand material located in the bar had all the hallmarks of a tailings impoundment.

22 Feb 2000

Don Carroll welcomed all to the meeting and outlined the scope and agenda for the meeting. He stated that the purpose of the meeting was to review latest river surveys and model updates. A sediment budget will also be prepared based on this latest information.

4.0 DATA REVIEW:

Andrew Marshall presented the following:

- 1997/1999 cross-section survey (Konkonda to Ogwa) and preliminary results
- Ok Tedi storage analysis (1982 –1997) (Ok Mani Junction to D'Albertis Junction)

4.1 1997/1999 CROSS SECTION SURVEYS

A hydrographic survey was undertaken in the Lower Ok Tedi and Middle Fly replicating the survey undertaken in 1997. The survey comprised of river cross-sections at approximately five-kilometre spacing between Konkonda (Ok Tedi) and Ogwa (Fly River). A total of 24 cross-sections in the Lower Ok Tedi and 102 cross-sections in the Middle Fly were replicated. Figure 1 shows cross-section coverage in the Lake Pangua – Obo area of the Middle Fly and is typical of coverage over the full study area.

Figure 1. Cross-section locations (Obo – Middle Fly)

The aim of the study was to determine the changes to bed level over the two-year period between surveys. Typical results of the survey are shown in Figure 2.

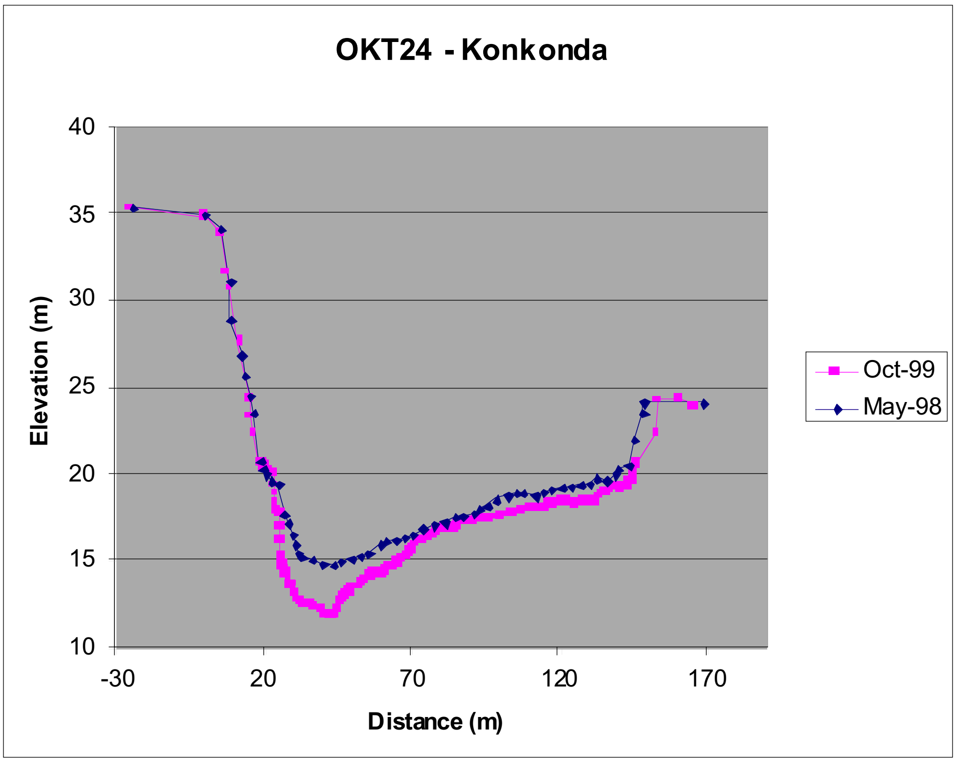

Figure 2. River cross-section (Konkonda – Lower Ok Tedi)

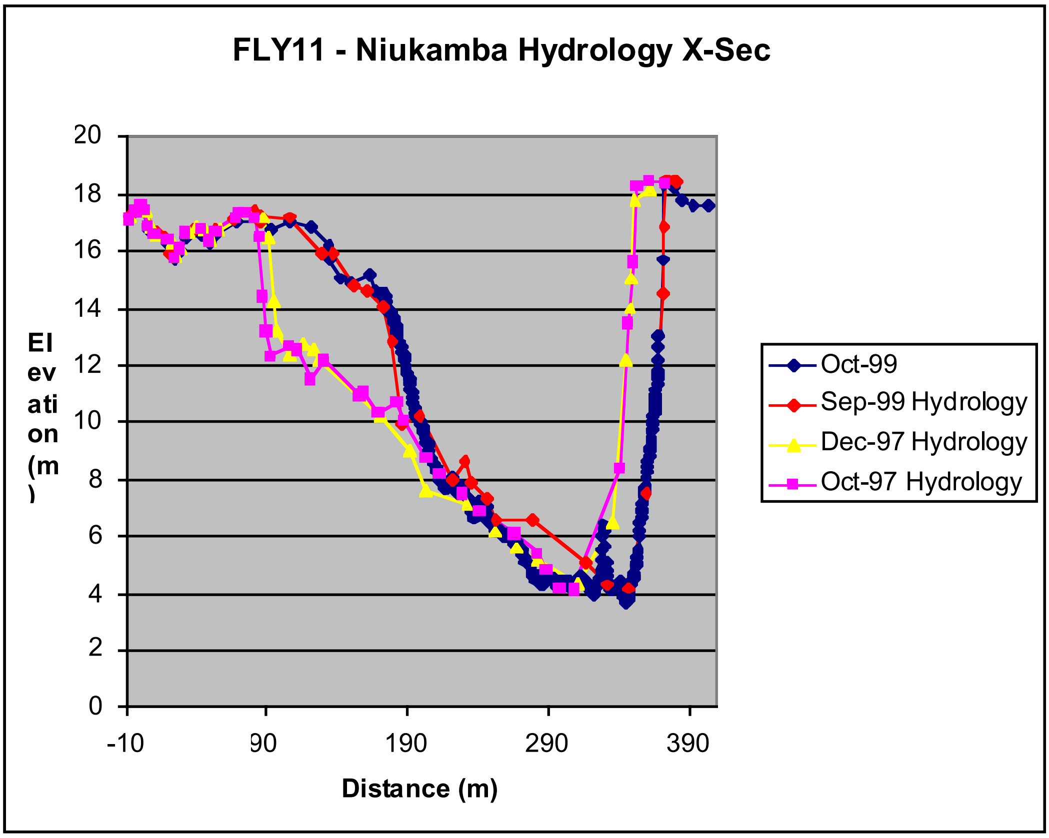

Figure 3. River cross-section (Nukumba Hydrology site – Middle Fly)

Where possible OTML Environment Hydrology sites was included in the survey. Such sites include Konkonda, 5km U/S D'Albertis (LOT), 500m U/S D'Albertis (Fly), Kuambit, Niukamba, Wygerin, Mabaduam, Manda, Bosset and Obo. Results for one of these sites (with only select Hydrology epochs) are included as Figure 3. In most cases the results showed good agreement, with those in doubt currently being evaluated, particularly for datum inconsistencies.

Average bed elevation changes have been derived for each cross-section and a volume/tonnage change in the river system between Konkonda and Obo has been calculated. At this stage the volume has been calculated by simple trapezoidal methods however further analysis and refined methods will enhance the accuracy of the volume determination.

The results for the Lower Ok Tedi show a net degradation of 3.1 Mt (at a bulk density of 1.75) during the period May 1998 to October 1999 below Konkonda. From the Dredge slot to Konkonda, an analysis of Dredeco cross-sections reveal that a further 4 Mt has been scoured. A long profile of the reach is included as Figure 4. The results are characterised by a 1.0 to 0.5 metre degradation between Konkonda and Bongabun then little systematic change to D'Albertis Junction. The results to Bongabun are in agreement with those derived independently by Dredeco. The results for the Middle Fly show a net degradation of 9.9Mt (at a bulk density of 1.75) during the period October 1997 to October 1999. The results are characterised by a systematic degradation between D'Albertis Junction and Mabaduam at the 1.0 metre level, then aggradation between Mabaduam and Obo at the 0.5 metre level. A long profile of the reach is included as Figure 5. Results for both the Lower Ok Tedi and Middle Fly are currently being refined and these results should be regarded as preliminary.

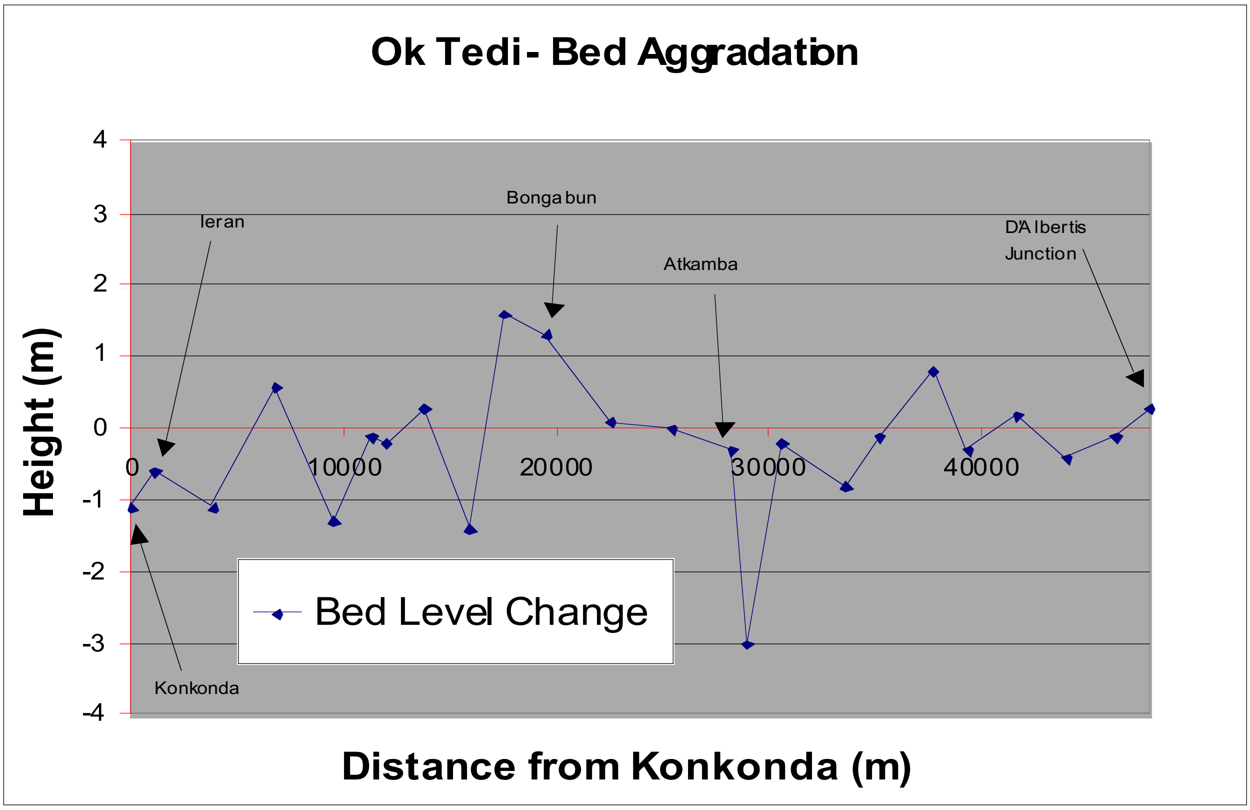

Figure 4. Lower Ok Tedi – Bed aggradation long profile

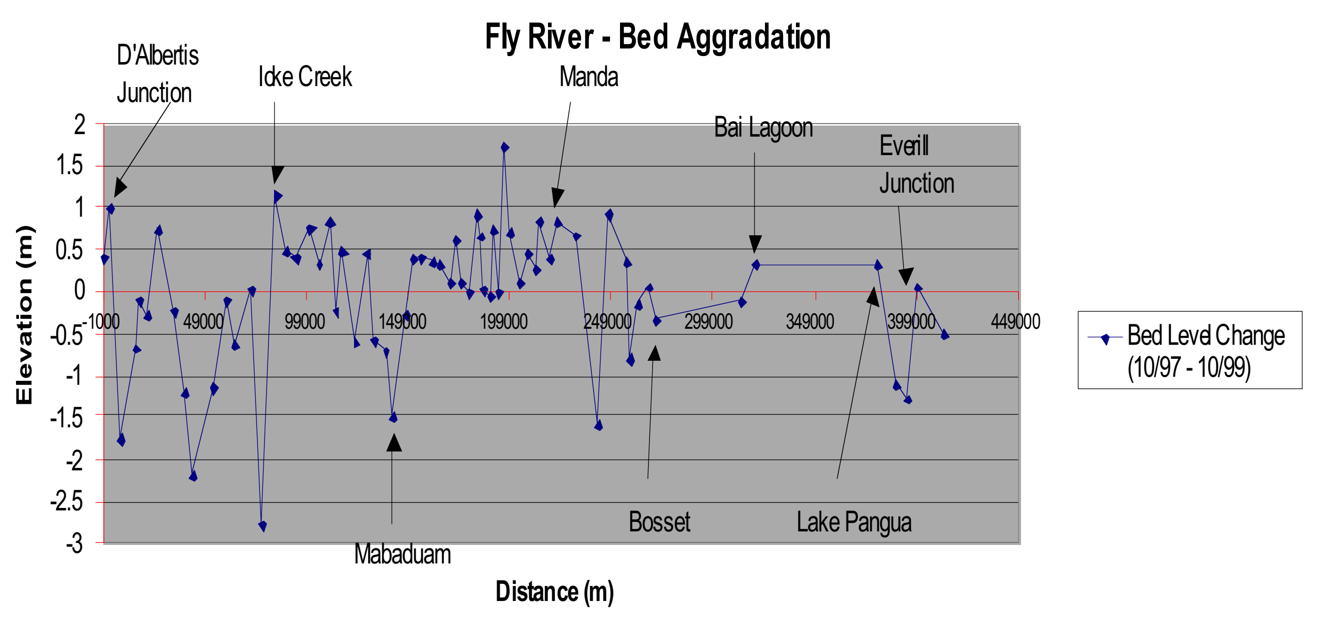

Figure 5. Middle Fly Long Profile

4.2 OK TEDI STORAGE ANALYSIS (1982 – 1997)

An analysis was carried out of all available data to estimate the net storage in the Ok Tedi (Ok Mani Junction to D'Albertis Junction) over the period **1982 to 1997** ie from pre mining to 1997. This analysis will be used to assist in improving sediment modelling and preparing sediment budgets.

Data sources include river cross-sections, aerial photography (epochs 1982, 1992), satellite imagery and ground survey data. A DTM of the estimated changes to the river has been compiled from which a summary map collated. The summary map delineates areas of net bed aggradation, net bed infill, net erosion and areas of no change. An example of these results is shown in Figure 6, comprising a limited reach directly above Komopkin. Yellow denotes zones of bed aggradation, red denotes zones of bank erosion, light blue denotes zones of bed infill, purple denotes zones of no net change (typically on islands within the main channel) and the light blue line is the 1982 channel profile.

The quantitative results of the analysis are included in Table 1. Note that no erosion estimate has been made for the Ok Tedi above Haidawogam. All tonnages are with respect to a bulk density of 1.75.

Table 1 Ok Tedi storage analysis (1982-1997) – Results

REACH	STORAGE (Mt)	EROSION (Mt)
Ok Mani – Ningerum	72.5	-
Ningerum – Konkonda	68.3	28.4
Konkonda – D'Albertis	67.7	37.6
TOTAL	**208.5**	**66.0**

This analysis will be extended to include the storage and erosion estimates for Ok Mani, Ok Gilor, Ok Mabiong, Sulphide Creek and Harvey Creek.

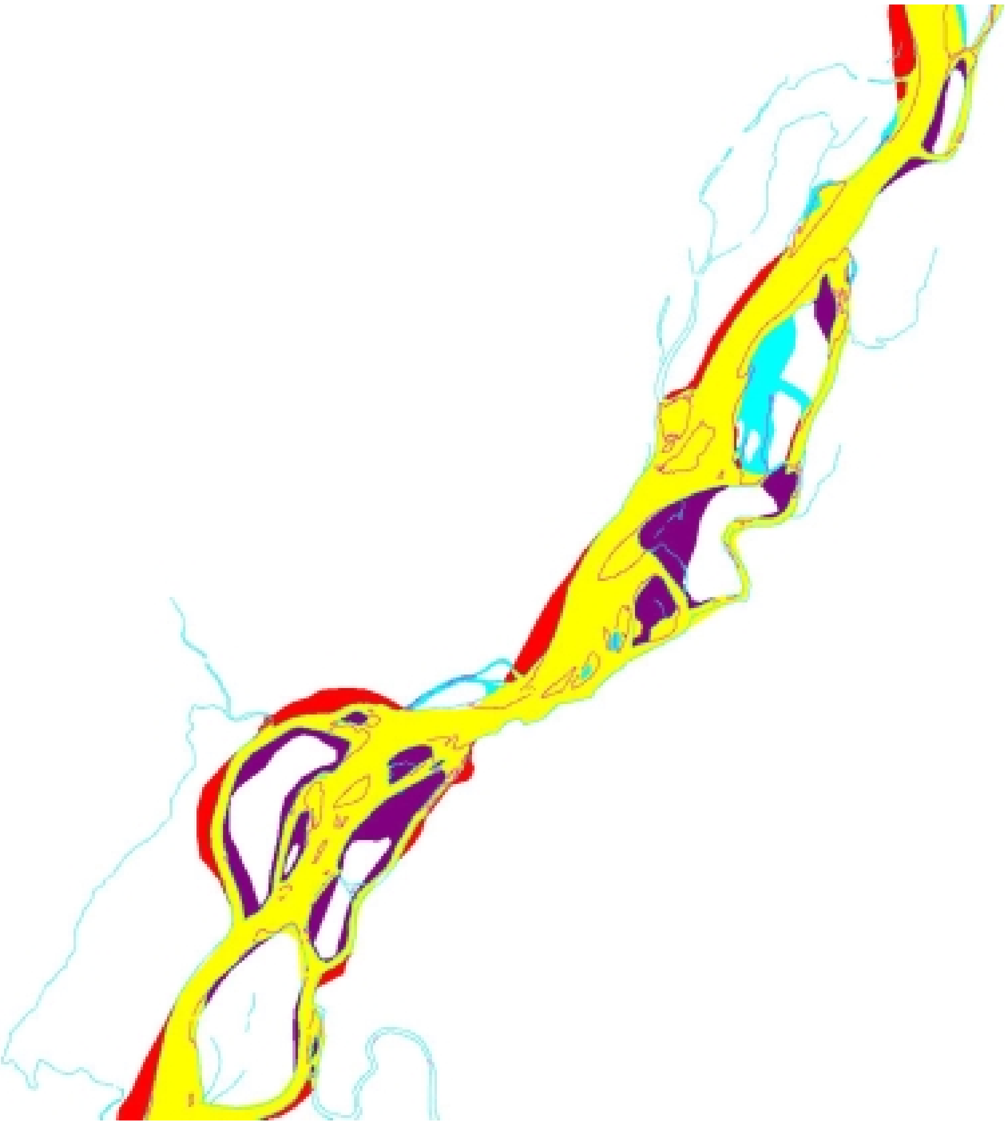

Figure 6. Ok Tedi channel change summary map (1982 – 1997) – Komopkin

5.0 APL/DREDGING EMP RIVER CROSS SECTION DATA AND PSD DATA

Arnold Moi next presented on recent river surveys and data collected during the period Sept 1997 to Sept 1999.

5.1 APL Cross Sectional Surveys

Surveys indicate that there is no net sedimentation in the UOT but there is lateral channel shift (braiding) and side wall erosion with gravel build around Ningerum, and there was some aggradation upstream of Bige. Channel behavior between Bige and Nukumba is summarised in the next section. The river is very active below the D'Albertis both vertically and laterally. The channel-build up and bank erosion however, decreases with distance downstream to past Wygerin. Downstream of Mabaduam sediment deposition of 0.5 to 1.0m has been observed in the riverbed, this is possibly due to the high flood levels induced by backwaters from the Agu and Strickland rivers during the current La Nina. Downstream of Everill there is some main channel aggradation possibly due to the high sediment loads from the Strickland.

5.2 Dredge EMP Survey Monitor

A series of river cross-section and floodplain transects were set up between upstream of Iogi and Wygerin for the dredging EMP monitoring program. The surveys show that there is no net channel modification upstream of Bige, but there is 1 to 2m degradation at Konkonda, with about a 1m at Bongabun decreasing with distance downstream to around 0.5m around D'Albertis Junction to Nukumba. On the floodplain close to Bige (dredging site) it was observed there was good under story re-growth observed even for the wet period. Further over-bank flooding seems to have decreased. Generally the initial deductions are that the dredging seems to have some effect which decreases with distance downstream, but effects seem not to have gone past Nukumba at this stage.

5.3 PSD (Particle Size Distributions*)*

Data using the revised sampling method indicate there are distinct differences in bed sediment sizes and distribution depending on location of sample collection as determined by flow patterns. Generally sizes decrease with distance downstream and fine at points of lower velocities. Coarse sediment is located at points of higher velocities and at points of large flow introduction. There is an abrupt spiking in sediment sizes at both the D'Albertis and Everill junctions. The latter can be explained by the introduction of coarse sediments by the Strickland but the former is possibly due to the sudden pickup in sediment transport due to reduced supply from the Ok Tedi - this is very tentative and needs further investigation.

6.0 DREDGE DATA: CROSS-SECTIONS, SLOT VOLUMES AND PARTICLE SIZE DATA

Juan Jeffery presented on the latest measurements of dredging/sand supply rates and particle size distributions of dredged materials.

He reported that the average rate of supply is about 20 Mtpa - the dredge is picking up about 17 Mt/a. The Dredge has a capacity however to dredge at a rate of 25 Mtpa, and presently, there are set periods when the dredge has to cease operations to allow the sand trap to fill up to economic levels. Juan also pointed out that supply had fallen off dramatically during the SAG1 shut down - see Figure 7.

Discussion followed particularly regard to the percentage of the dredged material that was tailings. Based on the level of magnetite in the dredged material and the particle size distribution of the material - see Figure 8, it was concluded that the material must consist of at least 50% tailings. It was also generally agreed that more work is needed in this area, particularly in correlating waste rock and tailings discharges from the mine to sand delivery at Bige.

Gary Edwards of Dredeco presented the results of Dredeco's cross-section surveys. These surveys extend downstream from the slot to Ieran and upstream to Dome. Cross-sections are at 500 m intervals over a 20 km reach. The results compare well to those collated by Marshall and Moi; i.e. there is significant degradation downstream of the dredge over a distance of 20 km. Gary also reported that he observed gravel deposits at some sections below the dredge slot. It was agreed that Dr. Cui and Arnold Moi should go to site after the workshop to assess the source of these gravels.

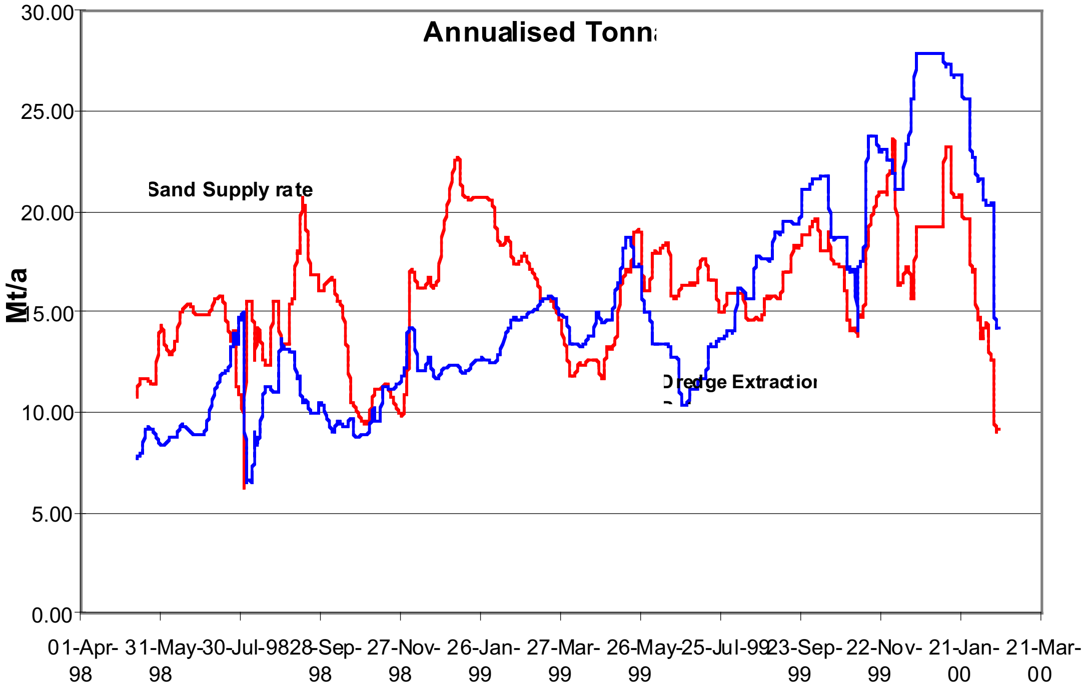

Figure 7. Measured Rates of Dredging and Sand Supply

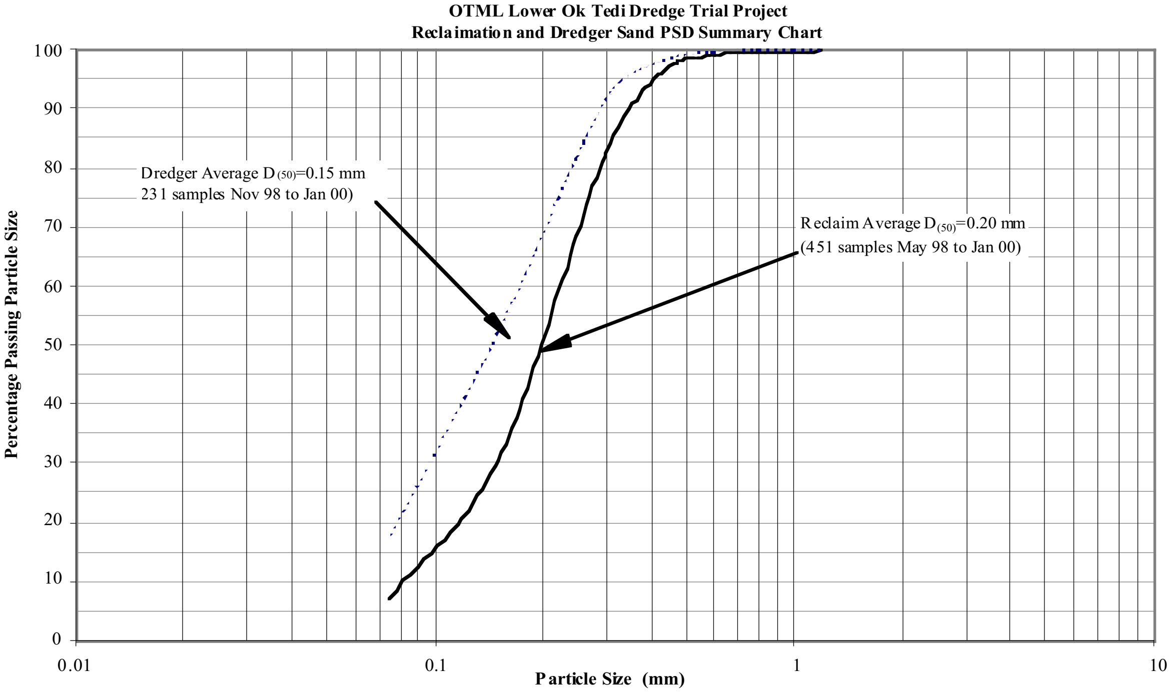

Figure 8. Particle Size Distributions of Dredged and placed materials

7.0 HERA SEDIMENT MODELLING: BASIC ASSUMPTIONS

Dr. Yantao Cui presented to the workshop the basic assumptions of the OkGrav and OkFly models. These are the two models used to simulate the sedimentation process in the Ok Tedi-Fly River system. OkGrav simulates the gravel bed reach in the upper Ok Tedi and produces input data for the OkFly model, which simulates the sand bed profile in the lower Ok Tedi, the lower upper Fly River downstream of Kiunga and the middle Fly River upstream of Obo.

7.1 OkGrav Model

Sediment sources for the OkGrav model include waste rock, tailings, slide material from Vancouver and Harvey Creek landslides, and natural sediment. Waste Rock is assumed to degrade to gravel, sand and silt and tailings are composed of sand and silt. Gravel is further assumed to abrade to produce sand and silt while traveling downstream. It is assumed that sand can be deposited in the Ok Mani and Ok Gilor/Mabiong fluvial runout zones. It is further assumed that only gravel can be deposited in the Ok Tedi gravel bed reach and sand and silt are transported instantaneously to Konkonda as it enters Ok Tedi.

The model assumes that gravel spreads out to the whole channel width as it aggrades, and cut through only in the main channel as it degrades. By assigning an abrasion coefficient that is changing in downstream direction, the gravel becomes more difficult to abrade as it is transported downstream. Because the gravel bed reach has a steep slope with high Froude number flows, the OkGrav model employs quasi-normal flow assumption and uses a duration curve, discounting the flow variation over different years. The sediment transport equation is the surface based bedload equation of Parker and the mass continuity equation considers the mass balance for different grain size groups.

The OkGrav model is used to predict the aggradation in the gravel bed reach in Ok Tedi, gravel budget in the Ok Tedi, Ok Mani and Ok Gilor/Mabiong reaches, and sand and silt production from abrasion of waste rock and gravel transport. Most importantly OkGrav produces sand and silt deliveries into Konkonda reach, which is the basic input data for the sand model OkFly.

Discussion followed, particularly, regarding the lack of sand storage in the Ok Tedi. Dr. Cui stated that while there is sand storage occurring in the Ok Tedi, its omission in terms of overall results is not significant. Nevertheless adjustments have been made to account for it and that this will be discussed tomorrow.

7.2 Ok Fly Model

In the sand model OkFly, it is assumed that the channel has a simple rectangular geometry. The floodplain is also assumed to be rectangular. Flow is simulated with the standard backwater calculation. Four water years selected from historic records were selected as “Wet”, “Average”, “Dry” and “El Nino” years. Using the selected four years record, a 35 year series were constructed as the hydrological series to be used in the model. The 35-year series was repeated to create 70 years of simulation. The downstream boundary of the model is set at Obo where water surface elevation for the same 4 years were used to set up the downstream boundary condition.

The sediment transport equation used is Brownlie’s bed material equation. A cutoff size is assumed so that the sediment that is finer than the cutoff size will not deposit in the main channel. The cutoff size was assumed to be 20 micron in the January runs and then modified to 43 microns in the May runs. Use of the cutoff assumption is a major problem in that it will not reproduce the downstream grain size and slope variation under pre-mine conditions. It is also considered that the failure to reproduce accurate aggradation downstream of Wygerin is due in part to the assumption of a single cutoff size.

The sediment’s vertical size distribution in the water column is assumed to obey Rouse’s law. Only the sediment in the water column that is higher than the floodplain contributes to deposition on the floodplain. The rate of floodplain deposition is assumed to be proportional to the sediment concentration over the floodplain, the water discharge over the floodplain, which is assumed to be no more than 30% of the total discharge, and inversely proportional to the width of floodplain squared. The floodplain deposition is calibrated by changing a coefficient so that the simulated rate matches the observed or estimated rates.

‘Zeroing’ processes are performed for both gravel and sand models to help the selection of certain calibration coefficients and make sure that the river conveys the same amount of sediment as measured under natural conditions.

Discussion followed particularly with regards to the cut-off value. Bob Watts suggested that the 63 micron is a more common cutoff and why had this not be used in the model. Secondly, he pointed out the anomalous flooding frequencies tabled in the model report, i.e. the differences between the January and May models - both of which were ‘consensus’ based. Dr. Cui responded that the 20 micron value is not right, but from the bed particle size distributions available there was sufficient evidence to suggest that 43 micron material is being stored in the bed. Bill Dietrich concurred. In response to the flooding frequencies, Dr. Cui stated that the relevant section could have been better worded. A consensus was reached in Minnesota regarding flooding frequencies, however, the May model results did not produce accurately the targeted frequencies, ie the frequencies presented are modeled frequencies, not agreed frequencies. He added that more work needs to be done in this area, particularly with regards to accounting for floodplain hydrology and hydraulics (eg standing water). Don Carroll stated that the dieback model is based on the difference in flooding frequencies with and without a mine, and the model is zeroed to produce no dieback under ‘no mining’ conditions. Thus the results are not that sensitive to the absolute level of flooding frequency - nevertheless it would be preferable to work with the more realistic frequencies.

7.3 Sensitivity Tests

Dr. Cui advised that no formal sensitivity tests were performed. However a total of 22 runs had been performed with some of them for both January and May models. All the results look reasonable by comparison with each other. Dr Cui added that the cutoff size used in the May model is closer to reality and thus results produced by this model should be used for environmental evaluations and risk assessment. Dr. Cui reinforced that all model results should be interpreted in a comparative way so as to increase their credibility. He added that while the simulation results compare well with field measurement for the reach upstream of Wygerin, however it under-predicts bed sedimentation below Wygerin. As a result, the model does not predict correct floodplain inundation frequencies in that reach, which in turn prevents meaningful prediction of forest dieback with the dieback model. New sedimentation theories need to be developed in order to correct this shortcoming of the current model.

8.0 HEC-6 MODELING

A. Moi set up an HEC-6 sediment transport model as part of his Masters study program. The Model network starts just upstream of Ningerum on the Ok Tedi and ends at Wygerin in the Middle Fly. The model has been setup to do two scenarios, dredging at 19mt/a and no dredging.

Model simulations as compared to current monitoring data show very good correspondence, both in magnitude and trend, predicting 2m of degradation at Konkonda decreasing with distance to around 0.5m at Kuambit-Nukumba end of 1999. Further work is still required to calibrate and extend the model into the Lower Middle Fly and out onto the floodplains.

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9.0 INTRODUCTION AND SCOPE OF MEETING

Murray Hohnen opened the meeting by thanking the various shareholder representatives for their attendance. He also thanked presenters for their efforts in contributing to a constructive meeting and noted that the reconnaissance trip was particularly informative. Finally he encouraged all to stay focused on the agenda and looked forward to seeing the results of the updated modeling results during the course of the day.

10.0 TECHNICAL SESSION: SUMMARY

Don Carroll opened the next session by inviting summaries from those who presented yesterday and invited comment from the workshop participants on what their impressions were to date.

There was considerable discussion with regards to the Reconnaissance trip. Craig Ford (INMET) said that although not diminishing the significance of the extent of dieback - he had expected it to be a lot worse. He also added that his major area of concern was Acid Rock Drainage, as evidenced by the iron staining of some of the sand/gravel bars in the Ok Tedi. Don Carroll added that an intensive year's program of sampling and investigations has been prepared to address this issue and a copy of the program is available. Craig also added that he was concerned with the error bands (or lack thereof) for the modeling results. John Burgess (BHP) raised the issue of the effectiveness of dumping limestone to manage the ARD issue, and added if this issue is not addressed it could be a fatal flaw for the project.

Summaries by various presenters concluded that the river cross-section data showed that there has be a marked degradation of the Ok Tedi below the dredge for a distance of 20 km. Below this there has not been much change. Likewise in the Middle Fly, there has been degradation in the upper Middle Fly to Mabaduan coupled with aggradation from Mabaduan to Manda. Below Manda, there also has been aggradation. It was generally concluded that the degradation below the dredge could be attributed to the dredge and El Nino mine closure, whereas further downstream to D'Albertis it was significant that there had been no net aggradation. It was unlikely that the Dredge has had any impacts on the Middle Fly, particularly considering the dominance of the La Nina flooding phenomenon that has occurred in this area for the past 2 years.

With regard the dredging, it was generally accepted that the dredging could keep up with a sand supply up to 25 Mtpa. Further, it is likely that at least 50% of the dredged material is tailings and further work needs to done relating sand supply to tailings and waste rock deliveries at the mine.

11.0 LATEST MODELLING RESULTS

11.1 Sediment Model Results

Don Carroll presented the latest OkGrav/OkFly results to the workshop. The latest results are based on three changes in inputs. These were (1) a reduction in sand from tailings based on latest PSD information (more silts) (2) an assumption of more competent waste rock (more gravels) and (3) the storage of sand in the gravel interstices in the Ok Tedi to Bige. These changes resulted in a 7 Mt/a reduction in sand supply to the Dredge slot i.e. from 27 Mt/a to 20 Mt/a. Two additional options were also run; reduction of mining to 200 ktpd and secondly, relocation of the Dredge to just upstream of D'Albertis Junction. It was also pointed out that these changes were applied from commencement of mining in 1985. This is not strictly correct, as properly, time dependent abrasion coefficients and tailings PSDs should have been incorporated in the OkGrav model. The consequence of this is the updated modeling works predicts lesser aggradation below Bige than the May 1999 model. Plots of the latest results are given in Figures 9,10 and 11.

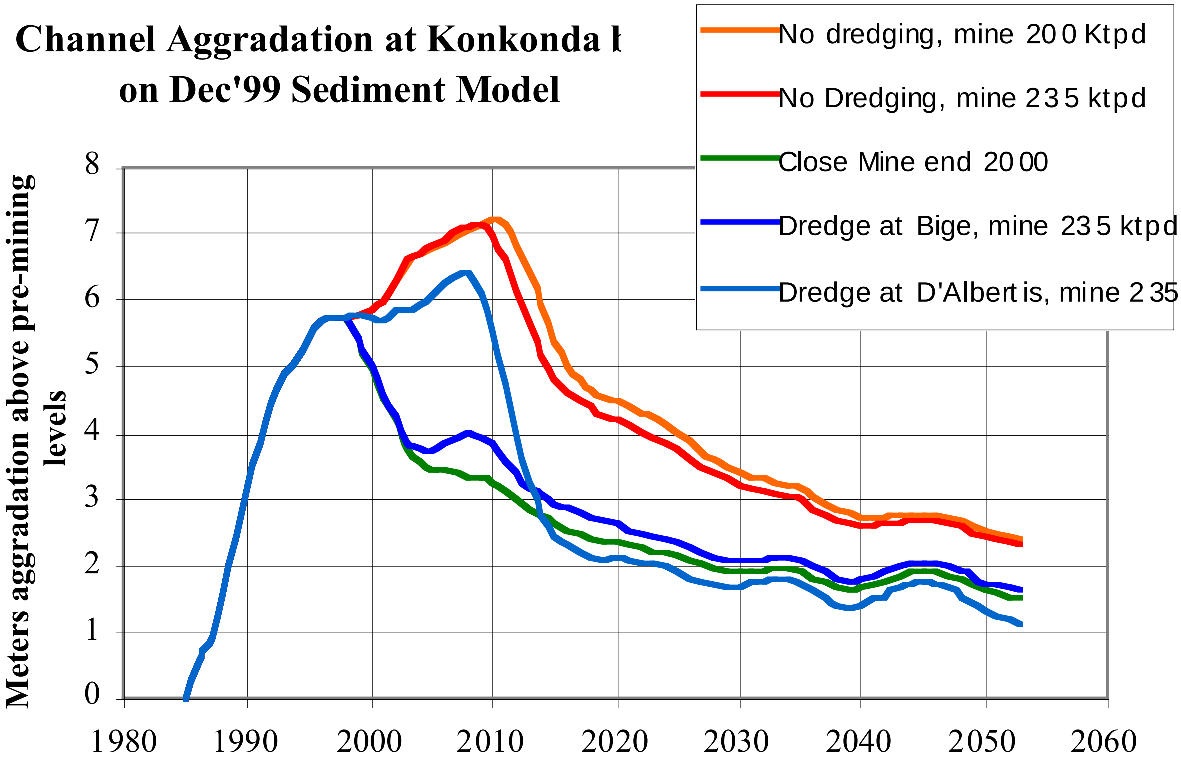


Figure 9. Updated Model Results for Konkonda

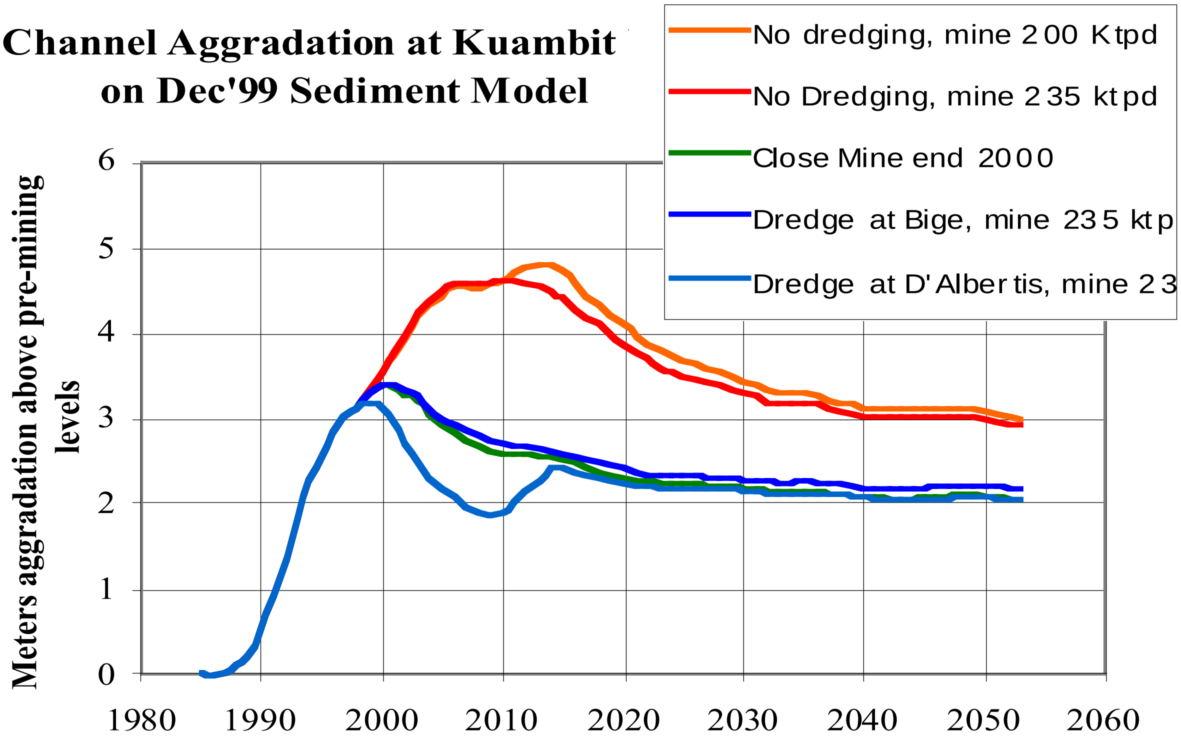


Figure 10. Updated Model Results for Kuambit

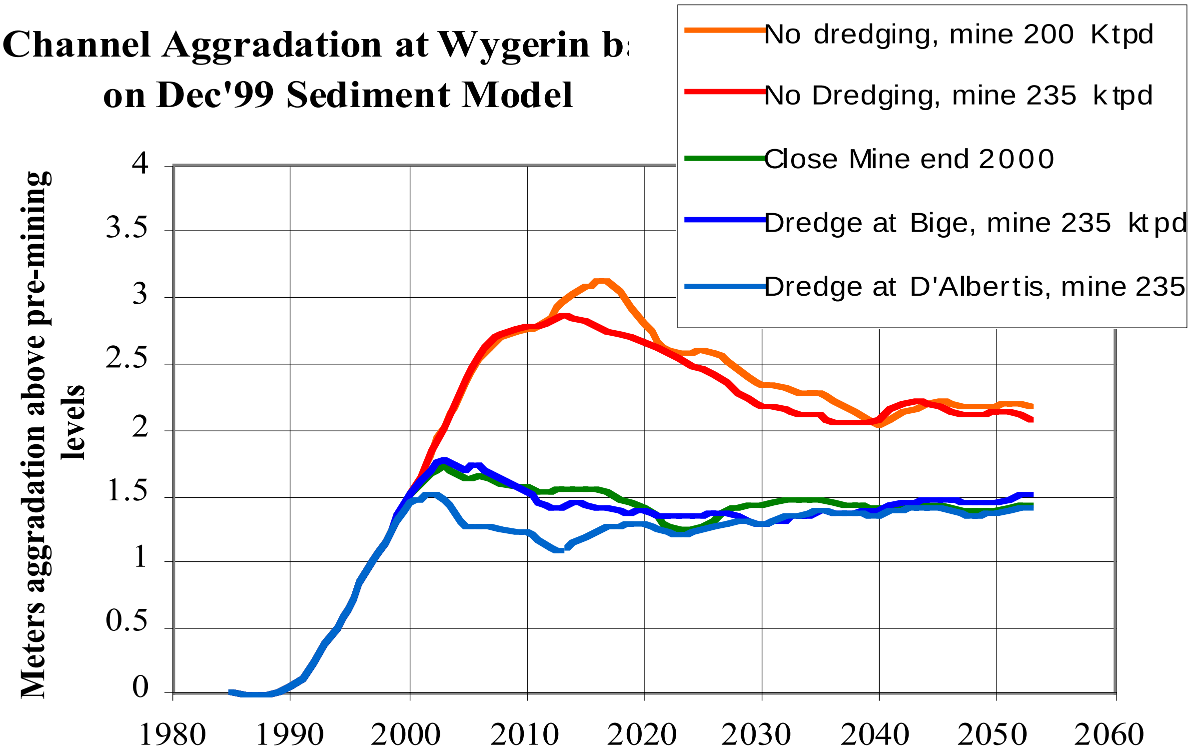


Figure 11. Updated Results for Wygerin

The results showed that the dredge is as effective as early mine closure in terms of bed aggradation. This differed from previous results where dredging was shown to midway between the 'no dredging' and the 'early closure' options (see Figure 12 for Wygerin). Further, as dredging rates of up to 25 Mt/a can now be attained, the results are insensitive to sand inputs - at least up to 28 Mt/a. The results also showed that reducing the mining rate and extending the mining life by three years had little effect in reducing aggradation, indeed the results showed a delayed recovery equal to the extended mine life. The results for the option of relocating of dredge to D'Albertis showed that there is benefit (greater reduction in aggradation) in the Middle Fly. However this was at the expense of increased aggradation in the Lower Ok Tedi, i.e. relocation of the dredge to D'Albertis results in better scouring in the upper Middle Fly than early mine closure, and worse than mine closure in the Lower Ok Tedi. It should be noted that the benefit is limited to the upper reaches of the upper Middle Fly and decreases downstream.

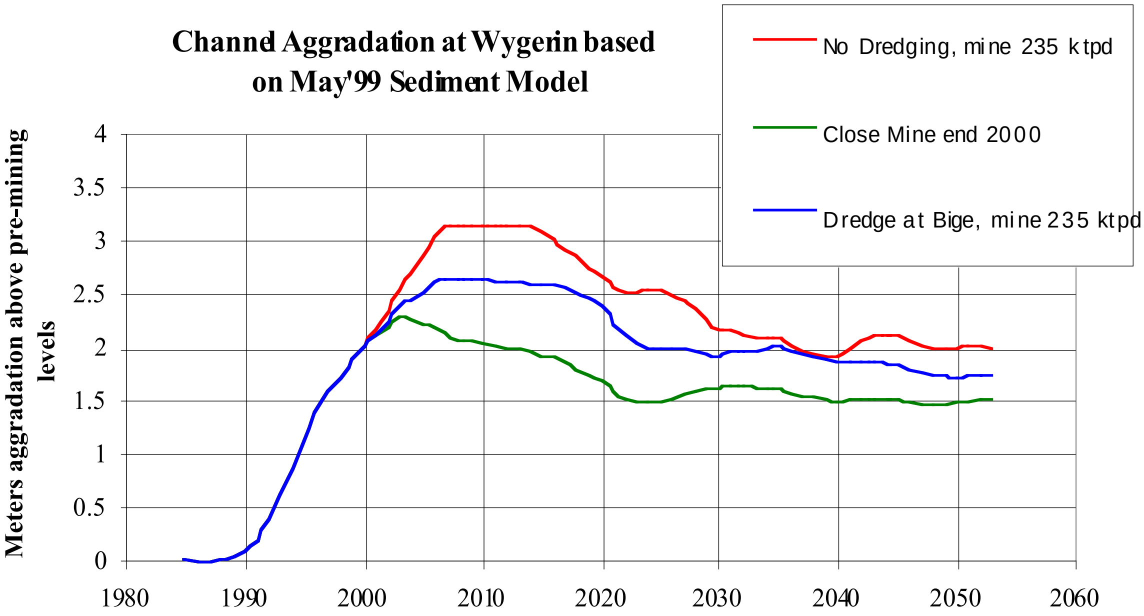


Figure 12. May '99 results for Wygerin

11.2 Dieback Extent and Predictions

Discussion followed on the issue of dieback spread, and if the updated results had any impact on previous estimates and benefits. Don Carroll stated that the updated results still showed a 10% reduction achieved through dredging, and secondly the modeled pessimistic mine impacted area based on sediment model aggradation predictions remained at 1350 sq. km. It should be noted that as the sediment model predicted little aggradation below Mabaduan, the dieback model did not predict mine impacted dieback below Mabaduan. Recent rivers surveys have clearly shown that significant aggradation can occur below Mabaduan. Further dieback has already occurred (particularly close to the scroll bar complexes) below Mabaduan. The extent to which the El Nino/ La Nino climatic phenomenon has contributed to this is not clear. Andrew Marshall reported that the extent of this dieback has not been report or been quantified to date.

Concern was expressed that the spread of dieback could eventually be greater than the 1350 sq. km estimate ie. if it spread substantially from Mabaduan through to the lower Middle Fly. There was also some discussion on the recovery mechanisms employed in the model, and how this sat with the 'recovery' observed close to the Dredge site. Don Carroll stated that the model does not account for secondary under-story re-growth, however, the model does take into account the re-establishment that can take up to 20 years to achieve. It was agreed that an estimate of the current extent of dieback including the lower Middle Fly must be undertaken, and the sediment model updated to allow deposition in the lower Middle Fly. Once this has been done, an updated upper limit for the mine impacted dieback area should be produced.

12.0 MINE WASTE RISK ASSESSMENT

Ken Voigt advised that the risk assessment process is quantitative and not qualitative. Any new information relating to the probability of a risk event occurring, the likely consequence, possible mitigating action and uncertainty will have to be assessed, described and quantified.

The results of recent investigative work conducted since the last combined risk assessment workshop will require that the overall risk assessment model be reviewed. Specifically the following risk issues will need reconsideration:

- Navigation in the upper Middle Fly
- Sedimentation and tie channels
- ARD/ Bioavailable Cu

An additional option ie relocating the dredge to D'Albertis Junction will also have to be considered.

The navigational issue is the most likely issue to have impact on the results of the overall risk assessment. Further work carried out involved a detailed simulation exercise using empirical river level data in the years after the severe El Nino of 1982 as a surrogate for the years following the 1997/98 El Nino event until mine closure in 2010. This work showed that navigational benefits for the two dredging options (Bige/D'Albertis Jct) were similar and much improved, however, for the 'no-dredge' option there will be significant disruptions to mining operations if appropriate mitigating action is not carried out or is not successful. As a consequence, the 'no-dredging' option will now have much higher navigational risks compared to the dredging options.

Ken concluded that it was not possible at this stage to determine what the effects will be for the risk assessment of the various mine waste management mitigation options. However, the OTML risk assessment consultants will be on site the week beginning the 6th March. They will be briefed on the new results and will identify any further work required to update the risk assessment model. A small workshop may follow to establish and agree on the quantities to be updated in the model.

13.0 SEDIMENT BUDGET

A sediment budget was prepared for the years 1985 to 1999 inclusive. The budget will be used as a guide for future modeling work, and assist in better understanding the depositional characteristics of the Ok Tedi and Fly River system. The prepared budget is shown in Figure 13.

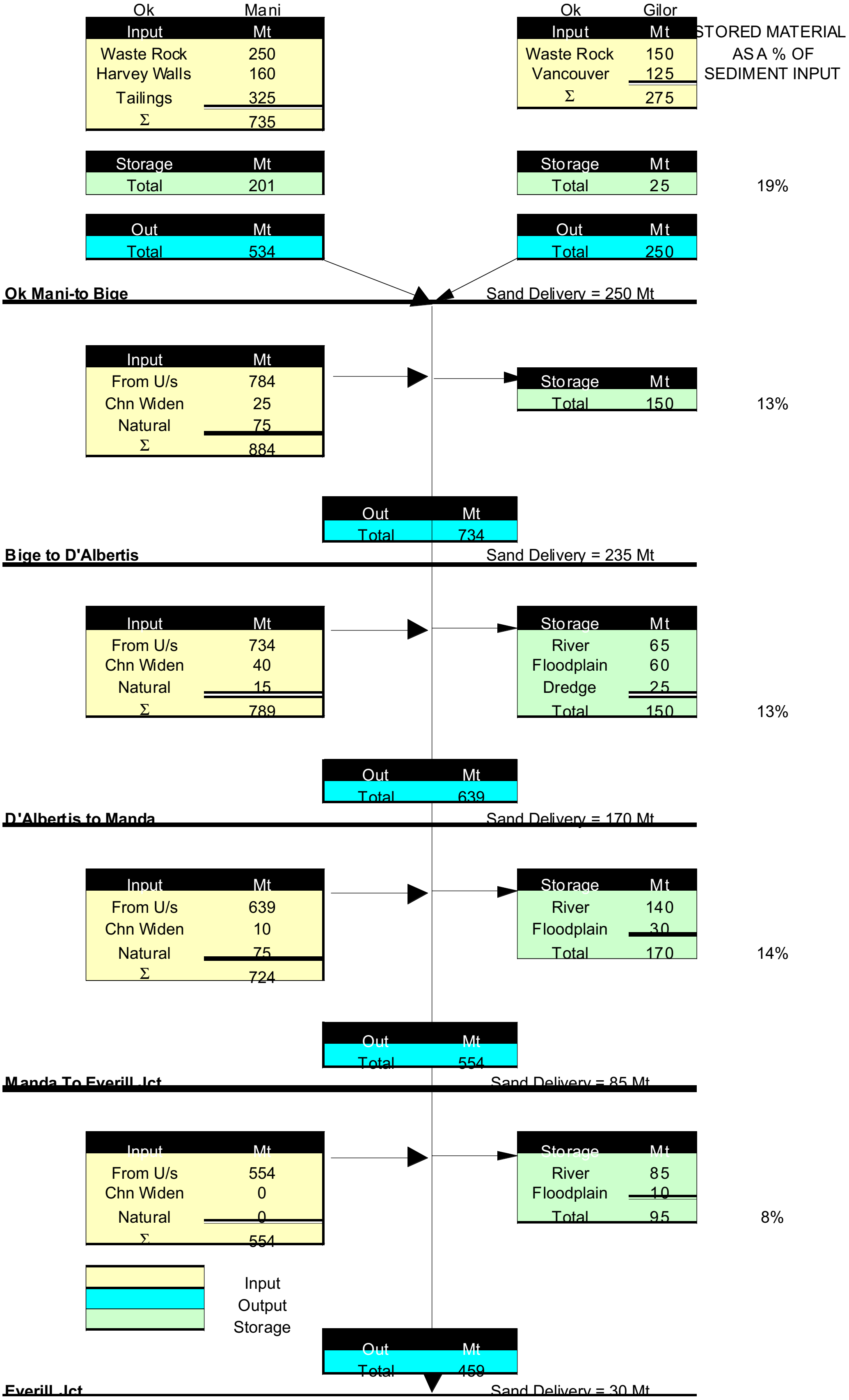
14.0 FUTURE WORK

14.1 Investigations

After much discussion the following investigations were identified:

1. Quantify floodplain deposition (using transects) and include Cu/Fe/S measurements. The network designed by G Day should be considered
2. Quantify the volumes/areas of exposed sand/gravel bars in the Ok Tedi
3. Develop better understanding of the Strickland/Fly Hydrology and Hydraulics
4. Map dieback areas to Obo
5. Conduct pre/post surveys of tie channels (Bai Lagoon)
6. Extend the river cross-section survey to well below Ogwa
7. Undertake an analysis of current floodplain flooding (in comparison to previous years to determine if current flooding levels are abnormal)
8. Develop a hypothesis to explain the sedimentation in the Lower Middle Fly and modify existing model accordingly.
9. Update the dieback model after the sediment model update.

Sediment Budget from 1985 to 1999 for the Ok Tedi/Fly river systems to Everill Jct, estimted at Sediment Workshop, Tabubil 21-23 Feb 2000



Ok Mani

Input	Mt
Waste Rock	250
Harvey Walls	160
Tailings	325
Σ	735

Storage	Mt
Total	201

Out	Mt
Total	534

Ok Gilor

Input	Mt
Waste Rock	150
Vancouver	125
Σ	275

Storage	Mt
Total	25

Out	Mt
Total	250

STORED MATERIAL AS A % OF SEDIMENT INPUT

19%

Ok Mani-to Bige

Sand Delivery = 250 Mt

Input	Mt
From U/s	784
Chn Widen	25
Natural	75
Σ	884

Storage	Mt
Total	150

13%

Out	Mt
Total	734

Bige to D'Albertis

Sand Delivery = 235 Mt

Input	Mt
From U/s	734
Chn Widen	40
Natural	15
Σ	789

Storage	Mt
River	65
Floodplain	60
Dredge	25
Total	150

13%

Out	Mt
Total	639

D'Albertis to Manda

Sand Delivery = 170 Mt

Input	Mt
From U/s	639
Chn Widen	10
Natural	75
Σ	724

Storage	Mt
River	140
Floodplain	30
Total	170

14%

Out	Mt
Total	554

Manda To Everill Jct

Sand Delivery = 85 Mt

Input	Mt
From U/s	554
Chn Widen	0
Natural	0
Σ	554

Storage	Mt
River	85
Floodplain	10
Total	95

8%

🟨	Input
🟦	Output
🟩	Storage

Out	Mt
Total	459

Everill Jct

Sand Delivery = 30 Mt