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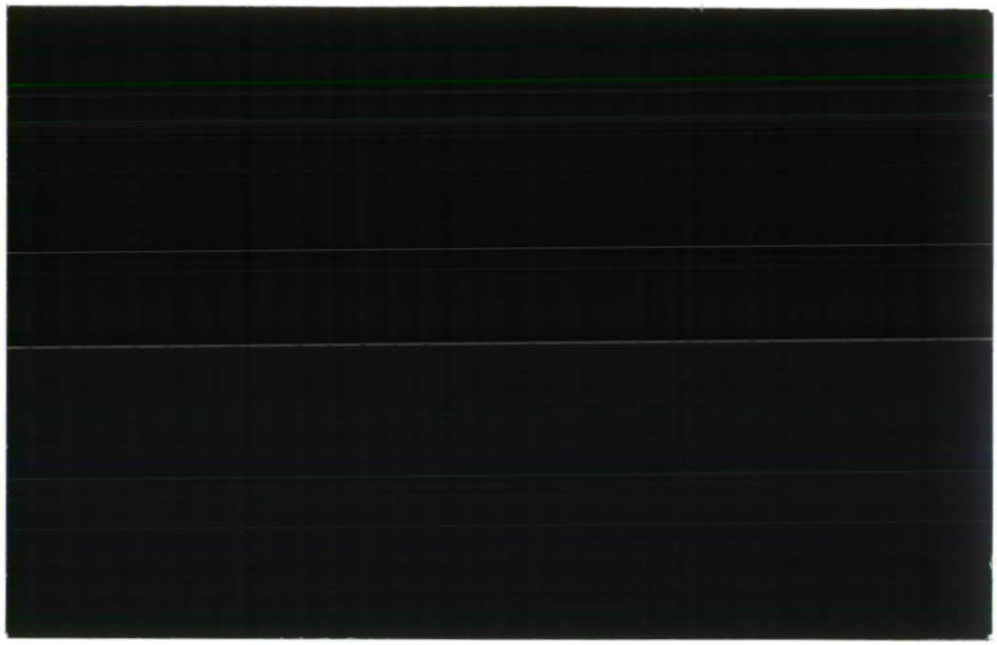

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RIVER BASIN MANAGEMENT PROJECT

CHILE

Report on a an advisory visit
during the period
10 September to 2 October
1994

by

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CONTENTS

1. INTRODUCTION

The Water Resources Systems Research Unit (WRSRU) of the University of Newcastle has a contract with the ODA for consultancy services for the River Basin Management Project: Chile. The main objective of the Project is to provide the National Forestry Corporation of Chile (CONAF) with a modelling system which can simulate the impact of changing land management on the hydrology of river basins. An additional part of the Project involves the provision of guidance and assistance to the University of La Serena (ULAS) in their development of a gully formation model which is to be added to the main SHETRAN modelling system.

Under this Project WRSRU has placed a subcontract with the Institute of Hydrology (IH) to advise on the choice of focus basins to be used during the training and familiarisation period, to advise on appropriate methodologies and instrumentation to be used in collecting data from these basins and to provide some training in the use of advanced data collection methodologies.

The IH subcontract calls for the following staff time inputs:

Year 1	J. R. Blackie	22 days in Chile	8 days in UK
	G. J. L. Leeks	22 days in Chile	8 days in UK
Year 2	J. R. Blackie	8 days in Chile	3 days in UK
	G. Roberts	8 days in Chile	3 days in UK
Year 3	J.R. Blackie	8 days in Chile	3 days in UK
	G.J.L. Leeks	8 days in Chile	3 days in UK

The Project started officially on 1 July 1994 and will run till 30 June 1997.

This report covers the first visit to Chile by J. R. Blackie in company with J. Bathurst of WRSRU. It is intended to supplement the Report to be prepared by J Bathurst as the Representative of the main Contractor.

2. OBJECTIVES

The objectives of the visit to Chile made in company with Dr James Bathurst of Newcastle University from 10 September to 2 October 1992 were:

1. To make contact with the Chilean counterpart management in the Project

2. To establish a detailed timetable for the various aspects of the Project

3. To assist in the selection of CONAF staff to be trained in the use of SHETRAN

4. To advise on the selection of catchments to be used as the focus basins in the SHETRAN training programme

5. To identify the instrumentation requirements for these focus basins

6. To identify, within University Departments and elsewhere, sources of local expertise which can be called on to assist in the focus basin field operations

7. To discuss the proposed development of a Gully Model addition for the SHETRAN model suite by the University of La Serena

8. To identify the fieldwork requirements for the La Serena programme and evaluate possible sites for the work

9. To advise on the instrumentation requirements for these field sites

10. To produce some guidance notes for the field operations and advise, on the basis of an evaluation of the expertise currently available in Chile, on the training requirements for this aspect of the work

3. PROGRAMME

Because James Bathurst (JB) and James Blackie (JRB) and the CONAF Project Manager, Wilfredo Alfaro (WA) all had to be involved jointly in a number of the above objectives it was not practical to operate in parallel for the first two weeks of the visit, i.e. for the duration of Bathurst's stay in Chile. A number of items in which JB's involvement was less essential were deferred to be undertaken by JRB during the third week. Whilst this meant some loss of productive time for JRB in his specific objectives, it had the advantage of all parties being fully aware of all aspects of the programme as it evolved. Summary schedules of the programme undertaken in weeks 1 and 2, when JB was present, and by JRB in week 3 are presented overleaf.

Programme for weeks 1 and 2

Date	Activity
10/9/94	Depart UK
11/9/94	Arrive Santiago
12/9/94	Meetings at CONAF HQ
	Meeting at British Council
	Meetings at CONAF
13/9/94	Meetings at CONAF
	Mini-Workshop at CONAF
14/9/94	Meetings at CONAF (am)
	Field trip to Alto Loyca (pm)
15/9/94	Field trip to Quebrada de Ramon catchment (am)
	Flight to La Serena
	Meeting at University with Ruben Salgado and Edmundo Gonzalez
16/9/94	Meetings at University
17/9/94	Free morning
	Working lunch with Ruben Salgado
18/9/94	Return to Santiago
19/9/94	Flight to Valdivia (National Holiday)
	Planning meeting with Andres Iroume
20/9/94	Meeting at CONAF Region X Office
	Meeting at University Forestry Science Faculty
	Field trip to Faculty catchment and experimental sites
	Field trip to four Forestry Institute catchments
	Scheduled return flight to Santiago aborted (weather)
21/9/94	To Puerto Montt by bus
	Afternoon flight to Santiago
	Drive to Talca in evening with WA and Edmundo Gonzalez
22/9/94	Meeting in CONAF Region VII Office
	Field trip to micro-catchments in Andes foothills
	Drive to Chillan
	Meeting at University with Luis Salgado and Eduardo Holzapfel
	Drive to Concepcion in evening
23/9/94	Meeting in CONAF Region VIII Office
	Field trip to Capihue catchments, then to Chosme active gully area
	Meeting in Concepcion with EULA Group from University
	Evening flight to Santiago
24/9/94	Project review meetings;
	La Serena component with Ruben Salgado and Edmundo Gonzalez (am)
	CONAF component plus overall review with above plus Wilfredo Alfaro (pm)
25/9/94	J. Bathurst returns to UK

Programme for week 3

Date	Activity
26/9/94	Planning meeting at CONAF with WA
	Meeting at British Council
	At CONAF arranging meetings and travel plans
	JRB and EG depart to Chillan by bus at 1630, arrive 2245
27/9/94	Meeting on Chillan campus with Luis Salgado
	Field trip to Quinchamali area
	Lunch in Chillan
	Field trip to Ninhue/Qhirihue area
	Message that proposed onward trip to Concepcion and then to Contulmo area on 28/9 would have to be cancelled
	Return to Santiago by bus, arriving 2345
28/9/94	Work in CONAF office
	Brief meeting with FAO Forestry Rep. in Chile
	Meeting with CONAF Director of International Relations
	Meeting with WA
29/9/94	Meeting with INGENDESA (Rio Maule catchments)
	Visit to Met. Office
	Work in CONAF Office
30/9/94	Meeting at British Council
	Meeting with Schwarz at Kuehne and Nagel
	Work in CONAF Office
	Meeting with WA
1/10/94	Free morning
	Phone discussion with Ruben Salgado
	Final meeting with WA
2/10/94	Flew back to UK, arriving 10.00 on 3/10/94

4. REPORT

4.1 Weeks 1 and 2.

The main report on activities during the first two weeks is being produced by JB. The following notes on aspects of the activities during this period are submitted as aide memoirs rather than as a comprehensive report.

The initial discussions on the visit programme took place on the morning of Monday, 12 September in CONAF Offices in Santiago. The basic agenda items were agreed at this meeting. This was followed by a meeting at British Council where aspects of the Project were clarified and questions raised about the detail of the formal involvement of BC. A representative of the Council was invited to attend the mini-workshop proposed for the afternoon of Tuesday, 13 September. Aspects in which BC can contribute were identified as;

Organisation of intensive English courses, if required
Organisation of workshop to be held in 1995
Assistance in setting up travel arrangements

Following this visit to BC work resumed on the agenda and the timetable for the first two weeks of the visit, interspersed with meetings with CONAF staff and briefings on the range of activities undertaken by CONAF

A mini-workshop was held on Tuesday 13 September. JB outlined SHETRAN, the Project and its potential value to CONAF to an audience consisting of relevant CONAF staff and representatives from the Universities involved in the Project.

On Wednesday 14 September the timetable of field trips was finalised and the selection process for the CONAF staff to be trained in the use of SHETRAN was completed.

This was followed by a field trip to the Alto Loyca area of the Coast Range South of the Maupo river in the Metropolitan Region. There we viewed the results of some early CONAF work on soil conservation, including gully stabilisation, on the highly erodible granitic soils which have been subject to peasant agriculture. In one small catchment these measures had been supplemented by the building of a small earth dam, the water from which is used to irrigate highly productive small plots of strawberries. The return from this high value crop comfortably exceeds that from the previous low yield wheat cultivation and is said to have covered the cost of the dam in a few years.

Also in this area is a large scale community project , run jointly by CONAF and JICA, the Japanese aid agency, in which an integrated range of soil and water conservation and socio-economic measures are being tested and demonstrated. A micro-catchment (approx. 25 ha) within this area is being instrumented with a V-notch and a recording raingauge. Since the conservation measures and the instrumentation are being installed simultaneously it is difficult to see what they

intend to monitor. The site is not suitable as a focus catchment for the CONAF SHETRAN training programme, nor are the few remaining untreated gullies in the area sufficiently active to be appropriate for the La Serena gully study.

On Thursday 15 September the day started with a field trip to view the Quebrada de Ramon, a 30 km^2 mountain catchment on the Eastern fringes of Santiago which regularly produces floods which cause damage in the city. The problem of floods from the Andean foothills catchments affecting urban areas is of great concern to CONAF and they hope that SHETRAN will be a useful tool in evaluating possible control measures once they have mastered it. There is strong pressure therefore to identify and use a catchment in this area as one of the focus catchments for the training programme.

The Quebrada de Ramon is the most accessible of these catchments. It is exploited as a source of water supply by a private company and there is an access road as far as the main river off-take works. This off-take suffered major damage last year through a combination of mud slides and a major flood. These mud slides also wiped out the access track beyond the off-take. Regrettably this has made the concept of instrumenting a sub-catchment in the upper basin impractical as the very steep unstable slopes make it difficult merely to walk in and therefore impossible to transport in the concrete, etc. that would be necessary to instal a flow gauging structure.

The use of the entire catchment as a focus basin is a possible alternative and this was discussed at some length. It would require, at the very least, the construction of a stabilised section immediately upstream of the water supply off-take where there is a suitable rock bar. No accurate records of abstraction are kept by the company, even when the off-take is fully functional, and the stabilised rated section downstream of the off-take (for monitoring compensation flows) was destroyed in last year's events. This would be a major engineering exercise which could not be designed and installed before the onset of the winter rains in March 1994, even if the water company were to agree to the proposal. It would also be a high risk exercise since there are still very large quantities of loose material in the streambed upstream of the site from last year's mud slides. Obtaining precipitation and meteorological data representative of the entire basin, altitude range 800-3500 m with semi-permanent snow cover above 2500 m, would also pose difficult problems as would characterising the soils.
In short the difficulty and time scale involved in obtaining usable data suggests that Ramon is not a suitable catchment for use during the two year training period.

On a broader front the visit to this catchment raised questions on the relevance of SHETRAN applications to this type of land use problem. The present semi-natural scrub forest and grass cover on the very steep unstable lower slopes, giving way to bare rock and snow cover at the higher levels, is unlikely to be improved on as a protective cover unless major soil conservation engineering measures are first applied. Such measures can not be simulated by SHETRAN in its present form, nor can the landslides to which the catchment is prone, although a landslide component is currently under development at Newcastle.

Following the visit to the Ramon catchment JB and JRB flew to La Serena in the evening for discussions with Ruben Salgado on the component of the programme to be undertaken under his supervision. These discussions, on the methods of developing a gully erosion model component to add to the SHETRAN model structure and on the fieldwork requirements for this work, continued through Friday 16 September and parts of Saturday, 17 September.

JB and JRB then returned to Santiago on Sunday 18 September and flew South to Valdivia in Region X on Monday 19 September (Chile's National day, a public holiday). At a brief meeting in the evening with Andres Iroume from the Universidad Austral de Chile, Valdivia, a programme for Tuesday 19 September was mapped out. This included visits to the relevant university departments, to the CONAF region X offices and then a series of field visits to sites of potential interest for the CONAF focus basin programme.

The morning programme of field visits, when we were accompanied by Andres Iroume and Anton Huber from the University and Hector Adriazola from CONAF, included a small catchment (93.2 ha) under indigenous forest (27%), pinus radiata plantation (33%) and grassland (40%) which Iroume has been monitoring for 10 years. Instrumentation on the catchment consists of a rectangular sharp crested weir, a chart water level recorder (made in-house by A. Huber) and further up the catchment a Lambrecht recording rain gauge. Unfortunately no regular monitoring of the meteorological variables has been undertaken. Soil moisture is not monitored within the catchment but a large body of soils and soil moisture information has been acquired in the course of Anton Huber's long term plot interception studies on a nearby site.

These interception studies, by far the most impressive fieldwork seen anywhere in Chile, will provide useful information for the application of SHETRAN to studies of pinus radiata and eucalyptus globulus plantations in Chile. Identical instrumentation to monitor rainfall, throughfall, stemflow and soil moisture has been installed in plots covering a range of ages and spacings of p. radiata. The data yield estimates of interception loss rates and transpiration rates. Rainfall and soil moisture studies in an adjacent site provide water use rates for grass. Within the last year a 1 year old plot of eucalyptus globulus has also been instrumented and its interception and transpiration rates will be monitored as it grows. As far as could be ascertained his is the only neutron soil moisture probe in operation in Chile.

In the afternoon we were joined by Luis Otero and Alvaro Contreras from the Forestry Institute who took the group to inspect a group of four small adjacent catchments, each in the range 100-150 ha, which appear to offer good prospects for selecting one or two of the required focus basins. Two are under p. radiata, one 12 years old and one 16 years old, and the remaining two are under native forest, primarily nothofagus spp. The soils are deep and stone free, volcanic in origin. Access on foot is possible at all times and by vehicle during the summer months. The local farmer over whose land access is achieved is already involved in cooperation on other activities with the forestry group. Access tracks and occasional small clearings within the catchments offer sites for raingauges and an automatic weather

station. No instrumentation has yet been installed but a section of the streambed at the outfall of one of the catchments was temporarily stabilised a year ago and regular gauging of this section has given a reasonable indication of the probable range of flows. Future management plans for these four catchments have yet to be finalised. Because of signs of an incipient disease problem it is possible that the 16 year old catchment may be felled early , i.e. at 17 or 18 year old rather than the 25-26 year old normal in this area. Mention was made of a further catchment close by which was within a year of felling but time did not permit inspection of this catchment.

The interest and enthusiasm of this group in Region X suggests that focus basins sited in this area would stand a reasonable chance of producing good quality data quickly. Their lack of access to and experience of modern instrumentation and logging equipment is not a major problem, given the field competence and instrumental ability demonstrated in the instrumentation they have either made or adapted for the present studies.

Bad weather resulted in the cancellation of all flights from Valdivia on the evening of 20/9/94 and effectively cost a day as JB and JRB had to re-position to Puerto Montt on the morning of 21/9/94 to catch an afternoon flight from there to Santiago. By doing the 6 hour drive to Talca that evening some of the lost time was recovered. The party on this extended field trip comprised JB, JRB, WA and Edmundo Gonzalez from La Serena.

After meetings in the CONAF Region VII office there was a field visit to a study using 3 micro-catchments (approx. 15 ha) to compare the responses of indigenous forest, clearing, burning and planting, and line clearing and planting. This study is unlikely to yield good quality hydrological data. The gauging structures (pre-formed mini-H flumes) are by-passed by a high proportion of the flow and have no recorders on them. The uncertainty in defining the catchment boundaries would make the value of any flow measurements dubious in any case.

Interesting though this study may be in terms of erosion and growth rates it does not meet the requirements for focus basins for the Project.

Thereafter followed a drive to Chillan and an interesting discussion with Luis Salgado and Eduardo Holtzapfel of the Agricultural Engineering Faculty of the University of Concepcion which is based on the Chillan campus. Salgado said that he was about to initiate work on a catchment in the Coast Range which might provide possible sites for the La Serena gully study. It was agreed that JRB plus Edmundo Gonzalez should pay a return visit to view this catchment in week 3.

On 23/9/94 after a meeting in the CONAF Region VIII Office in Concepcion there was a field trip to the Capihue catchment in the Florida area to see the extensive work done on gully stabilisation in this badly eroded area. The gullies in the area are large and complex and it was concluded that they were not appropriate for the field work associated with the La Serena component of the project. A second site, in the Chosme area, presented much better prospects. The very active gullies there were smaller and less complex in their development. Access to the site was good and prospects for

security of equipment were reasonable, given the active steps being taken by CONAF to involve the local farmers in the planning and establishment of a forest park in the area.

At a meeting at the CONAF Concepcion office later in the day Francisco Godoy from the EULA group within the University suggested that two of the catchments formerly included in the Bio Bio Project might be of interest as possible focus basins. Further discussion revealed however that they were both in the range 70-80 km^2 in area, that the back data comprised short records from one or two raingauges and that the flow records consisted of a few sporadic observations of water level on unstabilised sections at the outfalls.There appear to be no firm plans for future use of these catchments. They have little appeal as focus basins because of their size, the absence of any real data or information and the time and cost that would be involved in surveying and instrumenting them.

Saturday, 24/9/94 was devoted to review meetings, with Ruben Salgado and Edmundo Gonzalez on the La Serena component of the Project in the morning and early afternoon and on the CONAF component and the Project as a whole after Wilfredo Alfaro joined us at 1600. A provisional programme for JRB for week 3 was also mapped out.

J. Bathurst returned to UK on 25/9/94.

4.2 Week 3

Monday, 26/9/94 started with a discussion of the programme for the week and a review of the positions reached with regard to the options for the focus basins. WA accepted that the practical difficulties made it unrealistic to pursue the concept of using the Quebrada de Ramon as a focus basin. Since no other suitable basins can be identified this appeared to preclude the theme of urban flooding from the training programme. An alternative theme would be forestry management effects on the unstable granitic soils of the Coast Range to supplement the forestry work on the volcanic soils of the Andean foothills to be covered by the basins provisionally identified in Region X. WA indicated that suitable catchments may be present in the Contulmo area of Region VIII, some 150 km south along the coast from Concepcion. He agreed to discuss with CONAF Region VIII Office the possibility of a visit to this area by JRB on 28/9/94. Other points covered in this session were the fact that there is no formal agreement in the Project Document concerning duty free importation of equipment, and the realisation by CONAF that SHETRAN can not simulate 'engineering' soil conservation measures.

After various phone calls a meeting was arranged at British Council with Claire McVeigh and David Cordingley, from the Development and Training Services Group of BC in Manchester, who was in Chile for a few days on a training mission aimed at improving project management in the country offices.

The point was raised that there was no mention of the involvement of British Council in the Project Document. This point must be clarified with ODA. The discussion then

covered those aspects of the Project where BC could make a useful input..if requested These were identified as:

(a) Carrying out standard English tests on the trainees to assess their needs for further language training before coming to UK. There would be no charge for this, or for organising the attendance of the trainees at any courses deemed necessary, but the actual course costs would have to be met from Project funds.

(b) BC is willing to take on the organisation of the travel arrangements of the trainees, including the UK component of their journey, and to organise and administer the payment of their 'stipends' whilst in UK.

If it is the wish of ODA and Newcastle for BC to undertake these aspects then there must be a formal agreement between the parties. BC has funds to cover this type of work so there would be no additional cost to the Project.

After initiating arrangements to visit INGENDESA and the Met. Office on 29/9/94 and mapping out a provisional programme for a visit to the Contulmo area in Region VIII south of Concepcion on 28/9/94 JRB and Edmundo Gonzalez (EG) left for Chillan by bus.

Tuesday 27/9/94 began with a meeting with Luis Salgado and his PG student Jose Luis Arumi in the faculty of agricultural engineering on the Chillan campus of the University of Concepcion. Salgado then took JRB and EG to inspect possible sites for the gully model field work.

The first area visited, near Quinchamali some 25 km south-west of Chillan, contained many very active gullies, perhaps not quite as large as those at Chosme. Being immediately adjacent to a main road means that access is not a problem, but security might be. The surrounding area is heavily grazed with some cultivation. No previous contact has been made with the farmers in the area. The size of the gullies, the ease of access and the proximity to the Chillan campus make this an attractive proposition for the gully study but the gullies are technically less interesting than those at the Chosme site and the questions of access and security may prove to be more difficult here.

The first area visited in the afternoon, near Ninhue, was interesting but irrelevant to the gully study. It comprised of a large cattle farm with a linked series of small dams in the main catchment. Salgado and Arumi have been negotiating with the farmer to carry out a study on this catchment, their main interest being in the design and operation of the storage dams. The suggestion that their might be some active gully areas on his property generated considerable indignation from this competent and progressive farmer!

The second area, between Ninhue and Quirihue some 60 km from Chillan, contained many large, steep, spectacularly active gullies but these were across a very active river from the road and the only bridges in the areas were rather fragile footbridges.

Access, to install structures and instrumentation and to monitor the sites during the rains, would present considerable difficulties.

On returning to Chillan a phone call to WA revealed insuperable difficulties concerning JRB's proposed visit to the Contulmo area on 28/9/94. JRB and EG therefore returned to Santiago by bus.

Much of 28/9/94 was taken up with confirming times of visits on 29/9 and 30/9 and meetings with Patricio Sanhuez, Head of Fire Control in CONAF, Kyran Thelen, the FAO Forestry representative in Chile and Mario Alvarado, the Director of International Relations in CONAF. The latter had not been previously briefed on the Project and interrogated both WA and JRB in some detail.

Thereafter JRB and WA had an extended discussion on a range of aspects of the Project during which the lack of staff within CONAF with hydrological research experience, both in field activities such as catchment selection, instrumentation and monitoring and in modelling, other than applications of the USLE, was emphasised. The Catchment Management Group within CONAF is essentially a group of soil conservation engineers, highly skilled in adapting and developing soil conservation techniques to the conditions in and demands of the CONAF controlled areas of Chile, but not experienced in hydrological research.

The discussion also confirmed the impression gained from the field trips that hydrological monitoring, either for research or operational purposes, is not rated as a high priority activity in Chile. Even in the most active group encountered, that centred on the Austral University in Valdivia, instrumentation has yet to move beyond the chart recorder era and data bases are still largely of the hard copy variety.

In these circumstances it becomes even more essential that the programme for the CONAF trainees should be modified to include some basic catchment hydrology and some hands-on experience of modern instrumentation and monitoring techniques. Following this discussion JRB wrote a series of short notes on catchment selection, organisation of monitoring and the data requirements for the initiation of SHETRAN applications and for evaluation of SHETRAN outputs. Copies of these have been sent to WRSRU, Newcastle.

Thursday, 29/9/94, started with a meeting at INGENDESA. Francisco Verni, a senior engineer, described in some detail the catchments of the upper Rio Maule. Most of these large catchments are incorporated in a complex hydro generating scheme. Two catchments are unaffected by tunnels, dams or diversion channels. These are the Colorado and the Claro. Both of these are very large, 188 km^2 and 355 km^2 respectively, with altitude ranges extending from under 1000 m to well over 2000 m. Both have rated sections at their outfalls. That on the Colorado has been operational since 1964 and is checked regularly. The Claro rated section is said to be very unstable. Inputs to the catchments are said to be predominantly in winter snow. Apart from a rain gauge near the outfall on the Claro no input measurements are made. Sediment loads in both are said to be very high with a large component coming from 'geological' erosion. Vegetation is both is scrub forest and sparse grass giving way

to bare rock and snow at the higher altitudes. Verni produced diagrams of the catchments and listings of the instrumentation which have been passed on to WRSRU, Newcastle.

These are not ideal catchments for use in training on the application of SHETRAN!

The next meeting was at the Met. Office with Myrna Araneda Fuentes and her colleagues in the Climatology Dept. They maintain a very sparse network of manually read stations classed as types 1, 2 and 3. The basic type 1 has a raingauge, a temperature screen and may have a soil thermometer at 5 cm depth. Type 2 has in addition a recording raingauge and wind run. Type 3, of which there are very few and certainly none near any of the sites of potential interest as focus basins, also has class A pan, sunshine recorder, wind speed and direction and records of cloud cover. Most of the latter are at the larger airports. There appears to be no regular interchange of data with other monitoring organisations such as the Ministry of Public Works or the Agriculture Dept. Data storage is still hard copy only but they have plans to computerise. As far as they know, no one has done any Penman computation from their records or attempted to produce evaporation maps from the few class A pan records. A map showing isohyets and estimates of evaporation, referred to by Ruben Salgado, is said to be a product of Ministry of Public works based on their own sites only.

Friday, 30 September began with a meeting at British Council with Claire McVeigh. Points raised specifically related to

- The need to clarify the Project agreement on the dutiable status of equipment to be imported.
- The need to formalise the British Council involvement in the Project.
- Decisions on whether trainees should be tested for English competency and training.
- The need for training in field operations.

There was some discussion of the timing of next year's Workshop and the extent to which British Council should be involved in its organisation. This discussion must be taken further between Newcastle, CONAF and BC. WA expressed the view that the Workshop should not take place earlier than August 1995.

WA and JRB then visited Kuehne and Nagel, the Chilean agents for Balfour Williamson, and discussed the Project requirements with Walter Schwarz the general manager. He required some detailed briefing on the background and objectives of the Project and on the specific role of Balfour Williamson.

Thereafter the discussion threw up the following points:

(a) It is essential that agreement is reached between ODA and the Chilean government on the dutiable status of the equipment to be supplied.

(b) Even then it will be necessary to have a British Representative on the ground who can argue the toss with the Chilean Customs. Presumably this should be Cristina Vejar from BC?

(c) There has to be a clear statement on all documentation identifying the importer. Should this be CONAF, BC, or Kuehne and Nagel?

(d) If goods are not cleared to come in duty free the charges are Import Duty at 11% and Vat at 18%.

(e) Each item shipped must have a detailed description for submission to Customs. In general it takes four weeks from submission of this detailed description and the "duty free" documentation to obtain final tax exemption and release of the goods.

The rest of 30/9/94 and most of the final discussion session with WA on the evening of 1/10/94 were devoted to working through and expanding on the guidance notes on catchment selection, organisation of monitoring and the data requirements for the initiation of SHETRAN applications and for evaluation of SHETRAN outputs.

In the course of this it became apparent that CONAF had still to decide how they could most efficiently utilise the expertise to be gained from the Project. JRB suggested the initiation of a new specialist group within CONAF, an Applied Modelling Group. In addition to using SHETRAN to assess the effects of various land use strategies in problem areas throughout Chile, the Group could be expanded to include those with expertise on other types of modelling used within CONAF. Part of the Group's remit could be to develop, in conjunction with university departments, additional components for the SHETRAN suite that were seen to be necessary for its use in Chile. An obvious example would be a means of representing the effects of the soil and water conservation measures that they apply. This general concept of a core group of professional modellers will be discussed within CONAF.

JRB also stressed the importance of taking up the offer made by Ruben Salgado of an "initiation" course at La Serena for the trainees prior to their departure for Newcastle. In the context of the above suggestion, this would seem to be an appropriate time to outline future plans and objectives for the application of the expertise the trainees were about to acquire.

5. CONCLUSIONS

This initial visit to Chile has clarified a number of points but, inevitably, it has raised others that require to be resolved.

Selection of focus basins did not proceed as far as had been anticipated because the CONAF staff did not have a clear understanding of the requirements. Whilst considerable progress was made on this during the visit, some work remains to be done by CONAF staff before the final choices are made and the final details of the instrument requirements can be confirmed. Selection of the sites for the gully model development field work progressed well but the final choice between two sites remains to be made. The requirement for training in fieldwork is now seen to be greater than originally anticipated. This relates particularly to the concepts of catchment monitoring and the use of modern instrumentation.

5.1 CONAF focus basin selection

With the possible exception of one basin in Region X, there are no basins in Chile from which data of the required level are available for use in training in the application of SHETRAN.

A number of basins proposed as possible candidates for instrumentation to produce the required level of data were inspected.

The Quebrada de Ramon in the Andean foothills immediately East of Santiago, proposed as the site for work on modelling measures to alleviate flood damage, was found to be unsuitable on several counts. The most important of these were accessibility, the magnitude and complexity of the engineering work that would be necessary to produce streamflow and sediment yield data and the frequency of slope failures within the catchment.

The small catchments in the Alto Loyca area of the Metropolitan Region were considered unsuitable because of the considerable engineering controls on runoff and erosion already implemented or being implemented in them. In its present form SHETRAN can not represent such controls adequately. The remaining untreated gully areas were also considered unsuitable for the field study requirements of the La Serena component of the Project.

The small forested catchments viewed in Region X to the East of Valdivia offer good prospects for rapid instrumentation and production of relevant data. There is a pool of relevant experience and expertise centred on The Austral University, the Forestry Institute and the CONAF Region X office which has the enthusiasm to initiate and sustain the field work required. It is recommended that two of the focus basins, to obtain data on forestry practices, be selected from those provisionally identified in this area. It is suggested also that data from the small catchment monitored by the University group for some 10 years will be of some value in the initial training stages.

In the absence of a suitable basin to look at the problems of urban flooding from the Andean foothills it is proposed that the third focus basin should also concentrate on forestry effects, but on the granitic soils of the Coast Range to provide a contrast to those on the volcanic soils in Region X. A suitable area of active forestry development on these soils was identified by CONAF in the Contulmo district of

Region VIII. Circumstances prevented JRB from visiting this area during week 3 but it is suggested that CONAF staff should seek to identify a suitable catchment in this area using the guidelines summarised in note 1, Appendix 1.

5.2 Sites for the gully study

The basic requirements for these sites were finally agreed during the discussions at the University of La Serena with Ruben Salgado and Edmundo Gonzalez from 15-17 September. Potential sites were inspected in company with EG in the Alto Loyca area of the Metropolitan Region, in the Florida and Chosme areas of Region VIII near Concepcion and in areas near Quinchamali and Quirihue near Chillan also in Region VIII.

The ones that came closest to the technical requirements were at Chosme and Quinchamali. Of these, the site at Chosme offered potentially greater security and cooperation from the local farmers and from CONAF whereas the Quinchamali site is more accessible and close to the potential back-up facilities at the Chillan campus of the University of Concepcion. A final decision between these sites will be made after further investigation by La Serena staff.

5.3 Training requirements

In addition to the training requirements to achieve competence in the application of the SHETRAN modelling system it will be necessary to provide training for the CONAF personnel selected in various aspects of catchment hydrology. With the exception of the representative from Region X, none of those selected has much experience of the type of field data acquisition necessary to operate the focus basins. Where any monitoring of this type has been undertaken in Chile manually read or chart recording instrumentation has been used. There is no experience of using modern instrumentation coupled to intelligent solid state logging systems and downloading to computer data bases, the approach which is now the norm in UK. Against this background the training period in UK must contain a significant element of this type of training if the focus basin part of the Project is to succeed. The time allocation of IH staff will allow, at best, only a brief familiarisation visit to an operational catchment. It will be necessary therefore for WRSRU, Newcastle, to incorporate this into their training programme, either using in house expertise or making other arrangements.

5.4 Administrative matters

From the discussions with British Council and with Kuehne and Nagel the following points have emerged

There is an urgent requirement to clarify the position with regard to the dutiable status of the instrumentation to be purchased. This should be taken up with ODA and the Chilean Government.

The British Council in Chile are in a position to provide useful administrative assistance to the Project, at no additional cost, in terms of the assessment of language training requirements, organising travel arrangements for the trainees and assisting with the arrangements for the 1995 Workshop to be held in Chile. Their participation requires some form of agreement between them and ODA.

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Appendix 1

NOTE 1.

Criteria for basin selection for the CONAF focus basins

(a) Soil type. Sites in both the Coast Range (granitic) and the Andes foothills (volcanic)

(b) Vegetation cover. Relevant vegetation types should be included with at least one of the basins scheduled for a change in vegetation (eg mature forest about to be felled) during the two year period of data acquisition.

(c) Size. The basins should not be smaller than 100 ha but not larger than, say 2000 ha.

(d) Topography. It is essential that the drainage boundaries are well defined.

(e) A suitable site must exist on which to install a streamflow structure and a sediment trap. This site must be on a straight river reach where the streambed is not too steep, the cross-section is well defined and the bed is on rock or clay so that the flow will not by-pass the structure.

(f) Accessibility. The 'best' catchment in terms of (a)--(e) above is of no use if it is not possible to get to it to install the structure and other instrumentation or to get to it at all times during the winter to read the instruments.

(g) Where basins which meet the above conditions are identified preference should be given to those for which some previous data exist or for which it is possible to 'extend' the record by correlation with nearby instrumentation.

NOTE 2.

Data requirements from focus basins for input to SHETRAN

(1) Topography. Detailed topographic map, preferably 1: 10000 or better for basins in the 100 ha ---2000 ha range of sizes.

(2) Soil details. Soil type(s), details of physical structure, range of soil depths within the basin, infiltration and permeability characteristics from representative sites.

(3) Detailed vegetation cover maps.

(4) Longitudinal and lateral streambed channel profiles.

(5) Precipitation data. From the installed instrumentation, continuous data on the amount and time distribution of precipitation (preferably at time intervals of less than 1 hr) plus some indication of spatial variability over the basin (eg. from manually read storage gauges).

(6) Evaporation data. Preferably a continuous record of temperature, humidity, radiation and windspeed from which potential evaporation can be calculated. If this is not possible data from a Class A evaporation pan can be used.

NOTE 3.

Data required from the focus basins to check the performance of SHETRAN

(1) Streamflow. A record of streamflow at intervals of not more than 15 min so that the detailed structure of the hydrograph can be compared with that predicted by SHETRAN.

(2) Soil moisture. Profiles of soil moisture content at representative sites within the basinat weekly intervals so that the predictions in a sample of the SHETRAN grid squares can be compared with the observed data. There should be at least one site under each vegetation type.

(3) Suspended sediment. Regular (eg. daily) samples during all periods of flow, plus morefrequent (eg. hourly) samples through at least a selection of storm hydrographs.

(4) Bedload sediment. Ideally the contents of the sediment trap(s) should be estimatedafter each major storm event. this should be supplemented by periodic surveys of thedistribution of sediment along the streambed.

(5) Groundwater level. Observation wells at a few representative sites within the basin toprovide data for comparison with the model predicted groundwater levels. Levels can be monitored with a recorder, or read manually using a dipper at each visit to the basin

NOTE 4.

Work to be done on the final selection of CONAF focus basins and on organising the staff and facilities required to instrument and operate the basins

A. The Valdivia Area

(1) Make some arrangement with Andres Iroume, Anton Huber and the forest engineeringgroup within the University to provide advice, guidance and the use of laboratory facilities ..... possibly in return for access to the data to be acquired from the focus basins.

(2) Discuss the requirements for the focus basins (see NOTES 1--4) in detail with Hector Adriazola and the senior CONAF staff in Region X. This discussion should include the identification of staff to be involved in the final selection, surveying and information gathering on the basins, on who will take responsibility for choosing the sites for the gauging structures and the sediment traps, who will design and install these structures, who will select sites for the Automatic Weather Stations, the raingauges (both recording and manually read), the soil moisture monitoring sites and the groundwater monitoring sites.

(3) Having agreed on cooperation and staff responsibilities a basin selection/ planning meeting, with visits to the sites and with Wilfredo Alfaro in attendance, will need tobe organised.

(4) Once the final selections have been made a timetable for each person involved will be necessary , showing when each part of the operation is to be done, i.e.,the topographic maps acquired,the vegetation, soils and streambed surveys carried out,the instrument sites within the basins selected,the structure designs completed,the construction work completed.The timing of the installation of the instrumentation will depend on delivery dates but should not be later than March 1995.

(5) It will then be necessary to draw up programmes for the staff designated to do the routine data collection from the basins. Since there is no provision in the Project foron-site training it will be necessary to familiarise Hector Adriazola with theinstrumentation during his period in UK and for him to train the field staff on his return possibly with some assistance from Iroume and Huber.

(6) I would suggest that a team of two people visits each basin once per week. The loggerson the weather station and the water level recorder will store up to four weeks data and that on the recording raingauge up to two months or more, depending on rainfall frequency. However, the sediment sampler will need attention once per week and the soil moisture and groundwater level readings should be taken at least at this frequency.It is a wise precaution to download the loggers on each visit.

(7) On return from each visit the sediment samples must be analysed and the readings taken down each soil moisture access tube entered on the computer in a standard format.The contents of the memory unit used to download the loggers must also be transferred to files on the computer. If manually read raingauges are in use their readings must also be entered.

(8) The frequency with which the bedload sediment trap is surveyed and cleared out willdepend on local conditions. By building the trap immediately upstream of the stillingpool of a weir any 'overflow' from the trap will be caught in this pool, but it must notbe allowed to build up to the level where it will affect the hydraulic performance ofthe weir.

(9) In general a routine set of tasks should be laid out for each visit to the basin, e.g.

a) read manual raingauges
b) do soil moisture readings
c) read groundwater levels
d) download AWS logger
e) download water level logger
f) change bottles and battery on sediment sampler
g) inspect and , if necessary, survey and clear the bedload trap

(10) Each instrument and site should be inspected/checked for faults and problems.It is good practice for the observers to make notes on the timing of each operationand anything of note they see on each visit.

B The Contulmo Area

(1) The final selection of the basin in this area and the organising of the operational and advisory groups and lab. facilities will require considerable thought and discussion between Wilfredo Alfaro, Juan Rifo, senior CONAF staff in Concepcion and possibly the University.

(2) Thereafter the approach to basin selection, surveying, instrumenting and data collection will follow the same general plan as suggested above for the Valdivia basins.

The teams in both areas should be encouraged to keep in close touch with each other to ensure that the methods used and the checks carried out on the equipment and the data are comparable. This will help to ensure that data of similar quality is obtained from all the basins.