EMEND RESEARCH 1998

Ecological **M**anagement by **E**mulating **N**atural **D**isturbance

Prepared by: Lisa Cuthbertson and John Spence

CONTENTS

Interim Progress Report on the EMEND Project

Research Activities 1 April 1998 - 30 September 1998

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The initial 6 months of EMEND research in the current fiscal year have focused on fine-tuning the experimental design, laying out the experimental compartments and baselines on the ground and collecting pre-treatment data as required for various components of the project. The attached documents, prepared by Ms. Lisa Cuthbertson (Field manager and Information Co-ordinator), summarize the important aspects of field-camp use and research progress (i.e., summary of projects and personnel receiving support from Canfor/DMI and/or using the EMEND camp, activities of the Research Corps [Core Crew]). In this initial section of the interim report, I provide a brief overview of ongoing research and address several additional items that may be of interest.

Overview of EMEND research. Field research comprising the EMEND project has two main components: 1) collection of experiment-wide data, mainly by the Core Crew, required to ensure that comparisons of treatments can be made over all 4 forest types, and 2) research planned and executed by researchers interested in using part of the EMEND experiment as a template for their work. Work done under category 2 includes projects by graduate students.

Overall, 77 researchers used the EMEND facilities during the past summer (see EMEND FIELD RESEARCH CAMP 1998). Fifteen of these people (those identified as core crew, plus Langor, Sidders, Spence, Volney and Weber) contributed mainly or significantly to the activities of the Research Corps or "Core Crew". The remaining researchers fall mainly into category 2 as explained above.

The experiment-wide work conducted during the past summer included establishing access routes to each compartment through a series of "baselines" and laying out and mapping the two residual ellipses to be left in each harvested compartment. Six hundred 40 x 2 m strip plots were established (6 per compartment) and data about mensurational characteristics, site classifications and coarse woody material were collected between April and August. In addition, the core crew made regular collections of epigaeic arthropods and flying insects from all stands to serve as pre-treatment data for an experiment-wide analysis of treatment effects. Data about the biomass and composition of shrub understory are being collected during September and October. All strip plots and ellipses have or are in the process of being located with GPS. See EMEND CORE FIELD RESEARCH 1998 for details about these activities.

Research falling into category 2 spanned a wide range of projects, including plant and animal biodiversity, forest health, forest genetics, fire studies, soil studies, hydrology, silviculture and meteorology. At present 7 graduate students are actively involved in research at EMEND. See "A list of researchers and their field research team" for details. Projects underway are summarized individually under "EMEND RESEARCH 1998".

Changes to project design and methodology. Extensive discussions about the harvesting treatments occurred after many researchers visited the test harvests in early May 1998. These discussions resulted in the changes to the overall experiment as reflected in the May 22, 1998 document. Since then, treatments have been shifted among several compartments in two aspen-dominated blocks to meet concerns about whether they could be attained on certain sites and to accommodate an error made in non-EMEND harvesting last winter. These changes are reflected in the most current map of the EMEND site available through Steve Luchkow at DMI.

Discussions in August and September have focused on the probable wind-hardiness of the low-density residual treatments. A small sub-group that looked into this problem has recommended that 30% retention be substituted for the 20% retention treatment throughout the experiment. At this writing, it appears that this recommendation will be endorsed and even preferred by the great majority of the researchers and I expect that it will be adopted.

Administrative and organizational items:

As mentioned above, we organized a session at the camp in early May to allow interested researchers the opportunity to look over the "practice" harvests attempted last winter and to discuss implications for the experimental design. The web site has been revised to reflect the resulting changes to experimental design and to incorporate more information about last year's preliminary work to identify appropriate stands and to characterize the forests of the EMEND site. The website may be viewed at http://www.biology.ualberta.ca/emend/emend.html.

Since mid-August we have been planning for a series of EMEND presentations to be made to personnel of Canfor, DMI and Manning Diversified, Alberta LFS and other forest companies that may be interested in EMEND. These sessions have been scheduled for 7-8 October in Peace River.

Apart from organizing the work schedule of the core crew and developing guidelines for use of the research camp no additional administrative or organizational matters have been undertaken.

A list of researchers and their field research team

EMEND summer 1998

Universities of Alberta, Calgary, and Lethbridge

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Field team (EMEND core crew): Lisa Cuthbertson (EMEND field manager), Chad Grekul (EMEND assistant field manager), Alyssa Bradley, Tim Trahan, Jacqueline Pollard, Carmen Gibbs, Tom Patocka, Peter Volney, and Stephan Hebeisen (volunteer)

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Field team: Brent Magnan

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Field team: Colin Myrholm, Bruce Falkenberg, Peter Volney, Roger Brett, Howard Gates and assistance from the core crew (Roger and Howard are technicians under the direct supervision of **James Brandt** at the Canadian Forest Service).

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Field team: Ivor Edwards , Kim Handy, and Rob Martineau

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Supervisor: Robert Barclay

EMEND RESEARCH 1998

The following is a list of the research at the EMEND field site in 1998. First there is an overall statement of the research at EMEND and second, the actual research is presented for the 1998 season. Projects designated by an asterisk (*) received or been designated to receive some direct funding from the FRIAA budget during 1998.

Overall Statement

Assessing components of ecosystem integrity in the EMEND experiment

W.J.A. Volney, J.R. Spence, M.G. Weber, D.W. Langor, K.I. Mallett, J.D. Johnson, I. Edwards, G. Hillman and B. Kishchuk

One overall objective of the EMEND experiment is to compare the response of forests cut according to several alternative harvest plans, to those that arise through wild fire and other natural disturbances. An optimal impact experiment was designed to use wild fire and untreated checks as the basis for inferring the effects of harvesting on ecosystem function and recovery. The size and costs of the experiment required stratification of forested landscapes to obtain homogenous stand groupings in order to account for the effects of variation in cover types and initial stand structure on responses monitored. To the extent possible, forest stand descriptions (including understory vegetation, coarse woody debris, fuel loading, nutrient pools and arthropod diversity) are being monitored on a system of nested plots randomly located within the treatment compartments. Primary productivity, biodiversity of selected taxa, and nutrient fluxes will be derived from these estimates to provide the basis for powerful experiment-wide comparisons of ecosystem integrity among cover-types and harvesting intensity.

EMEND Research 1998

The main research areas are listed as follows:

Arthropod Diversity

Vegetation

Hydrology and Microclimate

Fire Ecology

Silviculture

Genetics

Soils and Nutrient Cycling

Avian diversity

ARTHROPOD DIVERSITY

John Spence; University of Alberta

Litter- and canopy-dwelling arthropods

Together with David Langor, Jan Volney and graduate students Julie Dunlop, Louis Morneau and David Shorthouse, I am involved in research to assess arthropod response to the harvest and fire treatments of EMEND. In addition to work summarized directly under headings for Ms. Dunlop and Mr. Morneau, we conducted experiment-wide collections of ground-dwelling (i.e., epigaeic) arthropods through pitfall trapping with assistance from the core crew. Resources available for this work during 1998 dictated that the data were collected at the stand level only. However, epigaeic arthropods were trapped and collected in all stands of each forest type to be subjected to the EMEND treatments. The material must now be sorted and identified to species for the main epigaeic taxa (carabid beetles, staphylinid beetles, spiders and perhaps ants). These pre-treatment data will be useful for describing differences in arthropod assemblages characterising the 4 basic EMEND forest types and will provide the first firm basis for framing hypotheses about changes in biodiversity that accompany succession in the boreal mixedwood.

In addition, they will serve as an average pre-treatment estimate of composition of assemblages for all contiguous compartments included in each stand. Because each replicate retains an uncut control compartment, we judged that compartment-specific estimates for these mobile animals were less important than were other pre-treatment data, given resources available. Compartment-specific estimates are required, however, to adequately assess effects post-treatment and these are planned for 1999 and 2000.

Dave Langor; Canadian Forest Service

My research investigates the epidemiology of the spruce beetle (SB), *Dendroctonus rufipennis*. I am looking at population responses of this insect to the different treatments. Work this summer has concentrated on assessing background beetle population levels in all of the coniferous and mixedwood stands, in collaboration with Mary Reid. Furthermore, Julie Dunlop and I have been assessing mortality factors affecting SB, in particular parasitism levels, to assess how harvesting treatments affects these parasitoids, and, consequently, population levels of SB. Finally, I co-ordinated the collection of core data on coarse woody debris. This involved several training sessions with the EMEND crew.

Mary Reid; University of Calgary

Populations of wood-inhabiting insects were sampled using baited Lindgren funnel traps from May through August, 1998. Two types of baits were used, one for woodborers and one for spruce beetles (*Dendroctonus rufipennis*), both supplied by Phero Tech Inc. One trap of each type was placed in a representative compartment of each forest type replicate.
When a single replicate was represented by disjunct forest stands, traps were placed in each stand. A total of 22 stands were sampled (5 AD, 4 AU, 6 CD, and 7 MX). In addition, some stands had a third trap containing lower release rates of alpha-pinene and ethanol (components of the woodborer baits). Traps were emptied every two weeks by the
EMEND core crew, and samples were either frozen or placed in ethanol. In addition, CD and MX stands (n=14 stands) were surveyed in late June for active breeding by bark beetles. Survey transects were 2 m wide at 50 m intervals, and ran the length of each stand. All green coarse woody debris (CWD) was measured and checked for bark beetles. These data were collected in collaboration with David Langor. Most CWD was

uninhabited, but spruce beetle were encountered occasionally and *Polygraphus rufipennis* more commonly.

Trap Sampling Locations

Forest Type, Stand, Rep, Compartment

AD 582 R3: 952, AD 121 R3: 907, AD 77 R1: 855, AD 66 R2: 864, AU 5 R1: 885, AU 9601 R2: 957, AU 481 R3: 946, AU 42 R1: 880, AU 9488 R3: 954, CD 445 R3: 934, CD 306 R3: 926, CD 314 R2: 922, CD 314 R2: 917, CD 43 R1: 897, CD 31 R1: 891, MX 423 R1: 937, MX 303 R1: 912, MX 201 R2: 903, MX 254 R3: 909, MX 9104 R3: 908, MX 49 R3: 872, MX 29 R2: 899

Bark Beetle Transects

MX 49, MX 44, MX 254, MX 9104, MX 201,202, MX 284, MX 29, MX 423, MX 303, CD 445, CD 43, CD 306, CD 31, CD 314

Ralf Carter; University of Lethbridge

Brent Magnan

Supervisor: Ralph Carter

My research concentrated on bumblebees and was funded by the University of Lethbridge. It began on June 15 and ended Aug 15. I concentrated on the deciduous dominant (AD) and the deciduous dominant with a white spruce understory (AU) stands. My main goal was to obtain data to determine how bumblebees track their resources. I achieved this by using the baselines as transects and counting both numbers of flowers and bumblebees. The flowers were counted using a 4 meter squared quadrat, which was placed randomly along the baseline every 10m. Only flower species utilised by bumblebees for either nectar or pollen were counted. I walked transects at approximately 10m/minute and recorded all the bumblebees seen within 2m of transect.

In addition to resource tracking I also looked at wing senescence. This was done away from my study sites, in areas of high flower concentrations (mainly cutlines and roadsides). I timed the bees for a minimum of 2 minutes and recorded total time and flying time. The bee was collected and pinned into a collection.

Lastly, these data I collected will give an indication to the amount of biodiversity present within the area.

Julia Dunlop; University of Alberta, M.Sc. Candidate

Supervisors: Dave Langor and John Spence

During May through August, various forest sampling methods were employed to obtain and monitor forest pest parasitoids. Parasitoids of phytophagous insects of caterpillars (Order: Lepidoptera) and sawflies (Order: Hymenoptera) were obtained through harvesting both aspen (*Populus tremuloides*) and white spruce (*Picea glauca*). Spruce beetle (*Dendroctonus rufipennis*) populations and their parasitoids were monitored with field observations of infested trees and bark sample examinations from white spruce sections.

Trees were harvested during June and July in 9 compartments over three forest types. Spruce harvesting was conducted mid-June and mid-July in both conifer dominant forest (compartments 918, 920, 896) and aspen dominant with a spruce understorey (compartments 888, 887, 961). In late July aspen was harvested in compartments 862, 953, 854. Harvested trees were measured and felled onto a large tarp to capture dislodged larvae. Larvae collected were reared in the laboratory for parasitoid/ host, larvae/ adult associations, and parasitoid phylogeny information. Spruce beetle populations were monitored during July and August, the six spruce trees were recently fallen and infested with beetle larvae. These trees were located in conifer dominant forest, within compartments 915, 916, 917. Field observations of parasitoid activity around the beetle infestations were taken, then 30 cm portions of the tree in the upper and lower infested area were removed. The tree portions were examined at the lab for larvae and parasitoid activity under the bark. Data was obtained for spruce beetle mortality, percent parasitism, developmental stage, and gallery length. Parasitised hosts and their parasitoids were reared on a novel diet to obtain species specific percent parasitism and parasitoid phylogenetic information.

Louis Morneau; University of Alberta; M.Sc. Candidate

Supervisors: John Spence and Jan Volney

Lepidoptera diversity of residual forest stands following fire and harvesting in a boreal mixedwood forest of Alberta.

Concerns about biodiversity have persuaded forest managers to base their activities on "natural disturbance" patterns. However, the effects of different disturbances on invertebrate communities are poorly understood. The objectives of my study are to examine these impacts on a boreal community of Lepidoptera and to develop an indicator taxon approach to monitor ecosystem integrity. Boreal mixedwood sites of three aspen types (aspen dominated, aspen dominated with spruce understory and spruce dominated) were sampled in 1998 using light trapping to get adults (moths) and tree sampling to get larvae (caterpillars). Larvae and pupae of spruce and aspen defoliators were reared for identification. Active catching was also done to examine butterfly diversity. In 1999, I will study two kinds of disturbances: partial harvesting with 20 and 50% residual trees and light, surface burns, in relation to undisturbed sites. I expect that assemblages of lepidopteran species will differ after disturbance depending on environmental factors (temperature, light, and water) and on the residual food plants community. The 50% residual sites should indicate the most vulnerable species of Lepidoptera. The 20% residual sites will allow analysis of the lepidopteran community still present after a severe perturbation. Finally, the low intensity fire will be compared to harvesting. This research will improve our ecological understanding of impacted invertebrate community after human and natural disturbances. Diversity of Lepidoptera can also be developed as a monitoring tool to ensure maintenance of ecosystem function.

VEGETATION

Ellen Macdonald; University of Alberta *

Stand types: Aspen-dominated, Conifer-Dominated, Mixedwood

Treatments: clearcut, 20%, 70% (3 replicates per stand type), burn (medium and high intensity for a total of 4 replicates per stand type)

Sample locations: all sample locations semi-random, i.e. they are tied in to the baseline transects to make relocation simpler. In addition, all are permanently marked with an 18 inch piece of rebar buried to within 4 inches of the top and marked with tree paint on the base of adjacent trees.

12 locations for 20%, 70%: 4 within residual patches, 8 within 'thinned' strips
8 locations for clearcut, burn: randomly located
(total of 384 plots)

Data: 3.99 m radius circular plot: Tree and snag density by species, snag condition, tree basal area, canopy and snag ht and dbh (2 of each per plot)

2 X 2 m plot: shrub cover to species

1 X 1 m plot: herb, dwarf shrub, bryophyte cover to species, dominant substrate, litter depth, depth of organic layer, soil samples(?)

sample point origin: canopy cover (densiometer), soil temperature at 10 cm, 30 cm (3 or 4 measurements over the summer), nutrient availability (resin bags), decomposition (cellulose disks), soil moisture (TDR - 3 or 4 measurements over the summer)

soil samples for nutrient analyses.

Additional sampling for vascular-nonvascular plant interactions:
6 additional 1 m X 1 m plots within all conifer-dominated and mixedwood stands. fire: randomly located; 20%,/70%: 2 in centre of residual patch, 2 at edge of residual patch, 2 in thinned area (anticipated to experience different levels of disturbance to the moss layer). (additional 120 plots). The only data collected will be: herbs, dwarf shrubs, bryophyte cover to species.

Mark Dale; University of Alberta

Emma Pharo; University of Alberta
Nested quadrats around all 72 pitfalls traps (1, 2, 5 m diameter) surveyed for all vascular plants, bryophytes and non-crustose lichens.
General bryophyte and non-crustose lichen surveys (2 hour search time) in the 20, 70, 100 % cut and the medium and high burns.

Within the stands,

AD 77, 66, 9481, 582, 121

AU 5, 42, 9601, 9488

CD 31, 43, 314, 306, 445

MX 303, 423, 284, 201-202, 29, 49, 254

Derek Johnson and Marty Siltanen; Canadian Forest Service

The work focussed on an analysis of the understorey vegetation (tall shrubs, low shrubs, herbs, bryophytes and ground lichens) in all 4 stand types including medium and high burns, controls, clearcuts and 50% retention. The sampling system consisted of a 5 x 5 m plot to measure tree and tall shrub cover, with a nested 2 x 2 m plot in the SE corner to measure cover for all other plants. Our 5 x 5 m plot was located at the midpoint of the 2 x 40 m tree plots within each compartment. We did a total of 312 plots over the summer. The goal of the research is to monitor the type, direction and rate of change in the ground vegetation following the various treatments to see if the pattern of change is the same in the burns and clearcuts, or if not, what level of tree retention comes closest to emulating the effects of fire (the "natural" disturbance).

Rene Martin, University of British Columbia; M.Sc. Candidate

Supervisor: Pam Krannitz

Is the Pollination Biology of *Cornus canadensis* in the Buffer Zone Impacted by Various Forest Practice Treatments?

During the summers of 1998-2000 I will be studying Bunchberry (*Cornus canadensis*) in the buffer zone to determine if various treatments impact the pollination biology of this common plant.
I have set up 12 plots/rep for the controls and the 70%, 50%, and 20% residuals. Each plot is located in the buffer zone surrounding the treatments, between 10 and 40 metres from the edge. For each plot I will collect data on: 1) pollen deposition; 2) fruiting success; 3) plant, inflorescence, and flower densities; 4) insect behaviour; 5) surrounding vegetation and cover class; and 6) abiotic factors such as light, ambient temperature, and soil moisture. Separate plots will also be set up to determine vegetative vs. reproductive growth.

Ken Mallett; Canadian Forest Service

We have removed traplogs from the sites and are in the process of identifying the *Armillaria* species in the area. We will use this information in conjunction with the forest health survey information to determine the extent and incidence of *Armillaria* root disease in the different forest types and treatments. The information will be used as a baseline so thjat we can see what happens with ARD in the various treatments after the treatments have been applied.

Tobias Laengle; University of Innsbruck; Honours degree candidate

Supervisor: Mike Weber (CFS)

Tobias Laengle is an undergraduate student from the University of Innsbruck, working on the difference in mycorrhizal infection between natural (control) and planted white spruce on the EMEND site. He is considering coming back for Ph.D. work to look at some microbiological aspect within EMEND.

FIRE ECOLOGY

Mike Weber; Canadian Forest Service

Fuel inventory on all the designated burn treatment plots was completed. This included surface fuels as well as forest floor (duff) mass. We also completed height-to-live-crown measurements on the burning treatments. This measure, in conjunction with the fuel inventory, is required for the preparation of the prescribed burn plans. Prescribed burn plans for all burn plots will be prepared during the winter months by ALFS co-operators in consultation with Mike Weber and Bill de Groot.

Ed Johnson and Matthew Dickinson; University of Calgary

Experimental burn units were visited and planning and co-ordination for next year's fires was discussed. Physical-process models are being finalized that will allow prediction of tree mortality through an understanding of fire effects on tree crowns, boles, and roots.

HYDROLOGY AND MICROCLIMATE

Graham Hillman; Canadian Forest Service

The hydrology study was established in the coniferous dominant stand (#314, replicate 2). Instrumentation was installed in the compartments designated as control, clearcut, 20, 50 and 75% residual treed areas in July and August, 1998. Each of the instrument stations consisted of a 64K data logger, with multiplexor, mounted on a cedar post and connected to eight soil temperature sensors and eight soil moisture sensors. In each compartment, two temperature sensors were installed horizontally, via small pits, at each of four depths: at the soil surface, at the interface between the organic layer and the mineral soil, and at depths 15 cm and 30 cm below the top of the mineral soil. Similarly, two soil moisture sensors were installed in the middle of the organic horizon, and at depths 15, 30 and 45 cm below the top of the mineral soil. The moisture sensors in the organic layer were placed horizontally, and those in the mineral soil were installed via the surface at an angle of about 20o. In the compartments designated as residual treed areas, one set of temperature and moisture sensors was installed near the centreline of a machine corridor and the other within a residual treed area. The data loggers recorded soil temperature and moisture every two hours; the data will be downloaded once a month.

Rick Hurdle; Canadian Forest Service

A 30 meter tower was put up in block 918, CD 100% residual (no cut). We are logging hourly averages of:

temperature @ screen height and mid crown
relative humidity @ screen height
solar radiation
net radiation
wind speed @ at 32 meters

plus hourly rainfall by tipping bucket and a wind rose (8 bin directional histogram weighted by wind speed) every 12 hours.

We also set a 10 meter in the cut block next to camp. That is logging hourly temperature, rh, wind and weighing rain gauge plus 12 hour wind roses. We hope to operate these over the winter if we can put them on telemetery.

SILVICULTURE

Derek Sidders; Canadian Forest Service *

My work as was in the design and initial layout protocol. Ellipses of 40 metres by 60 metres and 60 metres by 90 metres were designed and layed out by the core crew in all vegetation types and 10, 20, 50 and 75 % retention compartments (Total Compartments = 4 veg. X 4 treatments X 3 reps. = 48 compartments. Ellipse are marked in blue flagging tape. All ellipses followed the same location design which was prescribed as the northern side of the compartments with the easterly ellipse being the large and the westerly ellipse being the small. Spacing of the ellipses (which are shaped more canoe like actually) was designed at 80 metres apart from edge to edge and run parallel with the harvest designated skid trails (20 m intervals). Only where the ellipses were not operationally or physically possible due to compartment shape or harvest direction were the ellipses or an ellipse placed in a alternate location minimizing edge effect and influence from one another. Silviculture plots were also located on compartments of 50 and 70% retention and in the clearcut compartments of all vegetation types. Plots have been marked using a 3 inch PVC tube on one of the northern corners of the plot (see layout table). The plots are 100 metres (wide) by 50 metres in size in the greater than 70% Aspen and White Spruce vegetation types, and 50 metres by 50 metres in size in the Mixedwood and Aspen with understorey vegetation types (Total Compartments ={(100X50) 2 veg. X 3 treatments X 3 reps = 18} + {(50X50) 2 veg X 3 treatments X 3 reps = 18} = 36.

Pre-harvest surveys will be completed on all silviculture plots by the end of October.

Ellipse and silviculture plots are located using the baseline management system established by the core crew and as described in the compartment layout tables.

(see Lisa's tables)

Vic Lieffers; University of Alberta

Ken Greenway; Alberta Research Council

Richard Kabzems; Ministry of Forests, British Columbia

GENETICS

Om Rajora; University of Alberta *

Effects of Forest Fires and Forest Management Practices on Genetic Diversity in White Spruce in Northern Alberta:

Benchmarks for Genetic Biodiversity Indicators and Criteria for sustainable Forest Management

Activities and Progress

Fieldwork for sampling of white spruce trees in 30 blocks in two forest types - *conifer-dominated* and *mixed-woods* - was completed. Two replicates in each forest type were included in the study. Thirty-five trees per block in one and ten trees per block in the other replicate were sampled. Diameter of each and age of selected sampled trees were recorded. Foliage from individual 700 white spruce trees was collected and brought to the University of Alberta for DNA extraction and genetic diversity analysis.

(A) Conifer Dominated Stands

Stand 314 - Rep 2

Block	Treatment	No. of Trees
915	Low burn	35
916	Medium burn	35
917	10% residual	35
919	20% residual	35
920	50% residual	35
921	70% residual	35
922	Clear cut	35
923	High burn	35

Stands 31 and 43 - Rep 1

Block	Treatment	No. of Trees
890	70% residual	10

891	Low burn	10
892	Clear cut	10
895	10% residual	10
896	20% residual	10
897	Medium burn	10
898	50% residual	10

(B) Mixed-wood Stands

Stands 303, 423 and 428 - Rep 1

Block	Treatment	No. of Trees
910	20% residual	35
911	50% residual	35
912	70% residual	35
913	10% residual	35
914	Clear cut	35
936	Low burn	35
937	High burn	35
938	Medium burn	35

Stands 29, 201 and 202 - Rep 2

Block	Treatment	No. of Trees
899	Clear cut	10
900	10% residual	10
901	Medium burn	10
903	50% residual	10
904	Low burn	10
905	20% residual	10
906	70% residual	10

SOILS AND NUTRIENT CYCLING

Barbara Kishchuk; Canadian Forest Service

Pre-harvest soil nutrient data is being collected in all compartments in 1998. This work will be completed in fall of 1998. Soil sampling is being done in all six tree plots in each compartment. Samples of the forest floor (LFH), mineral soil from 0-7 cm, and mineral soil from 10-17 cm are being collected. These samples will be analyzed for nutrients and pH. Soil mass samples have been taken at the same location to estimate nutrient contents of the forest floor and mineral soil. Soil classification will be done at four locations within the study area in early October.

Ivor Edwards; Canadian Forest Service

Within each of two forest types (the Aspen Dominant stand, 77 Rep 1, Compartment 855, and buffer area just east of Compartment 858, and the Conifer Dominant stand, 314 Rep 2, Compartments 917 and 918), two soil pits (60 cm into the mineral soil) were dug for the purposes of i) determination of the Ecosites, ii) examination of the soil profiles, and iii) characterization of the soils by collecting samples of the various horizons for physical and chemical analyses. A total of twenty soil samples were collected. Surrounding soils in all cases were probed, using an auger, to determine the degree of heterogeneity.

Later this fall, in cooperation with R. Hurdle, CFS, the plan is to install probes to monitor soil temperature and soil moisture in the Aspen Dominant stand identified above. Weather permitting, time will be taken to walk through all compartments within the above stands.

AVIAN DIVERSITY

Fiona Schmiegelow; University of Alberta *

All compartments at the EMEND site (excluding the high burn treatments) were sampled for avian community diversity. At each compartment, one of three sampling designs was followed: one 100 m point count station, two 50 m point count stations, or one 100 m point count station and one 50 m point count station. Sampling designs varied due to size and shape differences among compartments. Each point count station was visited 3 times during the breeding season

(May 22 - June 30). Sampling was conducted from sunrise to 10 am, and we did not sample during rain or when the wind was higher than level 5 on the Beaufort scale. At each station, an observer recorded all birds seen and heard during a 5-minute period. To minimize overlap between adjacent point count stations, we did not record birds that were judged to be further than 100 m from the station.

In August, vegetation characteristics at each point count station were recorded. Using a nested design within a 11.3 m-radius circle centred on each station, we sampled ground cover, shrubs, saplings, poles, trees and snags. Our methods were consistent with those used in avian studies elsewhere in the province. The position of approximately 65 of the 143 point count stations was estimated using a Global Positioning System (GPS).

EMEND CORE FIELD RESEARCH 1998

1) Baselines
2) Ellipses (Harvest layout design)
3) Plots (40 x 2 m)
    a) Tree mensuration
    b) Tree coring
    c) Coarse woody material
    d) Nearest Neighbour Snags
    e) Shrubs
4) Arthropod collections
5) Site classification
6) GPS work

1) **BASELINES**

On recommendation of Derek Sidders and following the design by Lisa Cuthbertson, a baseline system, created to organise and direct research traffic through the EMEND study compartments, was established by the core crew in May of 1998.

The baseline systems are walking trails through each 10 ha compartment. It is a directional series of pigtails, flagged in pink with an aluminium tag, placed every 20 meters. Trees on either side of this baseline are marked by a pink paint strip, a half-meter in length from the base of each tree. At the boundary of each compartment, there is a wooden slate nailed into a tree, with the following information; the baseline number, the compartment number, the treatment type, and a label if at the start or the end of the baseline. There is also a pigtail at the boundary and has the aluminium tag marked with the baseline number, the compartment number and the meter number. The meter number starts with 0 meters then increases by increments of 20m in direction of the baseline.

Lisa Cuthbertson arbitrarily assigned the baseline numbers. It is a letter and number code. The study has compartments clustered in areas. Each distinct area was assigned a letter, A through to O. Within each areas anywhere from 1 to 12 directional baselines were designed. For example, aspen dominant stand 77, replicate 1, has 8 compartments. It was assigned the letter A and has 4 directional baselines through this area; A1, A2, A3, A4. See Baseline Appendix

It was the intent that researchers could easily walk these line without the use of a compass and use the pigtails as reference points in meters, from which to plan the placement of their study plots within each compartment.

2) **ELLIPSES**

The harvest design and layout for the EMEND study was planned and proposed by Derek Sidders. The core crew set up the ellipses, flagged in blue, and set up the start of the machine corridors, flagged in yellow.

Within each 10%, 30%, 50%, and 70% harvested compartments, there will be parallel machine corridors, running North and South, approx. 5m wide, cut every 20m from centre to centre of each machine corridor. The 15m strip of remaining trees will be thinned to a standing volume of 10%, 30%, 50%, and 70% depending on the treatment in each of the compartments. These harvest treatments have two ellipses, placed in the more northern half of each compartment and are of the size 60m x 90m (the large ellipse) and 40m x 60m (the small ellipse). These ellipses are residual leaves and are intended to represent fire skips left by fire burning through forested stands.

Using the baseline system as a reference point, the North and South tips and the West and East sides of each ellipse, were easily measured out and marked. The large ellipse was usually established first and then the small ellipse was usually measured 80m west from the west edge of the large ellipse. Every 20m between ellipses, yellow flagging for the machine corridors were placed (See Figure 2). The machine corridor system for each compartment was determined by the placement of these ellipses. A contractor for DMI, Theron ??, finished measuring and flagging out these machine corridors, within each compartment, based on the position of these ellipses.

3) **PLOTS (40 x 2 m)**

a) Mensuration and Characteristics

There are 100, 10 ha compartments, in the EMEND study. Within each compartment there are 6, randomly located, 40 x 2m tree plots. There are a total of 600 tree plots. These plots are oriented perpendicular (east-west) to the machine corridors (north-south). During the plot set up, a chain was pulled for 40m and on 1 m on either side of this chain, all pieces of wood 7.5 cm and over were painted with a pink line.

The core crew set up the plots in June and July. The first tree plot is usually located from a baseline. Double pink ribbon on a tree on the baseline indicates the start of the trail to the first plot. A trail in pink X's (marked on trees) lead the way between each plot.
Each tree within the plot is labelled with a pink number and a diameter at breast height (DBH) line.

For all trees within the plots, the core crew recorded, the species, the height (ht), the height to live crown (lc), the dead tops (dt) and the DBH's from July to August

b) Tree coring

In order to estimate the age of each compartment, the core crew cored trees outside each plot. For every species found within each plot, 2 cores were taken at the start and end of the plot. Conifer species were cored, perpendicular to the tree and 30cm from the base of tree and Deciduous species were cored, perpendicular to the tree and at DBH. These cores were stored in straws and placed in a freezer.

c) Coarse Woody Material (CWM) or Coarse Woody Debris (CWD)

For each plot the core crew measured all CWM, over 7.5 cm in diameter, that intersected the center and the two edges of the 40 x 2 m plot. For each piece of wood, the diameter, the decay class, the amount of bark, the height off the ground, the length and the species was recorded.

d) Nearest Neighbour snag

At the beginning of each plot, the closest snag (over 1.3m in height and over 5 cm in diameter) to the start pigtail and its nearest neighbour are measured. The distance between the two snags, the decay class, the species, the % of bark, the diameter at DBH and the height are recorded.

e) Shrubs

In each plot shrubs are being measured. The species, the stem diameter and the shrub height is recorded in a 10 x 2 m area within the plot.

4) **ARTHROPOD COLLECTIONS**

The core crew set up and monitored pitfall and window traps designed by John Spence and bark and woodborer beetle traps designed by Mary Reid.

The pitfall and window traps were established on a stand level and not on a compartment level. Within each of the stand types; deciduous dominant, deciduous dominant with a white spruce understory, coniferous dominant, and mixedwood, and within all 3 replicate stand types, there were 6 traps set up and spaced 50m apart. There were a total of 72 pitfall and window traps monitored from mid May to late August in 1998. Collections took place every two weeks.

Ground dwelling insects, such as carabid beetles, staphylinid beetles and spiders are captured by the pitfall traps. A hole is dug in the ground and a yoghurt container is placed flush with the ground surface. An inner collection cup is inserted within the yoghurt container and filled with a killing and preserving agent, ethylene glycol (car antifreeze). A wooden roof, 20 x 20 cm, is set above the trap by two long nails pounded into two opposing corners of the roof. This acts as a rain guard in order for the samples not to be splashed out.

The window traps capture flying insects. The window traps are a piece of clear Plexiglas, 15cm x 30cm, with a funnel type bag at the bottom of the glass. These traps were set up on dead trees with broken tops near to each pitfall trap. A collection whorl sac is attached to the base of the funnel and is filled with ethylene glycol.

Populations of wood-inhabiting insects were sampled using baited Lindgren funnel traps from May through August, 1998. Two types of baits were used, one for woodborers and one for spruce beetles (*Dendroctonus rufipennis*), both supplied by Phero Tech Inc. One trap of each type was placed in a representative compartment of each forest type replicate. When a single replicate was represented by disjunct forest stands, traps were placed in each stand. A total of 22 stands were sampled (5 ADOM, 4 ADOM U, 6 CDOM, and 7 MX). In addition, some stands had a third trap containing lower release rates of alpha-pinene and ethanol (components of the woodborer baits). Traps were emptied every two weeks by the EMEND core crew, and samples were either frozen or placed in ethanol. These funnel traps were hung on string that was strung between two trees. The base of the trap was 1 meter above the ground. There are 8 and 12 rung funnel traps with a collection cup at the base of the last funnel. There was a block of insecticide (1 cm^3) in the collection cup to kill the bark and woodborer beetles.

5) **SITE CLASSIFICATION**

Alyssa Bradley and Peter Volney were responsible to site classify a small subset of all forest types and all replicates. Ian Corns from the CFS will be using this information in ELDAR.

One small soil pit and one vegetation survey was assessed in all 10% and 50 % treatments for all forest types (a total of 24 compartments were assessed).

A small soil pit was dug and the information recorded is as follows; thickness of organic layer, humus type, soil texture, drainage, slope, moisture regime and nutrient regime. Nested vegetation plots were completed by recording the species and the percent cover of theses species in a 1 x 1m herb plot and a 2 x 2m shrub plot. In order to assess the trees, the dominant tree species in 3.99m radius tree plot was recorded and the canopy cover in 4 cardinal directions was assessed. An additional 20 x 20m walk around in the area was done in order to get a better idea of the dominant tree species.

The site classification guide, Field Guide to Ecosites of West-Central Alberta by Beckingham *et al.* 1996, was used to assess the compartments. The information from the soil pit and the vegetation plots was used to give a letter and number code to the type of each site.

6) **GPS WORK**

The core crew was instructed to GPS the ellipses, the baselines, and the tree plots. A hand-held Geo Explorer II was used to collect the points to give the positions of the above list. The data from the GPS unit was downloaded at DMI and their GPS technician is in the process of correcting the information and creating a map of the study area with the positions of the ellipses, the baselines and the plots.

EMEND FIELD RESEARCH CAMP 1998

A tally of the number of days that researchers used the EMEND camp

A total of 77 people used the EMEND camp facilities (May-Oct.).
The total number of days spent in camp for all EMENDers= **2056**

EMEND Personnel	Title	Project	Association	Number of days spent at the EMEND camp							
				May	*June*	*July*	*August*	*Sept.*	*Oct.*	**Total** *May-Aug*	**Total** *Sept.-Oct.*
Alyssa Bradley	Core crew	Core	U of A	20	24	22	18	20	~	84	
Athena McKnown	Assist.	Veg.	U of A	~	19	23	13	~	~	55	
Barb Kishchuk	Researcher	Soils	CFS	5	2	~	~	~	~	10	
Brent Frys	M.Sc.cand.	Silvi.	U of A	~	~	~	6	~	~	6	
Brent Magnan	Bee Leader	Insects	U of A	~	15	31	14	~	~	60	
Bruce Falkenberg	Assist.	Fungi	CFS	~	~	4	~	~	~	4	
Bruce Robson	Tech.	Hydro.	CFS	~	5	10	11	~	~	26	
Carmen Gibbs	Core crew	Core	U of A	25	18	27	20	~	~	90	
Cecilia Feng	Tech.	Hydro.	CFS	~	5	10	11	~	~	26	
Chad Grekul	Core crew	Core	U of A	26	24	24	18	20	~	92	
Colin Elner	Assist.	Veg.	volunteer	~	~	28	~	~	~	28	
Colin Myrholm	Tech.	Fungi	CFS	~	2	~	~	~	~	2	
Darryl Williams	Tech.	Insects	CFS	~	2	1	~	~	~	3	
Daryl's assistant-Jason	Assist.	Insects	CFS	~	2	1	~	~	~	3	
Dave Langor	Researcher	Insects	CFS	~	4	1	1	~	~	6	
Dennis Kuchar	Assist.	Genetics	U of A	~	~	~	6	~	~	6	
Derek Johnson	Researcher	Veg.	CFS	~	2	18	9	~	~	29	
Dorrie Wiwcharuk	Assist.	Insects	U of C	~	12	~	~	~	~	12	
Doug Jackson	Assist.	Soils	CFS	~	8	~	~	~	~	8	
Ed Stafford	Veg.Leader	Veg.	U of A	~	24	26	15	20	~	65	
Ellen Macdonald	Researcher	Veg.	U of A	~	4	~	~	~	~	4	
Emma Pharo	Researcher	Veg.	U of A	~	7	20	~	~	~	27	
Erin Flynn	Assist.	Veg.	U of A	~	19	23	13	~	~	55	

Gillian Turney	Veg.Leader	Veg.	U of A	~	21	26	27	~	~	54
Graham Hillman	Researcher	Hydro.	CFS	~	5	10	11	~	~	26
Grant Hammond	Assist.	Insects	CFS	~	10	2	1	~	~	13
Hannah Buckley	volunteer	Core	U of A	~	~	~	1	~	~	1
Howard Gates	Ranger	Veg.	CFS	~	~	~	~	3	~	~
Ivor Edwards	Researcher	Soils	CFS	~	~	1	~	4	~	1
Jacqueline Pollard	Core crew	Core	U of A	25	18	27	19	~	~	89
James Berge	Assist.	Birds	volunteer	~	~	~	16	~	~	16
Jan Volney	Researcher	Core/Insects	CFS	~	~	4	~	~	~	4
Jason Kuchar	Assist.	Genetics	U of A	~	~	~	11	?	~	11
Jazmin Grundon	Assist.	Veg./Soils	CFS	~	~	21	9	~	~	30
Jerry Hamilton	Assist.	Soils	CFS	~	8	16	~	~	~	24
Jessica Roberts	Assist.	Micro.	CFS	~	4	7	6	~	~	17
John Dale	Assist.	Veg.	U of A	~	~	~	19	~	~	19
John Spence	Researcher	Core/Insects	U of A	2	2	4	2	~	~	10
Jon Elefson	Tech.	Insects	CFS	~	~	~	~	4	~	~
Judy Pernitsky	Assist.	Insects	U of C	~	12	~	~	~	~	12
Julia Dunlop	M.Sc.cand.	Insects	U of A	28	24	23	14	~	~	88
Katrin Koch	Assist.	Veg.	volunteer	~	26	1	~	~	~	27
Kim Handy	Tech.	Soils	CFS	~	~	~	~	3	~	~
Krista Patriquin-Meldrum	M.Sc.	Bats	U of C	~	~	~	~	~	3	~
Ksenija Vujnovic	M.Sc.	Veg.	U of A	4	~	~	~	~	~	4
Lisa Christensen	Assist.	Birds/Veg.	U of A	22	20	20	16	~	~	78
Lisa Cuthbertson	Core crew	Core	U of A	25	18	27	20	~	~	90
Louis Morneau	M.Sc.cand.	Insects	U of A	28	26	27	22	4	~	101
Mark Dale	Researcher	Veg.	U of A	~	3	~	1	~	~	4
Marshall Grekul	Core crew	Core	volunteer	~	~	3	~	~	~	3
Marty Siltanen	Tech.	Veg.	CFS	~	2	23	~	~	~	25
Mary Reid	Researcher	Insects	U of C	~	5	~	~	~	~	5
Matthew Dickinson	Researcher	Fire	U of C	~	~	~	2	~	~	2
Mike Hobbs	Assist.	Fire	CFS	~	9	7	~	~	~	16
Mike Weber	Researcher	Fire	CFS	~	2	~	2	~	~	4
Mike Weber's guest	Researcher	Fire	??	~	~	~	2	~	~	2
Om Rajora	Researcher	Genetics	U of A	~	~	~	11	?	~	11
Paul Christensen	Assist.	Soils	CFS	~	~	~	~	13	~	~

Peter Szilagyi	Assist.	Veg.	CFS	~	2	23	9	~	~	34
Peter Volney	Core crew	Core	U of A	25	18	27	13	~	~	83
Phyllis Dale	Visitor	~	U of A	~	~	~	1	~	~	1
Ralf Carter	Researcher	Insects	U of L	~	5	~	~	~	~	5
Rene Martin	M.Sc.cand.	Veg.	UBC	~	21	23	15	~	~	59
Richard Kabzems	Researcher	Silvi.	MoF, BC	~	~	~	1	~	~	1
Rick Hurdle	Researcher	Micro.	CFS	~	4	7	6	~	~	17
Rob Martineau	Assist.	Soils	CFS	~	~	1	~	~	~	1
Robert Barclay	Researcher	Bats	U of C	~	~	~	~	~	3	~
Robin Naidoo	Bird Leader	Bird	U of A	22	20	~	~	~	~	42
Roger Brett	Ranger	Veg.	CFS	~	~	~	~	10	~	~
Sam Price	Assist.	Insects	U of A	28	26	25	13	~	~	92
Stefan Little	Assist.	Veg.	CFS	~	2	23	9	~	~	34
Stephan Hebeisen	Core crew	Core	volunteer	6	6	~	~	~	~	12
Stephen Pluhar	Assist.	Genetics	U of A	~	~	~	11	~	~	11
Tim Trahan	Core crew	Core	U of A	20	24	22	18	~	~	84
Tobias Laengle	Student	Veg.	CFS	~	2	~	~	~	~	2
Tom Patocka	Core crew	Core	U of A	25	18	27	19	20	~	89
Vic Lieffers	Researcher	Silvi.	U of A	~	~	~	1	~	~	1

APPENDIX:

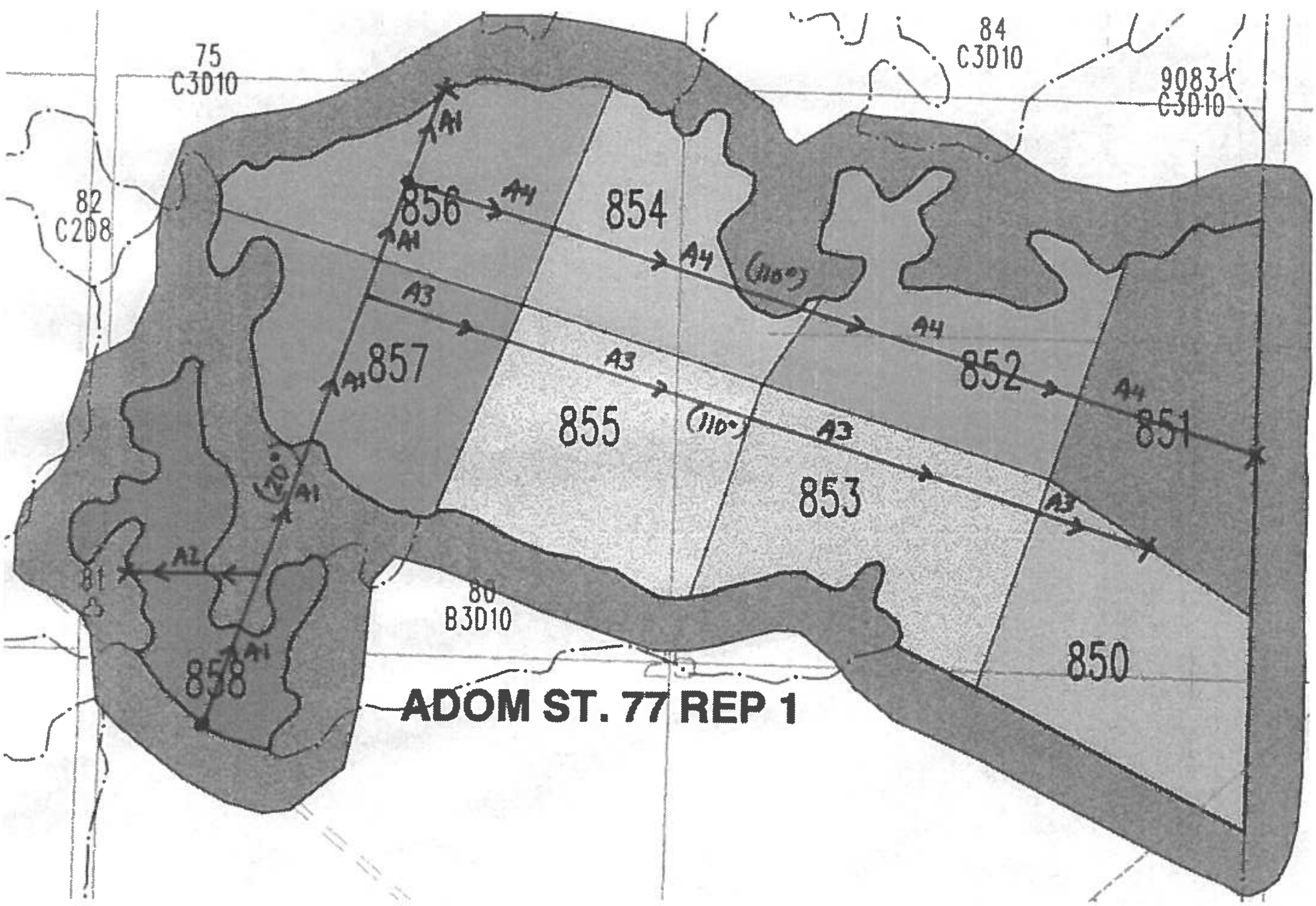
The baseline system

EMEND 1998

BASELINES: A1, A2, A3, and A4

STAND: AD 77 R1

COMPARTMENTS: 850 (CC), 851 (70%), 852 (CONTROL), 853 (50%), 854 (20%), 855 (10%), 856 (LB), 857 (MB), and 858 (HB)

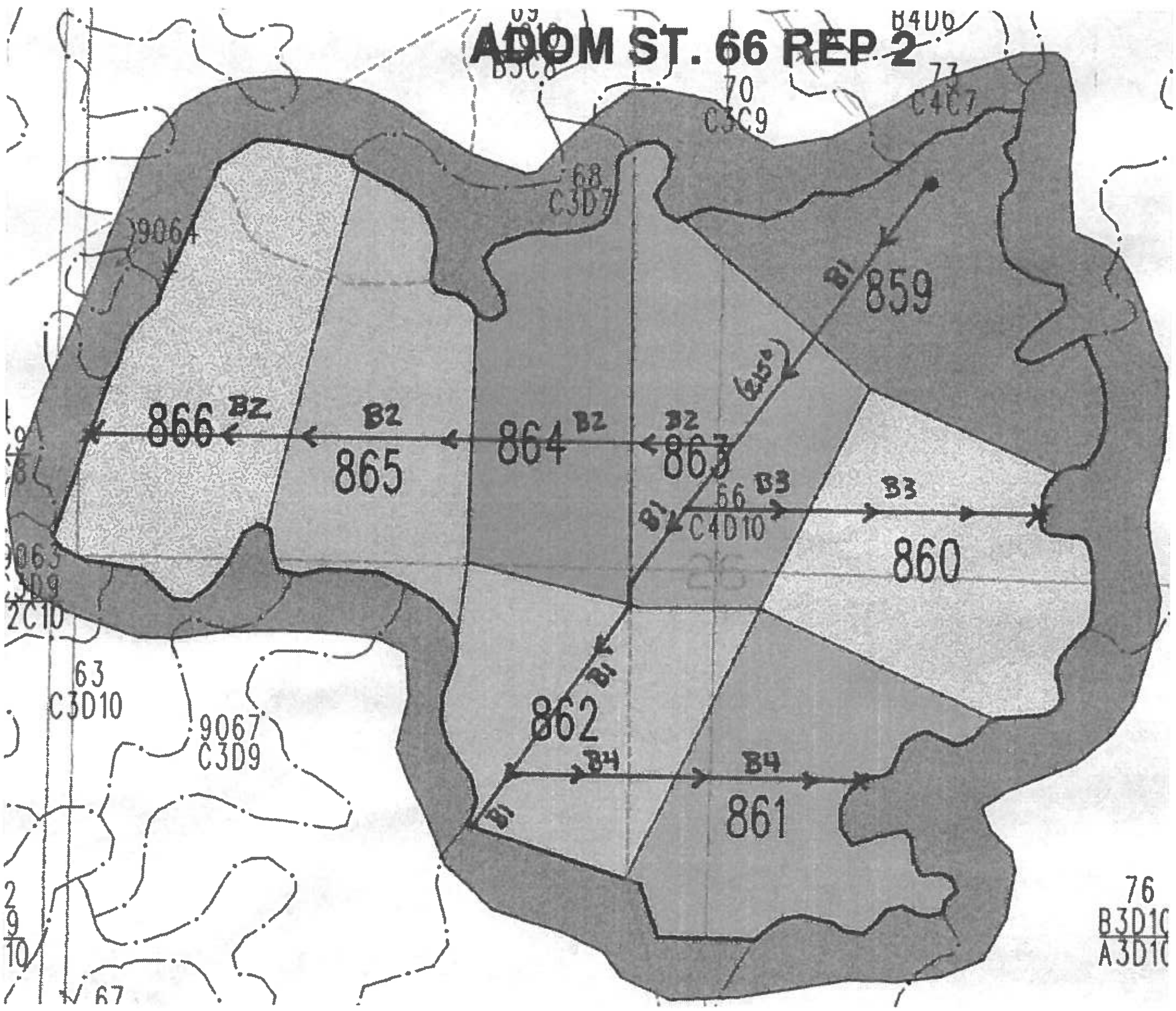


EMEND 1998

BASELINES: B1, B2, B3, and B4

STAND: AD 66 R2

COMPARTMENTS: 859 (70%), 860 (20%), 861 (10%), 862 (CONTROL), 863 (50%), 864 (CC), 865 (MB), and 866 (LB)

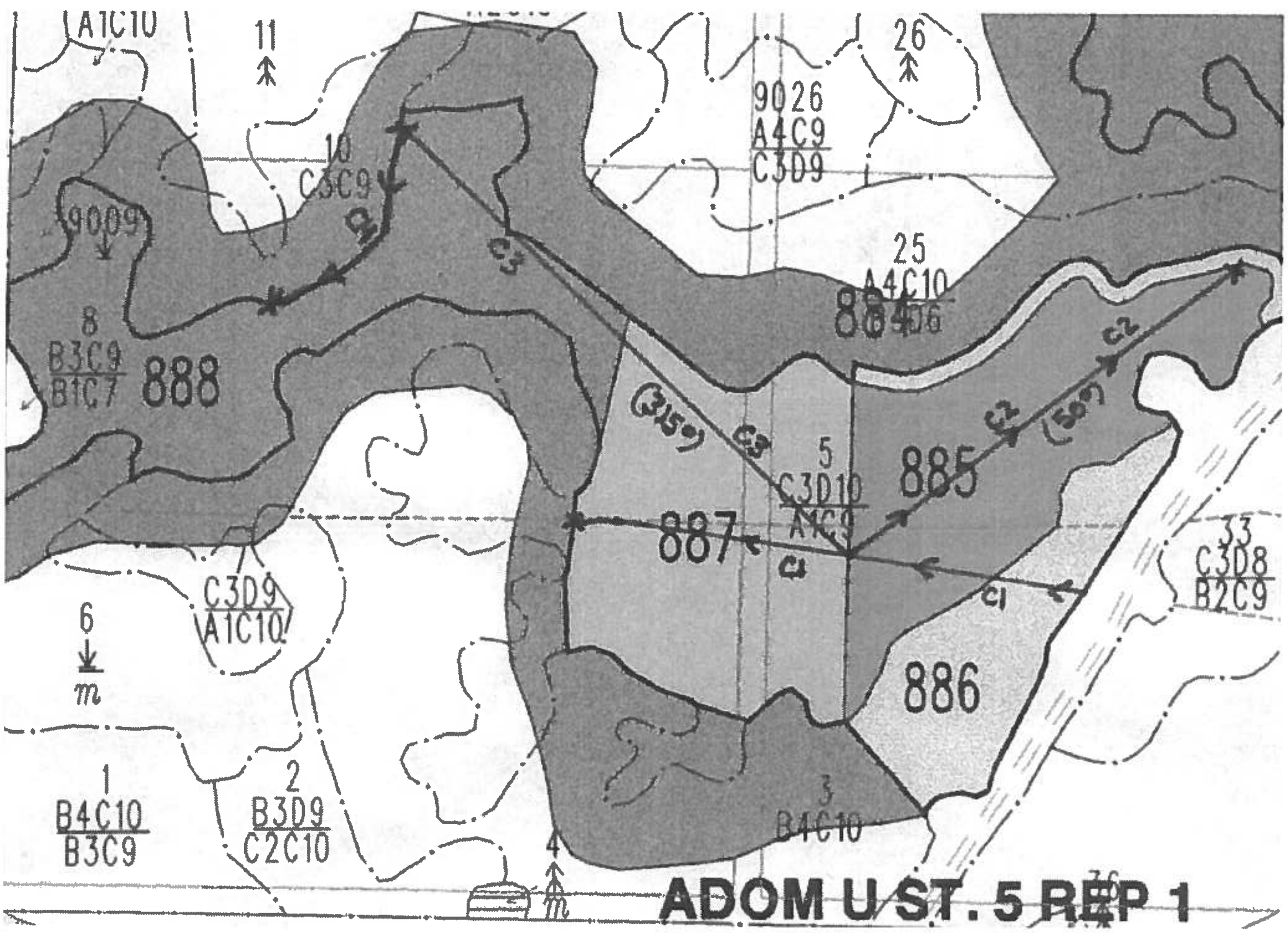


EMEND 1998

BASELINES: C1, C2, C3, and C4

STAND: AU 5 R1

COMPARTMENTS: 885 (MB), 887 (20%), and 888 (CONTROL)

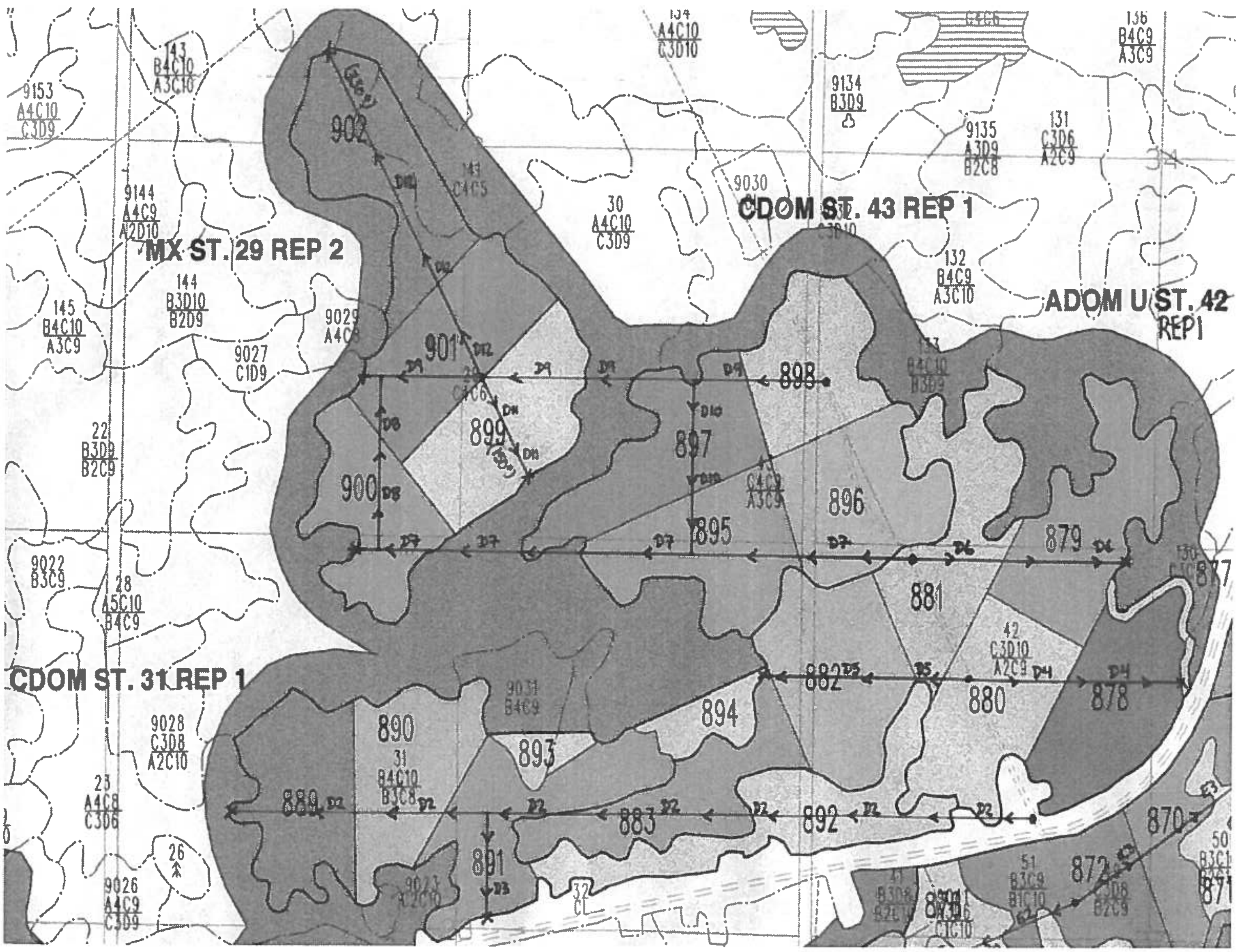


EMEND 1998

BASELINES: D2 to D12

STANDS/COMPARTMENTS:

AU 42 R1: 878 (HB), 879 (10%), 880 (CC), 881 (50%), 882 (70%), and 883 (LB)
CD 31 R1: 889 (CONTROL), 890 (70%), 891 (LB) and 892 (CC)
CD 43 R1: 895 (10%), 896 (20%), 898 (50%), and 897 (MB)
MX 29 R2: 899 (CC), 900 (10%), 901 (MB), and 902 (CONTROL)



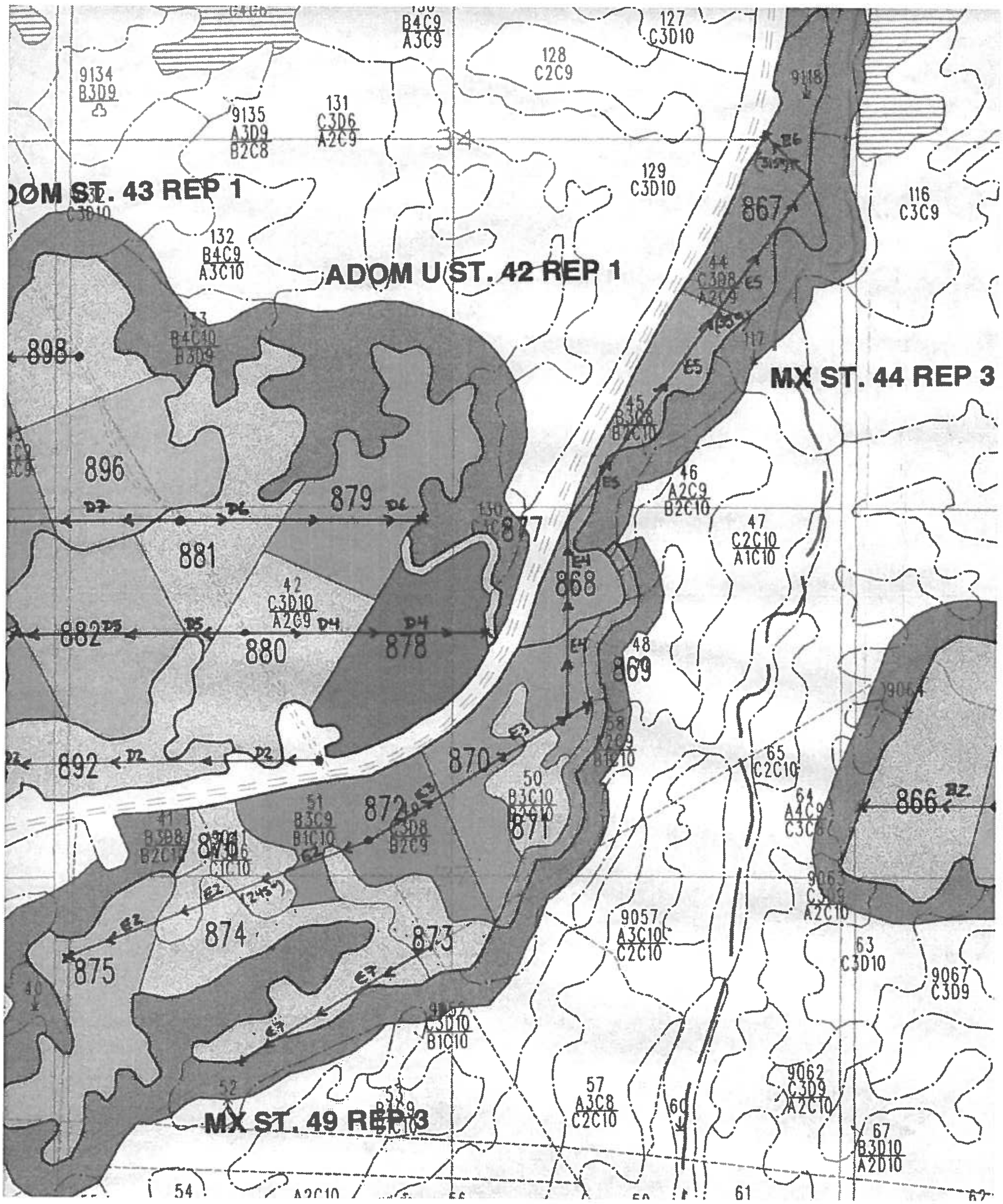
EMEND 1998

BASELINES: E2 to E7

STANDS/COMPARTMENTS:

MX 44 R3: 867 (CONTROL) and 868 (10%)

MX 49 R3: 870 (LB), 872 (MB), 874 (CC), and 875 (20%)

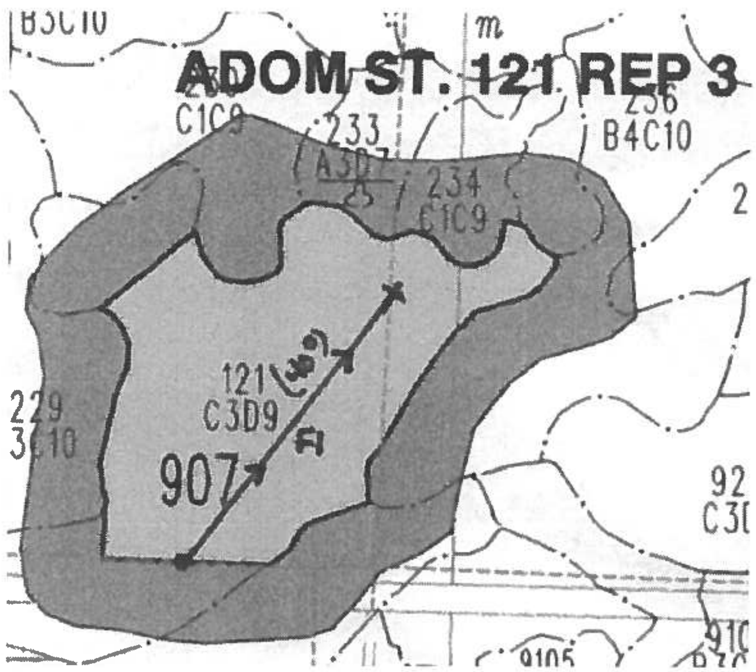


EMEND 1998

BASELINE: F1

STAND: AD 121 R3

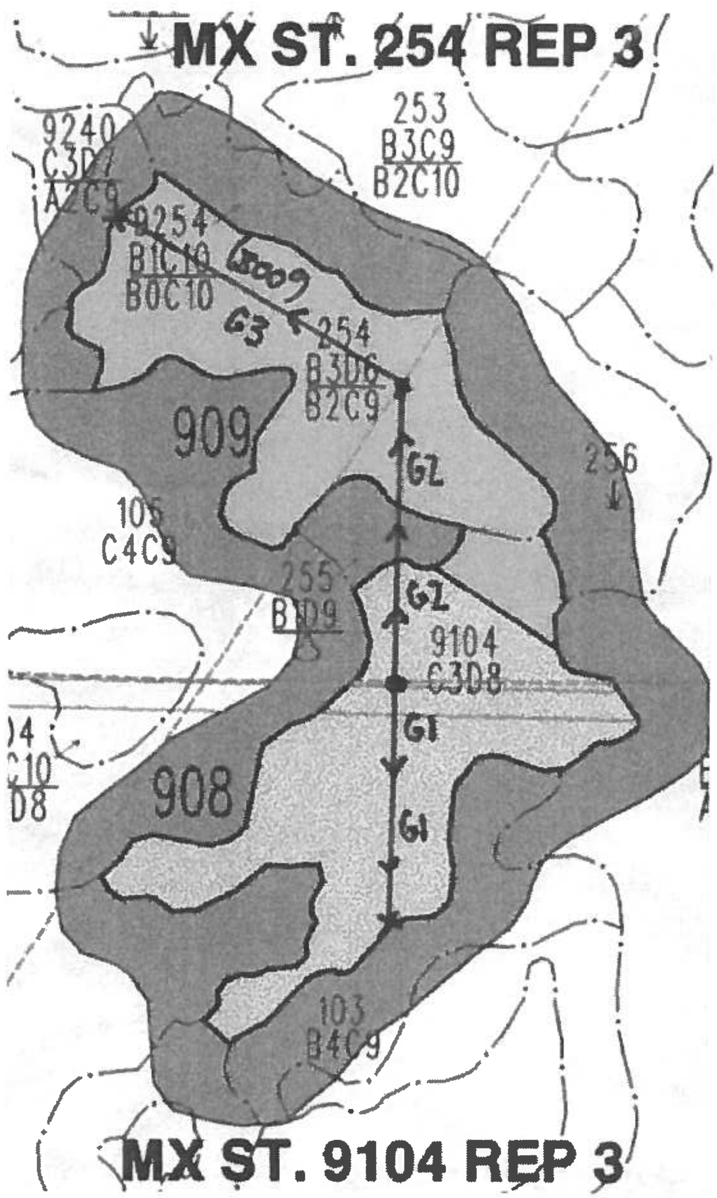
COMPARTMENT: 907 (70%)



EMEND 1998

BASELINES: G1, G2, and G3

STAND/COMPARTMENT:
<u>MX 254 R3</u>: 909 (70%)
<u>MX 9104 R3</u>: 908 (50%)

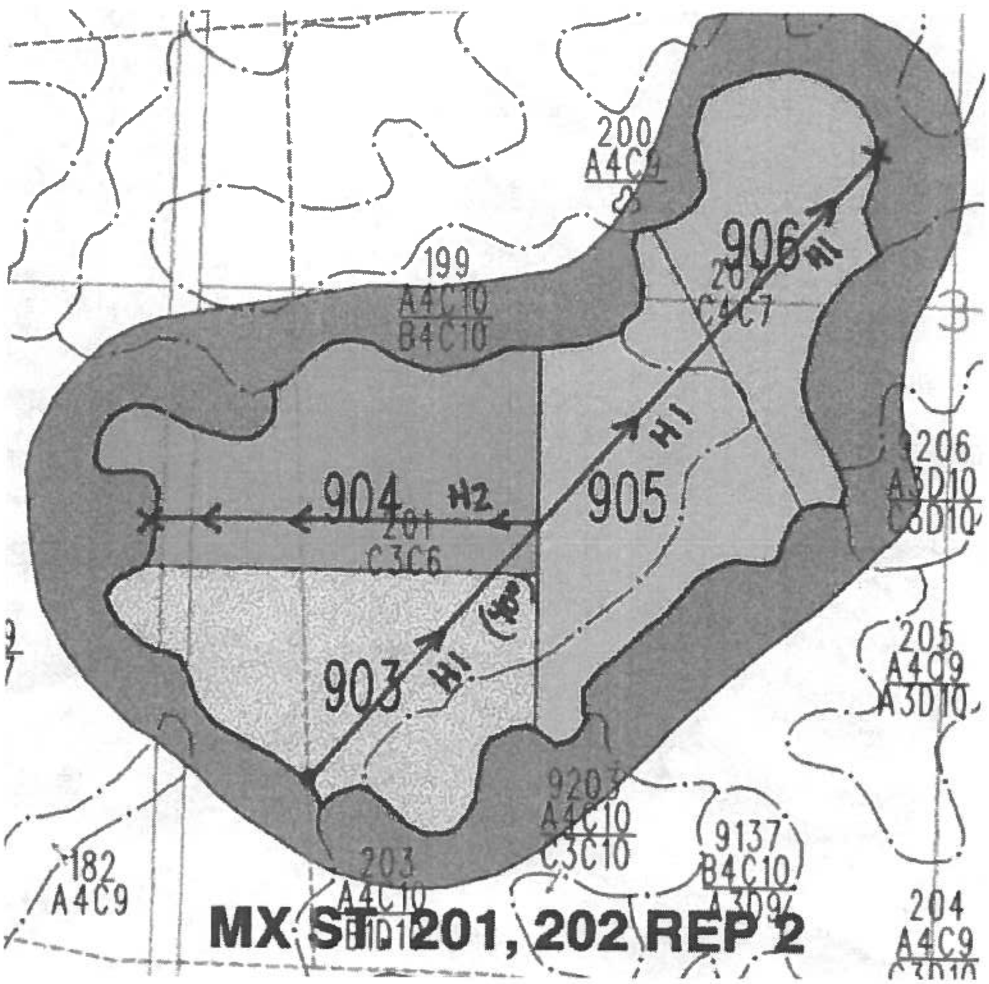


EMEND 1998

BASELINES: H1 and H2

STAND: MX 201, 202 R2

COMPARTMENTS: 903 (50%), 904 (LB), 905 (20%), and 906 (70%)

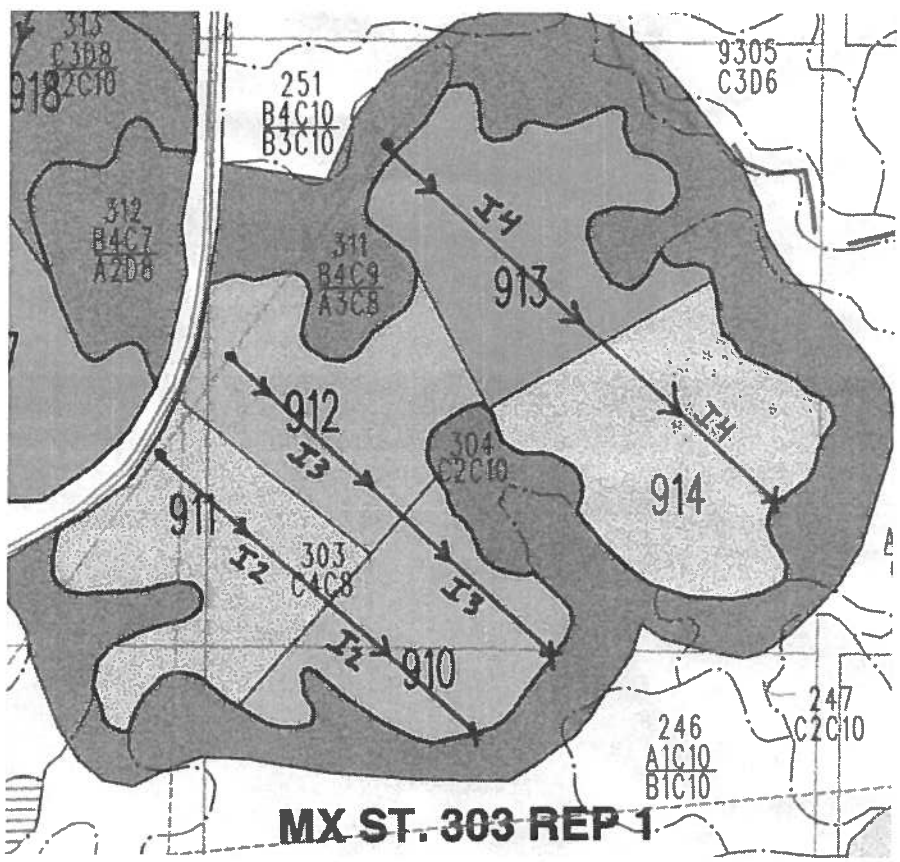


EMEND 1998

BASELINES: I2, I3, and I4

STAND: MX 303 R1

COMPARTMENTS: 910 (20%), 911 (50%), 912 (70%), 913 (10%), and 914 (CC)

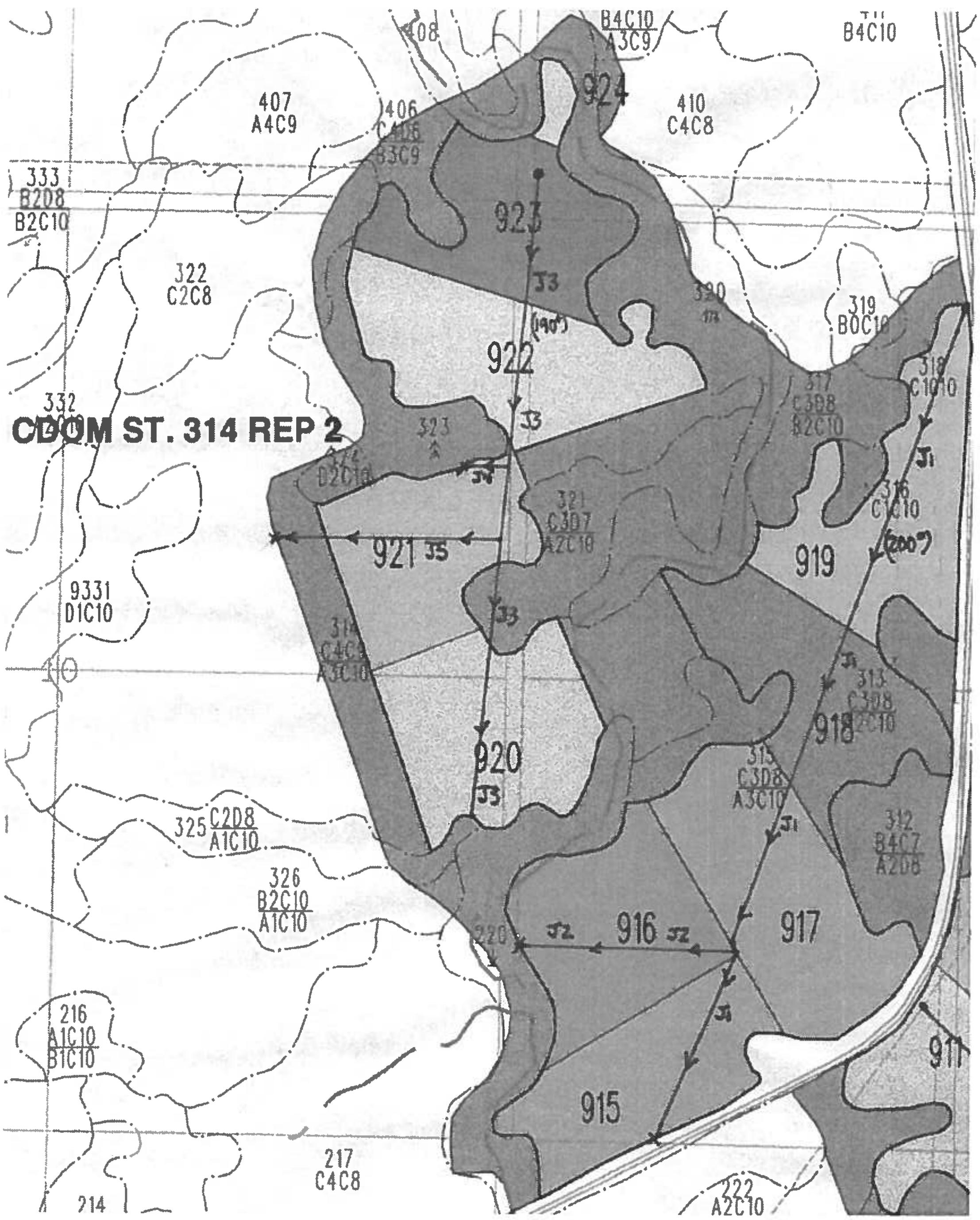


EMEND 1998

BASELINES: J1, J2, J3, J4, and J5

STAND: CD 314 R2

COMPARTMENTS: 915 (LB), 916 (MB), 917 (10%), 918 (CONTROL), 919 (20%), 920 (50%), 921 (70%), 922 (CC), and 923 (HB)

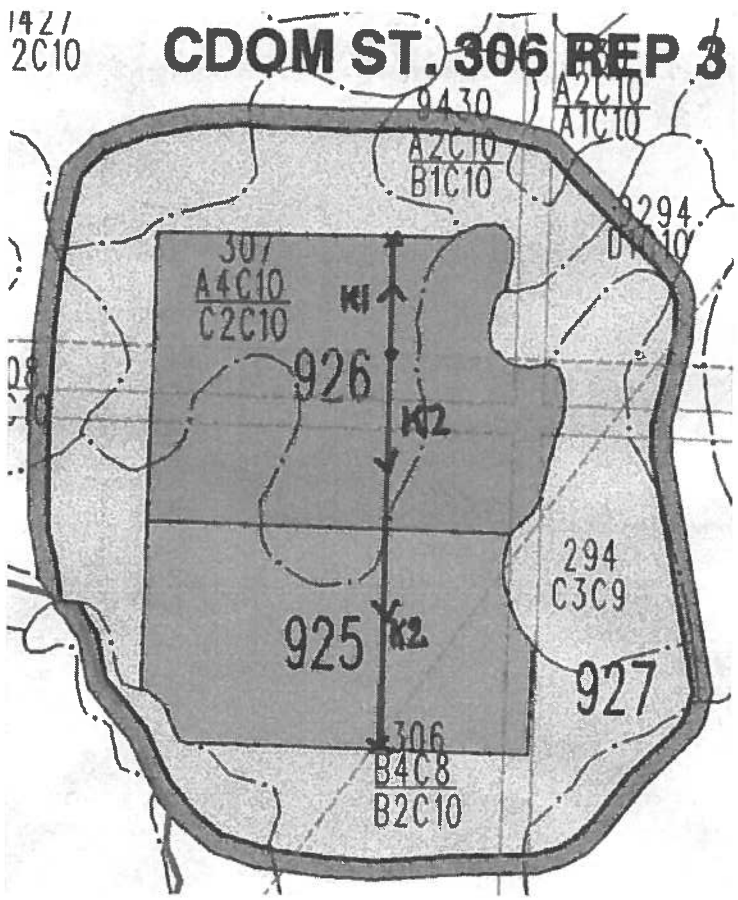


EMEND 1998

BASELINES: K1 and K2

STAND: CD 306 R3

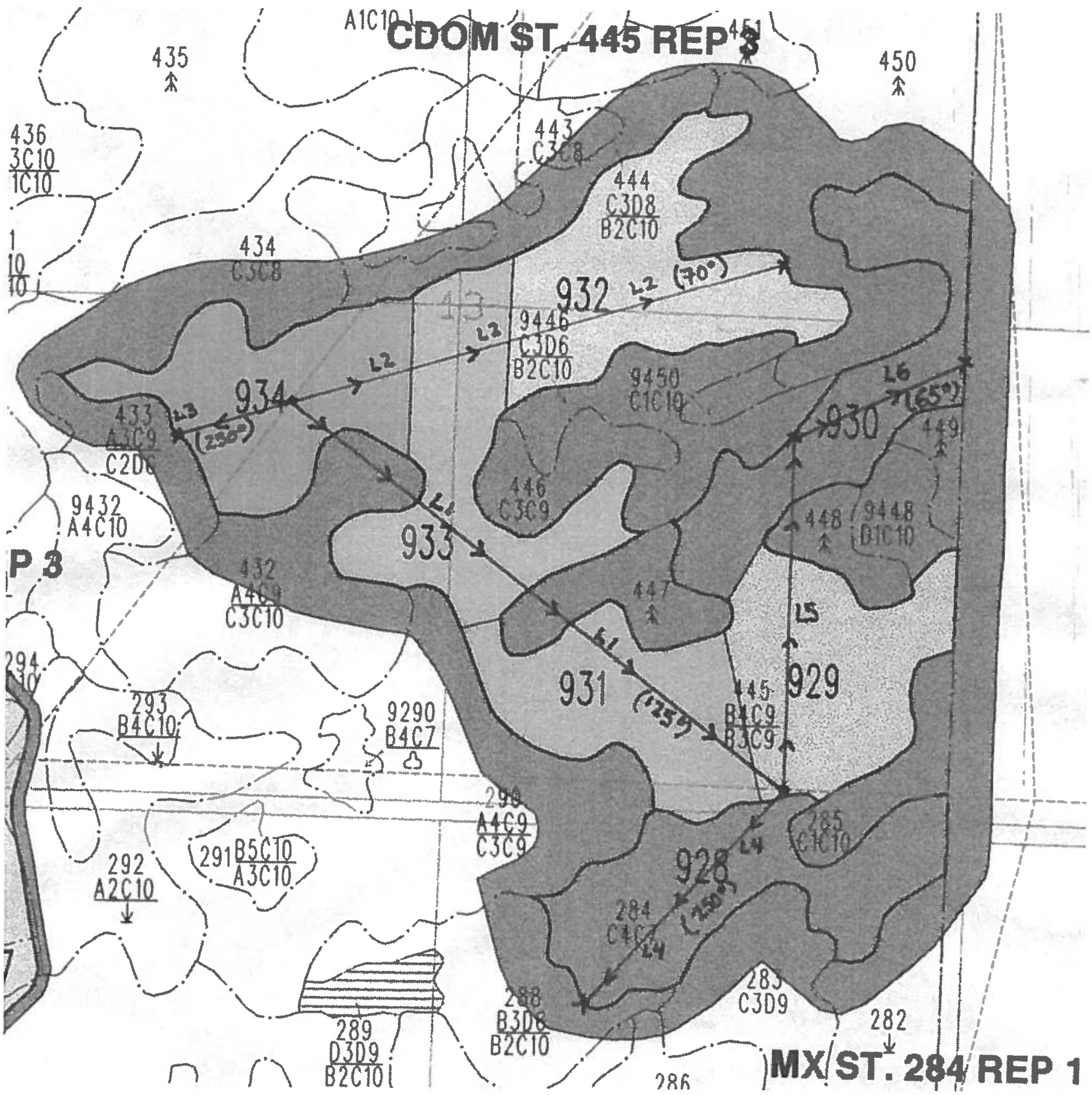
COMPARTMENTS: 925 (LB) and 926 (MB)



EMEND 1998

BASELINES: L1, L2, L3, L4, L5, and L6

STANDS/COMPARTMENTS:
MX 284 R1: 928 (CONTROL)
CD 445 R3: 929 (50%), 930 (CONTROL), 932 (CC), 933 (20%), and 934 (10%)

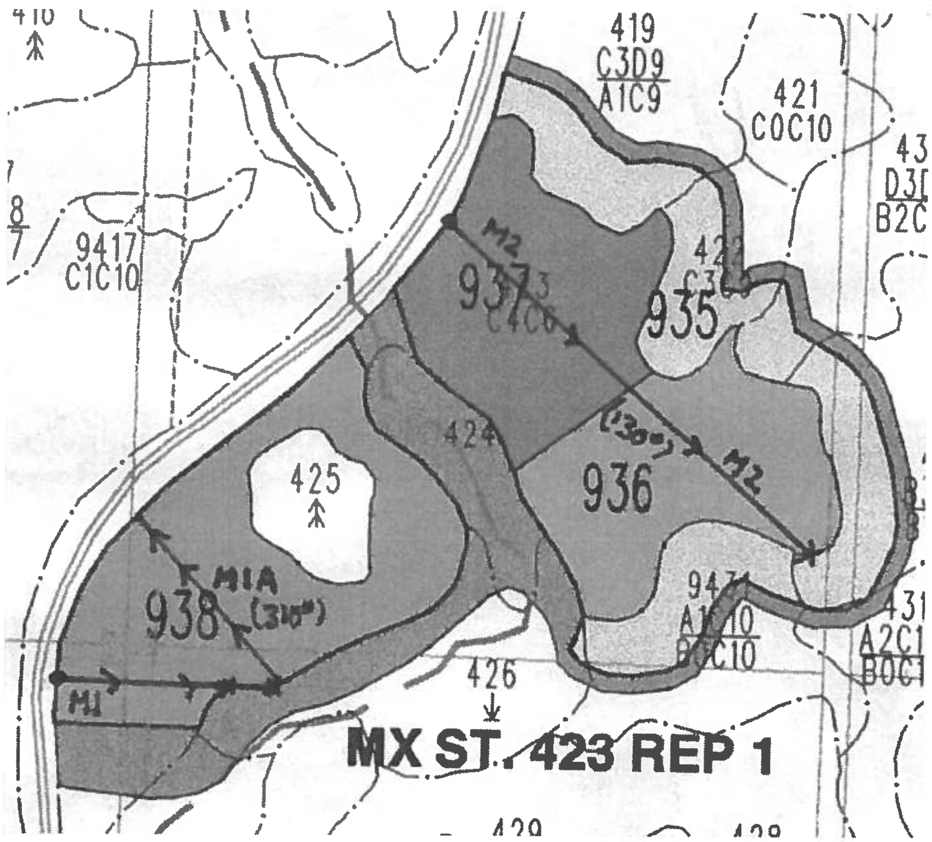


EMEND 1998

BASELINES: M1, M1A, and M2

STAND: MX 423 R1

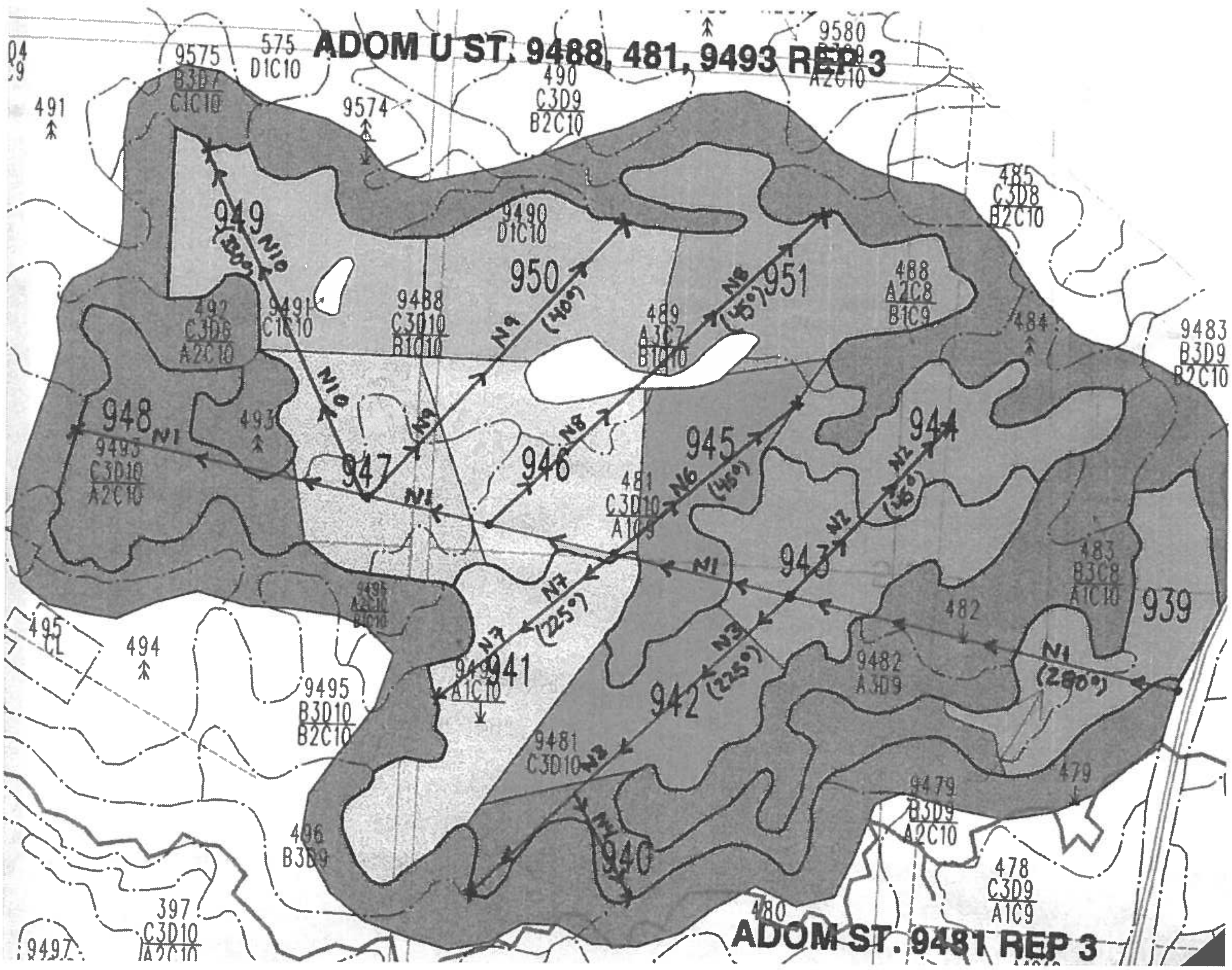
COMPARTMENTS: 936 (LB), 937 (HB), and 938 (MB)



EMEND 1998

BASELINES: N1, N2, N3, N4, N6, N7, N8, N9, and N10

STANDS/COMPARTMENTS: <u>*AU* 9488...R3</u>: 944 (LB), 945 (MB), 946 (CC), 947 (50%), 948 (CONTROL), 949 (20%), 950 (70%), and 951 (10%)
<u>*AD* 9481 R3</u>: 943 (LB), 942 (MB), 941 (CC), 940 (CONTROL), and 939 (10%)

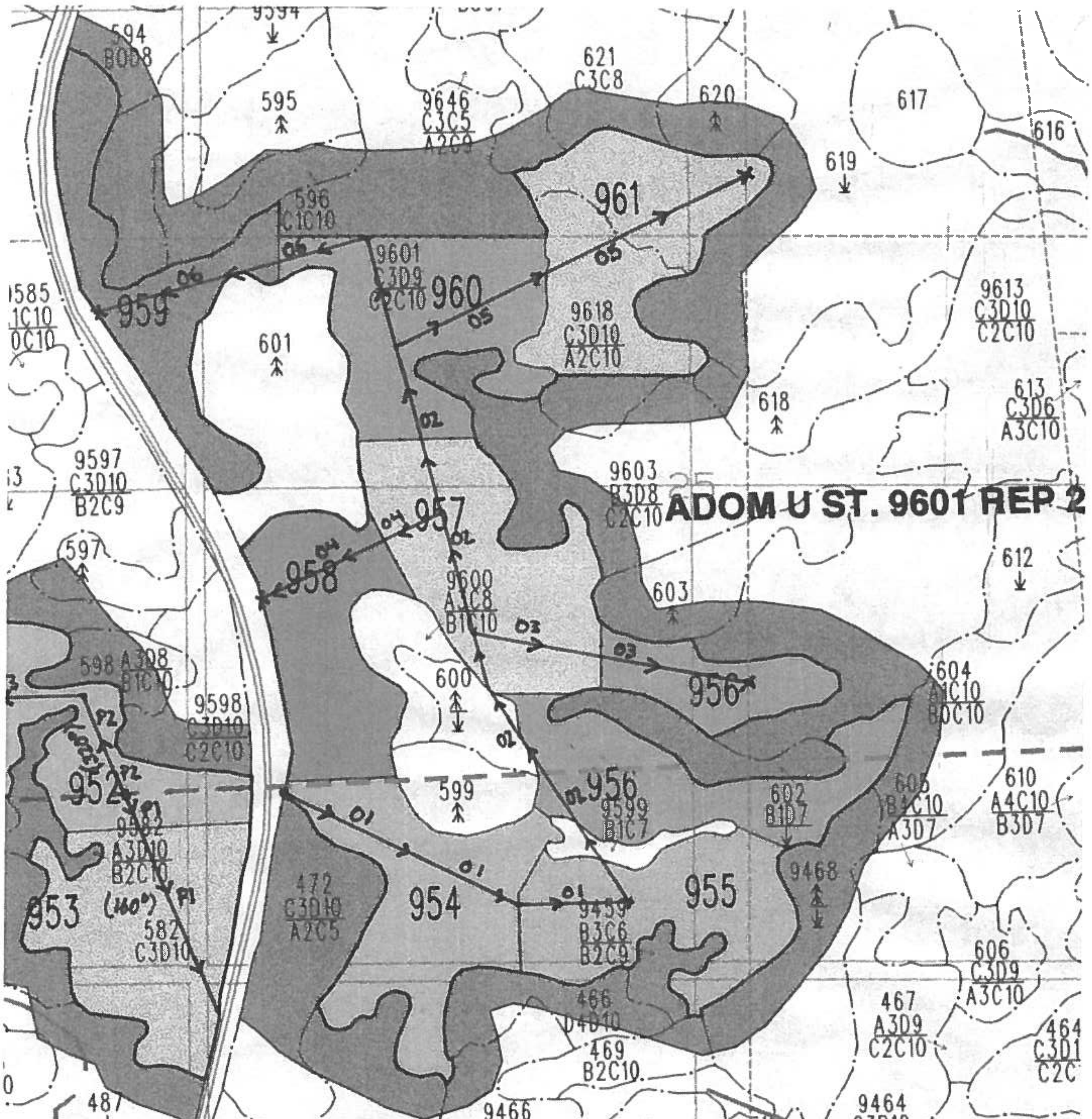


EMEND 1998

BASELINES: O1, O2, O3, O4, O5, and O6

STAND: AU 9601 R2

COMPARTMENTS: 954 (20%), 955 (70%), 956 (10%), 957 (CC), 958 (MB), 959 (CONTROL), 960 (LB), and 961 (50%)



EMEND 1998

BASELINES: P1, P2, and P3

STAND: AD 582 R3

COMPARTMENTS: 952 (20%) and 953 (50%)