VII-10 Flow Sheet and Layout

VII-10-1 Plant Flow Sheet

Following flow sheets have been prepared.

DWG. No. P-02 Cement Plant Flow Sheet (1)

DWG. No. P-03 Cement Plant Flow Sheet (2) (Power Plant)

VII-10-2 Plant Layout

In accordance with the following consideration, DWG. No. P-01 Plant Layout has been prepared and attached to the report.

- Arrangement of Machinery and Equipment

(1) In planning the arrangement of machinery and equipment, the following matters have been mainly taken into consideration.

(i) Easy handling of raw material, raw mix, fuel, clinker and cement.

(ii) Convenience for simple operation and easy maintenance and repair.

(iii) Wind direction

Although it differs from season to season, prevailing wind direction at the proposed plant site is mainly east and west.

In designing plant layout, adequate dust collecting facilities should be provided in the plant, and it is desirable that important machinery and equipment are arranged to be kept free from dust.

(iv) Location of main materials unloading

Limestone, iron ore, gypsum and coal are transported by trucks from south of the plant. And oil shale is transported by truck from north east of the plant.

(v) Space for future expansion

(2) The followings are some important items in planning the plant layout.

(i) Limestone, iron ore and gypsum storage yard

Limestone, iron ore and gypsum storage yards are to be located at western side of the plant, in order to make transportation of the materials convenient.

(ii) Coal storage yard

Coal storage yard is to be located at eastern side of the plant, in order to make transportation of the coal convenient.

(iii) Oil shale storage yard and power plant

Oil shale storage yard and power plant are to be located at the north east corner of the plant in order to make unloading of the oil shale convenient.

(iv) Workshop and Warehouse

Workshop and warehouse are to be located at the southern side of the plant in order to make connection with engineering department convenient.

(v) Offices and welfare facilities, etc.

Offices and welfare facilities are to be located near the main gate at the southern side of the plant, considering the road connection.

(vi) Space for future expansion

For the future plant expansion, sufficient open space is reserved to construct a separate new plant in parallel with the existing plant, since it is possible to execute construction works for the new plant without disturbing the operation of the existing plant.

VII-11 Plan for Company House

As mentioned in III-2, a country-wide recruitment is planned to secure the manpower requirement of the Project, especially for managers and engineers that are not suffciently secured in Mae Sot area.

Therefore, a housing for employees from the outside of Mae Sot area must be provided in the Project, and the housing is planned for 20% of total employees in this study.

VII-11-1 Site for Housing

(1) Site selection

Mae Pa Tai village along the provincial highway, located at 5km from the proposed plant and 4km from the town of Mae Sot has been selected as a site for housing, considering the living environment and the living convenience for residents.

(2) Land allocation

Houses	36,000m^2	(45%)
Welfare Facilities	20,000m^2	(25%)
Green Belt	14,000m^2	(18%)
Roads	10,000m^2	(12%)
Total	80,000m^2	(100%)

VII-11-2 Employee Houses

(1) Design standards

Houses for employees are designed according to the following standards, considering economics, life, non-flamability and comfortableness of living.

i) One-storied and/or two-storied isolated houses or semi-isolated (two houses) houses should be designed.

ii) Houses should be reinforced concrete block made.

(2) Sizes and numbers of employee houses

Rank	Type	No. Required	Area Required
Plant Manager	A	1	$200m^2$
Deputy Plant Manager	A	1	$150m^2$
Section chief	B	28	$120m^2$
Staff	B	1	$600m^2$
Dormitory	B	1	$600m^2$

Note: A: isolated B: semi-isolated

VII-11-3 Welfare Facilities

Welfare facilities of the Project plant is provided to accommodate not only employees living in the employee houses but also all emplyees working in the proposed plant. Moreover, it is planned to contribute to the local society by accommodating outside people living in the area. Outline of welfare facilities to be provided are as shown below.

- Guest house (for 20 guests)
- Club house (for 150 people)
- Sporting facilities (tennis court, small swimming pool, etc.)
- Small garden, open spaces (play-ground for children)
- Auxiliary facilities (water supply tower, swage treater, streetlights)

SECTION VIII ENVIRONMENTAL STUDY

VIII-1 Environmental Standards in Thailand

VIII-1-1 Environmental Quality Standard in Thailand

EQSD (Environmental Quality Standards Division) of NEB (Office of the National Environment Board) issued the environmental quality standards in Thailand in August 1980. In the issued standards, the following items are of major concern to the project, and have been taken into account in this study.

(1) Air quality standards

(i) Ambient air quality standards

Although there is currently no approved ambient air quality standards in Thailand, EQSD has submitted the proposed standards to NEB for reveiw and approval. Table 8-1-1 shows the proposed standards.

(ii) Emission standards for automobiles

(iii) Emission standards for motor launch

- detailed discussion is omitted, and reference is made to the original standards.

(iv) Emission stardards for industries

Ministry of Industry Notification
(Document No. 4, Article 77, 1971)

A factory which emits smoke from furnance or other machines must use smoke stack of adequate height and the black smoke released at the top of the stack shall not exceed 40 percent of Ringlemann Standard except for short periods of time when the furnance operation is started or the ash removing equipment is out of order.

Table 8-1-1 Ambient Air Quality Standards (Proposed by EQSD)

Pollutants \ Average values	1 hour	8 hour	24 hour	1 year	Method for measurement
	mg/m^3	mg/m^3	mg/m^3	mg/m^3	
Carbon monoxide	50	20	-	-	Non dispersive infrared detection
Nitrogen dioxide	0.32	-	-	-	Gas phase chemiluminescence
Sulfur dioxide	-	-	0.30	0.10*	Pararosaniline
Total suspended particulates	-	-	0.330	0.10	Gravimetric
Photochemical oxidant (Czone)	0.20	-	-	-	Chemiluminescence
Lead	-	-	0.01	-	Wet ashing

Note: * refer to geometric mean

(v) Labor standards

Ministry of Interior Notification (1977)

Department of Labor issued the occupational safety standards concerned with the chemical substances in the working environment in the notification of the Ministry of Interior. Standards for mineral dusts which is of most concern to the Project are excerpted in Table 8-1-2.

Table 8-1-2 Labour Standard for Mineral Dust

No.	Substances	Average amount of dusts throughout normal working time	
		(Mppof)	(mg/m^3)
1.	Silica		
	Crystalline:		
	Quartz (respirable dust)	$\frac{250}{\% SiO_2+5}$	$\frac{10\ mg/m^3}{\% SiO_2+2}$
	Quartz (total dust)	-	$\frac{30\ mg/m^3}{\% SiO_2+2}$
	Cristobalite	$\left(\frac{250}{\% SiO_2+5}\right)^{\frac{1}{2}}$	$\left(\frac{10\ mg/m^3}{\% SiO_2+2}\right)^{\frac{1}{2}}$
	Tridymite	$\left(\frac{250}{\% SiO_2+5}\right)^{\frac{1}{2}}$	$\left(\frac{10\ mg/m^3}{\% SiO_2+2}\right)^{\frac{1}{2}}$
2.	Amorphous, including natural diatomaceous earth	20	$\frac{80\ mg/m^3}{\% SiO_2}$
3.	Silicates (less than 1 % crystalline silica):		
	Asbestos	5*	-
	Tremolite	5*	-
	Talc (Asbestos form)	5*	-
	Talc (non-asbestos form)	20	-
	Mica	20	-
	Soapstone	20	-
	Portland cement	50	-
	Graphite	15	-
	Coal dust (respirable fraction less than 5% SiO_2)	-	2.4 mg/m^3
	Coal dust (for more than 5% SiO_2)	-	$\frac{10\ mg/m^3}{\% SiO_2+2}$
4.	Inert or nusisance dust		
	Respirable dust	15	5 mg/m^3
	Total dust	50	15 mg/m^3

Note: * means fibres/1 cc. of air

(2) Noise level standards

(i) Noise level standards for industry

Ministry of Industry Notification
(Document No. 4, 1971)
It is necessary for licence to provide effective ear plugs to persons in a factory which has noise level exceeding 80 dB.

(ii) Noise level standards for automobile

- detailed discussion is omitted, and reference is made to the original standards.

(iii) Noise level standards for launch

- detailed discussion is omitted, and reference is made to the original standards.

(iv) Labor standards

Ministry of Interior Notification (1976)
According to the notification, the following requirements must be met by an employer to ensure safe working conditions for employees.

(a) Employees shall not be continuously exposed to noise level greater than 91 dB(A) for more than 7 hours per day.

(b) If the working hours per day is more than 7 hours but less than 8 hours, employee shall not be continuously exposed to noise level exceeding 90 dB(A).

(c) For more than 8 hours per day, employees shall not be continuously exposed to noise level exceeding 80 dB(A).

(d) Employees shall not be permitted to work under conditions in which the noise level exceeds 140 dB(A).

(3) Waste water quality standards

(i) Industrial waste water standards

Ministry of Industry Notification (1979)

According to the notification, waste water should not be discharged from an industry unless it meets the following standards.

(a) pH value in a range of 5 - 9.
(b) Permanganate value shall not exceed 60 mg/1 .
(c) Total dissolved solids concentration shall not exceed 2,000 mg/1.
(d) Sulfite concentration (SO_2) as hydrogen sulfide (H_2S) shall not exceed 1 mg/1.
(e) Cyanide (CN) as hydrogen cyanide (HCN) shall not exceed 0.2 mg/1.
(f) Maximum heavy metal concentrations shall not exceed the following values.

- Zinc	5.0	mg/1
- Chromium	0.5	mg/1
- Arsenic	0.25	mg/1
- Copper	1.0	mg/1
- Mercury	0.005	mg/1
- Cadmium	0.03	mg/1
- Barium	1.0	mg/1
- Selenium	0.02	mg/1
- Lead	0.2	mg/1
- Nickel	0.2	mg/1
- Manganese	5.0	mg/1

(g) Tar = none
(h) Oil and grease concentration shall not exceed 5 mg/1.
(i) Formaldehyde concentration shall not exceed 1 mg/1.
(j) Phenols and Cresols concentration shall not exceed 1 mg/1.
(k) Free chlorine concentration shall not exceed 1 mg/1.

(l) Insecticide and radioactive substances = none

(m) If the mixture ratio of waste water and receiving water is between 1/8 to 1/150, 1/151 to 1/300 and 1/301 to 1/500, total suspended solids shall not exceed 30, 60, and 150 ppm respectively.

(n) BOD (at 5 day, 20°C) maximum allowable concentration may be 20 to 60 mg/l depending on location and characteristic of receiving water as well as discharging techniques as determined by inspector.

(o) Temparature shall not exceed 40°C

(p) Color and odor of waste water after discharged into receiving water shall not induce undesirable effects.

VIII-1-2 Environmental Impact Assessment and Industrial Projects

According to the National Environmental Quality Act (amended 1978), the Ministry of Sciense, Technology and Energy has issued the proclamation in which the types and sizes of projects or activities requiring Environmental Impact Assessment (EIA) reports and measures for the prevention of and remedy for the adverse effects on environmental quality are stipulated. In the proclamation, cement industries, regardless of their sizes, are stipulated as the projects that require the EIA reports. Therefore, the Initial Environmental Examination (IEE) report and the Environmental Impact Study (EIS) report must be prepared by the Project owner in accordance with the NEB's guideline for the Environmental Impact Assessment, when the Project becomes implementation stage. Appropriate measures and or remedy, if necessary, for the adverse effects on environmental quality may be advised by NEB after reviewing the EIS report.

VIII-2 Selection of Pollution Control Equipment

In order to meet the previously discussed environmental quality standards in Thailand, the necessary pollution control equipment is designed and selected in the Project as described below.

VIII-2-1 Pollution Control Equipment for Air Quality

Potential pollutants to be considered for the ambient air quality in the Project are suspended particulate, nitrogen dioxide and sulfur dioxide. Among these pollutants, nitrogen dioxide and sulfur dioxide are generated in the cement kiln and the fluidized bed combustion boiler. However, nitrogen dioxide emission can be easily controlled to sufficiently low level by the operational control, while sulfur dioxide emission is expected to be sufficiently low because generated sulfur dioxide is readily retained by lime content contained either in raw materials or in fuel oil shale. Besides the cement kiln being major source, particulate is generated at several other places in the production process, and the dust collector that reduces the suspended particulate in flue gas to 40% of Ringlemann Standards must be installed to meet the standards. In this study, 0.1 g/Nm^3 of suspended particulate concentration which is more strict than the above mentioned standards has been taken as design criteria for the dust collector. Appropriate electric precipitators, cyclones and bag filters have been selected depending upon the operating conditions.

VIII-2-2 Pollution Control Equipment for Waste Water

In the Project, no appreciable amount of waste water containing hazardous pollutants is expected to occur in the production process. A small amout of waste water generated in the boiler feed water treatment unit and from the labolatory is treated in the nutralization unit to meet the quality standard for ultimate discharge. Other miscellaneous waste water including sanitary sewage is also discharged after treated in the sewage treatment unit.

VIII-2-3 Pollution Control Equipment for Noises

No special measure must be taken to reduce the noise level to outside the plant, as there exist no private houses in the vicinity of the proposed plant site.

VIII-2-4 Improvement of Working Conditions

Sufficient measures have been considered in the plant design to reduce noise level and dust concentration in the working area of the plant so as to meet the standards.

VIII-2-5 Oil Shale Ash Landfill

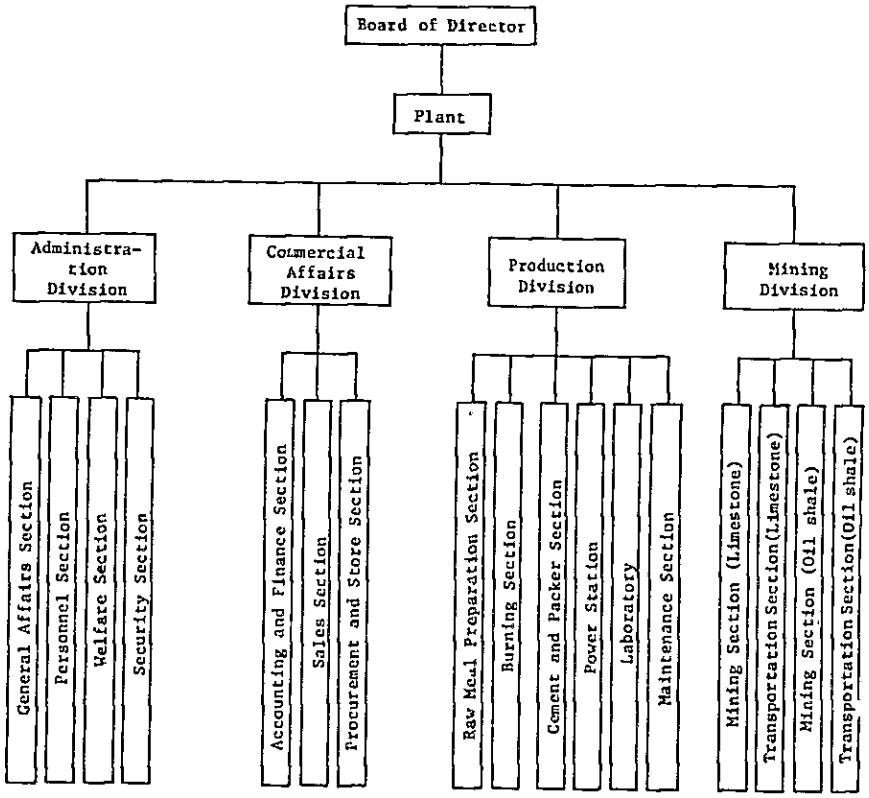
In the Project, a large volume of oil shale ash (combustion residue) is produced in the fluidized bed boiler, and most of the oil shale ash is utilized both as a raw material for the cement kiln and as a cement mixing material. However, it may be still necessary to dispose some excess ash to an appropriate disposal area (Landfill). Furthermore, removed top-soil in limestone quarry and oil shale mine must also be disposed properly. When disposing these materials, a sufficient measure should be taken to prevent the secondary pollution problem from the disposed materials. The method and measure for this problem are discussed in detail in SECTION IV of this report.

SECTION IX ORGANIZATION AND MANNING PLAN

IX-1 Organization

The outline of organization planned for the Project is shown in Table 9-1-1.

Fig. 9-1-1 The Organization Chart



IX-2 Manning Plan

Labor intensive manning plan has been prepared for the Project in an attempt to increase labor opportunity as much as possible in Mae Sot area.

IX-2-1 Manning Plan

Manning plan for plant and quarry of the Project is shown below.

XI-2-2 Manning Plan

The following is the breakdown of manning plan for the organization mentioned in IX-1.

(1)	Plant manager and plant vice-manager	:	2
(2)	Administration division		
	Administration manager	:	1
	General affairs section	:	8
	Personnel section	:	10
	Welfare section	:	6
	Security section	:	21
	Sub-total	:	46
(3)	Commercial affairs division		
	Commercial manager	:	1
	Accounting and finance section	:	8
	Sales section	:	8
	Procurement and store section	:	12
	Sub-total	:	29
(4)	Production Division		
	Production manager and assistant manager	:	2
	Staff of production division	:	6
	Raw Meal preparation section	:	34

Burning section		:	40
Cement and packer section		:	70
Power station		:	22
Laboratory		:	16
Maintenance section		:	74
Sub-total		:	264

(5) Mining Division

Mining manager and assistant manager		:	3
Staff of mining division		:	9
Limestone mining section		:	16
Limestone transportation section		:	19
Oil shale mining section		:	23
Oil shale transportation section		:	43
Sub-total		:	113

(6) Total personnel requirements : 454

IX-2-3 Detailed Breakdown

Detailed breakdown of personnel requirements for production division is shown below.

(1) Production management office

Production manager		:	1
Assistant manager		:	1
Engineer		:	6
Sub-total		:	8

(2) Raw Meal preparation section

Chief of section		:	1
Foreman		:	1
Limestone and iron ore unloading		:	4
Limestone and iron ore storage	2x4	:	8

	Oil shale silo, ash silo and raw mix	2x4	:	8
	Raw mill	2x4	:	8
	Raw meal silo and compressor	1x4	:	4
	Sub-total		:	34
(3)	Burning section			
	Chief of section		:	1
	Foreman		:	1
	NSP kiln and cooler	5x4	:	20
	Coal unloading		:	2
	Cool storage	2x4	:	8
	Coal mill	2x4	:	8
	Sub-total		:	40
(4)	Cement and packer section			
	Chief of section		:	1
	Foreman		:	2
	Gypsum		:	1
	Cement mill	4x4	:	16
	Cement silo	2x2	:	4
	Packer man	6x2+6 (paper bag)	:	18
	Weigh of bag	3x2	:	6
	Loading		:	22
	Sub-total		:	70
(5)	Power station			
	Chief of section		:	1
	Foreman		:	1
	Oil shale unloading		:	4
	Oil shale preparation	2x4	:	8
	Boiler and turbine	2x4	:	8
	Sub-total		:	22
(6)	Laboratory			
	Chief chemist		:	1

	Chemist		:	2
	Tester		:	12
	Assistant		:	1
	Sub-total		:	16
(7)	Maintenance section			
	Chief of section		:	1
	(i) Workshop (mechanical)			
	Foreman		:	1
	Welder and assistant		:	8
	Turner and assistant		:	4
	Fitter and assistant		:	8
	Blacksmith and assistant		:	3
	Construction worker and assistant		:	6
	Vehicle repairing and assistant		:	10
	Carpenter and assistant		:	4
	Shift mechanician	3x4	:	12
	(ii) Workshop (electrical)			
	Foreman		:	1
	Electrical and assistant		:	4
	Shift electrician	3x4	:	12
	(iii) Sub-total		:	74
(8)	Grand total		:	264

SECTION X CONSTRUCTION OF PLANT AND OPERATION PLAN

X-1 Procurement and Transportation of Machinery and Equipment and Construction Materials

The following is the three comprehensive categories of the items needed for cement plant construction.

(1) Mechanical and electrical equipment incorporated in a cement plant, and spare parts thereof (hereinafter referred to as Plant Equipment).

(2) Building materials forming permanent parts of these facilities to support or house the Plant Equipment, and to store the raw materials and fuel, and buildings and structures necessary for operating or maintaining the plant (hereinafter referred to as Plant Building Material).

(3) Equipment and temporary work materials needed in the construction of the facilities mentioned in (2) above using the Plant Building Material and those needed in the erection of the Plant Equipment (hereinafter referred to as Plant Construction Equipment).

X-1-1 Plant Equipment

The Plant Equipment consist of many components and many of them must be imported, however, the Plant Equipment which are available in Thailand should be procured locally as much as possible.

There are some common components among the Plant equipment, and, therefore, interchangeability should be taken into account when procuring (to procure, for example, machines of same type bucket elevators, belt conveyors, motors, etc. from the same manufacturer as far as it is possible).
The standards should be consistent and the ones well-known in Thailand.
In addition, the Plant Equipment should be durable and trouble free.

X-1-2 Construction Materials (Civil)

Almost all construction materials may be procured in Thailand, however the following points of materials with respect to the standard and quality must be investigated beforehand.

(1) Verification of the materials' standard and quality

(i) Verify that cement does not deteriorated due to factors such as aeration.

(ii) Coarse aggregates of crushed limestone and fine aggregates can be procured from local traders in Mae Sot. However the fineness, strength, impurities, etc. of the aggregates should be inspected.

(iii) In this area city water can be supplied, but underground water should be tested.

(iv) Tensile strength of deformed bars, formed steel and steel pipes must be tested.

(2) Verification of quality and accuracy

The following items are to be verified.

(i) For steel products, inspection of welded parts, dimension and product accuracy of all members, etc.

(ii) For concrete products, compressive strength, shape, dimension accuracy, etc.

(iii) For exterior and finishing materials, material (water resistance, durability, etc.), shape, color, etc.

(iv) For fixtures, material, shape, dimension accuracy, etc.

(v) For building equipment, capacity, material, shape, etc.

X-1-3 Transportation of Construction Materials and Equipment

In constructing a cement plant, the transportation condition is an important factor.
The heaviest equipment for the Project is approx. 60 ton with about 4 m diameter by 12 m length.
The transportation route for the Project is as described in VI-3-1-(3) (Transportation route of construction equipment).

The following three points must be considered when transporting large equipment.

(1) Existence of structures crossing about the road

(2) Contour of the road (hair-pin curve, road corner, etc.)

(3) Width of road and side clearance (including bridges)

No problems were observed on the route which was investigated, however as described in VI-3, the route between Tak and Mae Sot must be further investigated in detail before the Project implementation.

Major points to be considered for transportation of heavy equipment and material are as follows.

- Strength of bridge

- Gradient of road

The strength of bridge especially refers to the strengthening of the existing bridge (The First Bridge) described in VII-9-2-(3) (Access road), also problem on road gradient has been previously described.

The transportation may be conducted by the Express Transportation Organization on behalf of the contractor, since they have conducted the transportation of construction equipment and material for EGAT project. The organization is capable of conducting the transportation of the heavy, large equipment for the Project.

X-2 Construction Plan of Plant

The most important things in order to implement a cement plant construction project smoothly and completely as scheduled, are to appoint an appropriate consultant, to select a suitable construction contractor and to conclude a reasonable contract.
These matters are described hereinafter.

X-2-1 Appointment of Consultant

It is necessary to appoint the consultant who is well experienced in cement plant projects as an assistant for the implementation of the Project.

The consultant will:

- prepare the basic design of the Project
- prepare a tender document for tenderers
- evaluate tenders submitted by tenderers
- assist the client in negotiating with the tenderers and conclude a contract with the successful tenderer.

Futhermore, during the construction period, the consultant, on behalf of the client, will carry out the check and the approval of the detailed design submitted by the contractor, and supervise the construction works.

X-2-2 Forms of Contract

Generally speaking, the forms of contract should be examined on both faces, i.e., a face of the scope of contract works and a face of the contract account. As for the Project, the form of contract should be determined taking into account of such various conditions as the characteristics of the Project, the actual conditions of industries in Thailand, the import policy of Thailand and the source and method of the construction fund etc..

(1) Classification of contract by scope of works

The construction works of a plant is generally composed of design, supply of machinery and equipment, civil works, erection and commissioning etc., and the contract form is divided into two types, i.e., one type in which the construction works are performed by two or more contractors and the other type, so-called Full Turn Key type, in which the works are executed by only one contractor.

In the former, unless the scope of works, guarantee and responsibility of each contractor are strictly specified, the ambiguous parts, which will take place in the responsibility of each contractor, will cause the congestion of the construction works and hinderance in guarantee of plant performance. Accordingly a careful consideration should be taken for the preparation of the agreement and the conclusion of the contractor.

In the Full Turn Key type contract, the works are generally carried out by sub-contractors based on the contracts concluded between the contractor and several sub-contractors and therefore the same kinds of problems as those in the former may be existent. Nevertheless, this type of contract is simple and clear for the client because all the works are executed, all the guarantees are made and all the responsibilities are assumed by the contractor.
The contract amount of this type of contract, however, generally tends more expensive than that of the former due to the costs to be added to the estimate for covering the risk caused by those problems.

(2) Classification of contract by determining-method of contract amount

The form of contract is divided into two types by the captioned method, i.e., Lump Sum type and Cost plus Fee type.

The Lump Sum type is mostly adopted in case the scope of works is definite, and the following types are included in it.

- Lump Sum Fixed Price Contract:
  Original Type of the Lump Sum contract

- Lump Sum Contract with Escalation:
  This type is applied for eliminating the risk due to inflation.

- Lump Sum plus Unit Price Contract:
  This type is applied in case a part of quantity of work is undecided.

The Cost plus Fee type is adopted for the following cases in which,

- the definite estimate can not be made because the scope of works, the specification and the risk of inflation etc. are not determined at the conclusion of contract;

- the changes of specifications and construction works are foreseen; and

- the client wants to leave the door open to further negotiation on the determination of suppliers of machinery and equipment as well as method of construction works etc.

In this contract the following types are included.

- Cost plus Fixed Fee Contract

- Cost plus Sliding Fee Contract

- Cost plus Fee Contract with Ceiling Amount Guaranteed

The common problem of each type lies in whether which part of the scope of work is included in Cost and which is Fee.

Accordingly, it is important to specify clearly the distinction of Cost and Fee in the contract taking account of the characteristics of the project and the conditions of the client and the contractor.

The forms of contract are described as above and the form to be adopted for the Project should be determined after careful examination taking account of the various conditions given at the beginning.

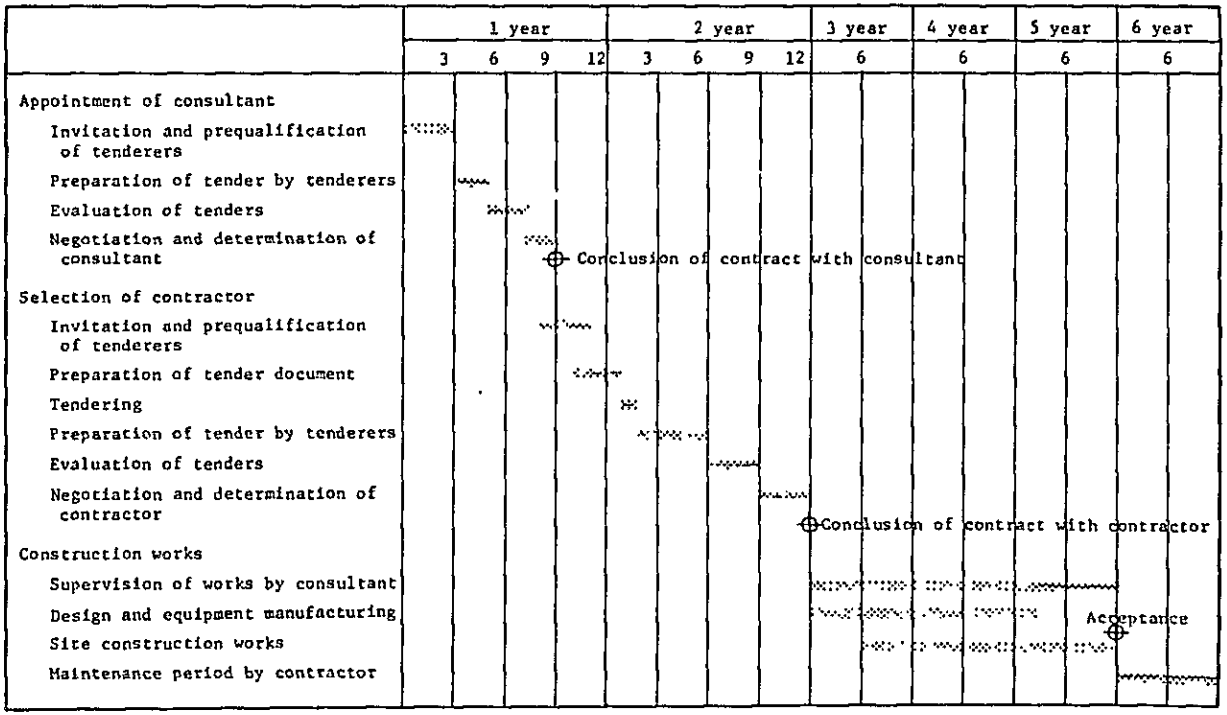
X-2-3 Schedule of Project Implementation

The approximate schedule of the Project implementation is described as follows. (In case of Full Turn Key Contract)

Appointment of a consultant	:	about 9 months
Selection of a contractor	:	about 1 year 3 months
Construction works	:	about 3 years
Total	:	about 5 years

The schedule mentioned above is estimated in case the Project is implemented smoothly.
The schedule bar chart is shown in Fig. 10-2-1.

Fig. 10-2-1 Schedule of Project Implementation



X-3 Operation Plan of Plant

The plant to be constructed in the Project is equipped with various modern facilities such as fluidized bed boiler using oil shale etc..
It is, therefore, necessary to train the employee sufficiently before the commercial operation.

The production in the initial stage should be determined considering the market demand. However the demand forecast in Table 2-1-13 shows considerable market demand.

The operation rate of the plant is determined tentatively as follows considering skillness of employee and experience in other similar projects.

1st year	:	70 %
2nd year	:	80 %
3rd year	:	70 %
4th year and thereafter	:	100 %

The figure mentioned above is rather conservative, and it is advisable that the operation rate be raised as much as possible.

SECTION XI TOTAL CAPITAL REQUIREMENT

The total capital requirement for the Project of integrated power generation and oil shale cement plant with a capacity of 808,500 tons per year of cement and 12.5 MW of power generation is described in this SECTION. The basic premises for the calculation of capital requirement are as follows;

(1) Base of price (1982 constant price base)

The prices and costs are fixed at 1982 price and therefore the escalation is not considered in the calculation.

(2) Exchange rate

Thai currency portion is calculated in Baht, and foreign currencies, both Y (Japanese yen) and US$ are converted into Baht using the exchange rate as described below:

1 U.S. Dollar (US$) = 23 Baht
1 U.S. Dollar (US$) = 240 yen
1 Baht = 10.4 Yen

(3) Others

The plant cost is estimated on a full turn-key lumpsum basis, and the import duty for equipment is assumed to be exempted.

XI-1 Total Capital Requirement

The total capital requirement is the total cost to be invested by the time when the Project starts commercial operation. The following table shows the results of calculation of the total capital requirement.

Table 11-1-1 Total Capital Requirement

(1,000 Baht)

	Foreign currency	Local currency	Total
Fixed capital	1,936,568	1,159,800	3,096,368
Working capital	0	105,259	105,259
Total	1,936,568	1,265,059	3,201,627

XI-1-1 Fixed Capital Requirement

In this study, the fixed capital requirement is defined as a sum of costs and expenses for quarry development, plant equipment, erection of plant, civil works, miscellaneous expenses, contingency, and consultant fee. Interest during construction and preoperation cost are capitalized and calculated in the fixed capital cost.

(1) Quarry development

The total cost for quarry development consists of costs for quarry equipment, roads for transportation of raw material, land acquisition, preparation for mining, facilities required for mining, etc.

(2) Equipment and machinery

The cost of the plant and auxiliary equipment is paid by foreign currency, and the engineering fee is also included in this item.

(3) Inland transportation

The inland transportation cost is the cost required for the transportation of import equipment and materials from the unloading port to the proposed plant site.

(4) Plant erection

This expense consists of the cost for field works such as storage, erection, assembly of the plant equipment at the plant site, and the cost for the equipment and materials necessary for the field works.

(5) Civil work

The costs required for land preparation, construction of access roads, buildings, foundation, concrete work and housing are estimated in the civil work cost.

(6) Expense for construction

This expense includes the general expenses associated with the field construction work, and some portion of expense for test run.

(7) Miscellaneous cost

(8) Contingency

The contingency is estimated to be 5 percent of a sum of (1)-(7).

(9) Consultant fee

This fee is the cost paid to consultants for preparation and evaluation of tender, supervision of construction works, etc.

(10) Land acquisition

The land needed for access road, housing and plant installation is to be purchased, and its cost is calculated is the land acquisition cost.

(11) Pre-operating expense

Pre-operating expense is the total of expenses required during the construction period, of which breakdown is shown in Table 11-1-2.

(i) Training expense

The training expense includes the salaries paid to 3 foremen and 20 operators during their training period in Thailand, the living expenses paid to 5 engineers during their training abroad, and the expenses paid to these engineers covering their travels abroad.

(ii) Administration cost

The personnel mentioned below are employed 2 years before the start of commercial operation, and salaries are paid to these personnel during the 2 years period. Indirect expenses incidental to such payment are also calculated in the administration cost.

- President (Concurrently serves as plant manager) and secretary 1/1
- Department heads 5
- Staff engineers 10
- Shift supervisors and analyst 3

(iii) Materals for test run

The expense required for the test run is estimated to cover the cost for raw materials and operating supplies required for the production of 1,000 tons of cement.

(12) Interest during construction

The interest during construction is calculated in the fixed capital cost.

(13) Fixed capital requirement

Table 11-1-3 shows a breakdown of the fixed capital requirement.

Table 11-1-2 Pre-Operating Cost

(1,000 Baht)

	-2	-1	Total
Training expenses	0	943	943
Administration cost	11,344	11,344	22,688
Materials for test run	0	1,344	1,344
Total	11,344	13,631	24,975

Table 11-1-3 Fixed Capital Requirement

(1,000 Baht)

	Foreign currency portion	Local currency portion	Total
Construction cost			
Development of quarry	142,520	80,250	222,770
Equipment and facilities	1,235,770	0	1,235,770
Inland transportation	0	7,360	7,360
Erection work for equipment	0	161,960	161,960
Civil and construction works	0	678,260	678,260
Expenses for construction	170,270	92,220	262,490
Miscellaneous expense	71,875	57,500	129,375
Contingency	81,020	53,880	134,900
Consultant fee	47,920	0	47,920
Sub-Total	1,749,375	1,131,430	2,880,805
Land acquisition	0	4,170	4,170
Pre-operating expense	775	24,200	24,975
Interest during construction	186,418	0	186,418
Fixed capital requirement	1,936,568	1,159,800	3,096,368

Note: Outline of cost estimation for civil and building

Construction cost of civil works and building of the Project has been estimated based on the cost data obtained from private compaines in Thailand, as no cost data for the public construction work was obtained by the study team. Reference was made to the cost data prevailing in Japan, when necessary, in the estimation. Cost estimation basis is briefly summarized below:

- Construction materials are to be procured in Thailand.

- Design of major structures is to be of reinforced concrete made.

- Foundation of the plant is direct fundation type. Oil shale layer underlying the proposed plant site is to be used as a support layer of the foundation. Where oil shale layer is too deep, an artificial support layer made of rubble mixed concrete is designed.

- Asphalt-concrete and macadam are the adopted for the pavement of in-plant roads in order to reduce the construction cost.

- Design of access road is as described in XII-9-2, (2).

XI-1-2 Working Capital

The initial working capital means the funds required for an enterprise to continue its daily business activities. In this study, the working capital is defined as a total of operating cash, raw materials and product inventories and account receivable minus account payable. Breakdown of the initial working capital is shown in Table 11-1-4. As the balance of account receivable minus account payable increases in parallel with the increase of operating rate, the balance is compensated for the increase in the initial working capital.

Table 11-1-4 Initial Working Capital

	Amount of inventory		Unit price (Baht/t)	Per cost (1,000 Baht)
	(day)	(dry/t)		
Raw Material				
Limestone	8.5	15,000	63.2	948
Oil shale	4.3	8,000	123.2	985
Oil shale powder	5.0	3,000	135.0	405
Oil shale combustion residue	3.5	3,000	0.0	0
Iron ore	118.0	3,200	840.0	2,688
Gypsum	22.6	1,900	560.0	1,064
Consumables				
Coal	14.8	1,500	700.0	1,050
Cement bag	14.0	34,300	5.0	172
Raw meal	4.3	7,000	100.0	700
Clinker	10.7	15,000	800.0	12,000
Product				
Unbaged cement	8.2	20,000	1,360.0	27,200
Baged cement	2.0	4,800	1,430.0	6,864
Cash				19,838
Sub-total				73,914
Account receivable				34,262
Account payable				-2,917
Initial working capital total				105,259

XI-2 Financing Plan

The sources for the required funds have not been fixed yet at present. However, the following financing plan is assumed for this calculation based on the discussion between the concerned authorities of Thailand and the study team.

(1) Equity

30% of the total capital requirement is paid-up by own capital fund.

(2) Conditions for long-term loan

70% of total capital requirement is covered by long-term loan.

Interest rate	:	10.0% p.a.
Debt repayment	:	12 installments/12 years equal annual payment, 3 years' grace period after commercial operation

(3) Condition for short-term loan

Short-term loan is borrowed when cash position shows deficit.

Interest rate	:	17% p.a.
Repayment of principal	:	All debt is to be paid back in the next year after borrowing.

SECTION XII FINANCIAL ANALYSIS

Financial analysis of the Project is made in this SECTION. The revenue and the cost in the integrated power generation and oil shale cement project are analyzed in detail and the profitability of the Project is evaluated. In this financial analysis, the construction period before the start of commerical operation and its operational life are considered to be 3 years and 20 years respectively.

Analysis is made on the assumption that the Project is implemented by a private business entity. The income statement and the cash flow table are formulated from the calculated revenue, investment and the production costs of the Project throughout the project period. The profitability of the Project is assessed by the calculated values of the FIRR (Financial Internal Rate of Return). The major premises for the financial analysis are described hereinafter.

XII-1 Premise of Financial Analysis
(For Base Case)

XII-1-1 Basic Premise

(1) Project life
- o Construction period : 3 years
- o Commercial operation period : 20 years

(2) Plant capacity
- o Oil shale cement : 323,400 t/yr
- o Mix cement : 485,100 t/yr
- o Electricity for sale : 14,256,000 kWh/yr

(3) Operation rate (330 days per year at 100% operation))
- o First year : 70 %
- o Second year : 80 %
- o Third year : 90 %
- o Forth year and after : 100 %

XII-1-2 Price Basis

(1) Price basis

The 1982 fixed price is adopted as a price basis in this financial analysis. That is, every prices and costs are calculated at 1982 fixed price basis and the escalation and inflation are not incorporated in the calculation.

(2) Exchange rate

- o 1 U.S. Dollar (US$) = 23 Bahts
- o 1 U.S. Dollar (US$) = 240 Yen
- o 1 Baht = 10.4 Yen

XII-1-3 Fund

The total capital required for the Project is explained in XI-2, and this plan is applied to this financial analysis. The financing conditions including short-term loan, which may be borrowed in case that shortage of funds occurs during the commercial operation period, are as described below:

(1) Debt equity ratio

- o 30 % is covered by equity (own capital fund)
- o 70 % is covered by long-term loan

(2) Condition of long-term loan

- o Interest rate : 10 % p.a.
- o Debt repayment : 12 installments/12 years equal annual payment, 3 years' grace period after commercial operation.

(3) Condition of short-term loan

- o Interest rate : 17 % p.a.
- o Debt repayment : All debt is to be paid back in the next year after borrowing.

XII-1-4 Tax and Insurance

According to the results of discussion made between the concerned authorities and the study team, the tax and the insurance in the analysis are treated as shown below:

(1) Tax

Corporate tax is assumed to be 35 percent of taxable income. Excise tax is 6 percent of total revenue, and business tax is 10 percent of the excise tax.

(2) Insurance

Insurance cost is assumed to be 0.5 percent of the investment cost excluding costs for contingency and consultant fee.

XII-1-5 Depreciation and Amortization

The conditions for the calculation of depreciation and amortization are set as follows based on the discussion results with the concerned authorities.

	Depreciation method	Salvage value
Machinery and equipment for quarry, vehicle	5 yr straight line	0
Machinery and equipment for plant	10 yr straight line	10 %
Civil and building	20 yr straight line	10 %
Pre-operation cost and interest during construction	10 yr straight line	0

XII-2 Disbursement Schedule of Total Capital Requirement

Disbursement schedule of the total capital requirement discussed in XI-1 is summarized in Table 12-2-1.

Table 12-2-1 Disbursement Schedule of Total Capital Requirement

(1,000 Baht)

Year	-3	-2	-1	Total
Construction cost	720,201	1,152,322	1,008,282	2,880,805
Land acquisition	4,170	0	0	4,170
Pre-operating expense	0	11,344	13,631	24,975
Interest during construction	0	50,706	135,712	186,418
Working capital	0	0	105,259	105,259
Total	724,371	1,214,372	1,262,884	3,201,627

Note: (-) in year indicates construction period.

30% of total capital requirement is paid by own capital fund and, the balance, 70% of the requirement is borrowed. The disbursement schedule of own capital and borrowed long-term loan is shown in Table 12-2-2.

Table 12-2-2 Debt and Equity

(1,000 Baht)

Year	-3	-2	-1	Total
Equity	217,311	364,312	378,866	960,489
Debt	507,060	850,060	884,018	2,241,138
Total	724,371	1,214,372	1,262,884	3,201,627

XII-3 Sales Plan

Sales volume and revenue of mix cement and oil shale cement, and those of electricity are described in Table 12-3-1.

Table 12-3-1 Sales Volume and Revenue

Products \ Year	1	2	3	4 - 20
Oil shale cement				
Sales volume (t/yr)	226,380	258,720	291,060	323,400
Unit price (Baht/t)	1,610	1,610	1,610	1,610
Mix cement				
Sales volume (t/yr)	339,570	388,080	436,590	485,100
Unit price (Baht/t)	1,310	1,310	1,310	1,310
Electricity				
Sales quantity (kWh/yr)	9,979,200	11,404,800	12,830,400	14,256,000
Unit price (Baht/kWh)	1.3	1.3	1.3	1.3
Revenue (1,000 Baht/yr)	822,281	939,750	1,057,219	1,174,688

XII-3-1 Production Plan

The plan for cement production and power generation is the same as described in XII-1-1 - (3).

XII-3-2 Sales Volume

Most of the product cement is planned to be marketed in the northern area of Thailand. As for the excess electricity generated in the Project, it is planned to be supplied to Mae Sot area through PEA. The current demand for electricity in Mae Sot area reaches approximately 7 million kWh/year and is expected to increase steadily in future. Excess electricity for sale is determined to be approximately 14 million kWh/year at 100 percent load operation.

XII-3-3 Prices of Products

Based on the results of market survey, prices for cement and electricity described below are applied in the calculation of revenue.

Oil shale cement	:	1,610 Baht/t
Mix cement	:	1,310 Baht/t
Electricity	:	1.3 Baht/t

XII-4 Production Cost

The production cost consists of operating cost, depreciation and interest of loan.

XII-4-1 Operating Cost

The operating cost is divided into direct cost and fixed cost. The direct cost covers costs required for raw materials, utilities, and maintenance. The fixed cost consists of costs required for direct operating labor, insurance, plant overhead and fixed cost for mining.

Table 12-4-1 shows the calculation results of operating cost during the commercial operation periods.

Table 12-4-1 Operating Cost

(1,000 Baht)

Year	1	2	3	4 - 20
Direct Cost				
Raw material				
Limestone	3,963	4,529	5,095	5,661
Oil shale	10,062	11,499	12,937	14,374
Iron ore	5,162	5,922	6,663	7,403
Gypsum	10,617	12,134	13,650	15,167
Sub-total	29,824	34,084	38,345	42,605
Fuel	18,105	20,691	23,278	25,864
Fire brick	6,767	7,734	8,700	9,667
Grinding media	5,110	5,840	6,570	7,300
Lube oil	410	469	527	586
Electricity	0	0	0	0
Paper bag	39,616	45,276	50,936	56,595
Repair	15,847	18,110	20,374	22,638
Direct cost total	115,679	132,204	148,730	165,255
Fixed cost				
Labor cost	24,317	24,317	24,317	24,317
Plant overhead and insurance	49,966	49,966	49,966	49,966
Fixed cost for mining	47,604	47,604	47,604	47,604
Fixed cost total	121,887	121,887	121,687	121,887
Operating cost	237,566	254,091	270,617	287,142

(1) Direct cost

(i) Cost for raw materials

Unit consumption of raw materials

Limestone	0.7002	t/t-cement
Oil shale	0.7630	t/t-cement
Iron ore	0.0109	t/t-cement
Gypsum	0.0335	t/t-cement

Unit price (dry base) : (Details are shown in ATTACHMENT 4)

Limestone	10.0	Baht/t
Oil shale	23.3	Baht/t
Iron ore	840.0	Baht/t
Gypsum	560.0	Baht/t

Unit raw materials cost per 1 ton of cement

52.696 Baht/t-cement

(ii) Cost for fuel

Unit consumption of fuel (coal) 0.0457 t/t-cement

Unit price 700 Baht/t

Unit fuel cost per 1 ton of cement

31.990 Baht/t-cement

Note: As oil shale for fuel use is calculated in (i), only coal requirement for kiln is counted in this cost item.

(iii) Cost for fire brick

Unit consumption of fire brick 0.657 kg/t-cement

Unit price 18,200 Baht/t

Unit fire brick cost per 1 ton of cement

11.957 Baht/t-cement

(iv) Cost for grinding media

Unit consumption of grinding media	
For raw material mill	0.120 kg/t-cement
For cement mill	0.250 kg/t-cement
Total	0.370 kg/t-cement
Unit price	24,400 Baht/t
Unit grinding mdia cost per 1 ton of cement	
	9.028 Baht/t-cement

(v) Cost for lube oil and grease

Unit consumption	
Lube oil	0.02 1/t-cement
Grease	5 g/t-cement
Unit lube oil and grease cost per 1 ton of cement	
	0.725 Baht/t-cement

(vi) Paper bag

Unit paper bag expense per 1 ton of cement

70.0 Baht/t-cement

(vii) Repair expenses

Unit repair expense per 1 ton of cement

28.0 Baht/t-cement

(2) Fixed cost

The fixed cost consists of direct labor cost, insurance, plant overhead and fixed cost for mining.

(i) Labor cost

The required number of labor and personnel for the plant operation is discussed in IX-2. They are divided as follows:

- Direct personnel (302)
- Indirect personnel (152)

The direct personnel are the workers below foreman class in the production department.

Since the indirect personnel expense is included in the plant overhead, only the personnel expense for the direct personnel will be discussed here. The personnel expense includes social security costs such as health insurance, welfare pension insurance, and these costs are assumed to be 20% of the paid wage and salary.

The direct personnel expense is shown below.

	(Unit: 1,000 Baht)
Salary and wage	20,264
Social security	4,053
Total	24,317

(ii) Cost for insurance

The cost for insurance is calculated to be 0.5% of construction cost (excluding contingency and consultant fee). The cost amounts to 13,490 thousand Baht per year.

(iii) Plant overhead

(a) Indirect personnel expense

This expense is personnel expense for the indirect personnel and includes 20% of the social security expense. The indirect personnel

are the general manager and staffs in the management department, such as personnel for personnel affair, accounting, sales, purchase, technical, and development and personnel above assistant engineer level. The number of the indirect personnel is 152. Annual indirect personnel expense is calculated here in the same way as in the previous section.

	(Unit: 1,000 Baht)
Wage, salary	18,018
Social security	3,604
Total	21,622

(b) Office expense

This expense is management expenses such as cost of stationery, communication, travel, etc.

(c) Other expense

Maintenance of recreation facilities, houses, club house, etc. are counted in the other expense.

(d) Total plant overhead cost

The total plant overhead cost is as follows:

	(Unit: 1,000 Baht)
Personnel expense	21,622
Office expense Other expense	14,854
Total	36,476

(iv) Fixed cost for mining

This cost consists of the fixed cost portion required for quarry operation.

XII-4-2 Depreciation and Interest

(1) Depreciation

The cost accounted as depreciation is as follows;

Table 12-4-2 Depreciation

(1,000 Baht)

	Depreciable cost	Depreciation method	Salvage value	Depreciation
Vechicle and Quarry equipment	152,180	5 yr straight line	0%	30,436
Machinery and equipment (plant)	1,638,440	10 yr straight line	10%	147,460
Buildings and civil work	1,090,185	20 yr straight line	10%	49,058
Pre-operating expense and interest during construction	211,393	10 yr straight line	0%	21,139

(2) Interest

The yearly interest to be paid is summarized in the Table 12-4-3.

Table 12-4-3 Interest

(1,000 Baht)

Year	1	2	3	4	5
Interest	224,114	224,114	224,114	224,114	205,438
Year	6	7	8	9	10
Interest	186,762	168,085	149,409	130,733	112,057
Year	11	12	13	14	15
Interest	93,381	74,505	56,029	37,352	18,676

XII-4-3 Production Cost

Table 12-4-4 shows the production cost of cement.

Table 12-4-4 Production Cost

(1,000 Baht)

Year	Production Cost				
	Operating cost	Depreciation	Interest	Total	Unit price (Baht/t-cement)
1	237,566	248,093	224,114	709,773	1,254
2	254,091	248,093	224,114	726,298	1,123
3	270,617	248,093	224,114	742,824	1,021
4	287,142	248,093	224,114	759,349	939
5	287,142	248,093	205,438	740,673	916
6	287,142	217,657	186,762	691,561	855
7	287,142	217,657	168,085	672,884	832
8	287,142	217,657	149,409	654,208	809
9	287,142	217,657	130,733	635,532	786
10	287,142	217,657	112,057	616,856	763
11	287,142	49,058	93,381	429,581	531
12	284,142	49,058	74,705	410,905	508
13	284,142	49,058	56,029	392,229	485
14	287,142	49,058	37,352	373,552	462
15	287,142	49,058	18,676	354,876	439
16	287,142	49,058		336,200	416
17	287,142	49,058		336,200	416
18	287,142	49,058		336,200	416
19	287,142	49,058		336,200	416
20	287,142	49,058		336,200	416

XII-5 Financial Analysis Method

Based on the study results and premise so far described in the financial analysis, the followings financial tables have been prepared.

(i) Profit and loss statement
(ii) Cash flow statement

In the study, as a criteria of the profitability of the project, financial internal rate of return (FIRR) is used.

(1) FIRR on I (Financial Internal Rate of Return on Investment)

FIRR on I stands for IRR (Internal Rate of Return) on Investment with the premise that the total investment for a project is covered by own funds. FIRR on I essentially indicates the profitaility of a project itself, and effects of financing conditions such as debt and equity ratio, loan conditions, etc. are excluded.

(2) FIRR on E (Financial Internal Rate of Return on Equity)

FIRR on E stands for IRR on Equity (own fund invested), and FIRR on E indicates the profitability of own capital invested.

(3) Cash flow

The cash flows in the calculation of FIRR are identified either as in-flow or as out-flow as shown in the following table.

	In-flow (+)	Out-flow (-)
FIRR on I (after tax)	Profit after tax Depreciation Amortization Salvage value Working capital (Project end) Land aquisition (Project end)	Construction cost Land acquistion Pre-operating expense Working capital
FIRR on E	Inflow items listed above Paid in capital Debt borrowed	Outflow items listed above Interest during construction (IDC) Interests besides IDC Repayment

XII-6 Results of Financial Analysis

(1) Summary of financial analysis

The results of financial analysis are summarized in Table 12-6-1.

Table 12-6-1 Summary of Financial Analysis

(1,000 Baht)

	FIRR on I (before tax)	FIRR on I (after tax)	FIRR on E
Total capital requirement	3,015,209	3,015,209	3,201,627
Fund arrangement			
Equity	3,015,209	3,015,209	960,489
Debt			2,241,138
Revenue	1,097,160	1,097,160	1,097,160
Production cost	516,595	516,595	740,673
Profit before tax	580,565	580,565	356,487
Tax		203,198	124,770
Profit after tax		377,367	231,717
Cash flow	810,017	606,819	293,048
FIRR on I (before tax) %	19.9		
FIRR on I (after tax) %		15.0	
FIRR on E %			26.9

Note: The revenue, production cost, profit before tax, tax, profit after tax and cash flow shown in the table are those in the fifth year after the commencement of commercial operation.

(2) Production cost summmary

Production cost is summarized in Table 12-6-2.
A portion of direct cost in the total cost of the Project is relatively small due to the fact that the most of raw materials for the production of cement are produced in own mine.

Table 12-6-2 Production Cost Summary

(1,000 Baht)

Year	Operating cost			Depreciation	Interest	Total	Unit price*
	Direct cost	Fixed cost	Total				
1	115,679	121,887	237,566	248,093	224,114	709,773	1,254
2	132,204	121,887	254,091	248,093	224,114	726,298	1,121
3	148,730	121,887	270,617	248,093	224,114	742,824	1,021
4	165,255	121,887	287,142	248,093	224,114	759,349	939
5	165,255	121,887	287,142	248,093	205,438	740,673	916
6	165,255	121,887	287,142	217,657	186,762	691,561	855
7	165,255	121,887	287,142	217,657	168,085	672,884	832
8	165,255	121,887	284,142	217,657	149,409	654,208	809
9	165,255	121,887	287,142	217,657	130,733	635,532	786
10	165,255	121,887	287,142	217,657	112,057	616,856	763
15	165,255	121,887	287,142	49,058	18,676	354,876	439
20	165,255	121,887	287,142	49,058	0	336,200	416

Note: * Baht/t-cement

(3) Debt service coverage ratio

The capability of debt repaying is generally expressed in so-called DSR (Debt Service coverage Ratio), and DSR is defined by the following formula.

$$DSR = \frac{\text{(Depreciation) + (Profit after tax) + (Interest)}}{\text{(Repayment of principal borrowed) + (Interest)}}$$

The results of calculation on DSR for the Project show 2.3 at the first year of commercial operation and 1.7 at the fourth year when the repayment is scheduled to start. Calculated DSR values always exceed 1.0 through the project life. Thus, the financial status of the Project is expected to stay in a favorable position throughout the project life.

(4) Break-even point

Calculated break-even point of the Project at the first year is about 65%, that is lower than the scheduled plant operation rate of 70%. Yearly break-even point values for the rest of the project period tend to decrease towards the project end, staying far below the scheduled operation rates during the project period.

(5) Profitability

Calculated rates of FIRR of Base Case are shown in Table 12-6-3.

Table 12-6-3 FIRR of Basic Case

(%)

FIRR on I (before tax)	19.8
FIRR on I (after tax)	15.0
FIRR on E	26.9

Calculated FIRR on I (before tax) and (after tax) of 19.8% and 15.0% show sound profitability of the Project.

Meanwhile, FIRR on E of 26.9%, which shows the profitability of equity invested, indicates the attractive feature of the Project for investors by far exceeding the actual interest rate offered by banks.

XII-7 Sensitivity Analysis

Sensitivity analyses are carried out for the changes of the following parameters.

- Changes in construction cost
- Changes in sales prices of products
- Changes in direct cost
- Changes in operation rate
- Changes in interest rate
- Others

(1) Changes in construction cost

Changes in the construction cost also cause changes of operating cost. The profitability is evaluated by varying the investment cost ±20%.

Construction Cost (1,000 Baht)

Base Case	+20%	-20%
2,800,805	3,456,966	2,304,644

As indicated in Table 12-7-1 and Fig. 12-7-1, the effects exerted by 20% changes of the construction cost upon FIRR on I are considerable.

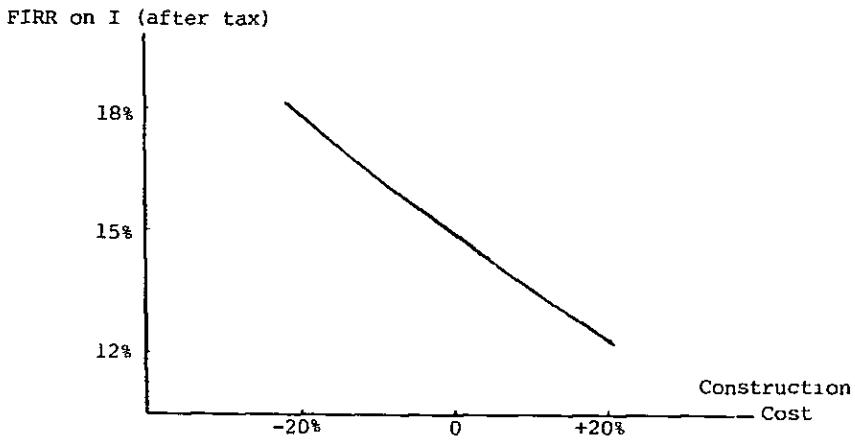
Table 12-7-1 FIRR vs Construction Cost

(Unit: %)

	Base Case	+20%	-20%
FIRR on I (before tax)	19.8	17.0	23.7
FIRR on I (after tax)	15.0	12.8	18.0
FIRR on E	26.9	21.5	33.9

Note: For further detail, refer to ATTACHMENT 3-(1).

Fig. 12-7-1 FIRR vs Construction Cost



(2) Changes in sales prices of products

The effects exerted on the profitability are studied by varying the prices of products ±20%.

		Base Case	+20%	-20%
Oil Shale Cement	(Baht/t)	1,610	1,932	1,288
Mix Cement	(Baht/t)	1,310	1,572	1,048
Electricity	(Baht/t)	1.3	1.56	1.04

As indicated in Table 12-7-2 and Fig. 12-7-2, when the sales prices of products rise by 20%, the rate of FIRR on I (after tax) increases by 3%. The revenue from the sale of electricity to local distribution accounts for only 1.6% of the total sales revenue, therefore, the changes of price in electricity do not appreciably affect the rate of FIRR.

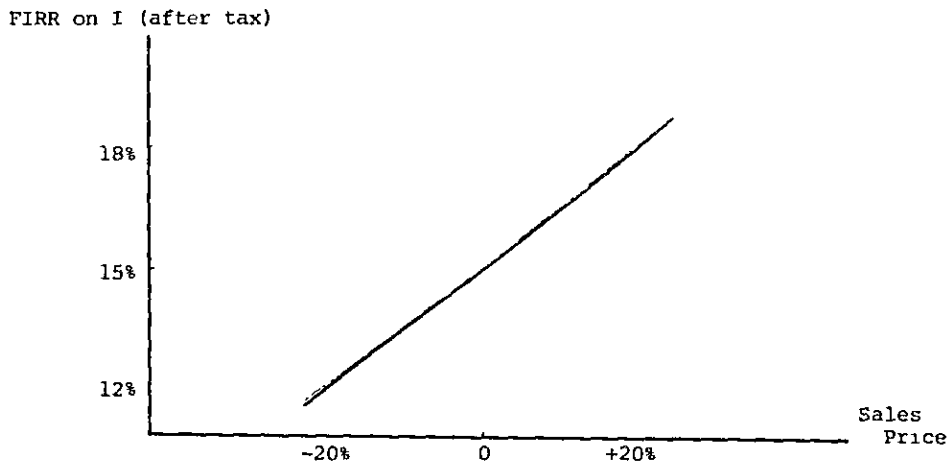
Table 12-7-2 FIRR vs Sales Price

(%)

	Base Case	+20%	-20%
FIRR on I (before tax)	19.8	24.3	14.8
FIRR on I (after tax)	15.0	18.5	11.1
FIRR on E	26.9	35.0	17.1

Note: For futher detail, refer to ATTACHMENT 3-(2)

Fig. 12-7-2 FIRR vs Sales Price



(3) Changes in direct cost

The direct cost of the Project consists of costs for raw materials (limestone, oil shale, iron ore, gypsum), fuel, fire brick, grinding media, paper bag and repair. The effects exerted on the profitability is studied by varying the direct cost ±20%. As indicated in Table 12-7-3, the effects exerted by ±20% changes of direct cost on FIRR on I (after tax) are relatively small.

Table 12-7-3 FIRR vs Direct Cost

(%)

	Base Case	+20%	-20%
FIRR on I (before tax)	19.8	19.1	20.5
FIRR on I (after tax)	15.0	14.5	15.6
FIRR on E	26.9	25.6	28.2

Note: For further detail, refer to ATTACHMENT 3-(3).

(4) Changes in operation rate

The effects exerted on the profitability are analyzed by varying the operation rate by ±20%. As indicated in Table 12-7-4, the rate of FIRR on I (after tax) increases by 3% when the operation rate rise by ±20%.

Table 12-7-4 FIRR vs Operation Rate

(%)

	Base Case	+20%	-20%
FIRR on I (before tax)	19.8	23.6	15.6
FIRR on I (after tax)	15.0	17.5	11.8
FIRR on E	26.9	33.8	18.8

Note: For futher detail, refer to ATTACHMENT 3-(4).

(5) Changes in interest

Summarized in Table 12-7-5 are the effects of changes in interest on FIRR on E.

The change in interest affects the rate of FIRR on E considerably. Therefore, in order to make the Project more attractive for investors, it is essential to borrow funds with low interest rate.

Table 12-7-5 FIRR vs Interest

(%)

	Base Case (10%)	+20% (12%)	-20% (8%)
FIRR on E	26.9	24.9	29.0

Note: For further detail, refer to ATTACHMENT 3-(5)

(6) Other sensitivity analyses

(i) Equity 25% case

When the equity ratio decreases from 30% of the Base Case to 25%, the rate of FIRR on E increases by 3%. The investors may enjoy more profit from the Project, if a portion of equity in the total capital requirement is further reduced and the long term loan with the same interest rate of 10% is still applicable.

(ii) Variation of taxe rates

Income tax rates for listed stock corporations and unlisted stock corporations are 35% and 45% respectively in the Kingdom of Thailand. Table 12-7-6 shows calculated FIRR of the Project when 45% of tax rate is applied and the other conditions remains unchanged.

Table 12-7-6 FIRR vs Variation of Income Tax Rate

(%)

	Base Case Tax Rate 35%	Income Tax Rate 45%
FIRR on I (before tax)	19.8	19.8
FIRR on I (after tax)	15.0	13.4
FIRR on E	26.9	24.9

FIRR on I (after tax) and FIRR on E decrease to the degree shown in Table 12-7-6 when 45% of income tax rate is applied. Investors of the Project must investigate merits and demerits of stock listing.

(iii) Tax exemption

It is possible that the Project takes advantage of income tax grace period of 3 to 8 years, if BOI's (the Board of Investment, Thailand) approval is obtained. In case 5 years tax grace period is given to the Project, FIRR on I (before tax) and FIRR on E are confirmed to increase about 2% and 4.6% respectively from those of the Base Case. Therefore, investors of the Project are recommended to seek for every possibility of obtaining the tax exemption to the Project.

SECTION XIII CASE STUDY - CHANGE IN POWER PLANT CAPACITY

In the previous section, financial aspects of the Project have been reviewed and evaluated for the Base Case of envisaged plant operation. In the Base Case the capacity of power generation plant has been designed at a capacity to cover whole electricity requirement for cement production with some excess electricity output for local distribution.

In this section, financial aspects of the Project are further evaluated for the cases in which the capacity of power plant are changed according to the following case-study prerequisites.

Case A-1: The capacity of power plant is designed to meet only the electricity requirement for cement production with no excess power for local distribution.
(Power self-supply case)

Case A-2: No power generation is planned in the plant, however oil shale is used as a fuel for kiln precalciner.
(No power generation case)

Case A-3: No power generation and no use of oil shale. This case represents the conventional type cement production project.
(No oil shale use case)

Principal differences in the construction and operation of the plant from that of the Base Case are summarized below for each case.

XIII-1 Power Self-Supply Case (Case A-1)

In the Base Case, the capacity of power plant is designed at 12.5 MW of which 1.8 MW is supplied to the local grid of Mae Sot area. In this case, the capacity of power plant is reduced by 2.0 MW which acccounts for the net reduction of 1.8 MW to local grid and the subsequent reduction in in-plant-loss, since no excess electricity generation for local distribution is planned.

Major differences from the Base Case can be listed as below:

(1) Investment cost

Investment cost of the plant for this case is estimated to be about 98% of the Base Case due to the smaller sized power plant required.

(2) Raw material consumption

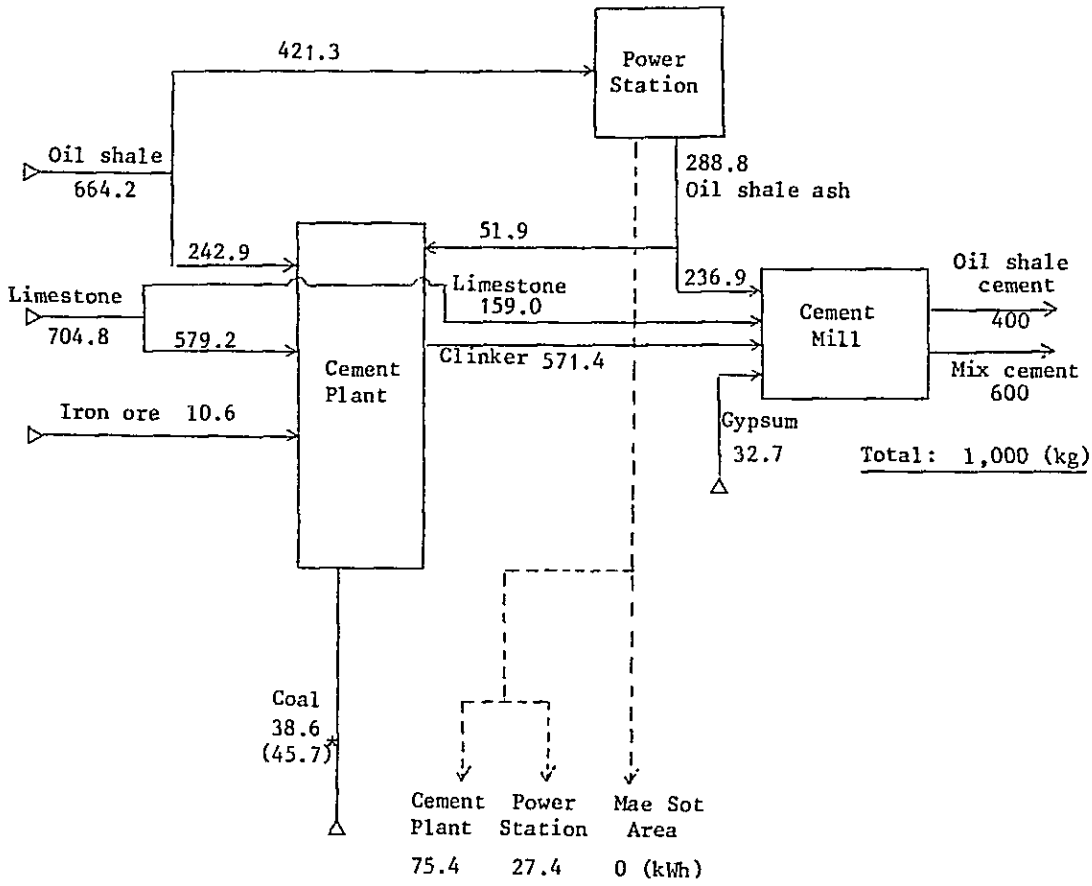
Consumption of oil shale is reduced with the reduced electricity output, while the consumption of limestone increases to compensate for the reduced oil shale combustion residue.

(3) Reduced sales revenue

No sales revenue from power distribution to the local grid makes the total sales revenue of this case smaller than that of the Base Case.

Note: Material balance of this case is shown in Fig. 13-1-1.

Fig. 13-1-1 Material Balance (Case A-1)



Note: * Figure in blanket shows the coal requirement in case calorific value of coal is 5,000 Kcal/kg.

XIII-2 No Power Generation Case (Case A-2)

Major differences from the Base Case can be summarized as below:

(1) Investment cost

Production of oil shale cement by use of oil shale combustion residue from the power plant is not feasible, as no power plant is installed in this case. Therefore, the production of cement clinker must be inceased by 30% from that of the Base Case in order to supply the same volume of cement products from the plant. The increase in investment cost for increasing the cement clinker production capacity, generally offsets the decrease of investment cost by omitting the power plant. In this study, the investment cost for this case is assumed to be the same as that of the Base Case, since the cost difference expected from the detailed cost estimation should be negligible for the purpose of study.

(2) Labor requirement

Total labor requirement of the plant can be reduced by 22 men who would be required for the power plant operation. The labor requirement in other section of the plant remains unchanged.

(3) Raw material consumption

Oil shale is used as a kiln precalciner fuel in this case, however the consumption of oil shale is further reduced from that of Case A-2, while the consumption of limestone increases.

(4) Fuel consumption

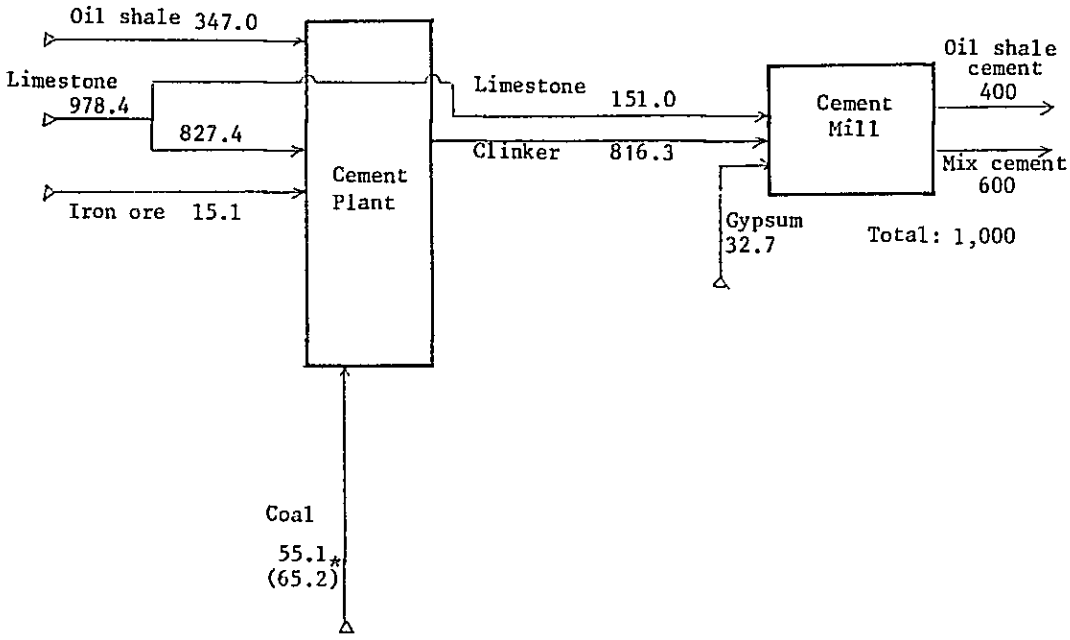
Consumption of coal increases to meet the increased cement ckinker burning capacity.

(5) Purchase of electricity

All electricity requirement for cement production in this case, must be met by the purchased electricity.

Note: The material balance for this case is shown in Fig. 13-2-1.

Fig. 13-2-1 Material Balance (Case A-2)



Note: * Refer to Fig. 13-1-1.

XIII-3 No Oil Shale Use Case (Case A-3)

Major differences from the Base Case can be summarized as below:

(1) Investment cost

Investment cost required for this case is assumed to be the same as that of the Base Case. (same as Case A-2).

(2) Labor requirement

(same as Case A-2)

(3) Raw material consumption

Oil shlae is not used at all in this case, however the consumption of limestone, marl, silica sand and iron ore increases as compared with that of the Base Case.

(4) Fuel requirement

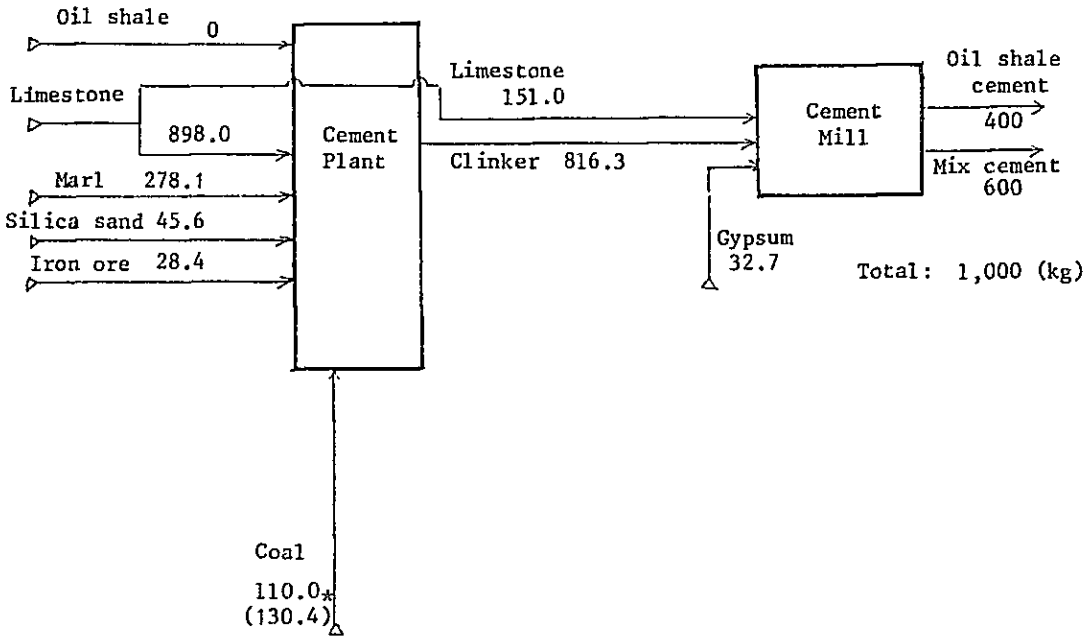
No use of oil shale should increase the use of coal.

(5) Purchase of electricity

All electricity requirement for cement production must be met by the purchased electricity. (same as Case A-2)

Note: Material balance for this case is shown in Fig. 13-3-1.

Fig. 13-3-1 Material Balance (Case A-3)



Note: * Refer to Fig. 13-1-1.

XIII-4 Summary of Case Study

Major parameters of the plant operation calculated for each case have been summarized in Table 13-4-1.

Financial analyses by the analysis method described in SECTION XII, have been made for all cases based on the operational parameters values indicated in Table 13-4-1.

Calculated FIRR on I (before tax), FIRR on I (after tax) and FIRR on E are summarized in Table 13-4-2.

Table 13-4-1 Premises of Case Study

Case	Base Case	Case A-1	Case A-2	Case A-3
Power Generation Sale / Purchase	12 5 MW Sale 1.8 MW	10.5 MW Sale 0 MW	0 Purchase (12.25 MW)	0 Purcahse (12.25 MW)
Cement production (t/yr)	808,500	808,500	808,500	808,500
Investment cost (%)	100	98	100	100
Labor requirement (person)	432	452	430	430
Direct Cost Raw material requirement (t/t-cement)				
Oil shale	0 7630	0.6808	0.3557	-
Limestone	0.7002	0.7225	1.0029	1.0759
Iron ore	0.0109	0.0109	0.0155	0 0291
Marl				0.2852
Silica sand				0.0467
Gypsum	0.0335	0.0335	0 0335	0.0335
Materials cost	(52.696)	(51.002)	(50.097)	(57.983)
Fuel (unit consumption x price) (t/t-cement x Baht/t)	0 0457 x 700 (31.99)	0.0457 x 700 (31.99)	0.0653 x 700 (45.71)	0.1306 x 700 (91.43)
Electricity (unit consumption x price) (kWh/t-cement x Baht/kWh)	(0)	(0)	120 x 1.45 (174.0)	120 x 1.45 (174.0)
Fire brick (unit consumption x price) (kg/t-cement x Baht/kg)	0.657 x 18.2 (11.957)	0.657 x 18.2 (11.957)	0.939 x 18 2 (17.086)	0.939 x 18.2 (17 086)
Grinding media (unit consumption x price) (kg/t-cement x Baht/kg)	0 370 x 24.4 (9.028)	0.370 x 24.4 (9.028)	0.420 x 24.4 (10.282)	0.420 x 24.4 (10.282)
Lube oil	(0.727)	(0.725)	0.725	(0.725)
Repair expense	(28.0)	(28.0)	28.0	(28.0)
Total	134.396	132.702	325.900	379.506

Note: Figures in blankets are indicated in Baht/t-cement

The following unit prices of raw material are used in the finanical calculation.

Oil shale	23.3 Baht/ton	Limestone	10.0 Baht/ton
Iron ore	840.0 Baht/ton	Marl	10.0 Baht/ton
Silica sand	25.0 Baht/ton	Gypsum	560.0 Baht/ton

Table 13-4-2 Financial Analyses Results - Case Study -

(%)

	Base Case	Case A-1	Case A-2	Case A-3
FIRR on I (before tax)	19.8	19.8	16.7	14.9
FIRR on I (after tax)	15.0	15.0	12.5	11.2
FIRR on E	26.9	26.9	21.4	17.3

Conclusions of Case Study:

The following conclusions can be drawn from the financial analyses results shown in Table 13-4-2.

(1) No appreciable difference in the profitability of the project is seen between Case A-1 and the Base Case. However, the distribution of excess electricity to the local grid in the Base Case should greatly contribute to the development of Mae Sot area, and can not be neglected in evaluating the Project. The contribution may be further emphasized when the electricity demand in this area increases in the future.

(2) The profitability of the Project decreases appreciably both in Case A-2 and in Case A-3, as compared with the profitability expected in the Base Case. Increase of direct cost resulting from the purchase of electricity is the major reason for this decrease of the profitability, along with the increase in fuel cost.

(3) From the analyses results, a considerable advantage of the Project (Base Case) has been pointed out as compared with the other project schemes of cement production in which no power generation plant is installed. Advantage becomes even more clear when compared with the conventional type cement production projects (Case A-3).

SECTION XIV ECONOMIC ANALYSIS

Detailed financial analysis of the Project has been made in the preceeding SECTION. In this section, the Project is further evaluated from the economic point of view, so that the feature of the Project can be visualized more clearly. The implementation of the Project will increase the supply of cement and electricity in the northern part of Thailand by utilizing the domestic natural resources and human resources, to meet the increasing demand of cement and electricity in the country. Relevant economic benefit and cost of the Project are evaluated quantitatively and qualitatively in this section.

Based on the discussion results with the concerned authorities, shadow price is not applied in this economic evaluation, and market price is used as a price basis in the economic analysis calculation. However, economic evaluation considering shadow price has been also made for the reference purposes.

XIV-1 Economic Benefit and Cost

For the calculation of economic benefit and cost associated with the Project, the effects of the Project on the national economy are first identified as shown in Table 14-1-1.

Table 14-1-1 Economic Benefit and Cost

Cost	Benefit
Investment cost Raw materials and utilities Labor cost	Increase of cement production Increase of electricity supply Installment of dormitory Development of infrastracture Increase of labor opportunity Saving of transportation cost of cement

XIV-1-1 Economic Benefit

(1) Direct benefit

Direct benefit of the Project is the economic value of electricity and cement.

(2) Indirect benefit

(i) Increase in employment opportunity

Implementation of the Project should increase the employment opportunity in Thailand, which can be counted as indirect benefit of the Project. Since the execution of the Project includes the development of quarry, it has a greater employment oppotunity in comparison with ordinary process industries. The direct increase of employment opportunity is expected to be 454 men during the commercial operation period of the Project.

(ii) Propagating effects on related industries

Propagating effects of the Project on the related industries may include increased demand for plant construction materials like steel and cement, expansion of the engineering construction industry, and increased demand of operating supplies required for the plant operation and products transportation.

(iii) Contribution to regional economic development

When the Project becomes operational, the following direct and indirect contributions of the Project to the regional economic development of Mae Sot area are expected. Development of quarry and subsequent operation of the quarry and plant in the Project should contribute to the area and the north part of Thailand, by creating new business opportunities for the commercial sector and the transportation sector.

XIV-1-2 Economic Cost

Economic cost imposed by the Project is mentioned below:

(1) Initial investment
(2) Labor cost
(3) Other production expense

(1) Initial investment

Included in the initial investment are those necessary for development of quarries (limestone, oil shale, etc.), infrastructures in the Project area, purchased plant machinery, construction cost of cement plant, cost of test runs, etc.. The amount of these investments is calculated based on the total capital requirement in the financial analysis and by re-evaluating the portion of foreign currency and deducting the interest during construction.

(2) Labor cost

Judging from the nature of the Project, relatively high skilled labor is required. Therefore, application of shadow wages seems not appropriate, and evaluation is made by applying the actual wage level in the base case. Even in the reference case (shadow price), only unskilled labor portion of whole labor requirement is evaluated by applying shadow wages.

(3) Other production expenses

Consumables and expenses necessary for the maintenance of equipment and machinery except those mentioned above, are evaluated as other production expense.

The taxes imposed by the tax law are not included in the cost in the analysis, because such taxes should be considered as a transfer cost in view of economic analysis.

XIV-2 Economic Internal Rate of Return (EIRR)

Major premises for EIRR calculation are the same as those described in the financial analysis.

Relevant benefit and cost are quantitatively evaluated to calculate EIRR values. Although it is desirable that the effects of saving and income distribution should also be studied quantitatively to evaluate the Project from the socio-economic point of view, only economic analysis has been made in this study due to insufficient data on socio-economic appraisal. In the study, the analysis is made on a market price basis for the Base Case based on the discussion results with the concerned authorities in Thailand, and further analysis considering shadow factors shown in Table 14-2-1 has been also made for the reference purpose.

Table 14-2-1 Shadow Factors

Shadow exchange	0.9
Equipments and machineries	0.86
Construction cost	0.86
Unskilled labor	0.92
Cement price	Market price
Electricity	Market price

The results of economic analysis for the Base Case are summarized in Table 14-2-2.

Table 14-2-2 Economic Benefit and Cost (Base Case)

(1,000 Baht)

Year	Benefit	Cost	Balance
-3		724,371	-724,371
-2		1,163,666	-1,163,666
-1		1,127,172	-1,127,172
1	822,281	242,044	580,237
2	939,750	258,569	681,181
3	1,057,220	275,095	782,125
4	1,174,690	287,142	887,548
5	1,174,690	287,142	887,548
6	1,174,690	287,142	887,548
7	1,174,690	287,142	887,548
8	1,174,690	287,142	887,548
9	1,174,690	287,142	887,548
10	1,174,690	287,142	887,548
11	1,174,690	287,142	887,548
12	1,174,690	287,142	887,548
13	1,174,690	287,142	887,548
14	1,174,690	287,142	887,548
15	1,174,690	287,142	887,548
16	1,174,690	287,142	887,548
17	1,174,690	287,142	887,548
18	1,174,690	287,142	887,548
19	1,174,690	287,142	887,548
20	1,271,553	287,142	1,010,411

EIRR = 21.4%

Table 14-2-3 Calculated EIRR

Base Case	Reference Case
21.4 %	23.5 %

Calculated rates of EIRR shown in Table 14-2-3 should be evaluated in comparison with opportunity cost of capital which indicates the return that would otherwise have been produced by the last acceptable project. In Thailand, the social rate of discount is estimated to be approx. 12%, and various international institutions are setting cut-off rate that is defined as the rate of return below which capital investment projects should be rejected, of projects to be 8% - 15%. Furthermore, the current interest rate of loan is around 17% p.a in Thailand. Judging from the above discussion, cut-off rate in Thailand can be estimated to be between 12% and 18%.

The calculated EIRR of the Project is 21.4% which is higher than the estimated cut-off rate (12% - 18%), and therefore the Project is justifiable in economic view. Calculated EIRR of 18.3% for 20% increase of initial investment confirms high profitability of the Project.

XIV-3 Tax

The total tax income to the government from the Project accumulates to 5,246 million Bahts during its 20 years commercial operation. This tax income should greatly contribute to the national economy of Thailand, if it is reinvested in the public sector works. Yearly tax income of the government from the Project is summarized in Table 14-3-1.

Table 14-3-1 Yearly Tax Income

(1,000 Baht)

Year	1	2	3	4	5
Tax income	74,654	115,024	155,393	195,762	202,299
Year	6	7	8	9	10
Tax income	219,488	226,025	232,561	239,098	245,635
Year	11	12	13	14	15
Tax income	311,181	317,718	324,254	330,791	337,328
Year	16	17	18	19	20
Tax income	343,864	343,864	343,864	343,864	343,864

Total: 5,246,531

XIV-4 Impact of Project on Foreign Exchange Balance

The expected impact of the Project on the foreign exchange balance in Thailand is studied in this section.

XIV-4-1 Total Foreign Currency Requirement for The Project

The total foreign currency requirement for the Project consisting of foreign currency portion of the total capital requirement, production cost, interest of loan and repayment of loan, accumulates to 6,613 million Bahts during the 23 years project period including pre-operational period.

(1) Foreign currency requirement during pre-operational period

The total capital requirement for the Project is divided into the foreign currency portion and the local currency portion as shown in Table 14-4-1. The foreign currency requirement during the pre-operational period is calculated to be 1,927 million Bahts.

Table 14-4-1 Break-down of Total Capital Requirement

(1,000 Bahts)

	Foreign currency	Local currency	Total
Investment cost	1,749,375	1,131,430	2,880,805
Land acquisition	0	4,170	4,170
Pre-operation cost	775	24,200	24,975
Interest during construction	186,419	0	186,419
Total	1,936,569	1,159,800	3,096,369

(2) Foreign currency expenses during operational period

After the start-up of the plant, expenses of foreign currency occur as a part of operating costs, interest of loan and repayment. The expense of foreign currency during the operational period of the project is shown in Table 14-4-2.

XIV-4-2 Foreign Currency Earnings and Savings

Product cement is planned to be marketed in the northern area of Thailand, and no direct export of cement is considered in the Project.

At present, the country is exporting cement to foreign market, however it is likely that without having installed considerable new cement capacity, the country will have to import cement to meet the increasing domestic demand in the near future.

The supply of cement from the Project should be evaluated not only in meeting the increasing domestic demand but also in suppressing the otherwise import of cement. In this regard, if the total output of cement from the Project is evaluated in foreign currency, it should reach to 22.8 billion Bahts.

14-4-2 Expense of Foreign Currency During Operation Period

(1,000 Baht)

Year	Foreign currency portion of production cost	Interest	Repayment	Total
1	13,713	224,114	0	237,827
2	14,311	224,114	0	238,425
3	14,910	224,114	0	239,024
4	15,509	224,114	186,762	426,385
5	15,509	205,438	186,762	407,709
6	15,509	186,762	186,762	389,033
7	15,509	168,085	186,762	370,356
8	15,509	149,409	186,762	351,680
9	15,509	130,733	186,762	333,004
10	15,509	112,057	186,761	314,327
11	15,509	93,381	186,761	295,651
12	15,509	74,705	186,761	276,975
13	15,509	56,029	186,761	258,299
14	15,509	37,352	186,761	239,622
15	15,509	18,676	186,761	220,946
16	15,509	0	0	15,509
17	15,509	0	0	15,509
18	15,509	0	0	15,509
19	15,509	0	0	15,509
20	15,509	0	0	15,509
Total	306,587	2,129,083	2,241,138	4,676,808

SECTION XV CONCLUSION AND RECOMMENDATION

XV-1 Conclusion

As a result of examination made in the foregoing sections in accordance with the premise described in I-1, the Project, that is the establishment of an integrated power and cement plant using oil shale in Mae Sot, is feasible from technical and economic points of view as described hereinafter.

(1) Cement market and supply and demand of electricity

It is expected that domestic demand and export of cement increase favourably, and to meet the increasing demand a construction of new cement plant is required in Thailand.

Demand of electricity is expected to increase for 10 years' period from now on at an average rate of 9.2% p.a..

(2) Natural and social conditions of Mae Sot

Both natural and social conditions are suitable for the Project implementation.

(3) Assessment of raw materials and raw materials supply

The raw materials mentioned below are suitable both in quality and quantity for the Project implementation and no problems are foreseen in their supply.

(i)	Limestone	:	Doi Din Chi deposit
(ii)	Oil shale	:	Ban Huai Kalok deposit (Mae Sot)
(iii)	Clay	:	Overburden and intercalation of Ban Huai Kalok oil shale deposit
(iv)	Siliceous material	:	Silica sand along the Moei river

Note: Both iron ore and gypsum are to be procured. Raw materials described in (iii) and (iv) mentioned above are not used at the initial stage.

(4) Assessment of fuel

(i) Coal

Domestic coal produced at Mae Ramat mine is suitable as a fuel for kiln burning.
Partial use of imported coal is considered.

(ii) Oil shale

Oil shale of Ban Huai Kalok deposit is suitable as a fuel for the fluidized bed boiler of power station and the precalciner of kiln.

(5) Utilities and infrastructure

No problems are expected for the Project implementation.

(i) Electricity : to be generated by self power station
(ii) Water : to be taken from the Moei river
(iii) Roads, harbour, and communication : sufficiently developed

Construction of short access roads and transportation roads for raw materials are required in the Project.

(6) Conceptional design of the plant

(i) Process: Power generation by fluidized bed boiler and cement production by dry process kiln with NSP as main equipment

(ii) Production capacity: Clinker base : 462,000 t/y
Cement base : 808,500 t/y

(iii) Plant site: A hilly land situated in the suburbs of Mae Sot

(iv) Standards, laws and regulations:
Standards, laws of Thailand are to be observed.

(v) Cement quality: Oil shale cement corresponds to ordinary portland cement specification (TIS-15, 1974) and mix cement specification (TIS-80, 2517)

(vi) Supply plan of fuel:

Coal : to be procured and transported by trucks
Oil shale: Refer to I-2-3

(vii) Distribution plan of products:

The products is to be mainly distributed in the northern region. Transportation is carried out by trucks.

(viii) Outline of plant design:

Equipment have been selected considering concerned conditions.

(ix) Specification of main equipment of the plant:

The specification of main equipment are determined based on design policy mentioned above.

(x) Flow sheet and plant layout: Refer to DWGS attached.

(xi) Plan for company house:

Company houses and welfare facilities are planned.

(7) Environmental study:

Considering the Environmental Standards of Thailand and other necessary conditions, machinery and equipment are to be selected and designed.

(8) Organization and manning plan

Typical organization and manning plan are prepared.

(9) Construction of the plant and operation plan

Considering various conditions in Thailand, the plan is to be made.

(10) Total fund requirement and financing

Table 15-1-1 Total Fund Requirement

(1,000 Baht)

	Foreign portion	Local portion	Total
Fixed fund	1,936,568	1,159,800	3,096,368
Working capital	-	105,259	105,259
Total	1,936,568	1,265,059	3,201,627

Financing plan : Equity/Loan = 30/70

(11) Financial analysis

Profitability of the Project is shown in Table 15-1-2.

Table 15-1-2 EIRR

EIRR on I (before tax)	19.8(%)
EIRR on I (after tax)	15.0
EIRR on E	26.9

Profitability of the Project is very high.

(12) Case study - change in power plant capacity

The capacity of power generation planned in the Project is most favourable from financial point of view, and through electricity supply the Project can contribute to the development of the area.

(13) Economic analysis

EIRR of the Project is 21.4% and is higher than estimated "cut off rate for projects in Thailand".

This figure shows that the Projects is quite favourable in terms of economic evaluation.

XV-2 Recommendation

The Project uses the latest technology and is of large capacity. In order to implement the Project satisfactorily, it is necessary to make a detailed plan and sufficient preparation.

It is recommended that immediate attention should be paid to the following items.

(1) Construction funds

The Project requires considerable amount of construction funds. In this report, the ratio of equity to loan is planned to be 30 to 70.

The loan is considered to be borrowed from the overseas countries. It is desirable to get the loan on as favourable conditions as possible.

(2) Land acquisition

It is necessary to acquire the land necessary for the Project such as the plant site, the quarry sites etc. in advance. After the acquisition the preliminary works such as foundation investigation, preliminary land preparation, construction of access road and piping of water supply can be commenced.

(3) Boring work

It is desirable to carry out boring at oil shale deposit and limestone deposit planned for the Project so that further detailed exploitation plan can be made.

(4) Pilot plant test of fluidized bed boiler

In order to make detailed design of fluidized bed boiler, it is necessary to carry out pilot plant test of fluidized bed boiler using tons of oil shale.

(5) Topographical survey

To facilitate the commencement of the Project in early stage, it is necessary to carry out the topographical survey of the plant site, raw material deposits and transportation route etc..

(6) Establishment of products standards

At present no standards on oil shale cement is established in Thailand. It is, therefore, necessary to establish such Standards.

(7) Negotiation for long term procurement

In order to procure domestic coal for long period on stable condition, negotiation should be made in early stage.

(8) Appointment of technical consultant

In order to execute the Project favourably, it is necessary to get the advice of the foreign technical consultant who is well experienced in the full scale consulting services of the construction of cement plant.

(9) Estimate of the construction cost

It is necessary to take the firm estimate of plant construction cost from a reliable supplier in early stage to consolidate the financing plan of the Project.

(10) Arrangement for electricity supply

A portion of electricity generated in the Project is planned to be supplied to Mae Sot area through PEA (Provincial Electricity Authority).
Thus, a necessary arrangement in the government offices including EGAT (Electricity Generation Authority of Thailand) must be made on this matter prior to the implementation of the Project.

(11) Project implementation body

The implementation of Project should greatly contribute to the national economy of Thailand, by utilizing domestic oil shale resource as raw material and fuel for cement production and by promoting a regional development of Mae Sot area. On the other hand, a certain market allocation arrangement is necessary, since the north region of Thailand where the existing cement manufacturers are currently marketing their cement products, is considered as a principal market for the Project.

Therefore, it is recommended that the Project should be implemented by an appropriate organization in a proper manner in view of the national economy of Thailand. It is recommended that the implementation body of the Project be studied by the concerned authorities including the Oil Shale Committee.

ATTACHMENT 1

BASE CASE

< PROFIT & LOSS STATEMENT > 30% equity case

(UNIT 000'Bahts)

PROJECT YEAR	1 YR	2 YR	3 YR	4 YR	5 YR	6 YR	7 YR	8 YR	9 YR
SALES VOL.(T/YR)	565950	646800	727650	808500	808500	808500	808500	808500	808500
SALES REVENUE	822291	939750	1057220	1174690	1174690	1174690	1174690	1174690	1174690
EXCISE TAX	54271	62024	69776	77529	77529	77529	77529	77529	77529
NET SALES REVEN.	768011	877727	987443	1097160	1097160	1097160	1097160	1097160	1097160
DIRECT COST									
RAW MATERIAL	29824	34084	38345	42605	42605	42605	42605	42605	42605
CONSUMABLES	12287	14042	15793	17553	17553	17553	17553	17553	17553
FUEL	18105	20691	23278	25864	25864	25864	25864	25864	25864
ELECTRICITY	0	0	0	0	0	0	0	0	0
REPAIR EXPENSE	15847	18110	20374	22638	22638	22638	22638	22638	22638
CEMENT BAGS	39617	45276	50936	56595	56595	56595	56595	56595	56595
SUB TOTAL	115679	132204	148730	165255	165255	165255	165255	165255	165255
FIXED COST									
SALARY/WAGE	24317	24317	24317	24317	24317	24317	24317	24317	24317
ADMIN.EXPENSE	49966	49966	49966	49966	49966	49966	49966	49966	49966
MISC. EXPENSE	47604	47604	47604	47604	47604	47604	47604	47604	47604
SUB TOTAL	121887	121887	121887	121887	121887	121887	121887	121887	121887
CASH INCOME	530445	623636	716826	810017	810017	810017	810017	810017	810017
DEPRECIATION	226954	226954	226954	226954	226954	196518	196518	196518	196518
AMORTIZATION	21139	21139	21139	21139	21139	21139	21139	21139	21139
INTEREST (LT)	224114	224114	224114	224114	205432	186762	168095	149409	130733
INTEREST (ST)	0	0	0	0	0	0	0	0	0
PROFIT B/TAX	58238	151429	244619	337809	356486	405598	424274	442550	461626
INCOME TAX	20383	53000	85617	118233	124770	141959	148496	155032	161569
PROFIT A/TAX	37855	98429	159002	219576	231716	263638	275778	287917	300057

PROJECT YEAR	10 YR	11 YR	12 YR	13 YR	14 YR	15 YR	16 YR	17 YR	18 YR	19 YR	20 YR
SALES VOL.(T/YR)	808500	808500	808500	808500	808500	808500	808500	808500	808500	808500	808500
SALES REVENUE	1174690	1174690	1174690	1174690	1174690	1174690	1174690	1174690	1174690	1174690	1174690
EXCISE TAX	77529	77529	77529	77529	77529	77529	77529	77529	77529	77529	77529
NET SALES REVEN.	1097160	1097160	1097160	1097160	1097160	1097160	1097160	1097160	1097160	1097160	1097160
DIRECT COST											
RAW MATERIAL	42605	42605	42605	42605	42605	42605	42605	42605	42605	42605	42605
CONSUMABLES	17553	17553	17553	17553	17553	17553	17553	17553	17553	17553	17553
FUEL	25864	25864	25864	25864	25864	25864	25864	25864	25864	25864	25864
ELECTRICITY	0	0	0	0	0	0	0	0	0	0	0
REPAIR EXPENSE	22638	22638	22638	22638	22638	22638	22638	22638	22638	22638	22638
CEMENT BAGS	56595	56595	56595	56595	56595	56595	56595	56595	56595	56595	56595
SUB TOTAL	165255	165255	165255	165255	165255	165255	165255	165255	165255	165255	165255
FIXED COST											
SALARY/WAGE	24317	24317	24317	24317	24317	24317	24317	24317	24317	24317	24317
ADMIN.EXPENSE	49966	49966	49966	49966	49966	49966	49966	49966	49966	49966	49966
MISC. EXPENSE	47604	47604	47604	47604	47604	47604	47604	47604	47604	47604	47604
SUB TOTAL	121887	121887	121887	121887	121887	121887	121887	121887	121887	121887	121887
CASH INCOME	810017	810017	810017	810017	810017	810017	810017	810017	810017	810017	810017
DEPRECIATION	196518	49058	49058	49058	49058	49058	49058	49058	49058	49058	49058
AMORTIZATION	21139	0	0	0	0	0	0	0	0	0	0
INTEREST (LT)	112057	93381	74705	56029	37352	18676	0	0	0	0	0
INTEREST (ST)	0	0	0	0	0	0	0	0	0	0	0
PROFIT B/TAX	480302	667577	686253	704930	723606	742282	760958	760958	760958	760958	760958
INCOME TAX	168106	233652	240189	246725	253262	259799	266335	266335	266335	266335	266335
PROFIT A/TAX	312196	433925	446065	458204	470344	482483	494623	494623	494623	494623	494623

< PROFIT & LOSS STATEMENT > 100% equity case

(UNIT 000'Bahts)

BASE CASE

PROJECT YEAR	-3 YR	-2 YR	-1 YR	1 YR	2 YR	3 YR	4 YR	5 YR	6 YR	7 YR	8 YR	9 YR
SALES VOLUME				306250	306300	306500	306500	306500	306500	306500	306500	306500
SALES REVENUE				322281	929750	1057220	1174690	1174690	1174690	1174690	1174690	1174690
EXCISE TAX				54271	52024	79776	77529	77529	77529	77529	77529	77529
NET SALES REVEN.				268011	877727	977443	1097160	1097160	1097160	1097160	1097160	1097160
DIRECT COST												
RAW MATERIAL				29824	34084	38345	42605	42605	42605	42605	42605	42605
CONSUMABLES				12237	14042	15799	17558	17558	17558	17558	17558	17558
FUEL				18105	20691	23273	25864	25864	25864	25864	25864	25864
ELECTRICITY				0	0	0	0	0	0	0	0	0
REPAIR EXPENSE				15947	18110	20274	22438	22438	22438	22438	22438	22438
CEMENT BAGS				39617	45276	50936	56595	56595	56595	56595	56595	56595
SUB TOTAL				115679	132204	148730	165255	165255	165255	165255	165255	165255
FIXED COST												
SALARY+WAGE				24817	24817	24817	24817	24817	24817	24817	24817	24817
ADMIN.EXPENSE				49966	49966	49966	49966	49966	49966	49966	49966	49966
MISC. EXPENSE				47604	47604	47604	47604	47604	47604	47604	47604	47604
SUB TOTAL				121987	121987	121987	121987	121987	121987	121987	121987	121987
CASH INCOME				530445	623636	716826	810017	810017	810017	810017	810017	810017
DEPRECIATION				226954	226954	226954	226954	226954	196519	196519	196519	196519
AMORTIZATION				2498	2498	2498	2498	2498	2498	2498	2498	2498
PROFIT B/TAX				200994	394184	487375	580565	580565	611001	611001	611001	611001
INCOME TAX				103843	197965	170581	203198	203198	213850	213850	213850	213850
PROFIT A/TAX				175646	256220	316794	377367	377367	397151	397151	397151	397151
CASH FLOW (FOIB)	-724871	-1168470	-1127179	525968	619138	712328	810017	810017	810017	810017	810017	810017
CASH FLOW (FOIA)	-724871	-1168470	-1127179	420620	431139	541767	583319	583319	593166	593166	593166	593166

PROJECT YEAR	10 YR	11 YR	12 YR	13 YR	14 YR	15 YR	16 YR	17 YR	18 YR	19 YR	20 YR
SALES VOLUME	306500	306500	306500	306500	306500	306500	306500	306500	306500	306500	306500
SALES REVENUE	1174690	1174690	1174690	1174690	1174690	1174690	1174690	1174690	1174690	1174690	1174690
EXCISE TAX	77529	77529	77529	77529	77529	77529	77529	77529	77529	77529	77529
NET SALES REVEN.	1097160	1097160	1097160	1097160	1097160	1097160	1097160	1097160	1097160	1097160	1097160
DIRECT COST											
RAW MATERIAL	42605	42605	42605	42605	42605	42605	42605	42605	42605	42605	42605
CONSUMABLES	17558	17558	17558	17558	17558	17558	17558	17558	17558	17558	17558
FUEL	25864	25864	25864	25864	25864	25864	25864	25864	25864	25864	25864
ELECTRICITY	0	0	0	0	0	0	0	0	0	0	0
REPAIR EXPENSE	22638	22638	22638	22638	22638	22638	22638	22638	22638	22638	22638
CEMENT BAGS	56595	56595	56595	56595	56595	56595	56595	56595	56595	56595	56595
SUB TOTAL	165255	165255	165255	165255	165255	165255	165255	165255	165255	165255	165255
FIXED COST											
SALARY+WAGE	24817	24817	24817	24817	24817	24817	24817	24817	24817	24817	24817
ADMIN.EXPENSE	49966	49966	49966	49966	49966	49966	49966	49966	49966	49966	49966
MISC. EXPENSE	47604	47604	47604	47604	47604	47604	47604	47604	47604	47604	47604
SUB TOTAL	121987	121987	121987	121987	121987	121987	121987	121987	121987	121987	121987
CASH INCOME	810017	810017	810017	810017	810017	810017	810017	810017	810017	810017	810017
DEPRECIATION	196519	49058	49058	49058	49058	49058	49058	49058	49058	49058	49058
AMORTIZATION	2498	0	0	0	0	0	0	0	0	0	0
PROFIT B/TAX	611001	760958	760958	760958	760958	760958	760958	760958	760958	760958	760958
INCOME TAX	213850	266335	266335	266335	266335	266335	266335	266335	266335	266335	266335
PROFIT A/TAX	397151	494623	494623	494623	494623	494623	494623	494623	494623	494623	494623
CASH FLOW (FOIB)	810017	810017	810017	810017	810017	810017	810017	810017	810017	810017	1205740
CASH FLOW (FOIA)	593166	543681	543681	543681	543681	543681	543681	543681	543681	543681	939406

ATTACHMENT 2

< CASH FLOW STATEMENT >

(UNIT 000´Bahts)

BASE CASE

ROE = 26.93 %
ROI(B/TAX)= 19.82 %
ROI(A/TAX)= 15.01 %

PROJECT YEAR	-3 YR	-2 YR	-1 YR	1 YR	2 YR	3 YR	4 YR	5 YR	6 YR	7 YR	8 YR	9 YR
CASH INCOME	0	0	0	550445	623636	716825	310017	310017	310017	310017	310017	310017
PAID IN CAPITAL	217311	364312	378865	0	0	0	0	0	0	0	0	0
DEBT BORROW(LT)	507060	850060	884013	0	0	0	0	0	0	0	0	0
DEBT BORROW(ST)	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL SOURCES	724371	1214370	1262880	550445	623636	716825	310017	310017	310017	310017	310017	310017
INVESTMENT	720201	1152220	1008220	0	0	0	0	0	0	0	0	0
LAND ACQUISITION	4170	0	0	0	0	0	0	0	0	0	0	0
PRE-OPE EXPENSE	0	11344	13531	0	0	0	0	0	0	0	0	0
W/C INCREASE	0	0	105259	4473	4473	4473	0	0	0	0	0	0
REPAYMENT (LT)	0	0	0	0	0	0	186752	186752	186752	186752	186752	186752
REPAYMENT (ST)	0	0	0	0	0	0	0	0	0	0	0	0
INTEREST (LT)	0	50706	155712	224114	224114	224114	224114	205438	186752	168055	149409	130733
INTEREST (ST)	0	0	0	0	0	0	0	0	0	0	0	0
INCOME TAX	0	0	0	23060	53009	35617	118232	124770	141959	140495	157452	161759
DIVIDEND	0	0	0	281470	342044	402619	290908	293047	294534	306574	319215	330953
TOTAL APPLICATN.	724371	1214370	1262880	550445	623636	716825	310017	310017	310017	310017	310017	310017
CASH FLOW (ROE)	-217311	-364312	-378865	281470	342044	402619	290908	293047	294534	306574	318313	330953
CASH FLOW (ROIB)	-724371	-1153570	-1127170	525962	619158	712049	310017	310017	310017	310017	310017	310017
CASH FLOW (ROIA)	-724371	-1153570	-1127170	420520	481133	541757	506819	506819	594166	594166	594166	594166

PROJECT YEAR	10 YR	11 YR	12 YR	13 YR	14 YR	15 YR	16 YR	17 YR	18 YR	19 YR	20 YR
CASH INCOME	310017	310017	310017	310017	310017	310017	310017	310017	310017	310017	310017
PAID IN CAPITAL	0	0	0	0	0	0	0	0	0	0	0
DEBT BORROW(LT)	0	0	0	0	0	0	0	0	0	0	0
DEBT BORROW(ST)	0	0	0	0	0	0	0	0	0	0	0
TOTAL SOURCES	310017	310017	310017	310017	310017	310017	310017	310017	310017	310017	310017
INVESTMENT	0	0	0	0	0	0	0	0	0	0	0
LAND ACQUISITION	0	0	0	0	0	0	0	0	0	0	0
PRE-OPE EXPENSE	0	0	0	0	0	0	0	0	0	0	0
W/C INCREASE	0	0	0	0	0	0	0	0	0	0	0
REPAYMENT (LT)	186762	186752	186752	186752	186752	186752	0	0	0	0	0
REPAYMENT (ST)	0	0	0	0	0	0	0	0	0		0
INTEREST (LT)	112057	93381	74705	56029	37352	18676	0	0	0	0	0
INTEREST (ST)	0	0	0	0	0	0	0	0	0	0	0
INCOME TAX	163196	232552	240129	245705	253012	259799	266385	266385	266385	266385	266385
DIVIDEND	243092	295222	308262	314557	322141	344702	543631	543631	543631	543631	543631
TOTAL APPLICATN.	310017	310017	310017	310017	310017	310017	310017	310017	310017	310017	310017
CASH FLOW (ROE)	243092	295222	308262	314557	322141	344702	543631	543631	543631	543631	-1235??
CASH FLOW (ROIB)	310017	310017	310017	310017	310017	310017	310017	310017	310017	310017	1235740
CASH FLOW (ROIA)	594166	543631	543631	543631	543631	543631	543631	543631	543631	543631	[illegible]

ATTACHMENT 3

< SENSITIVITY ANALYSIS >

FIXED INVESTMENT

VARIABLE	ROI B/TAX	ROI A/TAX	ROE
-30 %	26.24	19.93	38.29
-25 %	24.91	18.91	35.98
-20 %	23.70	17.99	33.87
-15 %	22.60	17.15	31.93
-10 %	21.60	16.38	30.14
-5 %	20.67	15.67	28.48
0 %	19.82	15.01	26.93
5 %	19.02	14.41	25.49
10 %	18.29	13.84	24.14
15 %	17.59	13.31	22.82
20 %	16.95	12.81	21.54
25 %	16.34	12.35	20.34
30 %	15.77	11.91	19.20

ALL PRICES

VARIABLE	ROI B/TAX	ROI A/TAX	ROE
-30 %	11.93	8.95	11.16
-25 %	13.39	10.07	14.20
-20 %	14.77	11.14	17.06
-15 %	16.10	12.16	19.79
-10 %	17.38	13.14	22.35
-5 %	18.62	14.10	24.73
0 %	19.82	15.01	26.93
5 %	20.98	15.91	29.06
10 %	22.11	16.78	31.10
15 %	23.21	17.62	33.08
20 %	24.29	18.45	34.99
25 %	25.34	19.26	36.85
30 %	26.37	20.05	38.65

VARIABLE COST

VARIABLE	ROI B/TAX	ROI A/TAX	ROE
-30 %	20.87	15.82	28.86
-25 %	20.70	15.69	28.54
-20 %	20.52	15.56	28.22
-15 %	20.35	15.42	27.90
-10 %	20.17	15.29	27.58
-5 %	19.99	15.15	27.26
0 %	19.82	15.01	26.93
5 %	19.64	14.88	26.61
10 %	19.46	14.74	26.28
15 %	19.28	14.60	25.95
20 %	19.10	14.46	25.62
25 %	18.92	14.32	25.28
30 %	18.74	14.18	24.94

OS-FACTOR

VARIABLE	ROI B/TAX	ROI A/TAX	ROE
-30 %	13.30	10.01	14.02
-25 %	14.48	10.91	16.46
-20 %	15.61	11.79	18.83
-15 %	16.71	12.63	21.02
-10 %	17.78	13.45	23.15
-5 %	18.81	14.24	25.09
0 %	19.82	15.01	26 93
5 %	20.80	15 77	28.72
10 %	21.75	16.50	30.45
15 %	22 69	17.22	32.12
20 %	23.60	17.92	33.75
25 %	24.50	18.60	35.34
30 %	25.38	19.28	36.88

LT-LOAN INTERST

VARIABLE	ROI B/TAX	ROI A/TAX	ROE
-100 %	19.82	15.01	36.83
-80 %	19.82	15.01	34.92
-60 %	19.82	15.01	32.96
-40 %	19.82	15 01	30.98
-20 %	19.82	15.01	28.96
0 %	19.82	15.01	26.93
20 %	19.82	15 01	24.90
40 %	19.82	15.01	22.86
60 %	19.82	15.01	20.43
80 %	19.82	15.01	18.13

P-CEMENT PRICE

VARIABLE	ROI B/TAX	ROI A/TAX	ROE
-30 %	16.54	12.50	20.67
-25 %	17.11	12.93	21.80
-20 %	17.67	13.36	22.92
-15 %	18.22	13.79	23.98
-10 %	18.76	14.20	24.98
-5 %	19.29	14.61	25.97
0 %	19.82	15.01	26.93
5 %	20.34	15.41	27.88
10 %	20.85	15.81	28.82
15 %	21.36	16.20	29.74
20 %	21.86	16.58	30.64
25 %	22.35	16.96	31.54
30 %	22.84	17.34	32.42

M-CEMENT PRICE

VARIABLE	ROI B/TAX	ROI A/TAX	ROE
-30 %	15.78	11.91	19.14
-25 %	16.49	12.45	20.55
-20 %	17.18	12 99	21.93
-15 %	17.85	13.51	23.29
-10 %	18.52	14.02	24.54
-5 %	19.17	14.52	25.75
0 %	19.82	15.01	26.93
5 %	20.45	15.50	28.09
10 %	21.07	15.98	29.23
15 %	21.69	16.45	30.34
20 %	22.29	16.92	31.43
25 %	22.89	17.38	32.50
30 %	23.48	17.83	33.56

FUEL

VARIABLE	ROI B/TAX	ROI A/TAX	ROE
-30 %	19.98	15.14	27.24
-25 %	19.96	15.12	27.19
-20 %	19.93	15.10	27.14
-15 %	19.90	15.08	27.09
-10 %	19.87	15.06	27.04
-5 %	19.84	15.04	26.98
0 %	19.82	15.01	26.93
5 %	19.79	14.99	26.88
10 %	19.76	14.97	26.83
15 %	19.73	14.95	26.78
20 %	19.71	14.93	26.73
25 %	19.68	14.91	26.68
30 %	19.65	14.89	26.63

RAW MATERIAL

VARIABLE	ROI B/TAX	ROI A/TAX	ROE
-30 %	20.09	15.23	27.44
-25 %	20.05	15.19	27.35
-20 %	20.00	15.16	27.27
-15 %	19.95	15.12	27.19
-10 %	19.91	15.09	27.10
-5 %	19.86	15.05	27.02
0 %	19.82	15.01	26.93
5 %	19.77	14.98	26.85
10 %	19.73	14.95	26.77
15 %	19.68	14.91	26.68
20 %	19.63	14.87	26.60
25 %	19.59	14.84	26.51
30 %	19.54	14.80	26.43

FIXED COST

VARIABLE	ROI B/TAX	ROI A/TAX	ROE
-30 %	20.68	15.66	28.54
-25 %	20.53	15.56	28.28
-20 %	20.39	15.45	28.01
-15 %	20.25	15.34	27.74
-10 %	20.11	15.23	27.47
-5 %	19.96	15.12	27.20
0 %	19.82	15.01	26.93
5 %	19.67	14.91	26.66
10 %	19.53	14.80	26.39
15 %	19.38	14.69	26.12
20 %	19.24	14.58	25.85
25 %	19.09	14.47	25.57
30 %	18.94	14.36	25.30

ATTACHMENT 4

MINING COST

(Wet base)

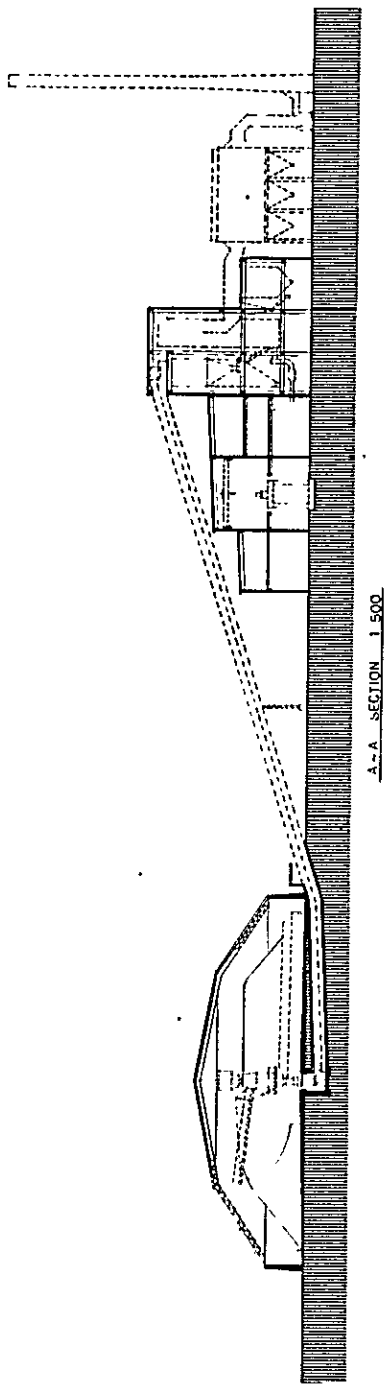
	Limestone (48,142 t/mo.)		Oil shale (53,555 t/mo.)	
	(1000 Baht/t)	(1000Baht/mo.)	(1000 Baht/t)	(1000 Baht/mo.)
Direct Cost				
Fuel	6.2		20.6	
Explosives	2.6		0.8	
Mine product tax	1.0		1.0	
Sub-total	9.8	472	22.4	1,200
Fixed cost				
Maintenance		744		1,765
Labor cost		371		668
Depreciation*		959*		2,003*
Royalty		1		1
Others		495		961
Sub-total	53.4	2,570	100.8	5,398
Total	63.2	3,042	123.2	6,598

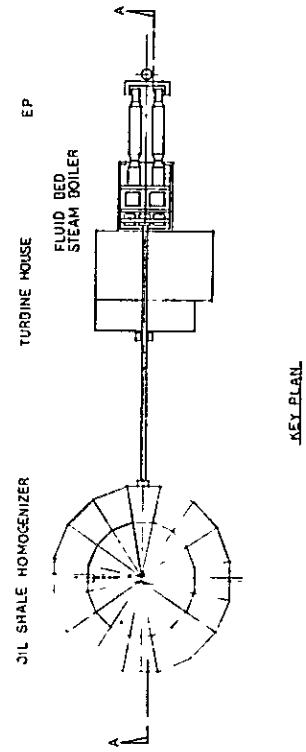
Note: 1) Land acquisition cost is depreciated (straight-line, 20 years) at a rate of 13,600 Bahts per month.

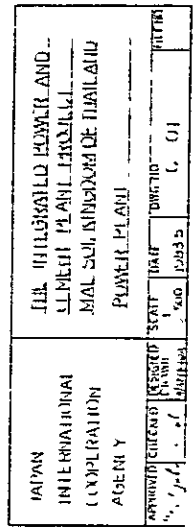
2) Royalty, according to Minerals Act (No. 2) BE 2516.
Iron ore and gypsum are purchased from outside:

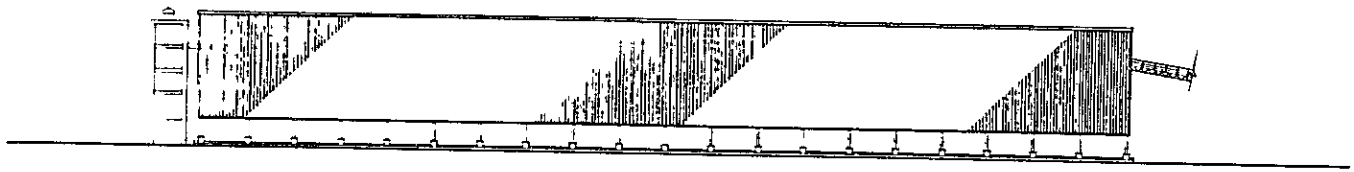
Iron ore	840 Baht/t
Gypsum	560 Baht/t

ATTACHMENT 5

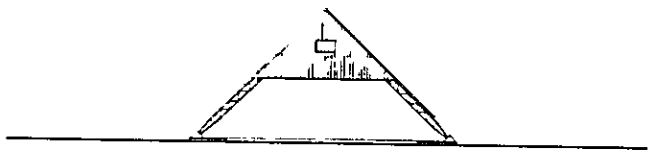




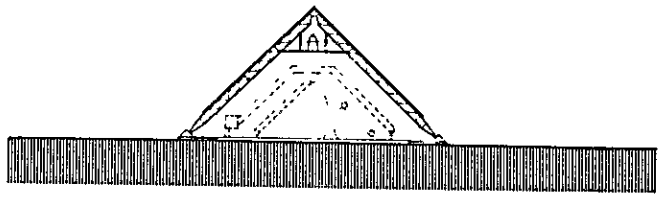




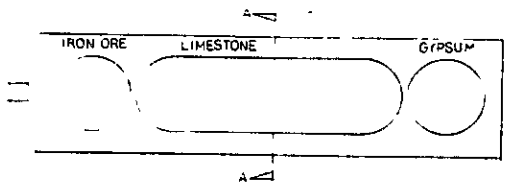
ELEVATION



ELEVATION



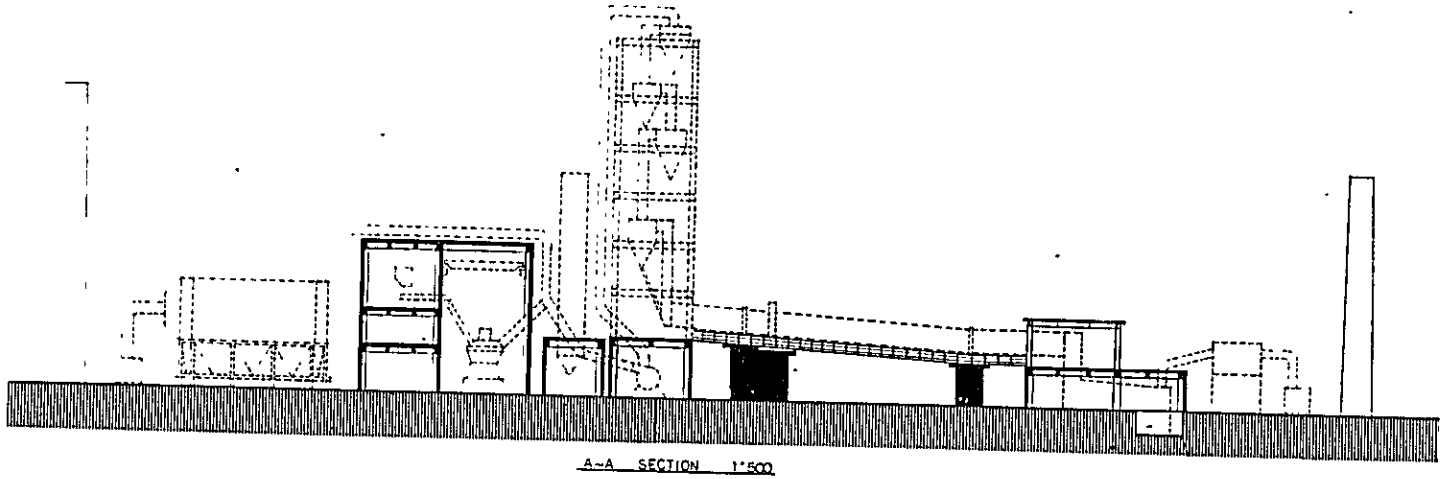
A-A SECTION 1:500



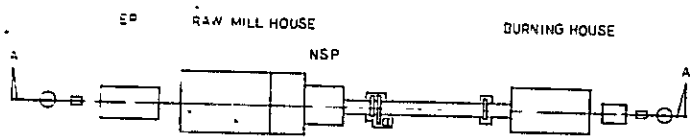
KEY PLAN

DESIGNED	CHECKED	DRAWN	SCALE	DATE	DRAWING NO.	FILE NO.

THE INTEGRATED POWER AND CEMENT PLANT PROJECT
MAE SOT, KAMPHAENG PHET, THAILAND
RAW MATERIAL STORAGE

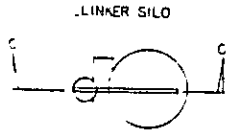


A-A SECTION 1:500

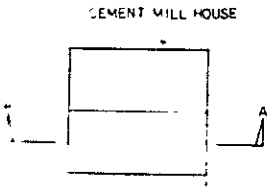


KEY PLAN

JAPAN INTERNATIONAL COOPERATION AGENCY		THE INTEGRATED LOWER AND CEMENT PLANT PROJECT IN THE KINGDOM OF THAILAND				
		RAW MILL HOUSE · BURNING HOUSE				
APPROVED	CHECKED	DESIGNED DRAWN	SCALE	DATE	DWG NO	REV NO
			1:500	1983.5	1-03	



KEY PLAN



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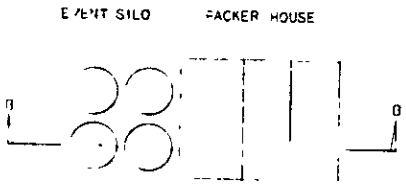
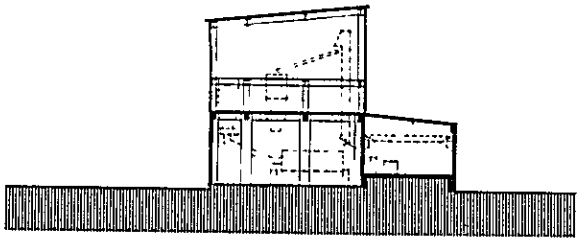
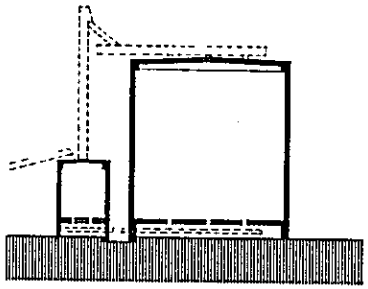


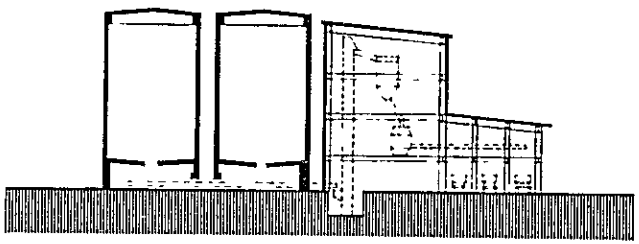
[illegible] PLAN



A-A SECTION 1:500



C-C SECTION 1:500



B-B SECTION 1:500

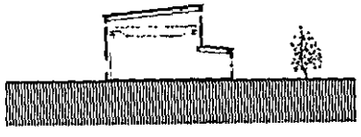
JAPAN
INTERNATIONAL
COOPERATION
AGENCY

THE DECENTRALIZED POWER AND CEMENT PLANT PROJECT
IN SARABURI, KINGDOM OF THAILAND
CLINKER SILO · CEMENT MILL
CEMENT SILO · PACKER HOUSE

SCALE	DATE	DWG NO.	SHEET
1:500	FEB'85	C-04	

ELEVATION 1 500

ELEVATION 1 500



SECTION 1 500

WORK SHOP

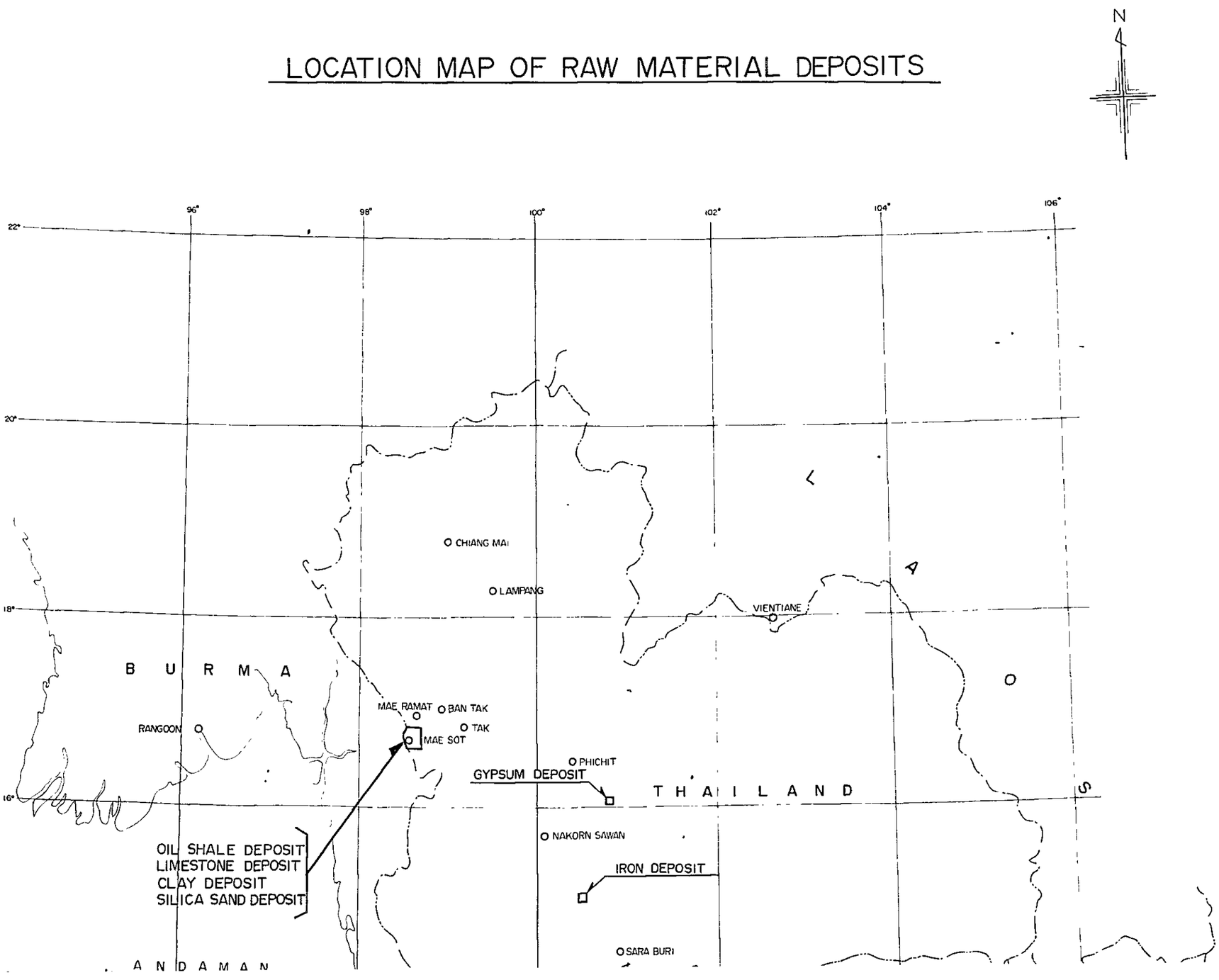
ELEVATION 1 500

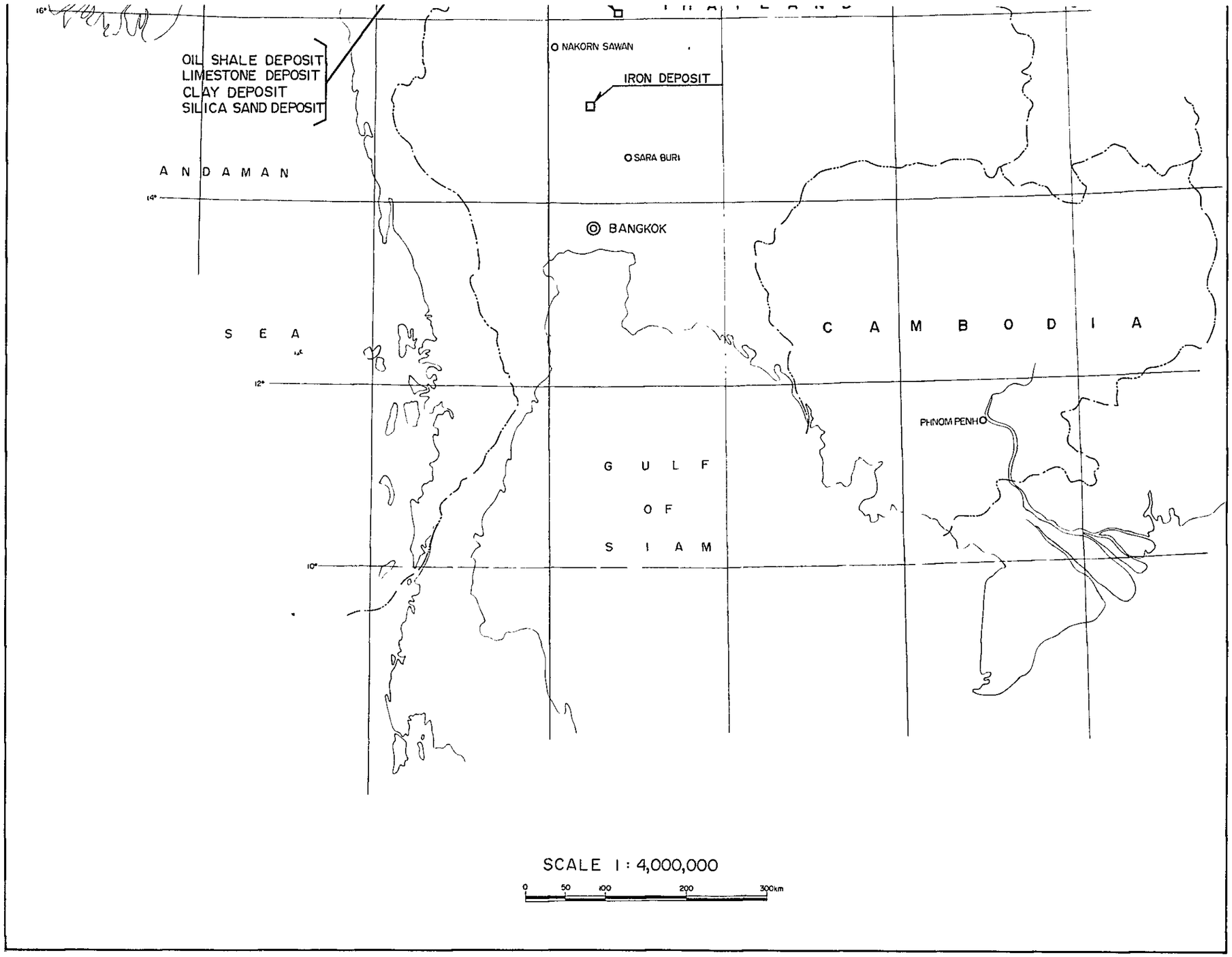
ELEVATION 1 500

OFFICE

JAPAN INTERNATIONAL COOPERATION AGENCY	THE INTEGRATED POWER AND CEMENT PLANT PROJECT IN MAE MOH KINGDOM OF THAILAND
	WORK SHOP・OFFICE
APPROVED / CHECKED / DESIGNED	SCALE 1/500 DATE 1983.5 DWG.NO. C-05 SHEET NO.

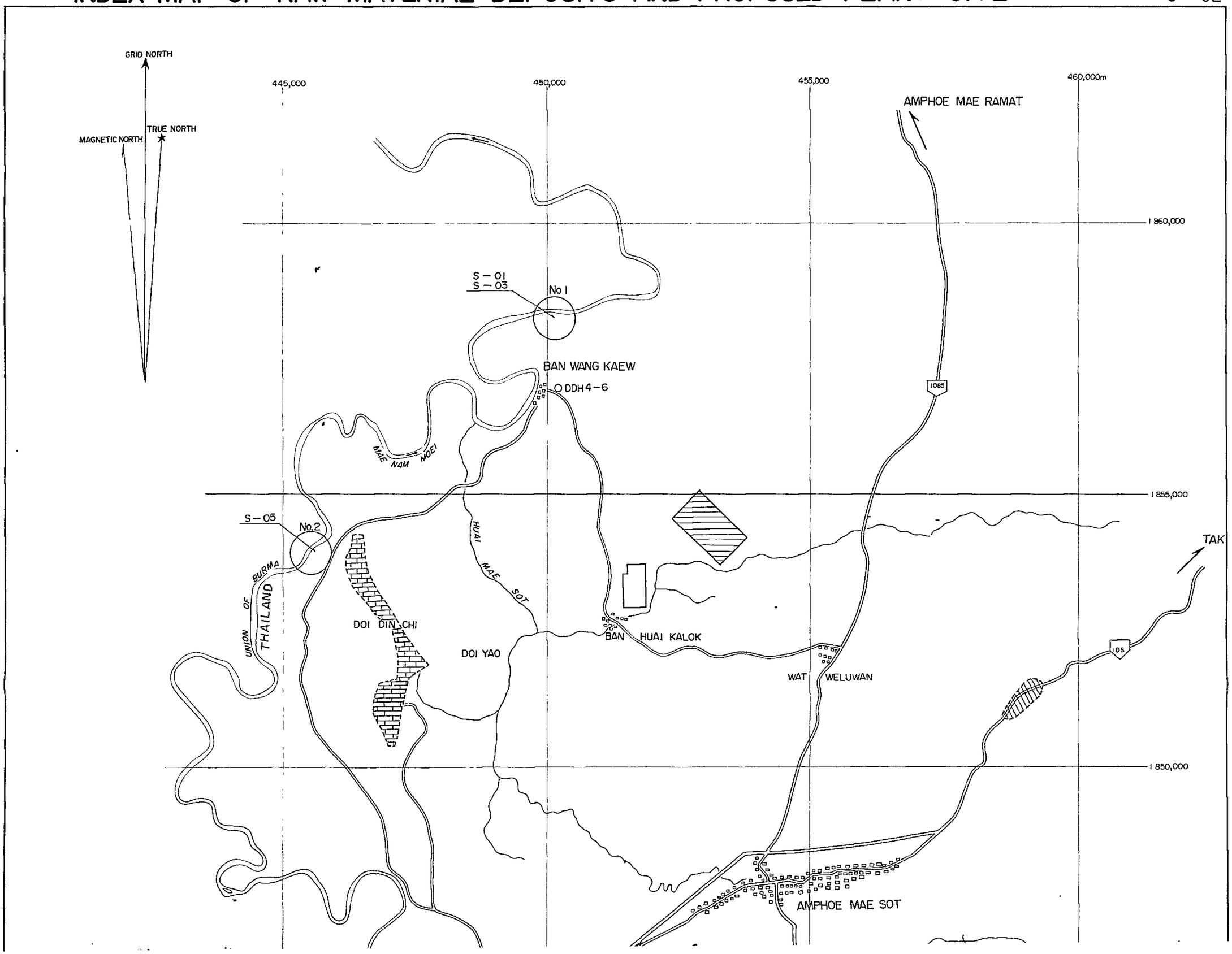
LOCATION MAP OF RAW MATERIAL DEPOSITS

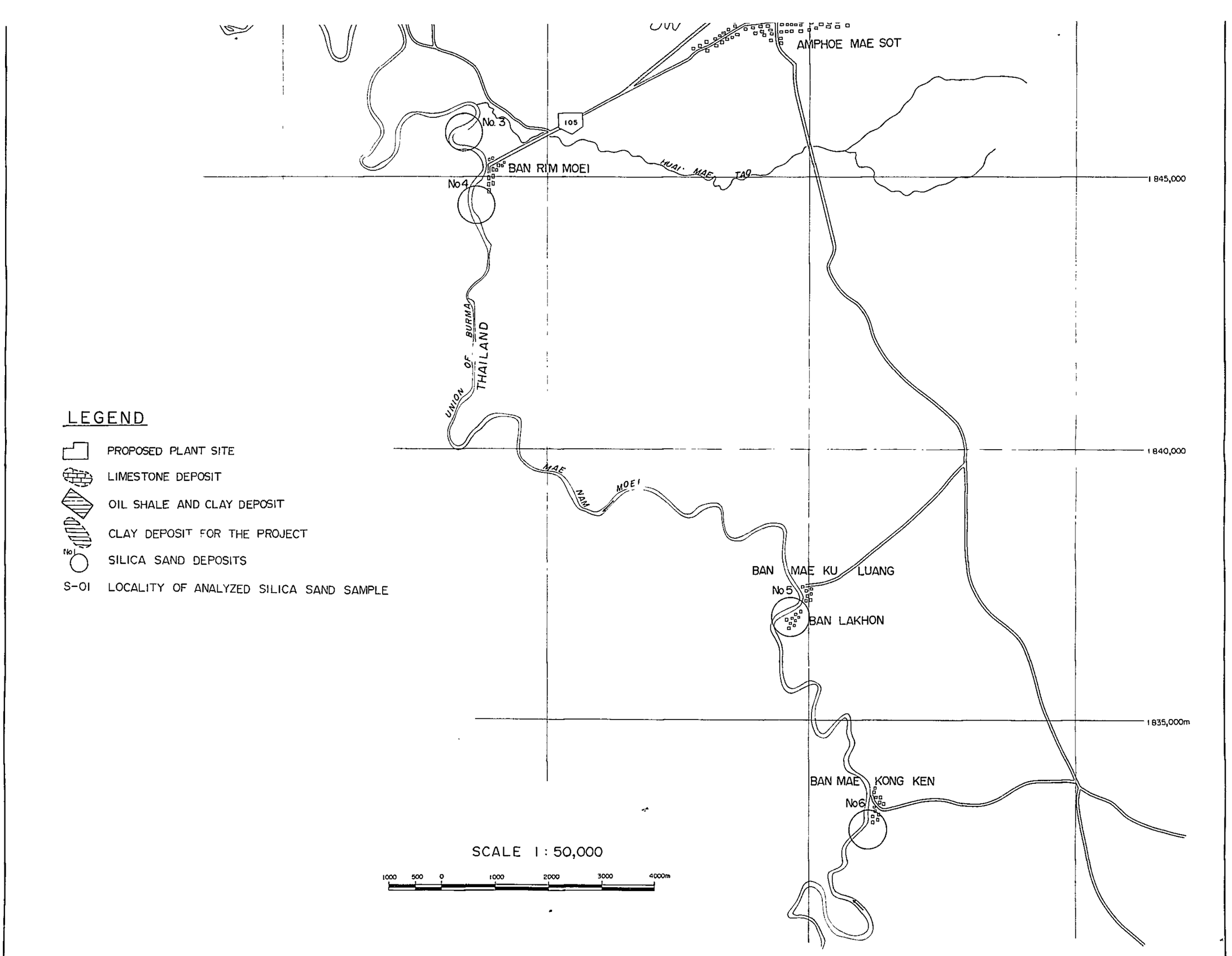




JAPAN INTERNATIONAL COOPERATION AGENCY

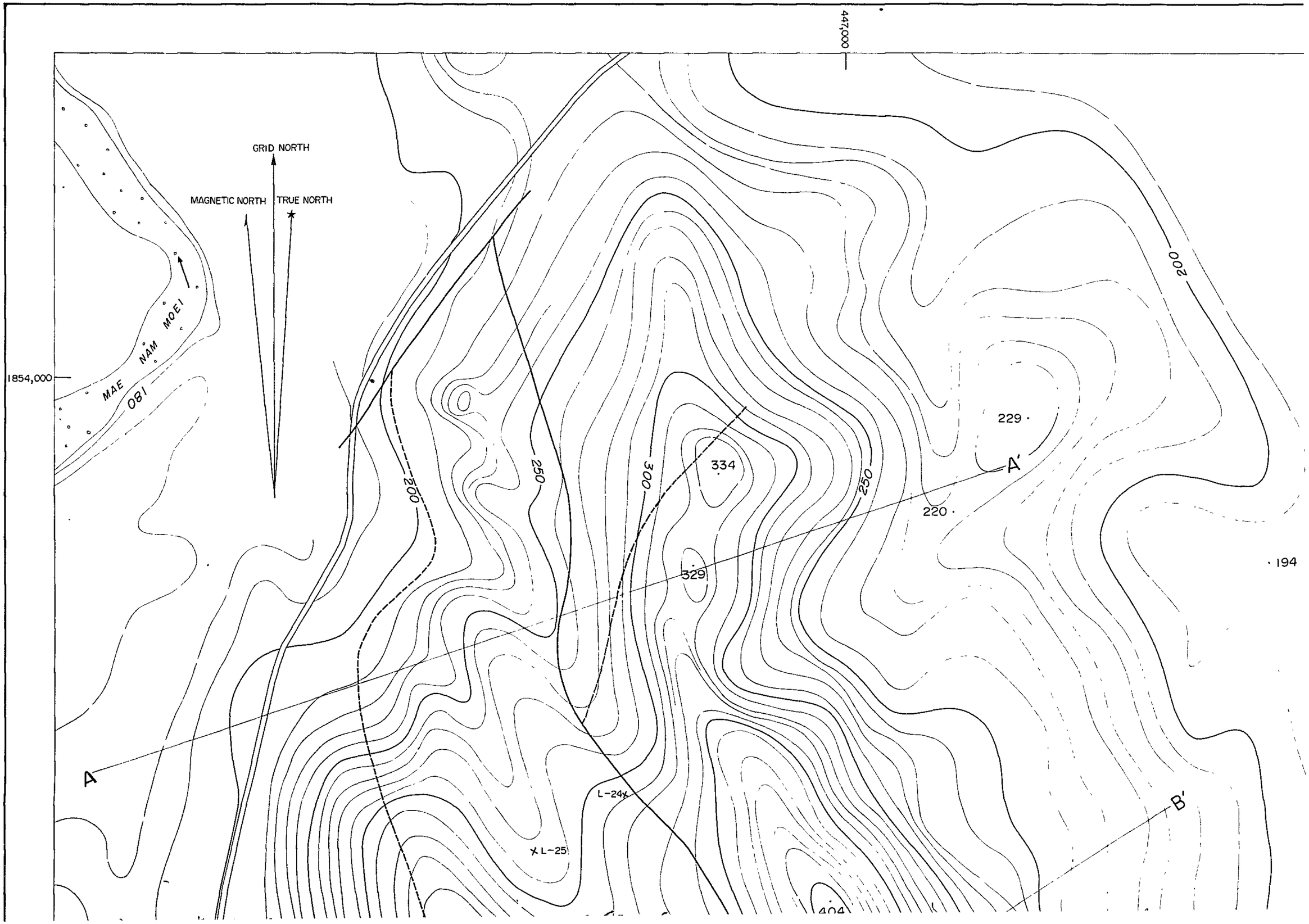
INDEX MAP OF RAW MATERIAL DEPOSITS AND PROPOSED PLANT SITE





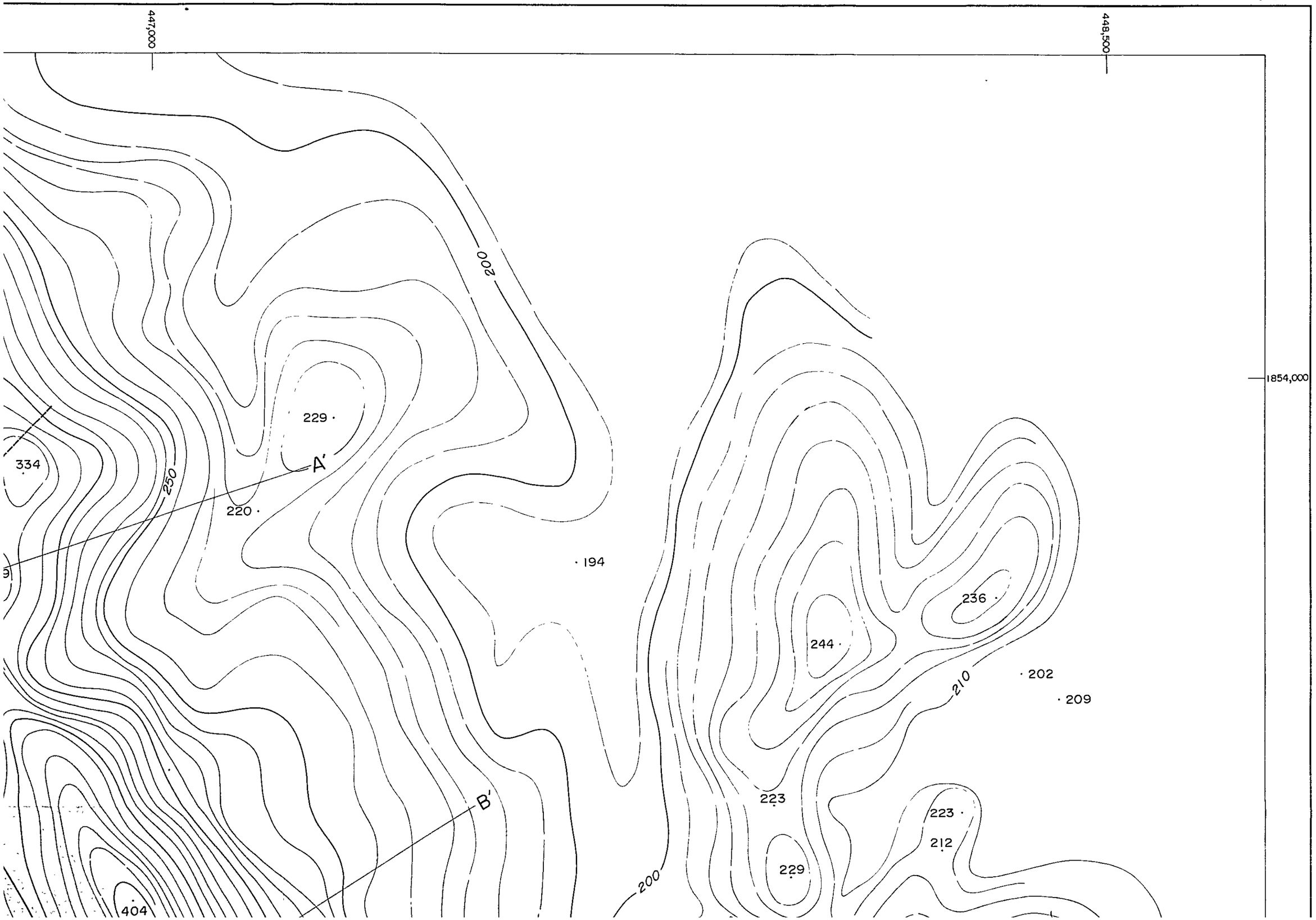
JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO JAPAN

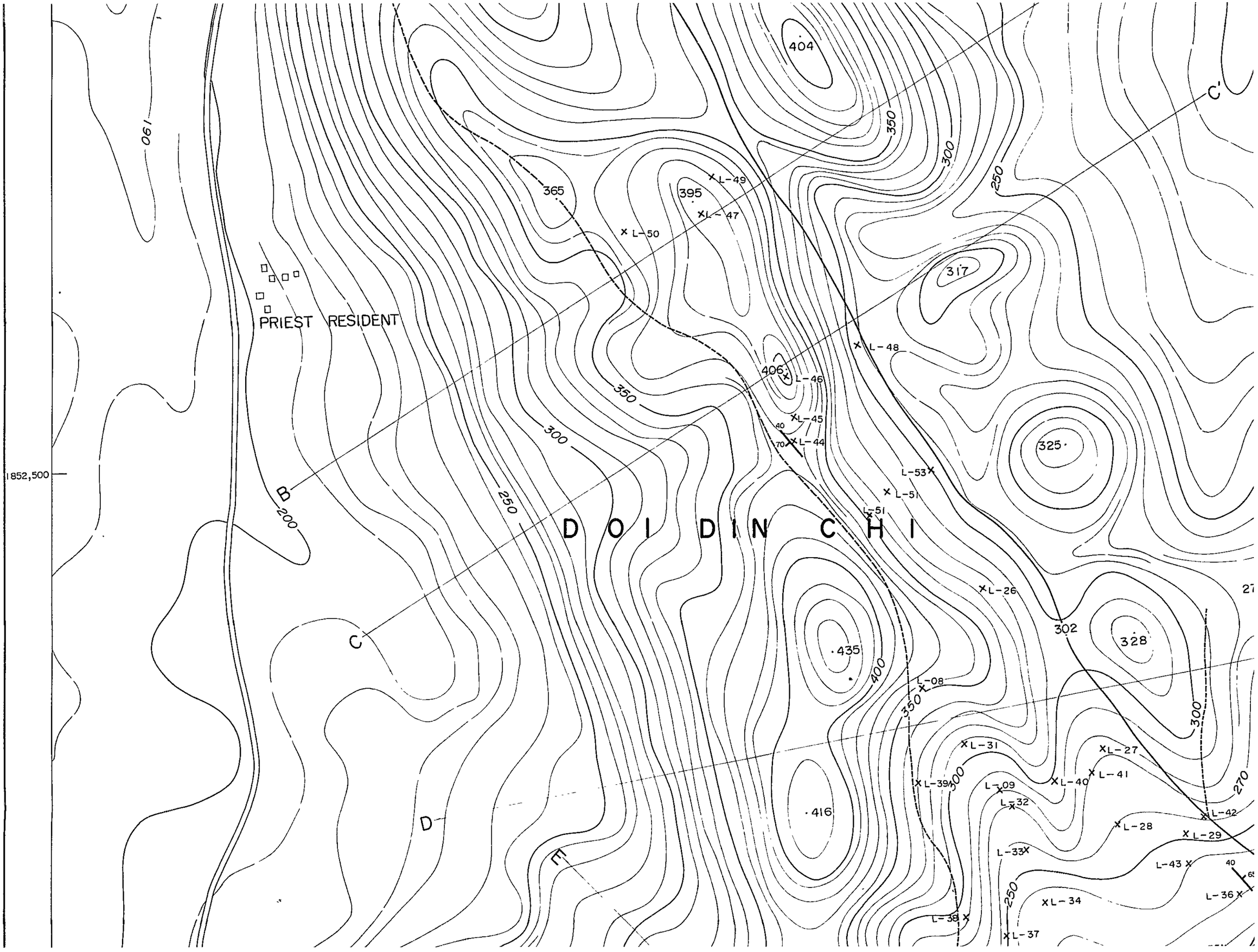
TOPOGRAPHICAL AND GEOLOGICAL MAP OF DOI DIN CHI LIME

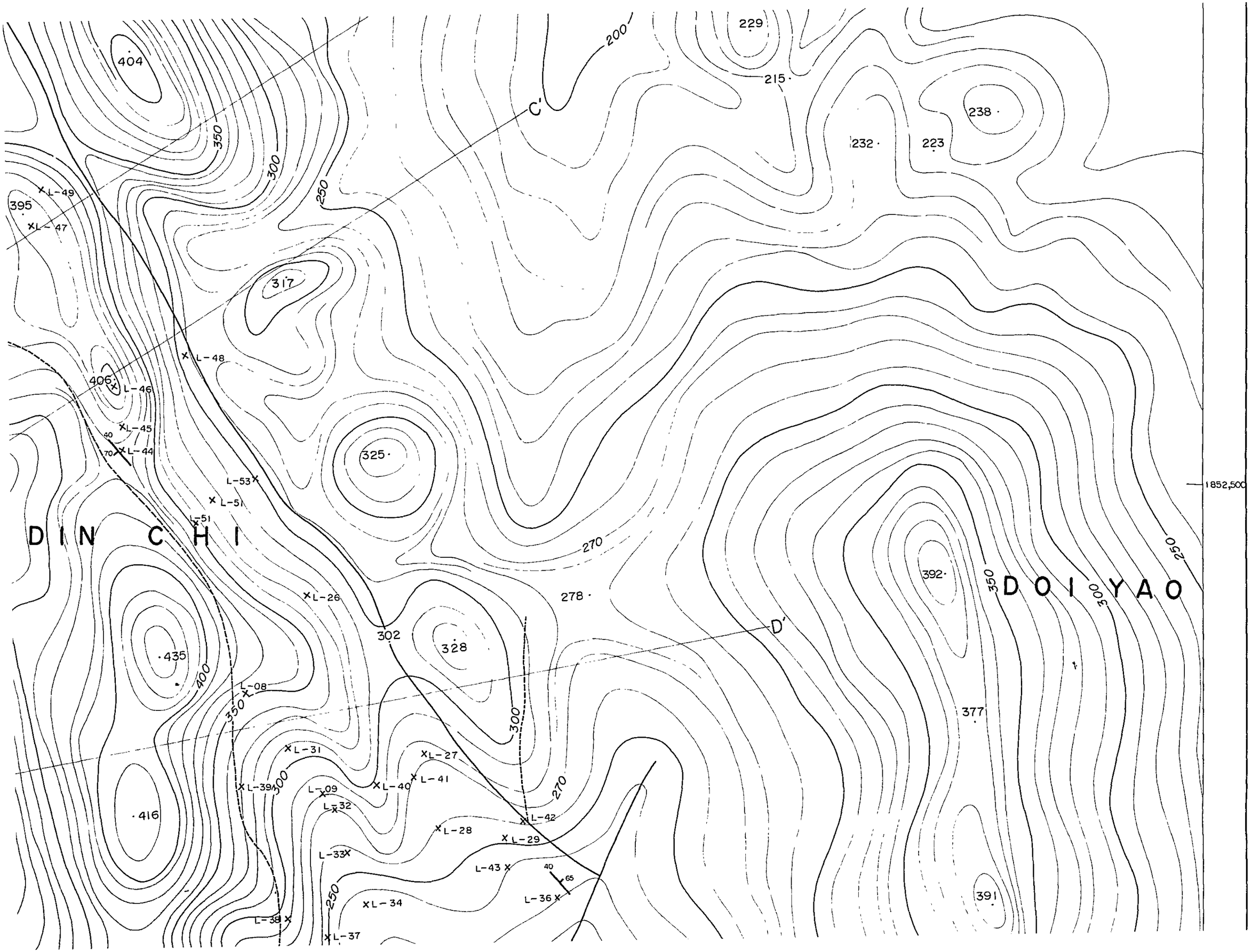


EOLOGICAL MAP OF DOI DIN CHI LIMESTONE DEPOSIT

G – 03




PRIEST RESIDENT
D O I D I N C H I
1852,500
190
200
250
300
350
365
395
404
317
406
435
416
325
328
302
400
270
L-49
L-47
L-50
L-48
L-46
L-45
L-44
L-53
L-51
L-26
L-08
L-31
L-27
L-41
L-40
L-39
L-09
L-32
L-42
L-28
L-29
L-33
L-43
L-36
L-34
L-38
L-37
A
B
C
C'
D
E
E'
40
70


404
350
300
250
200
229
215
238
232
223
C'
L-49
395
L-47
317
L-48
406
L-46
L-45
40
70
L-44
325
L-53
L-51
L-51
D I N C H I
270
L-26
278
302
328
D'
435
400
350
L-08
300
L-31
L-27
L-39
L-40
L-41
L-09
L-32
L-42
416
L-28
L-29
L-33
L-43
40
65
L-36
250
L-34
L-38
L-37
392
350
300
250
D O I Y A O
377
391
1852,500

1851,000

LEGEND

- SANDSTONE AND CONGLOMERATE
- CALCAREOUS CONGLOMERATE
- LIMESTONE
- STRIKE AND DIP
- PROBABLE FAULT
- ×L-01 LOCALITY OF ANALYZED GRAB – SAMPLE
- A-A' LINE FOR GEOLOGICAL CROSS SECTION

MUANG HIN

L-43 X
40
65
L-36 X
L-38 X
XL-34
250
XL-37
XL-10
L-35X
XL-11
223
424
400
XL-12
210
208
XL-15
LS-1X
XL-13
XL-14
238
XL-07
XL-04
XL-16
XL-03
F
60
XL-30
XL-20
XL-1
XL-06
217
224
292
L-20
206
L-21
L-05X
L-18
XL-22
XL-19
214
334
218
L-23
211
300
233
E
210
G
250
XL-01
263
226
391
350
300
250
200
1851,000

MUANG HIN

LEGEND

- SANDSTONE AND CONGLOMERATE
- CALCAREOUS CONGLOMERATE
- LIMESTONE
- STRIKE AND DIP
- PROBABLE FAULT
- ×L-01 LOCALITY OF ANALYZED GRAB-SAMPLE
- A-A' LINE FOR GEOLOGICAL CROSS SECTION

1851,000

292 · 206 · 218 · 211 · 208 · 212 · 214 · 210 · 263 · 244 · 266 · 334

250 · 300 · 250 · 250

L-20 · L-21 · L-05 · L-18 · L-22 · L-19 · L-23 · L-01

F · F' · G · G'

MUANG HIN

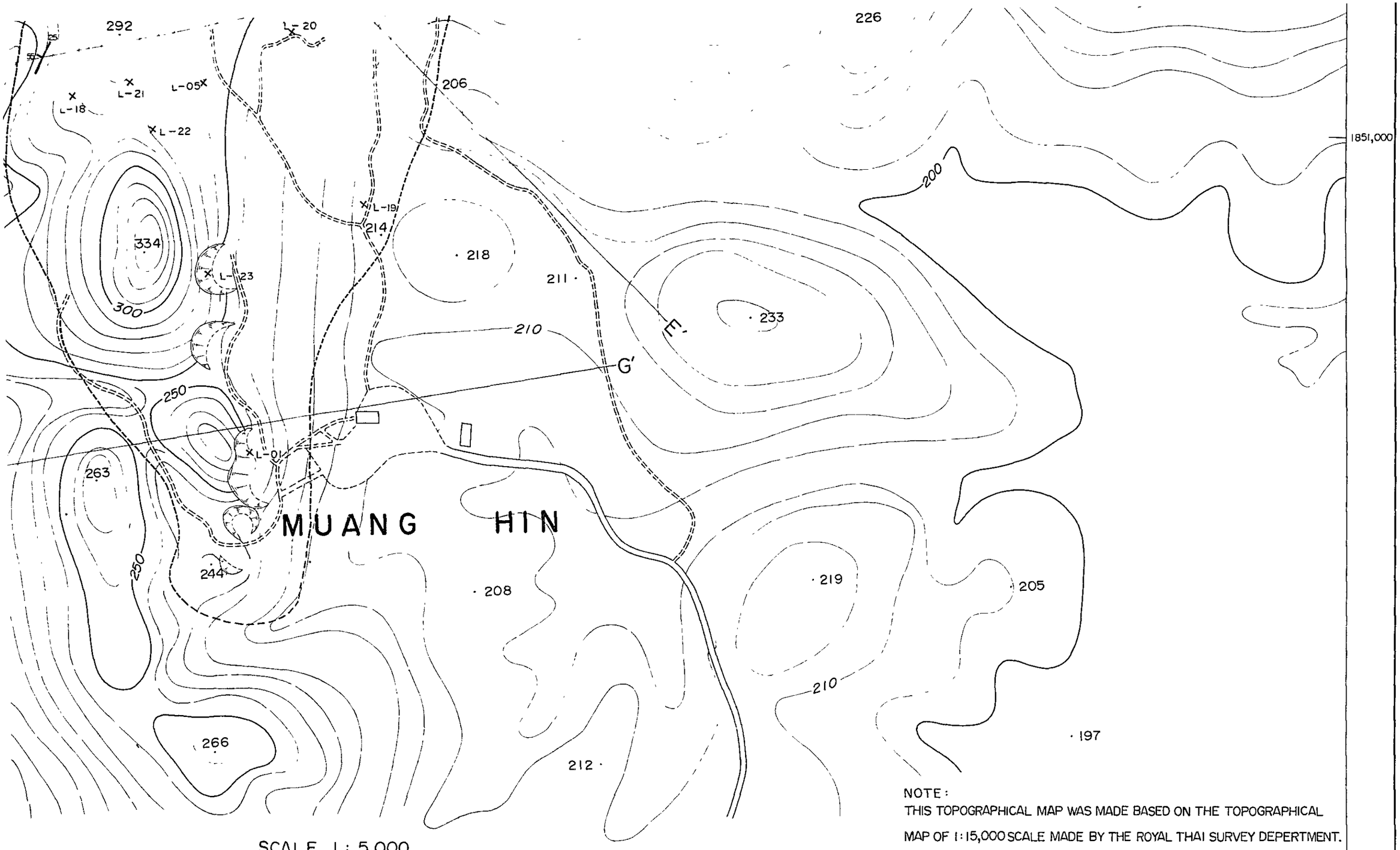
SCALE 1 : 5,000

0 50 100 200 300 400m

CONTOUR INTERVAL : 10 METERS

447,000

JAPA



SCALE 1 : 5,000

0 50 100 200 300 400m

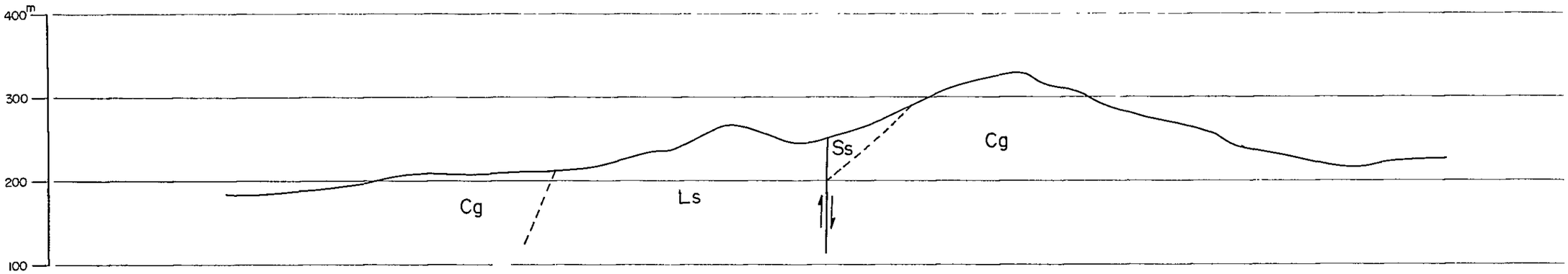
CONTOUR INTERVAL : 10 METERS

NOTE :
THIS TOPOGRAPHICAL MAP WAS MADE BASED ON THE TOPOGRAPHICAL MAP OF 1:15,000 SCALE MADE BY THE ROYAL THAI SURVEY DEPERTMENT.

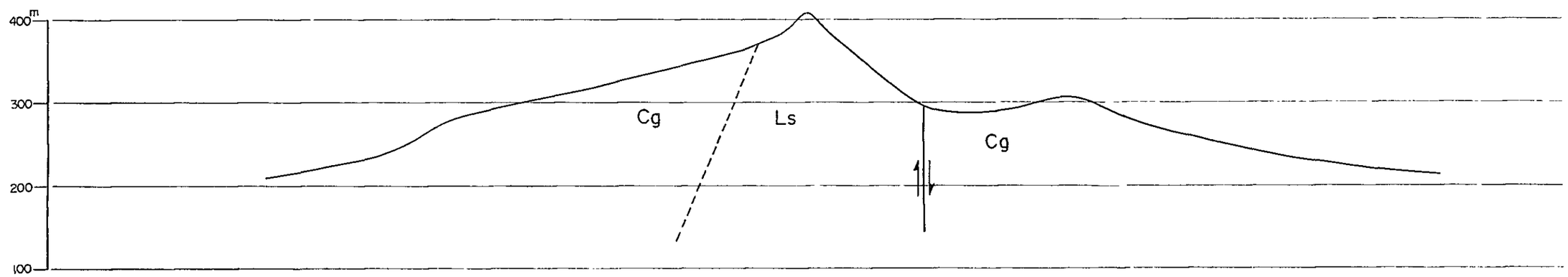
JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO JAPAN

GEOLOGICAL CROSS SECTION OF D(

Sec. A – A′

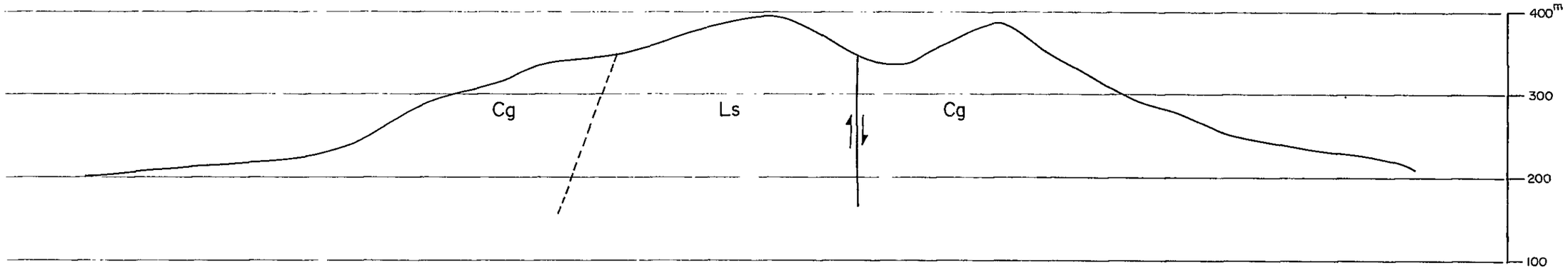


Sec. C – C′

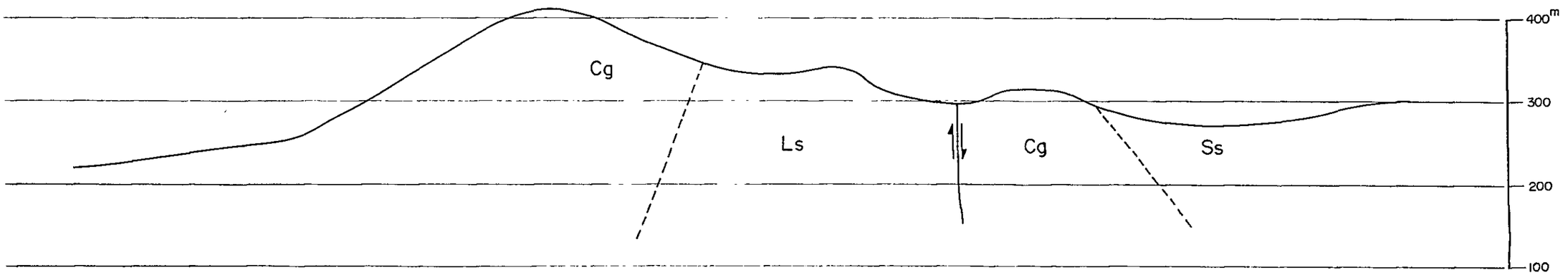


F DOI DIN CHI LIMESTONE DEPOSIT

Sec. B – B'

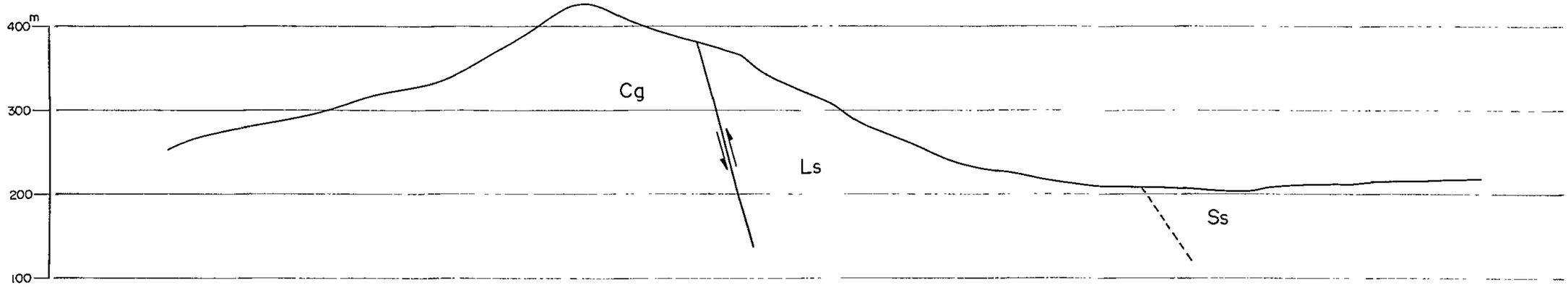


Sec · D – D'

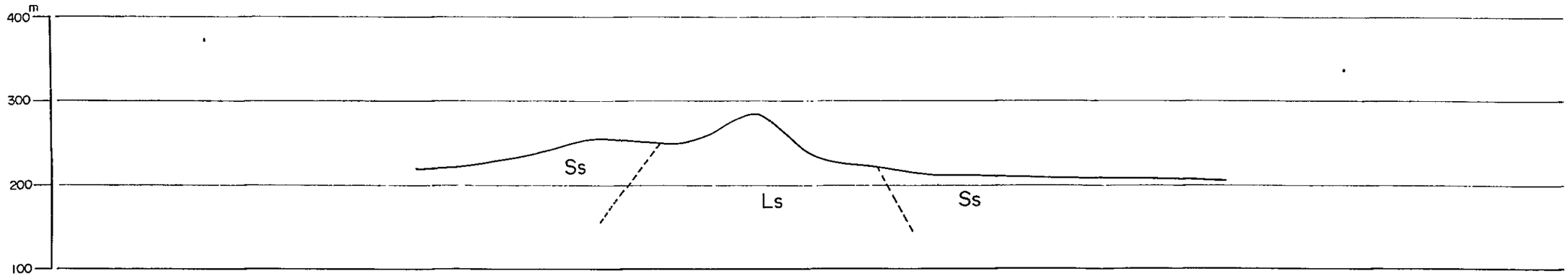


100

Sec. E – E'



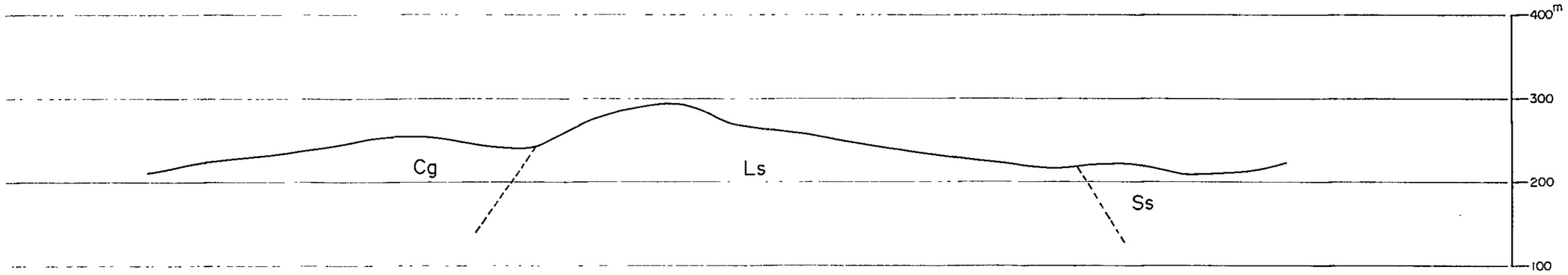
Sec. G – G'



SCALE 1 : 2,

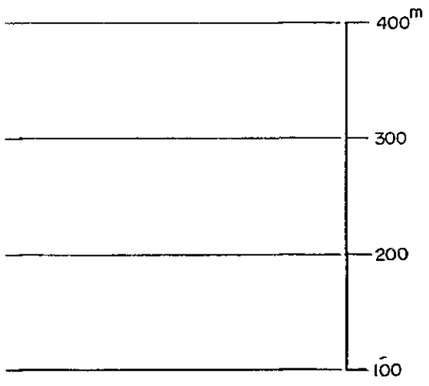
0 50 100

Sec. F – F'



LEGEND

Ss	SANDSTONE AND CONGLOMERATE
Cg	CALCAREOUS CONGLOMERATE
Ls	LIMESTONE
	PROBABLE FAULT



1 : 2,000

NOTE :

THIS GEOLOGICAL CROSS SECTIONS WERE MADE BASED ON DRAWING G – 03.

TOPOGRAPHIC AND GEOLOGICAL MAP OI

446,500

447,000

GRID NORTH

MAGNETIC NORTH

TRUE NORTH

1,852,500

375

350

325

300

275

250

225

406

L-46

L-45

49

70

L-44

MAP OF THE PROPOSED LIMESTONE QUARRY AT DOI DIN CHI

G – 05

447,500

1,852,500

L-48

L-53

L-52

L-51

L-26

325

300

275

250

300

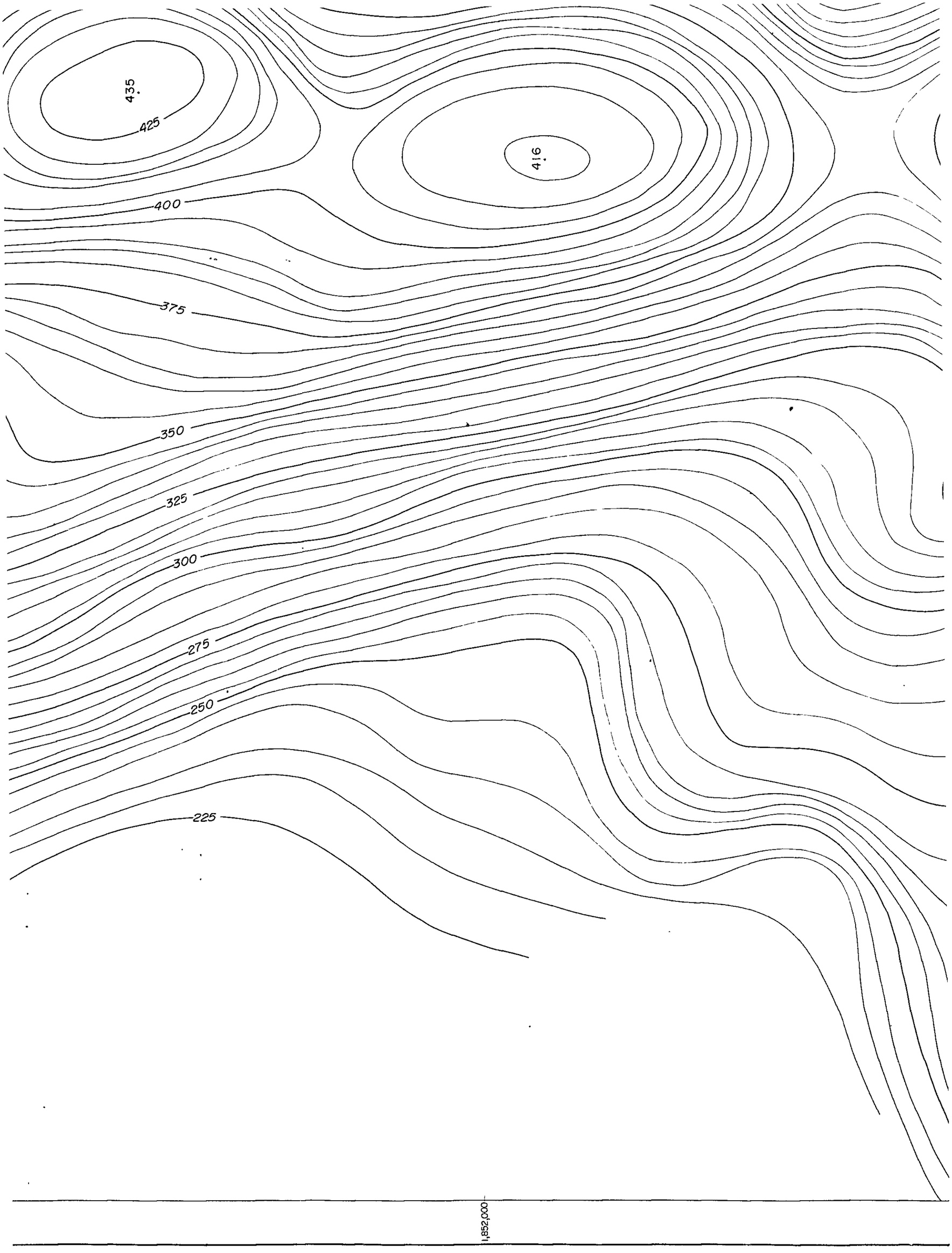
325

350

375

400

278


435
425
416
400
375
350
325
300
275
250
225
1,852,000

435

400

XL-08

XL-39

XL-31

302

328

300

XL-27

XL-40

XL-41

XL-09

XL-32

XL-33

XL-28

XL-29

XL-42

XL-43

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65

XL-36

XL-34

240

XL-38

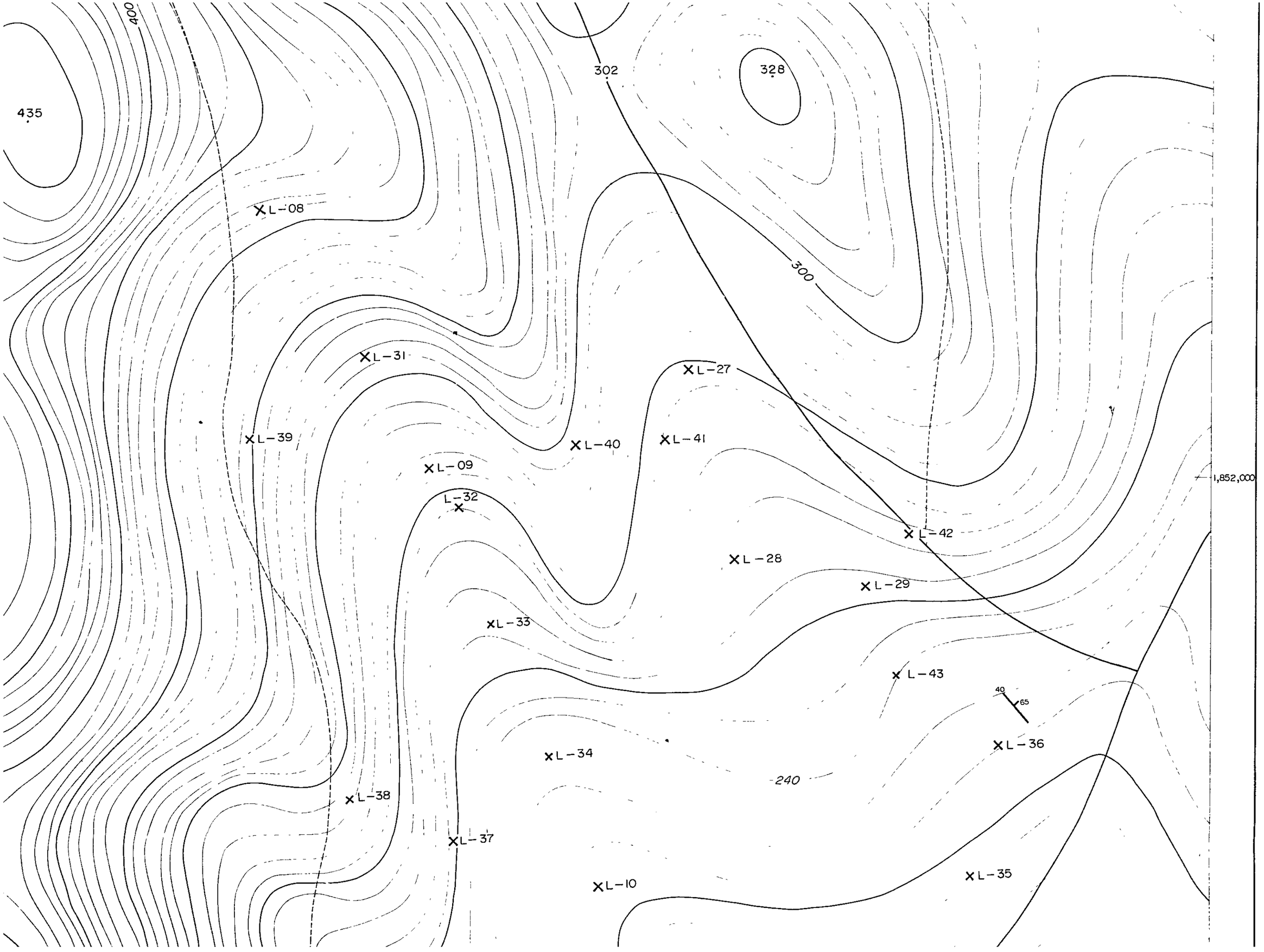
XL-37

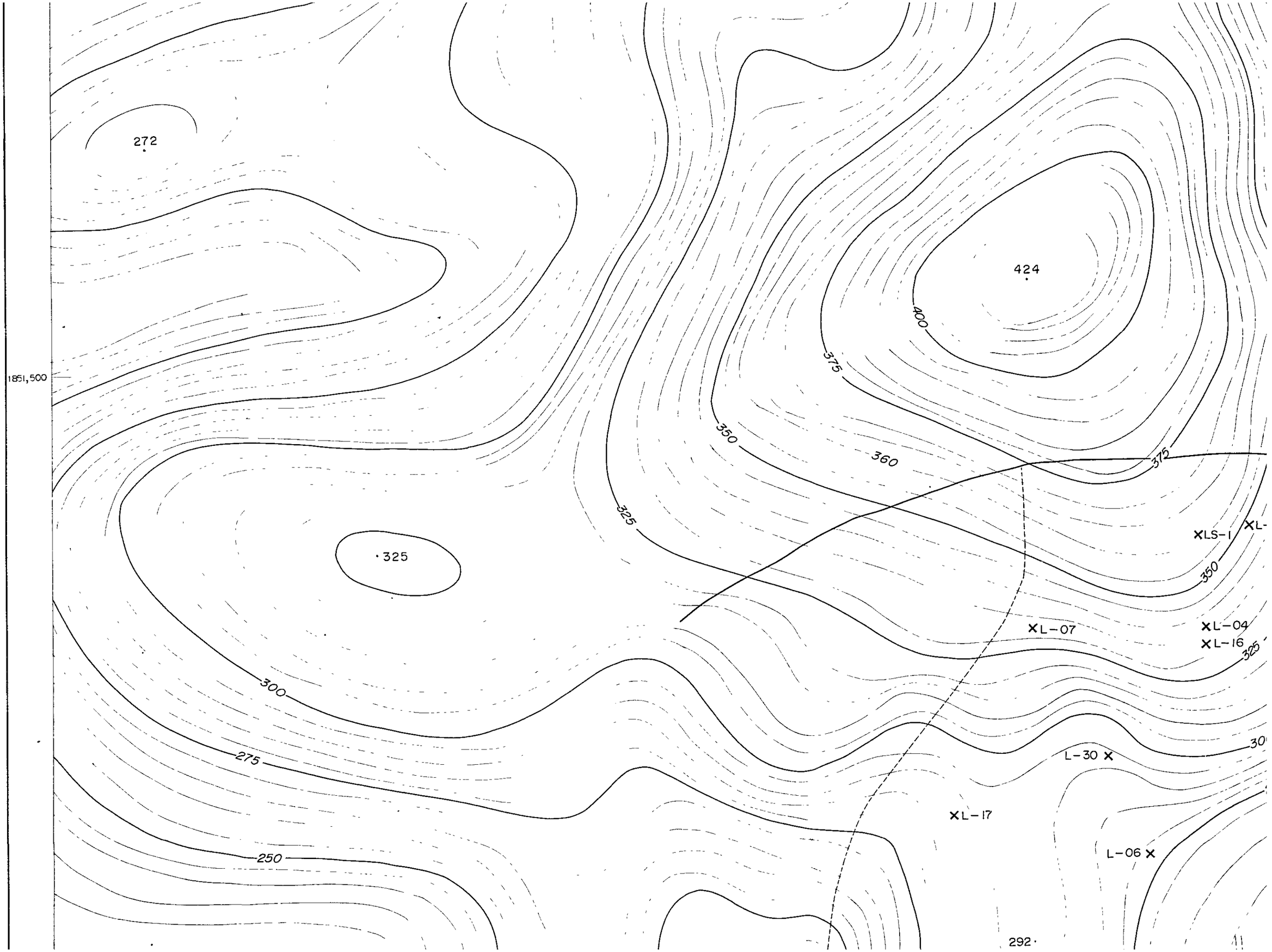
XL-10

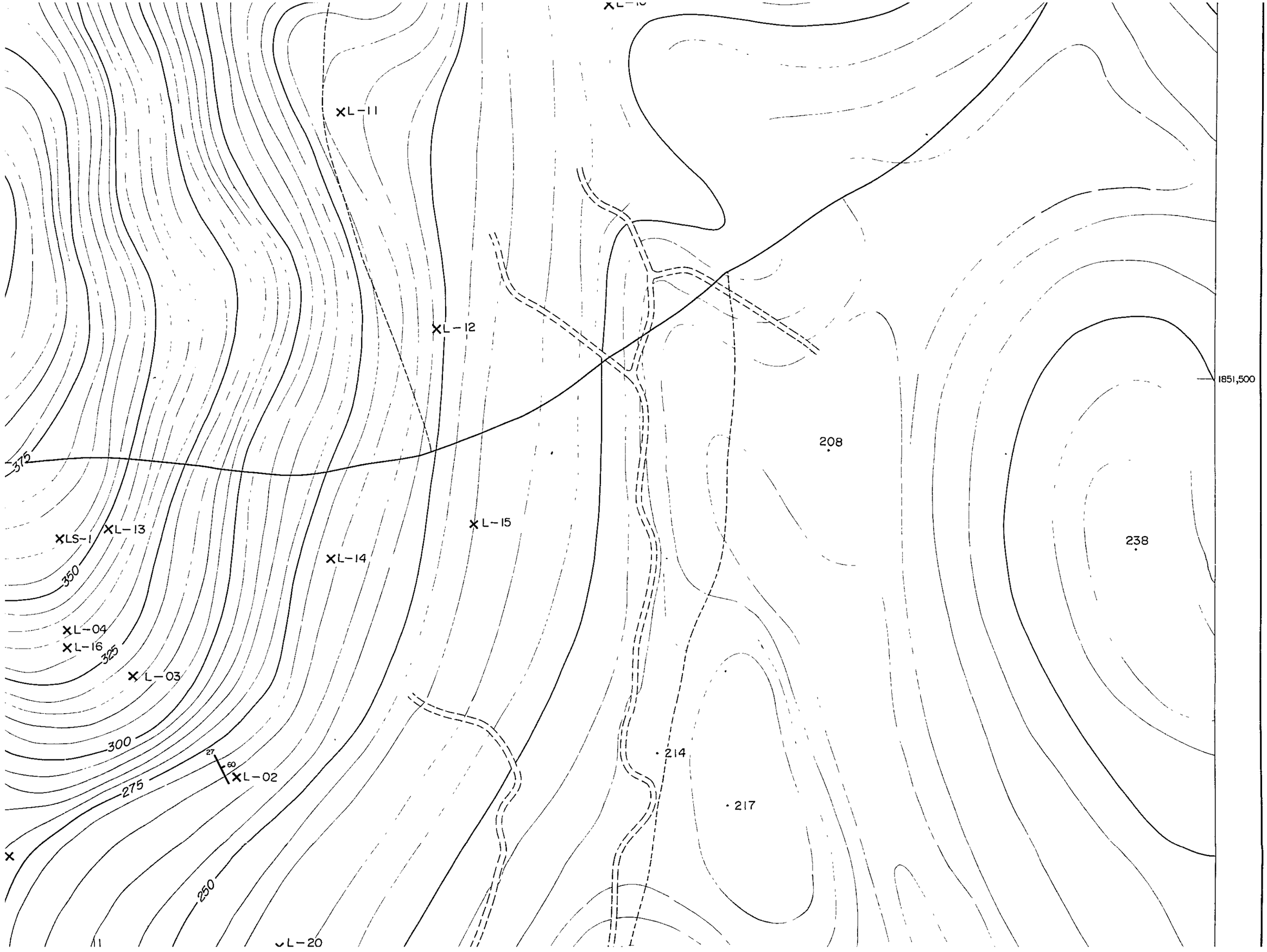
XL-35

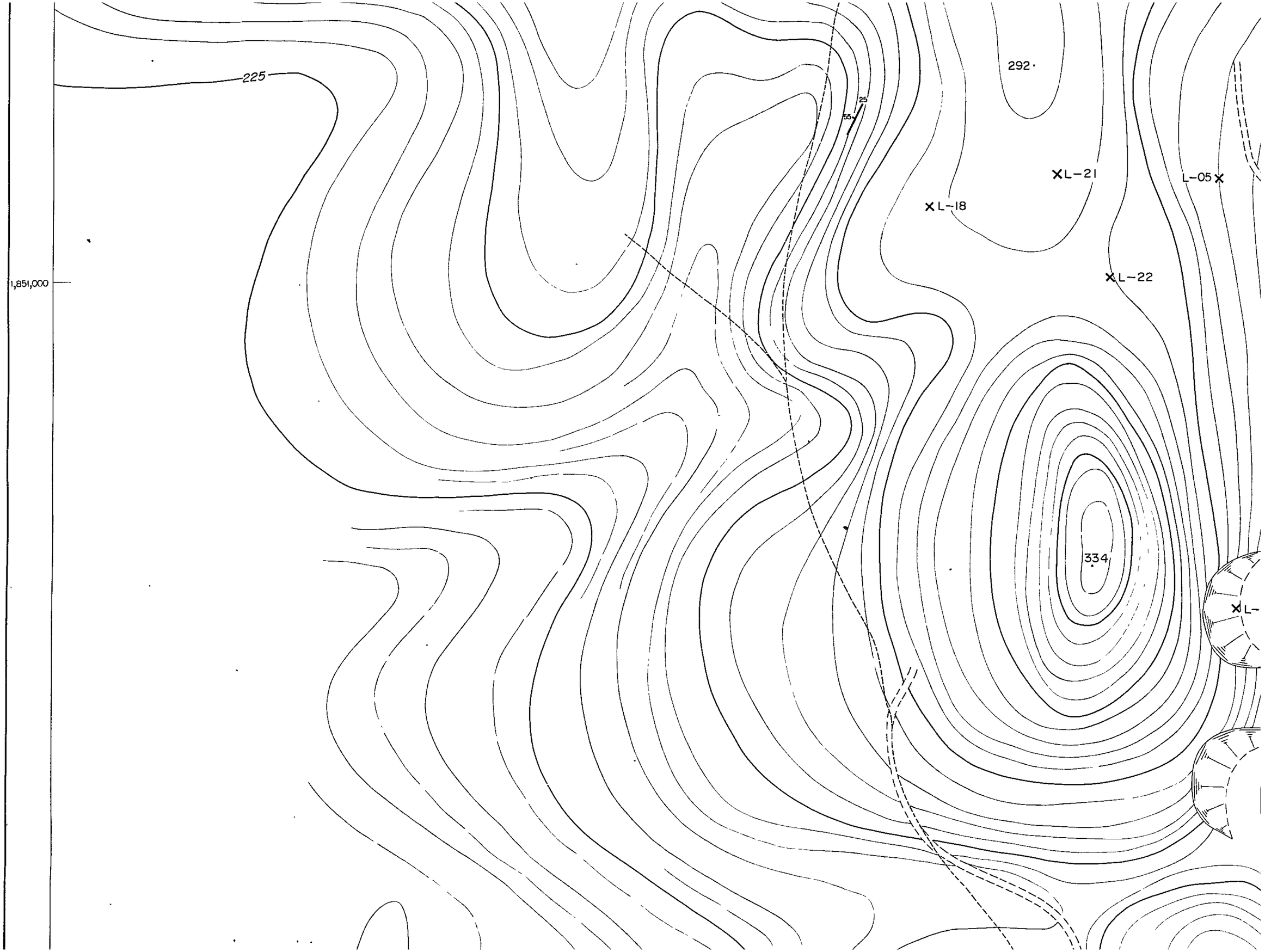
278

1,852,000


400
435
302
328
300
L-08
L-31
L-27
L-39
L-40
L-41
L-09
L-32
L-42
L-28
L-29
L-33
L-43
40
65
L-36
L-34
240
L-38
L-37
L-10
L-35
1,852,000


272
424
400
375
350
360
325
325
300
275
250
1851,500
LS-1
L-07
L-04
L-16
L-30
L-17
L-06
292


XL-11
XL-12
XL-10
XL-15
XL-14
XLS-1
XL-13
XL-04
XL-16
XL-03
XL-02
XL-20
375
350
325
300
275
250
27
60
208
214
217
238
1851,500


225
25
55
292
L-21
L-05
L-18
L-22
1,851,000
334
L-

L-20

L-05

225

206

1,851,000

L-19

214

218

211

L-23

225

LEGEND

- SANDSTONE AND CONGLOMERATE
- CALCAREOUS CONGLOMERATE
- LIMESTONE
- 55/30 STRIKE AND DIP
- PROBABLE FAULT
- XL-01 LOCALITY OF ANALYZED GRAB SAMPLE

218

225

250

263

244

1,850,500

446,500

447,000

SCALE 1:2,000

CONTOUR INTERVAL : 5 METERS

0 50 100

L-01

MUANG HIN

244

208

1,650,500

000
: 5 METERS

200m

NOTE:

THIS TOPOGRAPHICAL MAP WAS MADE BASED ON THE TOPOGRAPHICAL MAP OF 1:15,000 SCALE MADE BY THE ROYAL THAI SURVEY DEPARTMENT.

447,500

JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO JAPAN

MAP FOR RESERVES CALCULATION OF THE PROPOS

446,500

447,000

GRID NORTH

MAGNETIC NORTH

TRUE NORTH

1,852,500

375

350

325

300

275

250

225

406

L-46

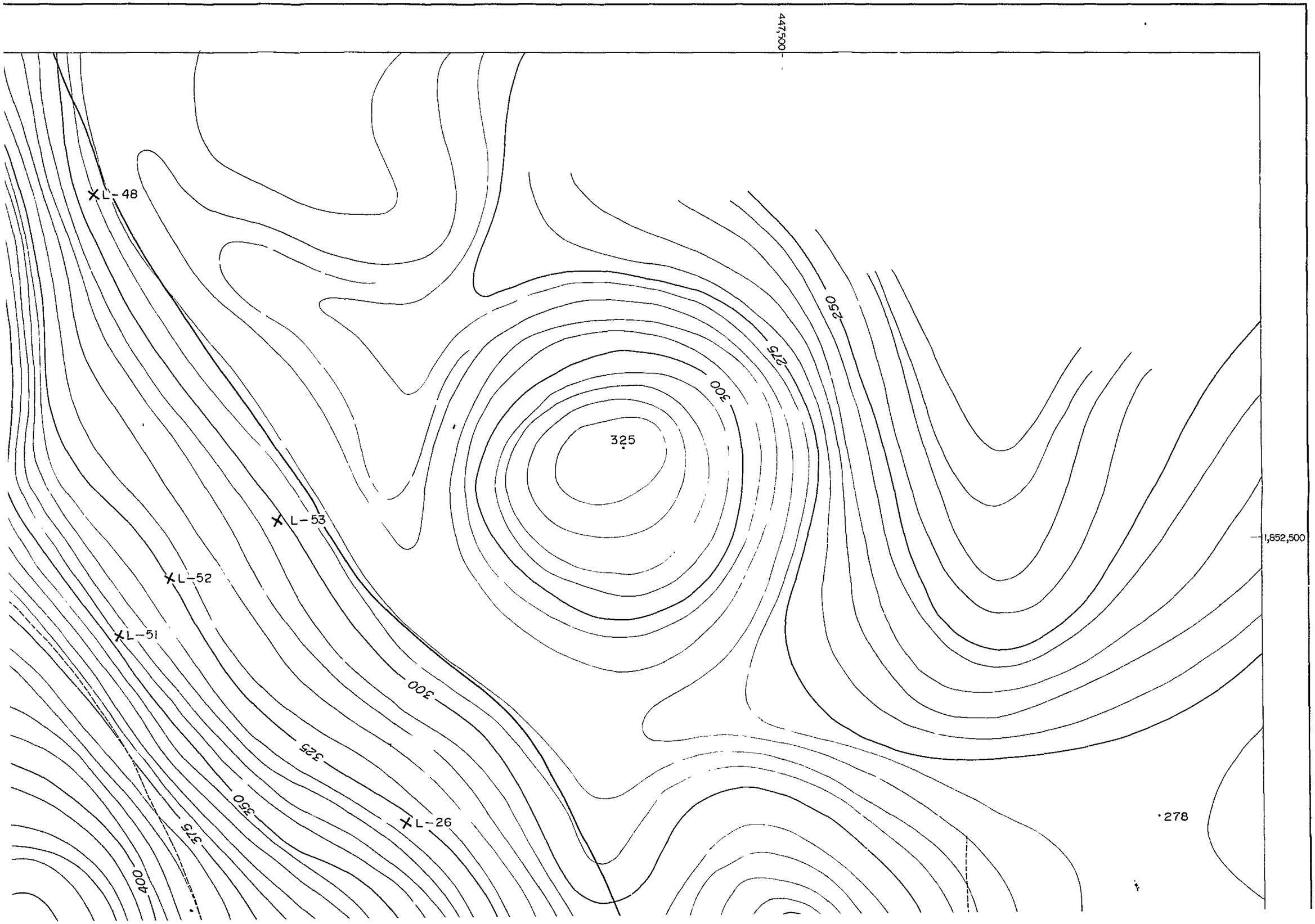
L-45

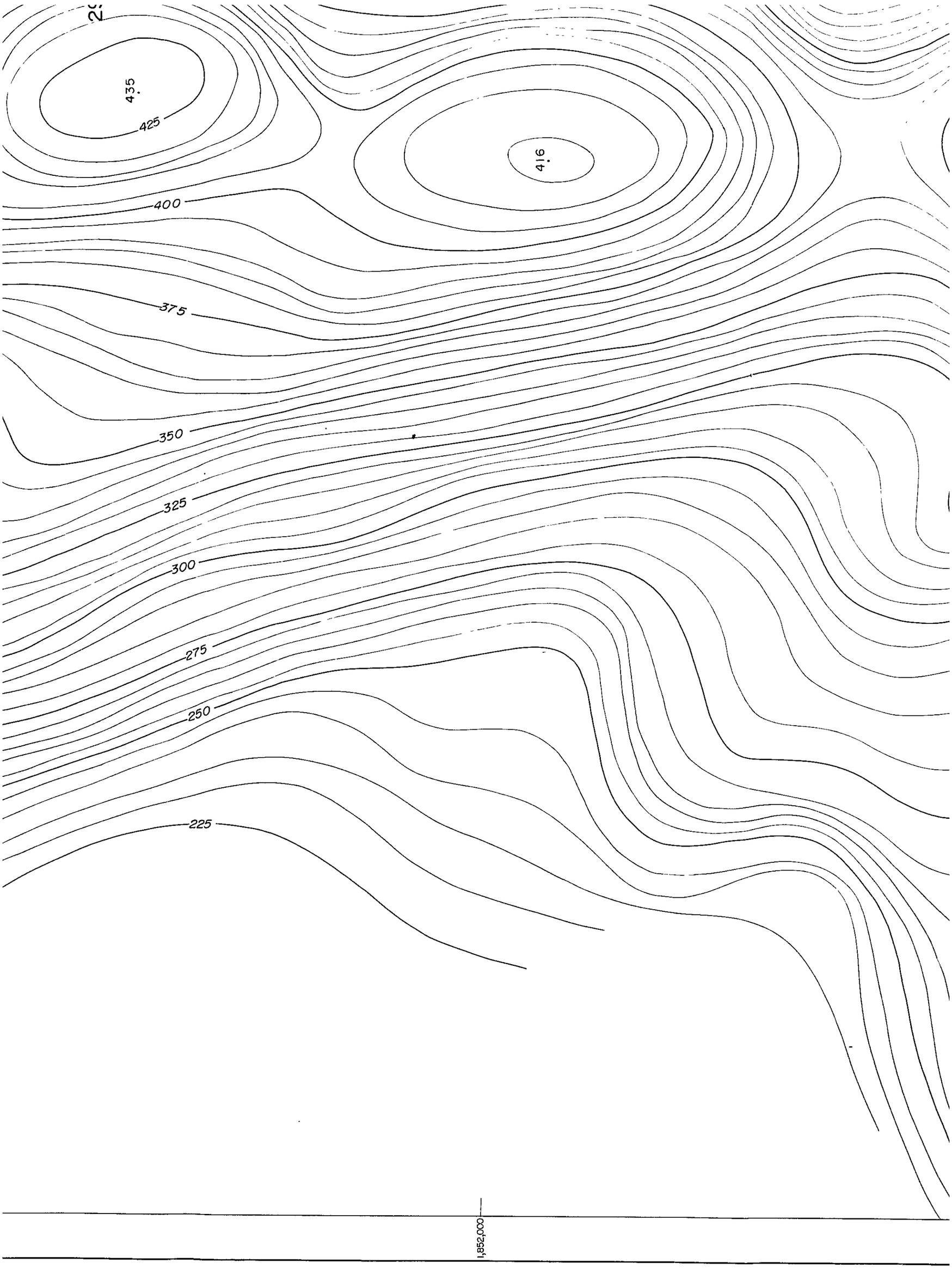
40

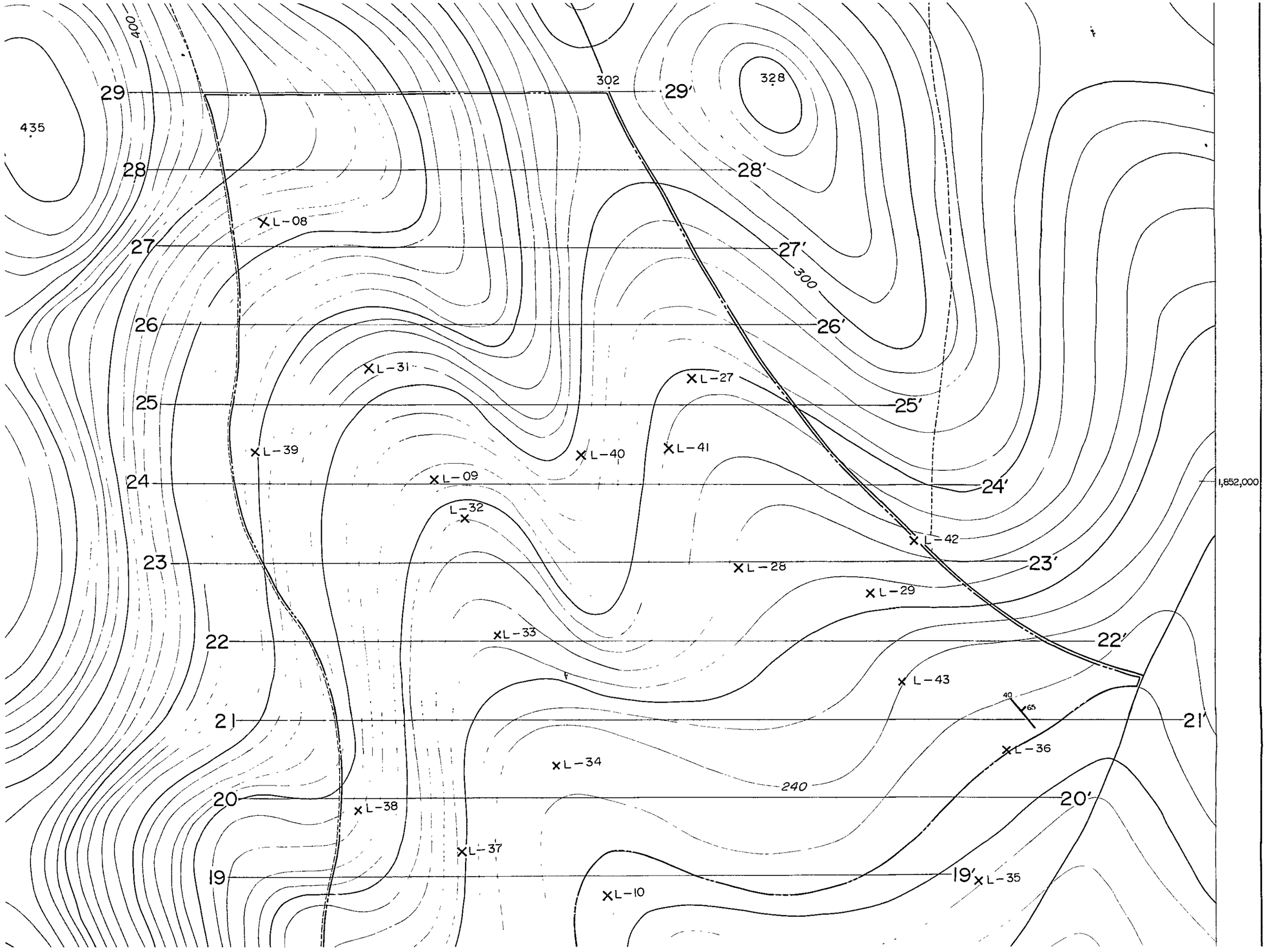
70

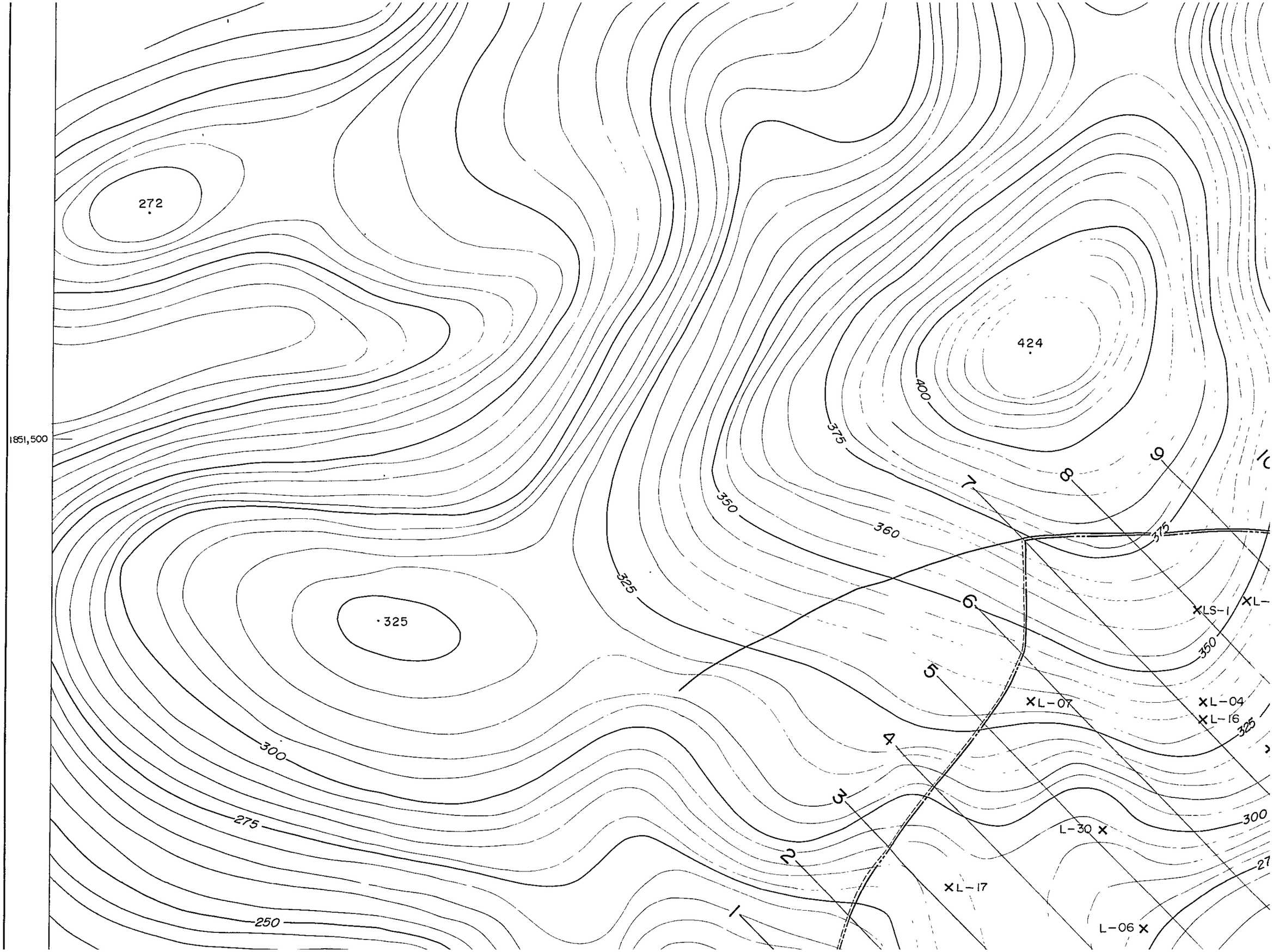
L-44

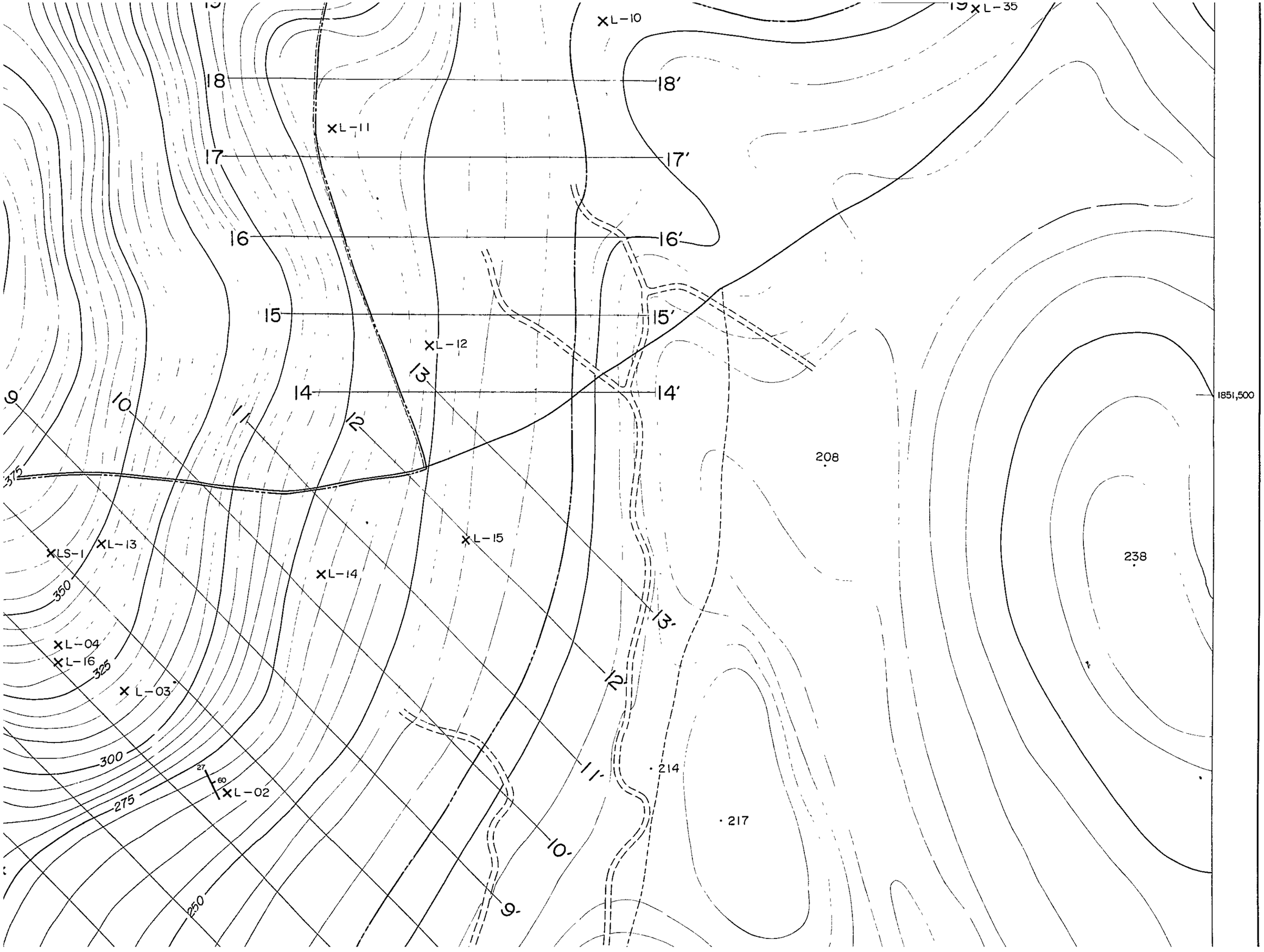
PROPOSED LIMESTONE QUARRY AT DOI DIN CHI




435
425
416
400
375
350
325
300
275
250
225
1,852,000


400
435
29
29'
302
328
28
28'
L-08
27
27'
300
26
26'
L-31
L-27
25
25'
L-39
L-40
L-41
24
L-09
24'
1,852,000
L-32
L-42
23
23'
L-28
L-29
22
L-33
22'
L-43
40
65
21
21'
L-36
L-34
240
20
20'
L-38
L-37
19
19'
L-35
L-10


272
424
325
1851,500
400
375
350
360
325
300
275
250
9
8
7
6
5
4
3
2
1
375
350
325
300
27
LS-1
L-07
L-04
L-16
L-30
L-17
L-06


18
18'
17
17'
16
16'
15
15'
14
14'
13
12
11
10
9
L-10
L-11
L-12
L-15
L-35
LS-1
L-13
L-14
L-04
L-16
L-03
L-02
350
325
300
275
250
375
18'
17'
16'
15'
14'
13'
12'
11'
10'
9'
1851,500
208
238
214
217

1,851,000

25

55

1-

XL-18

2-

XL-21

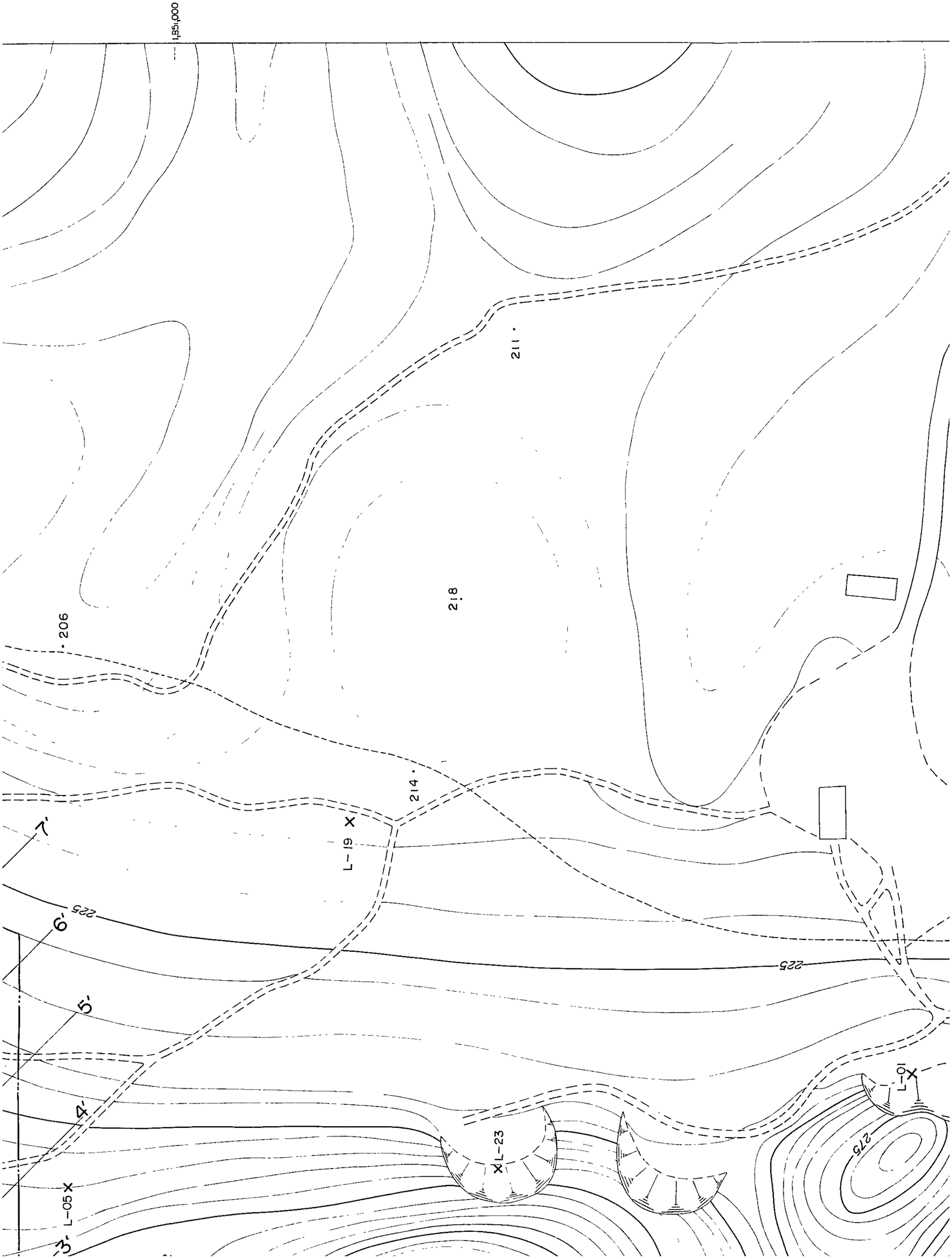
3-

L-05 X

XL-22

334

XL-


1,25,000
206
211
218
214
L-19
225
225
7'
6'
5'
4'
3'
L-05
L-23
L-01
275

LEGEND

- AREA FOR RESERVES CALCULATION
- I—I' LINE FOR SECTIONAL DRAWING
- STRIKE AND DIP
- PROBABLE FAULT
- ×L-01 LOCALITY OF ANALYZED SAMPLES

218

225

250

263

244

1,650,500

446,500

447,000

SCALE 1 : 2,000

0 50 100

CONTOUR INTERVAL : 5 METERS

L-01

MUANG HIN

244

208

1,850,500

1 : 2,000

200m

RVAL : 5 METERS

NOTE :

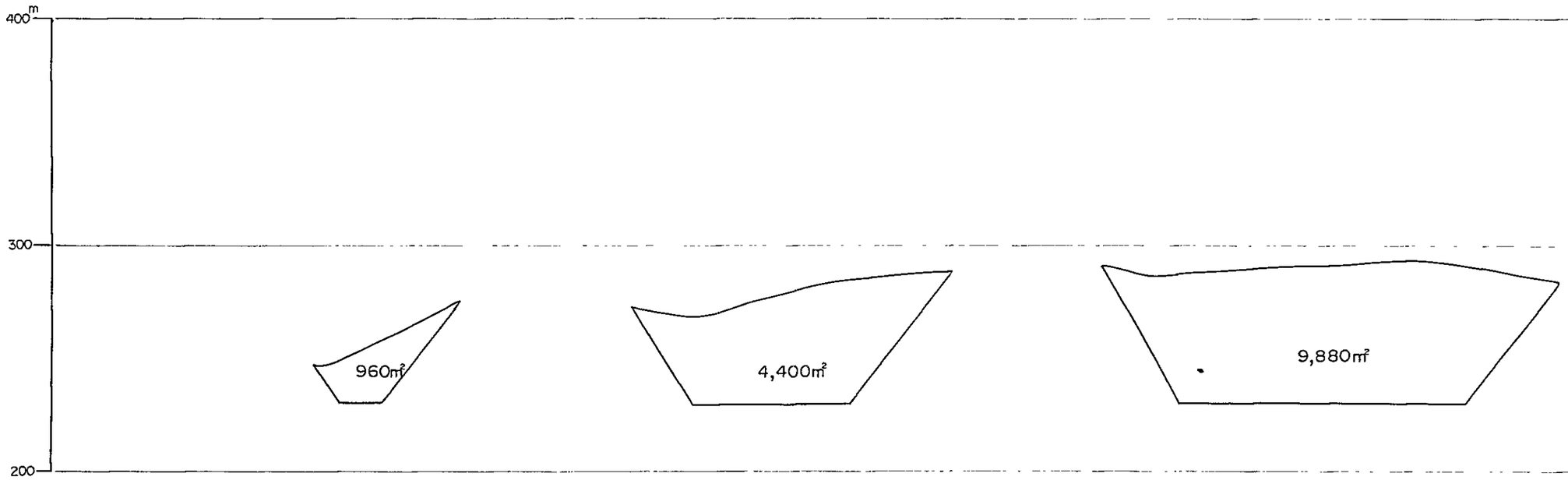
THIS TOPOGRAPHICAL MAP WAS MADE BASED ON THE TOPOGRAPHICAL MAP OF 1 : 15,000 SCALE MADE BY THE ROYAL THAI SURVEY DEPARTMENT.

447,500

JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO JAPAN

SECTIONAL DRAWINGS FOR RESERVES CALCULATION OF DC

Sec. 1 – 1'

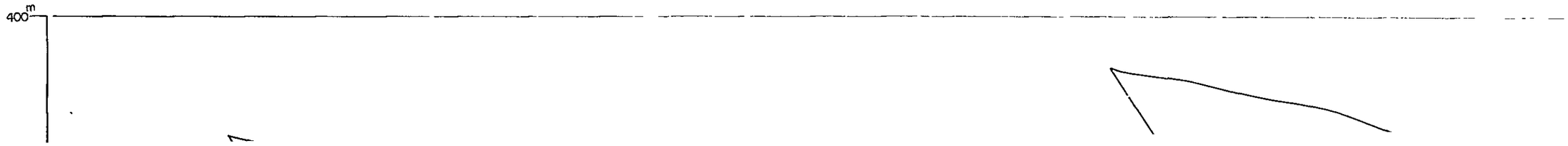


Sec. 2 – 2'

Sec. 3 – 3'

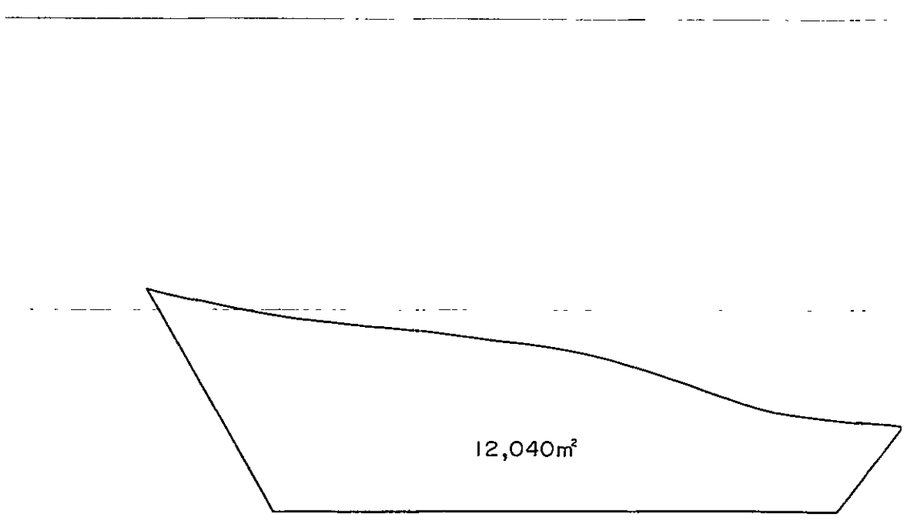
Sec. 6 – 6'

Sec. 7 – 7'



DOI DIN CHI LIMESTONE DEPOSIT (SOUTHERN DEPOSIT)

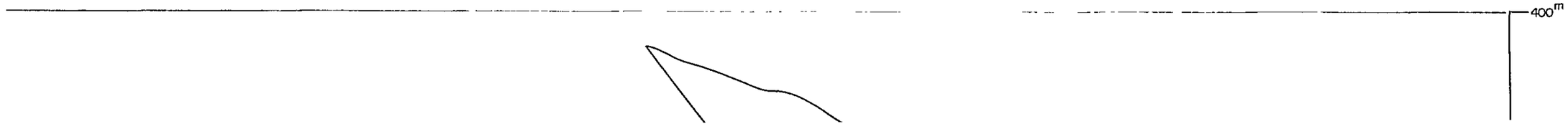
Sec. 4 – 4′

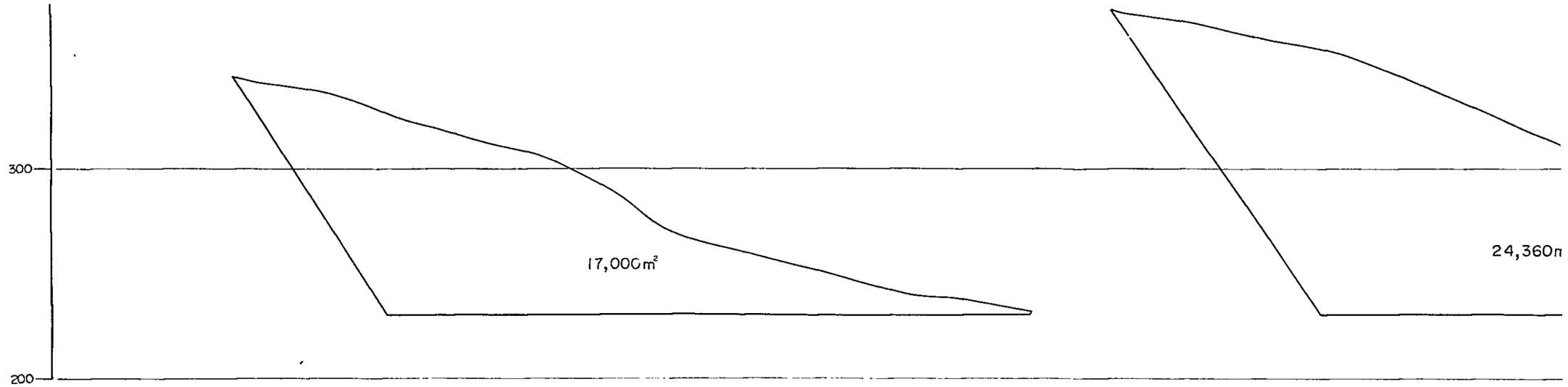


Sec. 5 – 5′

7′

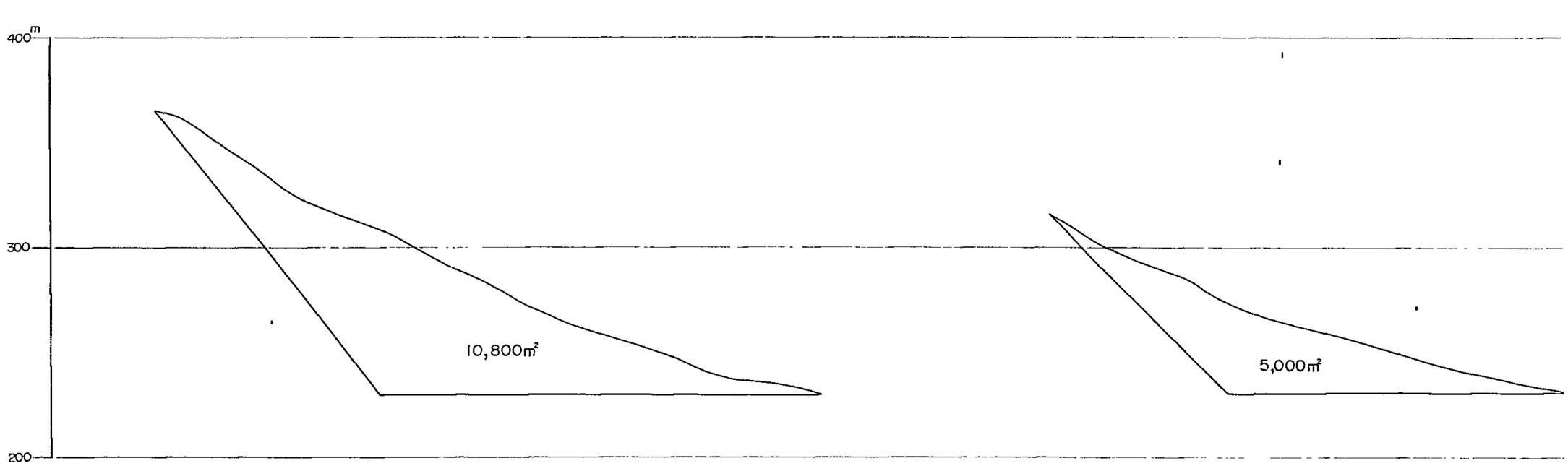
Sec. 8 – 8′





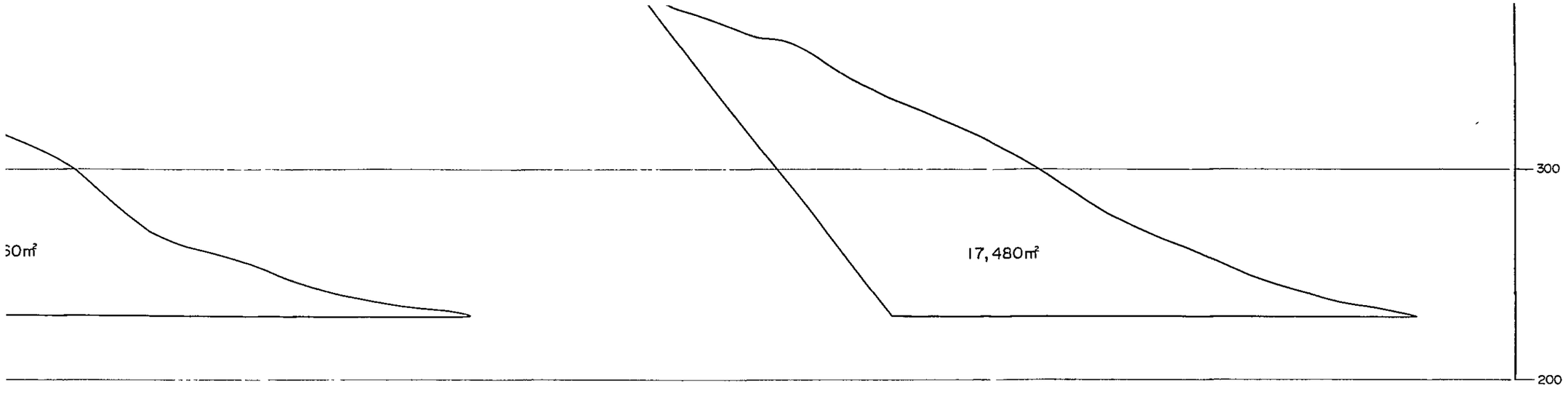
Sec. 9 – 9′

Sec. 10 – 10′



SCALE 1 :

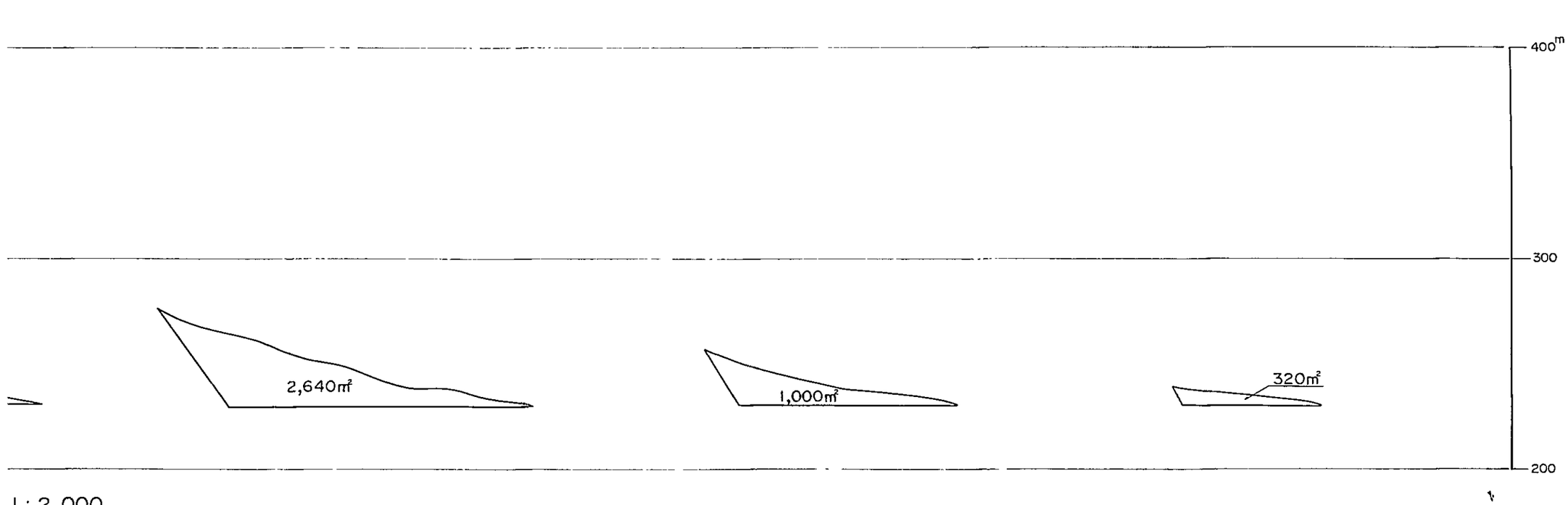
0 50 100



Sec. 11 – 11'

Sec. 12 – 12'

Sec. 13 – 13'



1 : 2,000

00 200m

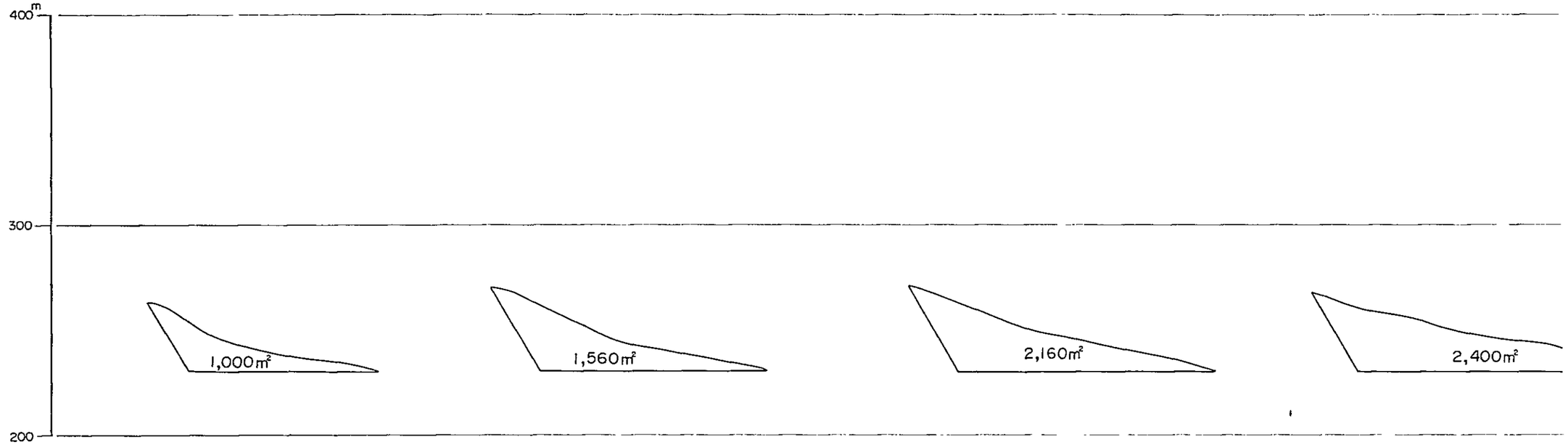
NOTE

THIS SECTIONAL DRAWINGS WERE MADE BASED ON DRAWING G – 06.

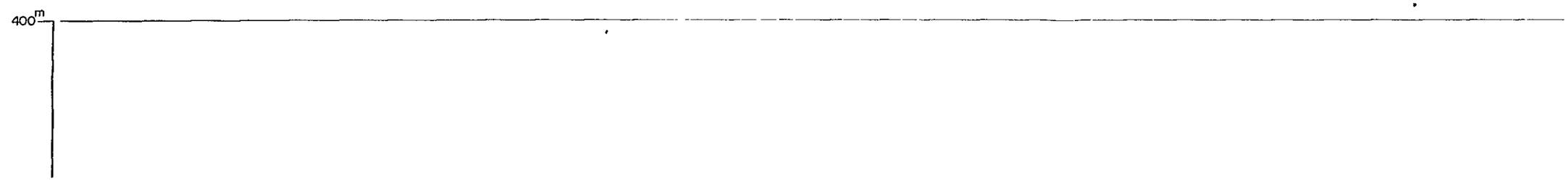
JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO JAPAN

SECTIONAL DRAWINGS FOR RESERVES CALCULATION OF DOI

Sec. 14 – 14′ Sec. 15 – 15′ Sec. 16 – 16′ Sec. 17 – 17



Sec. 20 – 20′

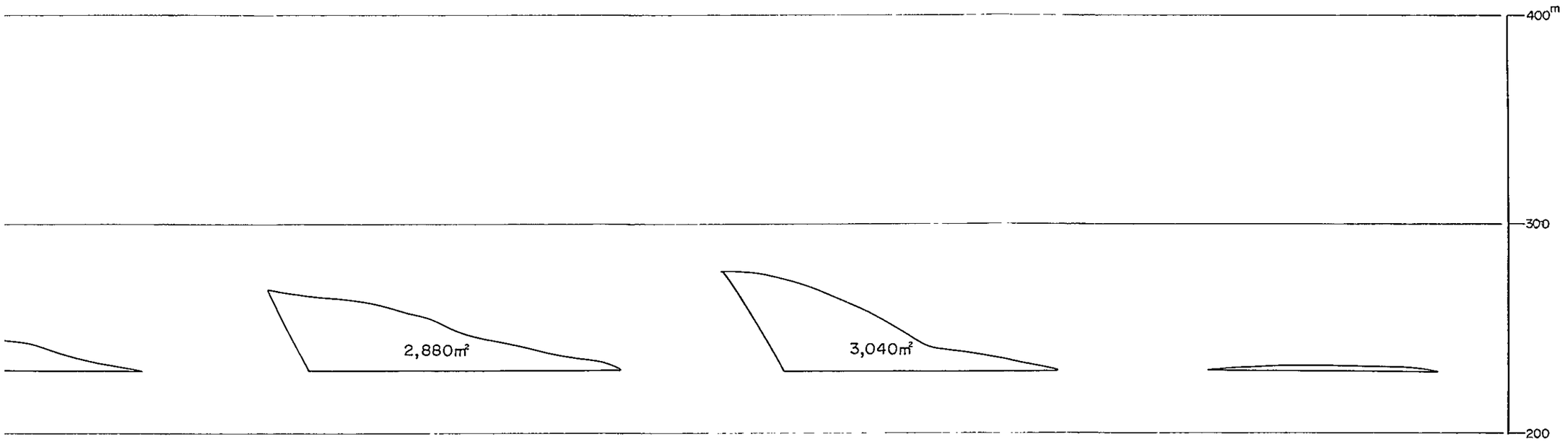


)I DIN CHI LIMESTONE DEPOSIT (NORTHERN DEPOSIT)

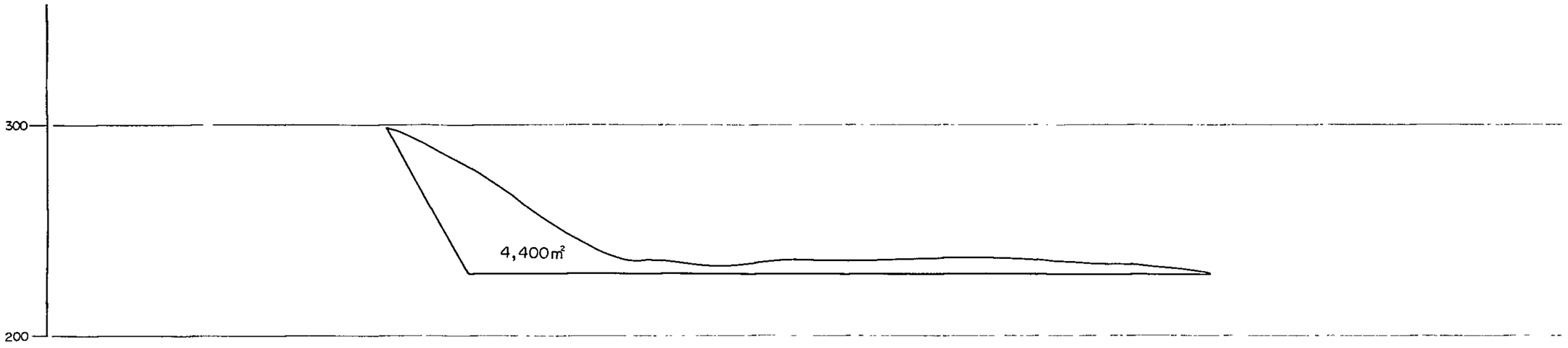
17'

Sec. 18 — 18'

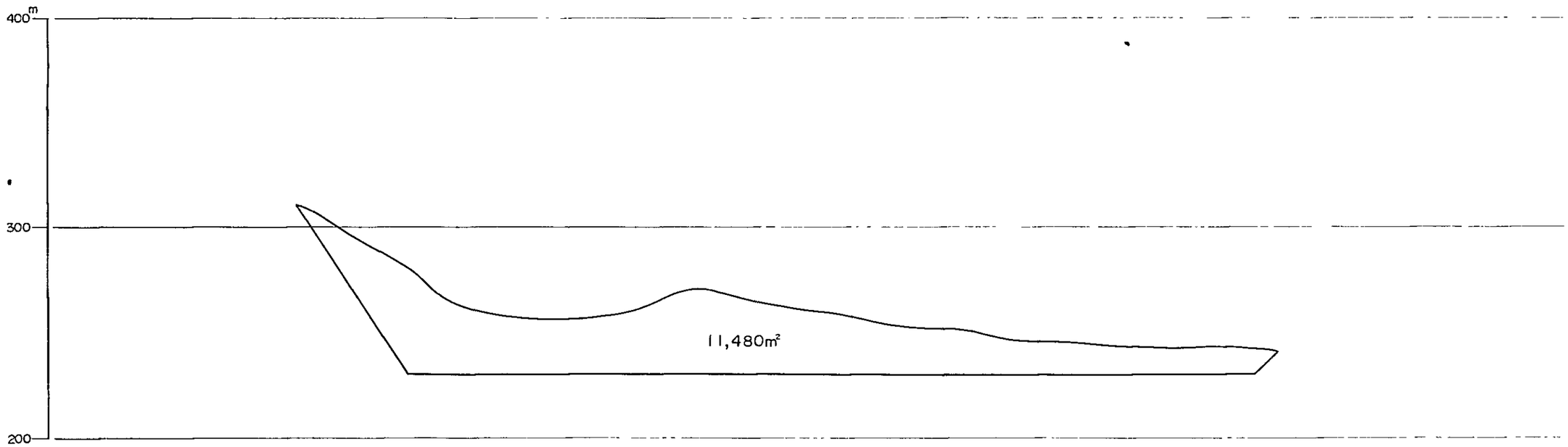
Sec. 19 — 19'



Sec. 21 — 21'

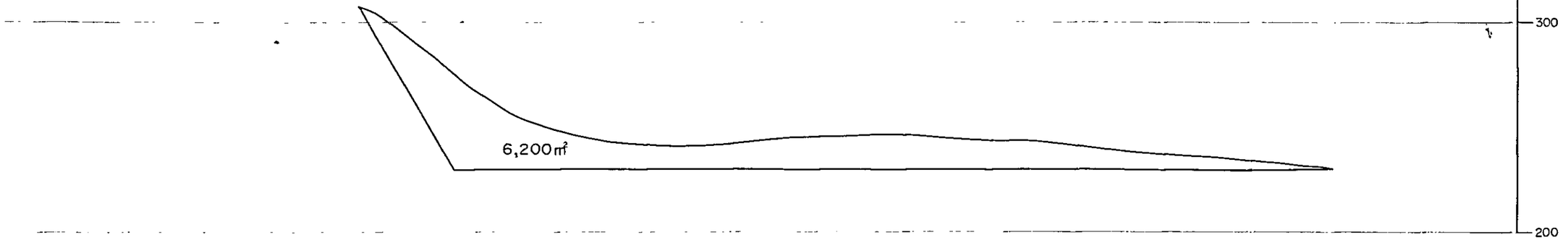


Sec. 22 – 22′

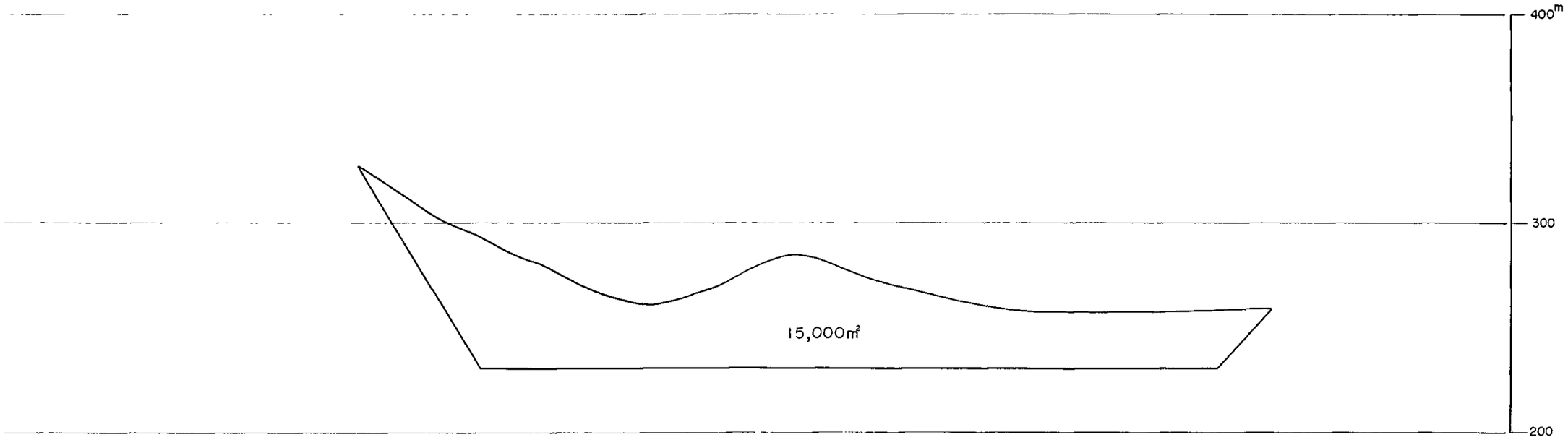


SCALE 1 : 2

0 50 100



Sec. 23 – 23'



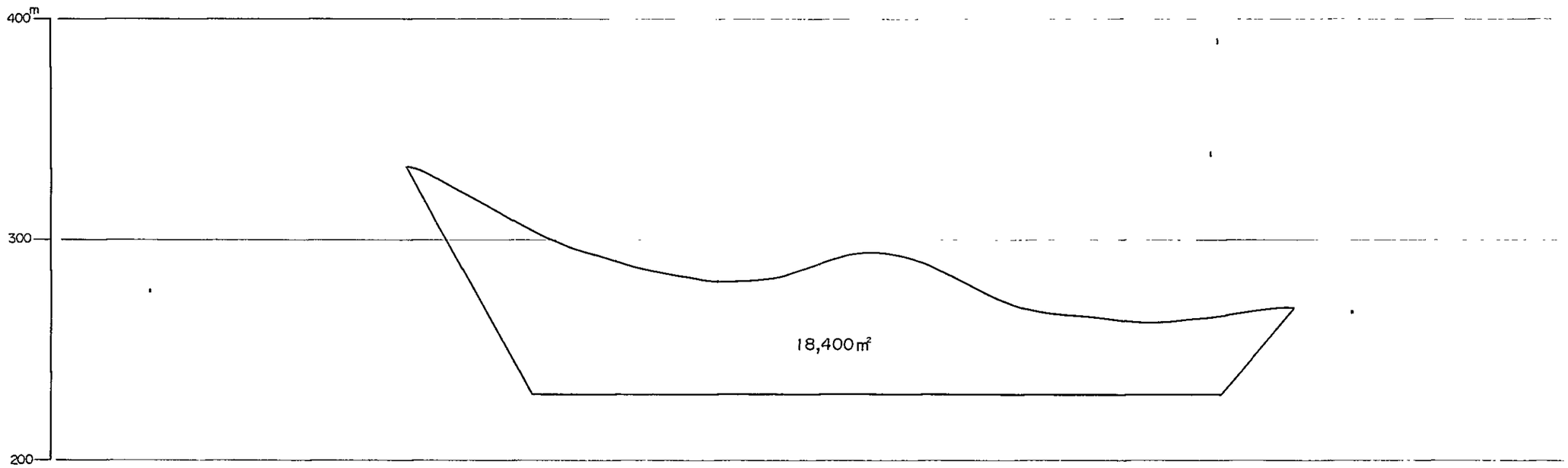
1 : 2,000

100 200m

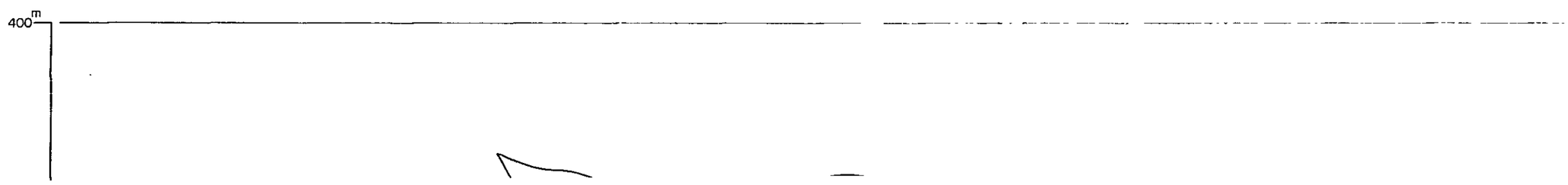
JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO JAPAN

SECTIONAL DRAWINGS FOR RESERVES CALCULATION OF DO

Sec. 24 – 24'

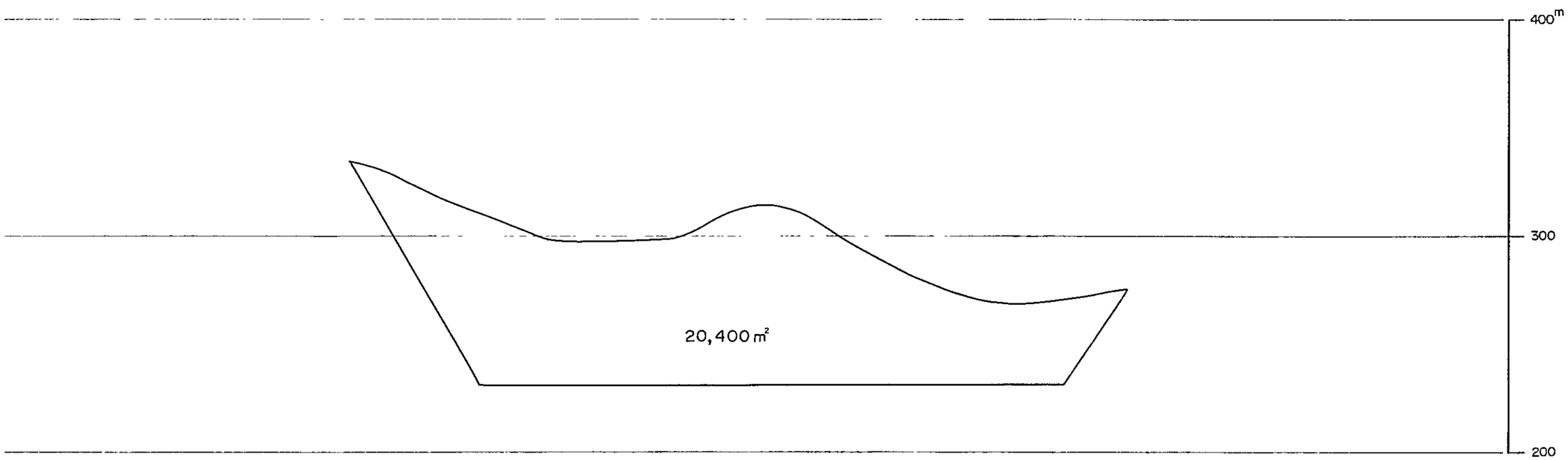


Sec. 26 – 26'

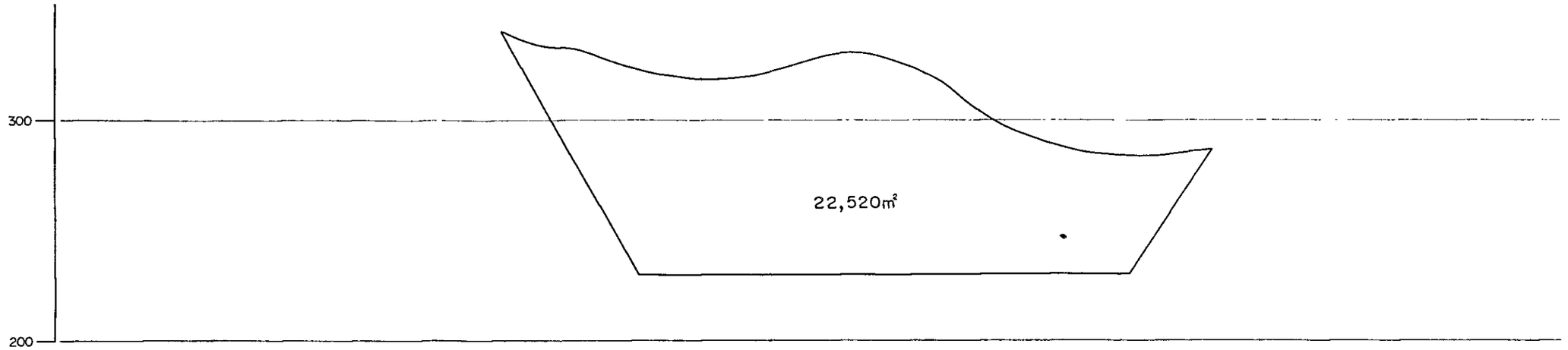


)OI DIN CHI LIMESTONE DEPOSIT (NORTHERN DEPOSIT)

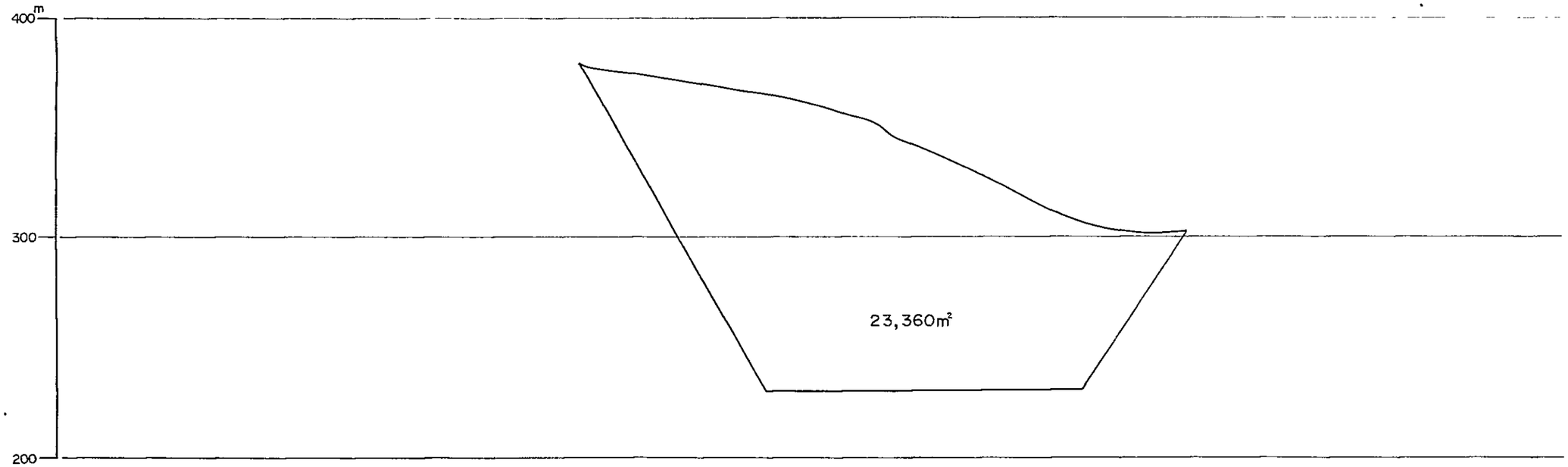
Sec. 25 – 25'



Sec. 27 – 27'

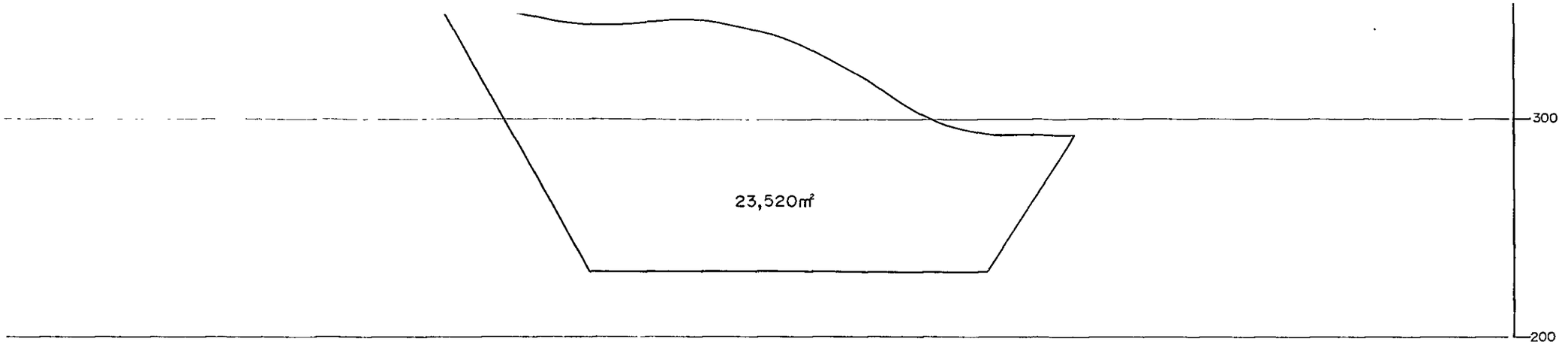


Sec. 28 – 28'

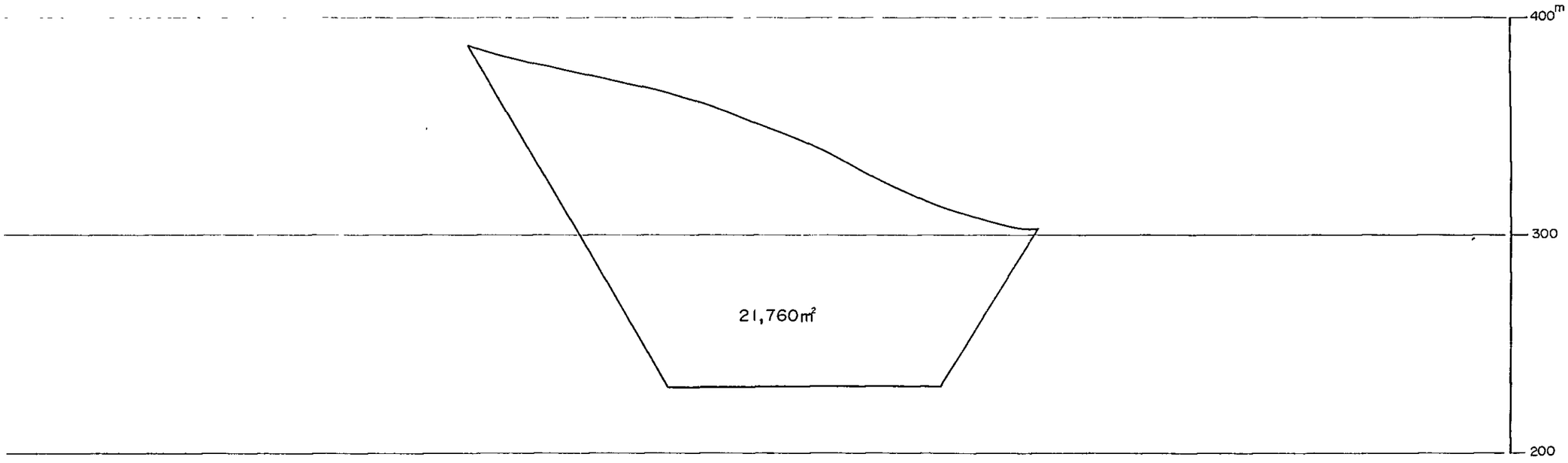


SCALE 1

0 50 100



Sec. 29 – 29′



1 : 2,000

100 200m

JAPAN INTERNATIONAL COOPERATION AGENCY, TOKYO JAPAN