U.S. ARMY GARRISON HONSHU JAPAN ESOS

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LIMA ARMY TANK PLANT
LIMA, OHIO

ENERGY ENGINEERING ANALYSIS PROGRAM
FIELD DATA SUBMISSION

PREPARED FOR

U.S. DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT
CORPS OF ENGINEERS
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DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
JAPAN DISTRICT

FINAL REPORT

JAPAN FY85 (ESOS No 1)

ENERGY SAVINGS OPPORTUNITY SURVEY OF DESIGNATED U.S. ARMY GARRISON HONSHU FACILITIES, FY85 ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

EXECUTIVE SUMMARY

SEPTEMBER 1988

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EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

1.0 INTRODUCTION

1.1 GENERAL.

This document provides the Executive Summary of the Energy Savings Opportunity Survey (ESOS) of Designated U.S. Army Garrison, Honshu Facilities, for Camp Zama, Japan prepared under Contract No. DACA79-85-C-0099 between the U.S. Army Engineer District, Japan and the Architect-Engineering firm of Daniel, Mann, Johnson, and Mendenhall, Sagami Facility, Japan. This project has been executed as a part of the Department of the Army's FY85 Energy Engineering Analysis Program (EEAP).

1.2 OBJECTIVE.

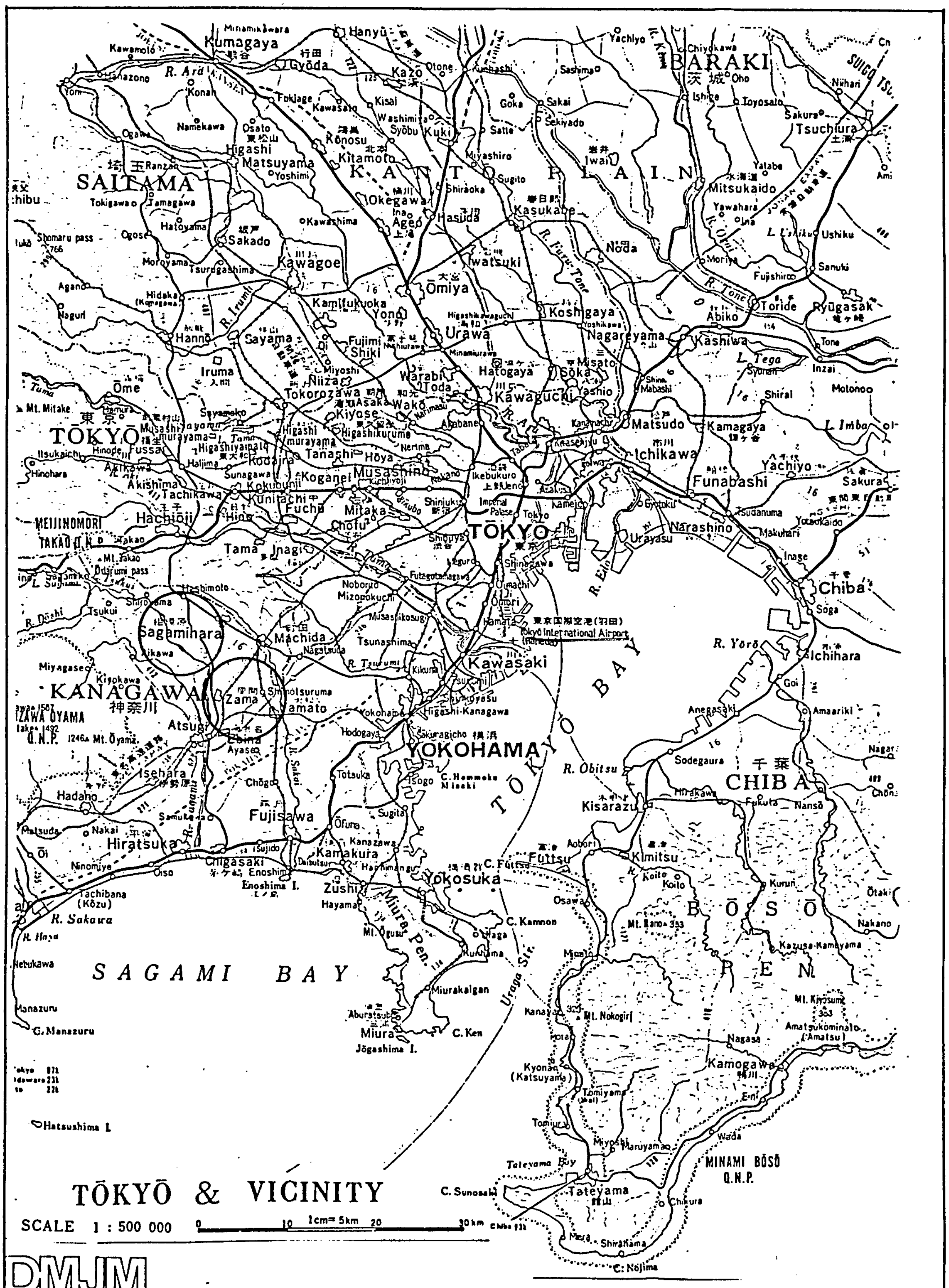
The overall objective of this project is to perform a complete energy audit and analysis of designated facilities in order to identify all Energy Conservation Opportunities (ECOs) and to evaluate ECOs related to designated facilities and projects from a previous study which have not been accomplished. The Camp Zama and the Sagamihara Dependent Housing Area (SDHA) installations are located as shown in Figure ES-1 (Tokyo and Vicinity Map). Specific locations of the designated facilities at Camp Zama and the SDHA are as shown in Figures ES-2 and ES-3, (Base Map - Camp Zama and Sagamihara Dependent Housing Area).

1.3 GUIDELINES

The "Energy Conservation Investment Program (ECIP) Guidance", described in letter DAEN-MPO-U of 10 August 1982 and subsequent revisions in letters DAEN-ZCF-U of 4 March 1985 and 11 June 1986 established criteria for ECIP projects. This guidance was used to perform an economic analysis of each Energy Conservation Opportunity (ECO). Construction cost escalation was calculated using the guidelines contained in AR 415-17 and the latest Tri-Service MCP Index. The "Scope of Work, FY85 OMA Project, Energy Survey of Designated U.S.Army Garrison, Honshu Facilities, Energy Engineering Analysis Program (EEAP)", dated 6 June 1985 and revised 12 July 1985, identifies the general guidelines for completing the study and the specifics of the analyses to be performed. Because it was used extensively in performing this study, it is summarized below.

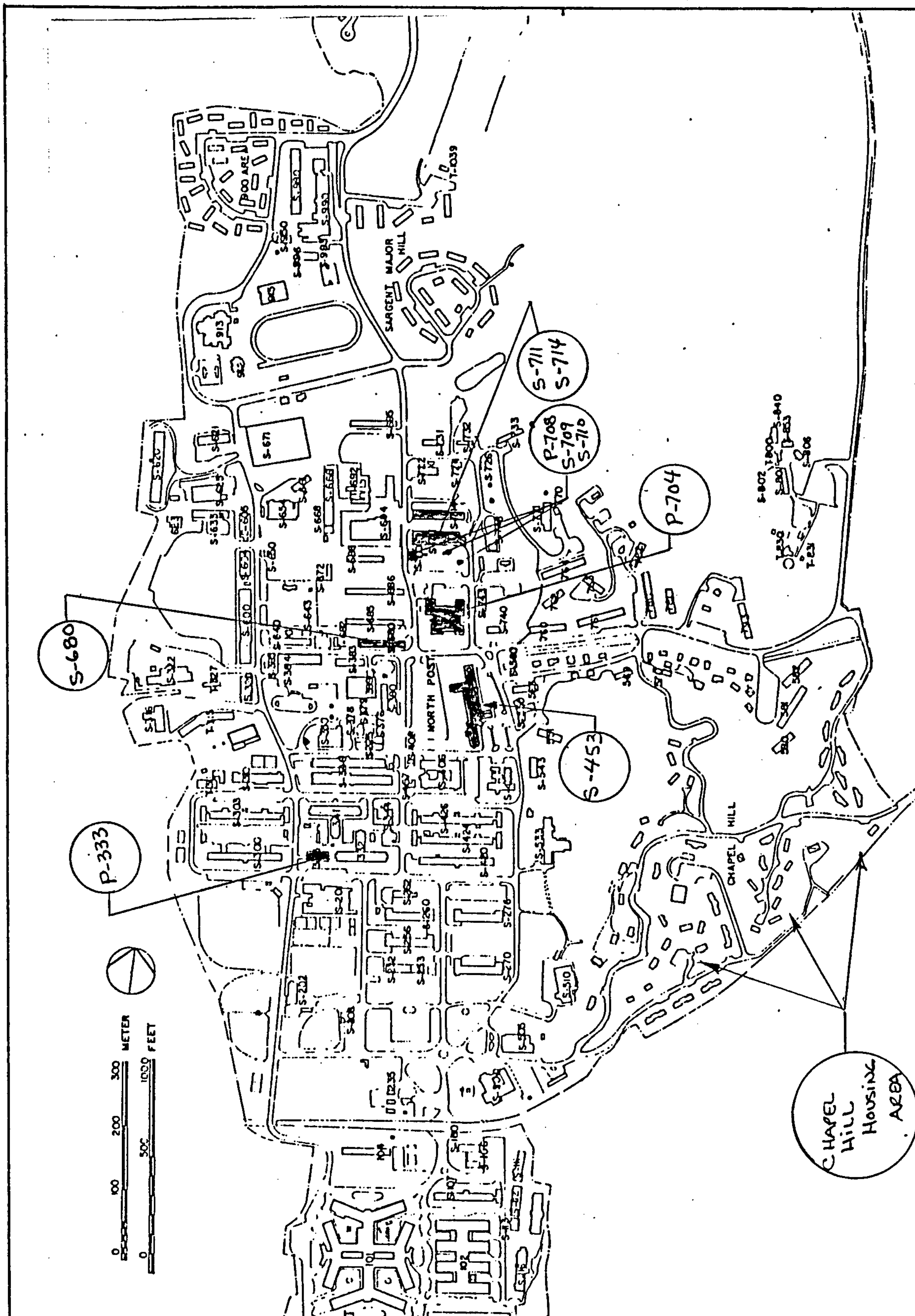
- Perform a complete audit and analysis of designated facilities.

- Identify all Energy Conservation Opportunities (ECOs) including low cost/no cost ECOs and perform complete evaluations of each.



TŌKYŌ & VICINITY
SCALE 1 : 500 000
1cm= 5km
0
10
20
30km
DMJM
SAGAMI BAY
TŌKYŌ BAY
KANTO PLAIN
SAITAMA
IBARAKI
KANAGAWA
TŌKYŌ
CHIBA
BŌSŌ PEN.
MINAMI BŌSŌ Q.N.P.
Kumagaya
Kawagoe
Ōmiya
Urawa
Hachiōji
Tachikawa
Musashino
Kawasaki
YOKOHAMA
Yokosuka
Kamakura
Fujisawa
Hiratsuka
Chigasaki
Sagamihara
Zama
Machida
Atsugi
Chiba
Funabashi
Ichikawa
Matsudo
Kisarazu
Tateyama
Kamogawa
Miura Pen.
Uraga Str.
Tokyo International Airport
C. Nojima
Hatsushima I.

FIGURE ES-1



BASE MAP - CAMP ZAMA

FIGURE ES-2

SAGAMIHARA DEPENDENT HOUSING AREA

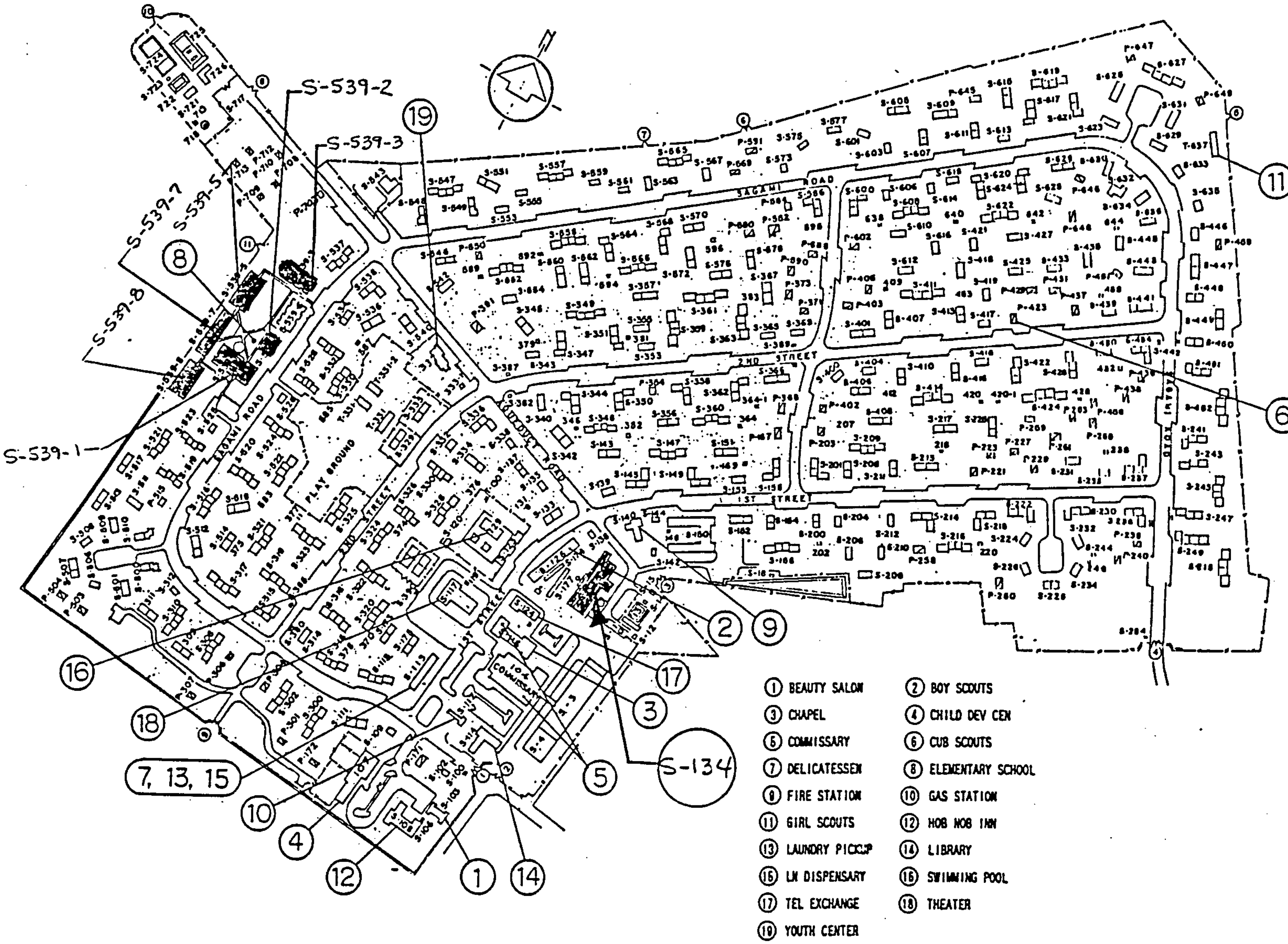


FIGURE ES-3

DMJM

- Prepare programming documentation for ECIP projects and implementation documentation for all justifiable ECOs.

- List and prioritize all recommended ECOs.

- Prepare a comprehensive report which will document the work accomplished, the results and the recommendations.

- Evaluate previously recommended but not implemented ECIP projects.

1.4 STUDY METHODOLOGY.

This study was divided into two phases. Phase I involved data gathering, field surveys, identification of Energy Conservation Opportunities (ECOs), and preliminary ECO analyses. Phase II included all final energy and economic analyses, categorization of projects for funding consideration, preparation of programming documents, and preparation of the Final Report. The Final Report presents all methods, results, and recommendations of this study. This Executive Summary specifically addresses the study results pertaining to the completion of all phases of the study.

2.0 BUILDING DATA.

This study included the audit and analysis of sixteen buildings with a total floor area of 172,648 square feet. These buildings are listed in Table ES-1 which also provides their location, category code, current use, total floor area and usable area.

TABLE ES-1
BUILDING DATA

BLDG. NO.	LOCATION	CAT. CODE	CURRENT USE	TOTAL FLOOR AREA (SF)	TOTAL USABLE AREA (SF)
S-134	SDHA	821 15	BOILER PLANT	15,442	14,750
P-333	Camp Zama	722 10	EM DINING FAC	5,234	4,959
S-453	Camp Zama	740 46	CONS. OPEN DINING	31,710	23,495
S-539-1	SDHA	730 48	DEP GRADE SCHOOL	9,827	8,063
S-539-2	SDHA	730 47	DEP KINDERGARTEN	3,717	3,084
S-539-3	SDHA	730 48	DEP GRADE SCHOOL	9,000	7,623
S-539-5	SDHA	730 48	DEP GRADE SCHOOL	9,105	8,195
S-539-7	SDHA	730 48	DEP GRADE SCHOOL	5,179	4,661
S-539-8	SDHA	730 48	DEP GRADE SCHOOL	11,214	10,093
S-680A	Camp Zama	740 21	COMMISSARY	5,110	4,627
S-680B	Camp Zama	550 90	PREVENTIVE MED.	3,695	3,555
P-704	Camp Zama	550 10	MED/DENT. CLINIC	29,180	27,642
P-708	Camp Zama	831 14	WASTE TREAT PLT.	408	328
S-709	Camp Zama	821 80	HEAT EXCHANGER	726	534

TABLE ES-1
BUILDING DATA (Cont'd)

BLDG. NO.	LOCATION	CAT. CODE	CURRENT USE	TOTAL FLOOR AREA (SF)	TOTAL USABLE AREA (SF)
S-710	Camp Zama	730 31	DRY CLEAN'G PLT.	3,424	2,912
S-711	Camp Zama	730 30	LAUNDRY FACILITY	17,818	15,556
S-714	Camp Zama	442 70/ 730 30	CARP SHOP/WHSE RUG CLEANING	11,859	11,442

SOURCE: SPACE UTILIZATION REPORT BY FACILITY NO. PCN AKA-011 AJO 11/20/87

3.0 PRESENT ENERGY CONSUMPTION.

During fiscal year 1987, Camp Zama and the Sagamihara Dependent Housing Area (SDHA) consumed a total of 508,586.8 MBtu of energy. Camp Zama used approximately 71 percent and the SDHA used the remainder. Tables ES-2 and ES-3 provide source energy consumption data for Camp Zama and the SDHA, respectively. All dollar values are based on the FY87 Budget Exchange Rate of ¥200.55 = $1.00.

Table ES-2
Energy Consumption,
Camp Zama

TYPE ENERGY	AMOUNT	DOLLARS	MBTU
Electricity	28,766,396 KWH	$3,108,642.98	98,179.7
Diesel Fuel	1,882,684 GALS	$1,412,013.00	261,128.3
LPG (Propane)	11,266 Cubic Meters	$ 16,032.36	1,131.1
Kerosene	16,326 GALS	$ 12,244.50	2,204.0
TOTAL		$4,548,932.84	362,643.1

Table ES-3
Energy Consumption,
Sagamihara Dependent Housing Area (SDHA)

TYPE ENERGY	AMOUNT	DOLLARS	MBTU
Electricity	9,792,972 KWH	$1,022,709.44	33,423.4
Diesel Fuel	809,840 GALS	$ 607,380.00	112,324.8
LPG (Propane)	1,947 Cubic Meters	$ 2,806.73	195.5
TOTAL		$1,632,896.17	145,943.7

3.1 ENERGY CONSUMPTION OF STUDY BUILDINGS VS BASEWIDE CONSUMPTION.

3.1.1 STUDY BUILDINGS.

Table ES-4 provides a tabulated list by building of the calculated/actual annual utilities usage of the buildings in this study. Annual energy consumption figures for all facilities except the Laundry/Dry Cleaning complex, Camp Zama were estimated using the Carrier Air Conditioning

Company E20 computerized building energy simulation program. The figures for the Laundry/Dry Cleaning Plant were taken from monthly cost reports provided by the Utilities Division, Camp Zama.

Table ES-4
Facility Consumption Baseline
Camp Zama/*SDHA

BLDG NO.	USE	BASELINE MBTU
P-333	Enlisted Dining Facility	3,051.8
S-453	Consolidated Club	5,769.4
P-704	Medical Clinic	5,727.8
S-680	Preventive Medicine/Commissary	628.4
P-708 thru S-714	Laundry/Dry Cleaning Plant	13,263.6
* S-134	Boiler Plant	1,628.0
* S-539	Dep. Kindergarten/Grade School	1,066.7

* Sagamihara Dependent Housing Area

3.1.2 TOTAL CONSUMPTION VS STUDY BUILDINGS

Charts ES-1 and ES-2 graphically illustrate the energy consumption of the study buildings versus the total consumption at Camp Zama and the Sagamihara Dependent Housing Area (SDHA). At Camp Zama the energy consumption of the study buildings represents approximately eight percent of the total consumption while those at the SDHA represent approximately 2 percent.

4.0 HISTORICAL ENERGY CONSUMPTION.

4.1 CAMP ZAMA.

Energy consumption data for the FY85 (New Baseline) through FY87 are shown in Chart ES-3 for Camp Zama. Total consumption in FY85 was 329,287.3 MBtu, in FY86 it was 358,306.3 MBtu (8.8% over the FY85 baseline), and in FY87 it was 362,643.1 MBtu (10.1% over the the FY85 baseline).

4.2 SAGAMIHARA DEPENDENT HOUSING AREA (SDHA).

Energy consumption data for the FY85 (New Baseline) through FY87 are shown in ES-4 for the SDHA. Total consumption in FY85 was 139,112.6 MBtu, in FY86 it was 151,697.7 MBtu (9.0% over the FY85 baseline), and in FY87 it was 145,943.5 MBtu (4.9% over the FY85 baseline).

5.0 REEVALUATED PROJECTS RESULTS.

In 1982 under Contract No. DACA84-80-C-0152, an Energy Engineering Analysis Program (EEAP) for U.S. Army Garrison, Honshu, Japan study

CHART ES-1
FY87 ENERGY CONSUMPTION
CAMP ZAMA

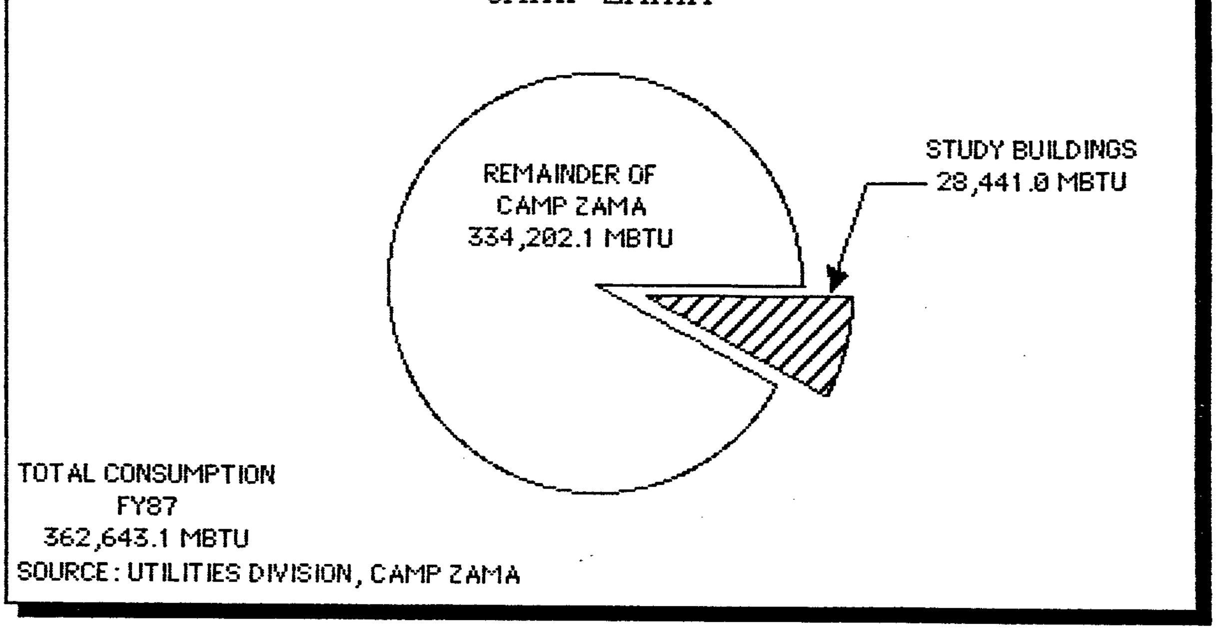
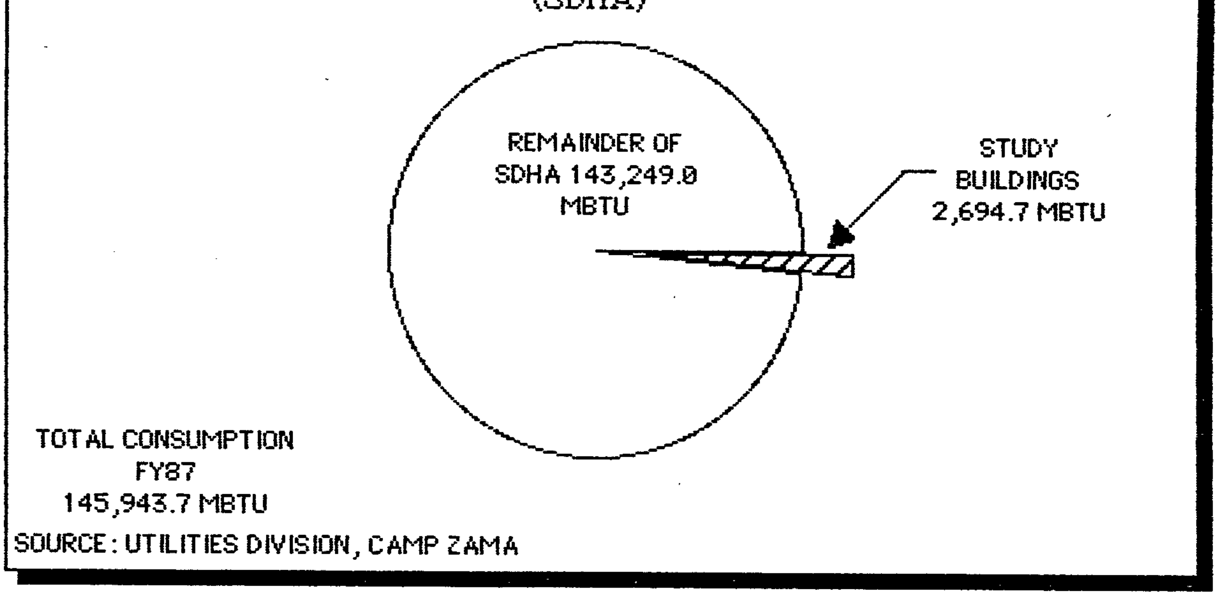


CHART ES-2
FY87 ENERGY CONSUMPTION,
SAGAMIHARA DEPENDENT HOUSING AREA
(SDHA)



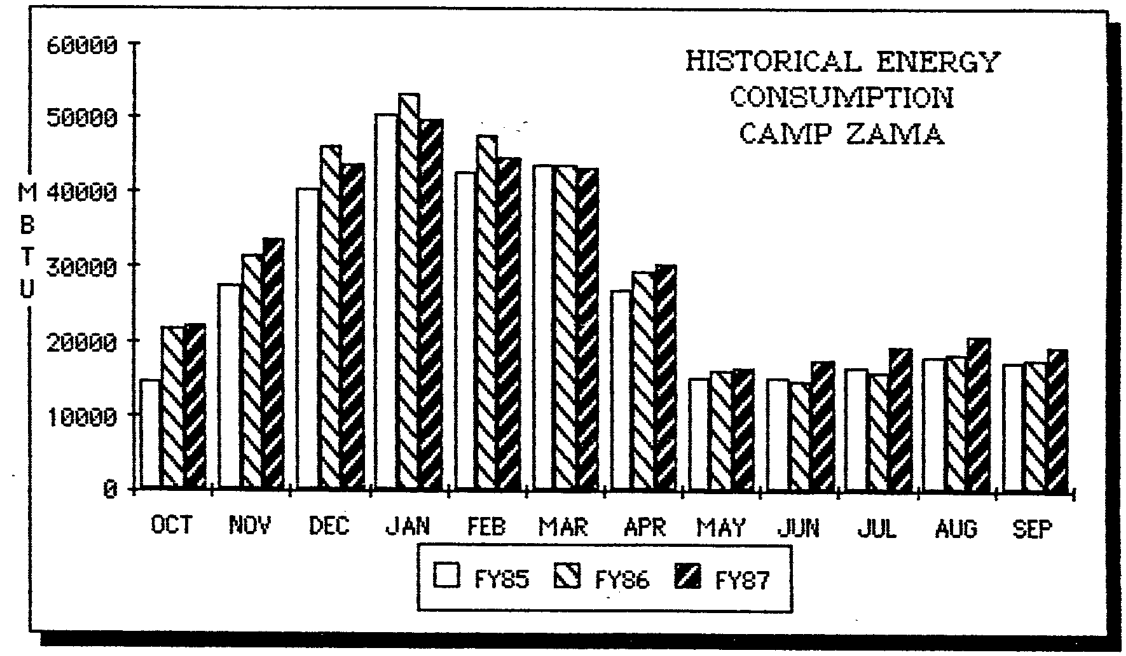


CHART ES-3

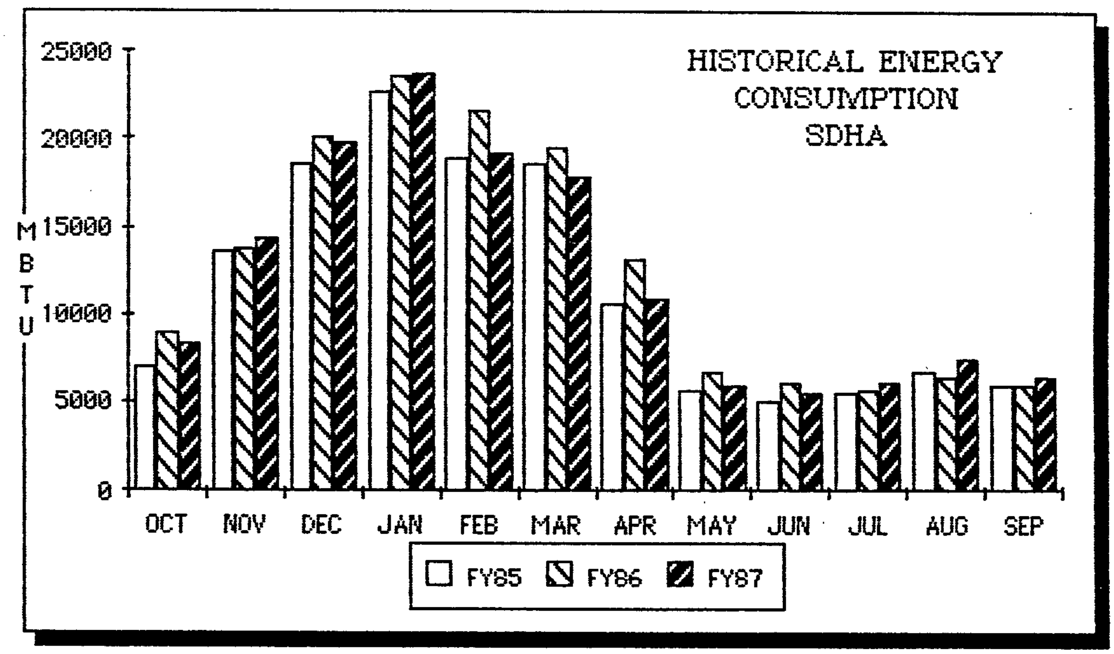


CHART ES-4

was accomplished. An evaluation of those projects and all ECOs for this study's designated facilities which were identified in the 1982 study has been accomplished and the results are summarized in the following paragraphs.

5.1 PREVIOUS ECOs RELATED TO DESIGNATED FACILITIES.

5.1.1 FY84 - CEILING INSULATION, CAMP ZAMA.

This ECO recommended the installation of ceiling insulation in thirty-one facilities which included Buildings S-453 and S-680. This ECO as related to the two designated facilities has been implemented (4-inch R-19 insulation installed). Since the 4-inch insulation lowered the "U" value to 0.06 vice the required 0.03, the installation of additional insulation was analyzed and was not found to be economically feasible because the SIR for both buildings was less than 1.0 (S-680 was 0.08 and S-453 was 0.24).

5.1.2 FY85 - THERMOSTATIC RADIATOR VALVES, CAMP ZAMA.

This ECO recommended the installation of thermostatic radiator valves for thirty-six facilities including Building S-680 which had steam or hot water radiators installed. This ECO was completed in S-680.

5.1.3 FY85 - REMOTE ZONE TEMPERATURE CONTROL, CAMP ZAMA.

This ECO recommended the installation of a central control system with twenty-seven stations to control steam or heating hot water flow during non-occupied periods. Each station would consist of an automatic shut-off valve complemented by a 7-day time clock and a thermostat to effectively provide a night temperature set-back from 65°F to 55°F. This ECO was to be applied to thirty-six facilities and included Building S-680. Since Building No. S-680 is to be demolished within one year, this ECO is no longer applicable or economically feasible.

5.1.4 FY83 - HEATING HOT WATER (HHW) TEMPERATURE CONTROL, BUILDING NO. S-134, SDHA.

This ECO is to provide an automatic temperature control for the heating hot water (HHW) heat exchangers at Boiler Plant S-134 to regulate the water temperature. With this system, it is intended to achieve a night set-back of temperature for the family housing units and to aid in more closely regulating the temperature of the hot water during the day.

The survey of the actual boiler plant operations indicated that the temperature of the HHW is manually controlled by the plant operator to meet heating demands. This manual operation is not considered as reliable as the recommended automatic control. The implementation of this ECO will save 8,589.2 MBtu but because the temperature is now manually controlled by the operator, credit for only 50% will be taken. Therefore, the potential energy savings are 4,294.6 MBtu; Dollar Savings = $28,730.87; Investment Cost = $84,312.92; Simple Payback = 2.93 years; and the Savings to Investment Ratio: = 4.53. This ECO should be implemented.

5.2 ECOs/PROJECTS FROM PREVIOUS STUDY WHICH HAVE NOT BEEN ACCOMPLISHED.

5.2.1 FY85 - HEAT PUMP HOT WATER HEATERS (ECIP), CAMP ZAMA.

ECIP Heat Pump Hot Water Heaters. This project called for the replacement of electric hot water heaters with heat pump hot water heaters in 176 units of Family Housing Area at Camp Zama which included the Chapel Hill area.

5.2.2 BACKGROUND.

Although many of the other family housing areas are provided with domestic hot water (DHW) from central boiler plants, the Chapel Hill area is not. DHW for that area is provided by individual electric hot water heaters (52 gallon, 1,000/1,500 watt dual element type, 200 volt, 50 cycle electric power).

5.2.3 PREVIOUS ANALYSIS.

The original analysis was accomplished in 1982 and was based on 176 dwelling units which included housing from areas other than just the Chapel Hill area. The ECO indicated that by replacing the electric hot water heater with a heat pump hot water heater at a cost of $279,500, the following energy savings and economic benefits would accrue: Annual Energy Savings (MBtu): 4,080; Annual Dollar Savings: $68,800; Energy Savings-to-Cost (E/C) Ratio: 14.6; Discounted Benefit to Cost (B/C) Ratio: 3; and the Discounted Saving-to-Investment (SIR) Ratio: 4. Note: The MBtu savings were based on the FY82 criteria which used 11,600 Btu/KWH conversion factor vice the current conversion factor of 3,413 Btu/KWH and the FY82 cost of electricity which was $16.86/MBtu.

5.2.4 REEVALUATION.

A reevaluation of this ECO indicated that to remove the existing electric hot water heaters and replace them with heat pump hot water heaters would cost approximately $1,600 per unit. Supplementing the existing electric hot water heaters with heat pumps will only cost an average of $880.98 per unit. Some heat pump units would be mounted on the existing tanks, some on brackets adjacent to the tank, and some would be floor mounted adjacent to the tanks. The installation of these new units would involve piping connection to the existing tank, power connection to the existing service, door louvers, and duct work. Two units would require soundproofing of two walls abutting the bedroom. Based on the analysis of this ECO, the following is provided: Energy Savings = 1,916.33 MBtu; Dollar Savings = $81,703.16; Investment Cost = $115,729.59; Simple Payback = 1.42 years; and the Savings to Investment Ratio = 7.65.

6.0 ENERGY CONSERVATION ANALYSIS.

6.1.1 ECOs INVESTIGATED. The ECOs listed in Tables ES-5, through ES-8 were investigated for the appropriate type of facilities indicated.

6.1.2 ECOs RECOMMENDED. The following ECOs were recommended:

a. Additional Ceiling Insulation Building Nos. P-333 (Enlisted Dining Facility) and P-704 (Health and Dental Clinic).

b. Use More Efficient Lighting Source/ Install Energy Efficient Lighting/Replace Incandescent Lighting/ Reduce Lighting Levels in all designated buildings except S-680 (Commissary/Preventive Medicine) which is to be demolished within one year.

c. Shut Off Range Hood/Kitchen Exhausts in Building No. P-333 (Enlisted Dining Facility).

d. Reduce Kitchen Make Up Air Temperature in Building No. P-333 (Enlisted Dining Facility).

e. Change to High Efficiency Motors in Building Nos. P-333 (Enlisted Dining Facility), P-704 (Health and Dental Clinic), S-539-7 (Dependent Grade School) and S-539-8 (Dependent Grade School).

f. Shut Down Energy to DHW Heater, Lower Temperature, and Modify the Controls in Building No. S-453 (Consolidated Open Dining Facility).

g. Lower Hot Water Heater Temperature, Building No. P-704, (Health and Dental Clinic).

h. Heat Recovery From Dishwashers in Buildings P-333 (Enlisted Dining Facility) and S-453 (Consolidated Open Dining Facility).

i. Reclaim Heat From Kitchen Exhaust, Building S-453 (Consolidated Open Dining Facility).

j. Insulate Electric Hot Water Heater, Building S-680 (Preventive Medicine).

TABLE ES-5

ENERGY CONSERVATION OPPORTUNITIES

GENERAL

- Insulation:
- Storm windows or double glazing
- Weather stripping and caulking
- Insulated panels
- Solar film
- Vestibules
- Reduction of glass area
- Shutdown energy to hot water heaters or modify controls
- Energy conserving fluorescent lamps
- Reduce lighting levels
- Replace incandescent lighting
- Use more efficient lighting source
- Night setback thermostats
- Infrared heaters
- Economizer cycles (dry bulb)
- Heat reclaim from kitchen exhaust
- Insulate piping
- Heat recovery from dishwasher hot water
- Booster heaters at major hot water users
- Lower domestic hot water temperature
- Upgrade HVAC controls
- Make HVAC more efficient
- Balance HVAC system
- Change to variable air volume (VAV) system
- Use air curtains at personnel entrances
- Pressurize kitchen area (to avoid using conditioned air from dining area)
- Install make up air supply for kitchen area
- Shut off range hood whenever possible

TABLE ES-6

ENERGY CONSERVATION OPPORTUNITIES

DINING FACILITIES

- Insulation:
- Storm windows
- Weather stripping and caulking
- Insulated panels
- Solar film
- Vestibules
- Reduction of glass area
- Shutdown energy to hot water heaters or modify controls
- Energy conserving fluorescent lamps
- Reduce lighting levels
- Replace incandescent lighting
- Use more efficient lighting source
- Night setback/setup thermostats
- Infrared heaters
- Economizer cycles (dry bulb)
- Heat reclaim from kitchen exhaust
- Insulate piping
- Heat recovery from dishwasher hot water
- Booster heaters at major hot water users
- Lower domestic hot water temperature
- Upgrade HVAC controls
- Make HVAC more efficient
- Balance HVAC system
- Change to variable air volume (VOV) system
- Use air curtains at personnel entrances
- Install make up air supply for kitchen area
- Shut off range hood whenever possible
- Use of heat pump to heat domestic hot water and cool dining area
- Waste heat recovery

TABLE ES-7
ENERGY CONSERVATION OPPORTUNITIES
LAUNDRY FACILITIES

- Insulation:
- Weather stripping and caulking
- Insulated panels
- Vestibules
- Reduction of glass area
- Shutdown energy to hot water heaters or modify controls
- Energy conserving fluorescent lamps
- Reduce lighting levels
- Replace incandescent lighting
- Use more efficient lighting source
- Night setback thermostats
- Economizer cycles (dry bulb)
- Heat reclaim from laundry exhaust
- Insulate piping
- Heat destratification
- Heat recovery from laundry wash water
- Booster heaters at major hot water users
- Lower domestic hot water temperature
- Upgrade HVAC controls
- Make HVAC more efficient
- Steam traps (size, operation, type)
- Balance HVAC system
- Change to variable air volume (VOV) system
- Use air curtains/plastic strip doors at personnel entrances
- Dryers equipped with temperature sensor located on discharge duct. Sensor to provide information to stop heating during drying cycle at the most energy efficient point.
- Recycle rinse water for a following wash cycle.
- Equip dryer exhaust with heat exchanger for preheating incoming air to dryer.

TABLE ES-7 (Continued)
ENERGY CONSERVATION OPPORTUNITIES
LAUNDRY FACILITIES

- Verify that supply steam and condensate system is functioning in the most efficient manner.
- Use high temperature, oil heated processes rather than steam.
- Use heat pump for domestic hot water heating and facility cooling.
- Use cold water for laundering
- Waste heat recovery
- Shut off steam during non-use hours
- Thermal storage
- Correct sizing of condensate lines

TABLE ES-8

ENERGY CONSERVATION OPPORTUNITIES

BOILER PLANT

- Controls to assure proper combustion air-fuel ratio
- Feedwater treatment
- Waste heat recovery, i.e. exhaust gases, process steam pressure drop, and steam condensate and blowdown
- Installation of new burner equipment
- Economizers/air preheaters
- Reduce excess air
- Loading characteristics and scheduling versus equipment capacity (equipment optimization)
- Variable speed circulation pumps or alternate pumps
- Steam pressure or hot water temperature reductions based on existing and projected requirements
- Reduction in make-up water quantities
- Use heavy oils for those plants with light oil burners
- Blowdown control
- Improvements in distribution system
- Steam driven auxiliaries versus electric drives
- Variable speed induced draft fans and forced draft blowers
- Instruments and controls to facilitate efficient operations

k. Add Economizer Cycle in Building Nos. S-453 (Consolidated Open Dining Facility).

l. Install Unheated Make Up Air for Kitchen in Building No. S-453 (Consolidated Open Dining Facility).

m. Make HVAC More Efficient in Building No. P-704 (Health and Dental Clinic).

n. Use Cold Water for Laundering in Building No. S-711 (Laundry Facility).

o. Shut Off Steam Supply after Hours, S-709 through S-711, (Laundry Complex).

p. Shut Off Steam During Non-Use Periods in Building No. S-709 (Heat Exchanger Building).

q. Install Variable Speed Pumps on the Heating Hot Water (HHW) and Domestic Hot Water (DHW) Systems in the Boiler Plant, Building No. S-134, SDHA.

r. Boiler Flue Stack Heat Recovery from four boilers in the Boiler Plant, Building No. S-134, SDHA.

s. Shut Off the Swimming Pool Hot Water Circulating Pump in the Boiler Plant, Building No. S-134, SDHA.

6.1.3 ECOs REJECTED. The following ECOs were rejected for reasons indicated.

a. Wall/Ceiling Insulation. Additional wall insulation for Building Nos. P-333, S-453, S-680, P704, and S-714 was was evaluated and rejected. Their SIRs were 0.70, 0.31, 0.05, 0.89, and 0.57 respectively. Additional ceiling insulation was evaluated and rejected for Building Nos. S-453, S-680, S-714, S-539-1, 2, 3, 5, 7, and 8. Their SIRs were 0.24, 0.08, 0.18, 0.56, 0.55, 0.55, 0.56, 0.56, and 0.55 respectively.

b. Double Glazing. The analysis for double glazing showed that on average, a savings of 0.093 MBtu/sq. ft. of cooling and heating could be achieved with a total savings of $1.69/sq. ft. per year. The removal of the existing window and replacement with a double-glazed glass window with a thermal break cost $25.25/sq. ft. Although the simple payback was 14.94 years, the SIR was only 0.82.

c. Solar Film. The energy saving analysis for solar film indicated that for all buildings in the study which were analyzed, the simple payback was approximately 13 plus years and the SIR for each building analyzed ranged from a low of 0.07 to a high of 0.79. There were no buildings where the installation of solar film was considered feasible (e.g. none had an SIR equal to or greater than 1.0).

d. Add a Vestibule. Installing vestibules was evaluated for Building Nos. S-453, S-680, S-539-1, 2, 3, 5, 7, and 8 and rejected. The energy savings for this ECO result in less than $29.00 in savings per building annually. The simple payback for this ECO was in excess of 25 years and the SIRs were 0.01, 0.02, 0.14, 0.13, 0.11, 0.18, 0.02, and 0.18 respectively.

e. Reduction of Glass Area. Most buildings analyzed had a 15% or less glass to wall ratio. Those which had more than 15% glass (S-453, P-704, S-711 and S-539-8) exhibited a simple payback exceeding 26 years and SIRs of 0.21, 0.55, 0.21, and 0.40 respectively.

f. Shut Down Energy to DHW Heater. The shut down of the DHW heater serving Building No. P-704 (Health and Dental Clinic) during non-occupied hours and the installation of an instantaneous hot water heater for the emergency room was not economical because the simple payback was 47.7 years and the SIR was 0.43.

g. Night Set Back. All buildings with central air conditioning and heating had the units turned off during unoccupied times except the Health and Dental Clinic (P-704). P-704 has a variable air volume (VAV) system and night setback is included in the ECO "Make HVAC More Efficient".

h. Infrared heaters: Not economically viable for all buildings in this study. Electric infrared heaters cost $38.09 per MBtu to operate versus $6.69 per MBtu to operate existing steam/hot water heating systems or nearly six times the cost per MBtu. Propane operated units cost $17.02 per MBtu or nearly three times the cost per MBtu. In addition, both propane and diesel oil fired units were rejected as a potential fire hazard if struck by volley balls or basketballs during play.

i. Energy Efficient Motors. The energy savings for this ECO in Building No. S-453 was 17.8 MBtu and in Building No. S-709 it was 5.0 MBtu. The SIRs for the motors in Building No. S-453 were: 0.41 for the 1 HP motor, 0.83 for each of two 3 HP motors, 0.86 for the 5 HP motor, and 0.71 for the 30 HP motor. The SIRs for each of two 30 HP motors in Building No. S-709 were 0.16. The reason for the low SIRs is that the projected life span of these buildings is only seven years. The replacement of motors in the Boiler Plant, Building No. S-134 were rejected for replacement with energy efficient motors because the energy savings were only 51.09 MBtu versus the replacement with variable speed pumps whose energy savings were 653.5 MBtu.

j. Add Economizer Cycle. Economizer cycles were considered and rejected for both Building Nos. P-333 (Enlisted Personnel Dining Facility) and S-680 (Commissary/Preventive Medicine). The investment of $7,407.27 for a savings of $620.87 per year in Building No. P-333 was not cost effective. The investment of $6,634.61 for a savings of $906.54 per year in Building No. S-680 was not cost effective. In addition, the SIRs were 0.68 and 0.14, respectively.

k. Add a Booster Heater. Adding a booster heater was considered for Building No. S-680 (Commissary/Preventive Medicine), but the overall savings to investment ratio was only 0.16.

l. Equip Dryers with Temperature Sensor to Stop Them at the Most Efficient Point. This was considered for the Laundry/Dry Cleaning complex, but the investment of nearly $2,500 to save less than $50.00 per year was not cost effective. The simple payback was 50.43 years and the SIR was 0.14.

m. Install Heat Exchanger to Preheat Dryer Air. This was considered for the Laundry/Dry Cleaning complex, but because the facility is expected to be demolished in 1995, the SIR was 0.66.

n. Use a Heat Pump for Hot Water Generation. To be the same cost as current steam operation the electric cost divided by the coefficient of performance (COP) must equal the cost of steam ($6.69/MBtu). Therefore, in order to be cost effective, the COP of the heat pump must be greater than ($38.09/MBtu)/COP = $6.69 or COP = 5.69. The best coefficient of performance (COP) of an electric operated heat pump is 3.6.

6.1.4 ECIP PROJECTS DEVELOPED. None.

6.1.5 OTHER ENERGY CONSERVATION PROJECTS DEVELOPED.

Table ES-9 (Prioritized List of Energy Conservation Opportunities) lists in descending order of Savings to Investment Ratio (SIR) all ECOs developed as of the analysis date of 9/88. For each ECO the programmed year cost (escalated construction cost, contingency and SIOH), annual energy savings by type and amount, annual dollar savings, the simple amortization (payback) period, and the year in which it is tentatively programmed, is provided.

6.1.6 OPERATIONAL OR POLICY CHANGE RECOMMENDATIONS.

Camp Zama should commence stocking the energy saving lite-white 34-watt fluorescent lamps (FSN 9G6240-01-053-8462). When conventional 40-watt fluorescent lamps burn out they should be replaced with these lower wattage lamps. In addition, when ballasts burn out they should be replaced with high-efficiency electromagnetic ballasts. A regularly

Table ES-9

PRIORITIZED ENERGY CONSERVATION OPPORTUNITIES

Analysis Date: 9/88

Bldg. No.	Use	Energy Conservation Opportunity (ECO)	Annual Energy Savings: Electricity MBtu	Steam MBtu	Value ($)	Construction and SIOH Cost ($)	SIR	Simple Payback (Yrs)	Funding: Cat.	Year
P-333	Enlisted Dining Fac.	Reduce Make-up Air Temperature		698.90	4,675.64	18.74	4704.98	0.00	OMA	FY89
P-704	Health/Dental Clinic	Lower Water Storage Temperature		27.59	184.58	15.19	317.38	0.08	OMA	FY89
P-704	Health/Dental Clinic	Energy Efficient Ltg.	97.48		3,681.86	1,290.71	40.63	0.35	OMA	FY89
P-333	Enlisted Dining Fac.	Energy Efficient Ltg.	8.29		311.36	193.73	24.75	0.62	OMA	FY89
	School Complex	Replace Incandescent Lighting	29.54		1,014.69	892.36	19.14	0.88	OMA	FY89
	Laundry Complex	Use Cold Water		1820.00	12,175.80	7,000.00	11.85	0.57	OMA	*
P-333	Enlisted Dining Fac.	Replace Incandescent Lighting	5.54		210.11	388.50	8.25	1.85	OMA	FY89
	Chapel Hill	DHW Heat Pumps (Past ECO)	2189.89	-273.56	81,703.16	145,608.65	7.85	1.78	QRIP	FY90
P-704	Health/Dental Clinic	HVAC More Efficient	884.80	2560.40	52,397.11	98,471.22	6.98	1.88	QRIP	FY90
S-453	Consol. Dining Fac.	Replace Incandescent Lighting	60.11		2,007.67	2,726.66	6.00	1.36	OMA	FY89
S-134	Boiler Plant, SDHA	Shut Off Swimming Pool Circ. Pump	110.80		4,220.37	11,314.83	5.39	2.68	PECIP	FY91
S-680	Com'sry/Prev. Med.	Insulate Electric Water Heater	1.96		74.66	19.10	4.63	0.26	OMA	FY89
S-134	Boiler Plant, SDHA	HHW Temperature Control (Past ECO)		4294.60	28,730.87	110,766.72	4.53	3.86	PECIP	FY91
P-333	Enlisted Dining Fac.	Shut Off Range Hood	22.50	42.00	1,138.01	3,318.18	4.25	2.92	PECIP	FY91
S-134	Boiler Plant, SDHA	Flue Stack Recovery		4245.70	28,403.73	41,038.31	4.21	1.44	QRIP	FY90
	Laundry Complex	Shut off Steam After Hours		384.10	2,569.63	5,792.11	3.97	2.25	PECIP	FY91
P-333	Enlisted Dining Fac.	Heat Recovery From Dishwasher	-1.64	323.20	2,099.74	13,028.14	3.74	6.20	OMA	FY89
S-134	Boiler Plant, SDHA	Variable Speed Pumps - HHW	421.30		16,047.32	62,944.72	3.73	3.92	PECIP	FY91
S-134	Boiler Plant, SDHA	Variable Speed Pumps - DHW	232.50		8,855.93	34,299.20	3.69	3.87	PECIP	FY91
	Laundry Complex	Reduce Lighting Load	1.78		68.71	158.47	3.06	2.31	OMA	FY89
S-453	Consol. Dining Fac.	Economizer Cycle	346.10		13,182.95	23,935.65	2.99	1.82	PECIP	FY91
	School Complex	More Eff. Lighting	19.37		736.30	3,877.90	2.89	5.27	OMA	FY89
	School Complex	Energy Efficient Ltg.	68.36		2,560.78	13,844.99	2.86	5.41	OMA	FY89
P-333	Enlisted Dining Fac.	Energy Eff. Motors	8.34		317.67	2,037.41	2.30	6.41	OMA	FY89
S-453	Consol. Dining Fac.	Lower DHW Temp/Add Booster Heater		141.00	943.29	3,751.63	1.80	3.98	PECIP	FY91
P-704	Health/Dental Clinic	Energy Eff. Motors	19.24		732.86	6,729.45	1.60	9.18	OMA	FY89
S-453	Consol. Dining Fac.	Make-Up Air Unit for Kitchen	151.78		5,781.30	23,340.21	1.34	4.04	PECIP	FY91
S-453	Consol. Dining Fac.	Shut Down Energy to DHW Heater	11.10	34.80	655.61	3,648.67	1.29	5.57	OMA	FY89
S-453	Consol. Dining Fac.	Energy Efficient Ltg.	23.05		870.56	4,752.18	1.23	5.46	OMA	FY89
	School Complex	Energy Eff. Motors	5.06		192.74	2,522.02	1.13	13.09	OMA	FY89
S-453	Consol. Dining Fac.	Heat Recovery from Dishwasher	-0.75	277.00	1,824.56	13,035.62	1.12	7.14	OMA	FY89
	Laundry Complex	Energy Efficient Ltg.	16.36		618.15	4,012.08	1.11	6.49	OMA	FY89
P-333	Enlisted Dining Fac.	Ceiling Insulation	2.20	2.60	101.19	1,401.20	1.04	13.85	OMA	FY89
S-453	Consol. Dining Fac.	Reclaim Heat From Kitchen Exhaust	-1.60	332.69	2,164.76	17,230.01	1.02	7.96	OMA	FY89
P-704	Health/Dental Clinic	Ceiling Insulation	23.50	29.20	1,090.47	15,623.68	1.01	14.33	OMA	FY89
TOTALS			4756.96	14940.22	282,344.14	679,028.24				

* Completed January 1987.

scheduled program of fixture cleaning should be instituted to increase the illumination levels from 7 to 12% conservatively.

7.0 ENERGY AND COST SAVINGS.

Charts ES-5, ES-6, and ES-7 provide a graphic view of the total potential energy and cost savings, the percentage of energy conserved and energy use and cost before and after the energy conservation opportunities are implemented for Camp Zama, the Sagamihara Dependent Housing Area, and the combined Camp Zama/SDHA, respectively.

8.0 PROJECT BREAKOUTS WITH TOTAL COST AND SIR.

8.1 QUICK RETURN ON INVESTMENT PROGRAM (QRIP).

a. Medical/Dental Clinic, Building No. P-704: Make HVAC Operations More Efficient. Programmed Year Cost: $98,471.22. Simple Payback: 1.88 years. SIR: 6.98

b. Boiler Plant, Building No. S-134, SDHA: Boiler Flue Stack Heat Recovery. Programmed Year Cost: $41,038.31. Simple Payback: 1.44 years. SIR: 4.21.

c. Chapel Hill Family Housing: Hot Water Heat Pumps, Seventy Units. Programmed Year Cost: $80,398.83. Simple Payback: 1.80 years. SIR: 7.57.

d. Chapel Hill Family Housing: Hot Water Heat Pumps, Fifty-Eight Units. Programmed Year Cost: $65,209.82. Simple Payback: 1.76 years. SIR: 7.74.

8.2 PRODUCTIVITY ENHANCING CAPITAL INVESTMENT PROGRAM (PECIP).

a. Enlisted Dining Facility, Building No. P-333: Shut Off Range Hood/Kitchen Hood Exhausts. Programmed Year Cost: $3,318.18. Simple Payback: 2.92 years. SIR: 4.25.

b. Consolidated Open Dining Facility, Building No. S-453: Add Economizer Cycle/Lower Domestic Hot Water Temperature & Add a Booster Heater/Install Make-Up Air for Kitchen. Programmed Year Cost: $60,340.01. Simple Payback: 3.03 years. SIR: 2.28.

c. Heat Exchanger Building, Building No. S-709: Shut Off Steam During Non-Use Periods. Programmed Year Cost: $5,792.11. Simple Payback: 2.25 years. SIR: 3.97.

CHART 5
POTENTIAL ENERGY AND
COST SAVINGS, CAMP ZAMA

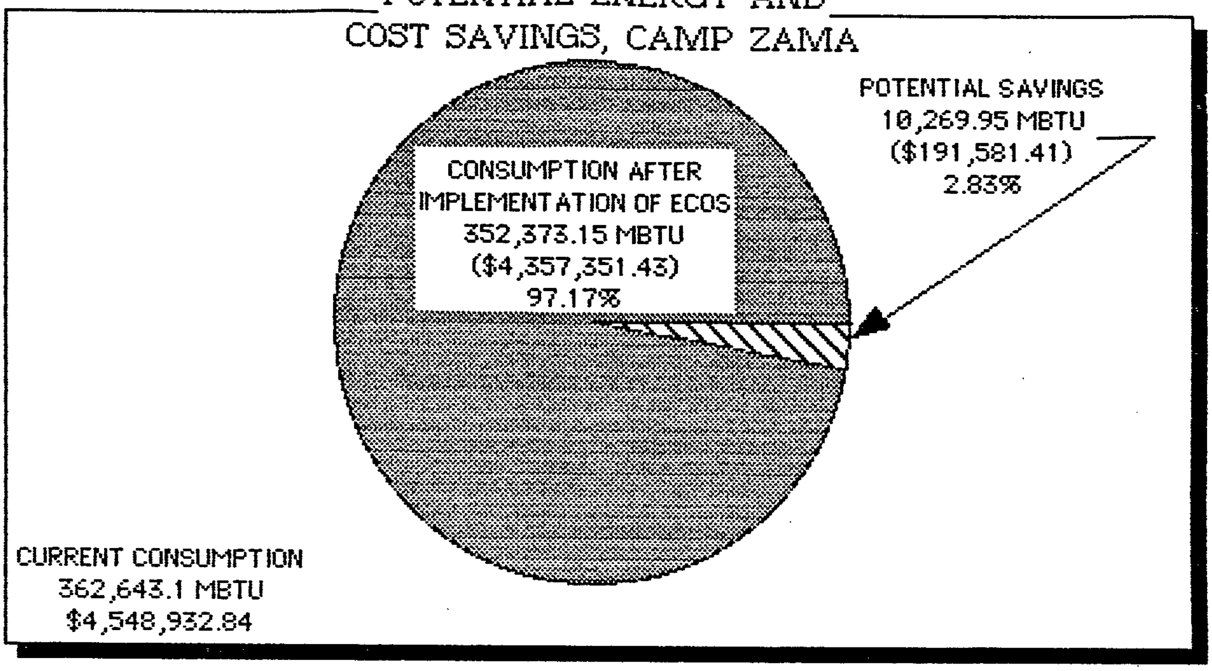


CHART 6
POTENTIAL ENERGY AND
COST SAVINGS, SDHA

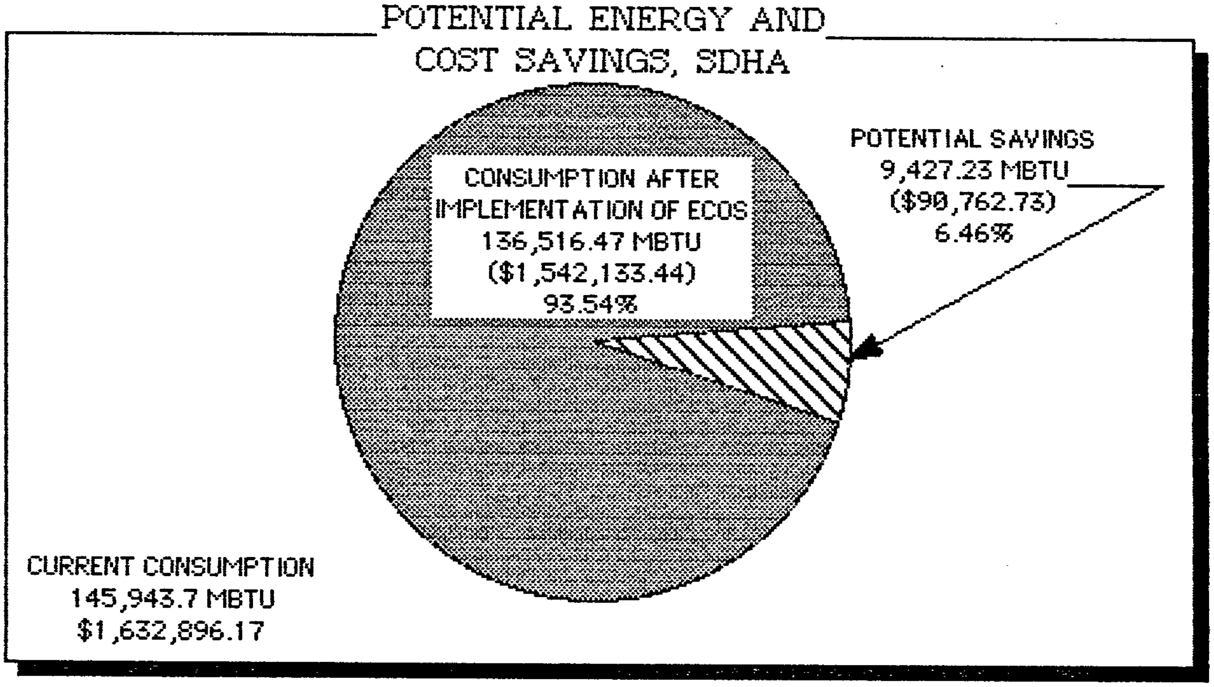
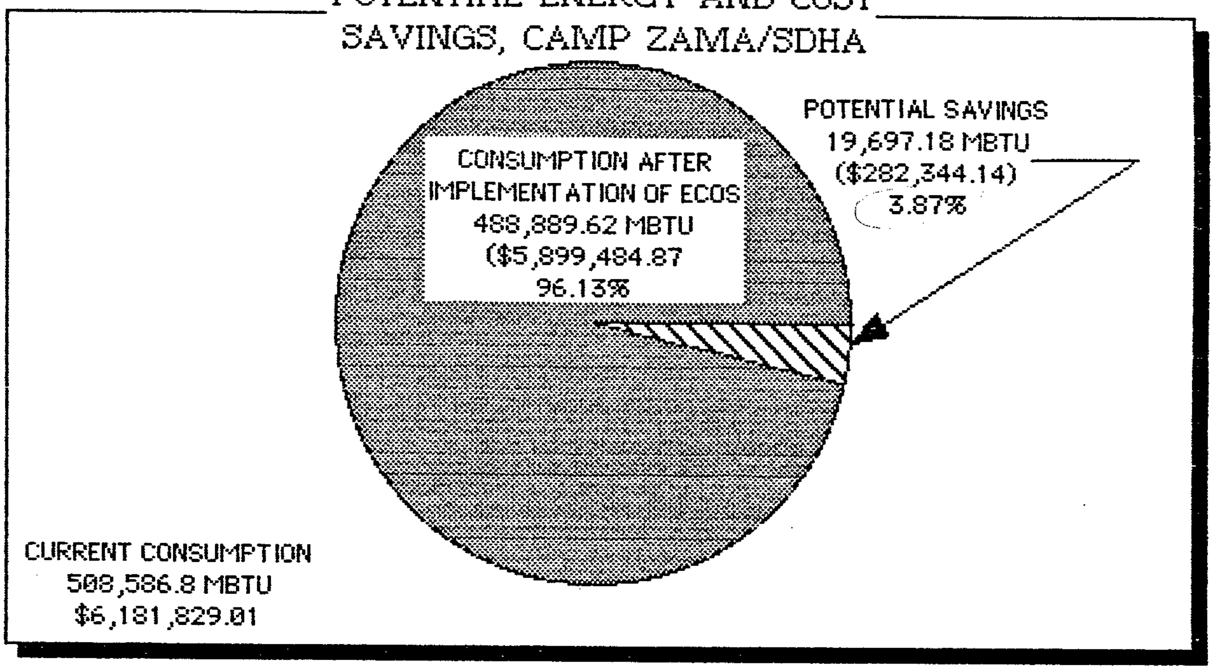


CHART 7
POTENTIAL ENERGY AND COST
SAVINGS, CAMP ZAMA/SDHA



d. Boiler Plant, Building No. S-134, SDHA: Install Variable Speed Pumps on HHW & DHW Systems. Programmed Year Cost: $97,243.92. Simple Payback: 3.90 years. SIR: 3.45.

e. Boiler Plant, Building No. S-134, SDHA: Shut Off Swimming Pool Hot Water Circulating Pump. Programmed Year Cost: $11,314.83. Simple Payback: 2.68 years. SIR: 5.39.

f. Boiler Plant, Buildng No. S-134, SDHA: Install HHW Temperature Controls on Heat Exchangers. Programmed Year Cost: $110,766.72. Simple Payback: 3.86 years. SIR: 4.53.

8.3 OTHER FUNDING PROGRAMS.

The remaining ECOs from Table ES-9 are listed below. They are to be accomplished using local OMA funds.

a. Enlisted Dining Facility, Building No. P-333, Camp Zama:

(1) Install Ceiling Insulation (Additional Ceiling Insulation). Programmed Year Cost: $1,401.20. Simple Payback: 13.85 years. SIR: 1.04.

(2) REPL Lighting (Install Energy Efficient Lamps and Replace Incandescent Lighting). Programmed Year Cost: $582.23. Simple Payback: 1.12 years. SIRs: 24.75 and 8.25, respectively.

(3) Heat RCVRY From Dishwasher. Programmed Year Cost: $13,028.14. Simple Payback: 6.20 years. SIR: 3.74.

(4) Reduce Make-up Air Temp. (Reduce Kitchen Make-Up (MA) Air Temperature). Programmed Year Cost: $18.74. Simple Payback: 1.5 days. SIR: 4,704.98.

(5) Install High Eff. Motors (Change to High Efficiency Motors). Programmed Year Cost: $2,037.41. Simple Payback: 6.41 years. SIR: 2.30.

b. Consolidated Open Dining Facility, Building No. S-453, Camp Zama:

(1) REPL Lighting (Install Energy Efficient Lighting and Replace Incandescent Lighting). Programmed Year Cost: $7,478.83. Simple Payback: 2.60 years. SIR: 1.23 and 6.00, respectively.

(2) Shut Down Energy To HWH (Shut Down Energy to DHW Heater). Programmed Year Cost: $3,648.67. Simple Payback: 5.57 years. SIR: 1.29.

(3) Reclaim Heat From Kitchen Exhaust. Programmed Year Cost: $17,230.01. Simple Payback: 7.96 years. SIR: 1.02.

(4) Heat Recovery From Dishwasher. Programmed Year Cost: $13,035.62. Simple Payback: 7.14 years. SIR: 1.12.

c. Medical/Dental Clinic, Building No. P-704, Camp Zama:

(1) REPL Lighting (Install Energy Efficient Lighting). Programmed Year Cost: $1,290.71. Simple Payback: 0.35 years. SIR: 48.72.

(2) Install Ceiling Insulation (Additional Ceiling Insulation). Programmed Year Cost: $15,623.68. Simple Payback: 14.33 years. SIR: 1.01.

(3) Lower Water STRG Temp. (Lower Domestic Hot Water Temperature). Programmed Year Cost: $15.19. Simple Payback: 0.08 years. SIR: 317.38.

(4) Install High Eff. Motors (Change to High Efficiency Motors. Programmed Year Cost: $6,729.45. Simple Payback: 9.18 years. SIR: 1.60.

d. Preventive Medicine, Building No. S-680, Camp Zama.

Insulate Hot Water Heater (Insulate Electric Hot Water Heater). Programmed Year Cost: $19.10. Simple Payback: 0.26 years. SIR: 4.63.

e. Laundry/Dry Cleaning Complex, Building Nos. P-708, S-709, S-710, S-711, and S-714, Camp Zama:

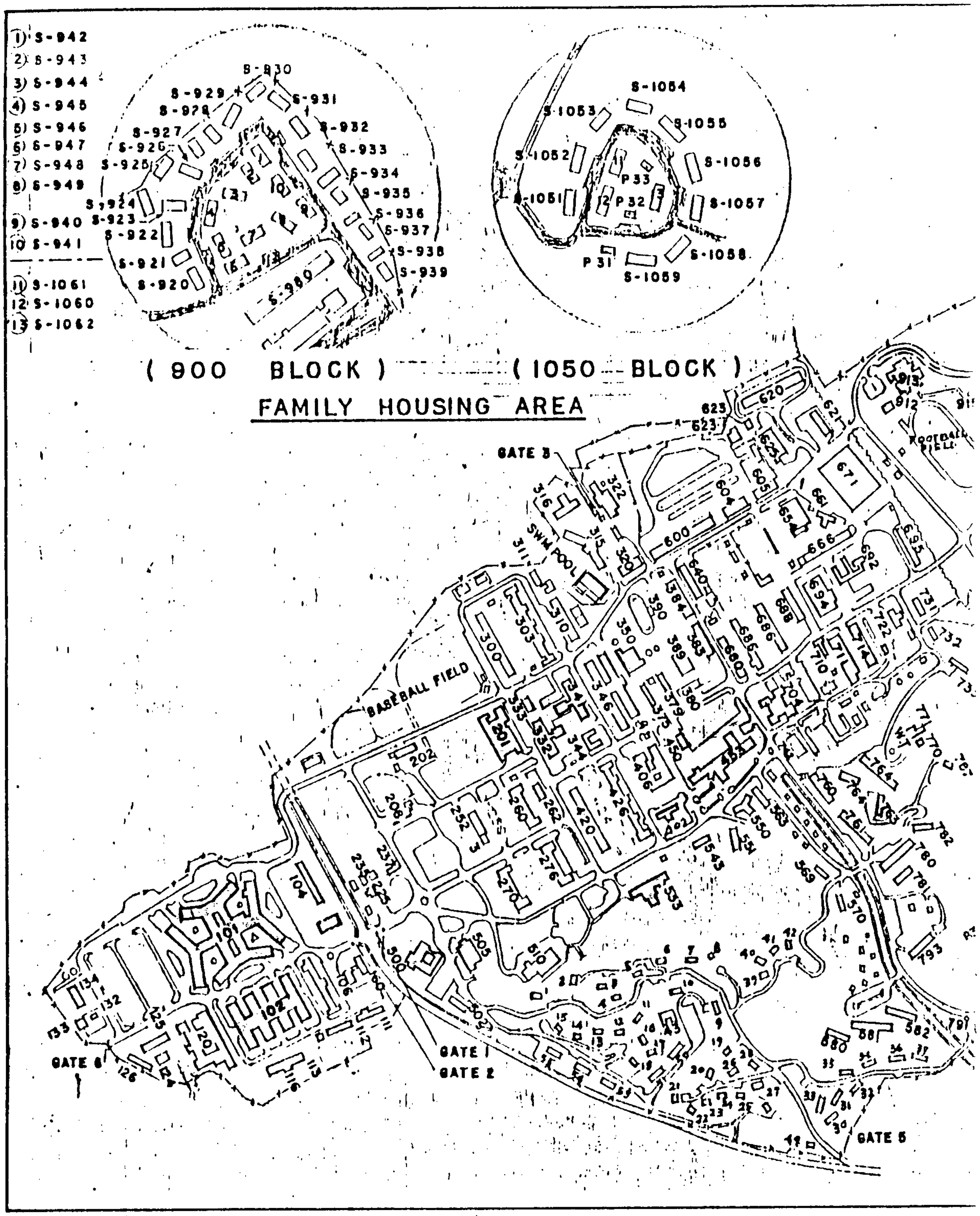
(1) REPL Lighting (Install Energy Efficient Lamps and Reduce Lighting Load). Programmed Year Cost: $4,170.56. Simple Payback: 6.07 years. SIR: 1.11 and 3.06, respectively.

(2) Use Cold Water (Use Cold Water for Laundering). Programmed Year Cost: $7,000. Simple Payback: 0.60 years. SIR: 11.85. (Completed in January 1987).

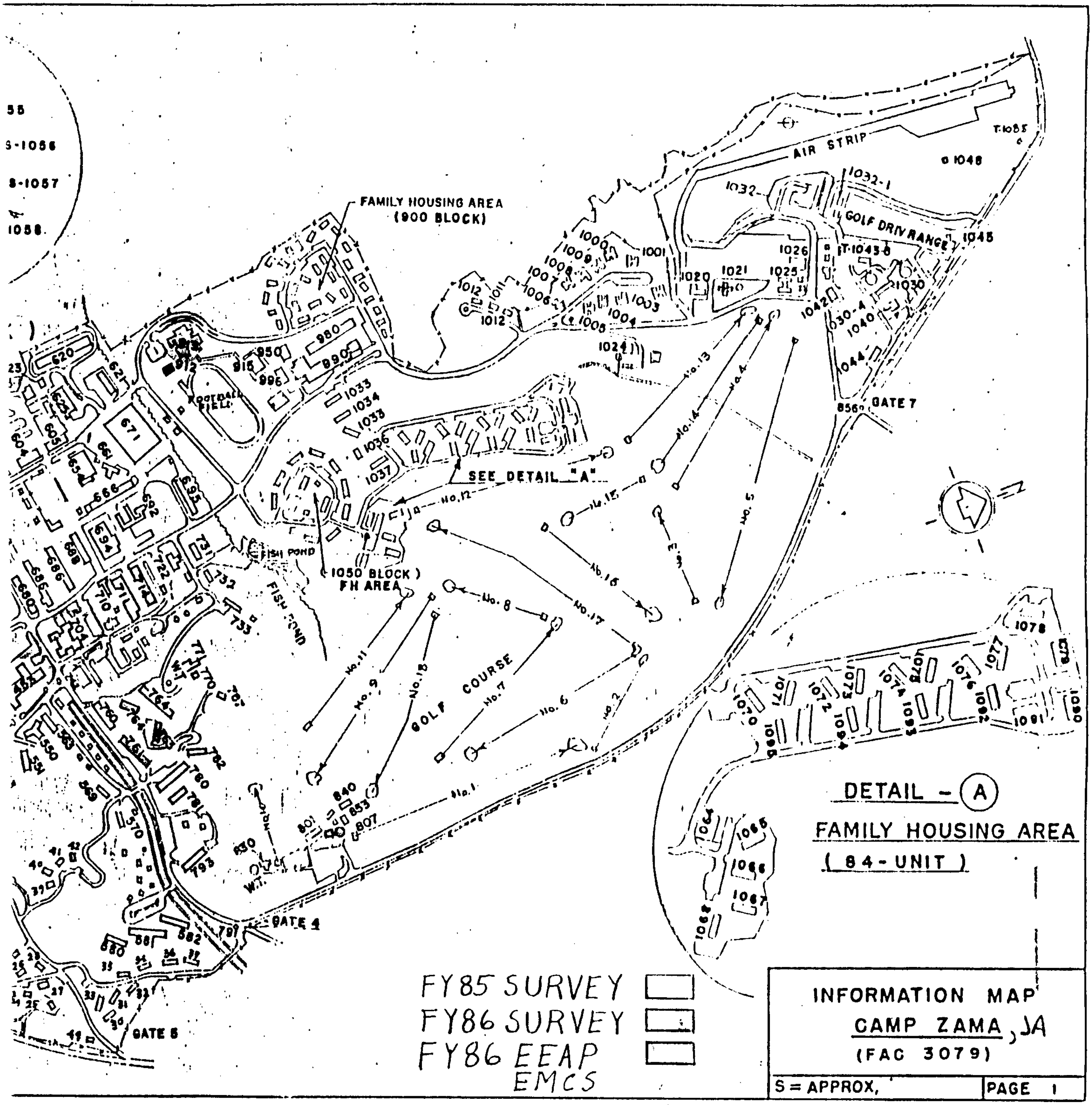
f. Dependent Kindergarten/Grade School Complex, Building Nos. S-539-1, 2, 3, 5, 7, & 8, SDHA:

(1) REPL Lighting (Install Energy Efficient Lamps, Use More Efficient Lighting Source and Replace Incandescent Lighting). Programmed Year Cost: $18,615.25. Simple Payback: 4.32 years. SIR: 2.86, 2.89 and 19.14, respectively.

(2) Install High Eff. Motors, Building No. S-539-7 and S-539-8 (Change to High Efficiency Motors). Programmed Year Cost: $2,522.02. Simple Payback: 13.09 years. SIR: 1.13.



1) S-942
2) S-943
3) S-944
4) S-945
5) S-946
6) S-947
7) S-948
8) S-949
9) S-940
10 S-941
11 S-1061
12 S-1060
13 S-1062
(900 BLOCK)
(1050 BLOCK)
FAMILY HOUSING AREA
GATE 3
SWIM POOL
BASEBALL FIELD
GATE 1
GATE 2
GATE 6
GATE 5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GOLF DRIV RANGE
GATE 7
SEE DETAIL "A"
FISH POND
1050 BLOCK)
FH AREA
GOLF COURSE
GATE 4
GATE 5
DETAIL - (A)
FAMILY HOUSING AREA
(84 - UNIT)
FY85 SURVEY
FY86 SURVEY
FY86 EEAP
EMCS
INFORMATION MAP
CAMP ZAMA, JA
(FAC 3079)
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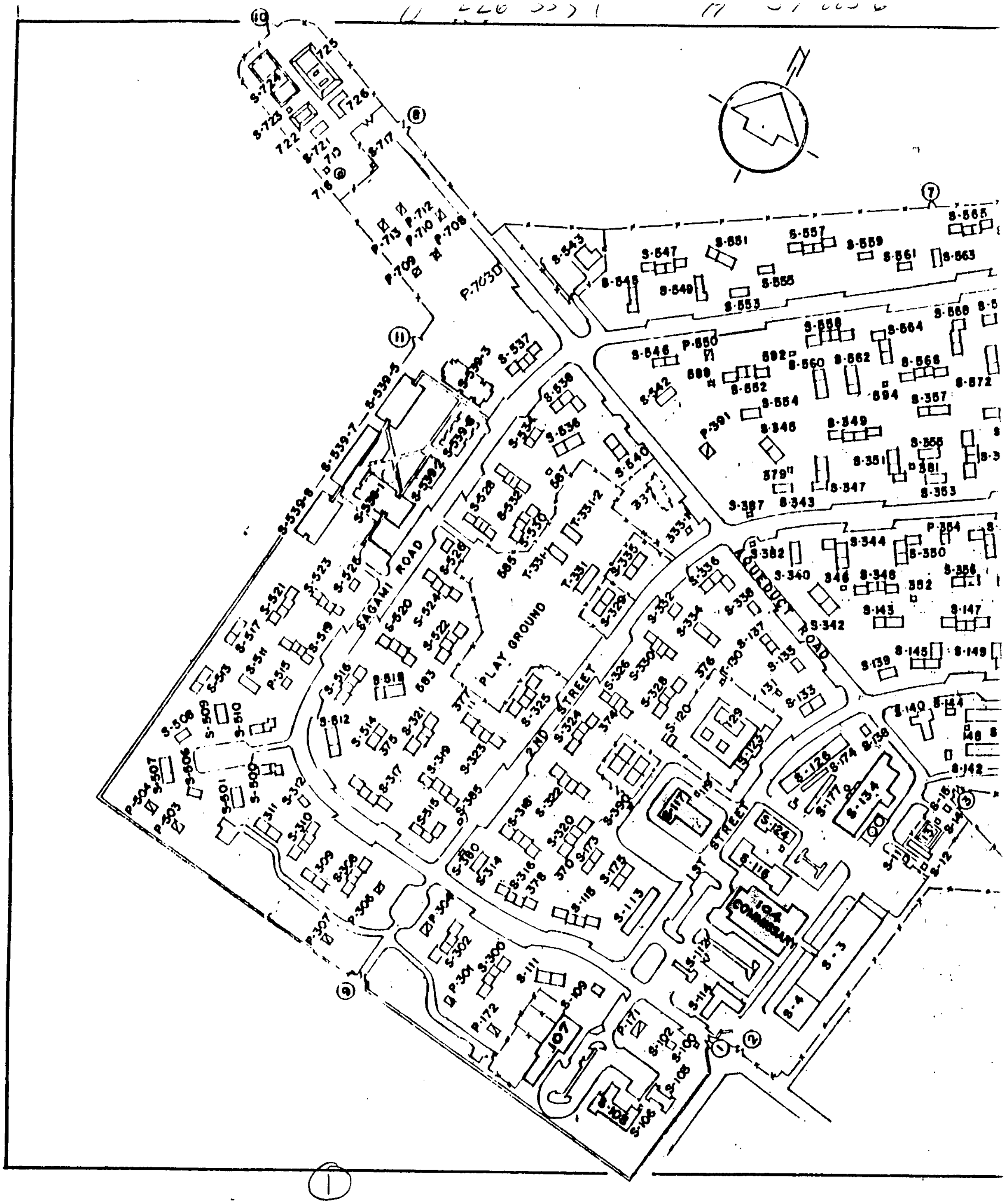
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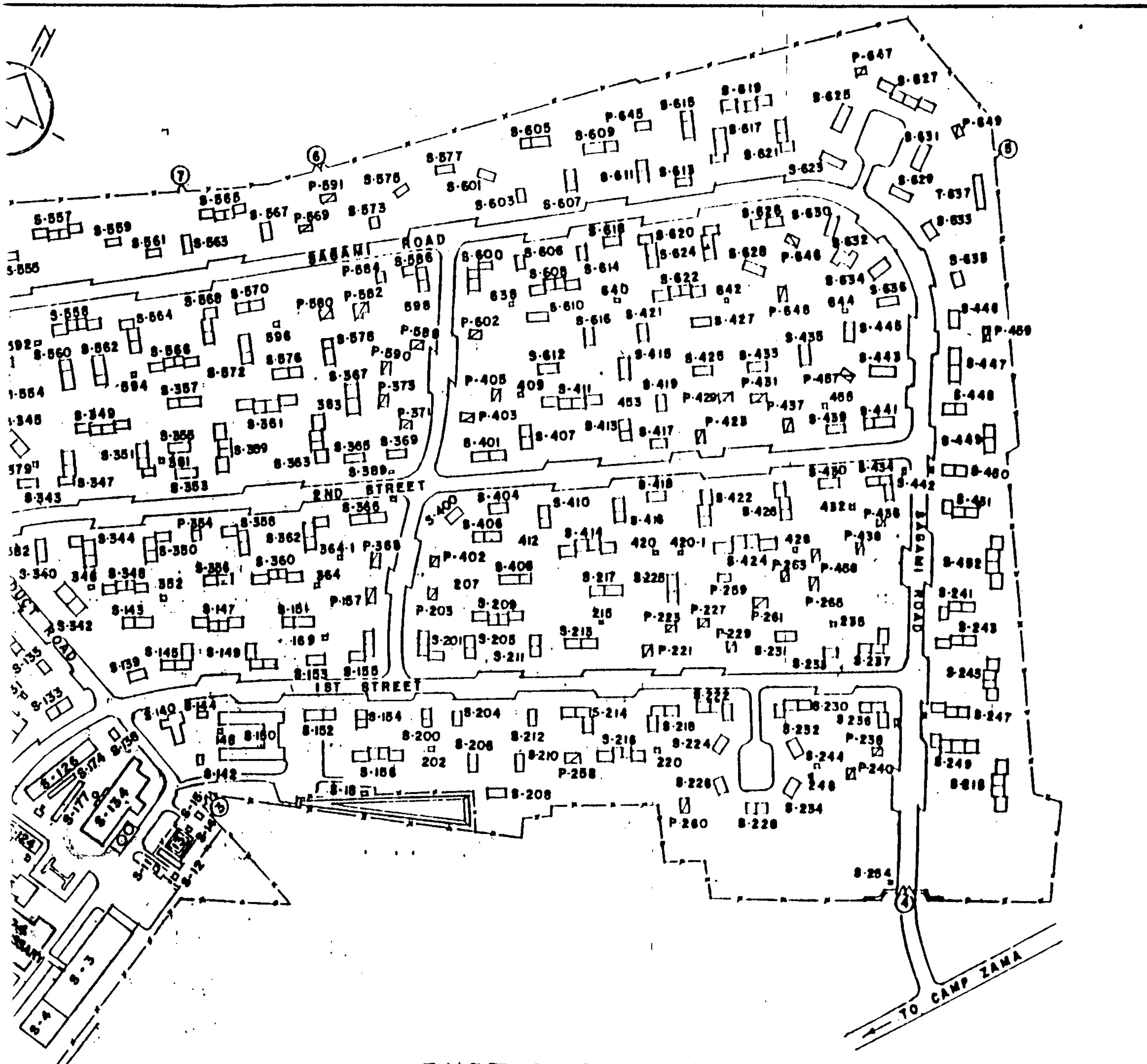
PLAY GROUND
2ND STREET
1ST STREET
AQUEDUCT ROAD
104
COMMISSARY

1



FY85 SURVEY
FY86 SURVEY
FY86 EEAP
EMCS

INFORMATION MAP
SAGAMIHARA F. H. AREA, JA

SCALE APP. 1:4000	DATE NOV 1982