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THE PANAMA CANAL

Work Order No. 1
EVALUATION OF LOCK CHANNEL ALIGNMENTS

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Initial Evaluation of Lock Channel Alignments
Part 2 of 4

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In association with
TAMS Consultants, Inc.

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS

PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

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1.0 SUMMARY

The Initial Evaluation of Lock Channel Alignments uses the data and information collected in the Review of Existing Information (Appendix A), and the methodology established in the Development of Evaluation Criteria (Appendix B) to perform preliminary evaluations of alternative channel alignments for a new third lane of Panama Canal locks. As part of the task, two new alternative alignments were proposed on both the Atlantic (Alignments 31 and 32) and the Pacific (Alignments 41 and 42) entrances. These alignments were analyzed along with twenty ACP proposed alignments. This task was designed to screen the large number of alternative alignments to identify the most favorable concepts to carry forward for further, more detailed analysis. The end result of the analysis was a narrowing from twenty-four alignment choices to eight: three at the Atlantic entrance and five at the Pacific entrance.

For the Atlantic entrance, of the three alternatives which remain for further evaluation, one alignment, 18, parallels the existing Gatun Locks on the west bank. Construction activities associated with the implementation of the third lane should not be disruptive to the existing canal operation. For Alignment 18, the construction of the locks through the Gatun Dam is an additional construction difficulty. Alignment 5 entails more excavation volume than the previous two alternatives and requires the relocation of a number of existing facilities. However, it presents the advantage of not being as disruptive of the canal operation during construction. Alternative 6, which utilizes the alignment of the 1939 excavation, has the smallest volume of excavation of all the considered alternatives. It is also sufficiently remote so as to avoid interference of the construction activities with the canal operation. This alternative will require the construction of new ancillary facilities, which will duplicate those existing at Gatun.

For the Pacific entrance, the ACP proposed two basic channel alignment schemes: single lock complexes (bypass alignments) that bypass or divide Lake Miraflores and two lock complex alignments (conventional alignments) that utilize the existing Lake Miraflores. Of the five to be carried forward, two fall in the first category and three in the second. Alignment 7 is the best of the single lock complex schemes because it minimizes excavation cost and provides operational simplicity. Alignment 3 is a conventional scheme that scores well largely because it minimizes excavation. Of the two new alternate alignments proposed for the Pacific entrance, Alignments 42 will be carried forward. The other new alignment, 41, was judged less favorable than Alignment 11, which will be carried forward. Both Alignments 11 and 42 utilize the existing Lake

Miraflores and two new lock complexes, one at Pedro Miguel and the other at Miraflores. These two alignments score well because they minimize disruption of existing operations during construction and maximize integration with existing operations.

Based on the results of this analysis, the OPCC decided to carry forward Alignments 5, 6 and 18 on the Atlantic entrance and Alignments 3, 7, 8, 11 and 42 on the Pacific entrance for further analysis. The five Pacific alignments represent the best concepts presented for evaluation. Among the five carried forward are two bypass alignments that provide the operational simplicity of a single lock complex as well operational balance with the Gatun locks. The other three Pacific alignments offer the advantages of integration with existing operations and make maximum use of the existing Lake Mirafores. For the Atlantic entrance, from the eight alternatives evaluated, the two most viable alignments are located on the east side, thereby avoiding the added difficulty of building the locks through the Gatun Dam. Alignment 18, which is on the west bank, offers additional room for ancillary structures such as water saving basins and control facilities. Further, its construction would not interfere with existing canal operations.

2.0 REVIEW OF INITIAL DESIGN PARAMETERS

Appendix C reviews design parameters that were applied throughout the initial analysis of the alignments. Each alignment was evaluated for a post-Panamax design vessel and lock. Some of the ACP proposed alignments showed features such as water saving basins and recycling ponds that others did not include. These features were generally not considered for the initial canal alignment comparison. In the Final Evaluation of Lock Channel Alignments, a layout will be prepared for each of the eight preferred alignments including a third and fourth lane and other ancillary structures such as water saving basins. As part of the Optimization of Layouts various lock sizes and design vessels will be analyzed for the two best alignments.

Table C-1 (Appendix C) provides the design parameters applied to the alignments during the Initial Evaluation. These parameters were applied universally to each alignment with the exception of the Pacific entrance alignments that passed immediately adjacent to the existing locks. For those alignments, bottom widths were slightly modified to account for the special condition of the existing locks. This is further described in section 3.0 Preliminary Quantity Takeoffs.

3.0 PRELIMINARY QUANTITY TAKEOFFS

Comparative manual quantity takeoffs were performed on selected alignments as part of the Initial Evaluation of Lock Channel Alignments. Quantity variations for the Atlantic entrance alignments were generally obvious by inspection. Therefore, simple hand calculations were sufficient to differentiate and score the "Excavation Cost" and "Construction Period" criteria for the Atlantic entrance alignments. The Pacific entrance alignments required additional analysis. Manual quantity takeoffs were performed on eight proposed Pacific alignments: 1, 3, 7, 8, 11, 14, 41, and 42. Initially, the quantities were calculated manually in order to provide a comparison with the quantities calculated with InRoads and LandDevelopment software during the Final Evaluation. A summary of these calculations is included in Appendix D. These eight were among the highest rated in preliminary evaluations (see Appendix E). Quantities were not calculated on the other Pacific alignments because they either were unnecessary by inspection, or they were similar enough to other alignments that another alignment's quantity would apply to them.

In the Final Evaluation of Lock Channel Alignments, detailed excavation takeoffs will be performed using 3-D Digital Terrain Model (DTM) for the eight alignments being carried forward. The DTMs will be constructed for the Atlantic and Pacific entrances using LandDevelopment and InRoads software. The DTMs will utilize the ASCii data provided by the ACP and DTM data from the 1993 Mobile District USACE survey. Quantities calculated from the DTM will be compared to those calculated manually during the Initial Evaluation to check the accuracy of the models.

4.0 SCORING ASSIGNMENTS FOR EACH ALIGNMENT

During the Initial Evaluation, the alignments were first analyzed and scored using the scoring criteria and the evaluation worksheet developed in Appendix B. One worksheet was completed for each alignment (see Exhibit E-1 in Appendix E) and the scores were then transferred to the matrix of raw scores (see Exhibit E-2). From these raw scores and the importance coefficients developed in Appendix B, weighted scores were calculated and tabulated (see Exhibit E-3).

The alignments were ranked based on the sum of the weighted scores. Category weighting was used to perform sensitivity analysis (see Exhibits E-4 and E-5). The sensitivity analysis used a variety of category weightings to highlight the strengths and weaknesses of each alignment. A variety of category weightings were tested to verify that no alignment was being improperly disqualified. Any alignments that appeared more than once in the top five for the various category weightings were reexamined and reevaluated.

The alignments and their scoring are described in the following sections. The scoring led to initial rankings that were later reviewed in the Final Evaluation (Part 3).

4.1 Atlantic Entrance Alignments

On the Atlantic entrance, the ACP had identified six basic alignments. Three were placed on the east side of the Gatun Locks (4, 5 and 6), and three were on the west bank (17, 18 and 19). Two additional alignments were developed for this initial evaluation, alignments 31 and 32. Both were placed on the west bank to address the issue of traffic congestion in the approach to the Gatun Locks.

4.1.1 Alignment 4

a. Description

This alignment shows a third lane alignment that parallels the existing Gatun Locks on their east side. This alternative uses the existing approach channel, which may require deepening and widening. The alignment is shown on Exhibit 4.

b. Scoring

This alternative will require a limited amount of excavation estimated at approximately 9 million cubic meters. Some of the construction will incorporate difficult cofferdam construction in the vicinity of the existing locks. The traffic through the adjacent existing lane and access to the facilities could be impaired during the construction. Construction of this alternative may be hampered by existing operations. Specifically, existing facilities will limit staging and stockpile areas.

This alignment will allow ready integration of the new locks into the existing operation. With careful planning, a fourth lane could be constructed on the east side of this alignment. This alignment ranks third among the east side alternatives. It will not be further evaluated.

4.1.2 Alignment 5

a. Description

This alternative shows a third lane near the existing Gatun Locks, on the east side. The proposed alignment forms a slight angle with that of the existing locks. This alternative will use the same existing approach channel since the entrance to the lock on the Atlantic entrance is located approximately 800 meters north of the existing locks. Deepening and widening of the approach channel may be required for two-way traffic. This alignment is shown on Exhibit 5.

b. Scoring

This alternative will require a larger volume of excavation than the previous alignment (approximately 17 million cubic meters) and the relocation of more buildings and facilities. Construction activities will be less disruptive to the canal operation than Alternative 4. Integration with the existing operation might require additional facilities. Construction of a fourth lane can be anticipated adjacent and to the east of this alignment. This alignment ranks second among the alternatives. It will be further evaluated.

4.1.3 Alignment 6

a. Description

This alternative uses the 1939 Third Locks excavation on the east side of the existing Gatun Locks. Entrance to the approach channel on the ocean side is nearly three kilometers north of the existing locks. The approach to the new lock would be approximately three kilometers and the lock facilities will be located at approximately one to one and one half kilometers from the existing locks, near the shore of Gatun Lake. The alignment is shown on Exhibit 6.

b. Scoring

This alternative has the smallest volume of excavation of all alignments considered on the Atlantic entrance (estimated at five million cubic meters). The other major advantage of this alternative is the remoteness of the construction; it will have practically no interference with the existing operation. The alignment interferes with the existing anchorage area but requires no other facility relocation. Staging areas are readily available near the site.

The new locks will constitute an entirely new operation separate from the existing locks with substantial duplication of equipment and facilities. A fourth lane can easily be built adjacent to this alignment. Alignment 6 ranks first among the Atlantic alternatives. It will be further evaluated at the next level of study.

4.1.4 Alignment 17

a. Description

This alternative parallels the existing Gatun Locks in their immediate vicinity on the west bank. It will use the same approach channel, which will require deepening and widening to allow for two-way traffic. The alignment goes through the Gatun Dam east abutment near the existing locks. Construction at that location might be particularly difficult due to the need for a cofferdam and the presence of the dam hydraulic fill. Preliminary layout of this alignment is shown on Exhibit 17.

b. Scoring

The volume of excavation required for this alternative is limited (approximately 8 million cubic meters). The construction is anticipated to be extremely difficult at both end of the facilities and particularly at the location of the Gatun Dam. The traffic through the adjacent lane may be restricted during part of the construction period. Staging and stockpile areas are readily available to the west of the canal, but access to the existing facilities will be somewhat disruptive.

This alignment will allow ready integration of the new locks into the existing operation. However, expansion of a fourth lane may be difficult since it will go further into the existing dam. This alignment ranks second among the west bank alternatives. It will not be further evaluated.

4.1.5 Alignment 18

a. Description

This alignment was initially shown with a shiplift. However, in order to compare equivalent alternatives, the alignment was evaluated for a set of locks. This alignment uses the existing excavation of the French Canal, on the west side of the approach channel approximately two kilometers north of the Gatun Locks. The proposed locks would cross the Gatun Dam approximately 500 meters east of the existing locks. The entrance of the approach channel on the ocean side may require deepening and widening for two-way traffic. Ship navigation may be difficult on the Gatun Lake side. This alignment is shown on Exhibit 18.

b. Scoring

The required volume of excavation for this alternative is estimated to be 14 million cubic meters. Construction of the new facilities will not significantly affect the operation of the canal and no major facility relocations are anticipated. The construction through the dam is expected to be difficult and could be hazardous to the dam. The required staging and stockpile areas may be limited by the presence of a wetland area that is unsuitable for the construction activities.

Integration with the existing operation may require additional facilities. In view of the difficulties with the Gatun Dam, the construction of a fourth lane, if desired, should be done simultaneously with the third. This alignment ranks first among the west bank alternatives. It will be considered for further evaluation.

4.1.6 Alignment 19

a. Description

This alternative, like Alternatives 17 and 18 is located on the west bank of the existing Gatun locks. The alignment crosses the dam further west between the spillway and the dam left abutment. It was also originally shown for a shiplift; for consistency the alignment is evaluated with locks. They will be located at approximately one kilometer from the existing facilities. As the alignment crosses the spillway channel, a new spillway and spillway channel will be required; a waterway (culvert) under the set of locks will be required to pass the discharge from the existing hydro power plant. The construction through the dam is expected to be difficult and could be hazardous to the dam. The layout of this alignment is shown on Exhibit 19.

b. Scoring

The estimated volume of excavation for this alternative is 16 million cubic meters. The construction activities will not interfere with the canal operation, but the distance from the existing facilities will necessitate duplication of equipment for the new operation. A very difficult construction is anticipated to deal with the existing dam. This alignment ranks third among the west bank alternatives on the Atlantic entrance, and is eliminated from further consideration.

4.1.7 Alignment 31

a. Description

This alignment is a variant of Alignment 18 at the Gatun Lake end. The ocean entrance does not use the existing approach channel but goes directly into Limon Bay. The purpose of this alternative would be to avoid traffic congestion in the approach channel if it were seen as a major issue. This alternative has no other advantage. The layout of this alignment is shown on Exhibit 21.

b. Scoring

Many of the advantages and disadvantages of this alignment are similar to Alternative 18. However, it requires and estimated 46 million cubic meters of excavation, more than three times the total of Alignment 18. The alignment ranks sixth and will not be considered for further evaluation.

4.1.8 Alternative 32

a. Description

This alignment is a variant of Alignment 19 at the Gatun Lake end. The ocean entrance does not use the existing approach channel but goes directly into Limon Bay. This alternative would avoid traffic congestion in the approach channel if it were seen as a major issue. The alignment will also require the construction of a new spillway. This alternative has no other advantage. The layout of this alignment is shown on Exhibit 22.

b. Scoring

The required excavation volume is estimated to be 51 million cubic meters. Pros and cons of this alternative are similar to those discussed above for Alternative 19. The alignment ranks seventh and will not be considered for further evaluation.

4.2 Pacific Entrance Alignments

For the Pacific entrance, the ACP proposed two basic alignment types. The bypass type consists of a single lock and a channel that bypasses or divides Lake Miraflores (Alignments 2, 7, 8, 9, 10, 12, 14, 15, 16 and 20). The conventional type utilizes two locks and the existing Lake Miraflores (Alignments 1, 3, 11, 13, 41 and 42), similar to the existing situation.

All alignments transit beneath the site of the formerly proposed Van Dam Bridge. The ACP is considering different bridge alignments that may be affected or adjusted by both the third and fourth lanes of the lock alignments. The location and clearance of this bridge are significant considerations for long-term planning of canal expansion.

However, for the initial evaluation of the alignments, only existing infrastructure was considered in comparing the alignments.

4.2.1 Alignment 1

a. Description

This conventional alternative mirrors the 1939 Third Locks Project plans and is west of the existing canal. The Pacific approach channel to the third lane thus makes maximum use of the 1939 Third Locks excavation. The alignment then crosses Lake Miraflores and continues on west of the Cerro Paraiso joining the Gaillard Cut north of the existing Pedro Miguel locks. The layout of this alignment is shown on Exhibit 1.

b. Scoring

Alignment 1 is handicapped by additional excavation required to bypass the Cerro Paraiso for the new Pedro Miguel locks (see Appendix D). The confluence of the alignment channel with that of the existing channel in Lake Miraflores and the multiple turns also pose concerns over navigational safety. This alignment will not be analyzed further.

4.2.2 Alignment 2

a. Description

This bypass alternative contains a single three-lift lock at the site of the 1939 Third Locks excavation. It then turns inland, arriving at the Gaillard cut just north of the existing Pedro Miguel locks. It requires a relatively sharp curve west of Lake Miraflores. It also features extensive channel excavation, two saddle dams, and a barrier dam to bypass Lake Miraflores. The layout of this alignment is shown on Exhibit 2.

b. Scoring

Alignment 2 has the advantage of a single lock complex at Miraflores that both simplifies operations and reduces excavation by raising the channel bottom elevation. However, extensive inland excavation and multiple turns that reduce navigational safety led to a lower score. It will not be analyzed further.

4.2.3 Alignment 3

a. Description

This conventional alternative places a third lane of locks immediately west of the existing locks at Miraflores and Pedro Miguel. The new Miraflores Locks are through relatively flat terrain while the new Pedro Miguel locks require significant excavation in the Cerro Paraiso. However, overall, this alternative involves a relatively small amount of approach channel excavation for the features shown. The layout of this alignment is shown on Exhibit 3.

b. Scoring

Alignment 3 benefits from its position adjacent to the existing locks. This both reduces excavation quantities (see Appendix D) by minimizing the length of new entrance channel and maximizes integration for operations. It additionally benefits from a maximum score for the "Minimize Maintenance Dredging" category. Concerns over interference with existing operations could be addressed in the construction sequence. During the initial evaluation, it scored the highest of all alignments. It will be further evaluated at the next level of study.

4.2.4 Alignment 7

a. Description

This bypass alternative uses the 1939 Third Locks excavation to site a single three-lift lock southwest of the existing Miraflores Locks. An extensive barrier dam isolates the new transit channel at Gatun Lake level from the existing Lake Miraflores, with the Lake Miraflores' western shoreline moved farther west to accommodate the channel. An emergency dam with wicket gates is provided at the upper end of the new transit channel, adjacent to Pedro Miguel locks. The layout of this alignment is shown on Exhibit 7.

b. Scoring

Alignment 7 ranked the highest of the options that bypass the existing Lake Miraflores channel and fourth overall. A single three-lift lock at Miraflores decreases excavation in the new channel. An emergency dam at Pedro Miguel reduces the chances of flooding

should the long cofferdam separating the expanded Gatun Lake from Lake Miraflores breach. The alignment ranks well for navigational safety and has lower excavation volumes (see Appendix D) than other bypass options because it utilizes part of the existing Lake Miraflores. It will be further evaluated at the next level of study.

4.2.5 Alignment 8

a. Description

This bypass alignment uses the 1939 Third Locks excavation and an extensive new channel to bypass Lake Miraflores. Three saddle dams help confine the channel in the lower topographic areas. The alignment passes through the western portion of the Cerro Paraiso. The layout of this alignment is shown on Exhibit 8.

b. Scoring

Alignment 8 takes a middle path between the inland bypasses (9, 10, 14, 15, 16, and 20) and those that divide Lake Miraflores (7 and 12). The route involves above-average excavation quantities, but does not require a long barrier dam that could be susceptible to catastrophic failure. Its construction will not interfere with existing operations. Significant flooding of lowlands increases environmental impact and infrastructure relocation, reducing those scores. It will be analyzed further alongside alignment 14 in the Final Evaluation of Lock Channel Alignments.

4.2.6 Alignment 9

a. Description

This bypass alignment was first proposed in the 1993 Canal Alternatives Study (CAS). It is a straight shot, located parallel to and approximately two kilometers southwest of the existing locks. Three lifts in succession bring vessels from tidewater up to Gatun Lake level, with a straight transit channel rejoining the existing channel in the Gaillard Cut, some four kilometers northwest of the Pedro Miguel Locks. The new channel goes through the identified unexploded ordinance (UXO) area for about three kilometers of its length. The layout of this alignment is shown on Exhibit 9.

b. Scoring

The alignment passes west and south of all other alignments. It received the lowest score for excavation cost and time and offers no opportunity for integration with existing operations. Its score was also lowered because it passed through a significant length of the UXO area. It impacts one of the largest land areas of all of the alignments reducing its score on environmental concerns. It does offer above-average opportunity for future expansion, but contains too many other flaws to be further considered.

4.2.7 Alignment 10

a. Description

This bypass alternative shows a ship lift, northeast of the existing Miraflores Locks. However, this alignment was analyzed using the initial evaluation design parameters: post-Panamax lock size and 256-m channel bottom width. It contains a Pacific approach and bypass channel to convey vessels around the existing Miraflores and Pedro Miguel Locks. A barrier dam is required to isolate the transit channel from Lake Miraflores. Additional barrier dams and saddle dams are required east of the alignment to limit inundation and maintain existing road and rail access through this developed area. The layout of this alignment is shown on Exhibit 10.

b. Scoring

This alignment received low scores for future expansion due to the relatively congested conditions in the new lock area. It also scored poorly on environmental, relocations and socio-economic factors. It has a relatively high excavation volume because it passes through the 175-m high Cerro Luisa east of the existing Pedro Miguel lock. Finally, some concerns were raised over navigational safety due to potential congestion north of the Pedro Miguel locks. It will not be analyzed further.

4.2.8 Alignment 11

a. Description

This conventional alternative has two separate locks: a two-lift lock is placed in the 1939 Third Project Locks excavation and a single lift lock is sited parallel to, and just west of,

the existing Pedro Miguel locks through the Cerro Paraiso. The alignment requires additional flooding of Lake Miraflores' western shore. The layout of this alignment is shown on Exhibit 11.

b. Scoring

Alignment 11 received a high overall score because it uses a portion of Lake Miraflores, but also provides better navigational safety by avoiding congestion near the existing locks. It also avoids the UXO area. Its main flaw is that it requires excavation of nearly the entire Cerro Paraiso. However, it will be further considered as part of the Final Evaluation of Lock Channel Alignments.

4.2.9 Alignment 12

a. Description

This bypass alignment is similar to Alignment 7. It uses the 1939 Third Locks excavation to site a three-lift lock. An extensive barrier dam isolates the new transit channel from the existing Lake Miraflores, with the western shoreline of the lake moved farther west to accommodate the channel. Significant flooding occurs west of the Cerro Paraiso. The layout of this alignment is shown on Exhibit 12.

b. Scoring

Alignment 12 is similar to Alignment 7. It will be considered as part of the analysis of Alignment 7 in the Final Evaluation of Lock Channel Alignments.

4.2.10 Alignment 13

a. Description

This conventional alignment is similar to Alternative No. 11. This alternative uses the 1939 Third Locks excavation to site a two-lift lock complex. The alignment of the other lock complex is slightly skewed and just west of the existing Pedro Miguel locks. Two saddle dams tie the new lock guidewalls back into a westerly-expanded Lake Miraflores shoreline and prevent additional flooding. The layout of this alignment is shown on Exhibit 13.

b. Scoring

Alignment 13 requires the excavation of nearly the entire Cerro Paraiso. It also may interfere with existing navigation through Lake Miraflores. In general it is less desirable than Alignment 11 and will not be further considered.

4.2.11 Alignment 14

a. Description

This bypass alignment is a straight shot (similar to Alignment 9), located parallel to and approximately one kilometer southwest of the existing locks. A single three-lift lock brings vessels from tidewater up to Gatun Lake level, with a straight transit channel rejoining the existing channel in the Gaillard Cut, approximately two kilometers northwest of the Pedro Miguel Locks. Unlike Alignment 9, this new channel avoids the UXO area for its entire length. The layout of this alignment is shown on Exhibit 14.

b. Scoring

Alignment 14 receives low ratings for excavation cost and time because it had a high excavation quantity (see Appendix D). It has similar strengths and weaknesses to Alignment 9. It receives high scores for navigational safety, future expansion and complete lack of interference with existing operations. It will be carried forward in Task 4 and further analyzed along with Alignment 8.

4.2.12 Alignment 15

a. Description

This bypass alternative uses only a fraction of the 1939 Third Locks excavation to site a single three-lift lock southwest of the existing Miraflores Locks. The skewed alignment provides for a straight shot between the 1939 excavation site and the existing northwest end of the Pedro Miguel Locks guidewalls. An extensive barrier dam isolates the new transit channel in an expanded Gatun Lake from the existing Lake Miraflores. Significant flooding occurs west of the Cerro Paraiso. The layout of this alignment is shown on Exhibit 15.

b. Scoring

Alignment 15 is similar to Alignment 7. It benefits from above-average navigational safety considerations. However, unlike Alignment 7 it does not make use of the existing 1939 Third Locks Project excavation or existing Lake Miraflores, raising excavation costs and construction time. Variations on this alignment will be with Alignment 7 in the Final Evaluation of Lock Channel Alignments.

4.2.13 Alignment 16

a. Description

This east side bypass alternative (similar to Alignment 10) shows a shiplift northeast of the existing Miraflores Locks, with a narrow Pacific approach and bypass channel to convey smaller vessels around the existing Miraflores and Pedro Miguel Locks. However, this alignment was analyzed using the initial evaluation design parameters: post-Panamax lock size and 256 m channel bottom width. A barrier dam is required to isolate the transit channel in an expanded Gatun Lake from Lake Miraflores. Additional cofferdams and saddle dams are required east of the alignment to limit inundation and maintain existing road and rail access through this developed area. The layout of this alignment is shown on Exhibit 16.

b. Scoring

This alignment was scored identically to Alignment 10. The proposed facilities (e.g. tunnel, bridges and roads) were not considered in this analysis in order to maintain consistent analysis criteria. It will not be carried forward for further analysis.

4.2.14 Alignment 20

a. Description

This bypass alignment is a straight shot along the same alignment as Alternative 14. New third and fourth lanes of three-lift lock complexes bring vessels from tidewater up to Gatun Lake level, with a straight transit channel rejoining the existing channel in the Gaillard Cut, approximately two kilometers northwest of the Pedro Miguel Locks.

Unlike Alternative No. 9, this new channel avoids the UXO Area for its entire length. The layout of this alignment is shown on Exhibit 20.

b. Scoring

Alignment 20 was scored identically to Alignment 14. The proposed fourth lane of locks was not considered in this analysis in order to maintain consistent analysis criteria. It will not be carried forward for further analysis.

4.2.15 Alignment 41

a. Description

This conventional proposed alignment uses the existing third locks excavation at Miraflores and a west side adjacent third lock at Pedro Miguel, similar to Alignment 3. It transits Lake Miraflores, making partial use of the existing channel. The layout of this alignment is shown on Exhibit 23.

b. Scoring

This alignment is variant of Alternatives 11 and 13. It has a low excavation quantity combined with better navigational safety from separation of the existing and new Miraflores Locks operations. It is also scores well because of limited environmental impact, few required relocations and good expansion potential for a fourth Miraflores lock. However, the fourth Pedro Miguel lock construction may significantly interfere with existing operations. Therefore, this alternative is less desirable than its variant, Alternative 11. It will not be further analyzed.

4.2.16 Alignment 42

a. Description

This alternative employs a third lane of locks immediately east of the existing locks at Miraflores and Pedro Miguel. It passes through the existing Miraflores spillway that would be relocated to the site of the 1939 Third Locks Project excavation. The alignment calls for widening the existing channel through Lake Miraflores but does not create any

new major entrance channels. At Pedro Miguel, it passes between the existing locks and the 175-m high Cerro Luisa. The layout of this alignment is shown on Exhibit 24.

b. Scoring

Alignment 42 is another partially optimized scheme, being a variant of Alternative 3. As such, it has most of the same positive and negative traits of Alignment 3. It has the lowest excavation quantity (see Appendix D) and construction time of all of the choices and offers maximum benefits of integration with existing operations. Concerns over interference with existing operations can be addressed in the construction sequencing. It scores poorly in the relocations criteria because of the required transfer of the Miraflores spillway and powerhouse. This alignment ranked second overall and will be carried forward for further analysis.

5.0 CONCLUSIONS

The initial evaluation of lock channel alignments has concluded that three Atlantic entrance schemes and five Pacific entrance schemes warrant further evaluation:

Atlantic: Alignments 5, 6, and 18.
Pacific: Alignments 3, 7, 8, 11, and 42.

Appendix E provides details of the Kepner-Tregoe evaluation and scoring.

Overall rankings of the Initial Evaluation were as follows:

Atlantic Entrance

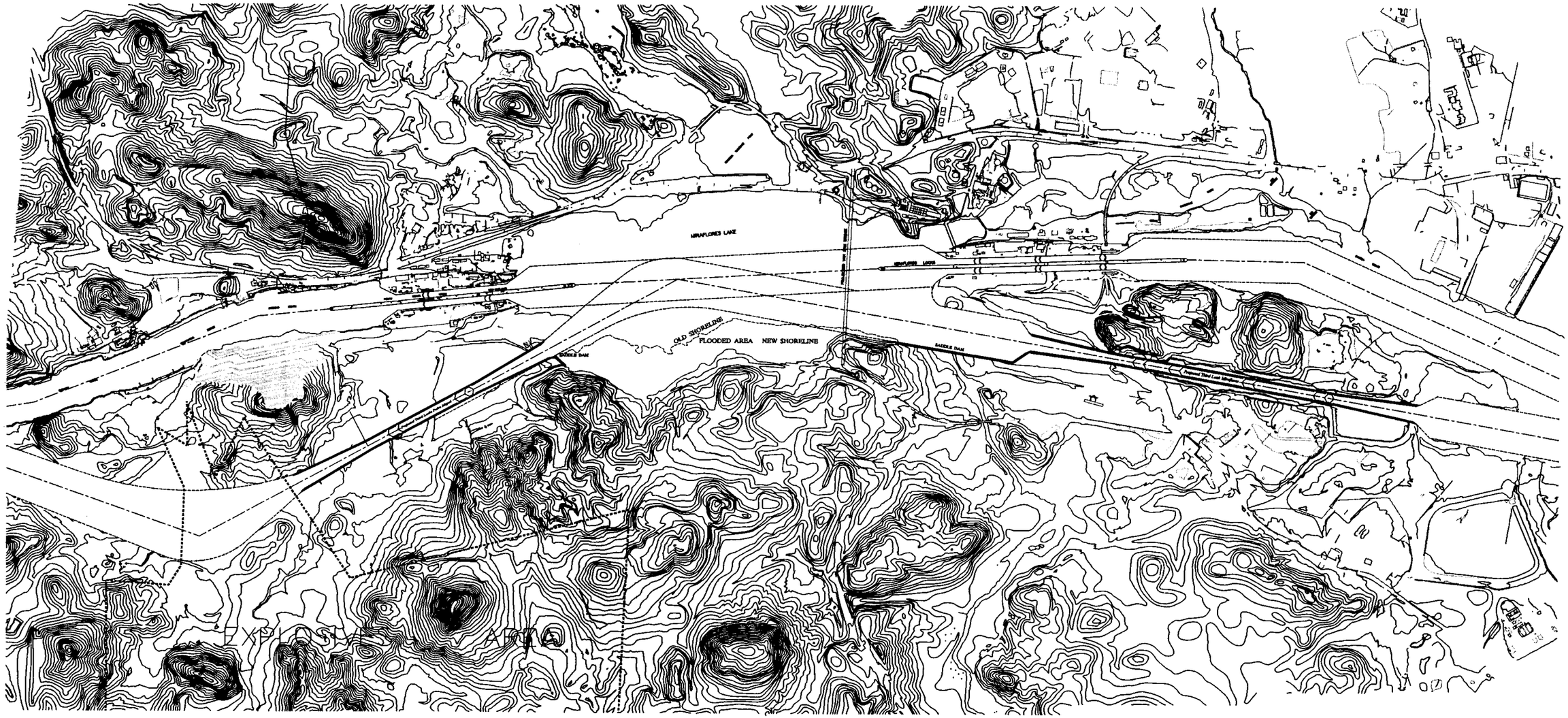
Alignment No.	Score	Rank	Carried Forward	Remarks
4	253	4	No	Combined with Alignment No. 5.
5	272	2	Yes	
6	309	1	Yes	Ranks first among east side alternatives.
17	236	5	No	
18	258	3	Yes	Ranks first among west side alternatives.
19	223	6	No	
31	217	7	No	
32	195	8	No	

Pacific Entrance

Alignment No.	Score	Rank	Carried Forward	Remarks
1	218	11	No	
2	199	16	No	
3	276	1	Yes	Highest ranking conventional alternative.
7	238	3	Yes	Highest ranking bypass alternative.
8	225	4	Yes	To be optimized with alignment 14.
9	220	10	No	
10	206	14	No	
11	232	5	Yes	
12	213	13	No	
13	229	8	No	
14	231	6	Yes	
15	218	12	Yes	To be optimized with Alignment 7
16	206	14	No	
20	231	6	No	
41	226	9	No	
42	253	2	Yes	

This task eliminated some of the less desirable alignments while highlighting the good features of all alignments. For the Atlantic entrance, the Final Evaluation will address in detail the pros and cons of the concentration of canal operation, as would occur with Alternative 5. This advantage will be balanced against the disruption of the canal operation during construction that would be avoided with Alternatives 6 and 18.

The five Pacific alignments carried forward allow for optimization of both of the general alignment schemes presented by the ACP: bypass alignments that use a single three-lift lock and conventional two lock complex alignments. In addition, both east and west bank alignments are preserved. The Final Evaluation of Lock Channel Alignments will include detailed quantity takeoffs for the remaining five Pacific alignments. The development of standard lock structures and features will also help discriminate among the five.

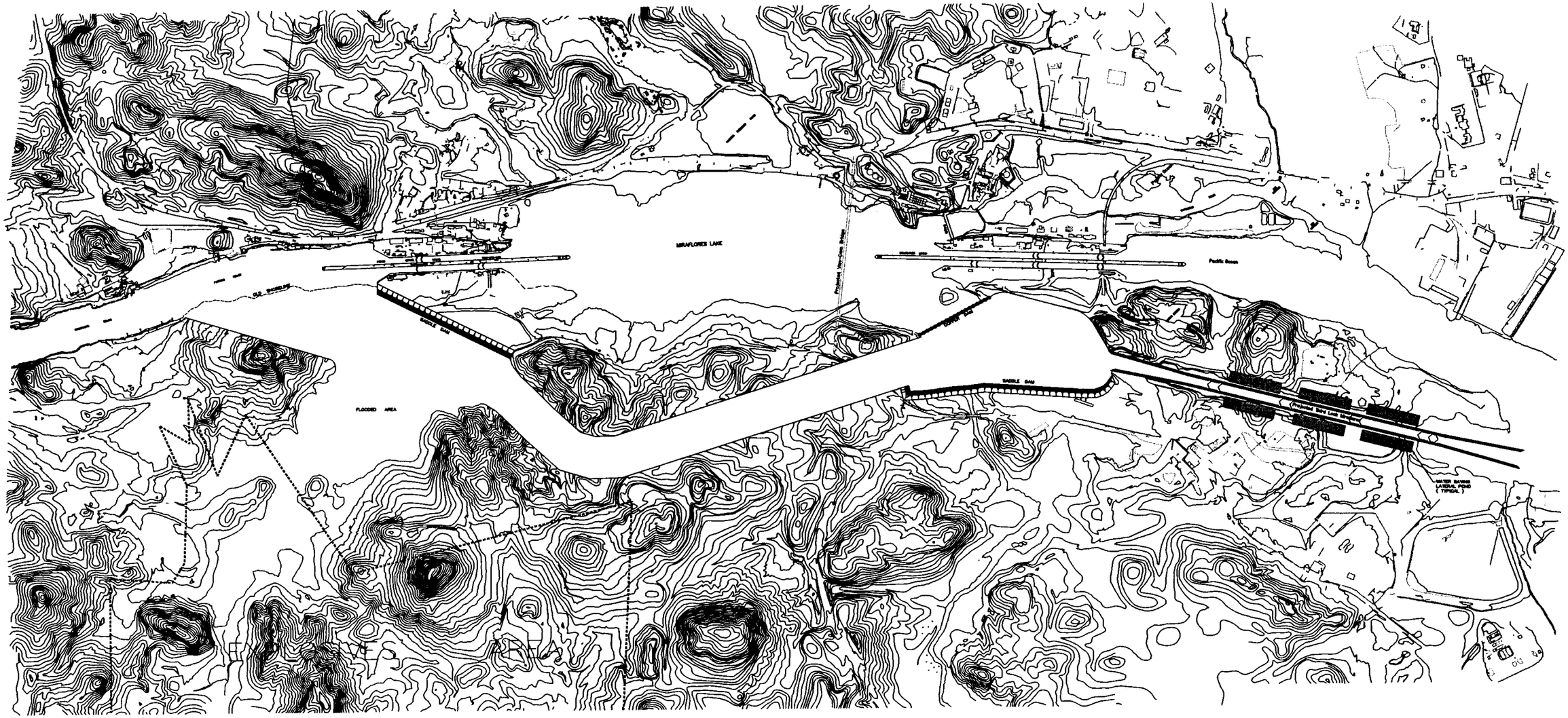


AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 1 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 1

USERNAME $USER
FILENAME $$$$$$$$$$$$$$$$DGNSPEC.$$$$$$$$$$$$$$$$ PT1E Chicago
PENTABLE L:\pen\none.tbl
TIME PLOTTED $DATE$ $TIME$

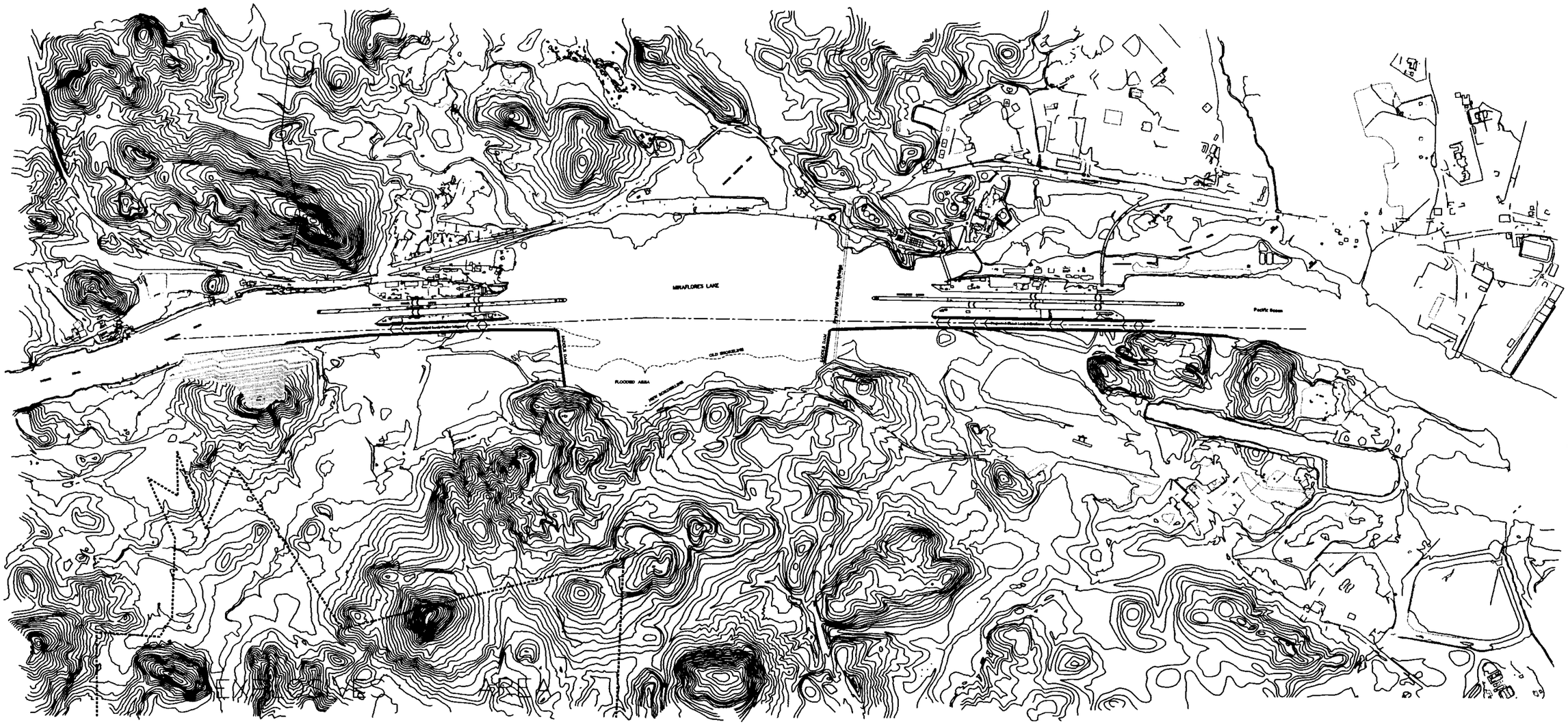


AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 2 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 2

USERNAME $USER$
FILENAME $$$$$$$$$$$$$$$$$$DGNSPEC$$$$$$$$$$$$$$$$$$ OFFICE:Chicago
PORTAND L:\pen\none.tbl
TIME PLOTTED $DATE$ $TIME$



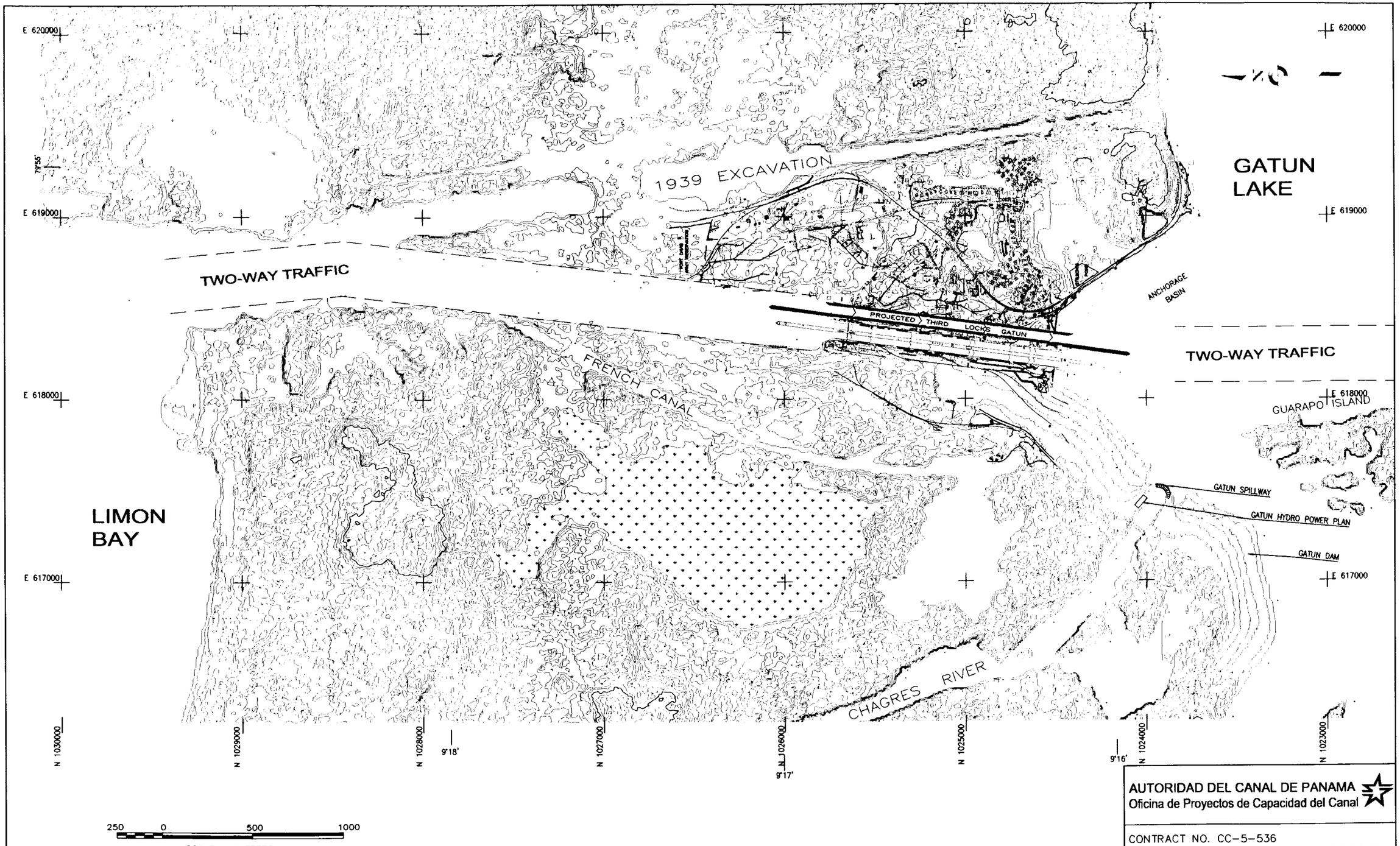
AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 3 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 3

USERNAME: $USER$
FILENAME: $$$$$$$
PORTAMED: L:\pen\
TIME PLOTTED: DA

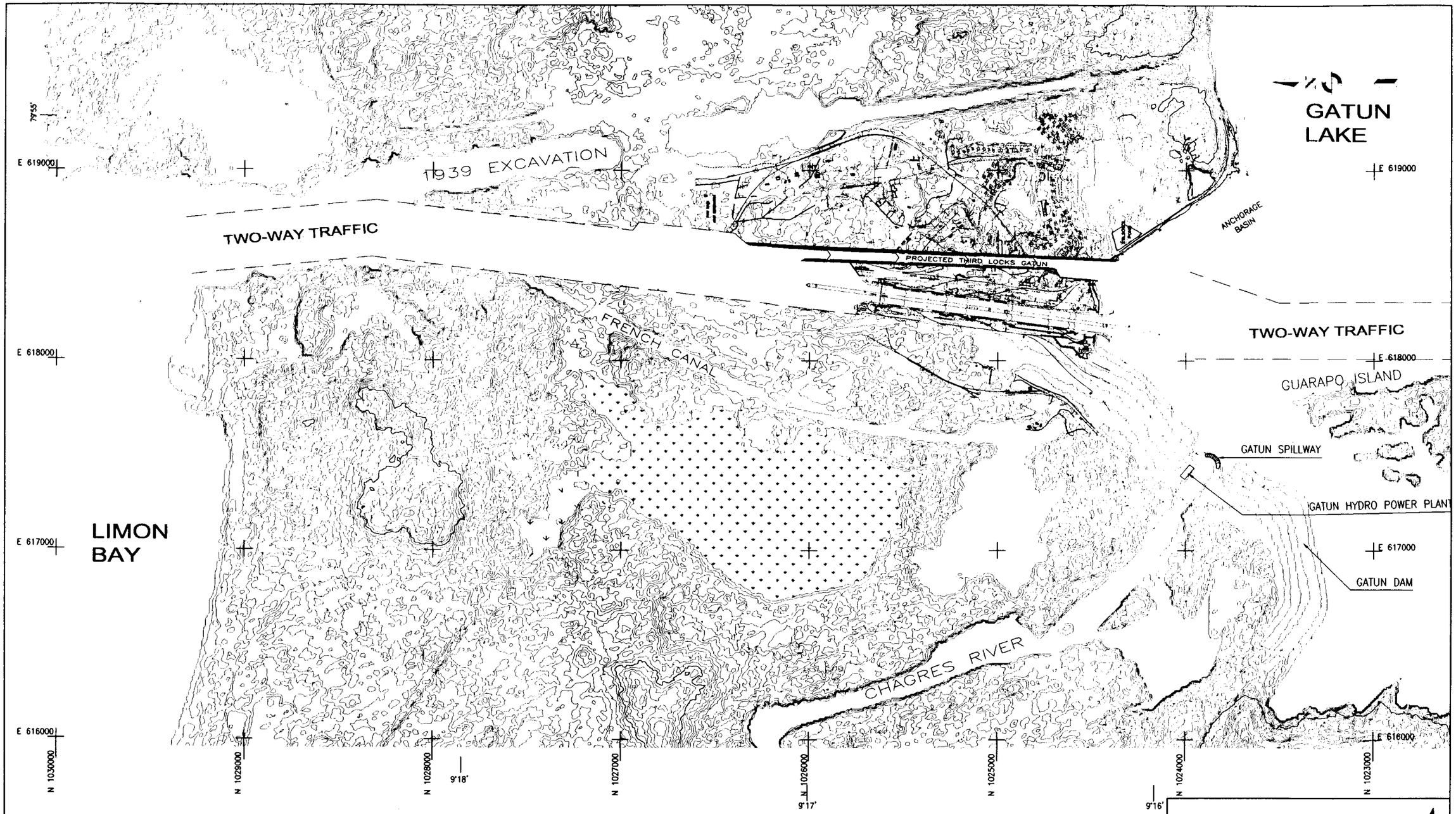
OFFICE: Chicago
DGNSPEC: $$$$$$$$$$$$$$$$$$
TIME: $



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 4 – Atlantic Entrance

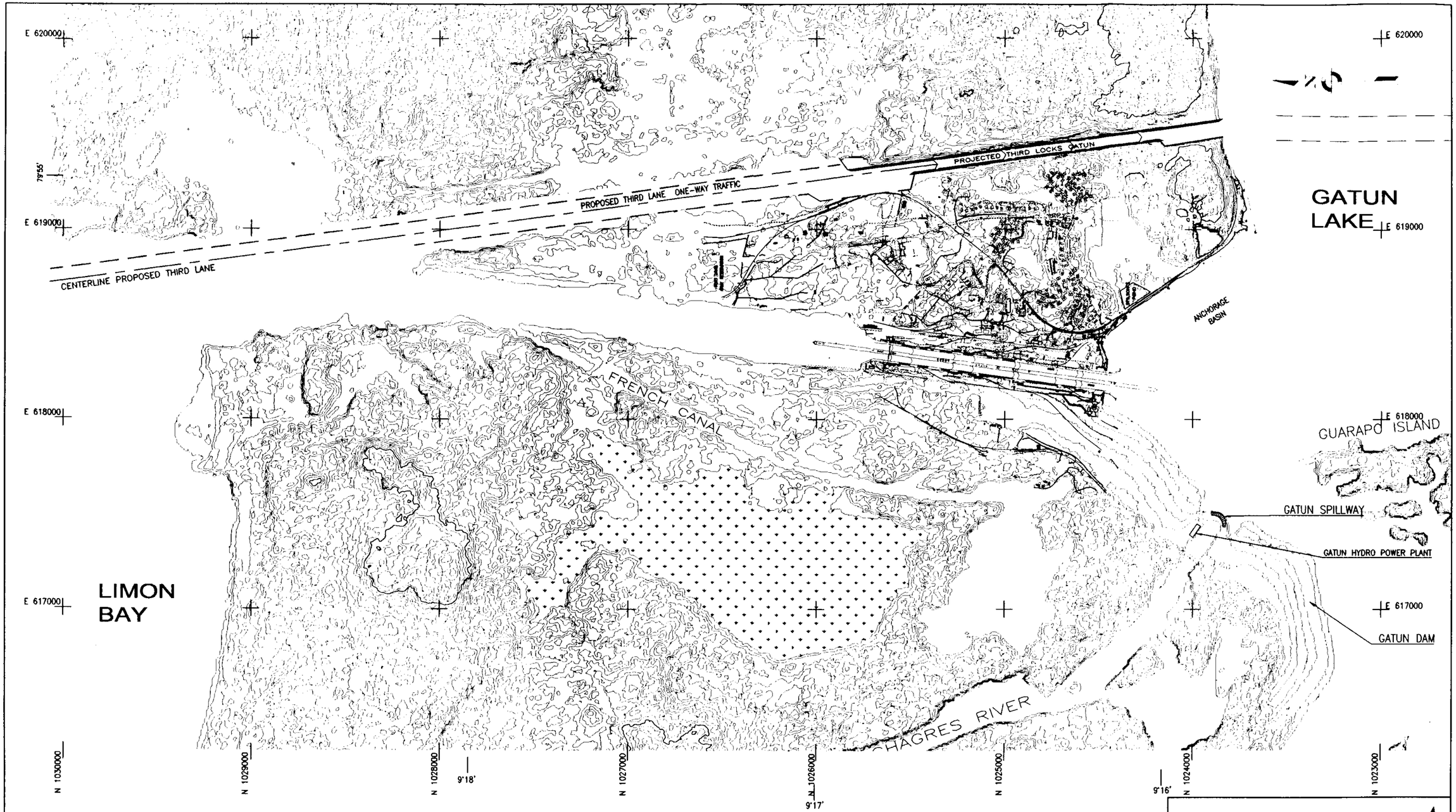
HARZA TAMS	August 2000	Exhibit 4



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 5 – Atlantic Entrance

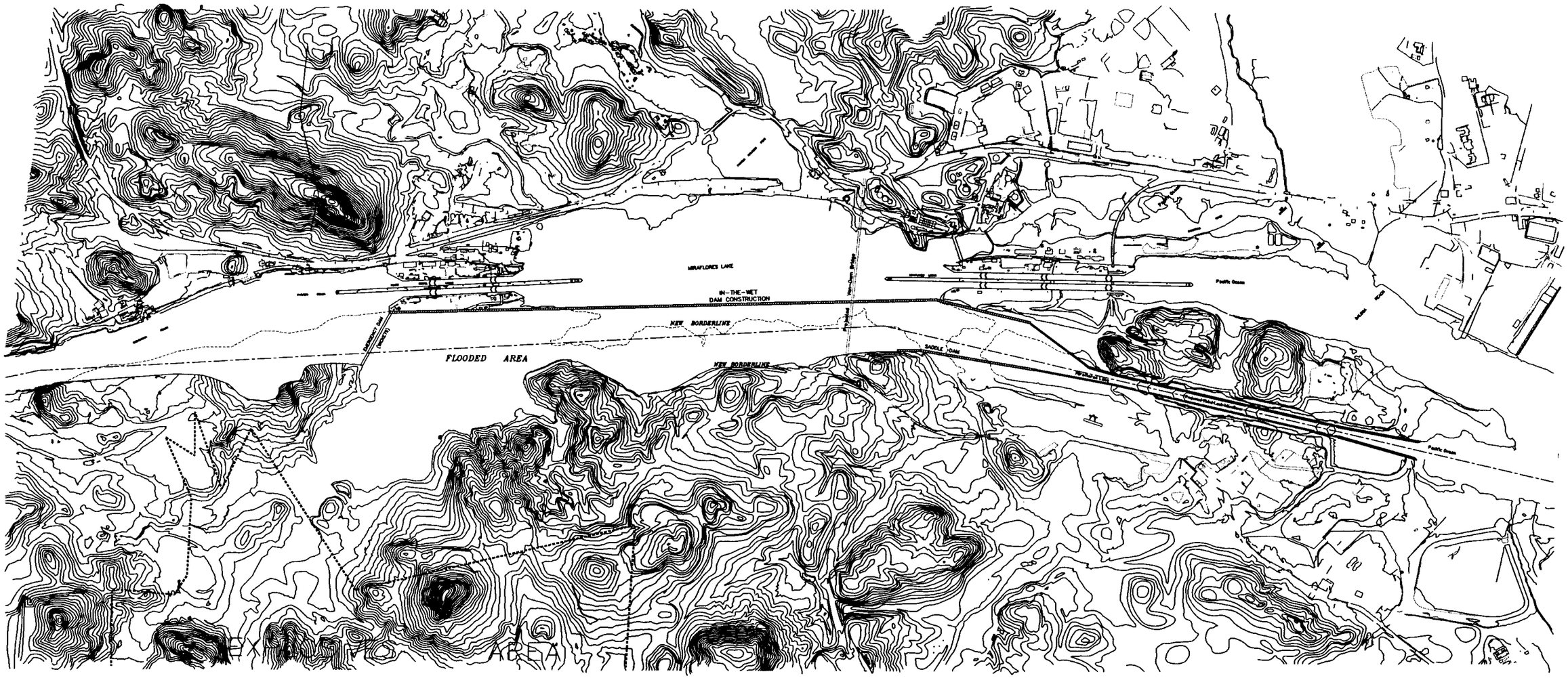
HARZA TAMS	August 2000	Exhibit 5



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 6 – Atlantic Entrance

HARZA TAMS	August 2000	Exhibit 6



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evlauation
Alignment 7 Pacific Entrance

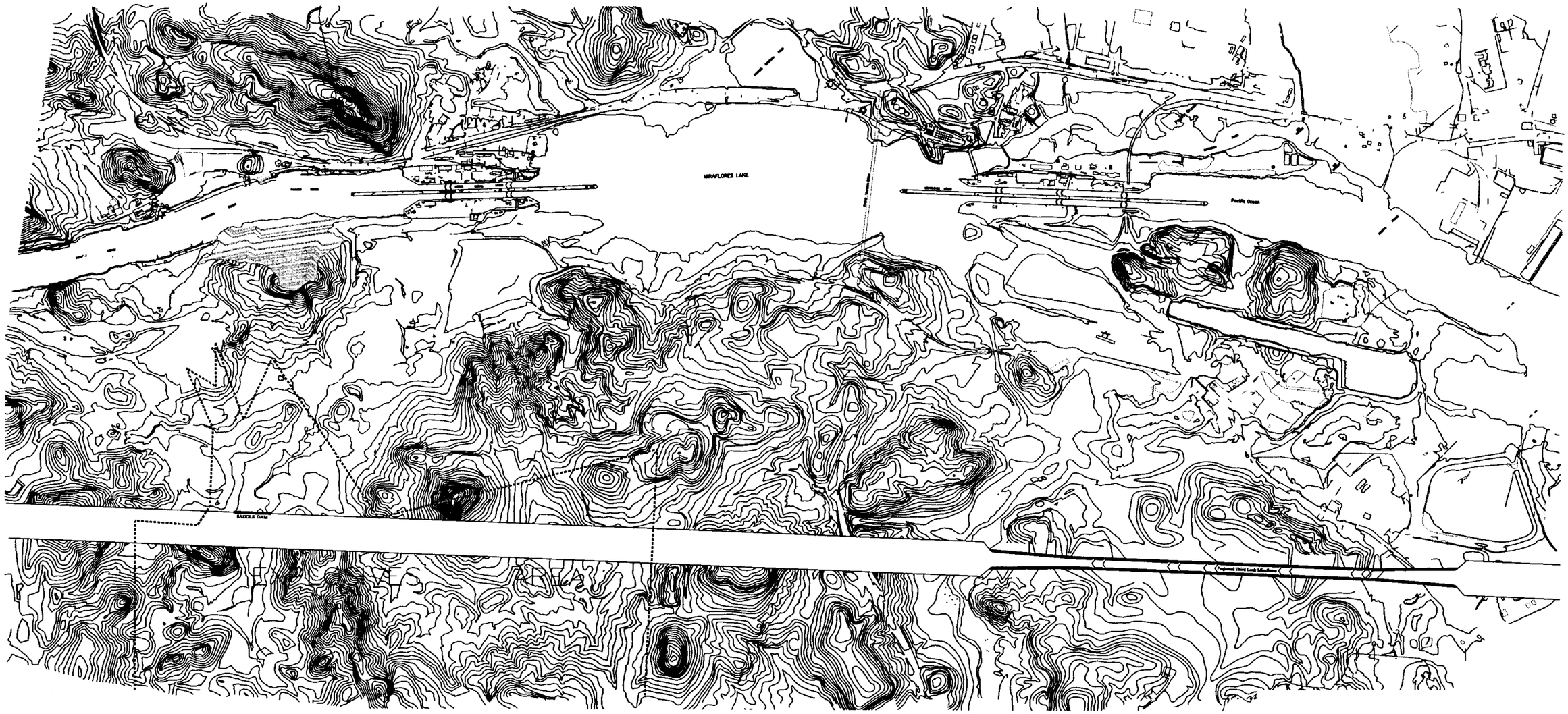
HARZA TAMS	August 2000	Exhibit 7

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 8 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 8

USERNAME $USER$
FILENAME $$$$$$$$$$$$$$$$DGNSPEC$$$$$$$$$$$$$$$$ $$$$$$$$$$$$$$$$
MODEL L:\pwn\none.tbl
TIME PLOTTED $DATE$ $TIME$



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 9 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 9

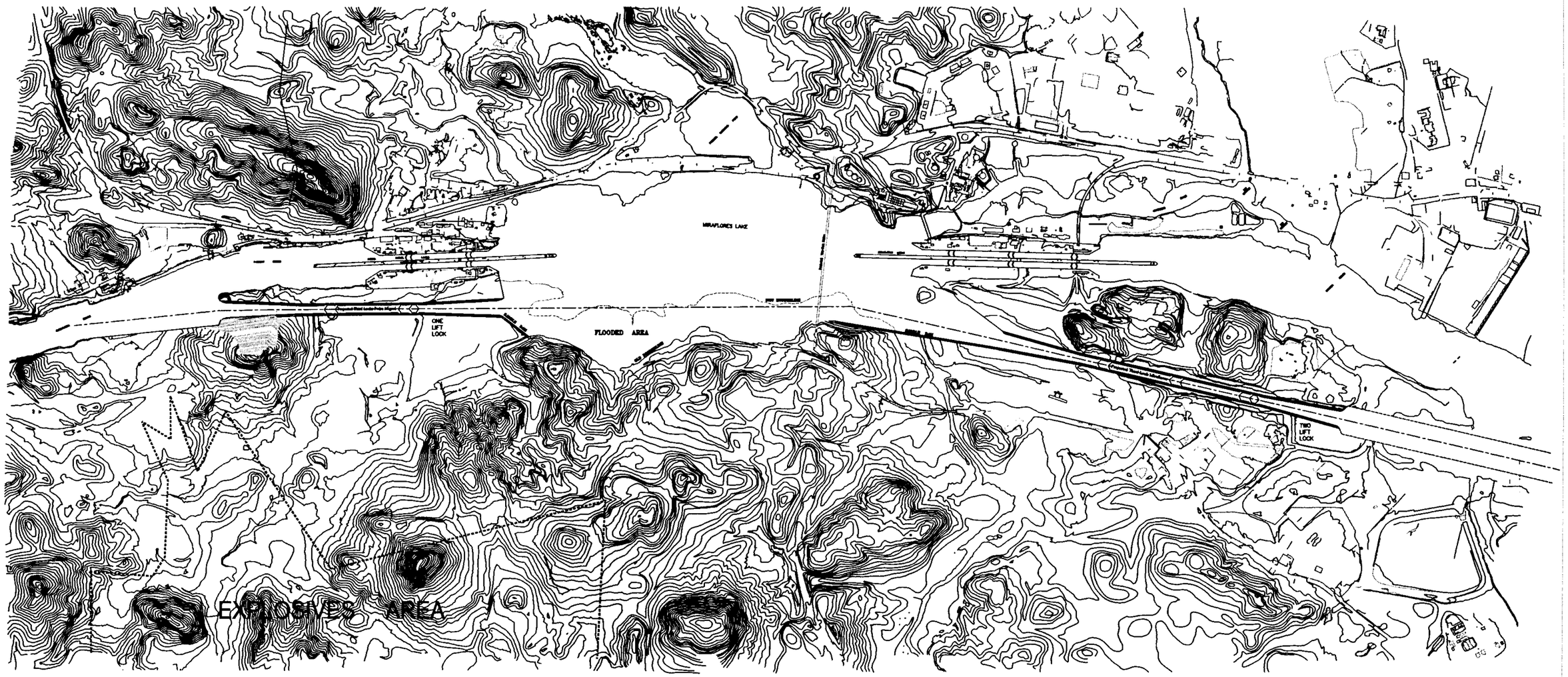
USERNAME: $USER$
FILENAME: $$$$$$$$
PROJNAME: LOPCO
TIME PLOTTED: $DATE$ $TIME$

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 10 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 10

USERNAME $USER$
FILENAME $$$$$$$$$$$$$$$$$$$$DGNSPEC$$$$$$$$$$$$$$$$$$$$
FILENAME $$$$$$$$$$$$$$$$$$$$DGN$$$$$$$$$$$$$$$$$$$$
TIME PLOTTED $DATE$ $TIME$

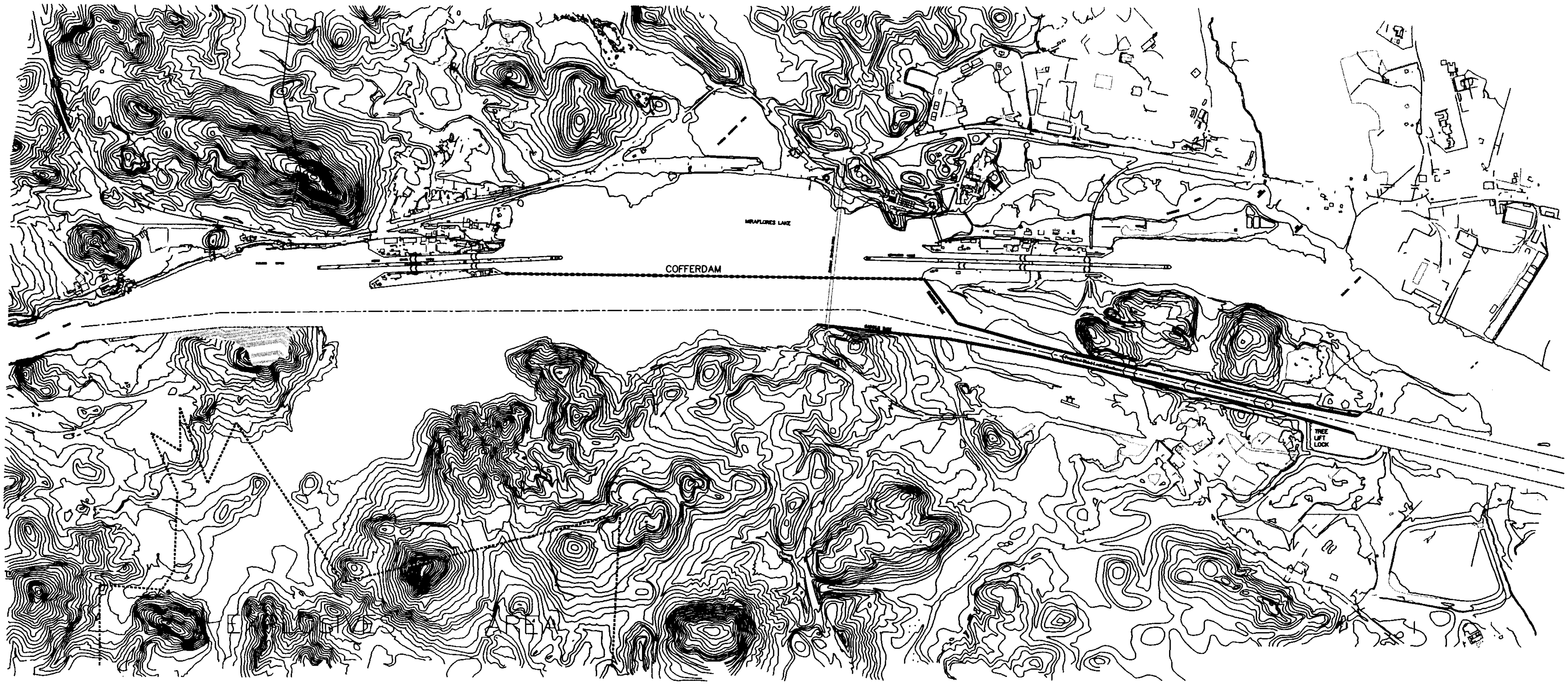


AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 11 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 11

USERNAME $USER
FILENAME $$$$$$$$$$$$$$$$$DGNSPEC$$$$$$$$$$$$$$$$$$
PENTABLE L:\pen\none.tbl
TIME PLOTTED $DATE$ $TIME$



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

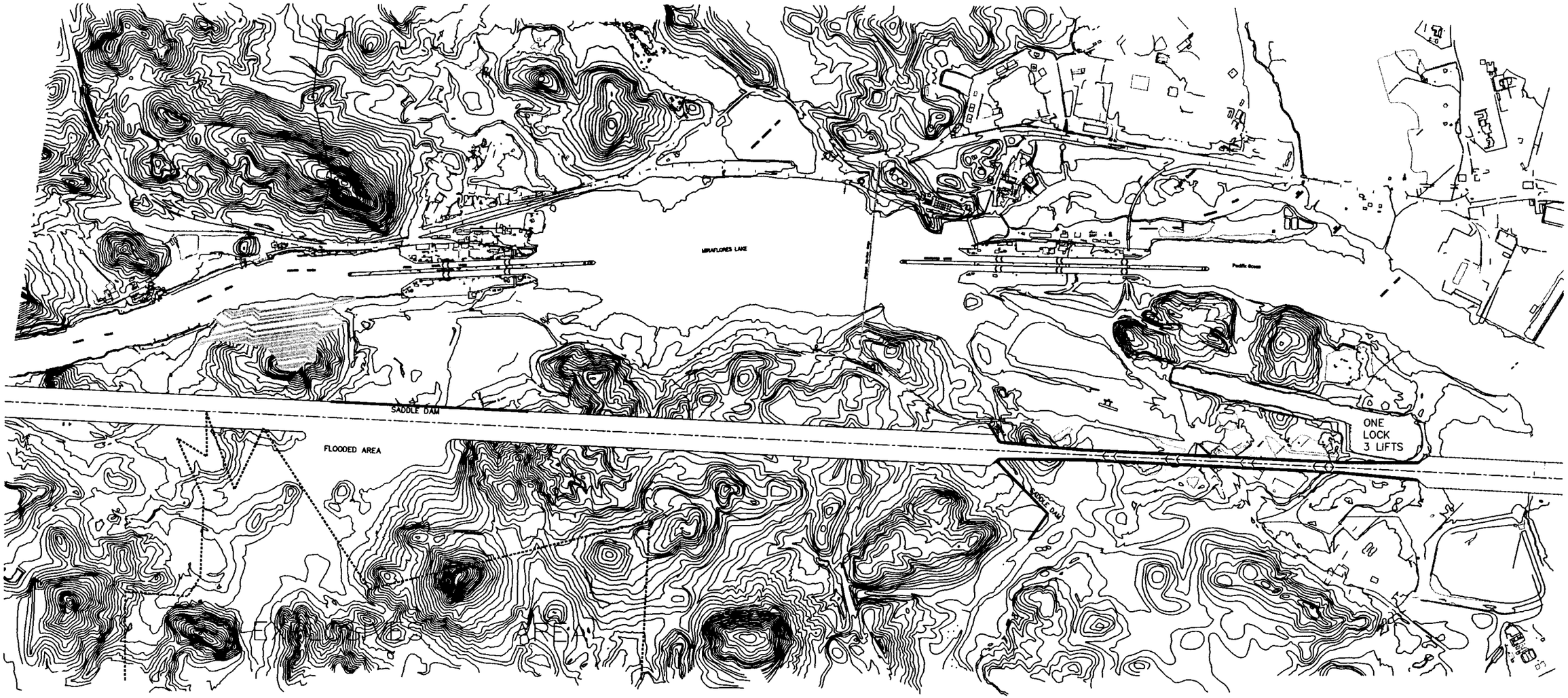
CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 12 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 12

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 13 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 13

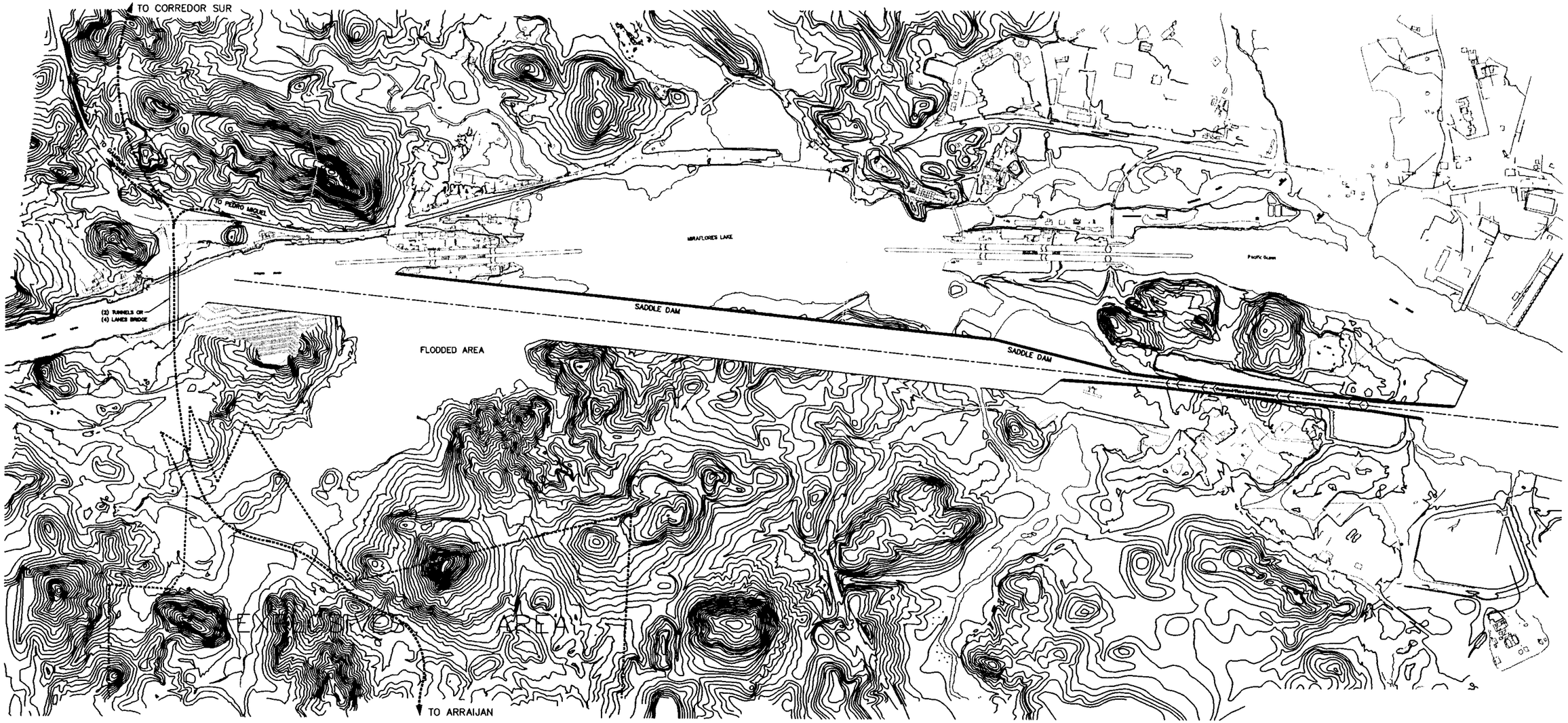


AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 14 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 14

USERNAME $USER$
FILENAME $FILE$
PLOTTER: LA_PRT\COPR:120 OFFICE:CHICAGO
TIME PLOTTED $DATE$ $TIME$

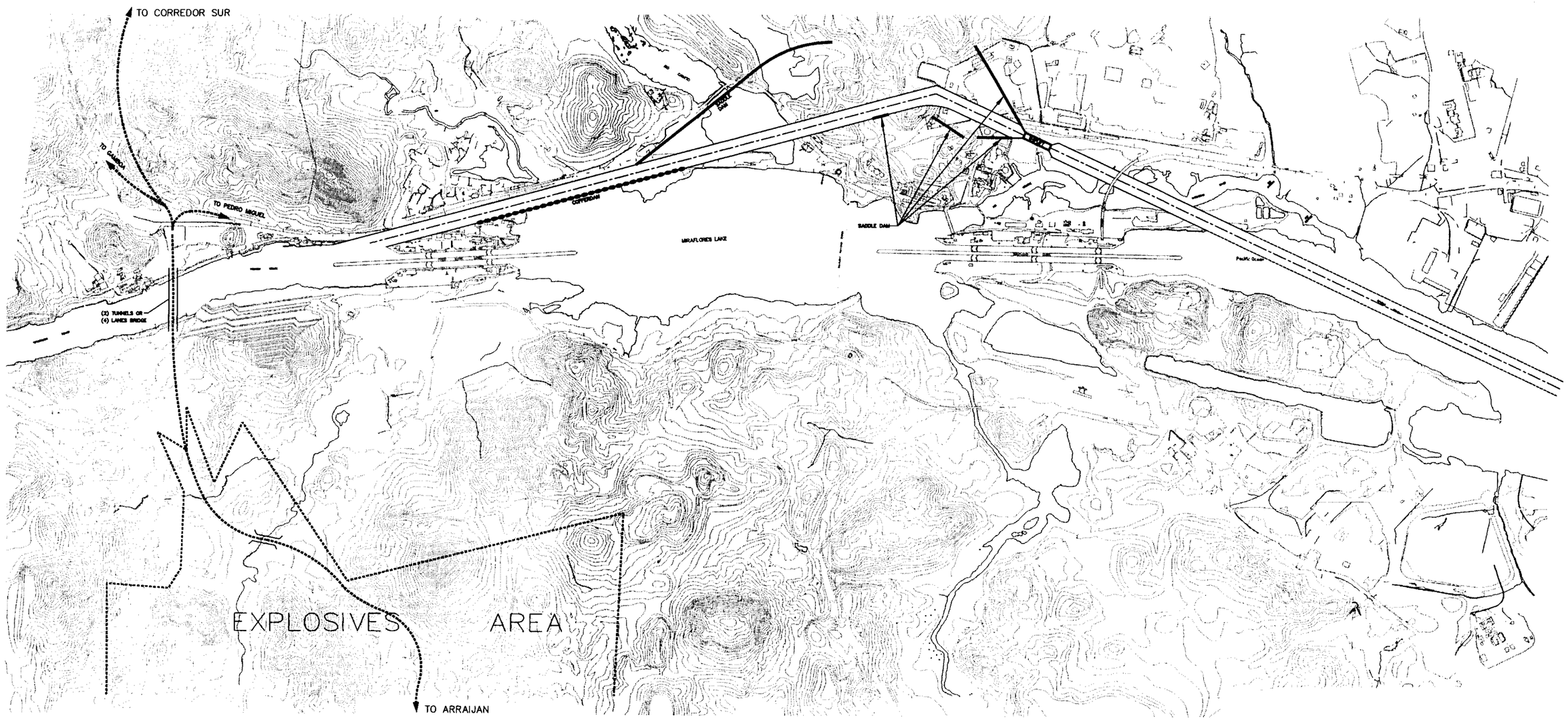


USERNAME $USER$
FILENAME $$$$$$$$$$$$$$$$$$$$DGNSPEC$$$$$$$$$$$$$$$$ OFFICE CHICOOO
PROJECT LIBRARY $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
TIME PLOTTED $DATE$ $TIME$

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 15 Pacific Entrance

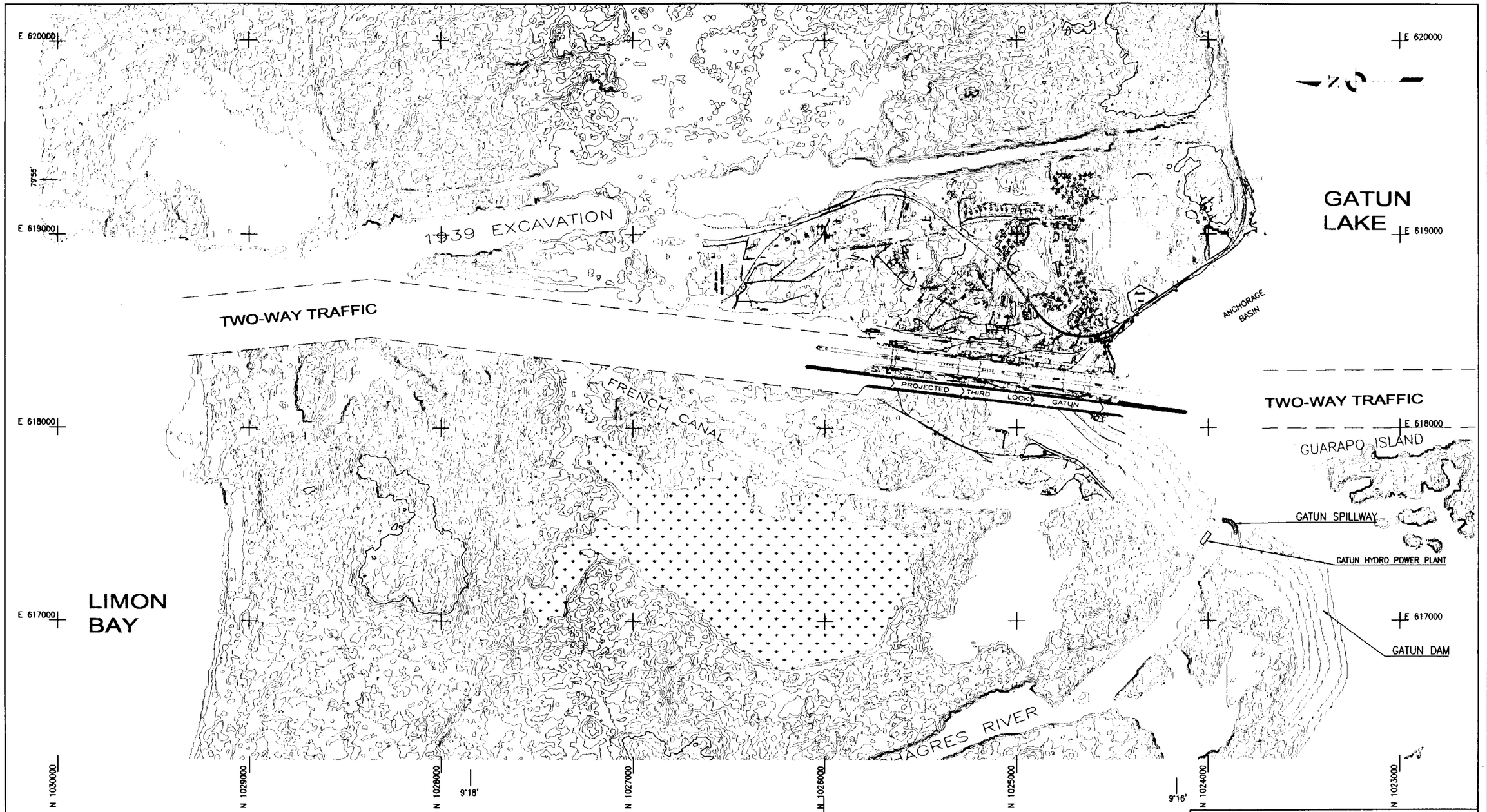
HARZA TAMS	August 2000	Exhibit 15



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 16 Pacific Entrance

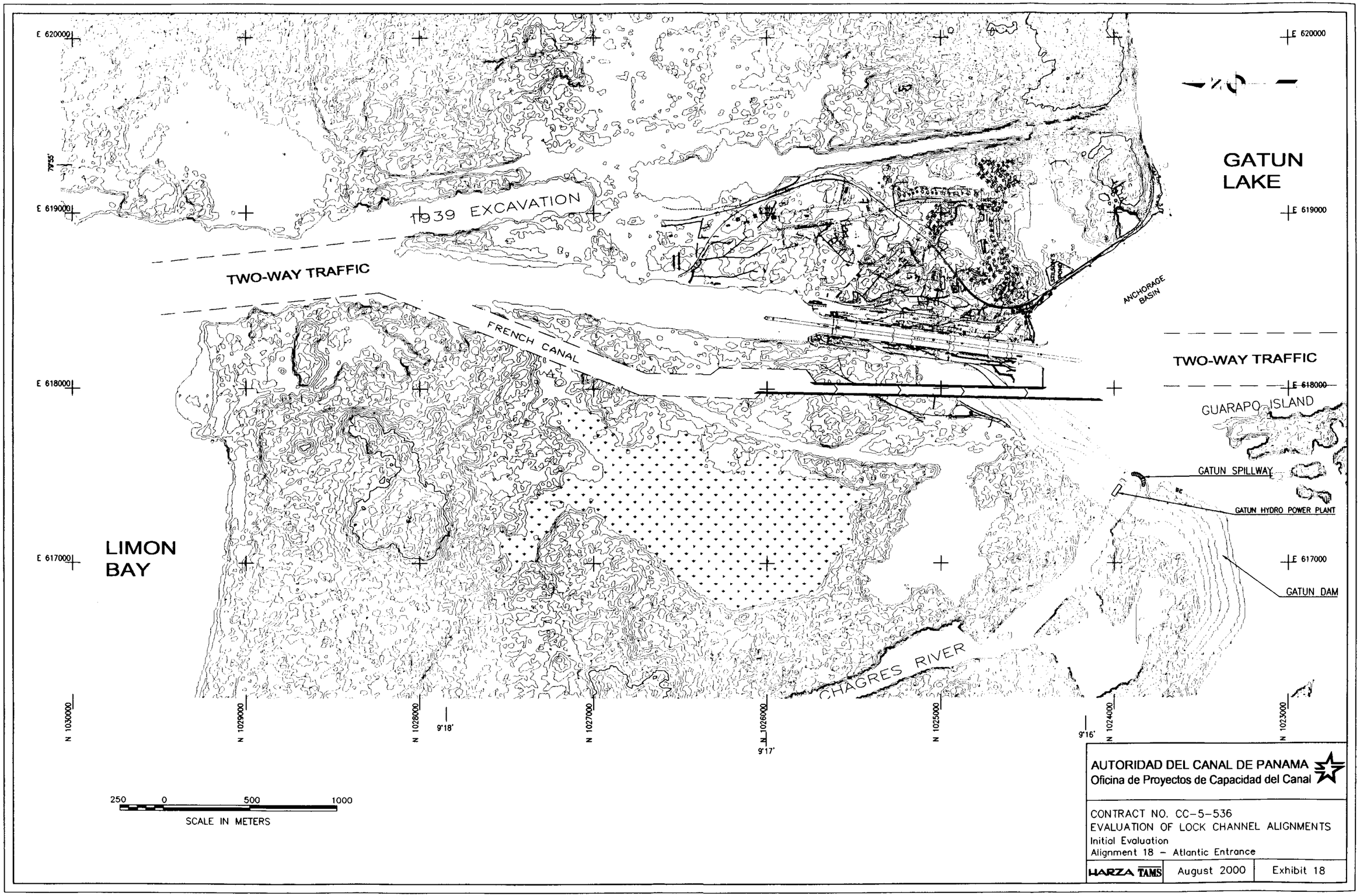
HARZA TAMS	August 2000	Exhibit 16



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 17 – Atlantic Entrance

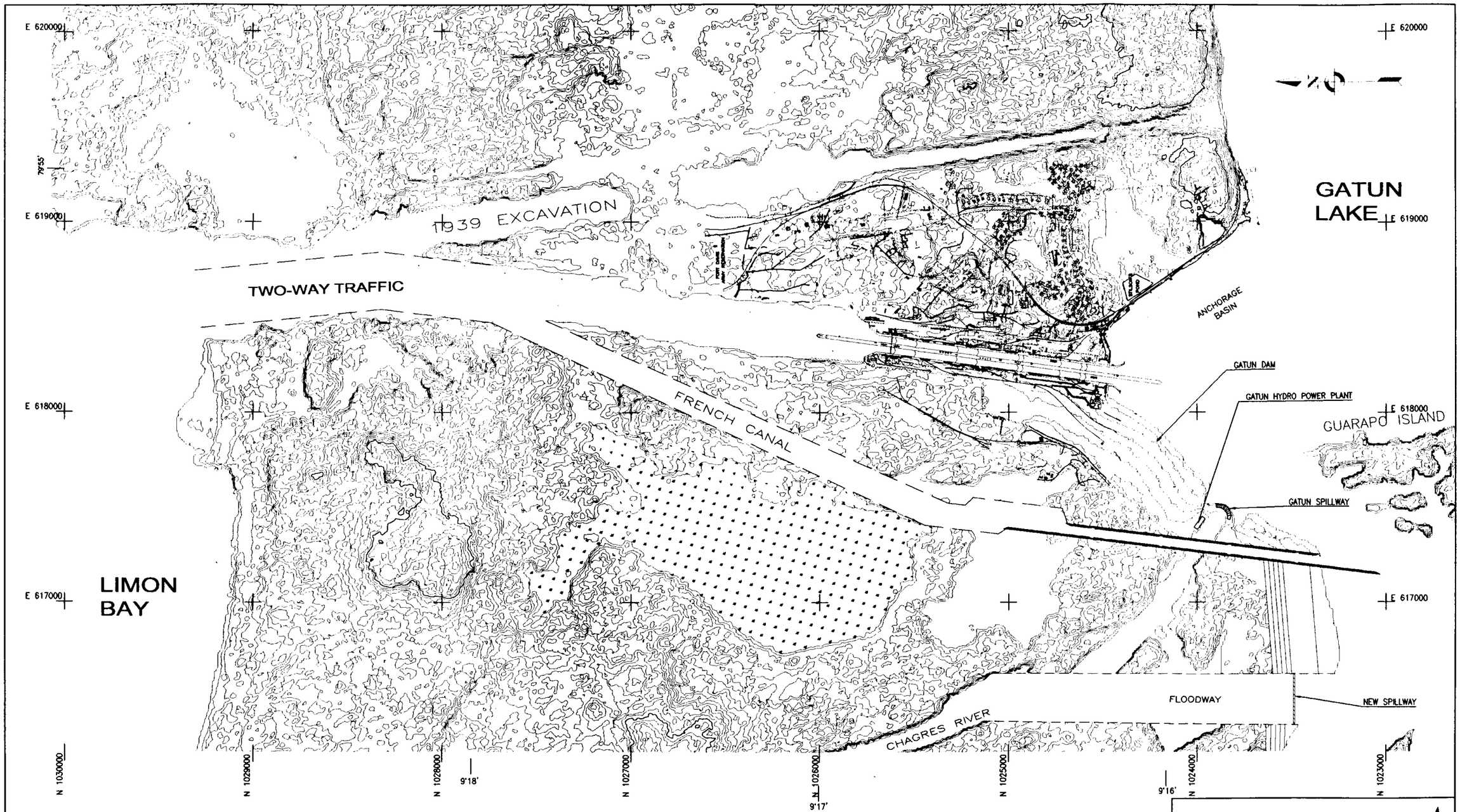
HARZA TAMS	August 2000	Exhibit 17



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 18 – Atlantic Entrance

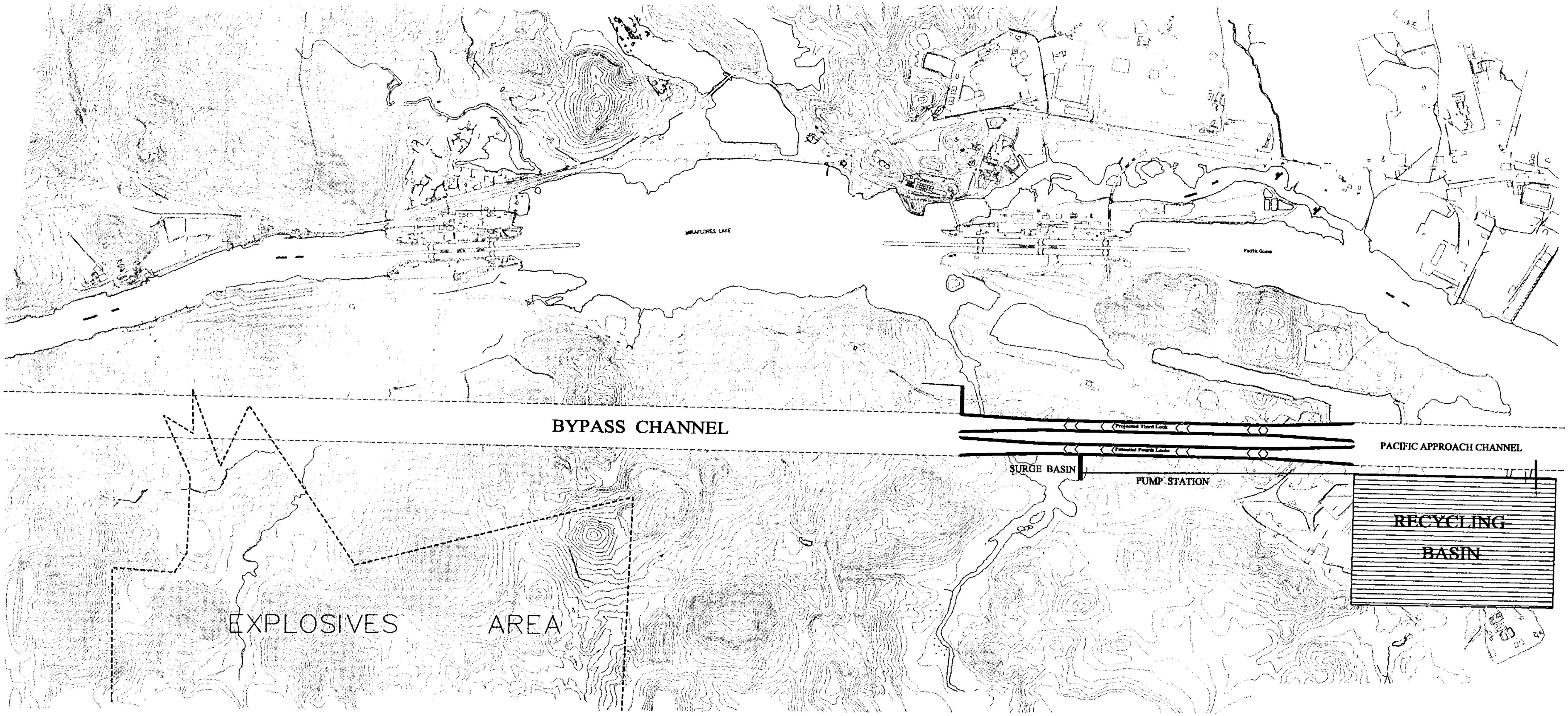
HARZA TAMS	August 2000	Exhibit 18



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 19 – Atlantic Entrance

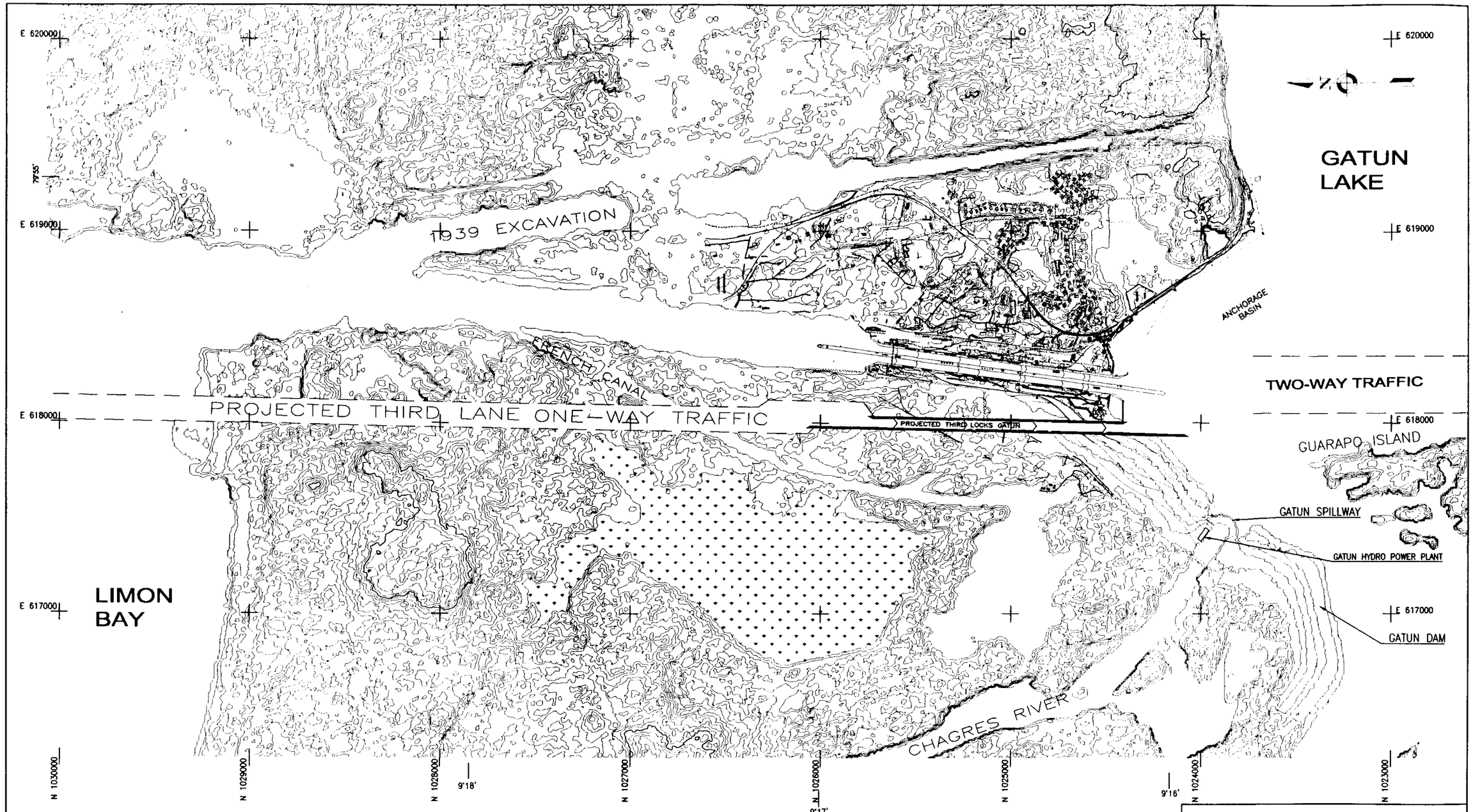
HARZA TAMS | August 2000 | Exhibit 19



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 20 Pacific Entrance

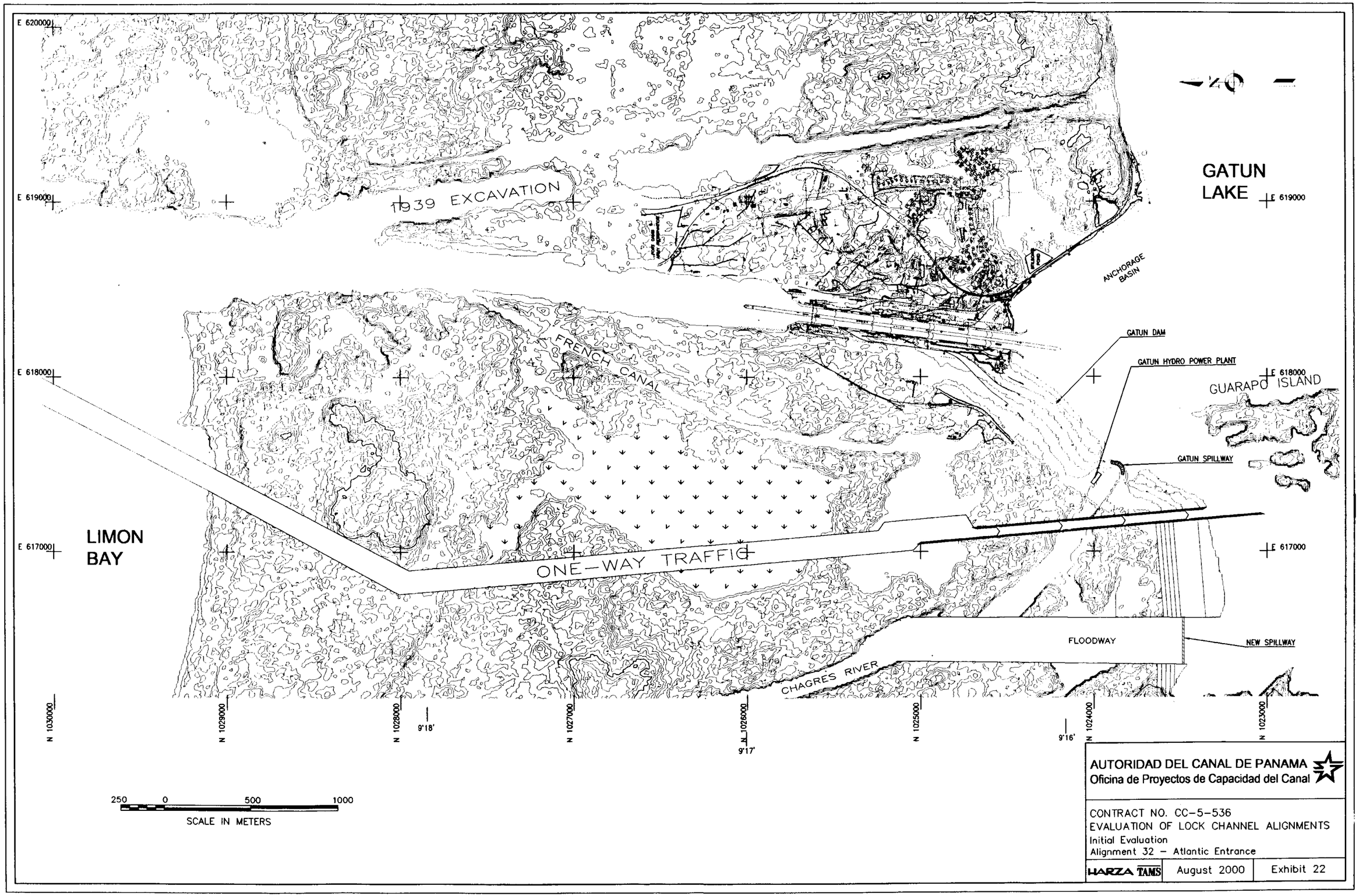
HARZA TAMS	August 2000	Exhibit 20

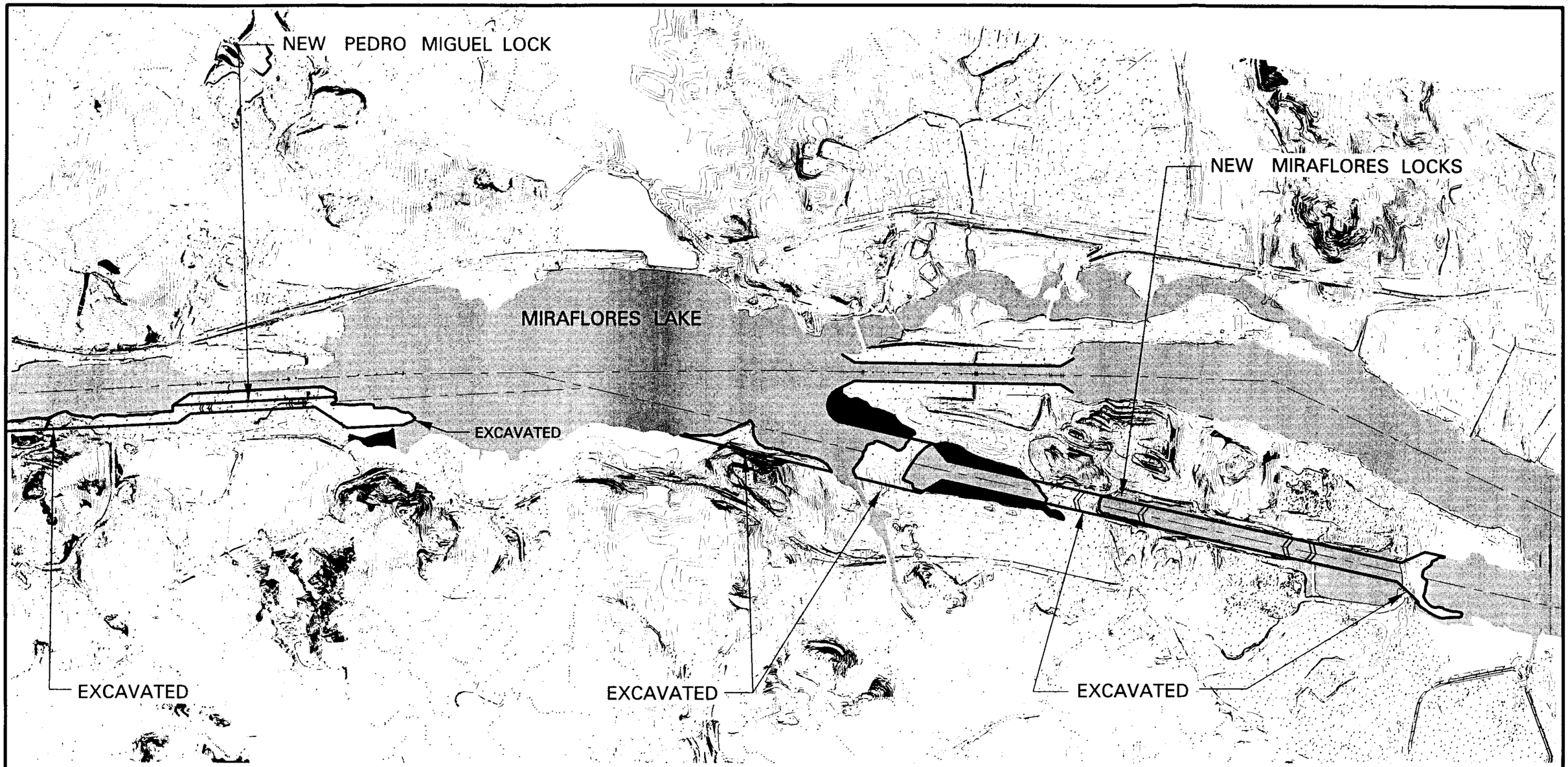


AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 31 – Atlantic Entrance

HARZA TAMS	August 2000	Exhibit 21


E 620000
E 619000
E 618000
E 617000
1939 EXCAVATION
GATUN LAKE
ANCHORAGE BASIN
GATUN DAM
GATUN HYDRO POWER PLANT
GUARAPO ISLAND
FRENCH CANAL
GATUN SPILLWAY
LIMON BAY
ONE-WAY TRAFFIC
FLOODWAY
NEW SPILLWAY
CHAGRES RIVER
N 1030000
N 1029000
N 1028000
9°18'
N 1027000
N 1026000
9°17'
N 1025000
9°16'
N 1024000
N 1023000
250 0 500 1000
SCALE IN METERS
AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal
CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 32 – Atlantic Entrance
HARZA TAMS
August 2000
Exhibit 22



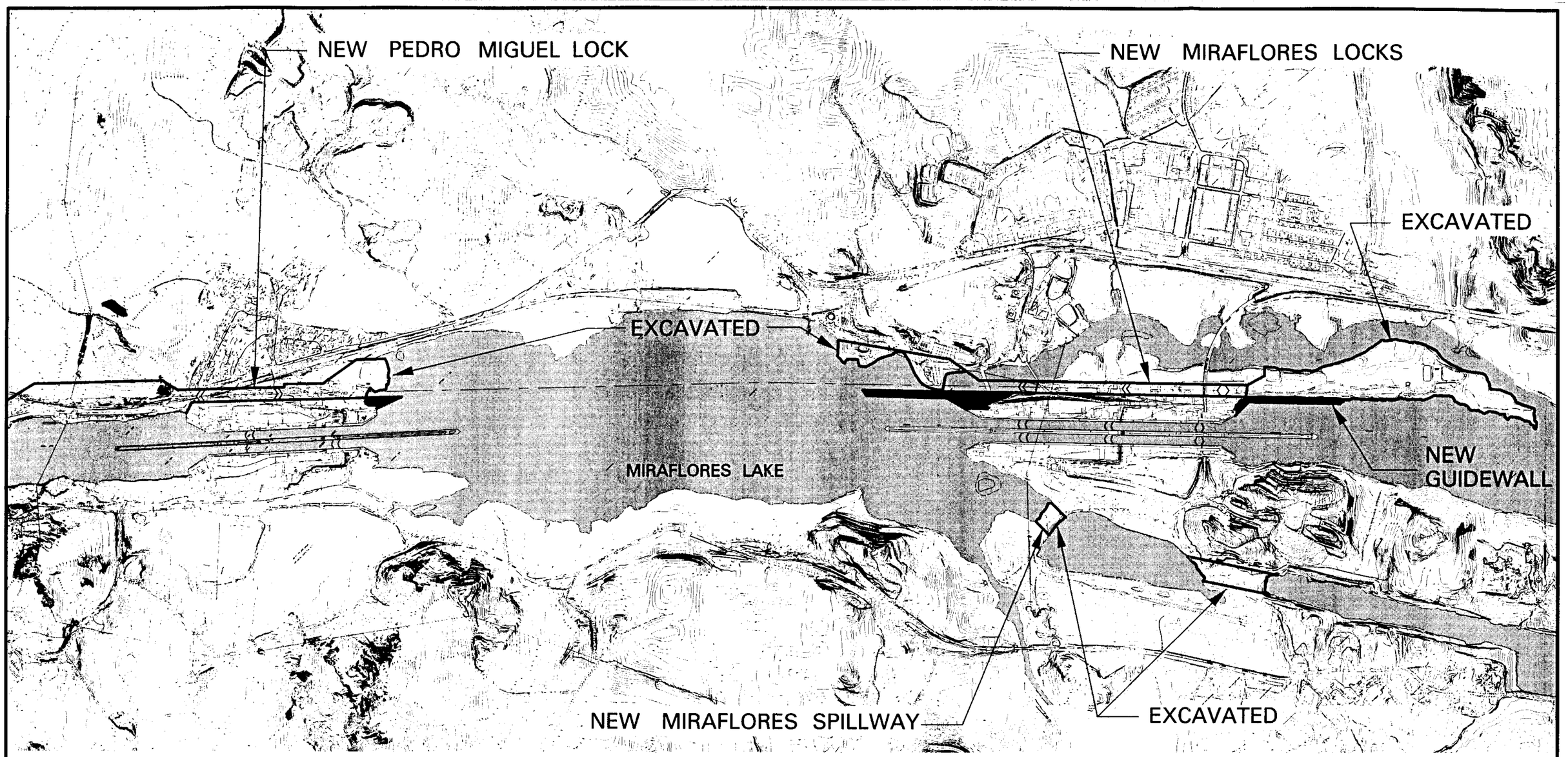
AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 41 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 23

CH0204
NS(83) volume2.exh-23-align_41.dgn Chicago
NONE TBL
AUG 2000 12:52:04

volume2\exh-23-align_41.dgn Aug 17 2000 12:52:02



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Alignment 42 Pacific Entrance

HARZA TAMS	August 2000	Exhibit 24

DN CH0204 Chicago
155623\volume2\exh-24-align_42.dgn
LOCK TEAM
AUG 2000 10:57:55

volume2\exh-24-align_42.dgn Aug 17, 2000 10:57:47

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX A

REVIEW OF EXISTING MATERIAL

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX A
REVIEW OF EXISTING MATERIAL

TABLE OF CONTENTS

CHAPTER		PAGE
1.0	Establish Data Transfer Procedures	1
2.0	Review of Geotechnical Information	1
3.0	Preparation of 3-D Digital Models	3
4.0	Review of Existing Site Conditions	3

ATTACHMENTS

Attachment	Title
A-1	File Transfer Protocol (FTP) Procedures
A-2	Inventory of ACP Supplied Data

This appendix documents the basic information used throughout the lock channel alignment study. It includes a review of the data received as well as outlining the procedure for file transfer between Harza and the Canal Capacity Projects Office of the Autoridad del Canal de Panama (ACP).

1.0 ESTABLISH DATA TRANSFER PROCEDURES

In order to verify that the systems and electronic file transfer protocols for information sharing between Harza and the ACP are compatible, Harza sent a preliminary summary memo (in Microsoft (MS) Word format) via e-mail. Harza attached several different file types to verify that the system could handle a variety of file types. Hard copies of these files were also included as an attachment. The ACP was able to open, manipulate and produce hard copies that matched provided hard copies for these files. Harza will continue to provide summary memos and other files by electronic means whenever possible. This will provide a rapid and efficient means of information transfer.

Harza created a directory on Harza's File Transfer Protocol (FTP) site for specific use on this project. Attachment A-1 contains information on the location of the FTP site and instructions for up/downloading information from the project directory. Both Harza and the ACP have successfully uploaded and downloaded files to and from the FTP site. "Zipping" files using WinZip software has been the most effective way of safeguarding files uploaded onto the site. Some large files have been corrupted during up/downloading. In general any files surpassing 1 Megabyte should be zipped before uploading to the FTP site.

2.0 REVIEW OF GEOTECHNICAL INFORMATION

During the initial site visit to the ACP offices, Harza met with staff from the Geology and Geotechnical Sections and received copies of several boring location maps. Harza also requested copies of the geotechnical summary sheets in electronic format and the Third Locks geological exploration drawings for Pedro Miguel and Gatun. Attachment A-2 lists information that has been requested and received. The geotechnical summary sheets

were provided partially in hard copy and partially in electronic format. Data on the predicted cut slopes was also provided by the ACP. Research was also done and geotechnical data was uncovered from the 1939 Third Locks Project.

2.1 Cut Slopes

The ACP directed Harza to use the five slope types provided in the 1993 Canal Alternatives Study (CAS). The CAS report presents slope criteria for five types of geological conditions that could be encountered along the proposed canal and lock routes. They are illustrated in Exhibit C-9. According to the CAS report, these were based on criteria provided by the Secretariat that are not available at present and therefore not possible to check. Nevertheless, it is assumed that, in general, these excavation criteria are suitable for planning purposes in the canal area provided that they are applied judiciously. It is also assumed that, during later phases of engineering activity, cut slope design for individual features and excavations would be adjusted on a case by case basis depending on actual conditions.

Of the five slope categories, Types 3, 4, and 5 have been identified for the Pacific Entrance layouts and Type 5 for the Atlantic Entrance layouts. They were used in screening studies and in the preparation of drawings and excavation quantity estimates. In principal, this approach is appropriate for this level and stage of study.

2.2 Boring Data

The ACP supplied a summary containing records from approximately 1000 borings completed as part of the 1939 Third Locks Project. The summary was available in hardcopy and also partially in electronic copy. The borings generally listed the elevation of top of sound rock, top of weathered rock and ground surface as well as a general description of the rock type. Many of the typed log entries were inconsistent with the electronic copies. In several cases, the top of rock was listed at an elevation above the ground surface. Where the top of rock was found above the existing ground, the top of rock elevation was changed to be the same as the existing ground.

Once the boring logs were entered in electronic format and corrected, geologic models of the boring areas were constructed in gINT for the Atlantic Entrance and GEMCOM for

the Pacific Entrance. For the Atlantic entrance, the boring data offered sufficient coverage to create a comprehensive model for the proposed alignment areas. For the Pacific entrance, the boring data was limited to the site of the proposed locks for the 1939 project. In particular, there were no borings east of the existing locks. It was not possible to construct a comprehensive GEMCOM model to cover the entire investigation area. See Part 3, Section 1.3 for a discussion of how quantities of sound rock, weathered rock and overburden were estimated for the Pacific entrance.

2.3 Other Information

Additional records were obtained from the 1939 Third Locks project. Among these were color maps showing the general distribution of rock type in the Pedro Miguel-Miraflores area. These maps were used to plot general foundation conditions for the proposed new locks and barrier dam as part of the Final Evaluation of Alignments (Part 3). Photographs of the 1939 excavation were also located and used to substantiate assumptions made about the use of the CAS slope types in the locks area.

3.0 PREPARATION OF 3-D DIGITAL MODELS

Electronic copies of the topographic and hydrographic survey ASCii data were obtained in order to create digital models and provide quantity takeoffs. Attachment A-2 lists the information requested and received. In the Final Evaluation IFSAR data from the 1993 USACE Mobile District survey was used to construct a DTM and perform quantity takeoffs. The models were limited by the accuracy of the IFSAR data and thus should not be construed as providing more than a basis of comparing the alignment alternatives.

4.0 REVIEW OF EXISTING SITE CONDITIONS

As part of this task, existing site conditions were reviewed to ascertain the likely impacts to the proposed channel alignments. Aerial photos, nautical charts, and maps were obtained and examined to identify potential construction or operational obstacles and to optimize layouts. This information was used throughout the evaluation.

FILE TRANSFER PROTOCOL (FTP) PROCEDURES

Downloading files from Harza's FTP Server

Files may be downloaded from the site using typical web browsers such as Netscape and Internet Explorer. A valid username and password is required. Upon selecting a directory from which to download, the user will be prompted for a username and password. For this project, the project directory is 15593TO1 with username and password of "panama" and "orchada1", respectively. The web browser will prompt the user to save the selected file(s) to the local machine.

Uploading files to Harza's FTP Server

There exist several methods for uploading files to the Harza FTP server. Harza uses PrimaSoft AutoFTP software, which is a freeware program that is available from the PrimaSoft website. However, the zip file that contains this program is available from the Harza FTP site for your use. The file is called "32paft.zip." This zip file contains the software for use with Windows 95/98 or NT. For other versions of this program, consult the PrimaSoft website as directed by the Harza ftp site.

Copy this file to your local hard drive in a temporary directory. Using another freeware program called "Winzip", unzip the file and save the zipped files in the same temporary directory. Double-click the "setup.exe" and a setup wizard will guide you through the PrimaSoft AutoFTP installation process.

Next, open the PrimaSoft program by either double-clicking the newly created icon or from the Start button if using Windows 95/98 or NT. For the first use, the user must configure the program. Initially, the program will prompt the user to specify the dial-up properties to use. (This will only occur for those that use a phone line to dial out locally from their machine as opposed to being tied into a network)

The next box (or the first box) the user encounters is the FTP Connection Information box. In this box, a new connection profile must be specified. Select New to setup a new profile. In the Name box, type in Harza. In the remote host box, type in ftp.harza.com. In the username box, type in panama. In the password box, type in orchada1. Select

Save at under the name of the profile to save this setup. Select the Connect box to connect to the site. For subsequent uses, just select the profile name from the list of profiles at the top of the FTP Connection Information box and hit Connect to connect to the Harza ftp site.

Once the user is connected, the PrimaSoft program appears as two split screens. The upper screen is the local computer drive and the lower screen is the Harza ftp site. By double clicking the Projects folder on the lower screen, various project numbers appear. Find 15593TO1 on the list and highlight it. A list of files currently on the site should appear. On the upper screen, highlight the file the user wishes to transfer to the Harza ftp site. Just below the upper screen, there is a series of icons. If the user places the mouse over the icons, the icon functions will appear. The icon with an arrow and the letter U is the upload icon. Select this icon and the Transfer Manager screen appears. By selecting the Start icon at the top left of the window, the file will be transferred to the ftp site. The words "Transfer Complete" will appear at the bottom of the window indicating that the file has been successfully transferred. Multiple files may be uploaded and transferred together by selecting the Start icon after all desired files have been placed into the Transfer Manager window. Click the OK icon to close the window.

LIST OF ACP SUPPLIED INFORMATION

No	Drawing or Report Title	Date	Drawing No. or Filename	Type*
1	Canal Area and Vicinity, Miraflores Locks	August 1999		HC
2	Underkeel Clearance and Over the Sill Clearance for 39.5 feet Draft Vessels	August 1999		HC
3	Special Hydrography, Balboa Reach, STA.2310+00 TO STA. 2343+00	July 1999	SK-H-60__	HC
4	Special Hydrography, Balboa Reach, STA.2343+00 TO STA. 2376+00	July 1999	SK-H-60__	HC
5	The Panama Canal, Isthmian Canal Studies, Location Map of Borings	December 1999	SK 2-1-19__ (Sheet 19)	HC
6	The Panama Canal, Isthmian Canal Studies, Location Map of Borings	December 1999	SK 2-1-19__ (Sheet 20)	HC
7	The Panama Canal, Isthmian Canal Studies, Location Map of Borings	December 1999	SK 2-1-19__ (Sheet 21)	HC
8	The Panama Canal, Isthmian Canal Studies, Location Map of Borings	December 1999	SK 2-1-19__ (Sheet 48)	HC
9	The Third Locks Project, New Miraflores Locks, Site Map, Original Topography (Feb. 1942)	December 1999	M 5651-113	HC
10	The Third Locks Project, New Miraflores Locks, Prior Excavation Completion Plan(Feb. 1942)	December 1999	M 5651-114	HC
11	The Third Locks Project, New Miraflores Locks, Geology Explorations Plan and Section, STA. 125+00 TO 150+00 (Feb. 1942)	December 1999	5505-M-143	HC
12	The Third Locks Project, New Miraflores Locks, Geology Explorations Plan and Section, STA. 125+00 TO 150+00 (Feb. 1942)	December 1999	5505-M-144	HC
13	The Third Locks Project, New Miraflores Locks, Geology Explorations Plan and Section, STA. 100+00 TO 125+00 (Feb. 1942)	December 1999	5505-M-145	HC
14	The Third Locks Project, New Miraflores Locks, Geology Explorations Plan and Section, STA. 100+00 TO 125+00 (Feb. 1942)	December 1999	5505-M-146	HC
15	The Third Locks Project, New Miraflores Locks, Geology Explorations Plan and Section, STA. 80+00 TO 100+00 (Feb. 1942)	December 1999	5505-M-147	HC
16	The Third Locks Project, New Miraflores Locks, Geology Explorations Locks Area (Feb. 1942)	December 1999	5505-M-148	HC

No	Drawing or Report Title	Date	Drawing No. or Filename	Type*
17	The Panama Canal, The Third Locks Project, New Miraflores Locks (Feb. 1942)	December 1999	(Cover Page)	HC
18	The Panama Canal, The Third Locks Project, New Miraflores Locks, New Pedro Miguel Lock, Index of drawings (Feb. 1942)	December 1999	MP 5651-102	HC
19	The Panama Canal, The Third Locks Project, New Miraflores Locks, New Pedro Miguel Lock, Index of drawings (Feb. 1942)	December 1999	MP 5651-103	HC
20	The Panama Canal, The Third Locks Project, New Miraflores Locks, New Pedro Miguel Lock, Project Location (Feb. 1942)	December 1999	MP 5651-109	HC
21	The Third Locks Project, Alternative No. 0	October 1999	Modle-Seccion.dgn	E
22	The Third Locks Project, Alternative No. 1	October 1999	ALT-1.dgn	E
23	The Third Locks Project, Alternative No. 2	October 1999	ALT-2.dgn	E
24	The Third Locks Project, Alternative No. 3	October 1999	ALT-3.dgn	E
25	The Third Locks Project, Alternative No. 4	October 1999	ALT-4.dgn	E
26	The Third Locks Project, Alternative No. 5	October 1999	ALT-5.dgn	E
27	The Third Locks Project, Alternative No. 6	October 1999	ALT-6.dgn	E
28	The Third Locks Project, Alternative No. 7	October 1999	ALT-7.dgn	E
29	The Third Locks Project, Alternative No. 8	October 1999	ALT-8.dgn	E
30	The Third Locks Project, Alternative No. 8A	October 1999	ALT-8A.dgn	E
31	The Third Locks Project, Alternative No. 8B	October 1999	ALT-8B.dgn	E
32	The Third Locks Project, Alternative No. 9	October 1999	ALT-9.dgn	E
33	The Third Locks Project, Alternative No. 10	October 1999	ALT-10.dgn	E
34	The Third Locks Project, Alternative No. 10B	October 1999	ALT-10B.dgn	E
35	The Third Locks Project, Alternative No. 11	October 1999	ALT-11.dgn	E
36	The Third Locks Project, Alternative No. 12	October 1999	ALT-12.dgn	E
37	The Third Locks Project, Alternative No. 12B	October 1999	ALT-12B.dgn	E
38	The Third Locks Project, Alternative No. 13	October 1999	ALT-13.dgn	E
39	The Third Locks Project, Alternative No. 14	October 1999	ALT-14.dgn	E
40	The Third Locks Project, Alternative No. 15	October 1999	ALT-15.dgn	E
41	The Third Locks Project, Alternative No. 16	October 1999	ALT-16.dgn	E
42	The Third Locks Project, Alternative No. 17	October 1999	ALT-17.dgn	E
43	The Third Locks Project, Alternative No. 18	October 1999	ALT-18.dgn	E
44	The Third Locks Project, Alternative No. 19	October 1999	ALT-19.dgn	E
45	The Third Locks Project, Alternative No. 20	October 1999	ALT-20.dgn	E
46	The Third Locks Project, Alternative No. 21	October 1999	ALT-21.dgn	E

No	Drawing or Report Title	Date	Drawing No. or Filename	Type*
47	Miraflores Lock Salinity Survey	October 1999	Gatlock.dgn	E
48	Pacific Entrance Topography	October 1999	_pacific.dgn	E
49	Atlantic Entrance Topography	October 1999	_atlantic.dgn	E
50	Panama 1:50,000, Colon, Edition 3-IGNTG DMA, Series E762, by the Instituto Geografico Nacional "Tommy Guardia"	October 1999	Sheet 4244 III	Topo
51	Panama 1:50,000, Gatun, Edition 2-IGNTG DMATC, Series E762, by the Instituto Geografico Nacional "Tommy Guardia"	October 1999	Sheet 4243 IV	Topo
52	Panama 1:50,000, Alcalde Diaz, Edition 3-IGNTG, Series E762, by the Instituto Geografico Nacional "Tommy Guardia"	October 1999	Sheet 4243 II	Topo
53	Panama 1:50,000, Panama, Edition 3-IGNTG, Series E762, by the Instituto Geografico Nacional "Tommy Guardia"	October 1999	Sheet 4242 I	Topo
54	Panama 1:50,000, Escobal, Edition 2-DMA, Series E762, by the Instituto Geografico Nacional "Tommy Guardia"	October 1999	Sheet 4243 III	Topo
55	Final Report of the Commission for the Study of Alternatives to the Panama Canal, Volume I	October 1999	N/A	Rpt.
56	Final Report of the Commission for the Study of Alternatives to the Panama Canal, Volume IV, Engineering and Cost Estimates, Phase I	October 1999	N/A	Rpt.
57	Final Report of the Commission for the Study of Alternatives to the Panama Canal, Volume VII, Engineering and Cost Estimates, Phase II (I)	October 1999	N/A	Rpt.
58	Concepts Study for Canal Alternatives	October 1999	N/A	Rpt.
59	Structural Geologic Map – Gatun Dam and Vicinity, Scale 1:10,000 by the Isthmian Canal Commission	October 1999	N/A	HC
60	Location of Borings in the Vicinity of Gatun Dam, Scale 1:5,000 by the Isthmian Canal Commission	October 1999	N/A	HC
61	Topography and Borings Location Map – West and East Gatun Dam, Scale 1:2,000 by the Panama Canal Commission	October 1999	N/A	HC
62	The Panama Canal, Isthmian Canal Studies, Location of Core Borings, Scale 1:3,000	October 1999	SK 2-1-2 (Sheet 2)	HC
63	The Panama Canal, Isthmian Canal Studies, Location of Core Borings, Scale 1:3,000	October 1999	SK 2-1-2 (Sheet 3)	HC

No	Drawing or Report Title	Date	Drawing No. or Filename	Type*
64	Special Hydrographic Survey – Atlantic Entrance, Scale 1:1,000 (July 1999)	December 1999	SK-H-607 (Sheet 6 of 8)	HC
65	Special Hydrographic Survey – Gatun Approach, Scale 1:1,000 (July 1999)	December 1999	SK-H-607 (Sheet 7 of 8)	HC
66	Lake Miraflores Hydro Data	December 1999	Miraflo	E
67	Hydrographic survey ASCii data for Pacific Entrance through Miraflores locks	December 1999	5684 ... 6884	E
68	ASCii Topographic data for Pacific end	December 1999	5292 - All sections	E
69	ASCii Topographic data for Pacific end	December 1999	5296 - 1, 2, 6, 7, 11, 12, 16	E
70	ASCii Topographic data for Pacific end	December 1999	4896 - 16, 17, 18, 21, 22, 23	E
71	1:5000 Map index of entire canal	December 1999	Mbindex	E
72	1:1000 Map index of entire canal	December 1999	Pcanal	E
73	ASCii Hydrosurvey data for Gaillard Cut	December 1999	g_cutm	E
74	Pacific boring location map	December 1999	TLHOLES	E
75	Pacific boring location map	December 1999	pm-mi	E
76	Pacific boring location map	December 1999	pm-mi2	E
77	Scanned images of 1939 boring location maps	December 1999	Final1 - final 4	E
78	Atlantic side ASCii data	December 1999	Wes_anc	E
79	Atlantic side ASCii data	December 1999	East_anc	E
80	Atlantic side ASCii data	December 1999	Cristoba	E
81	Atlantic side ASCii data	December 1999	alta4	E
82	Atlantic side ASCii data	December 1999	3rdlock	E
83	ASCii data for Atlantic side	December 1999	1616 ... 4008	E
84	Atlantic General overview map with boring locations	December 1999	Colonwithholes	E
85	Atlantic General overview map	December 1999	Colon	E
86	Atlantic boring location map	December 1999	Gatunthirdlocksfixed	E
87	Atlantic boring location map	December 1999	Gatunthirdlock	E
88	Gatun 1 m contour map	December 1999	sk-348	E
89	Index of entire channel	December 1999	Pindex	E
90	Canal ASCii data	December 1999	Dirinfo	E
91	Folder containing 1:5000 GIS mapping (5 m contour)	December 1999	5000 (folder)	E
92	Folder containing 1:1000 GIS mapping (5 m contour)	December 1999	1000 (folder)	E
93	GIS Grid DEM with 10 m plan resolution	December 1999	Dem0	E
94	GIS Grid DEM with 10 m plan resolution	December 1999	Dem1	E

No	Drawing or Report Title	Date	Drawing No. or Filename	Type*
95	GIS Grid DEM with 10 m plan resolution	December 1999	Dem2	E
96	GIS Grid DEM with 10 m plan resolution	December 1999	Dem3	E
97	GIS Grid DEM with 10 m plan resolution	December 1999	Dem4	E
98	GIS Grid DEM with 10 m plan resolution	December 1999	Dem5	E
99	GIS Grid DEM with 10 m plan resolution	December 1999	Info	E
100	GIS Grid DEM with 10 m plan resolution	December 1999	pcc_dem30	E
101	Contour Maps	December 1999	_atlantic	E
102	Contour Maps	December 1999	_pacific	E
103	Contour Maps	December 1999	4242_11a	E
104	1939 Third Locks Project Drawings New Miraflores / Pedro Miguel Locks	December 1999	N/A	HC
105	Table of Contents	December 1999	N/A	HC
106	Reconnaisance Study by USACE	December 1999	N/A	HC
107	1999 PCC Memo: Adv./Disadv. of Alts.	December 1999	Alignments	E
108	Geotech. Data Summary Sheets (Miraflor., PM & Gatun)	December 1999	N/A	HC
109	Gatun Dam/Spillway - Plan & Sections	December 1999	N/A	HC
110	Aerial Photos - Atlantic & Pacific	December 1999	N/A	E
111	USACE Canal O&M Study, June 1996	December 1999	N/A	HC
112	Cut Widening Program Summary	December 1999	Cut-Widening Program-Summary	E
113	Calcs. to deepen Gatun Lake	December 1999	N/A	HC
114	Miraflores Locks (long sheet)	January 2000	# 6126	HC
115	Mitering Lock Gates (all locks)	January 2000	# 5150	HC
116	Miraflores Locks - General Plan + Sections of Lower Locks	January 2000	# 7089	HC
117	Miraflores Locks - Plan of Upper Approach	January 2000	# 7088	HC
118	Pedro Miguel Locks - Plan of Upper Approach	January 2000	# 7087	HC
119	Miraflores Locks - Plan of Lower End of Upper apr. Upper End of Lower Locks	January 2000	# 7067	HC
120	Miraflores Locks - Plan of Middle Portion of Upper Locks	January 2000	# 7066	HC
121	Miraflores Locks - Plan of Forebay and Upper Portion of Upper Lock	January 2000	# 7065	HC
122	Miraflores Locks - General Plan + Sections of Upper Locks	January 2000	# 7064	HC
123	Pedro Miguel Locks - Plan of Lower Portion of Lock	January 2000	# 7046	HC

No	Drawing or Report Title	Date	Drawing No. or Filename	Type*
124	Pedro Miguel Lock - Plan of Middle Portion of Lock	January 2000	# 7045	HC
125	Pedro Miguel Lock - Plan of Forebay and Upper Portion of Lock	January 2000	# 7044	HC
126	Stoney Gate Valves - For all Locks (Perspective View)	January 2000	# 7200	HC
127	Miraflores Locks - Plan of Lower Portion of Lower Locks	January 2000	# 7130	HC
128	Miraflores Locks - Lower Approach + Wing Walls	January 2000	# 7131	HC
129	Victoria Disposal Area Map	January 2000	# 6122-56	HC
130	Victoria & Velasquez Spoil Dumps	January 2000	# 6122-23 (No. 2)	HC
131	Velasquez Spoil Dump (Balboa Reach)	January 2000	# 6122-23 (No. 4)	HC
132	Bas Obispo Spoil Dump (Feb. 1991)	January 2000	N/A	HC
133	West Pedro Miguel Spoil Dump (Aug. 1982) - Sheet 1 of 2	January 2000	N/A	HC
134	West Pedro Miguel Spoil Dump (Aug. 1982) - Sheet 2 of 2	January 2000	N/A	HC
135	Atlantic Entrance Disposal Sites (June 1998)	January 2000	SK-343	HC
136	Farfan Dredge Material Disposal Site (April 1997)	January 2000	SK-295B	HC
137	Pacific Entrance New Anchorages and Spoil Dump Areas (May 1981)	January 2000	SK-H-590	HC
138	Panama Pacific Coast, Bahia de Panama - Approaches to Balboa (1994)	January 2000	21603	HC
139	Panama Canal Soundings from Gatun to Gamboa (from US Navy and PCC surveys to 1994)	January 2000	21604	HC

* HC = Hard Copy, E = Electronic File, Topo = Topographic Map, Rpt = Report

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX B

DEVELOPMENT OF EVALUATION CRITERIA

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX B
DEVELOPMENT OF EVALUATION CRITERIA

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B-2	Alignment Evaluation Criteria Description
B-3	Alignment Evaluation Importance Coefficients
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B-5	Raw Scores for Three Alignments
B-6	Weighted Scores – Ranking Approach 1
B-7	Weighted Scores – Ranking Approach 2

The purpose of this task is to establish and document the methodology that will be used to evaluate the various lock channel alignments. Harza adopted the evaluation procedure of Kepner and Tregoe (1981) to perform the alignment evaluations. The three basic steps of the Kepner and Tregoe approach are:

1. Identification of relevant evaluation criteria (or attributes) and an assessment of the relative importance of each attribute (importance coefficient).
2. Determination of appropriate quantitative measures for each of the evaluation criteria.
3. Measurement or assessment of quantities or qualities of each alternative with respect to each evaluation attribute, and the assignment of a "score". Weighted scores are then derived from the product of the score and importance coefficient. The sums of the weighted scores for each alternative serve as a guide to identify the most favorable alternative(s).

1.0 EVALUATION CRITERIA

Harza and ACP team members worked closely to develop appropriate evaluation criteria during a meeting in Panama on October 22, 1999. Each of the sixteen evaluation criteria has been assigned to one of the following five evaluation categories: Technical, Operational, Constructibility, Economic and Other Impacts.

Exhibits B-1 and B-2 describe how the scores will be awarded to each alignment for each evaluation criterion. Harza made scoring as objective as possible by using quantifiable criteria.

2.0 IMPORTANCE COEFFICIENTS

Team members assigned importance coefficients to each of the criteria in the range 10 (most important) to 1 (least important). Composite importance coefficients are developed based on the average of each individual assessment. Exhibit B-3 shows the importance coefficients from five representatives of Harza and TAMS and six representatives of the

ACP, which are combined to develop a composite importance coefficient. The composite importance coefficients are then normalized to employ the full range of possible scores from 1 to 10. The highest average importance coefficient has a normalized score of 10.0. The lowest average importance coefficient is normalized to 1.0. To illustrate,

Impacts on Existing Operations	avg. IC= 9.2;	normalized IC = 10.0 (Highest)
Stability of Bank Slope	avg. IC= 4.7;	normalized IC = 1.0 (Lowest)

The column titled "Normalized ICs" illustrates the distribution of all other importance coefficients between 1 and 10. Normalization respects the ranking of the coefficients while providing a numerical means of differentiating among alignments.

3.0 EVALUATION PROCEDURE

The scoring procedure involves the assignment of a numerical value to each alignment for each criterion. The assigned value are in the range 5 (most favorable) to 1 (least favorable). The accompanying spreadsheet includes a reference sheet that shows the method of scoring for each of the criteria. Weighted scores, which are the product of the raw score and the importance coefficient are then determined. For the purposes of illustration three alignments (Nos. 4 and 17 on the Atlantic side and No. 1 on the Pacific Side) are evaluated and raw scores entered into the spreadsheet. Exhibit B-4 is a worksheet developed to record the evaluations and the rationale behind each of the assigned scores for each of the alignments.

4.0 RANKING

The alignments are ranked based on the sum of the weighted scores. Initially two ranking systems are proposed. Exhibit B-5 shows the raw scores, and Exhibits B-6 and B-7 illustrate both approaches for the three alignments for which preliminary evaluations were performed.

The simplest approach is to sum all of the weighted scores and rank the alignments on the basis of the gross score. In this approach the relative number of criteria within a given

category can impact the overall ranking. For example, the Other Impacts category contains three criteria, Environmental, Socio-Economic, and Relocation. If these criteria were to be combined into a single criterion, Other Impacts, then in the final analysis, alignments that scored relatively highly on each of the three criteria, but relatively poorly in other categories would receive a lower overall ranking.

A second approach is to combine the weighted scores from each evaluation category into a single value, and then to assign a weighting factor to each of the categories. Each evaluation category has been evenly weighted at this stage. Use of this approach introduces an additional degree of freedom into the analysis that can be exercised if certain categories of criteria are deemed to be more significant than others. A benefit of this approach is that the relative number of criteria in each category does not impact the final ranking. For example, the Other Impacts category contains three criteria, Environmental, Socio-Economic, and Relocation. If these criteria were to be combined into a single criterion, Other Impacts, then in the final analysis, alignments that scored relatively highly on each of the three criteria, but relatively poorly in other categories would receive the same final ranking as if there had been three individual criteria. Adjusting the weighting factor assigned to Other Impacts may alter the final ranking.

Harza will evaluate alignment rankings using both approaches. Then, Harza will determine which methodology provides the best results and will apply that approach to ranking the top four alignments for each entrance. The top eight (three at the Atlantic entrance, five at the Pacific entrance) will be carried forward for further analysis in the Final Evaluation of Lock Channel Alignments.

Evaluation of Lock Channel Alignments

Criteria Values

Evaluation Category	Evaluation Criteria	Criteria Values 1	2	3	4	5
Technical	Maintain Stability of Bank Slopes	difficult	poor	moderate	good	excellent
	Potential for Future Expansion	difficult	poor	moderate	good	excellent
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	major	significant	moderate	minor	none
Operational	Maximize Navigational Safety and Ship Maneuverability	difficult	poor	reasonable	good	excellent
	Maximize Integration with Existing Operations	difficult	poor	reasonable	good	excellent
	Accessibility of Equipment, Materials and Personnel for Operations	difficult	poor	moderate	good	excellent
	Minimize Maintenance Dredging	major	significant	moderate	minor	none
Constructibility	Impacts on Existing Canal Operations During Construction	major	significant	moderate	minor	none
	Accessibility of Construction Equipment, Materials and Personnel	difficult	poor	moderate	good	excellent
	Ease of Construction	difficult	poor	moderate	good	excellent
Economic	Relative Cost of Locks and Special Features	expensive	high	average	low	cheap
	Excavation Cost (incl. Temporary Works)	2 std dev above	1 std dev above	average	1 std dev below	2 std dev below
	Minimize Construction Time	2 std dev above	1 std dev above	average	1 std dev below	2 std dev below
Other Impacts	Environmental	major	significant	moderate	minor	none
	Socio-Economic	major	significant	moderate	minor	none
	Relocations (e.g. Utilities, Infrastructure)	major	significant	moderate	minor	none

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Development of Evaluation Criteria
Alignment Evaluation Criteria Values

HARZA TAMS | August 2000 | Exhibit B-1

Evaluation of Lock Channel Alignments
Alignment Evaluation Criteria

Criteria	Description
Maintain Stability of Bank Slopes	The alignment is rated based on whether or not there is a significant amount of Cucaracha formation or Pacific or Atlantic muck in it. Excavations in these material types are subject to unstable slopes and frequent slides. Alignments containing Cucaracha formation or Atlantic or Pacific muck are assigned a score of one or two. Those that have little or no Cucaracha or Atlantic or Pacific muck receive a four or five.
Potential for Future Expansion	The rating is based on whether a fourth lane could be later added to the proposed third lane. Alignments that allow easier future expansion receive higher scores. Scores of four or five are awarded to alignments that allow another lock to be added without major new excavation, such as a new entrance channel. Alignments that would require additional massive excavation or relocations in order to add a fourth lock receive scores of one or two.
Special Site Considerations e.g. Susceptibility to Catastrophic Events	Scoring assesses whether the alignment contains special features which either enhance or detract from its overall attractiveness. Emergency dams which would protect from flooding and the loss of Lake Gatun in the event of a cofferdam failure raise an alignment's score. Alignments on the Atlantic side which pass through the Gatun Dam and could be undermined by liquifaction or an earthquake receive a below average score.
Maximize Navigational Safety and Ship Maneuverability	This category rates an alignment on maritime safety considerations. This includes whether or not congestion will occur and whether ships must maneuver excessively to enter or exit locks. An alignment that uses only one azimuth and avoids congestion receives a score of five. Alignments with one or two new azimuths and contain minimal congested areas receive a four. Those that contain two azimuths and create some congestion receive a three. Those that utilize three or more new azimuths and/or create moderate to severe congestion receive a one or two. One point is added to alignments which allow for new safe berthing areas for ships awaiting lockage or transit.
Maximize Integration with Existing Operations	Alignments that allow use of existing control systems and sharing of tugs rate higher in the integration category than those that do not. If a proposed alignment places the locks close enough to the existing locks that they may be controlled from a joint control center then the alignment receives a score of four or five. If integration of some control features (such as the occasional sharing of tugs) will be possible then the alignment receives a three. If joint control is difficult or impossible then the alignment receives a two or one.

Evaluation of Lock Channel Alignments
Alignment Evaluation Criteria

Criteria	Description
Accessibility of Equipment, Materials and Personnel for Operations	If existing infrastructure allows ready access to an alignment's structures, the alignment receives a higher mark. A good rating is also possible if necessary infrastructure is easily constructed. Scores of four or five are assigned to alignments that interface with major roads and are readily accessed from existing canal operations areas. Alignments which have moderately good road and maritime access and some access to existing operations receive a three. Alignments inaccessible by existing infrastructure and separated from existing operations equipment are assigned scores of one or two according to the severity of the condition.
Minimize Maintenance Dredging	Higher rates are given to alignments that minimize additional maintenance dredging. In general this means that if an alignment involves construction of large sections of new channels, it will receive a lower score. Alignments which add less than two km of new channel receive a five. Alignments adding two to four km receive a four. Alignments adding four to six km receive a three. Six to eight km receives a two and over eight km receives a one.
Impacts on Existing Canal Operations During Construction	A maximum score is awarded to alignments that will have no impact on existing operations during construction. Alignments that will require dump barges to pass through channel traffic or will require some use of lock operations' areas for staging will receive a two. Alignments that require dump barges to pass through existing locks or require extensive use of lock operations' staging areas receive a one. Alignments that completely avoid existing operations receive a five. Those that interfere minimally such as an occasional barge passing through an existing approach channel or create some additional traffic on access roads to operations areas receive a four.
Accessibility of Construction Equipment, Materials and Personnel	This category rates the relative ease with which construction equipment, materials and personnel will be able to access the work site. Scores of four and five are awarded to alignments whose construction takes place in open areas with access by existing infrastructure. A score of one or two is awarded to alignments that have constrained staging and construction zones due to existing infrastructure.

Evaluation of Lock Channel Alignments
Alignment Evaluation Criteria

Criteria	Description
Ease of Construction (e.g. Proximity to UXO (Pacific side only) or HTRW or interference with spillway outlet (Gatun only))	Alignment scores are assigned according to whether an alignment passes through a UXO or HTRW area or causes interference with the Gatun spillway outlet. An alignment which completely avoids these areas receives a five. Alignments which avoid these areas but may involve future expansion in the areas receive a four. Those which do not pass through the areas but may involve some operations close receive a three. Alignments that pass through a small part of the areas receive a two. Alignments passing through a large portion of the areas receive a one.
Relative Cost of Locks and Special Features	This category rates the cost of structures such as locks, cofferdams, saddle dams and guide walls relative to the average of the cost of structures for all of the alignments. Alignments that require many costly auxiliary structures receive a one or two. Those with an average cost receive a three while alignments with minimal auxiliary structures and lower than average lock costs receive a score of four or five.
Excavation Cost (incl. Temporary Works)	Alignments with lower excavation costs receive higher scores. This is determined by measuring the volume to be excavated as well as the type of material and excavation method. In general, excavation in dry conditions is less costly then dredging. Further, soft materials are more cheaply excavated than competent rock. A score of four or five is awarded to a project with a minimum of excavation and favorable excavation conditions (i.e. much excavation can be accomplished in the dry). Score of one or two go to alignments requiring large amounts of excavation and disposal and/or difficult excavation or disposal conditions which would lead to elevated unit cost.
Minimize Construction Time	The alignments that have the shortest construction period receive the best scores. The construction time is determined by estimating the amount of time required for excavation (which is a function of the excavation volume and the type of material to be excavated) and construction of locks and special features. A score of three is assigned to alignments within one standard deviation of the overall construction time. Scores of two and one are awarded to alignments that require greater than one or two standard deviations more time than the average, respectively. Similarly, scores of four and five are awarded to alignments that require greater than one or two standard deviations less time than the average.

Evaluation of Lock Channel Alignments
Alignment Evaluation Criteria

Criteria	Description
Environmental	A low score is attributed to alignments that require new flooding of large areas or pass through environmentally sensitive areas. If very minor or no new flooding is required and little undeveloped area is required for an alignment, it receives a four or five. Scores of one or two are awarded to alignments requiring massive new flooding or excavation in virgin or ecologically sensitive zones.
Socio-Economic (e. g. Relocations of homes or businesses)	A low score is awarded to an alignment if its construction requires displacement of homes or businesses or if construction will cause excessive noise, dust or other nuisances in residential or commercial zones. Alignments which require minimal relocation and nuisance receive a four or five. Those with major relocation and/or nuisances are awarded a one or two according to degree.
Relocations (e.g. Utilities, Infrastructure)	The highest ratings are awarded to alignments that do not require major relocation of existing infrastructure such as roads, railroads or electrical lines. Alignments which require many costly relocations (such as railroads, bridges or multilane highways receive a one or two. Those with minimal required relocations receive a four or five.

Evaluation of Lock Channel Alignments

Importance Coefficients

Evaluation Category	Evaluation Criteria	Importance Coefficients (IC)											Statistics					
	Team Member	JFB	MRW	JPM	JMH	NP	1	2	3	4	5	6						
	Organization	Harza	Harza	TAMS	Harza	Harza	PCC	PCC	PCC	PCC	PCC	PCC	Average	High	Low	Standard Deviation	Normalized ICs	Rank
Technical	Maintain Stability of Bank Slopes	2	6	1	2	2	3	7	9	9	7	4	4.7	9.0	1.0	3.0	**1.0**	16
	Potential for Future Expansion	6	8	9	8	6	8	10	9	9	9	7	8.1	10.0	6.0	1.3	**7.8**	4
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	6	7	5	5	4	5	8	7	5	6	5	5.7	8.0	4.0	1.2	**3.0**	10
Operational	Operational Efficiency	9	9	9	8	8	4	10	9	10	10	10	8.7	10.0	4.0	1.7	**9.1**	2
	Maximize Integration with Existing Operations	7	5	7	3	4	6	9	10	5	8	3	6.1	10.0	3.0	2.3	**3.8**	8
	Accessibility of Equipment, Materials and Personnel for Operations	7	5	4	3	6	3	9	8	8	6	5	5.8	9.0	3.0	2.0	**3.2**	9
	Minimize Maintenance Dredging	7	6	3	3	7	7	7	7	4	7	2	5.5	7.0	2.0	2.0	**2.5**	13
Constructibility	Impacts on Existing Canal Operations During Construction	10	10	10	10	10	9	10	9	10	8	5	9.2	10.0	5.0	1.5	**10.0**	1
	Accessibility of Construction Equipment, Materials and Personnel	7	5	4	6	4	4	6	6	8	6	5	5.5	8.0	4.0	1.3	**2.7**	12
	Ease of Construction (e.g. Proximity to unexploded ordinance)	3	5	2	5	4	6	8	4	8	7	5	5.2	8.0	2.0	1.9	**1.9**	15
Economic	Relative Cost of Locks and Special Features	9	9	9	8	8	7	1	7	5	8	7	7.1	9.0	1.0	2.3	**5.8**	6
	Excavation Cost (incl. Temporary Works)	7	7	7	8	8	10	10	7	9	7	10	8.2	10.0	7.0	1.3	**8.0**	3
	Minimize Construction Time	7	8	6	5	4	7	8	5	9	6	7	6.5	9.0	4.0	1.5	**4.7**	7
Other Impacts	Environmental	7	8	5	5	8	6	10	8	7	8	7	7.2	10.0	5.0	1.5	**6.0**	5
	Socio-Economic	6	8	3	2	6	6	8	8	3	5	7	5.6	8.0	2.0	2.2	**2.8**	11
	Relocations (e.g. Utilities, Infrastructure)	4	8	7	4	4	2	8	6	6	6	5	5.5	8.0	2.0	1.9	**2.5**	13

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Development of Evaluation Criteria
Alignment Evaluation Importance Coefficients

HARZA TAMS | August 2000 | Exhibit B-3

Evaluation of Lock Channel Alignments

Alignment Evaluation Worksheet

ALTERNATIVE:-		**Alt. No. 0 – Third Locks Projects (Pacific)** This alternative shows a third lane alignment, with two lifts in sequence, from tidewater to Lake Gatun level, bypassing Lake Miraflores. The alignment is west of the existing canal.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes		
	Potential for Future Expansion		
	Special Site Considerations e.g. Susceptibility to Catastrophic Events		
Operational	Maximize Navigational Safety and Ship Maneuverability		
	Maximize Integration with Existing Operations		
	Accessibility of Equipment, Materials and Personnel for Operations		
	Minimize Maintenance Dredging		
Constructibility	Impacts on Existing Canal Operations During Construction		
	Accessibility of Construction Equipment, Materials and Personnel		
	Ease of Construction (e.g. Proximity of unexploded ordnance)		
Economic	Relative Cost of Locks and Special Features		
	Excavation Cost (incl. Temporary Works)		
	Minimize Construction Time		
Other Impacts	Environmental		
	Socio-Economic		
	Relocations (e.g. Utilities, Infrastructure)		

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Development of Evaluation Criteria
Alignment Evaluation Worksheet

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Evaluation of Lock Channel Alignments

Evaluation Category	Evaluation Criteria	Importance Coefficient	Raw Scores for each Alignment Alternative																									
			Atlantic (Gatun) Side							Pacific (Panama City) Side																		
			4	5	6	17	18	19	21	0	1	2	3	7	8	9	10	11	12	13	14	15	16	20	H1	H2	H3
Technical	Maintain Stability of Bank Slopes	1.0	3			3					2																
	Potential for Future Expansion	7.8	2			5					4																
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	3.0	4			1					3																
Operational	Maximize Navigational Safety and Ship Maneuverability	9.1	3			1					4																
	Maximize Integration with Existing Operations	3.8	5			3					2																
	Accessibility of Equipment, Materials and Personnel for Operations	3.2	5			1					2																
	Minimize Maintenance Dredging	2.5	3			3					3																
Constructibility	Impacts on Existing Canal Operations During Construction	10.0	1			4					3																
	Accessibility of Construction Equipment, Materials and Personnel	2.7	5			1					3																
	Ease of Construction (e.g. Proximity to unexploded ordinance)	1.9	5			5					2																
Economic	Relative Cost of Locks and Special Features	5.8	5			4					3																
	Excavation Cost (incl. Temporary Works)	8.0	4			2					2																
	Minimize Construction Time	4.7	3			3					3																
Other Impacts	Environmental	6.0	5			3					3																
	Socio-Economic	2.8	4			5					3																
	Relocations (e.g. Utilities, Infrastructure)	2.5	2			5					3																

SAMPLE

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Development of Evaluation Criteria
Raw Scores for Three Alignments

HARZA TAMS | August 2000 | Exhibit B-5

Evaluation of Lock Channel Alignments

Ranking Approach #1

Evaluation Category	Evaluation Criteria	Importance Coefficient	Weighted Scores for each Alignment Alternative																									
			Atlantic (Gatun) Side							Pacific (Panama City) Side																		
			4	5	6	17	18	19	21	0	1	2	3	7	8	9	10	11	12	13	14	15	16	20	H1	H2	H3
Technical	Maintain Stability of Bank Slopes	1.0	3	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Potential for Future Expansion	7.8	16	0	0	39	0	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	3.0	12	0	0	3	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operational	Maximize Navigational Safety and Ship Maneuverability	9.1	27	0	0	9	0	0	0	0	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Maximize Integration with Existing Operations	3.8	19	0	0	11	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Accessibility of Equipment, Materials and Personnel for Operations	3.2	16	0	0	3	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Minimize Maintenance Dredging	2.5	7	0	0	7	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Constructibility	Impacts on Existing Canal Operations During Construction	10.0	10	0	0	40	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Accessibility of Construction Equipment, Materials and Personnel	2.7	13	0	0	3	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ease of Construction (e.g. Proximity to unexploded ordinance)	1.9	10	0	0	10	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Economic	Relative Cost of Locks and Special Features	5.8	29	0	0	23	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Excavation Cost (incl. Temporary Works)	8.0	32	0	0	16	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Minimize Construction Time	4.7	14	0	0	14	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Impacts	Environmental	6.0	30	0	0	18	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Socio-Economic	2.8	11	0	0	14	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Relocations (e.g. Utilities, Infrastructure)	2.5	5	0	0	12	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total Weighted Score		254	0	0	226	0	0	0	0	223	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rank		1	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SAMPLE

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Development of Evaluation Criteria
Weighted Scores - Ranking Approach 1

HARZA TAMS | August 2000 | Exhibit B-6

Evaluation of Lock Channel Alignments

Ranking Approach #2

CATEGORY WEIGHTED RANKING			Ranking for each Alignment Alternative																										
			Atlantic (Gatun) Side							Pacific (Panama City) Side																			
Evaluation Category	Category Weight (%)		4	5	6	17	18	19	21	0	1	2	3	7	8	9	10	11	12	13	14	15	16	20	H1	H2	H3
Technical	20	TOTAL	31	0	0	45	0	0	0	0	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NORMALIZED	14	0	0	20	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operational	20	TOTAL	69	0	0	31	0	0	0	0	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NORMALIZED	20	0	0	9	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Constructibility	20	TOTAL	33	0	0	52	0	0	0	0	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NORMALIZED	13	0	0	20	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Economic	20	TOTAL	75	0	0	53	0	0	0	0	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NORMALIZED	20	0	0	14	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Impacts	20	TOTAL	46	0	0	44	0	0	0	0	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		NORMALIZED	20	0	0	19	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	100	Score	86	0	0	82	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Rank	1	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Development of Evaluation Criteria
Weighted Scores - Ranking Approach 2

HARZA TAMS | August 2000 | Exhibit B-7

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THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX C

DESIGN CRITERIA

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX C
DESIGN CRITERIA

TABLE OF CONTENTS

EXHIBITS

Exhibit	Title
C-1	Summary of Initial Design Parameters
C-2	Proposed Gatun Locks Profile
C-3	Proposed Gatun Locks Cross Sections
C-4	Proposed Separate Pacific Locks Profile
C-5	Proposed Separate Pacific Locks Cross Sections
C-6	Proposed Combined Pacific Locks Profile
C-7	Proposed Combined Pacific Locks Cross Sections
C-8	Typical Canal Sections
C-9	Excavation Slope Criteria
C-10	Layout Showing Application of CAS Slope Types

Summary of Initial Design Parameters

	Parameter	Dimension	Comments/ Source
VESSEL	Vessel Dimensions Small Panamax Post-Panamax	Length x Draft x Beam 183 m x 8.7 m x 24.0 m 294 m x 12.0 m x 32.3 m 350 m x 14.0 m x 46 m	Concepts Study for Canal Alternatives (1997) pp. ii-iii.
	Design Vessel	350 m x 14.0 m x 46 m	Post-Panamax

CHANNEL	Channel Bottom Width	276 Meters	October 22, 1999 Meeting Between PCC and Harza; Six X design ship beam
	Channel Depth*	16.76 Meters (55 feet)	Concepts Study for Canal Alternatives (1997), p. ii.
	Side Slopes Type 1 Unaltered Volcanic Rock Type 2 Intact Sedimentary Rock Type 3 Soft Volcanic Rock Type 4 Highly Weathered Rock Type 5 Unconsolidated Deposits	Underwater Above Water 2H:3V 2H:3V 1H:1V 1H:1V 1H:2V 1H:1V 1H:2V 2H:1V 2.5H:1V 10H:1V	Canal Alternatives Study Volume IV (1993) pp. I.3-26 - I.3-28

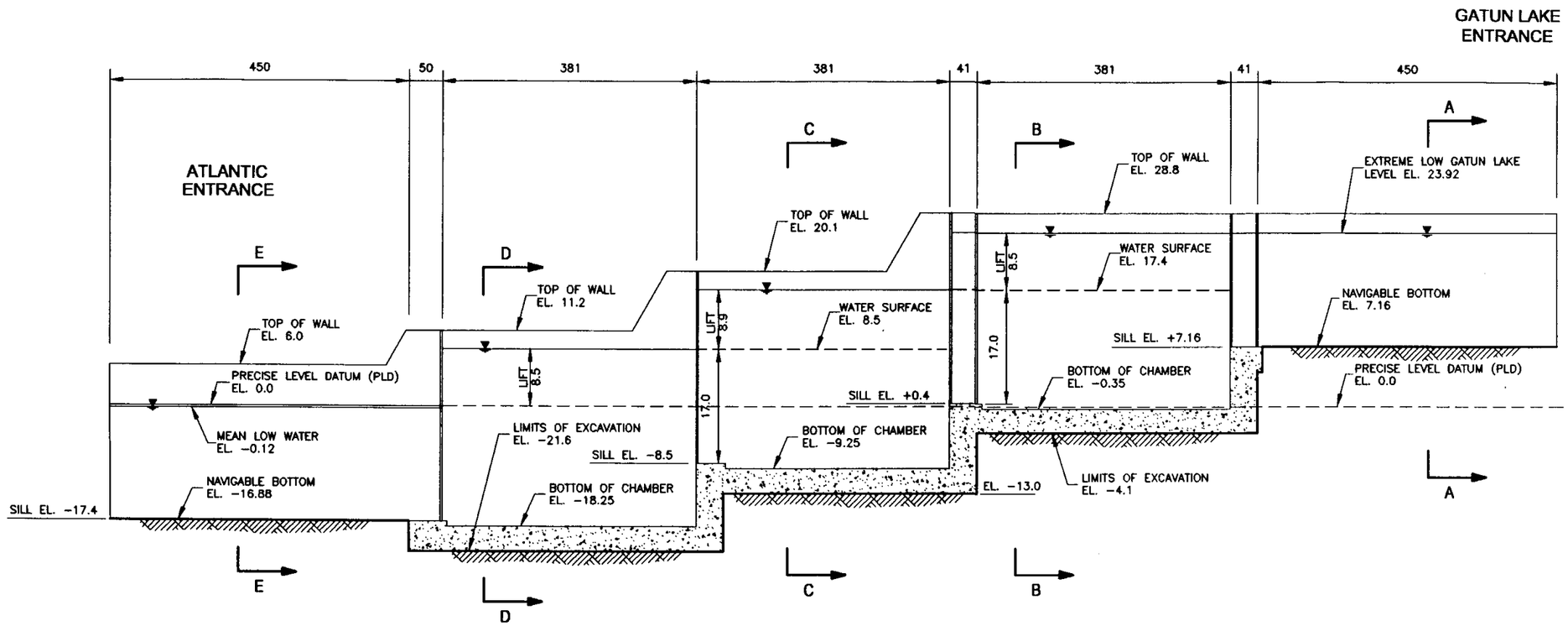
LOCK	Lock Dimensions Small Panamax Post-Panamax	Length x Depth x Width 198 m x 10.1 m x 26.5 m 325 m x 13 m x 33 m 381 m x 16 m x 49 m	Scope of Work; p. 5. Design Beam = 24.0 m Design Beam = 32.3 m Design Beam = 46.0 m
	Design Lock	381 m x 17 m x 49 m	Concepts Study for Canal Alternatives, p. iii. Depth over sills

*Comparative Volume Calculations for the Pacific entrance alignments assumed a channel depth of 15.2 m

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

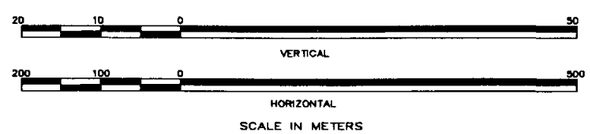
CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Summary of Initial Design Parameters

HARZA TAMS	August 2000	Exhibit C-1



NOTES

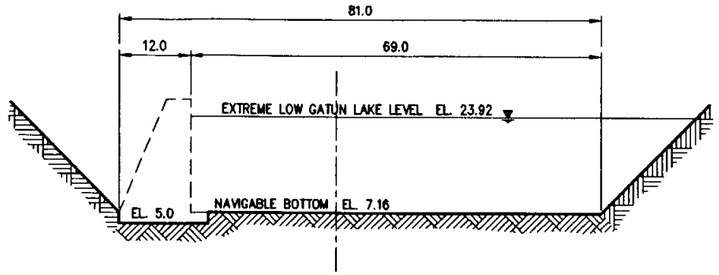
1. LOCK DIMENSIONS
   LENGTH: 381m
   WIDTH: 49m
   DEPTH: 17m
2. SEE EXHIBIT C3 FOR SECTIONS



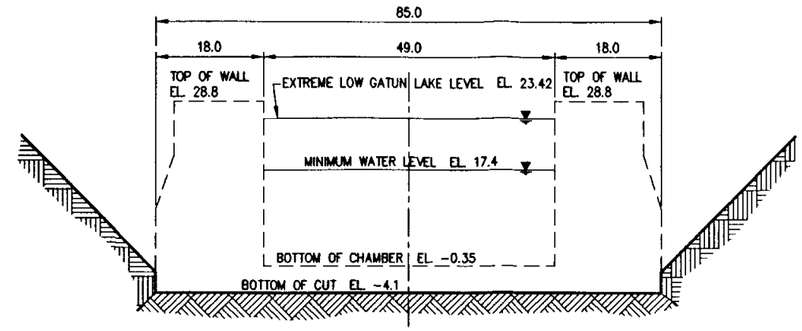
AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Proposed Gatun Locks Profile

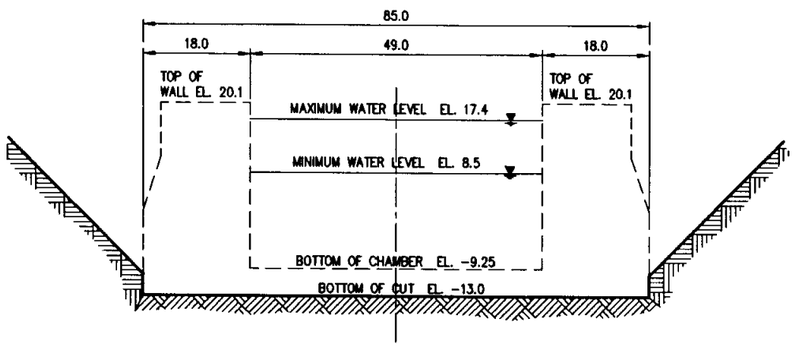
HARZA TAMS	August 2000	Exhibit C-2



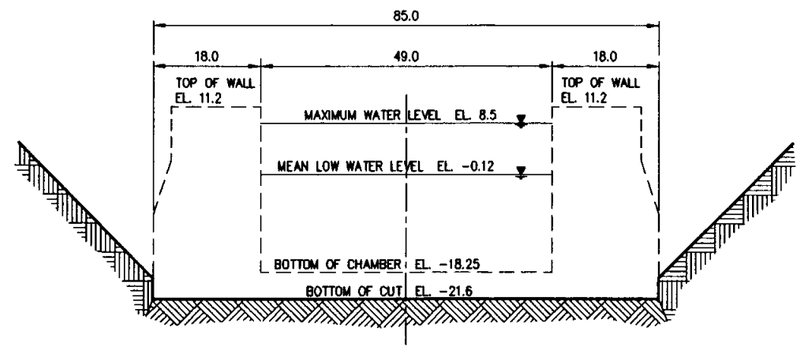
SECTION A–A
Guide Wall – Gatun Approach



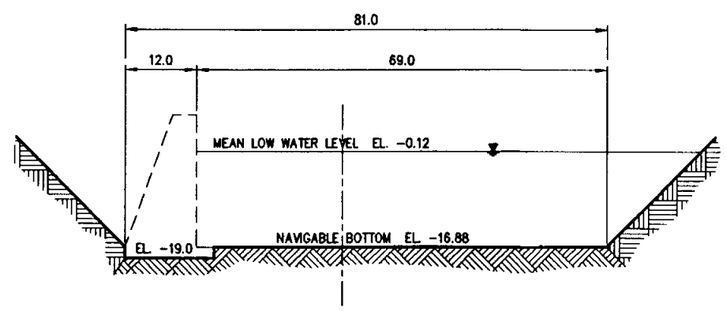
SECTION B–B
Upper Chamber



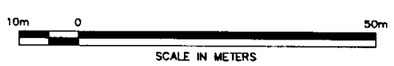
SECTION C–C
Intermediate Chamber



SECTION D–D
Lower Chamber



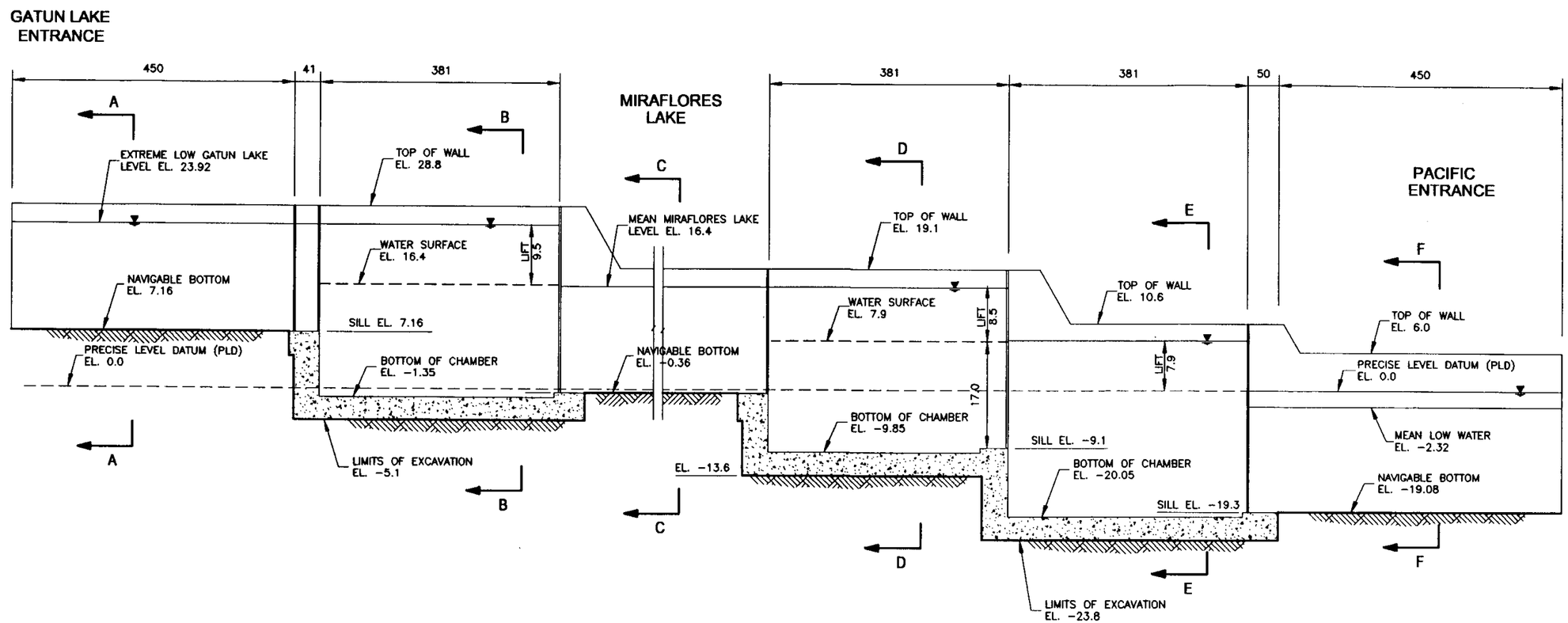
SECTION E–E
Guide Wall – Atlantic Approach



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

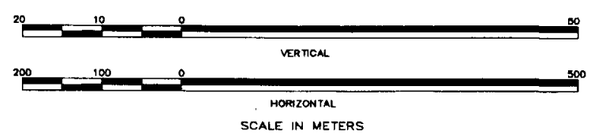
CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Proposed Gatun Locks Cross Sections

HARZA TAMS	August 2000	Exhibit C-3



NOTES

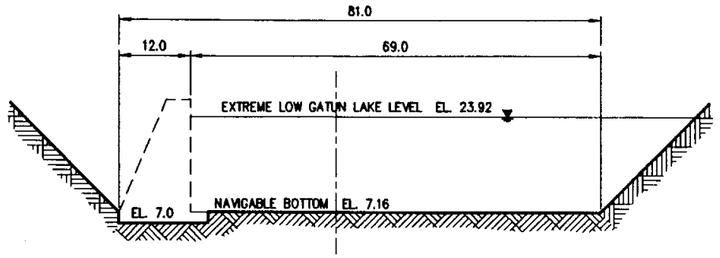
1. LOCK DIMENSIONS
   LENGTH: 381m
   WIDTH: 49m
   DEPTH: 17m
2. SEE EXHIBIT C5 FOR SECTIONS



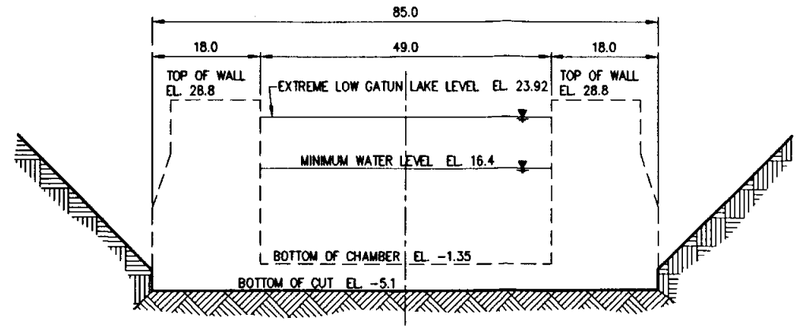
AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Proposed Separate Pacific Locks Profile

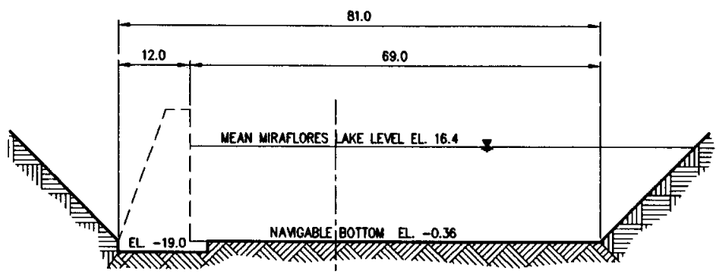
HARZA TAMS	August 2000	Exhibit C-4



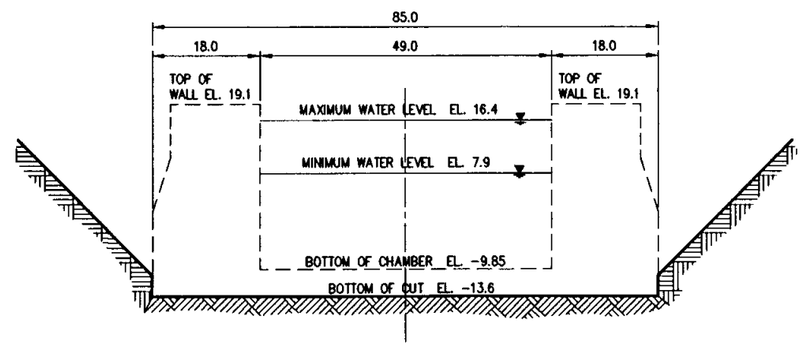
SECTION A–A
Guide Wall – Gatun Approach



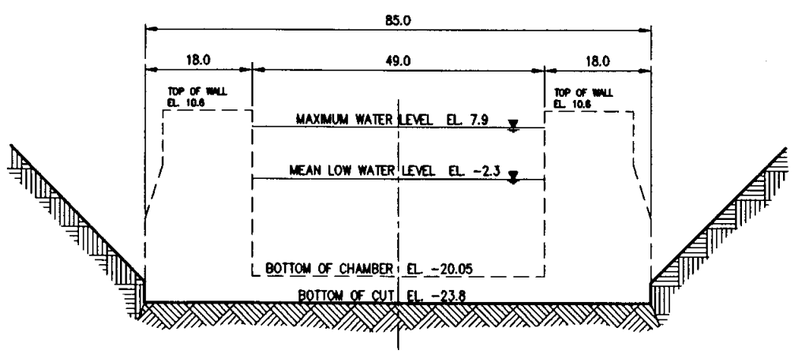
SECTION B–B
Pedro Miguel Chamber



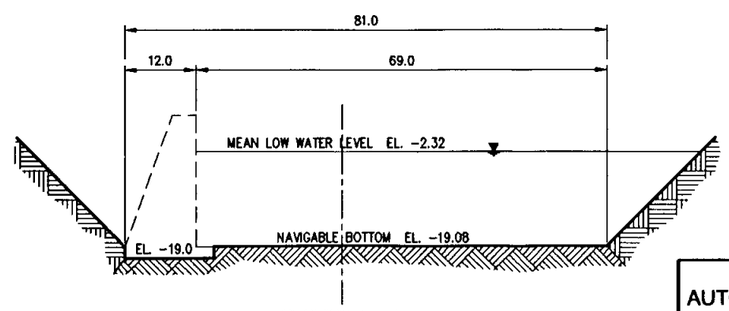
SECTION C–C
Guide Wall – Miraflores Lake Approach



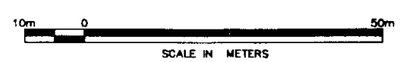
SECTION D–D
Miraflores Upper Chamber



SECTION E–E
Miraflores Lower Chamber



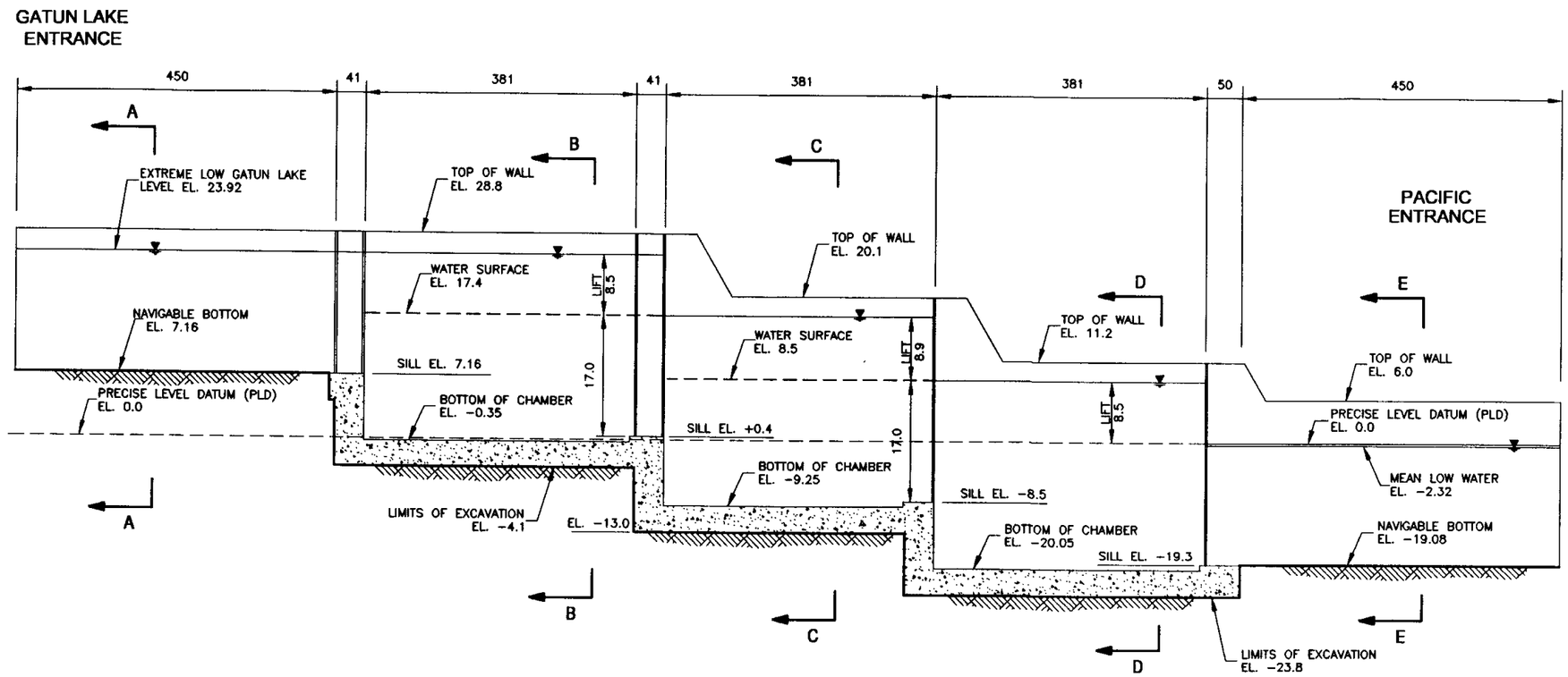
SECTION F–F
Guide Wall – Pacific Approach



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

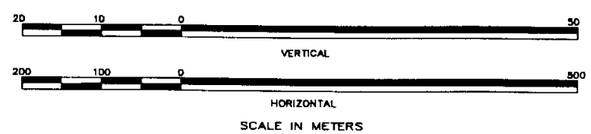
CONTRACT NO. CC–5–536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Proposed Separate Pacific Locks Cross Sections

HARZA TAMS | August 2000 | Exhibit C–5



NOTES

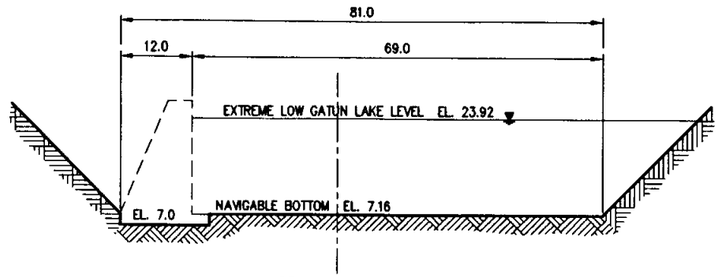
1. LOCK DIMENSIONS
   LENGTH: 381m
   WIDTH: 49m
   DEPTH: 17m
2. SEE EXHIBIT C7 FOR SECTIONS



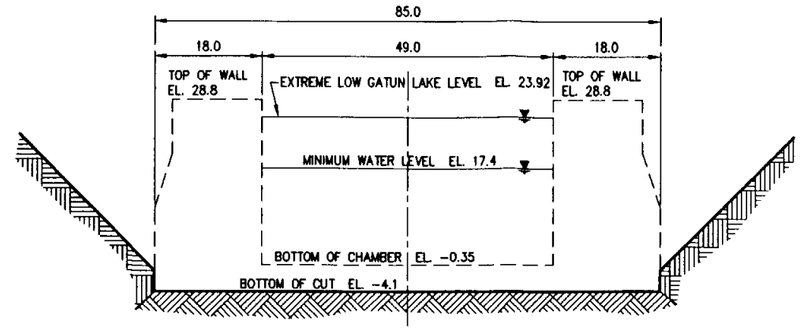
AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Proposed Combined Pacific Locks Profile

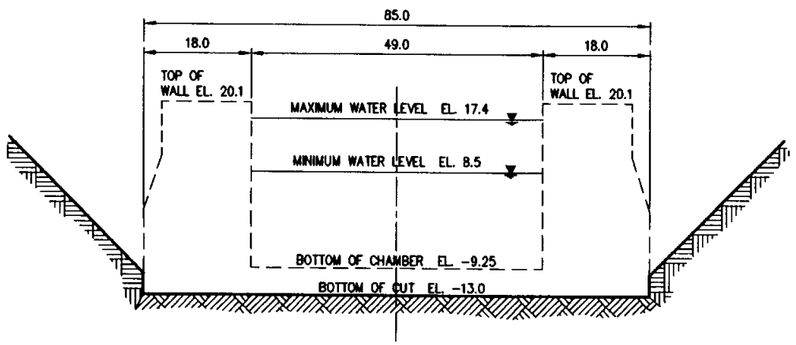
HARZA TAMS | August 2000 | Exhibit C-6



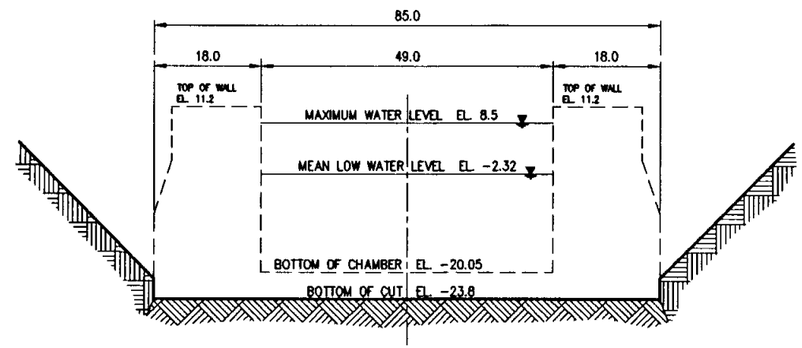
SECTION A–A
Guide Wall – Gatun Approach



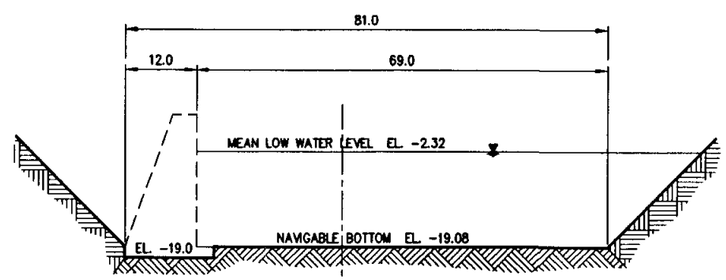
SECTION B–B
Upper Chamber



SECTION C–C
Intermediate Chamber



SECTION D–D
Lower Chamber

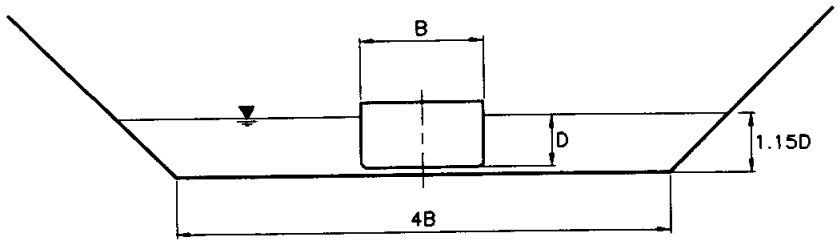


SECTION E–E
Guide Wall – Pacific Approach

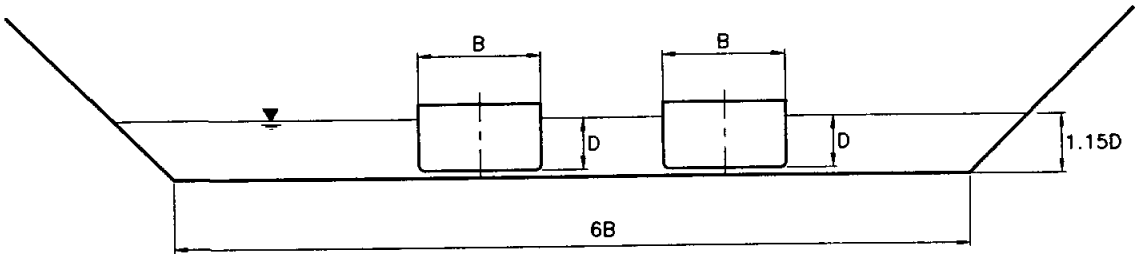
AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC–5–536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Proposed Combined Pacific Locks Cross Sections

HARZA TAMS	August 2000	Exhibit C–7



ONE WAY



TWO WAY

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Typical Canal Sections

HARZA TAMS	August 2000	Exhibit C-8

EXCAVATION SLOPE CRITERIA

Slope criteria for 5 types of geological conditions have been developed based on the criteria provided by the Secretariat and are described below.

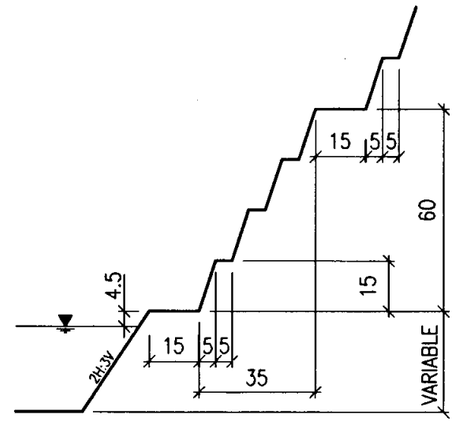
TYPE 1. Strong, unaltered or slightly altered volcanic rocks, e.g. basalt and hard agglomerate limestone. Slopes not exceeding 60 meters in height of moderately consolidated, intact sedimentary rocks and tuffs.

TYPE 2. High slopes of moderately consolidated intact sedimentary rocks and tuffs, altered but still solid volcanic rocks.

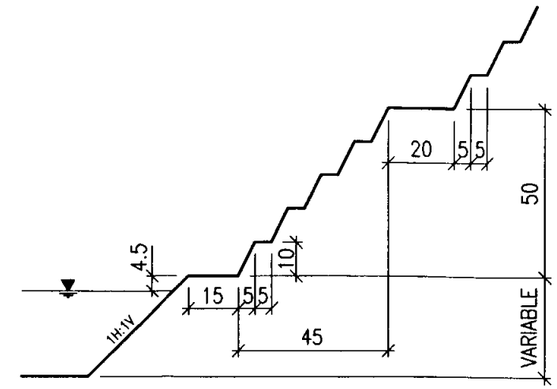
TYPE 3. Soft volcanic sedimentary rocks, including soft agglomerate, with partial clay shales, but relatively stable as to form high massive hills.

TYPE 4. Soft volcanic sedimentary rocks, including soft agglomerate, with frequent development of clay shales and technically highly distorted and sheared, located in a landslide-inflicted zone.

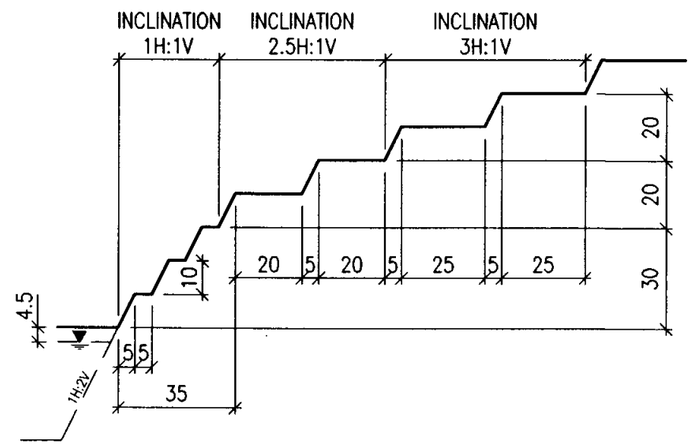
TYPE 5. Unconsolidated deposits.



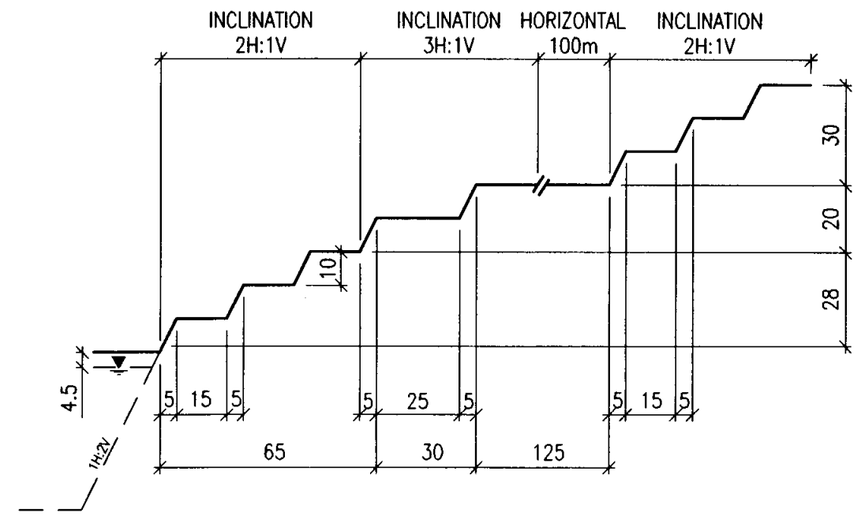
Slope criteria for Type 1 geology.



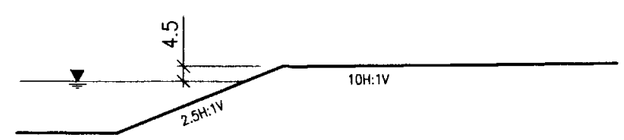
Slope criteria for Type 2 geology.



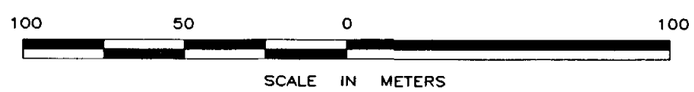
Slope criteria for Type 3 geology.



Slope criteria for Type 4 geology.



Slope criteria for Type 5 geology.

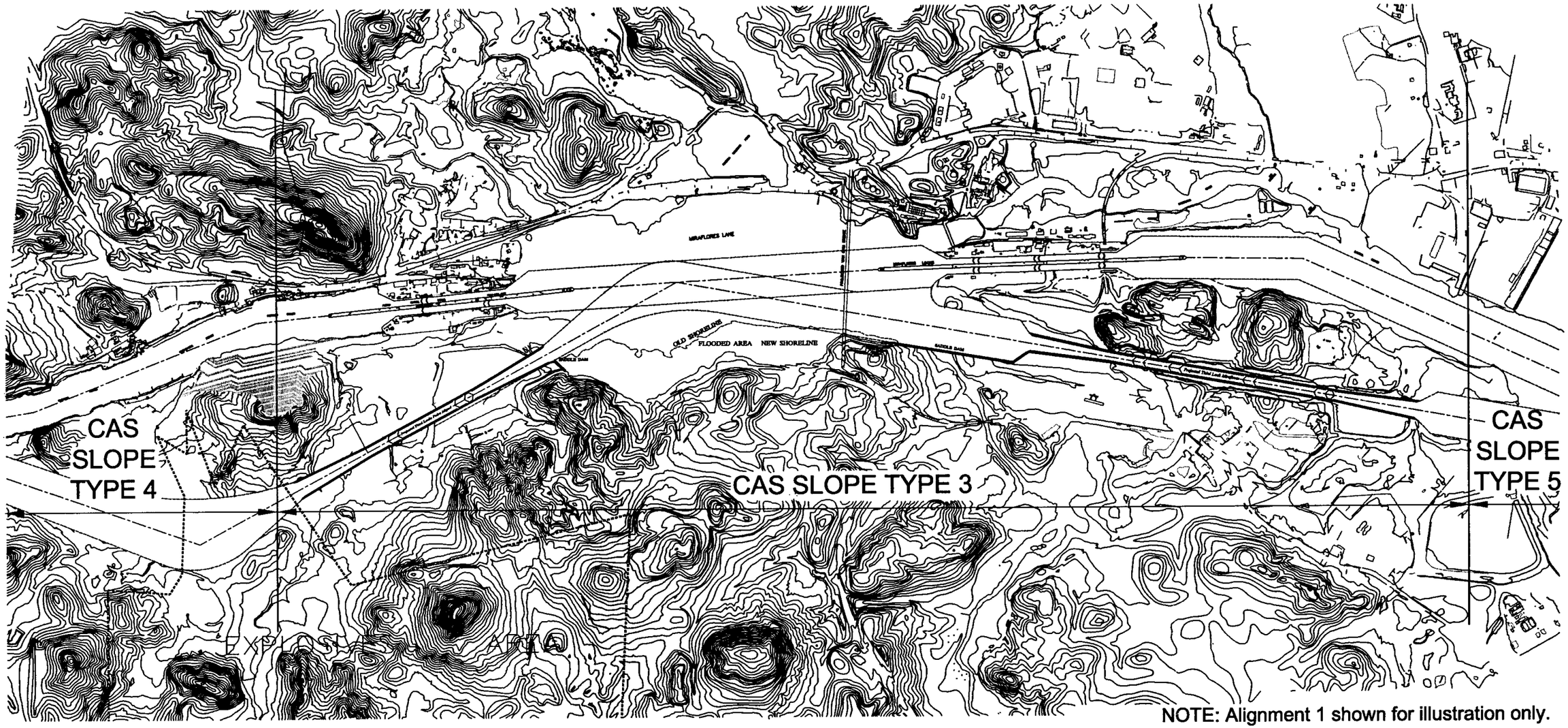


Source: Canal Alternative Study – Volume IV (1993)

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Excavation Slope Criteria

HARZA TAMS | August 2000 | Exhibit C-9



AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Layout Showing Application of CAS Slope Types

HARZA TAMS	August 2000	Exhibit C-10

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX D

EXCAVATION QUANTITY COMPARISON FOR PACIFIC ENTRANCE

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX D
EXCAVATION QUANTITY COMPARISON FOR PACIFIC ENTRANCE

TABLE OF CONTENTS

EXHIBITS

Exhibit	Title
D-1	Summary of Excavation Quantities – Atlantic Entrance
D-2	Summary of Excavation Quantities – Pacific Entrance
D-3	Sections for Excavation Quantities – Alignment 1
D-4	Sections for Excavation Quantities – Alignment 3
D-5	Sections for Excavation Quantities – Alignment 7
D-6	Sections for Excavation Quantities – Alignment 8
D-7	Sections for Excavation Quantities – Alignment 11
D-8	Sections for Excavation Quantities – Alignment 14
D-9	Sections for Excavation Quantities – Alignment 41
D-10	Sections for Excavation Quantities – Alignment 42

SUMMARY OF EXCAVATION QUANTITIES
Atlantic Entrance

Alignment No.	Approximate Length (km)	Approximate Volume (million m^3)
4	1.5	9
5	2.0	17
6	4.0	5
17	1.5	8
18	4.0	14
19	5.0	16
31	5.5	46
32	6.0	50

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Summary of Excavation Quantities-Atlantic Entrance

HARZA TAMS	August 2000	Exhibit D-1

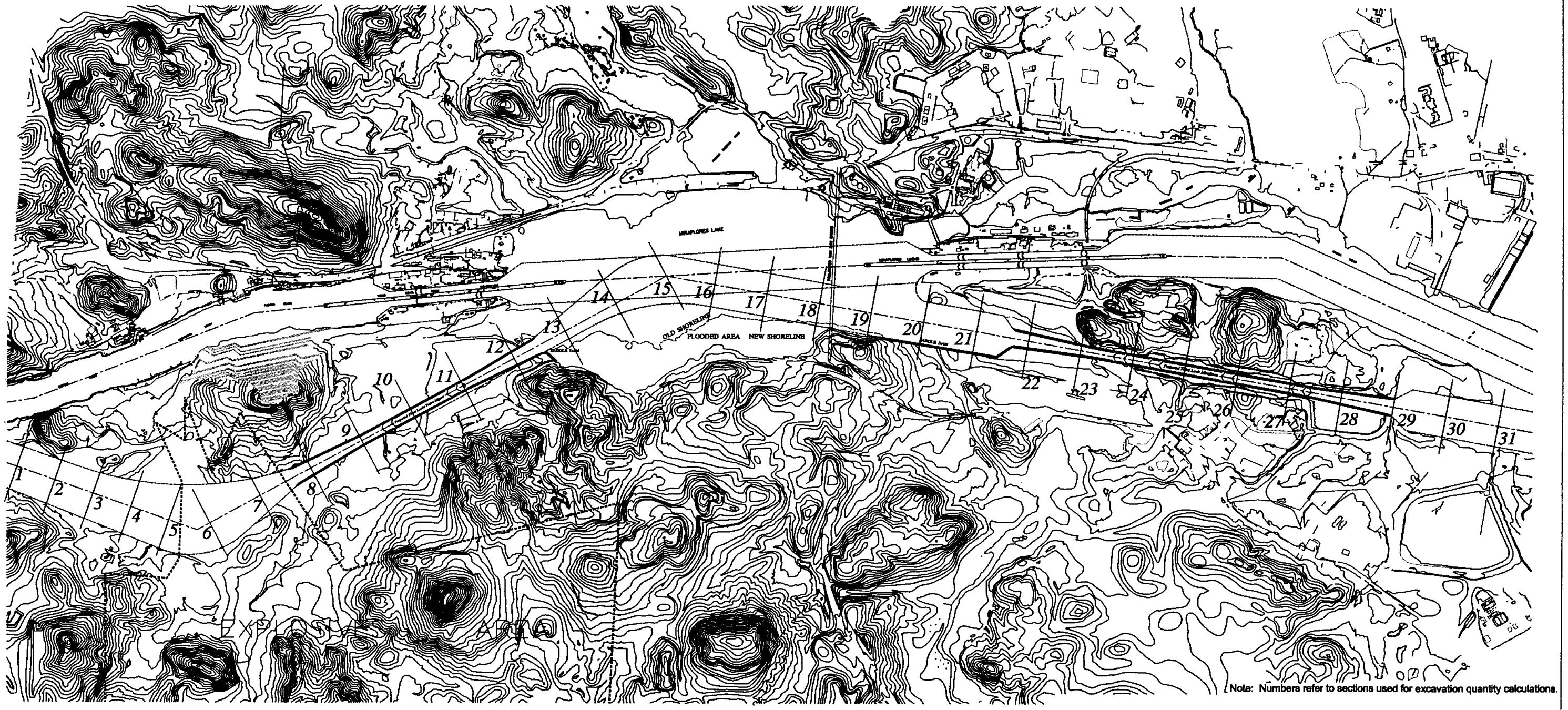
SUMMARY OF EXCAVATION QUANTITIES
Pacific Entrance

Alignment No.	Approx. Length (km)	Approx. Volume (million m^3)
1	9.6	50
3	6.6	16
7	8.1	32
8	9.3	77
11	8.1	41
14	10.2	108
41	7.7	27
42	6.2	12

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Summary of Excavation Quantities-Pacific Entrance

HARZA TAMS	August 2000	Exhibit D-2



Note: Numbers refer to sections used for excavation quantity calculations.

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Sections for Excavation Quantities - Alignment 1

HARZA TAMS	August 2000	Exhibit D–3

USERNAME $USER$
FILENAME $FILENAME$
PATH $PATH$ OFFICE Chicago
TIME PLOTTED $DATE$ $TIME$

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

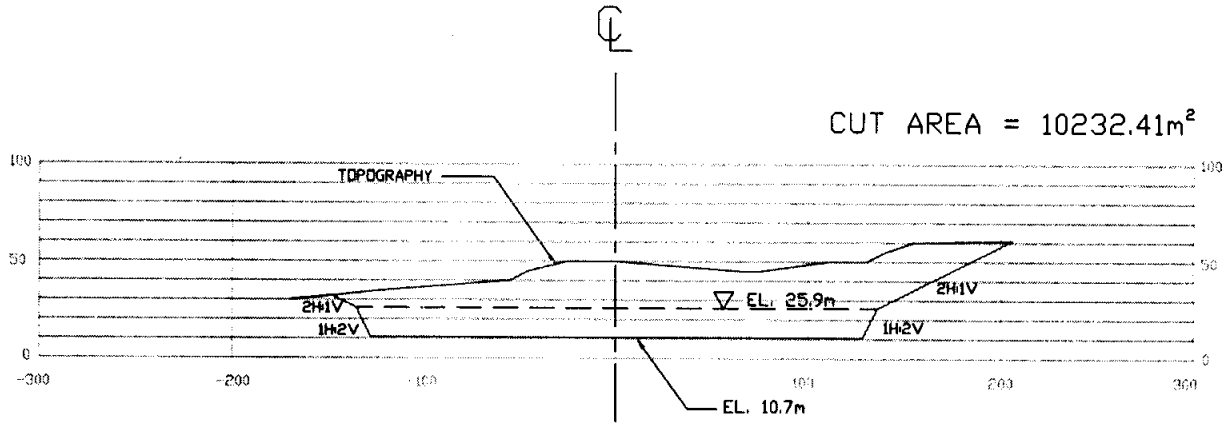
APPENDIX D
EXCAVATION QUANTITY COMPARISON FOR PACIFIC ENTRANCE

SAMPLE EXCAVATION QUANTITY CALCULATION

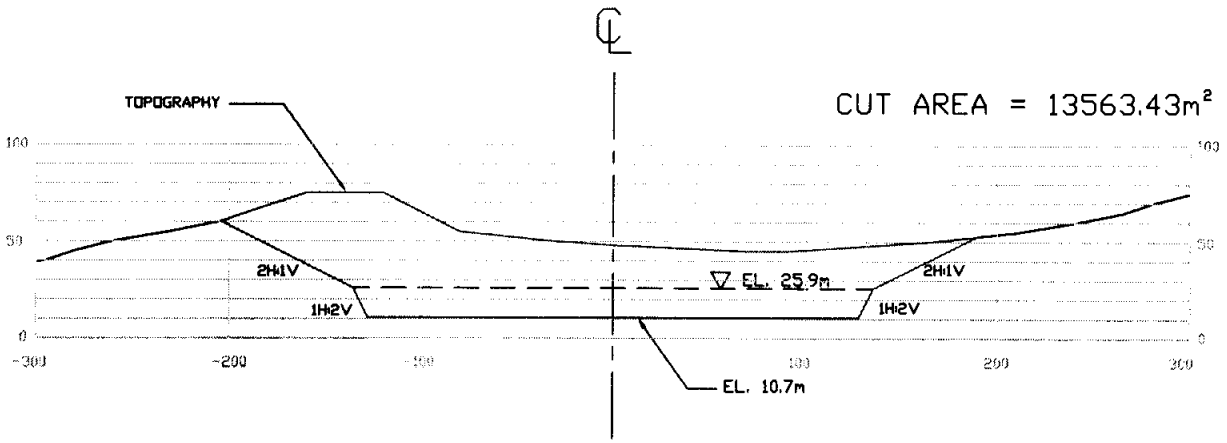
Volume Computation Spreadsheet

Alignment #1

Section No.	Area (m^2)	Distance (m)	Volume (m^3)	Cum Volume (m^3)
0	0	0	-	-
1	5116.21	300	767,431	767,431
2	10232.41	300	2,302,292	3,069,723
3	13563.43	300	3,569,376	6,639,099
4	11733.06	300	3,794,474	10,433,573
5	10966.08	300	3,404,871	13,838,444
6	8859.91	300	2,973,899	16,812,342
7	5539.14	300	2,159,858	18,972,200
8	7068.47	300	1,891,142	20,863,341
9	4114.83	300	1,677,495	22,540,836
10a	3260.87	300	1,106,355	23,647,191
10b	5857.50	0	-	23,647,191
11	4980.43	300	1,236,195	24,883,386
12	4979.30	300	1,493,960	26,377,346
13	3797.62	300	1,316,538	27,693,884
14	761.60	300	683,883	28,377,767
15	433.74	280	167,348	28,545,114
16	491.32	300	138,759	28,683,873
17	960.25	300	217,736	28,901,609
18	1755.56	300	407,372	29,308,980
19	2957.20	380	895,424	30,204,405
20	6937.14	300	1,484,151	31,688,556
21	4920.42	300	1,778,634	33,467,190
22	4149.11	300	1,360,430	34,827,619
23	4434.10	300	1,287,482	36,115,101
24	7433.83	300	1,780,190	37,895,290
25	2770.78	300	1,530,692	39,425,982
26a	5256.83	300	1,204,142	40,630,123
26b	11082.41	0	-	40,630,123
27	6992.02	300	2,711,165	43,341,288
28	5435.78	300	1,864,170	45,205,458
29	6020.37	300	1,718,423	46,923,880
30	3367.64	300	1,408,202	48,332,082
31	4246.80	300	1,142,166	49,474,248
32	0.00	300	637,020	50,111,268

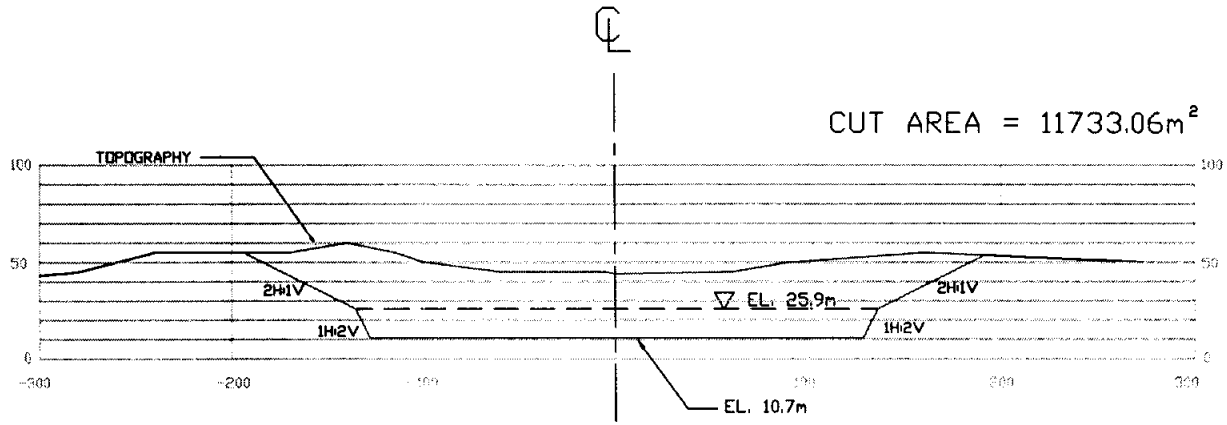


SECTION 2 C.A.S. SLOPE TYPE 4

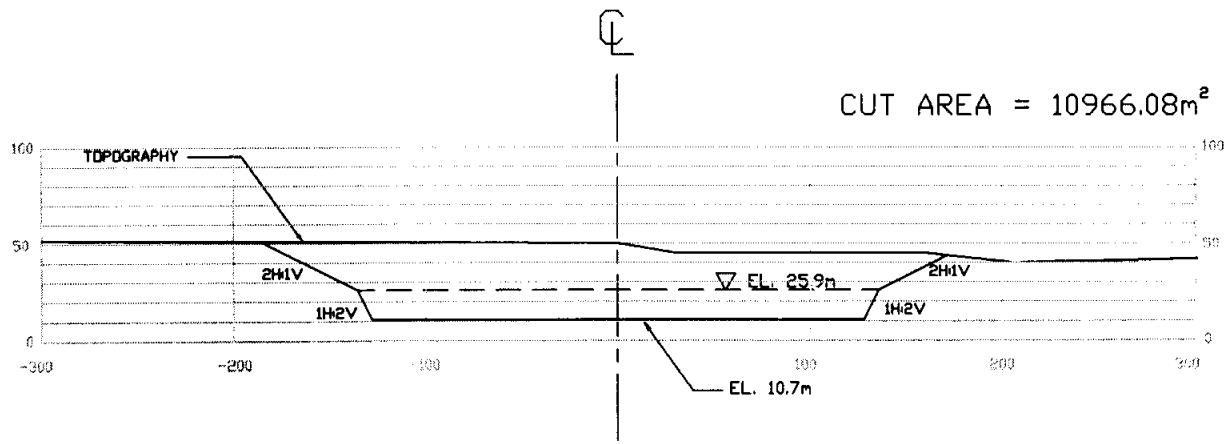


SECTION 3 C.A.S. SLOPE TYPE 4

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTIONS 2/3		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 1998	SCALE= 1:4,000

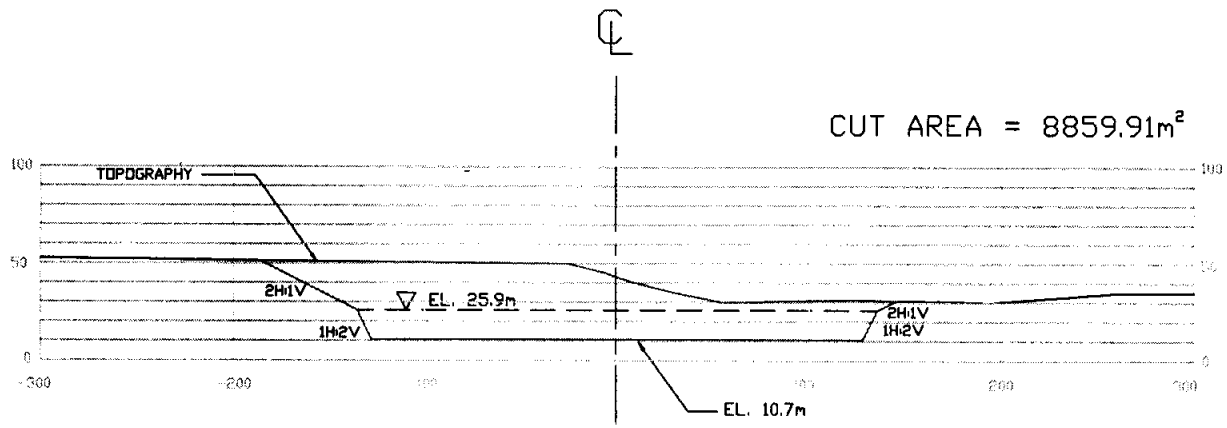


SECTION 4 C.A.S. SLOPE TYPE 4

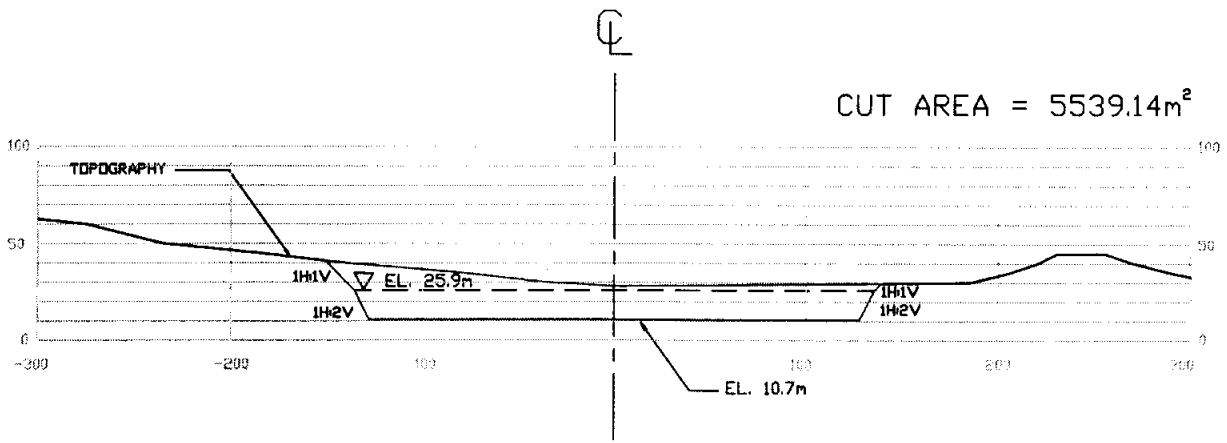


SECTION 5 C.A.S. SLOPE TYPE 4

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTIONS 4/5		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 19	SCALE= 1:4,000

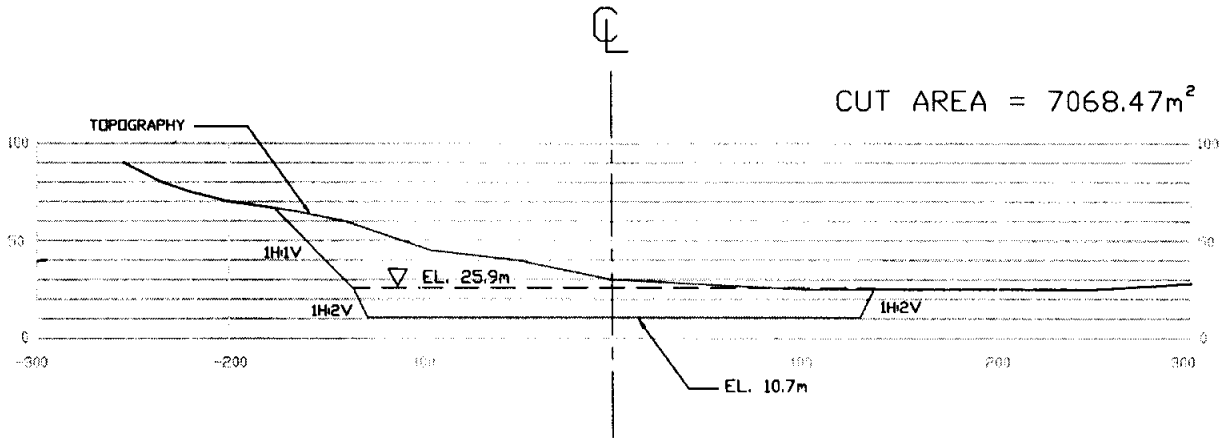


SECTION 6 C.A.S. SLOPE TYPE 4



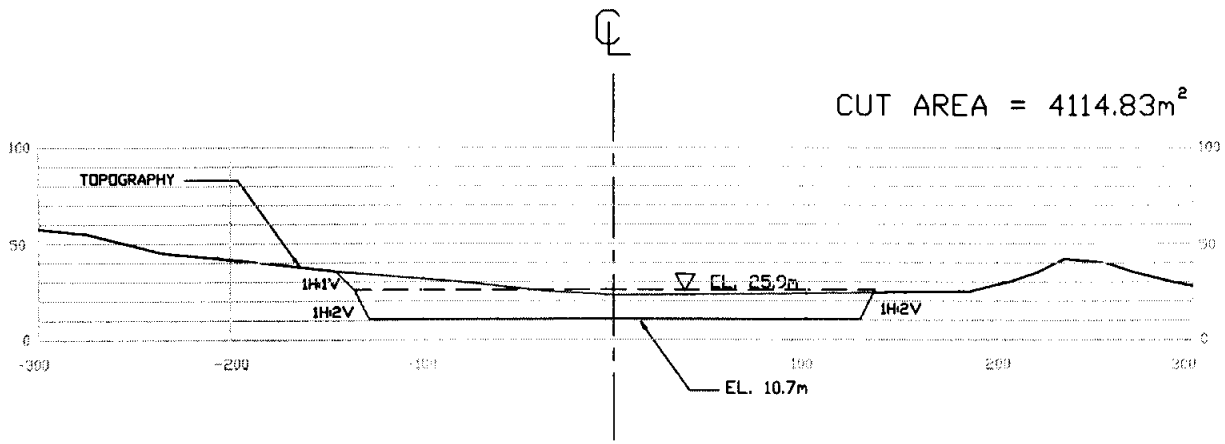
SECTION 7 C.A.S. SLOPE TYPE 3

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTIONS 6/7		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 1999	SCALE= 1:4,000



SECTION 8

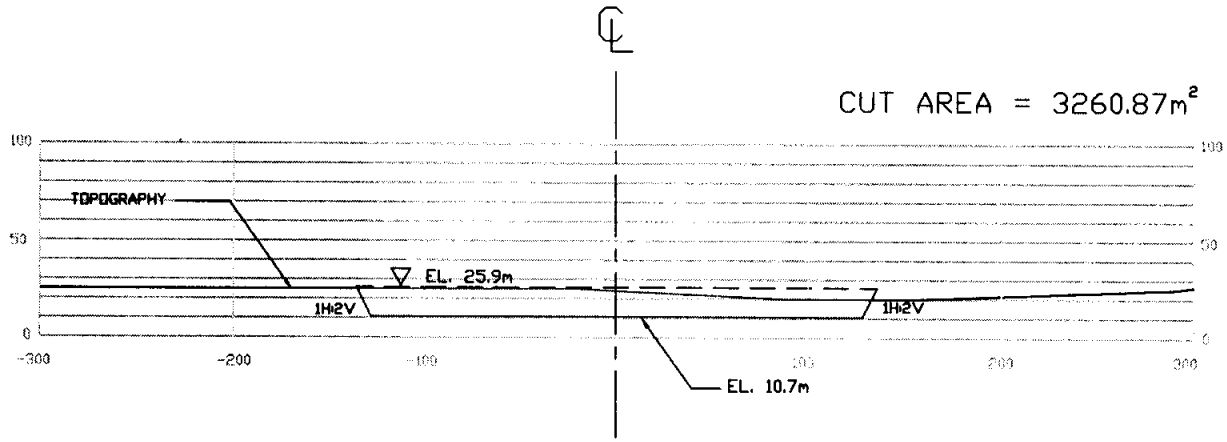
C.A.S. SLOPE TYPE 3



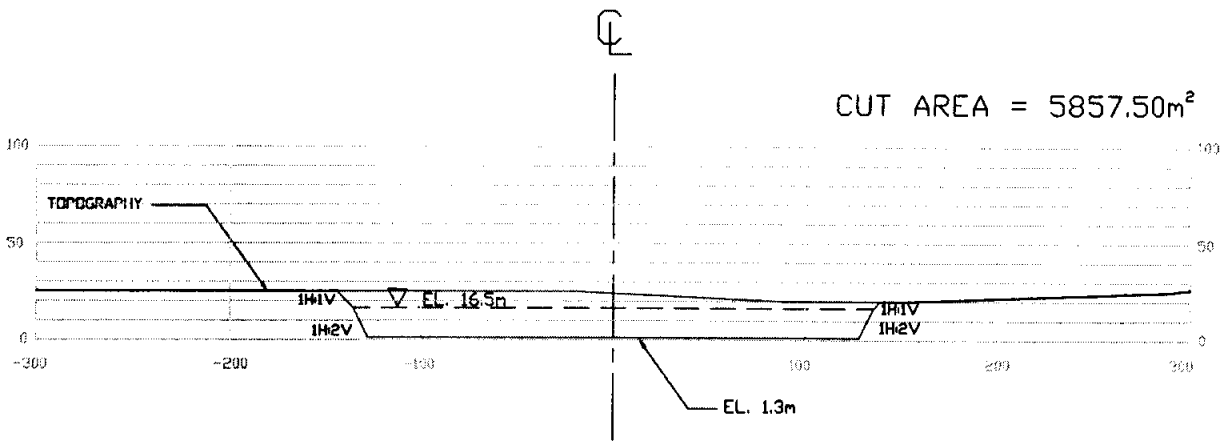
SECTION 9

C.A.S. SLOPE TYPE 3

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTIONS 8/9		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 19	SCALE= 1:4,000

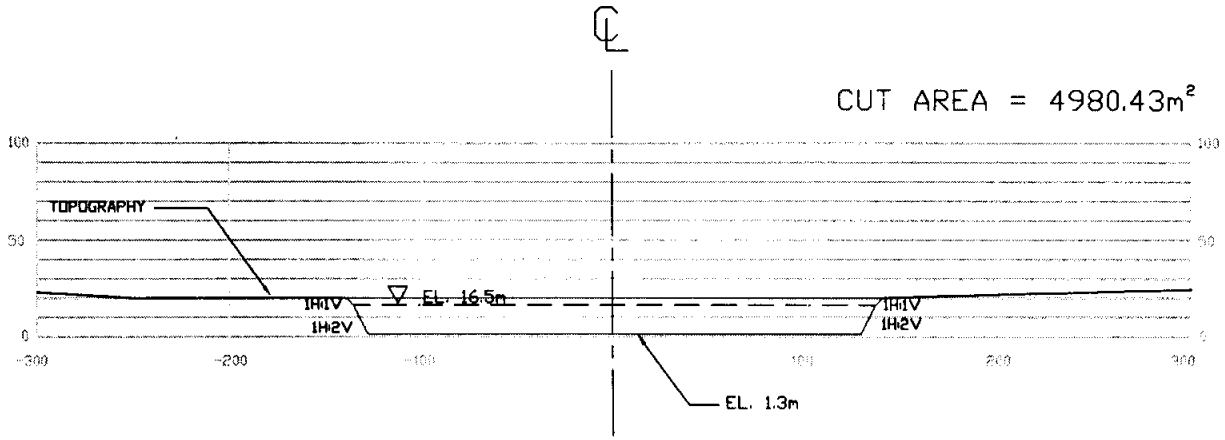


SECTION 10a C.A.S. SLOPE TYPE 3

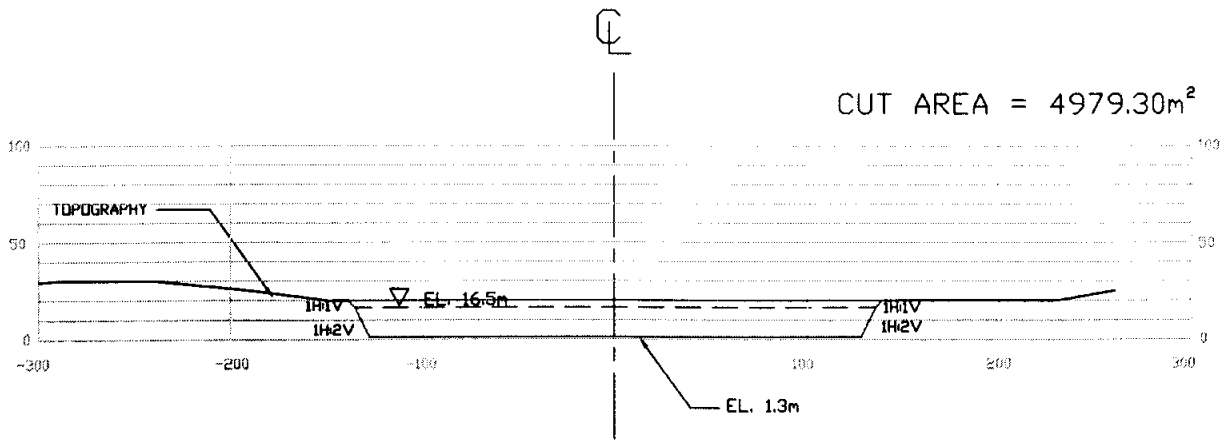


SECTION 10b C.A.S. SLOPE TYPE 3

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTION 10		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 1999	SCALE= 1:4,000

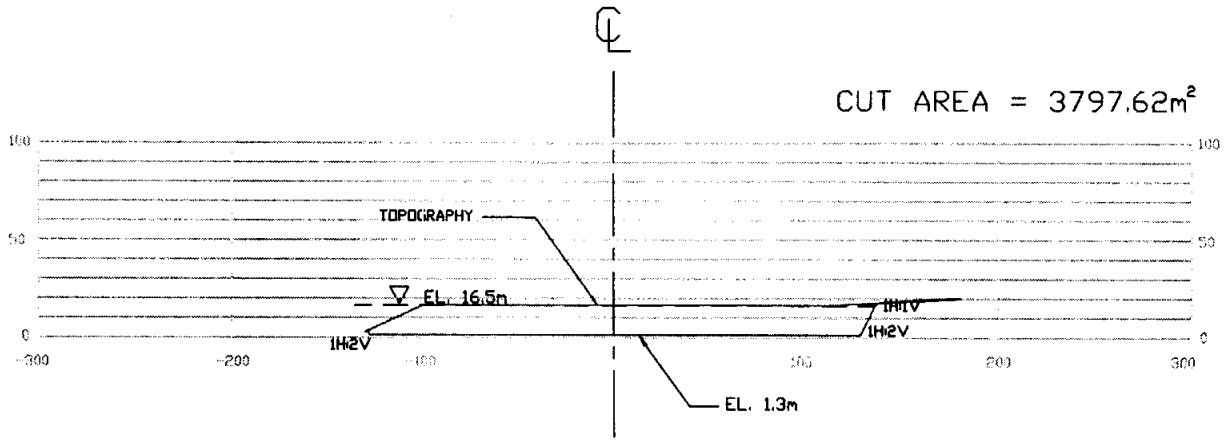


SECTION 11 C.A.S. SLOPE TYPE 3

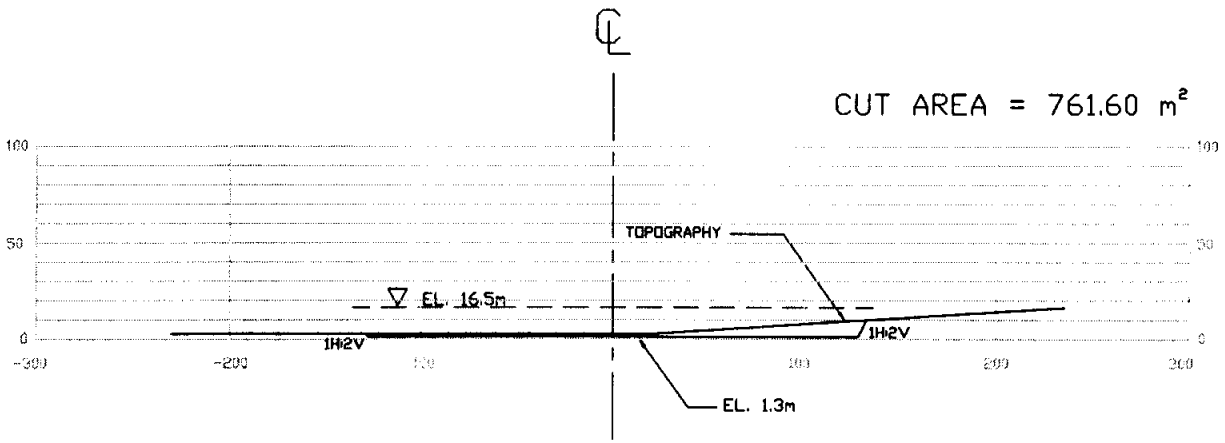


SECTION 12 C.A.S. SLOPE TYPE 3

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTION 11/12		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 19	SCALE= 1:4,000

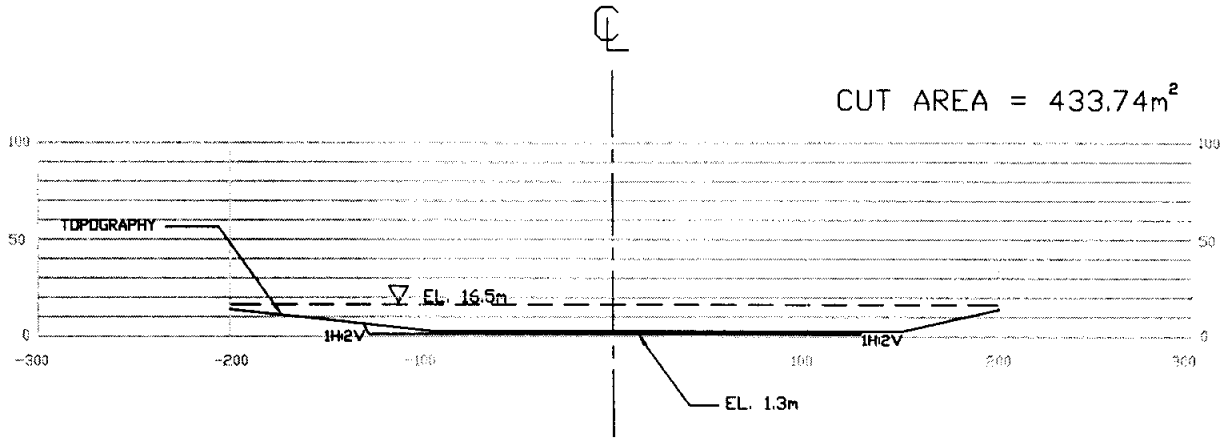


SECTION 13 C.A.S. SLOPE TYPE 3

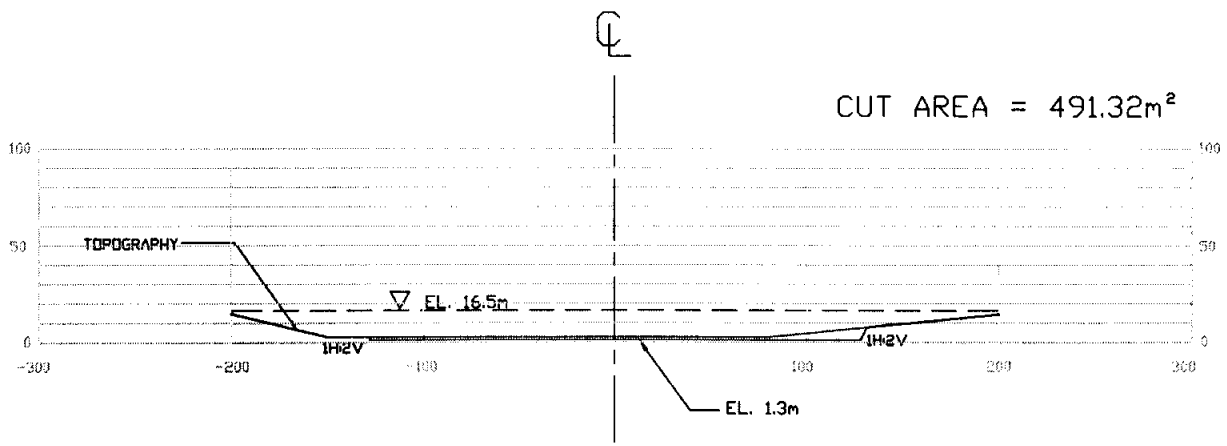


SECTION 14 C.A.S. SLOPE TYPE 3

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTION 13/14		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 1998	SCALE= 1:4,000

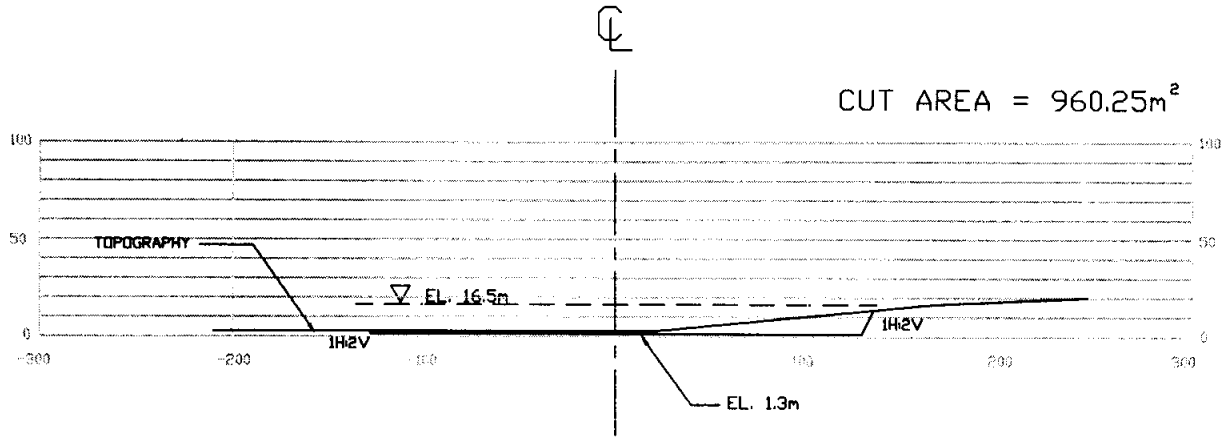


SECTION 15 C.A.S. SLOPE TYPE 3

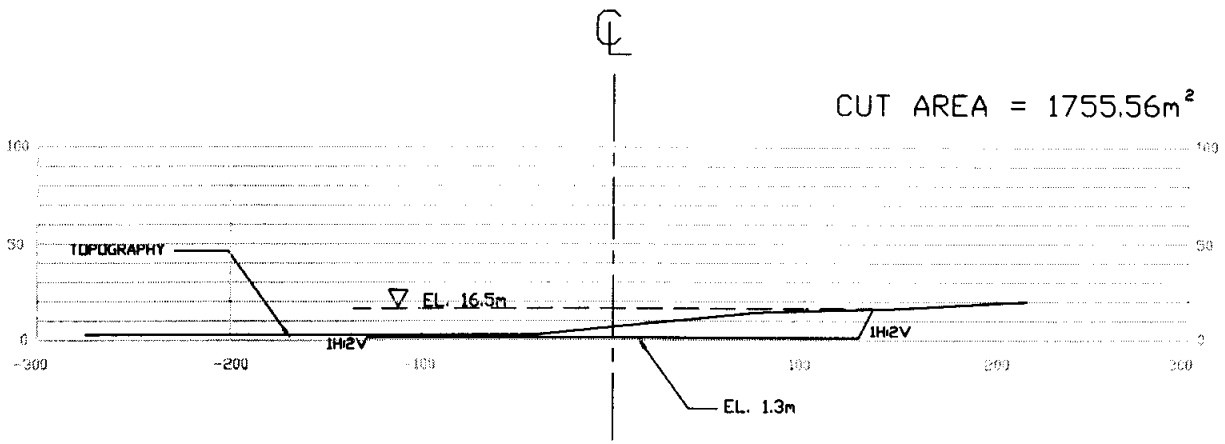


SECTION 16 C.A.S. SLOPE TYPE 3

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTION 15/16		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 19	SCALE= 1:4,000

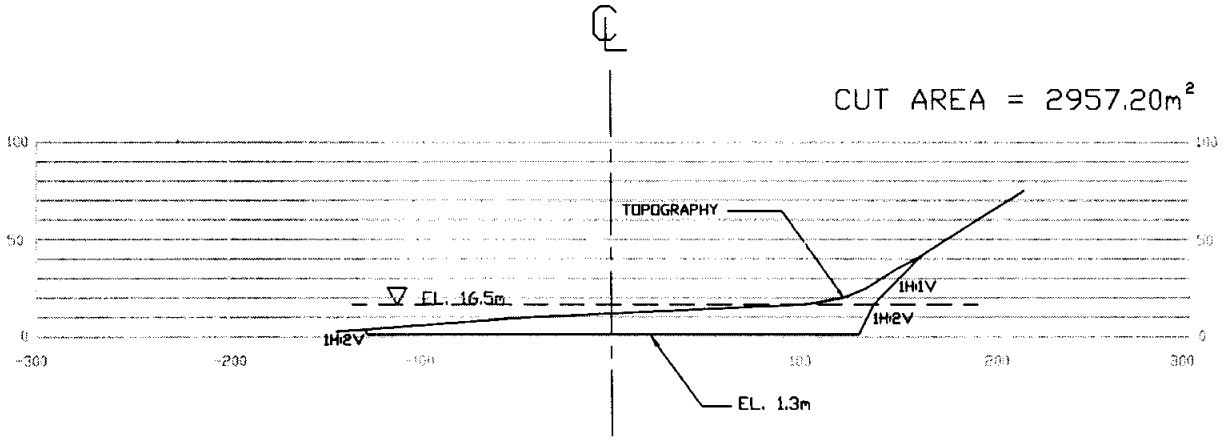


SECTION 17 C.A.S. SLOPE TYPE 3

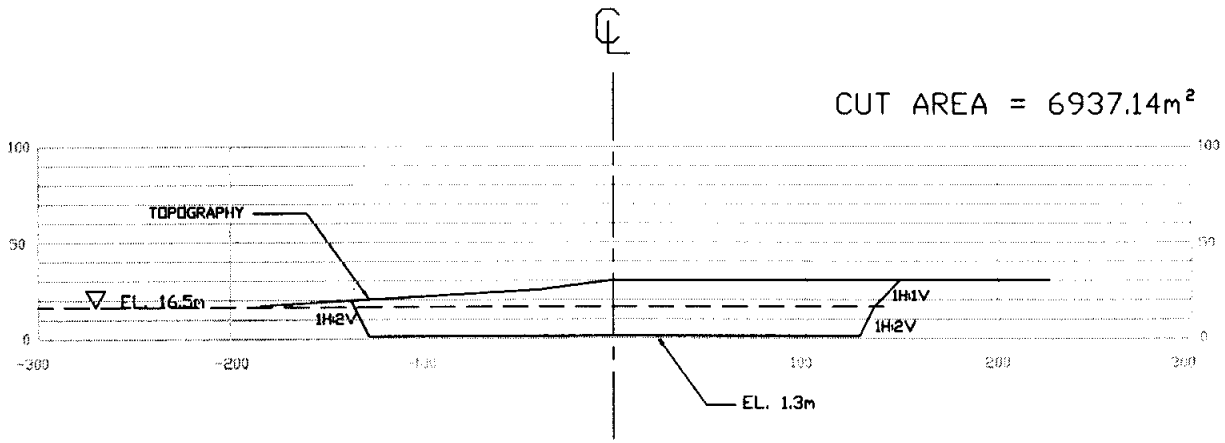


SECTION 18 C.A.S. SLOPE TYPE 3

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTION 17/18		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 1999	SCALE= 1:4,000

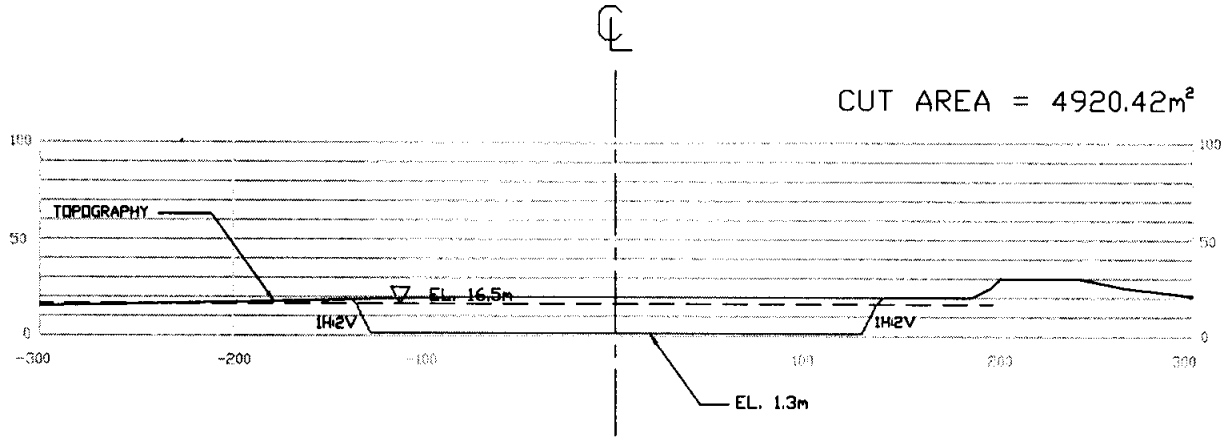


SECTION 19 C.A.S. SLOPE TYPE 3

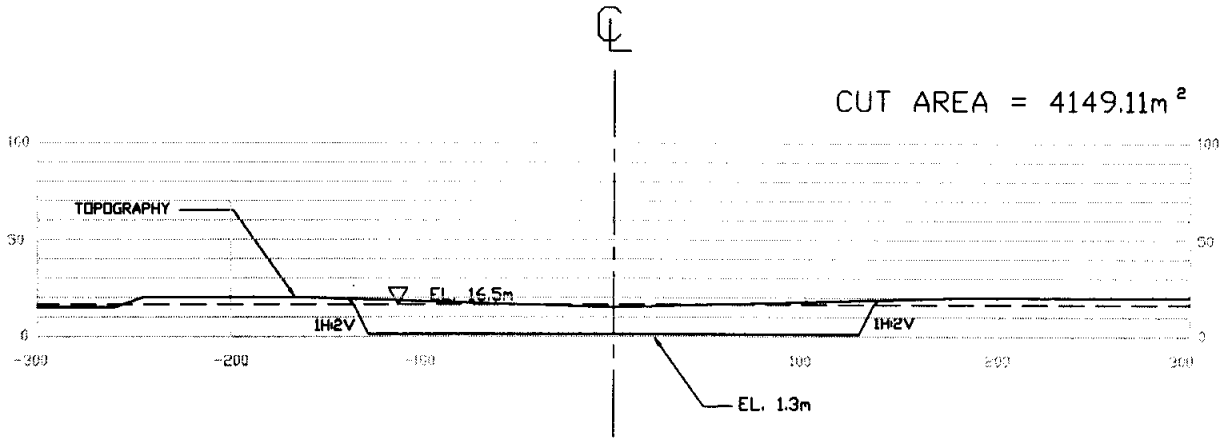


SECTION 20 C.A.S. SLOPE TYPE 3

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTION 19/20		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 19	SCALE= 1:4,000



SECTION 21 C.A.S. SLOPE TYPE 3



SECTION 22 C.A.S. SLOPE TYPE 3

PANAMA CANAL		
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HARZA ENGINEERING COMPANY		
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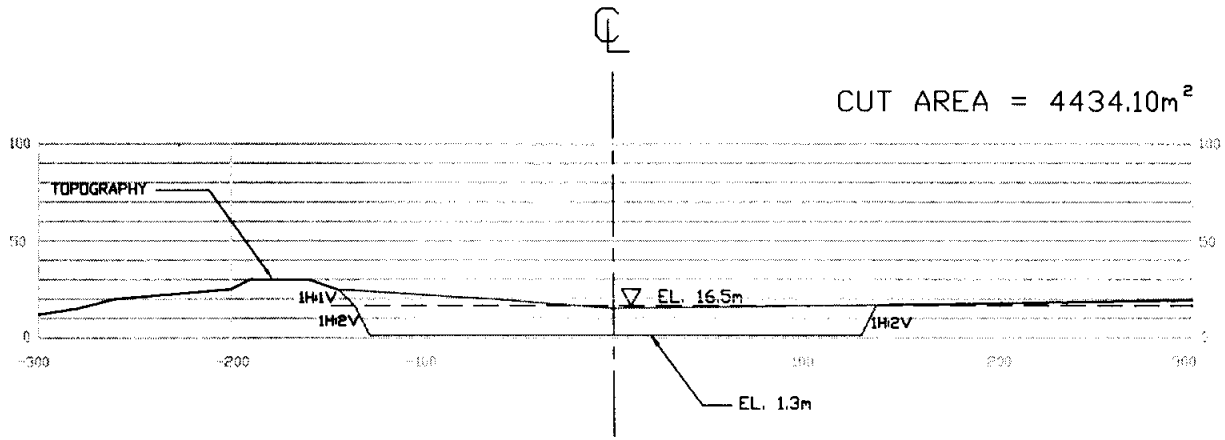

SECTION 23 C.A.S. SLOPE TYPE 3

PANAMA CANAL	
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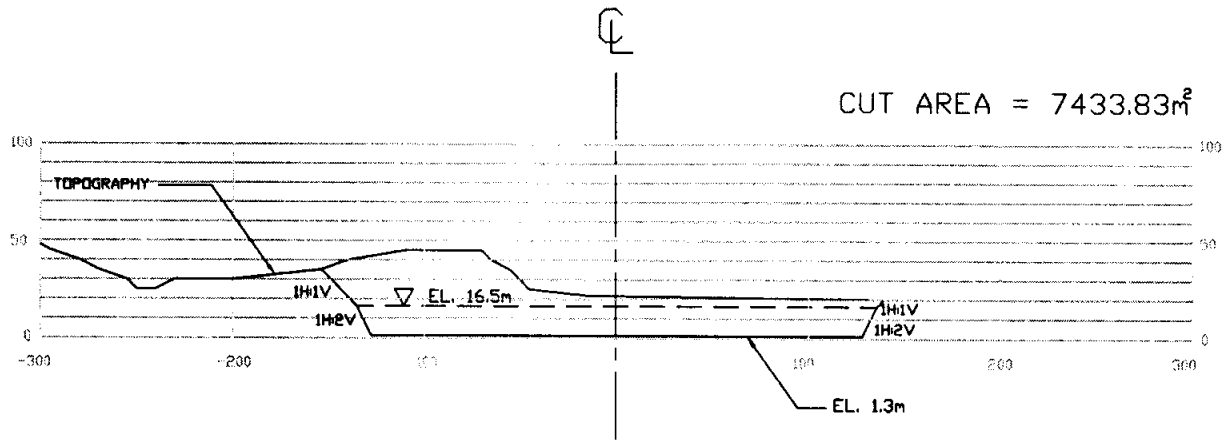
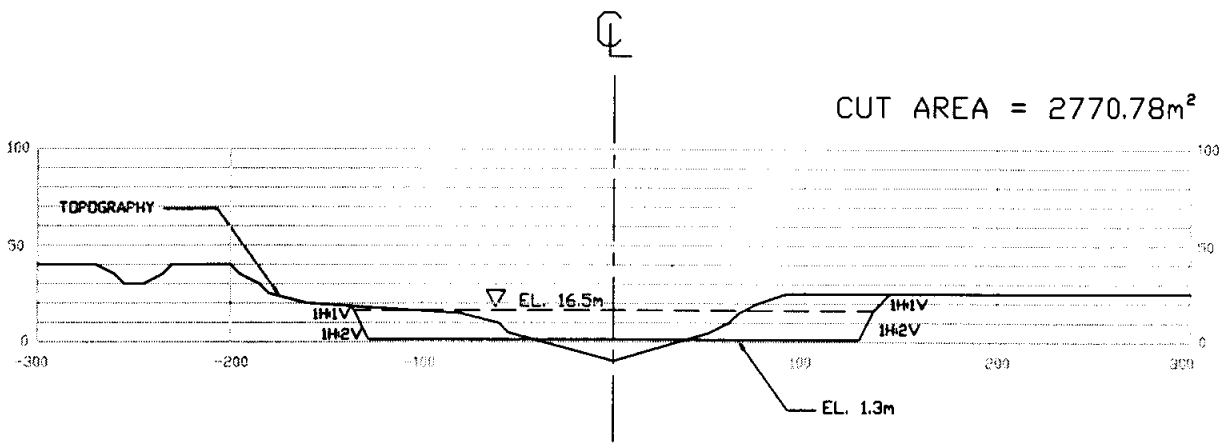
ALT.1 SECTION 23	
HARZA ENGINEERING COMPANY	
CHICAGO, ILLINOIS	DATE: DEC. 19	SCALE= 1:4,000



SECTION 24 C.A.S. SLOPE TYPE 3



SECTION 25 C.A.S. SLOPE TYPE 3

PANAMA CANAL		
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ALT.1 SECTION 24/25		
HARZA ENGINEERING COMPANY		
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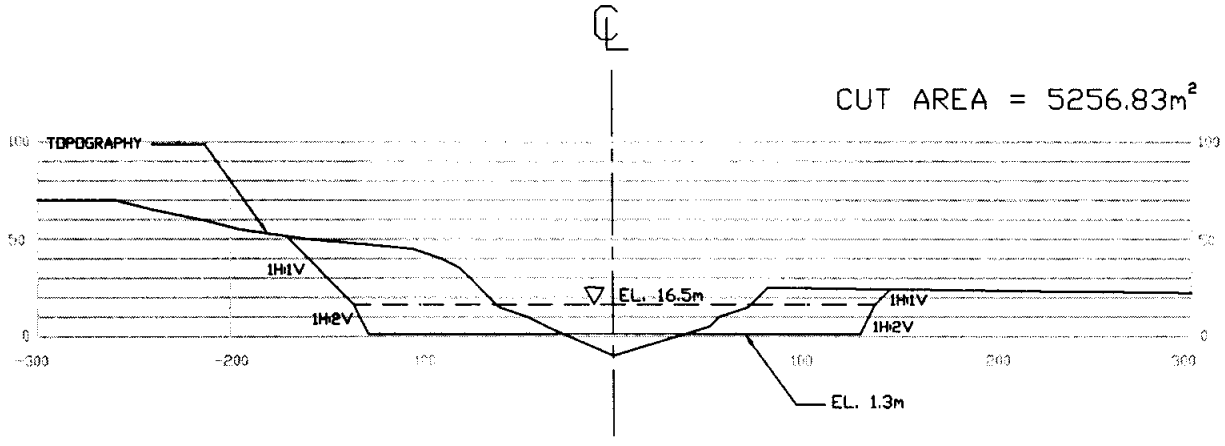
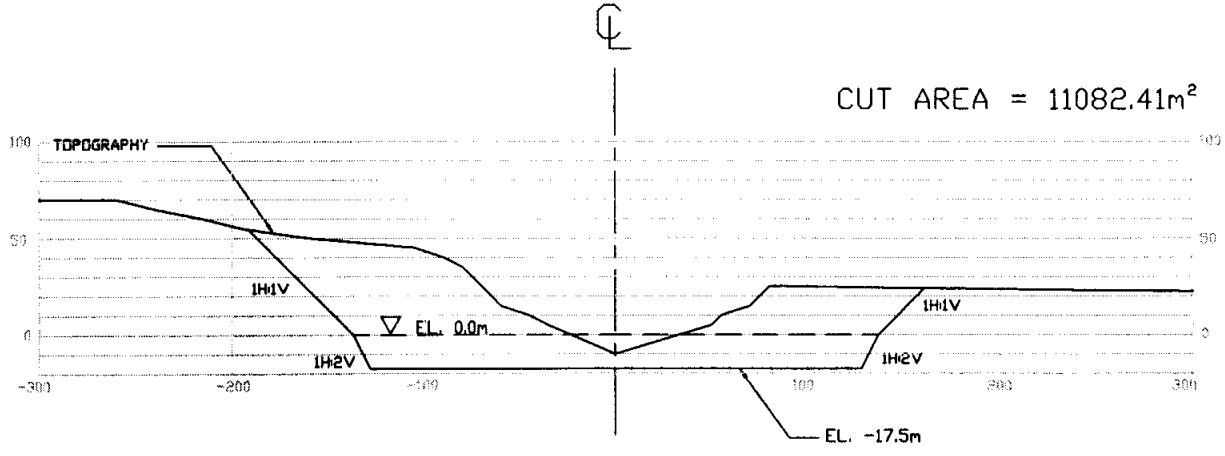


SECTION 26a C.A.S. SLOPE TYPE 3



SECTION 26b C.A.S. SLOPE TYPE 3

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTION 26a/26b		
HARZA ENGINEERING COMPANY		
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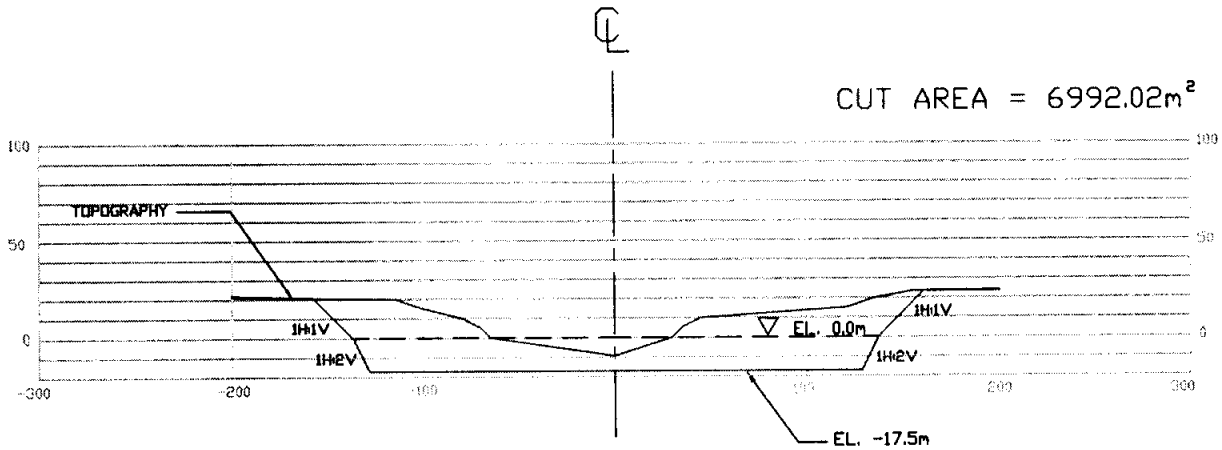
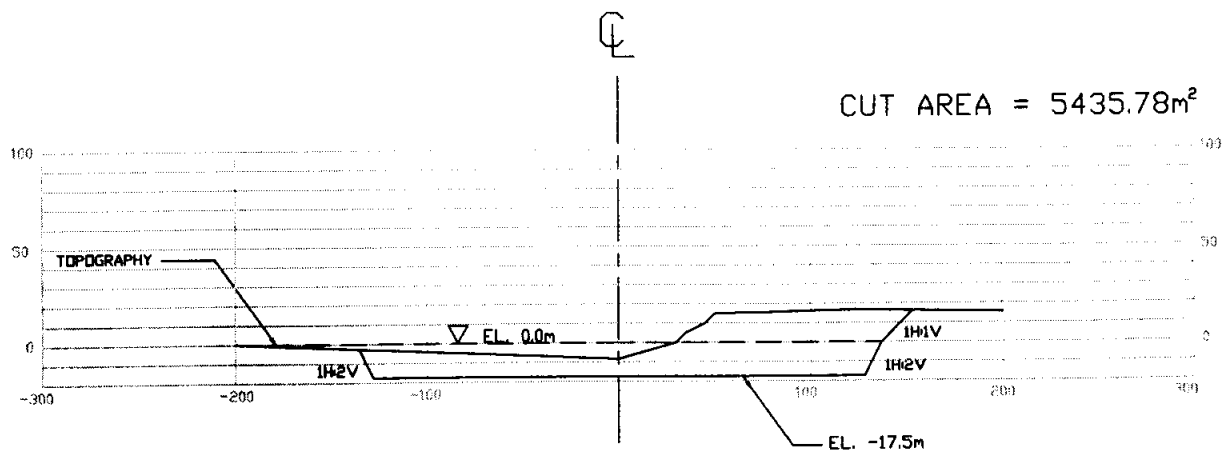


SECTION 27 C.A.S. SLOPE TYPE 3



SECTION 28 C.A.S. SLOPE TYPE 3

PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTION 27/28		
HARZA ENGINEERING COMPANY		
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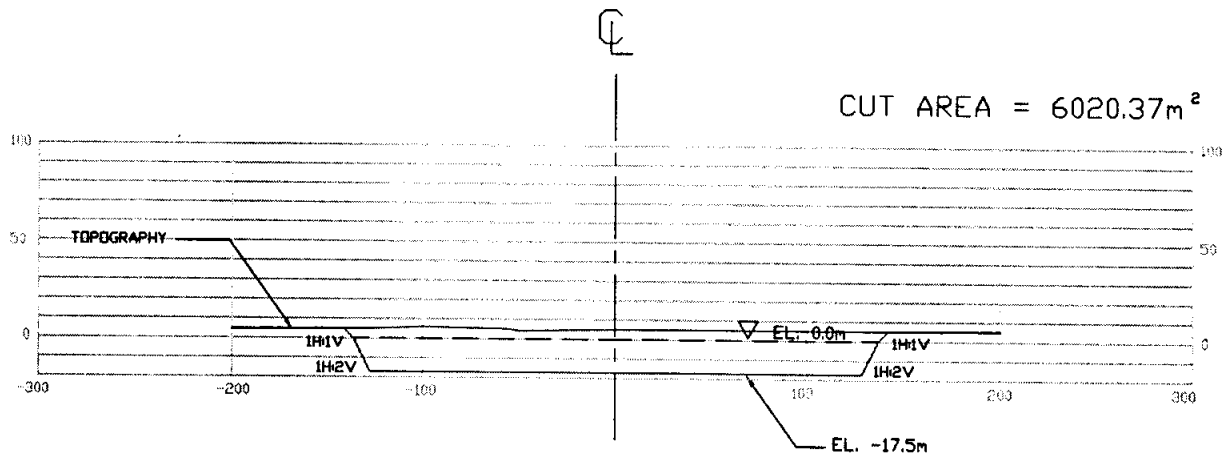
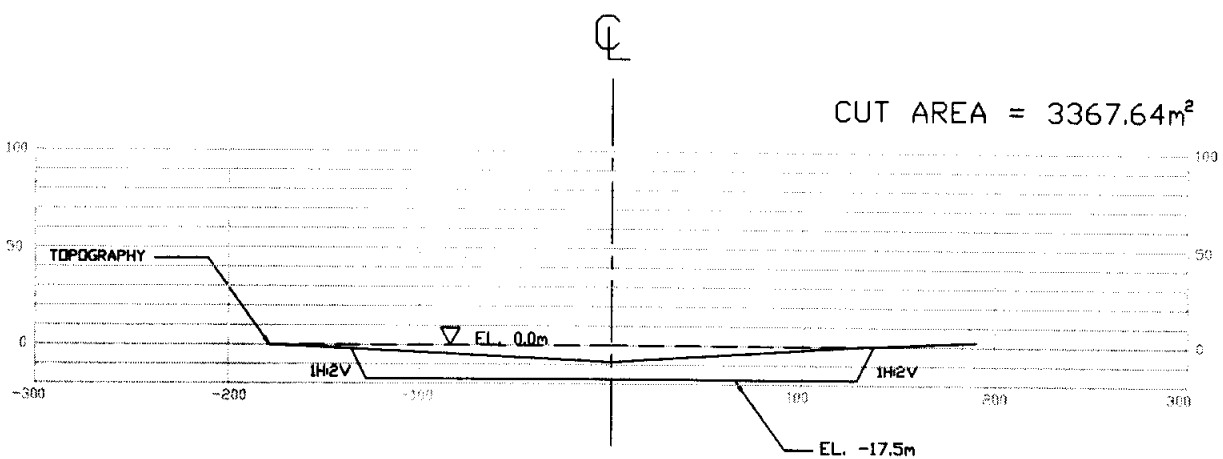


SECTION 29 C.A.S. SLOPE TYPE 3



SECTION 30 C.A.S. SLOPE TYPE 3

PANAMA CANAL		
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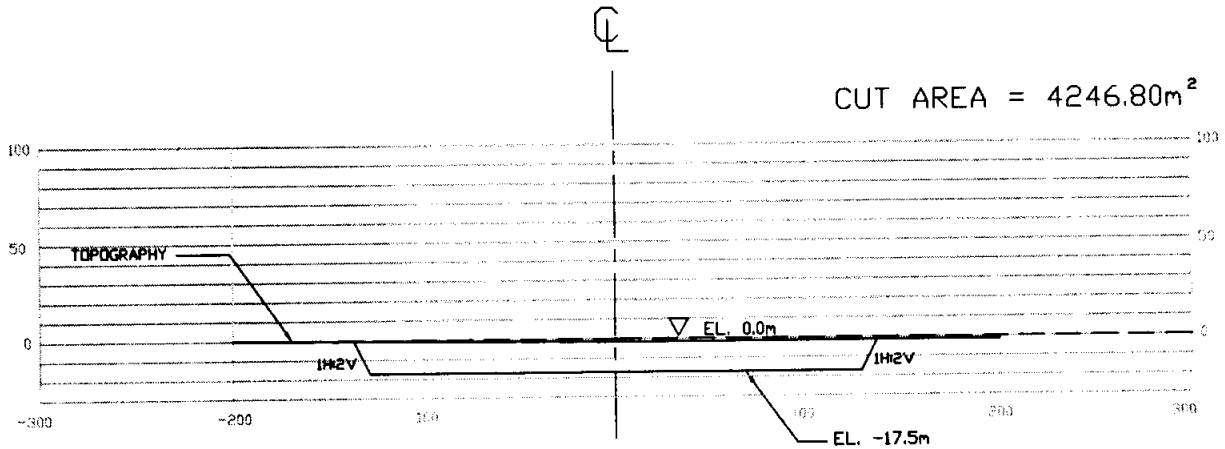


SECTION 31 C.A.S. SLOPE TYPE 3

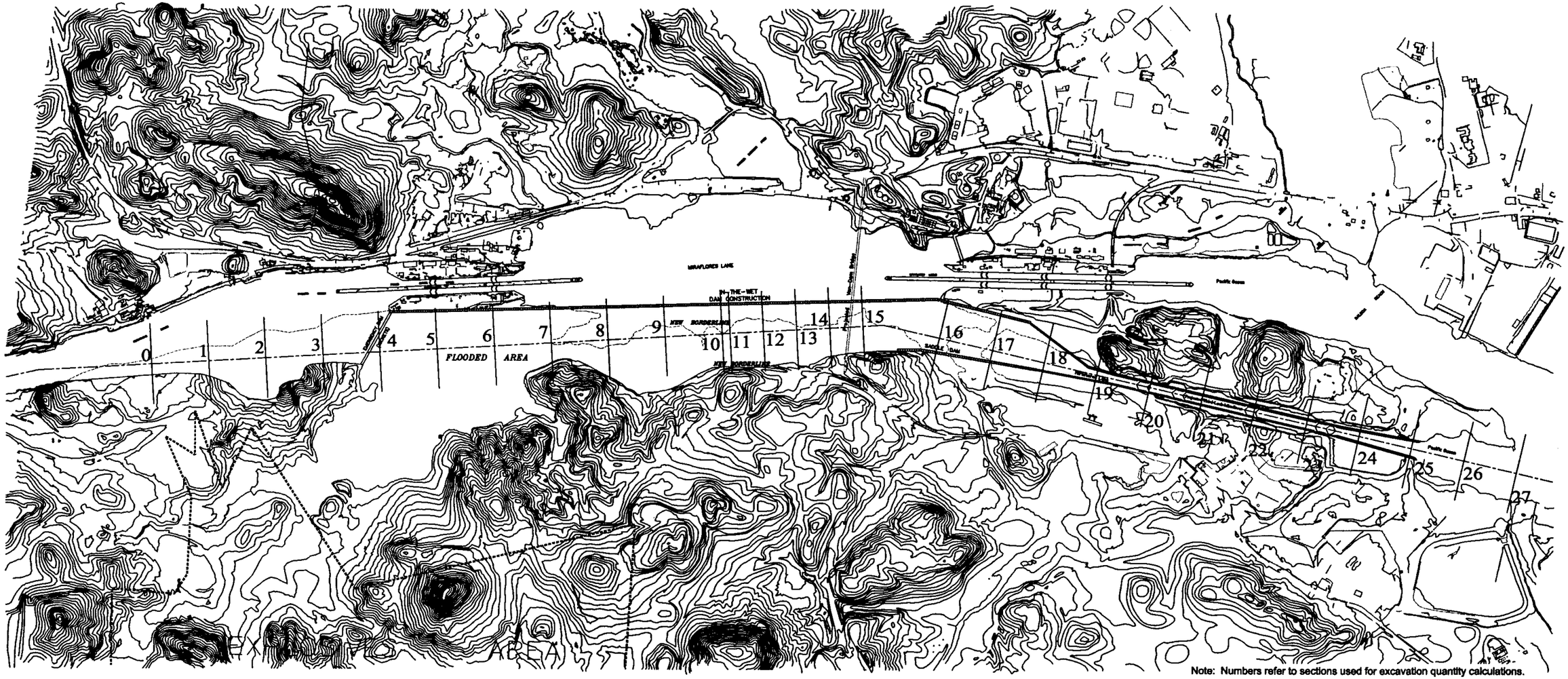
PANAMA CANAL		
Lock Channel Alignments		
ALT.1 SECTION 31		
HARZA ENGINEERING COMPANY		
CHICAGO, ILLINOIS	DATE: DEC. 1990	SCALE= 1:4,000

Note: Numbers refer to sections used for excavation quantity calculations.

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Sections for Excavation Quantities - Alignment 3

HARZA TAMS | August 2000 | Exhibit D-4

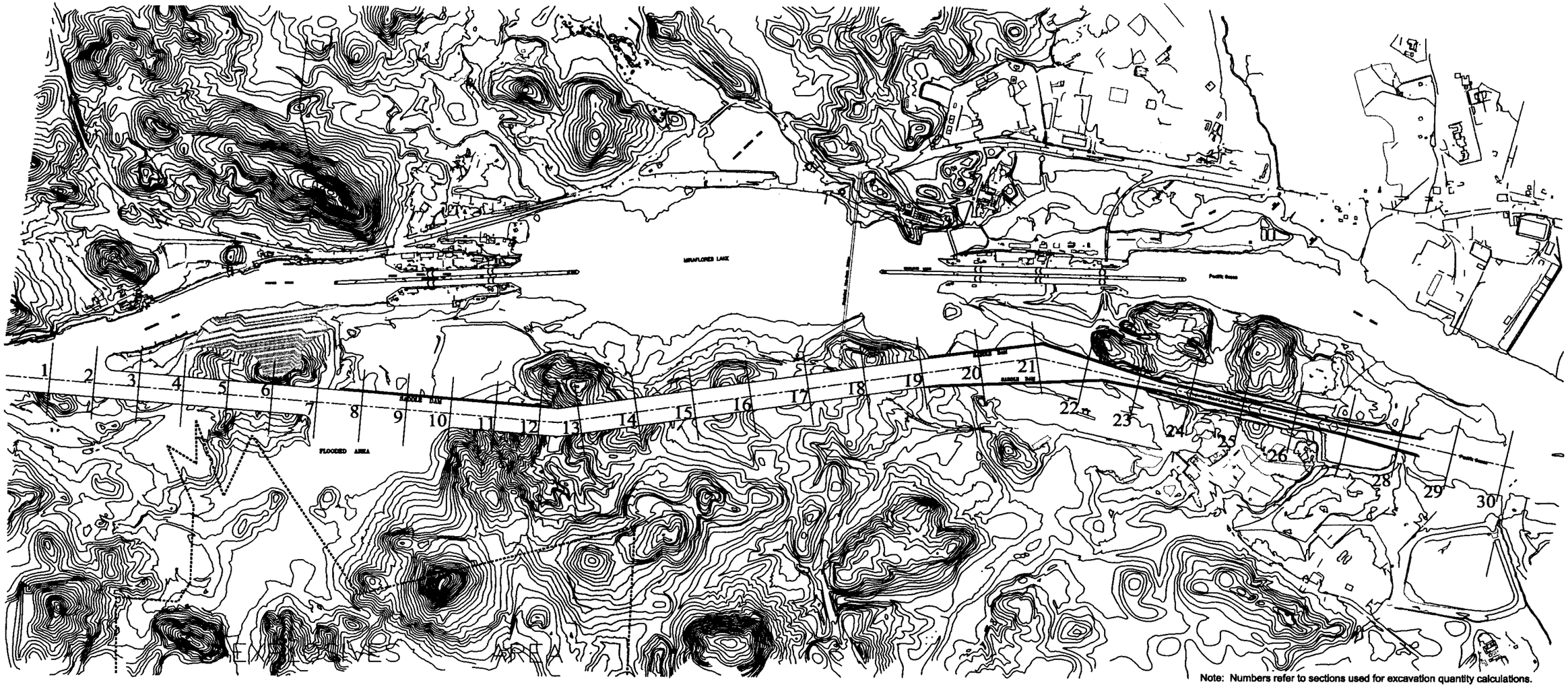


Note: Numbers refer to sections used for excavation quantity calculations.

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Sections for Excavation Quantities - Alignment 7

HARZA TAMS	August 2000	Exhibit D-5



Note: Numbers refer to sections used for excavation quantity calculations.

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Sections for Excavation Quantities - Alignment 8

HARZA TAMS	August 2000	Exhibit D-6

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Note: Numbers refer to sections used for excavation quantity calculations.

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Sections for Excavation Quantities - Alignment 11

HARZA TAMS	August 2000	Exhibit D-7

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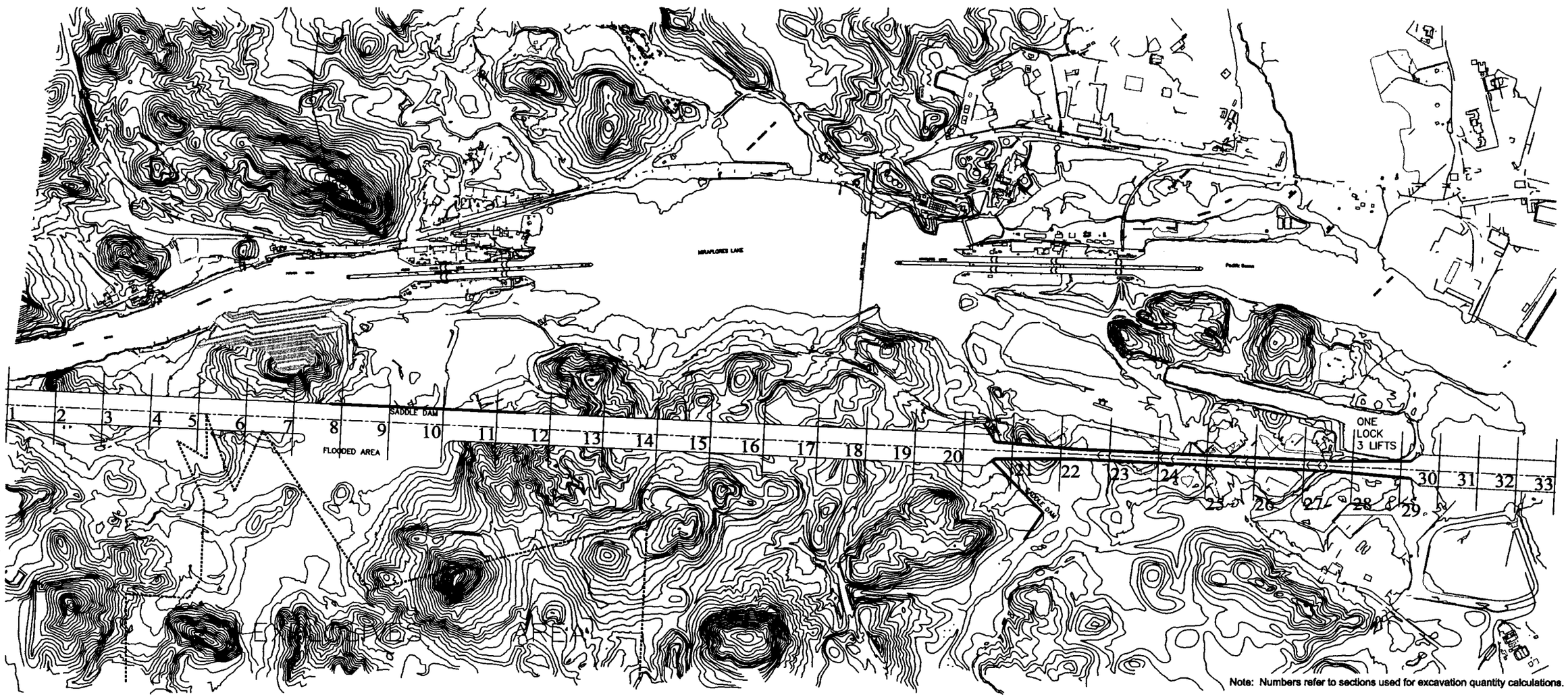
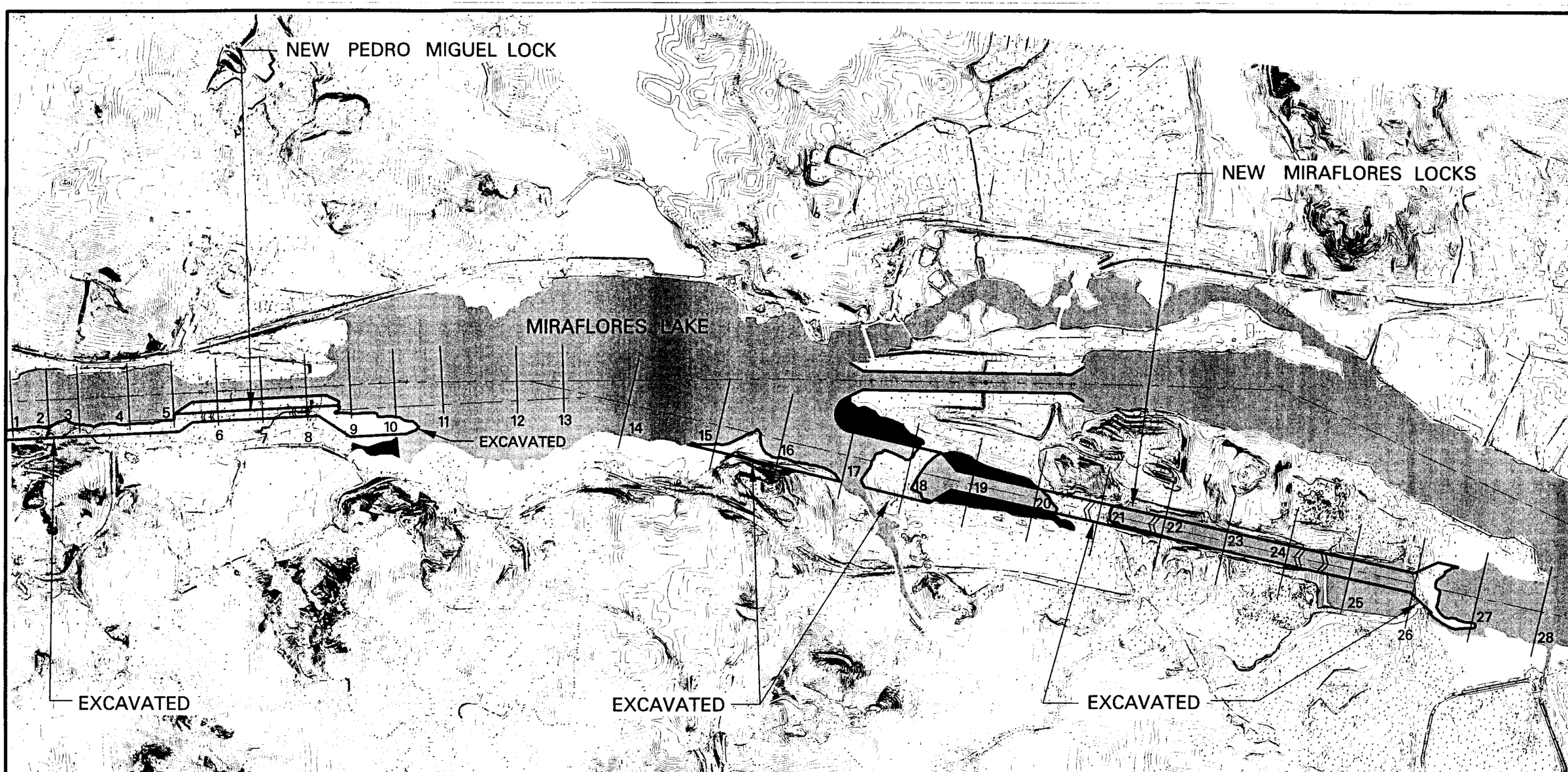


Note: Numbers refer to sections used for excavation quantity calculations.

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Sections for Excavation Quantities - Alignment 14

HARZA TAMS	August 2000	Exhibit D-8



Note: Numbers refer to sections used for excavation quantity calculations.

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Section for Excavations Quantities – Alignment 41

HARZA TAMS	August 2000	Exhibit D-9

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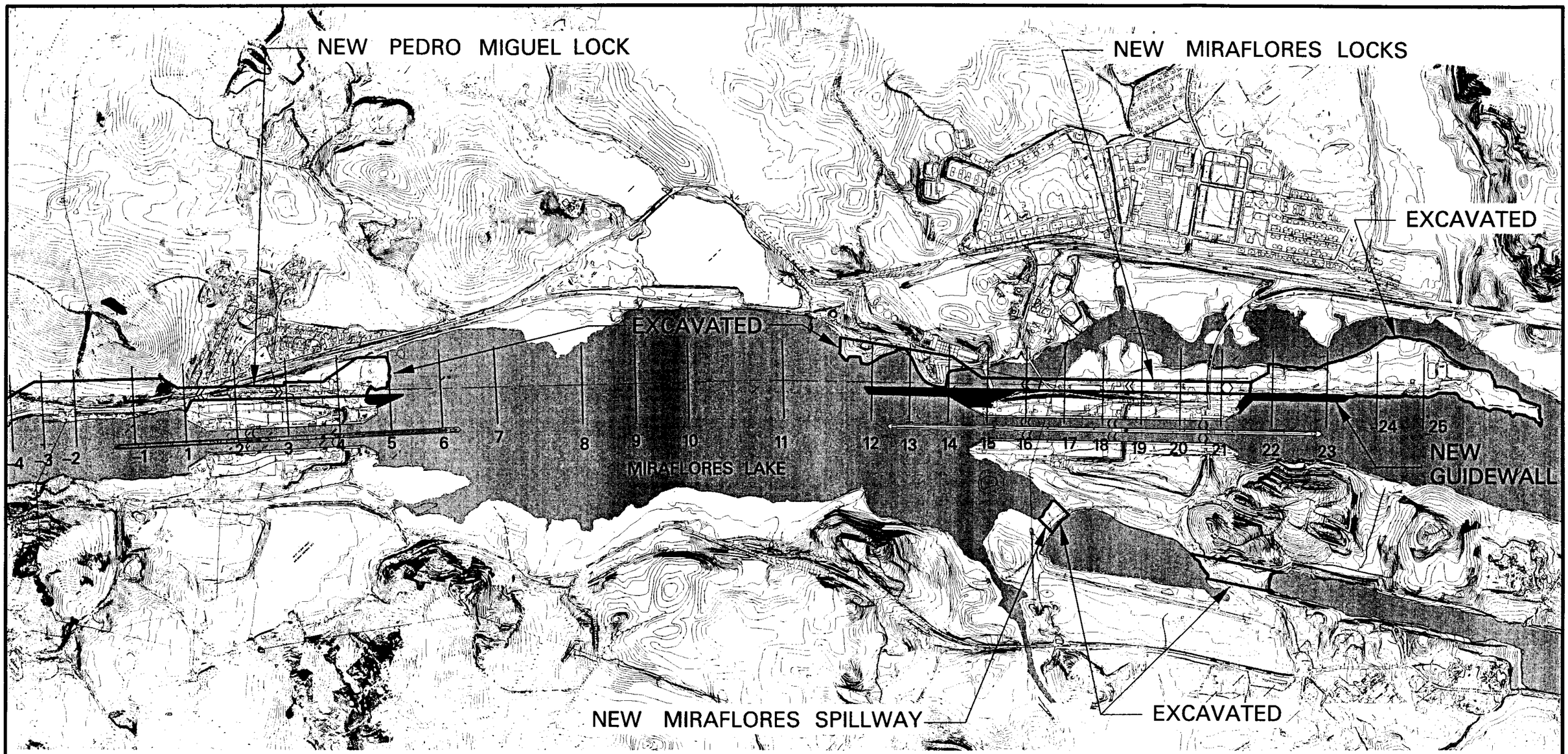
23 AUG 2000 08:25:35
Chicago

volume2\exh-d9-align-41.dgn Aug 23, 2000 08:25:34



Note: Numbers refer to sections used for excavation quantity calculations.

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Sections for Excavations Quantities – Alignment 42

HARZA TAMS	August 2000	Exhibit D-10

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THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX E

KEPNER-TREGOE EVALUATION OF ALIGNMENTS

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX E
KEPNER-KREGOE EVALUATION OF ALIGNMENTS

TABLE OF CONTENTS

EXHIBITS

Exhibit	Title
E-1	Evaluation Worksheets
E-2	Raw Scores for each Alignment Alternative
E-3	Weighted Scores for each Alignment Alternative
E-4	Sensitivity Analysis of Atlantic Alignments
E-5	Sensitivity Analysis of Pacific Alignments

Evaluation Worksheet for Alignment Alternatives

ATLANTIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 4 – Third Locks Projects** This alternative shows a third lane alignment, with three lifts in sequence from tidewater to Lake Gatun. The alignment is east of the existing canal.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	5	Minimal relief in topography on either side of the proposed alignment.
	Potential for Future Expansion	4	Location of a fourth lane is restricted to the east side of the proposed alignment due to the proximity of the existing locks.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	5	None. Proposed alignment does not disturb Gatun Dam.
Operational	Maximize Navigational Safety and Ship Maneuverability	1	Maritime congestion will be increased at both entrances to the locks. Congestion is increased along the entire length of the Atlantic approach canal.
	Maximize Integration with Existing Operations	5	A joint control center will be possible in addition to sharing of many operational facilities and personnel (i.e.: tugs, emergency personnel).
	Accessibility of Equipment, Materials and Personnel for Operations	5	Proposed alternative is readily accessible from existing roads and canal operations areas.
	Minimize Maintenance Dredging	5	Less than two kilometers of total channel length will be added.
Constructibility	Impacts on Existing Canal Operations During Construction	1	Dump barges may pass through existing canal. Temporary cofferdam will restrict channel traffic at the Atlantic approach. Existing operations facilities may be relocated. Existing lock operations areas may be used for construction staging.
	Accessibility of Construction Equipment, Materials and Personnel	4	Proposed alignment is readily accessible along entire length of channel. Existing infrastructure will limit staging and construction zones.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	3	Proximity to existing canal will limit freedom of movements for construction operations. Size, type and placement of temporary cofferdams is limited due to existing canal operations.
Economic	Relative Cost of Locks and Special Features	5	Basic three-lift lock alignment. No special features.
	Excavation Cost (incl. Temporary Works)	4	Less than average amount of material to be excavated (approx. 10 million m^3). Favorable excavation conditions.
	Minimize Construction Time	4	Possible delays due to canal operations. Less than average amount of excavation.
Other Impacts	Environmental	5	Proposed alignment to be built in urban "brownfield." No new flooding is required.
	Socio-Economic	4	Although some existing lock operations facilities will require relocation, no homes or businesses will be displaced.
	Relocations (e.g. Utilities, Infrastructure)	1	Proposed alignment will necessitate relocation of utilities especially those servicing the existing canal. The drawbridge crossing the existing locks will be expanded/replaced.

Evaluation Worksheet for Alignment Alternatives

ATLANTIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 5 – Third Locks Projects** This alternative shows a third lane alignment, with three lifts in sequence from tidewater to Lake Gatun. The alignment is east of the existing canal.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	5	Minimal relief in topography on either side of the proposed alignment.
	Potential for Future Expansion	5	Addition of a fourth lane may be added to either side of the proposed alignment.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	5	None. Proposed alignment does not disturb Gatun Dam.
Operational	Maximize Navigational Safety and Ship Maneuverability	3	Maritime congestion is increased along the entire Atlantic approach canal length. Congestion is avoided at the Gatun approach.
	Maximize Integration with Existing Operations	4	A joint control center may be possible. Also, many operational facilities and personnel may be shared (i.e.: tugs, emergency personnel).
	Accessibility of Equipment, Materials and Personnel for Operations	5	Proposed alternative is readily accessible from existing roads and canal operations areas.
	Minimize Maintenance Dredging	5	Less than two kilometers of total channel length will be added.
Constructibility	Impacts on Existing Canal Operations During Construction	3	Construction of proposed alignment will interfere with operations and channel traffic at Atlantic approach. Temporary cofferdam will restrict canal entrance and existing lock operations areas may be used for construction staging.
	Accessibility of Construction Equipment, Materials and Personnel	3	Proposed alignment passes through town of Gatun, severely limiting staging and construction zones. Proposed alignment is readily accessible along entire length of channel.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	3	Size, type and placement of temporary cofferdams is limited due to existing canal operations.
Economic	Relative Cost of Locks and Special Features	5	Basic three-lift lock alignment. No special features.
	Excavation Cost (incl. Temporary Works)	3	Moderate amount of material to be excavated (approx. 17 million m^3). Favorable excavation conditions.
	Minimize Construction Time	3	Possible delays due to canal operations. Average construction time required based on excavation estimates.
Other Impacts	Environmental	5	Proposed alignment to be built in urban "brownfield." No new flooding is required.
	Socio-Economic	1	Homes and businesses will be displaced.
	Relocations (e.g. Utilities, Infrastructure)	2	Utilities and roads will be relocated.

Evaluation Worksheet for Alignment Alternatives

ATLANTIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 6 – Third Locks Projects** This alternative shows a third lane alignment, with three lifts in sequence from tidewater to Lake Gatun. The alignment is east of the existing canal, located in the 1939 excavation.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	5	Minimal relief in topography on either side of the proposed alignment.
	Potential for Future Expansion	5	Addition of a fourth lane may be added to either side of the proposed alignment.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	5	None. Proposed alignment does not disturb Gatun Dam.
Operational	Maximize Navigational Safety and Ship Maneuverability	4	Maritime congestion is increased only along one-third of the Atlantic approach canal length. Congestion is avoided at the Gatun approach.
	Maximize Integration with Existing Operations	2	A separate control center, independent of the existing locks, will be necessary. Sharing of some control features may be possible.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Proposed alternative is moderately accessible from existing roads and canal operations areas.
	Minimize Maintenance Dredging	3	Four and one-half kilometers of total channel length will be added.
Constructibility	Impacts on Existing Canal Operations During Construction	4	Minimal interference with existing canal.
	Accessibility of Construction Equipment, Materials and Personnel	5	Proposed alignment is readily accessible along entire length of channel. Minimal restriction to staging and construction zones.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	5	No constraints or limitations to construction operations.
Economic	Relative Cost of Locks and Special Features	5	Basic three-lift lock alignment. No special features.
	Excavation Cost (incl. Temporary Works)	5	Minimal amount of material to be excavated (est. 5 million m^3). Favorable excavation conditions.
	Minimize Construction Time	5	Less than average construction time to complete proposed alignment based on estimated amount and type of excavations.
Other Impacts	Environmental	4	No new flooding is required. Minimal undeveloped area required for proposed alignment.
	Socio-Economic	4	Minimal number of homes to be displaced.
	Relocations (e.g. Utilities, Infrastructure)	2	Bridge on highway 836 to be replaced.

Evaluation Worksheet for Alignment Alternatives

ATLANTIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 17 – Third Locks Projects** This alternative shows a third lane alignment, with three lifts in sequence from tidewater to Lake Gatun. The alignment is west of the existing canal, through the Gatun Dam.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	5	Minimal relief in topography on either side of the proposed alignment.
	Potential for Future Expansion	3	Location of a fourth lane is restricted to the west side of the proposed alignment due to the proximity of the existing locks. Fourth lane will pass through Gatun dam.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	Proposed alignment passes through Gatun Dam.
Operational	Maximize Navigational Safety and Ship Maneuverability	2	Maritime congestion will be increased at both entrances to the locks. Congestion is increased along the entire length of the Atlantic approach canal.
	Maximize Integration with Existing Operations	5	A joint control center will be possible in addition to sharing of many operational facilities and personnel (i.e.: tugs, emergency personnel).
	Accessibility of Equipment, Materials and Personnel for Operations	4	Proposed alternative is readily accessible from existing roads and canal operations areas. Accessiblity will be hampered by drawbridge over existing canal.
	Minimize Maintenance Dredging	5	Less than two kilometers of total channel length will be added.
Constructibility	Impacts on Existing Canal Operations During Construction	1	Dump barges may pass through existing canal. Temporary cofferdam will restrict channel traffic at the Atlantic approach. Existing operations facilities may be relocated. Existing lock operations areas may be used for construction staging.
	Accessibility of Construction Equipment, Materials and Personnel	3	Proposed alignment is fairly accessible along entire length of canal. Existing infrastructure will limit staging and construction zones.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	2	Proximity to existing canal will limit freedom of movements for construction operations. Size, type and placement of temporary cofferdams is limited due to existing canal operations. Locks must be integrated with existing Gatun dam.
Economic	Relative Cost of Locks and Special Features	4	Basic three-lift lock alignment. Integration with existing Gatun dam will require auxiliary structures.
	Excavation Cost (incl. Temporary Works)	4	Less than average amount of material to be excavated (approx. 10 million m^3) . Favorable excavation conditions.
	Minimize Construction Time	3	Possible delays due to canal operations. Proposed alignment will pass through the Gatun Dam.
Other Impacts	Environmental	4	Proposed alignment to be built in urban "brownfield." No new flooding is required.
	Socio-Economic	4	Although some existing lock operations facilities will require relocation, no homes or businesses will be displaced.
	Relocations (e.g. Utilities, Infrastructure)	5	Minimal relocations required.

Evaluation Worksheet for Alignment Alternatives

ATLANTIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 18 – Third Locks Projects** This alternative shows a third lane alignment, with three lifts in sequence from tidewater to Lake Gatun. The alignment is west of the existing canal, within the French Canal and through the Gatun Dam, east of the spillway.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	5	Minimal relief in topography on either side of the proposed alignment.
	Potential for Future Expansion	4	Fourth lane will pass through Gatun dam.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	Proposed alignment passes through Gatun Dam.
Operational	Maximize Navigational Safety and Ship Maneuverability	4	Maritime congestion is increased along one-third of the Atlantic approach canal length. Azimuth for proposed alignment crosses existing canal azimuth at the Gatun approach.
	Maximize Integration with Existing Operations	3	A separate control center, independent of the existing locks, will be necessary. Sharing of some control features may be possible.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Accessibility is limited to north and south ends of proposed alignment.
	Minimize Maintenance Dredging	4	Four kilometers of total channel length will be added.
Constructibility	Impacts on Existing Canal Operations During Construction	4	Construction will have a minimal impact on existing canal operations.
	Accessibility of Construction Equipment, Materials and Personnel	2	Poor accessibility to proposed alignment. Construction and staging zones are limited by wetlands.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	2	Proposed alignment passes through Gatun dam adding an additional degree of difficulty to the project. Size, type and placement of temporary cofferdams is limited due to existing canal operations.
Economic	Relative Cost of Locks and Special Features	3	Basic three-lift lock. Integrating the lock into the dam increases the cost of the project.
	Excavation Cost (incl. Temporary Works)	3	Average amount of material to be excavated (approx. 15 million m^3). Difficult excavation conditions due to wetlands and the hydraulic fill of Gatun Dam.
	Minimize Construction Time	3	Integrating the lock into the Gatun Dam will increase construction time.
Other Impacts	Environmental	3	Proposed alignment borders environmentally sensitive wetlands area.
	Socio-Economic	5	No homes or businesses will be displaced.
	Relocations (e.g. Utilities, Infrastructure)	4	Minimal relocations of infrastructure required (highway 82).

Evaluation Worksheet for Alignment Alternatives

ATLANTIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 19 – Third Locks Projects** This alternative shows a third lane alignment, with three lifts in sequence from tidewater to Lake Gatun. The alignment is west of the existing canal, within the French Canal and through the Gatun Dam, west of the spillway.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	5	Minimal relief in topography on either side of the proposed alignment.
	Potential for Future Expansion	4	Fourth lane will pass through Gatun dam.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	Proposed alignment passes through Gatun Dam.
Operational	Maximize Navigational Safety and Ship Maneuverability	3	Maritime congestion is increased along one-third of the Atlantic approach canal length. Gatun approach will require navigation through groups of small islands. Navigation is limited during spillage.
	Maximize Integration with Existing Operations	1	Joint control with existing control systems will be difficult or impossible.
	Accessibility of Equipment, Materials and Personnel for Operations	2	Accessibility is limited to north and south ends of proposed alignment.
	Minimize Maintenance Dredging	3	Five kilometers of total channel length will be added.
Constructibility	Impacts on Existing Canal Operations During Construction	4	Construction will have a minimal impact on existing canal operations.
	Accessibility of Construction Equipment, Materials and Personnel	2	Poor accessibility to proposed alignment. Construction and staging zones are limited by wetlands.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	1	Proposed alignment passes through Gatun dam adding an additional degree of difficulty to the project. Size, type and placement of temporary cofferdams is limited due to existing canal operations.
Economic	Relative Cost of Locks and Special Features	3	Basic three-lift lock. A new spillway will be required on the right abutment of the dam.
	Excavation Cost (incl. Temporary Works)	3	Average amount of material to be excavated (approx. 15 million m^3). Difficult excavation conditions due to wetlands and Gatun Dam hydraulic fill.
	Minimize Construction Time	2	In addition to excavation and lock construction, integration of the lock into the Gatun Dam increases construction time.
Other Impacts	Environmental	2	Proposed alignment borders environmentally sensitive wetlands area.
	Socio-Economic	5	No homes or businesses will be displaced.
	Relocations (e.g. Utilities, Infrastructure)	4	Minimal relocations of infrastructure required (highway 82).

Evaluation Worksheet for Alignment Alternatives

ATLANTIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 31 – Third Locks Projects** This alternative shows third and fourth lane alignments, with three lifts in sequence from tidewater to Lake Gatun. The alignment is east of the existing canal, located in the 1939 excavation.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	5	Minimal relief in topography on either side of the proposed alignment.
	Potential for Future Expansion	4	Fourth lane will pass through Gatun dam.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	Proposed alignment passes through Gatun Dam.
Operational	Maximize Navigational Safety and Ship Maneuverability	4	Maritime congestion is avoided along the Atlantic approach canal. Azimuth for proposed alignment crosses existing canal azimuth at the Gatun approach.
	Maximize Integration with Existing Operations	2	A separate control center, independent of the existing locks, will be necessary. Difficult or impossible to share any control features.
	Accessibility of Equipment, Materials and Personnel for Operations	2	Accessibility is severely restricted.
	Minimize Maintenance Dredging	3	Five and one-half kilometers of total channel length will be added.
Constructibility	Impacts on Existing Canal Operations During Construction	4	Construction will have a minimal impact on existing canal operations.
	Accessibility of Construction Equipment, Materials and Personnel	2	Poor accessibility to proposed alignment. Construction and staging zones are limited by wetlands.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	2	Proposed alignment passes through Gatun dam adding an additional degree of difficulty to the project.
Economic	Relative Cost of Locks and Special Features	3	Basic three-lift lock. Integrating the lock into the dam increases the cost of the project.
	Excavation Cost (incl. Temporary Works)	1	Large amount of material to be excavated (approx. 46 million m^3). Difficult excavation conditions due to wetlands and the hydraulic fill of Gatun Dam.
	Minimize Construction Time	1	More than average excavation material and integrating the lock into the Gatun Dam will increase construction time.
Other Impacts	Environmental	2	Proposed alignment borders environmentally sensitive wetlands area.
	Socio-Economic	5	No homes or businesses will be displaced.
	Relocations (e.g. Utilities, Infrastructure)	4	Minimal relocations of infrastructure required (highway 82).

Evaluation Worksheet for Alignment Alternatives

ATLANTIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 32 – Third Locks Projects** This alternative shows a third lane alignment, with three lifts in sequence from tidewater to Lake Gatun. The alignment is east of the existing canal.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	5	Minimal relief in topography on either side of the proposed alignment.
	Potential for Future Expansion	4	Fourth lane will pass through Gatun dam.
	Special Site Considerations e.g Susceptibility to Catastrophic Events	4	Proposed alignment passes through Gatun Dam.
Operational	Maximize Navigational Safety and Ship Maneuverability	4	Maritime congestion is avoided along the Atlantic approach canal. Gatun approach will require navigation through groups of small islands. Navigation is limited during spllage.
	Maximize Integration with Existing Operations	1	A separate control center, independent of the existing locks, will be necessary. Not possible to share any control features.
	Accessibility of Equipment, Materials and Personnel for Operations	1	Accessibility is severely restricted.
	Minimize Maintenance Dredging	2	Six and one-half kilometers of total channel length will be added.
Constructibility	Impacts on Existing Canal Operations During Construction	4	Construction will have a minimal impact on existing canal operations.
	Accessibility of Construction Equipment, Materials and Personnel	2	Poor accessibility to proposed alignment. Construction and staging zones are limited by wetlands.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	1	Proposed alignment passes through Gatun dam adding an additional degree of difficulty to the project.
Economic	Relative Cost of Locks and Special Features	1	Basic three-lift lock. A new spillway will be required on the right abutment of the dam.
	Excavation Cost (incl. Temporary Works)	1	Large amount of material to be excavated (approx. 50 million m^3). Difficult excavation conditions due to wetlands and Gatun Dam hydraulic fill.
	Minimize Construction Time	1	In addition to excavation and lock construction, integration of the lock into the Gatun Dam increases construction time.
Other Impacts	Environmental	2	Proposed alignment borders environmentally sensitive wetlands area.
	Socio-Economic	5	No homes or businesses will be displaced.
	Relocations (e.g. Utilities, Infrastructure)	4	Minimal relocations of infrastructure required (highway 82).

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 1 – Third Locks Projects (1939)** This alternative shows a third lane alignment that parallels the existing Miraflores/Pedro Miguel lock arrangement to the west, i.e., two lifts from tidewater to Lake Miraflores, with the third lift at a separate location to lift vessels from Lake Miraflores to Lake Gatun. The Pacific approach channel to the third lane makes maximum use of the 1939 Third Lock excavation. The vessel transit through Lake Miraflores would be below the "Projected Van Dam Bridge," requiring consideration of vessel clearances (vertical and horizontal) under the bridge.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	1	The northern end of the alignment passes through Cucaracha formation.
	Potential for Future Expansion	4	A fourth lock could be added alongside each of the proposed locks.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	2	The alignment contains three new azimuths but avoids congestion near the entrance and egress to each of the existing locks.
	Maximize Integration with Existing Operations	2	New control centers are required for each new third lock. Tugs may be shared for some operations.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Access is available via existing and rerouted roads.
	Minimize Maintenance Dredging	2	Additional dredging will be required in new approach channels but the alignment makes use of already maintained Lake Miraflores.
Constructibility	Impacts on Existing Canal Operations During Construction	4	Some disturbance will take place as a result of construction staging and dredging for the new channels.
	Accessibility of Construction Equipment, Materials and Personnel	3	Excavation for the new channels in Lake Miraflores will be hindered by ship traffic between the existing locks. Waterborne plant will be able to access the sites by Lake Miraflores. Terrestrial equipment can utilize existing roads.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	2	Part of the Pedro Miguel Third lock passes through an explosives area.
Economic	Relative Cost of Locks and Special Features	3	One two lift lock, one one lift lock and two small saddle dams.
	Excavation Cost (incl. Temporary Works)	3	Pedro Miguel third lock passes behind Cerro Paraiso. The channel to connect to the Gaillard cut must be wide to allow for a sharp curve. Miraflores third lock utilizes existing Miraflores excavation.
	Minimize Construction Time	3	The excavation of the new Pedro Miguel lock will require extra time, but excavation of new Miraflores locks will be sped by the use of existing excavation.
Other Impacts	Environmental	2	Some new flooding of Lake Miraflores is required.
	Socio-Economic	4	No major displacements of homes or businesses.
	Relocations (e.g. Utilities, Infrastructure)	3	Relocation of Carretera Borinouen

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 2 – Saddle Dam and Cofferdam** This alternative shows three lifts in sequence located at the 1939 Third Locks excavation, with extensive channel- excavation, two saddle dams, and a cofferdam to bypass Lake Miraflores. Parallel water saving basins are shown on either side of the locks. Although not shown, this alignment would also appear to require another span of the Van Dam Bridge to complete the access to the west.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	3	The alignment does not pass through Cucaracha formation.
	Potential for Future Expansion	4	Must relocate water saving ponds to construct a fourth lane.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	3	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	2	Separate channel, but congestion will occur north of existing Pedro Miguel locks. Contains three new azimuths.
	Maximize Integration with Existing Operations	3	The new third lock will require separate controls and additional tugs, but using a single lock instead of two will reduce the total number of operations personnel required.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Good existing access.
	Minimize Maintenance Dredging	2	New channel requires additional maintenance.
Constructibility	Impacts on Existing Canal Operations During Construction	4	The new saddle dam construction near the existing Pedro Miguel locks and the cofferdam near the Miraflores locks may cause some disruption of existing operations.
	Accessibility of Construction Equipment, Materials and Personnel	3	Excavation in the existing Miraflores third lock excavation site will be relatively straightforward. Access for the rest of the excavation will be difficult.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	3	The excavation passes near but not inside of the indicated explosives area.
Economic	Relative Cost of Locks and Special Features	3	One triple lift lock, two saddle dams, and one cofferdam.
	Excavation Cost (incl. Temporary Works)	2	Deep excavation through mountains is somewhat mitigated by immediate lift to 85' PLD.
	Minimize Construction Time	2	The three lift locks and extensive excavation required will increase construction time.
Other Impacts	Environmental	1	Large scale flooding.
	Socio-Economic	3	No major relocations of homes or businesses would be required. Construction noise and traffic will affect homes and businesses.
	Relocations (e.g. Utilities, Infrastructure)	2	Relocation of carretera.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 3 – Third Parallel Locks to Existing Locks** This alternative places a third lane of locks immediately adjacent to, and west of, the existing locks at Miraflores and Pedro Miguel. Small saddle dams are shown to tie the new lock guidewalls back into a westerly-expanded Lake Miraflores. An additional set of miter gates is shown for the upper lift at Miraflores. It appears that this replicates the existing Miraflores lock, with the flexibility to shorten or lengthen the chamber to better suit the vessel locking through.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	5	The alignment does not pass through Cucaracha formation or pacific muck.
	Potential for Future Expansion	3	The Miraflores locks could be readily expanded to accommodate a fourth lane. Adding a fourth lane to Pedro Miguel would require the excavation of a large portion of the Cerro Paraiso.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	3	Good sight lines but additional congestion in the lock entrance and exit areas.
	Maximize Integration with Existing Operations	5	The side-by-side new locks would allow use would allow integration of the new locks with the existing control systems. Additionally, tugs could be fully shared between existing and new locks.
	Accessibility of Equipment, Materials and Personnel for Operations	4	Good access for new structures, but new facilities must be constructed to replace existing infrastructure that will be removed during the excavation.
	Minimize Maintenance Dredging	5	Uses existing Lake Miraflores transit area.
Constructibility	Impacts on Existing Canal Operations During Construction	2	Construction will interfere with existing operations on a constant basis.
	Accessibility of Construction Equipment, Materials and Personnel	2	Canal operations will limit access to the site.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	4	The alignment does not pass through or near the UXO site.
Economic	Relative Cost of Locks and Special Features	4	One two lift lock, one one lift lock and two saddle dams.
	Excavation Cost (incl. Temporary Works)	5	Excavation will be relatively small due to existing entrance channels on all sides of both locks.
	Minimize Construction Time	5	While little excavation will be required, existing lock operations will slow construction.
Other Impacts	Environmental	5	Limited flooding of Lake Miraflores is required.
	Socio-Economic	4	No major relocations of homes or businesses would be required. Construction noise and traffic will affect homes and businesses.
	Relocations (e.g. Utilities, Infrastructure)	4	Large-scale relocation of existing lock operations buildings is required.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 7 – The Third Locks Projects and Dams** This alternative uses the 1939 Third Locks excavation to site three lifts of locks southwest of the existing Miraflores locks. An extensive barrier dam (noted as "In-the-Wet Construction") isolates the new transit channel from the existing Lake Miraflores, with the western shoreline of the Lake moved farther west to accommodate the channel. An emergency dam with wickets is shown at the upper end of the new transit channel, adjacent to Pedro Miguel locks.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	3	The alignment does not pass through Cucaracha formation.
	Potential for Future Expansion	4	A fourth lock could be constructed beside the proposed third three-lift lock.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	Emergency dam would protect structures from a flood.
Operational	Maximize Navigational Safety and Ship Maneuverability	5	New channel will ease congestion entering and exiting locks. Add one point for new berthing areas possible along the new dam dividing Upper and Lower Lake Miraflores.
	Maximize Integration with Existing Operations	3	The new third lock will require separate controls and additional tugs, but using a single lock instead of two will reduce the total number of operations personnel required.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Operations will be similar to existing locks.
	Minimize Maintenance Dredging	2	New channel will require additional maintenance.
Constructibility	Impacts on Existing Canal Operations During Construction	3	"In-the-wet" dam construction may inhibit some of the traffic flow in Lake Miraflores.
	Accessibility of Construction Equipment, Materials and Personnel	3	Both marine and terrestrial accesses are available.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	3	The work zone does not pass through the indicated explosives area.
Economic	Relative Cost of Locks and Special Features	1	One two-lift lock plus "in the wet" saddle dams and an emergency dam.
	Excavation Cost (incl. Temporary Works)	4	Uses existing Miraflores excavation and raises the level of the west side of Lake Miraflores to minimize excavation.
	Minimize Construction Time	4	A single three-lift lock through the existing Miraflores excavation will be constructed relatively quickly. The virtual removal of the Cerro Paraiso will require extra time.
Other Impacts	Environmental	1	Massive flooding of the west side of Miraflores and Pedro Miguel is required.
	Socio-Economic	4	No major relocations of homes or businesses would be required. Construction noise and traffic will affect homes and businesses.
	Relocations (e.g. Utilities, Infrastructure)	3	Relocate Carretera, Powerline and VanDam bridge.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 8 – New Third Locks Alignment Project** This alignment, with only two lifts of locks in the 1939 Third Locks excavation, utilizes an extensive new channel to bypass Lake Miraflores. Three saddle dams are shown help confine the channel in the lower topographic areas. Again, an additional span of the Van Dam Bridge would be required to provide access to the west of the new channel.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	2	The alignment does not pass through Cucaracha formation.
	Potential for Future Expansion	4	Fourth locks could be constructed alongside proposed third lock in existing Miraflores excavation.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	3	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	4	New alignment contains three azimuths but the separate channel creates less congestion around existing locks.
	Maximize Integration with Existing Operations	3	The new third lock will require separate controls and additional tugs, but using a single lock instead of two will reduce the total number of operations personnel required.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Operations will be similar to existing locks.
	Minimize Maintenance Dredging	2	New channel requires additional maintenance.
Constructibility	Impacts on Existing Canal Operations During Construction	5	New channel bypasses existing locks.
	Accessibility of Construction Equipment, Materials and Personnel	3	Both marine and terrestrial accesses are available.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	3	The works do not pass through the indicated explosives area.
Economic	Relative Cost of Locks and Special Features	3	One two-lift lock and three saddle dams.
	Excavation Cost (incl. Temporary Works)	2	New channel required but raising immediately to 25.91 m PLD reduces excavation volume.
	Minimize Construction Time	2	The new locks utilize the existing Miraflores excavation, but new excavation is required for the rest of the bypass channel.
Other Impacts	Environmental	2	Some flooding required.
	Socio-Economic	4	No major relocations of homes or businesses would be required. Construction noise and traffic will affect homes and businesses.
	Relocations (e.g. Utilities, Infrastructure)	2	Carretera must be relocated.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 9 – Canal Alternatives Study Alignment** This alignment is a straight shot, located parallel to and approximately 2 km southwest of the existing locks. Three lifts in succession bring vessels from tidewater up to Lake Gatun level, with a straight transit channel rejoining the existing channel in the Gaillard Cut, some 4 km northwest of the Pedro Miguel Locks. The new channel goes through the Explosives Area for about 3 km of its length.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	1	The alignment does not pass through Cucaracha formation.
	Potential for Future Expansion	4	A fourth lock could be easily added beside the proposed three-lift third Miraflores lock.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	5	New approach and interior channel bypass existing operations.
	Maximize Integration with Existing Operations	1	The proposed alignment would require separate control systems and a separate guidance system (tugs).
	Accessibility of Equipment, Materials and Personnel for Operations	3	Existing roads will require only slight modifications to provide access for operations personnel and equipment.
	Minimize Maintenance Dredging	1	Additional maintenance dredging required for both new approach channel and new interior channel.
Constructibility	Impacts on Existing Canal Operations During Construction	5	None.
	Accessibility of Construction Equipment, Materials and Personnel	2	Remote location.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	1	The alignment passes through the center of an explosives area.
Economic	Relative Cost of Locks and Special Features	4	One three-lift lock and one saddle dam.
	Excavation Cost (incl. Temporary Works)	1	New approach channel and long interior channel through highly terrain create high excavation volumes.
	Minimize Construction Time	1	Massive excavation volumes will increase construction period.
Other Impacts	Environmental	2	The alignment passes largely through undeveloped land.
	Socio-Economic	3	No major relocations of homes or businesses would be required. Construction noise and traffic will affect homes and businesses.
	Relocations (e.g. Utilities, Infrastructure)	2	The alignment bisects only one major road.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 10 – Ship Lift and Cofferdams** This alternative shows a ship lift, northeast of the existing Miraflores Locks, with a narrow Pacific approach and bypass channel to convey smaller vessels around the Miraflores and Pedro Miguel Locks. A cofferdam is required to isolate the transit channel from Lake Miraflores. Additional cofferdams and saddle dams are required east of the alignment to limit inundation and maintain existing road and rail access through this developed area. The east approach to the proposed Van Dam Bridge would be bisected by the new channel, requiring an additional bridge span.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	4	The alignment does not pass through Cucaracha formation or Pacific muck.
	Potential for Future Expansion	2	The lock location does not allow for easy construction of a side-by-side fourth lane.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	2	Potential flooding and loss of Lake Gatun if coferdam failed..
Operational	Maximize Navigational Safety and Ship Maneuverability	3	The new alignment provides a separate channel but creates a congested intersection north of the existing Pedro Miguel locks.
	Maximize Integration with Existing Operations	3	The new locks will require separate control systems. However, one lock structure instead of two will reduce overall operations requirements for the new alignment.
	Accessibility of Equipment, Materials and Personnel for Operations	4	Access for operations should be relatively good since the proposed locks are adjacent to existing road and rail infrastructure.
	Minimize Maintenance Dredging	2	New channels require additional maintenance.
Constructibility	Impacts on Existing Canal Operations During Construction	4	Most construction work would avoid existing operations.
	Accessibility of Construction Equipment, Materials and Personnel	4	Construction access is generally good but may be hampered by a lack of staging area due to existing infrastructure.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	4	The alignment does not pass through an explosives area.
Economic	Relative Cost of Locks and Special Features	2	One double lift lock and a saddle dam with a highway and railroad on the crest.
	Excavation Cost (incl. Temporary Works)	3	One lift reduces the excavation volume by raising the water level to 85' PLD.
	Minimize Construction Time	3	The relocation of a highway and railroad on top of a to be constructed saddle dam will increase construction time.
Other Impacts	Environmental	2	The alignment calls for some new flooding.
	Socio-Economic	2	Some relocation of homes and businesses necessary.
	Relocations (e.g. Utilities, Infrastructure)	1	Railroad, highways and antennas must be relocated.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 11 – Alignment 1A Two Locks** This alternative uses the 1939 Third Locks excavation to site two lifts of locks southwest of the existing Miraflores locks. The alignment of the third lift lock is nearly parallel to, and just west of, the existing Pedro Miguel locks. Two cofferdams are shown to tie the new lock guidewalls back into a westerly-expanded Lake Miraflores shoreline. The vessel transit through Lake Miraflores would be below the "Projected Van Dam Bridge," requiring consideration of vessel clearances (vertical and horizontal) under the bridge.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	3	The alignment passes through a small quantity of Cucaracha formation and some Pacific muck.
	Potential for Future Expansion	3	Side-by-side fourth locks could be constructed at both the proposed Miraflores and Pedro Miguel third locks.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	4	The new alignment provides a relatively straight obstruction free passage from one lock to the next.
	Maximize Integration with Existing Operations	3	The new Miraflores locks will require separate control but the Pedro Miguel locks may integrate with the existing locks. The joint use of tugboats should achieve some synergy.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Marine and terrestrial access to both new sets of locks is good.
	Minimize Maintenance Dredging	2	New maintenance will be required in the new Pacific approach and in the widened Miraflores Lake.
Constructibility	Impacts on Existing Canal Operations During Construction	3	Both the Miraflores and Pedro Miguel excavations and construction will not interfere considerably with existing operations.
	Accessibility of Construction Equipment, Materials and Personnel	3	Access is good for both lock excavations and constructions.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	3	The alignment does not pass through an explosives area.
Economic	Relative Cost of Locks and Special Features	3	One two-lift lock, one one-lift lock and two saddle dams.
	Excavation Cost (incl. Temporary Works)	3	Excavation uses existing Miraflores third lock excavation.
	Minimize Construction Time	3	Construction time will be reduced by utilizing the existing Miraflores third locks excavation. However, the new Pedro Miguel lock will require excavation of a large portion of the Cerro Paraiso.
Other Impacts	Environmental	3	Additional flooding of Lake Miraflores is required.
	Socio-Economic	4	No major relocations of homes or businesses would be required. Construction noise and traffic will affect homes and businesses.
	Relocations (e.g. Utilities, Infrastructure)	3	Relocation of a carretera is required.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 12 – Alignment 1B One Lock 3 Lifts** This alignment is similar to Alternative No. 7. This alternative uses the 1939 Third Locks excavation to site three lifts of locks southwest of the existing Miraflores locks. An extensive cofferdam isolates the new transit channel from the existing Lake Miraflores, with the western shoreline of the Lake moved farther west to accommodate the channel. Two small saddle dams tie the new lock guidewalls into the cofferdam and the modified western shoreline of the Lake.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	3	The alignment does not pass through Cucaracha formation.
	Potential for Future Expansion	4	Side-by-side fourth locks could be constructed at the proposed Miraflores third locks.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	1	If the cofferdam were to rupture, the existing Miraflores locks would flood.
Operational	Maximize Navigational Safety and Ship Maneuverability	4	Separate entrance channel and good sight lines increase navigational safety. An additional point is added for new berthing facilities possible along the new dam separating Upper and Lower Lake Miraflores.
	Maximize Integration with Existing Operations	3	Separate controls will be required for the new Miraflores locks.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Marine and terrestrial access for the locks is good.
	Minimize Maintenance Dredging	2	Single lock increases water level in Lake Miraflores and thus reduces dredging.
Constructibility	Impacts on Existing Canal Operations During Construction	2	Construction of the cofferdam to separate the two halves of Lake Miraflores will cause some interference with existing canal operations.
	Accessibility of Construction Equipment, Materials and Personnel	3	Much of the site lies adjacent to existing infrastructure.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	3	The alignment does not pass through an explosives area.
Economic	Relative Cost of Locks and Special Features	2	One triple-lift lock, two cofferdams and one saddle dam.
	Excavation Cost (incl. Temporary Works)	4	Uses existing Miraflores excavation and floods western half of Miraflores Lake to 85' PLD.
	Minimize Construction Time	4	Excavation will be reduced, thus reducing construction time, by flooding Lake Miraflores to 85' PLD.
Other Impacts	Environmental	1	Large scale flooding required.
	Socio-Economic	3	No major relocations of homes or businesses would be required. Construction noise and traffic will affect homes and businesses.
	Relocations (e.g. Utilities, Infrastructure)	3	Carretera and other infrastructure require relocation.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 13 – Alignment 1 Lift and Two Lift Locks** This alignment is similar to Alternative No. 11. This alternative uses the 1939 Third Locks excavation to site two lifts of locks southwest of the existing Miraflores locks. The alignment of the third lift lock is slightly skewed, and just west of, the existing Pedro Miguel locks. Two saddle dams are shown to tie the new lock guidewalls back into a westerly-expanded Lake Miraflores shoreline. The vessel transit through Lake Miraflores would be below the "Projected Van Dam Bridge," requiring consideration of vessel clearances (vertical and horizontal) under the bridge.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	2	The alignment does not pass through Cucaracha formation.
	Potential for Future Expansion	3	Adding a fourth lane to the Pedro Miguel locks would require passage through the Cerro Paraiso.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	3	The new alignment lies on two new azimuths. Separate entrance channels will be constructed, but some congestion will take place in Lake Miraflores.
	Maximize Integration with Existing Operations	3	The new Pedro Miguel locks will integrate well with existing locks. Tugs and possible control operations may be shared.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Operations personnel and equipent will have ready access to the new locks.
	Minimize Maintenance Dredging	4	New approach channels will require additional dredging, but use of the existing lake Miraflores area will reduce total volumes.
Constructibility	Impacts on Existing Canal Operations During Construction	3	Construction of the new Pedro Miguel locks will interfere with existing operations because of the close proximity of the new locks to existing locks.
	Accessibility of Construction Equipment, Materials and Personnel	3	Much of the site lies adjacent to existing infrastructure.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	3	The alignment does not pass through an explosives area.
Economic	Relative Cost of Locks and Special Features	3	One two-lift lock, one one-lift lock and two saddle dams are called for.
	Excavation Cost (incl. Temporary Works)	3	Uses existing Miraflores third lock excavation but requires new excavation for third Pedro Miguel locks.
	Minimize Construction Time	3	Excavation volumes are relatively small, but two separate locks will be constructed.
Other Impacts	Environmental	3	Some new flooding of Lake Miraflores is required.
	Socio-Economic	4	No major relocations of homes or businesses would be required. Construction noise and traffic will affect homes and businesses.
	Relocations (e.g. Utilities, Infrastructure)	4	Required infrastructure relocations are less than average.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 14 – Alignment 3 (One Lock of 3 Lifts)** This alignment is a straight shot (similar to Alternative No. 9), located parallel to and approximately 1 km southwest of the existing locks. Three lifts in succession bring vessels from tidewater up to Lake Gatun level, with a straight transit channel rejoining the existing channel in the Gaillard Cut, approximately 2 km northwest of the Pedro Miguel Locks. Three saddle dams are shown. Unlike Alternative No. 9, this new channel avoids the UXO Area for its entire length.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	1	The alignment passes through a significant area of Cucaracha formation.
	Potential for Future Expansion	4	A fourth lane could be added adjacent to the proposed third lock.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	5	The alignment calls for separate internal and entrance channels, bypassing all existing locks.
	Maximize Integration with Existing Operations	2	The alignment requires completely separate control centers and guidance systems.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Access to the new operations areas is limited.
	Minimize Maintenance Dredging	1	Additional dredging will be required in both the approach and bypass channels.
Constructibility	Impacts on Existing Canal Operations During Construction	5	None.
	Accessibility of Construction Equipment, Materials and Personnel	2	Mountainous conditions make access difficult.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	2	The proposed channel passes through the center of an explosives area.
Economic	Relative Cost of Locks and Special Features	5	One three-lift lock and one small saddle dam.
	Excavation Cost (incl. Temporary Works)	1	The alignment does not use existing Miraflores excavation and requires a long deep cut through existing hilly terrain.
	Minimize Construction Time	1	Extensive excavation will require extra time.
Other Impacts	Environmental	2	Extensive flooding and large-scale excavation of untouched areas are required.
	Socio-Economic	3	The site of the proposed locks presently contains several homes and business. These and the surrounding developments will be significantly affected by the construction.
	Relocations (e.g. Utilities, Infrastructure)	2	Extensive infrastructure relocation is required.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 15 – The Third Locks Project** This alternative uses the 1939 Third Locks excavation to site three lifts of locks southwest of the existing Miraflores locks. The skewed alignment provides for a straight shot between the 1939 excavation site and the existing northwest end of the Pedro Miguel Locks. A saddle dam isolates the new transit channel from the existing Lake Miraflores. The plan shows a proposed tunnel or bridge spanning the existing channel northwest of the Pedro Miguel Locks. Additional roads are proposed including a route to Arraijan which shows two additional bridges spanning the flooded area west of Miraflores Lake.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	3	The alignment does not pass through Cucaracha formation.
	Potential for Future Expansion	4	A fourth lane could be added adjacent to the proposed third lock.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	2	If the saddle dam dividing the two halves of Lake Miraflores ruptured then the existing Miraflores locks would flood.
Operational	Maximize Navigational Safety and Ship Maneuverability	4	The alignment lies on one azimuth but some congestion will occur north of the Pedro Miguel locks.
	Maximize Integration with Existing Operations	3	The new channel will require separate control and guidance operations.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Terrestrial and marine access are available to the new locks.
	Minimize Maintenance Dredging	3	New bypass and approach channels require additional maintenance.
Constructibility	Impacts on Existing Canal Operations During Construction	3	Excavation near the Pedro Miguel locks will interfere with existing operations.
	Accessibility of Construction Equipment, Materials and Personnel	3	Construction access is available from existing infrastructure.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	3	The alignment does not pass through explosives area.
Economic	Relative Cost of Locks and Special Features	3	One two-lift lock and two saddle dams.
	Excavation Cost (incl. Temporary Works)	2	Uses part of the existing Miraflores third locks excavation and raises the water level of the western of half of Lake Miraflores to 85' PLD.
	Minimize Construction Time	2	The alignment will require an average construction period.
Other Impacts	Environmental	2	Extensive flooding is required.
	Socio-Economic	4	No major relocations of homes or businesses would be required. Construction noise and traffic will affect homes and businesses.
	Relocations (e.g. Utilities, Infrastructure)	3	Relocation of some infrastructure is required.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 16 – The Ship Lift Projects** This alternative shows a ship lift northeast of the existing Miraflores Locks. Dams are required to isolate the transit channel from Lake Miraflores and to limit inundation and maintain existing road and rail access. The new channel would bisect the proposed Van Dam Bridge East approach requiring an additional bridge span. The plan also shows a proposed tunnel or bridge spanning the existing channel northwest of the Pedro Miguel Locks. A new road and bridge to Arraijan are proposed. The proposed bridge crossings require consideration of vessel clearances (vertical and horizontal).	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	4	The alignment does not pass through Cucaracha formation or Pacific muck.
	Potential for Future Expansion	2	The proposed third lock is in a developed industrial area. There may not be room to accommodate a fourth lock.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	2	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	3	The alignment utilizes two azimuths and some congestion will occur north of the Pedro Miguel locks.
	Maximize Integration with Existing Operations	3	The new locks require new control and guidance systems.
	Accessibility of Equipment, Materials and Personnel for Operations	4	Marine and terrestrial access for the locks is good.
	Minimize Maintenance Dredging	2	The new channel and approach would require additional maintenance.
Constructibility	Impacts on Existing Canal Operations During Construction	4	Some interference will occur during excavation near the existing Mriaflores and Pedro Miguel locks.
	Accessibility of Construction Equipment, Materials and Personnel	4	Existing infrastructure provides good access for construction equipment and personnel.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	4	The alignment does not pass through an explosives area.
Economic	Relative Cost of Locks and Special Features	2	One lock (shiplift shown) and one cofferdam.
	Excavation Cost (incl. Temporary Works)	3	New approach channel requires significant excavation. Raising the channel to 85' PLD reduces interior channel excavation.
	Minimize Construction Time	3	An average construction period is required.
Other Impacts	Environmental	2	Some new flooding is required.
	Socio-Economic	2	No major relocations of homes or businesses would be required. Construction noise and traffic will affect homes and businesses.
	Relocations (e.g. Utilities, Infrastructure)	1	The alignment requires relocation of both a railroad and highway.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 20 – Third and Fourth Locks Projects** This alignment is a straight shot parallel to and approximately 1 km southwest of the existing Miraflores and Pedro Miguel Locks. Three lifts in succession bring vessels from tidewater up to Lake Gatun level, with a straight transit channel rejoining the existing channel in the Gaillard Cut, approximately 2 km northwest of the Pedro Miguel Locks. A fourth lane is shown, running parallel and adjacent to the third lane, southwest of the Miraflores Locks. This channel avoids the Explosives Area for its entire length.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	1	The alignment does not pass through Cucaracha formation.
	Potential for Future Expansion	4	Assuming initial construction of only a third lane, a fourth side-by-side lock is feasible.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	5	Construction of approach channel and bypass channel avoids all existing lock operations and congestion.
	Maximize Integration with Existing Operations	2	The placement of the locks and bypass channel offer no opportunities for integration with existing lock operations.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Access to the new operations areas is limited.
	Minimize Maintenance Dredging	1	New channels require large-scale additional maintenance.
Constructibility	Impacts on Existing Canal Operations During Construction	5	None.
	Accessibility of Construction Equipment, Materials and Personnel	2	Difficult access through hilly terrain.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	2	Alignment passes through explosives area.
Economic	Relative Cost of Locks and Special Features	5	One two lift lock.
	Excavation Cost (incl. Temporary Works)	1	The alignment does not make use of existing Miraflores third lock excavation and requires deep cuts through virgin hilly terrain.
	Minimize Construction Time	1	The required excavation volume would require longer construction time than the average alignment.
Other Impacts	Environmental	2	The new channel passes through virgin areas but does not call for massive new flooding.
	Socio-Economic	3	The site of the proposed locks presently contains several homes and business. These and the surrounding developments will be significantly affected by the construction.
	Relocations (e.g. Utilities, Infrastructure)	2	An above average number of infrastructure relocations are required.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 41 – West Bank Alignment** This alternative shows a third lane alignment that parallels the existing Miraflores/Pedro Miguel lock arrangement with two lifts from tidewater to Lake Miraflores and the third lift at a separate location to lift vessels from Lake Miraflores to Lake Gatun. The Pedro Miguel third lock is immediately west of the existing locks. The Pacific approach channel to the third lane makes use of the 1939 Third Lock excavation. The vessel transit through Lake Miraflores would be below the proposed Van Dam Bridge requiring consideration of vessel clearances (vertical and horizontal).	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	3	The alignment does not pass through Cucaracha formation.
	Potential for Future Expansion	2	A fourth lane could readily be added to the Miraflores third lock, but massive excavation of the Cerro Paraiso would be required for a fourth Pedro Miguel lock.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	3	The new configuration is on two azimuths and creates some congestion inside Lake Miraflores.
	Maximize Integration with Existing Operations	4	Joint control operations are possible at Pedro Miguel while Miraflores may benefit from some sharing of tugs.
	Accessibility of Equipment, Materials and Personnel for Operations	3	Operations access is readily available at both new locks from existing infrastructure.
	Minimize Maintenance Dredging	4	The alignment adds approximately 2.1 km of new channel.
Constructibility	Impacts on Existing Canal Operations During Construction	1	The new Pedro Miguel locks will interfere significantly with operations because of the close proximity to existing locks. The new Miraflores locks will only minimally interfere with the existing ones' operations.
	Accessibility of Construction Equipment, Materials and Personnel	3	All construction areas are readily accessible, however construction at the Pedro Miguel locks will be significantly restrained by existing operations.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	4	Proposed excavations are not adjacent to UXO areas. However, a fourth lane at Pedro Miguel might pass through the zone in order to avoid completely removing the Cerro Paraiso.
Economic	Relative Cost of Locks and Special Features	3	Two-lift lock in Miraflores and one lift lock in Pedro Miguel as well as two new saddle dams.
	Excavation Cost (incl. Temporary Works)	4	Excavation volume will be minimized by using the existing Miraflores excavation and because little new access is required.
	Minimize Construction Time	4	Estimated construction time is more than one standard deviation below the estimated average.
Other Impacts	Environmental	4	No massive flooding or excavation in virgin areas is required.
	Socio-Economic	4	No significant relocations of homes or business are required.
	Relocations (e.g. Utilities, Infrastructure)	5	Few major infrastructure relocations are required.

Evaluation Worksheet for Alignment Alternatives

PACIFIC ENTRANCE

ALTERNATIVE:-		**Alt. No. 42 – East Bank Alignment** This alternative places a third lane of locks immediately east of the existing locks at Miraflores and Pedro Miguel. It is similar to alignment 3, but takes advantage of the flat area east of the existing Miraflores locks to reduce excavation. The Miraflores spillway and power plant must be relocated to the 1939 Third Locks excavation site.	
Evaluation Category	**Evaluation Criteria**	**Score**	**Comments**
Technical	Maintain Stability of Bank Slopes	4	The alignment does not pass through Cucaracha formation.
	Potential for Future Expansion	3	Expansion is possible on the west side of both Miraflores and Pedro Miguel. However, either expansion would require both new excavation and relocations.
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	4	No unusual susceptibility to catastrophic failure.
Operational	Maximize Navigational Safety and Ship Maneuverability	3	Congestion will occur at both Miraflores and Pedro Miguel.
	Maximize Integration with Existing Operations	5	Joint controls are possible for both sets of locks.
	Accessibility of Equipment, Materials and Personnel for Operations	5	Operations are readily accessible by existing infrastructure. East side location makes for easiest access possible.
	Minimize Maintenance Dredging	5	Less than two km of new channel are required.
Constructibility	Impacts on Existing Canal Operations During Construction	1	Construction of both new sets of locks will significantly impact existing locks operations. All canal operations buildings will be relocated for excavations.
	Accessibility of Construction Equipment, Materials and Personnel	3	Construction access for both excavations will be hampered by existing operations.
	Ease of Construction (e.g. Proximity of unexploded ordnance)	4	Proposed excavations are not adjacent to UXO areas.
Economic	Relative Cost of Locks and Special Features	3	Two-lift lock in Miraflores and one lift lock in Pedro Miguel. A new spillway must be constructed to replace the existing east side spillway which will be demolished.
	Excavation Cost (incl. Temporary Works)	5	Little new excavation is required.
	Minimize Construction Time	5	Estimated construction time is more than one standard deviation below the estimated average.
Other Impacts	Environmental	5	No massive flooding or excavation in virgin areas is required.
	Socio-Economic	2	Relocation of many homes and businesses is required for new Pedro Miguel lock.
	Relocations (e.g. Utilities, Infrastructure)	1	Most existing operations buildings must be relocated. The existing power plant must be demolished and rebuilt on the west side adjacent to the new spillway.

Evaluation of Lock Channel Alignments

Evaluation Category	Evaluation Criteria	Importance Coefficient	Raw Scores for each Alignment Alternative																							
			Atlantic Side								Pacific Side															
			4	5	6	17	18	19	31	32	1	2	3	7	8	9	10	11	12	13	14	15	16	20	41	42
Technical	Maintain Stability of Bank Slopes	1.0	5	5	5	5	5	5	5	5	1	3	5	3	2	1	4	3	3	2	1	3	4	1	3	4
	Potential for Future Expansion	7.8	4	5	5	3	4	4	4	4	4	4	3	4	4	4	2	3	4	3	4	4	2	4	2	3
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	3.0	5	5	5	4	4	4	4	4	4	3	4	4	3	4	2	4	1	4	4	2	2	4	4	4
Operational	Maximize Navigational Safety and Ship Maneuverability	9.1	1	3	4	2	4	3	4	4	2	2	3	5	4	5	3	4	4	3	5	4	3	5	3	3
	Maximize Integration with Existing Operations	3.8	5	4	2	5	3	1	2	1	2	3	5	3	3	1	3	3	3	3	2	3	3	2	4	5
	Accessibility of Equipment, Materials and Personnel for Operations	3.2	5	5	3	4	3	2	2	1	3	3	4	3	3	3	4	3	3	3	3	3	4	3	3	5
	Minimize Maintenance Dredging	2.5	5	5	3	5	4	3	3	2	2	2	5	2	2	1	2	2	2	4	1	3	2	1	4	5
Constructibility	Impacts on Existing Canal Operations During Construction	10.0	1	3	4	1	4	4	4	4	4	4	2	3	5	5	4	3	2	3	5	3	4	5	1	1
	Accessibility of Construction Equipment, Materials and Personnel	2.7	4	3	5	3	2	2	2	2	3	3	2	3	3	2	4	3	3	3	2	3	4	2	3	3
	Ease of Construction (e.g. Proximity to unexploded ordinance)	1.9	3	3	5	2	2	1	2	1	2	3	4	3	3	1	4	3	3	3	2	3	4	2	4	4
Economic	Relative Cost of Locks and Special Features	5.8	5	5	5	4	3	3	3	1	3	3	4	1	3	4	2	3	2	3	5	3	2	5	3	3
	Excavation Cost (incl. Temporary Works)	8.0	4	3	5	4	3	3	1	1	3	2	5	4	2	1	3	3	4	3	1	2	3	1	4	5
	Minimize Construction Time	4.7	4	3	5	3	3	2	1	1	3	2	5	4	2	1	3	3	4	3	1	2	3	1	4	5
Other Impacts	Environmental	6.0	5	5	4	4	3	2	2	2	2	1	5	1	2	2	2	3	1	3	2	2	2	2	4	5
	Socio-Economic	2.8	4	1	4	4	5	5	5	5	4	3	4	4	4	3	2	4	3	4	3	4	2	3	4	2
	Relocations (e.g. Utilities, Infrastructure)	2.5	1	2	2	5	4	4	4	4	3	2	4	3	2	2	1	3	3	4	2	3	1	2	5	1

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CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Raw Scores for each Alignment Alternative

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Evaluation of Lock Channel Alignments

Evaluation Category	Evaluation Criteria	Importance Coefficient	Weighted Scores for each Alignment Alternative																							
			Atlantic Side								Pacific Side															
			4	5	6	17	18	19	31	32	1	2	3	7	8	9	10	11	12	13	14	15	16	20	41	42
Technical	Maintain Stability of Bank Slopes	1.0	5	5	5	5	5	5	5	5	1	3	5	3	2	1	4	3	3	2	1	3	4	1	3	4
	Potential for Future Expansion	7.8	31	39	39	23	31	31	31	31	31	31	23	31	31	31	16	23	31	23	31	31	16	31	16	23
	Special Site Considerations e.g. Susceptibility to Catastrophic Events	3.0	15	15	15	12	12	12	12	12	12	9	12	12	9	12	6	12	3	12	12	6	6	12	12	12
Operational	Maximize Navigational Safety and Ship Maneuverability	9.1	9	27	36	18	36	27	36	36	18	18	27	45	36	45	27	36	36	27	45	36	27	45	27	27
	Maximize Integration with Existing Operations	3.8	19	15	8	19	11	4	8	4	8	11	19	11	11	4	11	11	11	11	8	11	11	8	15	19
	Accessibility of Equipment, Materials and Personnel for Operations	3.2	16	16	10	13	10	6	6	3	10	10	13	10	10	10	13	10	10	10	10	10	13	10	10	16
	Minimize Maintenance Dredging	2.5	12	12	7	12	10	7	7	5	5	5	12	5	5	2	5	5	5	10	2	7	5	2	10	12
Constructibility	Impacts on Existing Canal Operations During Construction	10.0	10	30	40	10	40	40	40	40	40	40	20	30	50	50	40	30	20	30	50	30	40	50	10	10
	Accessibility of Construction Equipment, Materials and Personnel	2.7	11	8	13	8	5	5	5	5	8	8	5	8	8	5	11	8	8	8	5	8	11	5	8	8
	Ease of Construction (e.g. Proximity to unexploded ordinance)	1.9	6	6	10	4	4	2	4	2	4	6	8	6	6	2	8	6	6	6	4	6	8	4	8	8
Economic	Relative Cost of Locks and Special Features	5.8	29	29	29	23	17	17	17	6	17	17	23	6	17	23	12	17	12	17	29	17	12	29	17	17
	Excavation Cost (incl. Temporary Works)	8.0	32	24	40	32	24	24	8	8	24	16	40	32	16	8	24	24	32	24	8	16	24	8	32	40
	Minimize Construction Time	4.7	19	14	23	14	14	9	5	5	14	9	23	19	9	5	14	14	19	14	5	9	14	5	19	23
Other Impacts	Environmental	6.0	30	30	24	24	18	12	12	12	12	6	30	6	12	12	12	18	6	18	12	12	12	12	24	30
	Socio-Economic	2.8	11	3	11	11	14	14	14	14	11	9	11	11	11	9	6	11	9	11	9	11	6	9	11	6
	Relocations (e.g. Utilities, Infrastructure)	2.5	2	5	5	12	10	10	10	10	7	5	10	7	5	5	2	7	7	10	5	7	2	5	12	2
	SUM OF WEIGHTED SCORES		257	278	315	241	262	227	221	198	222	203	282	242	239	224	210	236	217	234	235	222	210	235	234	258
	RANK		4	2	1	5	3	6	7	8	11	16	1	3	4	10	14	5	13	8	6	12	14	6	9	2

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Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Weighted Scores for each Alignment Alternative

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Evaluation of Lock Channel Alignments

Sensitivity Analysis of Atlantic Alignments

Weighting					Top Ranking Alignments				
Technical	Operational	nstructabl	Economic	Other	1	2	3	4	5
60%	10%	10%	10%	10%	6	5	4	18	19
10%	**60%**	10%	10%	10%	5	6	18	17	4
10%	10%	**60%**	10%	10%	6	18	5	31	19
10%	10%	10%	**60%**	10%	6	4	5	17	18
10%	10%	10%	10%	**60%**	6	17	4	18	5
35%	**35%**	10%	10%	10%	6	5	18	4	31
35%	10%	**35%**	10%	10%	6	5	18	31	19
35%	10%	10%	**35%**	10%	6	5	4	18	17
35%	10%	10%	10%	**35%**	6	5	18	4	17
10%	**35%**	**35%**	10%	10%	6	5	18	31	19
10%	**35%**	10%	**35%**	10%	6	5	4	18	17
10%	**35%**	10%	10%	**35%**	6	5	18	17	4
10%	10%	**35%**	**35%**	10%	6	5	18	4	19
10%	10%	**35%**	10%	**35%**	6	18	5	31	19
10%	10%	10%	**35%**	**35%**	6	4	17	5	18
20%	20%	20%	20%	20%	6	5	18	4	17
Normalized Importance Coefficients					6	5	18	4	17

Alignment	Appearances in Top 5
4	13
5	17
6	17
17	10
18	17
19	6
31	5
32	0

Mode	6	5	18	4	19

Alignments to carry forward for Task 4 :

6, 5, 18

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CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Sensitivity Analysis of Atlantic Alignments

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Evaluation of Lock Channel Alignments

Sensitivity Analysis of Pacific Alignments

Weighting					Top Ranking Alignments				
Technical	Operational	Constructablity	Economic	Other	1	2	3	4	5
60%	10%	10%	10%	10%	7	3	14	20	9
10%	**60%**	10%	10%	10%	3	42	7	14	20
10%	10%	**60%**	10%	10%	8	14	20	9	10
10%	10%	10%	**60%**	10%	3	42	41	7	12
10%	10%	10%	10%	**60%**	3	41	42	13	11
35%	**35%**	10%	10%	10%	3	7	42	14	20
35%	10%	**35%**	10%	10%	8	14	20	9	7
35%	10%	10%	**35%**	10%	3	42	7	1	11
35%	10%	10%	10%	**35%**	3	42	13	41	11
10%	**35%**	**35%**	10%	10%	8	14	20	3	9
10%	**35%**	10%	**35%**	10%	3	42	7	41	11
10%	**35%**	10%	10%	**35%**	3	42	41	11	13
10%	10%	**35%**	**35%**	10%	3	8	42	14	20
10%	10%	**35%**	10%	**35%**	3	8	13	14	20
10%	10%	10%	**35%**	**35%**	3	42	41	13	11
20%	20%	20%	20%	20%	3	42	8	7	14
Normalized Importance Coefficients					3	42	7	8	11

Alignment	Appearances in Top 5
1	1
2	0
3	15
7	9
8	7
9	4
10	1
11	7
12	1
13	5
14	9
15	0
16	0
20	8
41	6
42	12

Mode	3	42	7	14	11

Alignments to carry forward for Task 4 :

3, 7, 8, 11, 14, 15, 42

AUTORIDAD DEL CANAL DE PANAMA
Oficina de Proyectos de Capacidad del Canal

CONTRACT NO. CC-5-536
EVALUATION OF LOCK CHANNEL ALIGNMENTS
Initial Evaluation
Sensitivity Analysis of Pacific Alignments

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THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX F

REFERENCES

THE PANAMA CANAL
EVALUATION OF LOCK CHANNEL ALIGNMENTS
PART 2 - INITIAL EVALUATION OF LOCK CHANNEL ALIGNMENTS

APPENDIX F
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