

APPENDIX 2C:

HYDRAULIC ANALYSIS OF
PROPOSED TRANSMISSION MAIN

TECHNICAL MEMORANDUM

TO: Don Antrobus, GWA **DATE:** July 27, 2006

FROM: Darin Izon

SUBJECT: Sinajana Transmission Main

Attachments: (A) Drawing Number T-3 of Sinajana & Agana Heights Water Transmission Line – Phase I, prepared by Juan C. Tenorio, P.C.

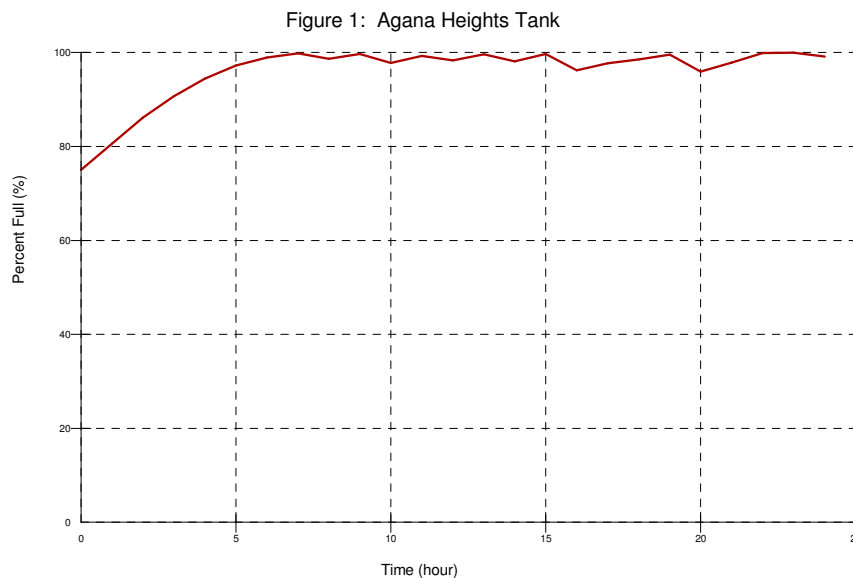
Per your request, we have updated the GWA hydraulic model to include the proposed Sinajana Transmission Main as shown on Attachment A. A maximum day demand scenario was simulated over a 24-hr period in order to analyze the output of the eleven (11) “A”-series wells located along this transmission main and their ability to either maintain or increase storage tank water levels. To estimate maximum day demand, a peaking factor of 1.5 times the average day demand was used. In addition, a diurnal demand curve was inputted into the hydraulic model to simulate the variations in water demand throughout the day. The well pumps were modeled using the current EPA permitted flowrates as their design flow.

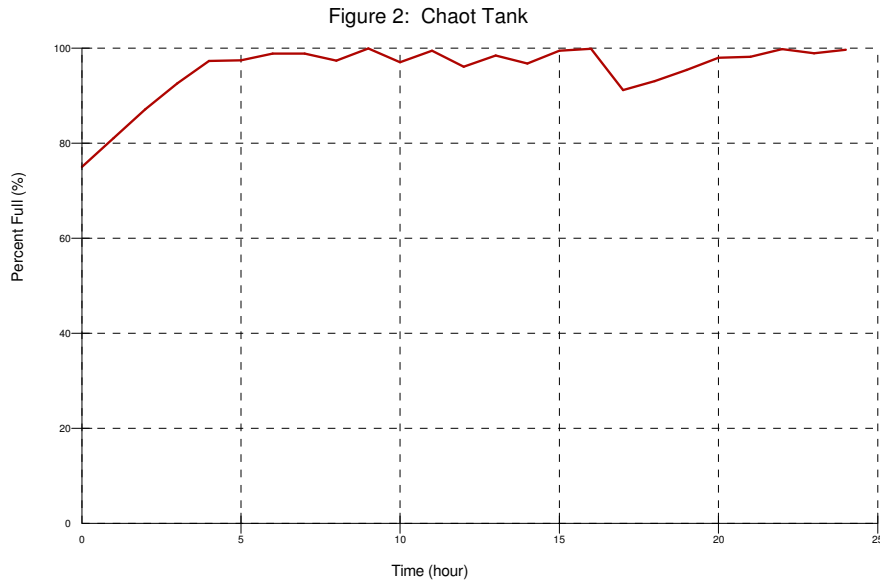
The “A”-series wells were assigned to pump into the Agana Heights or Chaot Storage Tanks as follows:

Agana Heights Tank: Wells A-23, A-25, A-31 & A-32

Chaot Tank: Wells A-1, A-3, A-5, A-6, A-12, A-29 & A-30

The wells were assigned to their respective storage tanks based on their hydraulic capacities and physical location. Figures 1 and 2 show how full the Agana Heights and Chaot Tanks are throughout the maximum day demand scenario simulation. The initial volume for both tanks at the start of the scenario is 75% full. With all eleven (11) wells online, the tanks are filled at about the 7th hour, and remain nearly filled for the duration of the maximum day demand scenario.





It should be noted that during this scenario simulation, the pumps for wells A-25, A-31 & A-32 pump 1.5 times or more of their EPA permitted flowrates into the Agana Heights Tank as shown in Table 1. This indicates that the well pumps have much more lift capacity than is needed. It would be prudent to retrofit these wells with properly sized pumps that would operate with more efficiency, reducing power and maintenance costs while pumping within the EPA permitted flowrate limits. For the wells that pump into the Chaot Tank, Table 1 shows that all seven (7) are within their EPA permitted flowrate limits.

We ran a scenario simulation where the pumps for Wells A-23, A-25, A-31 & A-32 were operated at their EPA permitted flowrates, and the results indicate the Agana Heights Tank will be filled to about 90% at the end of the scenario simulation, as opposed to being completely filled as shown in Figure 1 using the non-compliant flowrates.

Table 1: Well Flowrate Data

| Storage Tank | Well # | EPA Permitted Flowrate (gpm) | Scenario Avg. Flowrate (gpm) |
|--------------|--------|------------------------------|------------------------------|
| Agana Hts. | A-23 | 317 | 180 |
| | A-25 | 245 | 360 |
| | A-31 | 293 | 525 |
| | A-32 | 173 | 297 |
| Chaot | A-1 | 216 | 187 |
| | A-3 | 180 | 175 |
| | A-5 | 269 | 233 |
| | A-6 | 241 | 208 |
| | A-12 | 235 | 225 |
| | A-29 | 403 | 365 |
| | A-30 | 755 | 650 |

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If the eleven (11) “A”-series wells are routed as discussed in this scenario, then a portion of the Sinajana Transmission Main along Route 4 between Well A-25 and Spring Lane would not need to be constructed since it represents a pressure zone break between the lower Agana Heights Zone (Hydraulic Grade of 236 ft.) and the higher Chaot/Mangilao Zone (Hydraulic Grade of 381). If this portion of the transmission main is constructed, then a zone valve would need to be installed and kept normally closed in order to maintain the pressure zone separation.

If you have any questions regarding this analysis, please do not hesitate to call us.

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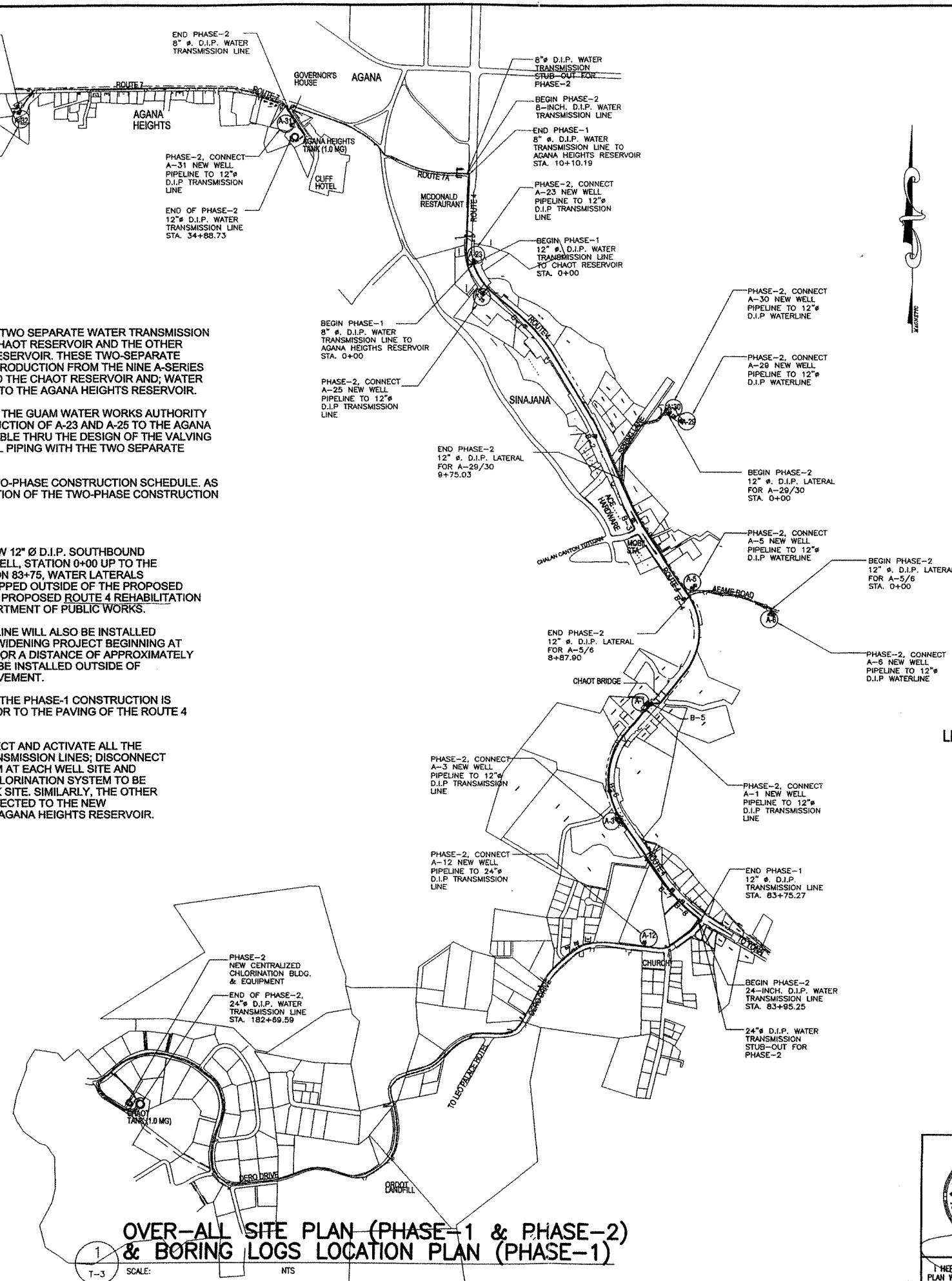
PROJECT DESCRIPTION:

- THE ULTIMATE GOAL OF THIS PROJECT IS TO INSTALL TWO SEPARATE WATER TRANSMISSION LINES; THE FIRST LEADING TO THE EXISTING 1.0 MG CHAOT RESERVOIR AND THE OTHER LEADING TO THE EXISTING 1.0 MG AGANA HEIGHTS RESERVOIR. THESE TWO SEPARATE TRANSMISSION LINES WILL TRANSPORT THE WATER PRODUCTION FROM THE NINE A-SERIES WELLS A-23, A-25, A-29, A-30, A-5, A-6, A-1, A-3 & A-12 TO THE CHAOT RESERVOIR AND; WATER PRODUCTION FROM THE A-SERIES WELLS A-31 & A-32 TO THE AGANA HEIGHTS RESERVOIR.
- THE SYSTEM WHEN COMPLETED WILL ALSO PROVIDE, THE GUAM WATER WORKS AUTHORITY (GWA) THE FLEXIBILITY TO DIVERT THE WATER PRODUCTION OF A-23 AND A-25 TO THE AGANA HEIGHTS RESERVOIR. THIS DIVERSION IS MADE POSSIBLE THRU THE DESIGN OF THE VALVING SYSTEM AT THE CONNECTIONS OF THE WELL LATERAL PIPING WITH THE TWO SEPARATE WATER TRANSMISSION LINES.
- THE TOTAL PROJECT WILL BE ACCOMPLISHED IN A TWO-PHASE CONSTRUCTION SCHEDULE. AS DEPICTED IN THE OVER-ALL SITE PLAN, THE DESCRIPTION OF THE TWO-PHASE CONSTRUCTION SCHEDULE ARE AS FOLLOWS:

PHASE-1:

- PHASE-1 CONSTRUCTION IS TO INSTALL THE NEW 12" Ø D.I.P. SOUTHBOUND ALONG ROUTE 4 ROADWAY STARTING AT A-23 WELL, STATION 0+00 UP TO THE INTERSECTION OF ROUTE 4/DERO ROAD, STATION 83+75. WATER LATERALS AND/OR STUB-OUTS WILL BE INSTALLED AND CAPPED OUTSIDE OF THE PROPOSED EDGE OF THE NEW ASPHALT PAVEMENT OF THE PROPOSED ROUTE 4 REHABILITATION AND RECONSTRUCTION PROJECT OF THE DEPARTMENT OF PUBLIC WORKS.
- THE SECOND 8" Ø D.I.P. WATER TRANSMISSION LINE WILL ALSO BE INSTALLED AHEAD OF THE DPW ROUTE 4 RESURFACING & WIDENING PROJECT BEGINNING AT THE A-23 WELL NORTHBOUND ALONG ROUTE 4 FOR A DISTANCE OF APPROXIMATELY 1,010 LINEAR FEET. AN 8" Ø D.I.P. STUBOUT WILL BE INSTALLED OUTSIDE OF PROPOSED ROUTE 4 PROJECT EDGE OF A.C. PAVEMENT.
- PLEASE NOTE THAT THE PRIMARY PURPOSE OF THE PHASE-1 CONSTRUCTION IS TO INSTALL THE NEW TRANSMISSION LINES PRIOR TO THE PAVING OF THE ROUTE 4 PROJECT.

PHASE-2: THIS PHASE OF THE PROJECT WILL CONNECT AND ACTIVATE ALL THE NINE A-SERIES WELLS TO THE NEW WATER TRANSMISSION LINES; DISCONNECT THE INDIVIDUAL EXISTING CHLORINATION SYTEM AT EACH WELL SITE AND CONSTRUCT & INSTALL A NEW CENTRALIZED CHLORINATION SYSTEM TO BE LOCATED BEFORE THE CHAOT RESERVOIR TANK SITE. SIMILARLY, THE OTHER TWO A-SERIES WELLS A-31 & A-32 WILL BE CONNECTED TO THE NEW TRANSMISSION LINE LEADING TO THE EXISTING AGANA HEIGHTS RESERVOIR.

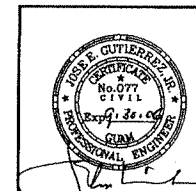


LEGEND/SYMBOL:

- PHASE-1 TRANSMISSION LINE
- - - PHASE-2 TRANSMISSION LINE
- A-XX INDICATES AN EXISTING WELL SITE
- B-X APPROXIMATE BORING LOCATION

OVER-ALL SITE PLAN (PHASE-1 & PHASE-2) & BORING LOGS LOCATION PLAN (PHASE-1)

SCALE: NTS



I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

| REVISION | DATE | BY | DESCRIPTION | APPROVED |
|--|------|----|---|----------|
| | | | | |
| PROJECT NO. | | | GOVERNMENT OF GUAM GUAM WATERWORKS AUTHORITY | |
| GWA NO. WD1-094-EPA GRANT ID# FS-97011902-0 | | | | |
| CONTRACT NO. | | | PROJECT TITLE: | |
| DESIGN BY: JEG/JCT | | | SINAJANA & AGANA HEIGHTS WATER TRANSMISSION LINE (FOR THE "A" SERIES WELL) | |
| DRAWN BY: AIS | | | SHEET CONTENTS: | |
| CHECKED BY: JCT | | | OVER-ALL SITE PLAN (PHASE-1 & PHASE-2) & BORING LOGS LOCATION PLAN (PHASE-1) | |
| SUPV. BY: JEG | | | RECOMMENDED BY: | |
| PROJECT ENGINEER | | | CHIEF OF ENGINEERING | |
| SECTION ENGINEER | | | DATE | |
| SCALE: AS SHOWN | | | JUAN C. TENORIO, P.C. CONSULTING ENGINEERS PEREZ BUILDING, 197 HERNAN CORTES AVENUE, HAGTNA, GUAM 96910 TEL.(671)479-8888/98 * FAX.(671)477-3277 | |
| | | | DRAWING NUMBER | |
| | | | T-3 | |
| | | | SHEET 3 OF 17 | |