State of Hawaii
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

September 11, 1981

Chairman and Members
Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Gentlemen:

Certification of Ground Water Withdrawals and Uses,
Waialua Ground Water Control Area, Oahu

The Waialua Ground Water Control Area was designated by the Board of
Land and Natural Resources on February 27, 1981 under authority of Chapter 177,
ERS, and Chapter 156 of Title 13, Administrative Rules entitled "Rules for the
Control of Ground Water Use in the State of Hawaii". The Department's regulatory
procedures provide for water users to declare their existing water uses within a
niner-day period which ended June 4, 1981 and allows the Board 180 days to
certify the declared uses.

The recommended certification of total annual, average daily, and maximum
daily withdrawals for individual wells and/or well fields is tabulated in the
attachment, "Certification of Ground Water Withdrawals and Uses, Waialua Ground
Water Control Area", for the Waialua, Mokuleia, and Kawaihae Subareas. A com-
parison of the recommended quantity for certification and the sustainable yield
adopted by the Board on July 24, 1981 is tabulated below:

<table>
<thead>
<tr>
<th>Subarea</th>
<th>Sustainable Yield (mgd)</th>
<th>Recommended Certification (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waialua</td>
<td>60</td>
<td>1.612</td>
</tr>
<tr>
<td>Mokuleia</td>
<td>20</td>
<td>7.753</td>
</tr>
<tr>
<td>Kawaihae</td>
<td>10</td>
<td>5.360</td>
</tr>
</tbody>
</table>

The remaining ground water supplies may be withdrawn by obtaining
permits from the Board of Land and Natural Resources.

RECOMMENDATION:

That the Board certify the existing withdrawals and uses for each well
tabulated on the attached "Certification of Ground Water Withdrawals and Uses,
Waialua Ground Water Control Area" dated September 11, 1981, subject to any
special conditions and applicable laws, rules and regulations.

Respectfully submitted,

ROBERT T. CHEUCK
Manager-Chief Engineer

APPROVED FOR SUBMITTAL:

SUSUMU ONO, Chairman

Approved by the Board of
Land & Natural Resources
at the meeting held on

C8
## State of Hawaii
### DEPARTMENT OF LAND AND NATURAL RESOURCES
### CERTIFICATION OF GROUND WATER WITHDRAWALS AND USES
### Waialua Ground Water Control Area

### Waialua Subarea

#### Waialua Sugar Co.

<table>
<thead>
<tr>
<th>Pump</th>
<th>State Well No.</th>
<th>Total Wells</th>
<th>Use</th>
<th>Source Capacity (mgd)</th>
<th>5-yr. Ave. Withdrawal (mgd)</th>
<th>Maximum Daily Use (mgd)</th>
<th>Total Annual Withdrawal (mgd)</th>
<th>Average Daily Withdrawal (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3407-04, 05, 06, 14, 15</td>
<td>5</td>
<td>Agr.</td>
<td>6.0</td>
<td>2.33 Agr.</td>
<td>6.0</td>
<td>850.45</td>
<td>2.33</td>
</tr>
<tr>
<td>2</td>
<td>3307-01 to 06, 08 to 10</td>
<td>9</td>
<td>Agr./Dom.</td>
<td>10.0</td>
<td>4.37 Agr./Dom.</td>
<td>10.0</td>
<td>1,595.05*</td>
<td>4.37*</td>
</tr>
<tr>
<td>2A</td>
<td>3307-07, 11 to 14</td>
<td>5</td>
<td>Agr./Dom.</td>
<td>7.0</td>
<td>4.45 Agr./Dom.</td>
<td>7.0</td>
<td>1,308.80</td>
<td>3.58</td>
</tr>
<tr>
<td>3</td>
<td>35-5-01 to 20</td>
<td>20</td>
<td>Agr./Dom.</td>
<td>7.0</td>
<td>3.16 Agr./Dom.</td>
<td>7.0</td>
<td>1,112.98</td>
<td>3.05</td>
</tr>
<tr>
<td>4</td>
<td>3407-11, 12, 16, 19</td>
<td>4</td>
<td>Agr./Dom.</td>
<td>5.5</td>
<td>3.93 Agr./Dom.</td>
<td>5.5</td>
<td>1,368.75</td>
<td>3.75</td>
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<tr>
<td>8</td>
<td>3506-03, 04</td>
<td>2</td>
<td>Agr./Dom.</td>
<td>3.0</td>
<td>1.66 Agr./Dom.</td>
<td>3.0</td>
<td>605.90*</td>
<td>1.66*</td>
</tr>
<tr>
<td>9</td>
<td>3106-02</td>
<td>1</td>
<td>Agr.</td>
<td>0.75</td>
<td>0.16 Agr.</td>
<td>0.75</td>
<td>58.4</td>
<td>0.16</td>
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<tr>
<td>10</td>
<td>3306-01 to 12</td>
<td>12</td>
<td>Agr.</td>
<td>12.0</td>
<td>6.62 Agr.</td>
<td>12.0</td>
<td>2,416.30</td>
<td>6.62</td>
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<tr>
<td>17</td>
<td>3104-02</td>
<td>1</td>
<td>Agr./Dom.</td>
<td>15.0</td>
<td>8.63 Agr./Dom.</td>
<td>15.0</td>
<td>2,992.37</td>
<td>8.19</td>
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</table>

#### Mill Pumps

<table>
<thead>
<tr>
<th>Pump</th>
<th>State Well No.</th>
<th>Total Wells</th>
<th>Use</th>
<th>Source Capacity (mgd)</th>
<th>5-yr. Ave. Withdrawal (mgd)</th>
<th>Maximum Daily Use (mgd)</th>
<th>Total Annual Withdrawal (mgd)</th>
<th>Average Daily Withdrawal (mgd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3407-07 to 10, 16, 17, 30, 31</td>
<td>8</td>
<td>Agr.</td>
<td>10.0</td>
<td>4.63 Agr.</td>
<td>10.0</td>
<td>1,689.05</td>
<td>4.63</td>
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<tr>
<td>24</td>
<td>3192-02</td>
<td>1</td>
<td>Agr.</td>
<td>4.50</td>
<td>2.58 Agr.</td>
<td>4.50</td>
<td>941.70</td>
<td>2.58</td>
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<tr>
<td>25</td>
<td>3283-01</td>
<td>1</td>
<td>Agr.</td>
<td>4.50</td>
<td>3.10 Agr.</td>
<td>4.50</td>
<td>1,131.50</td>
<td>3.10</td>
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<tr>
<td>26</td>
<td>3283-02</td>
<td>1</td>
<td>Agr.</td>
<td>4.50</td>
<td>2.76 Agr.</td>
<td>4.50</td>
<td>1,007.40</td>
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#### Subtotal (Waialua Sugar Co.)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Total Wells</th>
<th>Use</th>
<th>Source Capacity (mgd)</th>
<th>5-yr. Ave. Withdrawal (mgd)</th>
<th>Maximum Daily Use (mgd)</th>
<th>Total Annual Withdrawal (mgd)</th>
<th>Average Daily Withdrawal (mgd)</th>
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<tr>
<td></td>
<td></td>
<td>70</td>
<td>89.75</td>
<td>48.38</td>
<td></td>
<td>94.75</td>
<td>17,658.70</td>
<td>48.38</td>
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#### Board of Water Supply

| Waialua Wells | 3405-01, 02 | 2 | Mun. | 4.22 | 1.72 Mun. | 4.22 | 63.145 | 1.72 |

#### Private Users

| Kawaguchi, Howard | 3506-07 | 1 | Agr. | 0.180 | 0.458 Agr. | 0.180 | 21.17 | 0.058 |
| Kawamata, Kengo | 3406-03 | 1 | Agr. | 0.144 | 0.144 Agr. | 0.144 | 36.5 | 0.1 |
| Kunihiro, Shizuo | 3406-06, 3407-02 | 2 | Agr. | 0.2116 | 0.2116 Agr. | 0.2116 | 365.0 | 1.0 |
| Oceanic Properties | 3405-03, 04 | 2 | Mun. | 2.016 | 0.644 Mun. | 2.016 | 365.0 | 1.0 |
| Polynesian Shores | 3406-08 | 1 | Oth. | 0.144 | 0.144 Oth. | 0.144 | 53.56 | 0.144 |

#### Subtotal (Private Users)

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<tr>
<th></th>
<th></th>
<th>Total Wells</th>
<th>Use</th>
<th>Source Capacity (mgd)</th>
<th>5-yr. Ave. Withdrawal (mgd)</th>
<th>Maximum Daily Use (mgd)</th>
<th>Total Annual Withdrawal (mgd)</th>
<th>Average Daily Withdrawal (mgd)</th>
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<tr>
<td></td>
<td></td>
<td>7</td>
<td>2.34</td>
<td>0.702</td>
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<td>2.34</td>
<td>548.23</td>
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#### TOTAL - Waialua Subarea

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<th>Use</th>
<th>Source Capacity (mgd)</th>
<th>5-yr. Ave. Withdrawal (mgd)</th>
<th>Maximum Daily Use (mgd)</th>
<th>Total Annual Withdrawal (mgd)</th>
<th>Average Daily Withdrawal (mgd)</th>
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<tr>
<td></td>
<td></td>
<td>79</td>
<td>96.41</td>
<td>50.312</td>
<td></td>
<td>96.41</td>
<td>18,838.38</td>
<td>51.612</td>
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*For Agr./Dom. uses, specific quantities for each use are to be prorated when additional information becomes available.
<table>
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<tr>
<th>User/Source</th>
<th>State Well No.</th>
<th>Total Wells</th>
<th>Total Source Capacity (mgd)</th>
<th>5-yr. Ave. Withdrawal (mgd)</th>
<th>5-yr. Ave. Use</th>
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<tr>
<td><strong>MOKULEIA Subarea</strong></td>
<td></td>
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<tr>
<td>Waialua Sugar Co.</td>
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<tr>
<td>Pump 5</td>
<td>3411-04, 06 to</td>
<td>8</td>
<td>Agr. 8.5</td>
<td>2.55 Agr.</td>
<td>7.0</td>
<td>920.75</td>
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<td></td>
<td>11, 12</td>
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<td>Pump 11</td>
<td>3409-13</td>
<td>1</td>
<td>Agr./Dom. 1.5</td>
<td>0.53 Agr./Dom.</td>
<td>1.5</td>
<td>40.15</td>
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<td>Subtotal (Waialua Sugar Co.)</td>
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<td></td>
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<tr>
<td>Private Users</td>
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<td></td>
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<tr>
<td>Army - Billingham</td>
<td>3412-02</td>
<td>1</td>
<td>Dom. 0.72</td>
<td>No data Dom.</td>
<td>0.720</td>
<td>20.08</td>
<td>0.055</td>
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<tr>
<td>Air Force - Kamehameha Pt.</td>
<td>3314-03</td>
<td>1</td>
<td>Oth. 0.016</td>
<td>0.018 Oth.</td>
<td>0.016</td>
<td>6.47</td>
<td>0.011</td>
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<tr>
<td>Mokuleia Assoc.</td>
<td>3409-16</td>
<td>1</td>
<td>Dom. No data</td>
<td>No data Dom.</td>
<td></td>
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<td></td>
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<tr>
<td>Mokuleia Homesteads</td>
<td>M10-01</td>
<td>1</td>
<td>Agr./Dom. Nat. Flow 0.5</td>
<td>Agr./Dom. 0.5</td>
<td>0.5</td>
<td>102.5*</td>
<td>0.5*</td>
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<td></td>
<td>M110-03</td>
<td>1</td>
<td>Agr./Dom. 1.5</td>
<td>Agr./Dom. 1.5</td>
<td>1.5</td>
<td>547.50*</td>
<td>1.5*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M1410-05</td>
<td>1</td>
<td>Agr. Nat. Flow 0.1</td>
<td>To be sealed</td>
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<tr>
<td></td>
<td>M310-01</td>
<td>1</td>
<td>Agr./Dom. 1.5</td>
<td>No data Agr./Dom.</td>
<td>1.5</td>
<td>382.25</td>
<td>1.05</td>
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<tr>
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<td>M310-02</td>
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<td>Agr./Dom. 1.5</td>
<td>No data Agr./Dom.</td>
<td>1.5</td>
<td>382.25</td>
<td>1.05</td>
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<tr>
<td>Subtotal (Private Users)</td>
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<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL - Mokuleia Subarea</td>
<td></td>
<td>17</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>KAWAILOA Subarea</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waialua Sugar Co.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump 4</td>
<td>3505-02 to 04,</td>
<td>9</td>
<td>Agr. 14.0</td>
<td>5.53 Agr.</td>
<td>14.0</td>
<td>2,018.45</td>
<td>5.53</td>
<td></td>
</tr>
<tr>
<td></td>
<td>06 to 08, 11 to 13</td>
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<td>Private User</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meadow Gold Farm</td>
<td>3704-01</td>
<td>1</td>
<td>Ind. 0.648</td>
<td>0.420 Ind.</td>
<td>0.648</td>
<td>156.95</td>
<td>0.420</td>
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<tr>
<td>TOTAL - Kawailoa Subarea</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*For Agr./Dom. uses, specific quantities for each use are to be prorated when additional information becomes available.
ITEM 1  
MINUTES OF THE MAY 19, 1993 MEETING

Unanimously approved as submitted (Cox/Nakata).

ITEM 2  
OLD BUSINESS/REPORTS

Ms. Loui reported on two follow up items:

1) Guidelines for modification of the water use permits
   Staff finds that Administrative Rules 171-23 are clear regarding changes that require modification. Therefore, it was felt that guidelines are not necessary.

2) Guidelines for Emergency permits
   Still being worked on. Eventually, amendments to the Administrative Rules will be made to more clearly address emergency permits.

ITEM 3  
WAIALUA SUGAR COMPANY, VOLUNTARY REDUCTION OF PERMITTED WATER USE IN THE WAIALUA GROUND WATER MANAGEMENT AREA, WAIALUA, OAHU

Mr. Sakoda submitted amended recommendations for the Commission review and action (see attached).

Mr. Cox had the following questions:

1) Are the statements regarding "dry years and "wet years" correct for that area and time?
   Rainfall data provided by Climate Center was utilized, it was jointly determined that these were wet and dry years based on actual rainfall information.

2) In terms of the water level in the aquifer, what has happened during the periods noted?
   The water level data for the Waialua Aquifer is not that good. No problems have been expressed. USGS is drilling in that area to get more data.

3) What length of time is being discussed in Waialua Sugar Company's (Waialua Sugar) statement: "We cannot afford to short ourselves of water. As we understand, we can exceed the permitted use during dry periods as may be required."
   No specifics have been set, it would be on a case by case basis.

Mr. Nakata asked:

1) Why was there a discrepancy in the amount of pumpage?
   Mr. Sakoda replied that Waialua Sugar was still in the process of converting from furrow to drip. During that time, fields lie fallow longer than normal.

2) What percentage of the acreage was under drip irrigation?
Milton Agadar, Waialua Sugar Irrigation Superintendent stated that approximately 90% is fed by drip irrigation from the Waialua Aquifer.

Mr. Martin provided testimony (see Commission file) urging the Commission to review all data presently available and consider imposing further allocation reductions. He also felt specific quantitative guidelines and protocols for administering dry period extractions need to be part of the State Water Resource Protection Plan and water use permit conditions.

Mr. Cox commented that unless more information was available he would be uncomfortable in trying set a time for the dry period because it would vary considerably from aquifer to aquifer. Mr. Sakoda agreed that a generalized guideline would be difficult to make because every situation would be different.

In regards to the word "voluntary", Mrs. Black suggested "agreement" because if there is no water, how could it be a "voluntary reduction". Mr. Sakoda stated that it is voluntary because the Water Code provides that a water user can voluntarily give up or reduce their allocation without going through the public hearing process.

Mr. Ing asked how the data was obtained for the graph and if all the active pumps were metered. Mr. Sakoda said data was submitted monthly by Waialua Sugar. Mr. Agadar responded that all the pumps are metered.

Mr. Ing asked why the 12-month moving average of pumping was used and if this was an industry practice. In Hawaii, 12-month moving averages have been used by the water industry.

Unanimously approved as amended (Cox/Nakata).

ITEM 4  
HOUSING FINANCE AND DEVELOPMENT CORPORATION, APPLICATION FOR A WELL CONSTRUCTION PERMIT, KEOPU-HFDC WELL 1 (WELL NO. 3957-03), NORTH KONA, HAWAI'I

The following items were discussed:

1) The nearby Haseko Well is not being pumped but is proposed to be pumped at 700 gallons per minute.

2) This well would be required to follow the CWRM's pump test protocol, which is a seven day test. The best data possible will be obtained for input into the Groundwater Model currently being developed jointly by USGS/CWRM.

3) If the HFDC wells interfere with the Haseko well, the Hawaii County BWS would not award the full amount of water commitments to the wells.

4) There have been mixed results of the testing of the high level wells. Some have stabilized quickly while others have not.

Mr. Martin expressed concerns regarding ceded lands, the effects on other wells due to a first come-first serve process, and requirements for a water license.

Mr. Tam said public lands are set aside by executive order for county and other state department uses. Setting aside or transferring water to a sub-agency of the state for public purposes is not a transfer to a private entity. Therefore, the use by the counties of state lands for providing municipal water supply does not require a license under the Land Board or the Commission.

Unanimously approved (Cox/Nakata).
Chairperson and Members
Commission on Water Resource Management
State of Hawaii
Honolulu, Hawaii

Gentlemen:

Waialua Sugar Company
Voluntary Reduction of Permitted Water Use in the
Waialua Aquifer System, Waialua Ground Water Management Area
Waialua, Oahu

Background: Present authorized uses of ground water in the Waialua Aquifer System of the Waialua Ground Water Management Area (GWMA) total 43.114 mgd. The sustainable yield for the Waialua Aquifer System (formerly called the Waialua Subarea) was originally 60 mgd when the Board of Land and Natural Resources adopted the sustainable yield in July 1981. The Commission on Water Resource Management, in October 1991, accepted an updated table of sustainable yields for Oahu. Under the updated table, the sustainable yield for the Waialua Aquifer System was reduced from 60 mgd to 40 mgd. The new sustainable yield was formally adopted by the Commission on March 17, 1993. Authorized uses now exceed the sustainable yield by 3.114 mgd.

The Commission staff has reviewed the authorized uses versus the actual uses in the entire Waialua GWMA. Allocations in the Waialua Aquifer System are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Allocations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waialua Sugar Company</td>
<td>39.940 mgd</td>
</tr>
<tr>
<td>Honolulu BWS</td>
<td>2.730 mgd</td>
</tr>
<tr>
<td>Private Users</td>
<td>0.444 mgd</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43.114 mgd</strong></td>
</tr>
</tbody>
</table>

Preliminary review of Waialua Sugar Company's pumpage data indicates that they have used less than 30 mgd of their 40 mgd allocation over the last five years (see attached graph). Water use by the Honolulu BWS and private users has not changed significantly.

Waialua Sugar Company calculated their irrigation requirements using the same methodology that Oahu Sugar Company used to determine their irrigation requirements in the Pearl Harbor area. Irrigation requirements were calculated for dry years (1983 - 1986) and wet years (1988 - 1991). Pumping required was calculated to be about 46 to 48 mgd for dry years and about 35 to 36 mgd for wet years.

Waialua Sugar Company has reviewed their water use over the past 20 years and, based on historical water use, conversion to drip irrigation, and other factors, has voluntarily reduced its permitted water use in the Waialua Aquifer System from 39.9 mgd to 36.0 mgd effective June 1, 1993. This voluntary reduction reduces the allocations in the Waialua Aquifer System to 39.174 mgd, which is less than the sustainable yield of 40 mgd, and allows an additional 0.826 mgd to be allocated.

In voluntarily reducing its allocation, Waialua Sugar Company states that they "want to be on record that sugar production is highly dependent upon water; without adequate water, yields will suffer. We cannot afford to short ourselves of water. As we understand, we can exceed the permitted use during dry periods as may be required" (See attached letter).
Chairperson and Members
Commission on Water Resource Management

June 2, 1993

RECOMMENDATION:

That the Commission accept Waialua Sugar Company's voluntary reduction of permitted use in the Waialua Aquifer System, from 39.940 to 36.0 mgd. The 3.94 mgd reduction will be taken from sources in the Waialua Aquifer System presently being determined by Waialua Sugar Company. Staff will be working with them to determine the source-by-source reductions and will bring the results to the Commission for approval.

Respectfully submitted,

RAE M. LOUI
Deputy Director

Attach.

APPROVED FOR SUBMITTAL

KEITH W. AHUE, Chairperson
May 12, 1993

Ms. Rae Loui
Deputy Director
State Water Commission
P. O. Box 621
Honolulu, Hawaii 96809

Dear Ms. Loui:

We have had several meetings over the past months to discuss Waialua Sugar Company's permitted water use from the Waialua aquifer. Waialua Sugar has a permitted use of 39.9 million gallons per day. When you add the permitted use of the City Water Department, you have a combined use which is higher than the sustainable yield.

<table>
<thead>
<tr>
<th>Source</th>
<th>Use (MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waialua Sugar Company</td>
<td>39.9</td>
</tr>
<tr>
<td>Board of Water Supply</td>
<td>2.2</td>
</tr>
<tr>
<td>Total Sustainable Yield</td>
<td>40.0</td>
</tr>
<tr>
<td>Over Permitted Use</td>
<td>(3.1)</td>
</tr>
</tbody>
</table>

We have reviewed our water use over the past 20 years and while we have peaked at times over our permitted use, it appears we could reduce the permitted use given recent historical water use, conversion to drip irrigation and other factors.

Before going further, we want to be on record that sugar production is highly dependent upon water; without adequate water, yields will suffer. We cannot afford to short ourselves of water. As we understand, we can exceed the permitted use during dry periods as may be required.

Based on the above discussions and research into this matter, Waialua Sugar Company is voluntarily reducing its permitted water use in the Waialua aquifer from our current 39.9 million gallons per day to 36.0 million gallons per day effective June 1/93.

Sincerely,

Michael F. O'Brien
President
Dole Food Hawaii

cc: M. Agader
    J. A. Russell
    G. Yim
**DESCRIPTION**

Date of report: 12/20/19  
Person filing report: D.R. Craddick

A. OWNER: Castle & Cooke  
NAME: Waialua Haleiwa  
ISLAND: Oahu

B. GENERAL LOCATION: TMK 6-4-0101

C. DRILLING COMPANY: Water Resources Intl.

D. TYPE OF RIG: Harris 3,500  
DRILLING COMPLETED: 10/79  
DRILLER: Vierra & Gonsalves

E. ELEVATION, msl: Top of drilling platform: 208 ft.  
Bench mark and method used to determine height of drilling platform above ground surface: Ground

F. HOLE SIZE:  
10 inch dia. to 236 ft. below drilling platform.  
15 inch dia. to 336 ft. below drilling platform.  
16 inch dia. to 236 ft. below drilling platform.

G. CASING INSTALLED:  
16 in. I.D. x 5/0 in. wall solid section to 236 ft. below drilling platform.  
16 in. I.D. x 5/0 in. wall perforated section to 236 ft. below drilling platform.

H. ANNUlus: Grouted 0 ft. to 236 ft. below drilling platform.

Gravel packed ft. to ft. below drilling platform.

I. PERMANENT PUMP INSTALLATION:  
- Pump type, make, serial no.  
- Capacity: g.p.m.  
- Motor type, H.P., voltage, r.p.m.

Depth of pump intake setting ft. below which elevation is ft.

Depth of bottom of airline ft. below which elevation is ft.

**HYDROLOGY**

J. INITIAL WATER LEVEL: ft. below drilling platform, Date of measurement:

K. INITIAL CHLORIDE: ppm, total depth of well 336 ft. below drilling platform

L. PUMPING TESTS:

Date: 06/26-31, 1979  
Reference point (R.P.) used: which elevation is ft.

Start water level ft. below R. P.  
Start water level ft. below R. P.

End water level ft. below R. P.  
End water level ft. below R. P.

Depth of well ft. below R. P.  
Depth of well ft. below R. P.

Elapsed Time (hours)  
Rate (gpm)  
Draw down (ft.)  
Cl- (ppm)  
Temp. °F

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>Rate (gpm)</th>
<th>Draw down (ft.)</th>
<th>Cl- (ppm)</th>
<th>Temp. °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 76</td>
<td>1000</td>
<td>182</td>
<td>36</td>
<td>71.3</td>
</tr>
<tr>
<td>to</td>
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</table>

**SUBSURFACE FORMATION**

M. DRILLER'S LOG:

Depth, ft.  
Rock Description & Remarks  
Water Level ft.  
Depth, ft.  
Rock Description & Remarks  
Water Level ft.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>0 to 30</td>
<td>Clay</td>
<td></td>
<td>to</td>
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<td></td>
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<tr>
<td>30 to 57</td>
<td>Rock</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>57 to 142</td>
<td>Weathered Rock</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>142 to 236</td>
<td>Rock</td>
<td></td>
<td>to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>236</td>
<td></td>
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</tbody>
</table>

N. REMARKS:

**FOR DRILLER'S USE**

Job Name: Waialua Haleiwa  
Job No: 228

**FOR OFFICIAL USE**

Latitude 21° 34' 48"  
Longitude 158° 05' 43.43"  
Well no: 3405-04

**INSTRUCTIONS:** Send three(3) copies to: Manager-Chief Engineer, Division of Water and Land Development, P. O. Box 373, Honolulu, Hawaii 96809.

NOTICE OF INTENT TO DRILL

WELL OR PROJECT NAME: Paalaa-Kai Well 42 ISLAND: Oahu

OWNER OF WELL: Oceanic Properties
Mailing Address: 130 Merchant St. PO Box 2790

DRILLING COMPANY: Water Resources Intl Inc.
Mailing Address: 1828 Paa St. 96111

Proposed Construction Date: 9/77 Proposed Completion Date: 10/79 Proposed Depth

PROPOSED USE OF WELL:
(a) Domestic 
(x) Irrigation 
(c) Industrial (type) 
(d) Cooling (type) 
(e) Waste Disposal (type) 
(f) Soils Invest. 
(g) Foundation Invest. 
(h) Others (specify)

LOCATION OF WELL: (Attach copy of tax map, USGS topographic map, plantation field map, road map, or prepared drawing showing exact location. If not available, prepare a hand-drawn sketch map (not necessarily to scale) in the space below showing sufficient landmarks, distances, and directions for location in the field)

TAX MAP KEY:

Date Submitted: 8/22/79
Signature of Owner: D R Arick

FOR OFFICIAL USE
Latitude: 21°11'41"
Longitude: 158°05'42"
Well No. 3405-03

FOR DRILLER'S USE
Job Name: Paalaa Kai
INSTRUCTIONS: Send three (3) copies to: Manager-Chief Engineer, Division of Water and Land Development, P. O. Box 373, Honolulu, HI 96809.

INSTRUCTIONS: Send three (3) copies to: Manager-Chief Engineer, Division of Water and Land Development, P. O. Box 373, Honolulu, HI 96809.

FOR OFFICIAL USE
Latitude: 21°11'41"
Longitude: 158°05'42"
Well No. 3405-03
OCEANIC PROPERTIES, INC.
HONOLULU, HAWAII

PAALAKAI WATER SYSTEM
WAILUA, OAHU, HAWAII

SITE LAYOUT FOR WELLS/RESERVOIR

JUNE 1979
of Honolulu, Board of Water Supply (BWS). (The Acquisition Agreement is attached to the executed Paalaa-Kai Development Agreement between the City and Oceanic Properties, Inc.)

In addition, the agreement between the two parties calls for the construction documents for the project to segregate costs of constructing a 0.2 million gallon per day (MGD) system (total demand of Paalaakai Subdivision only), and a 1.0 MGD system (BWS requirement to meet a portion of the entire future North Shore demand, including the Paalaakai Subdivision). If the construction cost of the 1.0 MGD system is acceptable to the BWS, then they will pay for the difference in cost between the 1.0 and 0.2 MGD system. The bid cost of the 0.2 MGD system will be financed by Oceanic Properties, Inc., regardless of which system is selected.

The transmission line will follow the alignment of the existing haul cane road to its point of connection with the Board of Water Supply's 16 inch transmission main along Kamehameha Highway. Exhibits 3 and 4 show the proposed project.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>WELL DATA</th>
<th>Well No. 1</th>
<th>Well No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Elevation (Feet MSL)</td>
<td>207</td>
<td>208</td>
<td></td>
</tr>
<tr>
<td>Bottom of Casing Elevation (Feet MSL)</td>
<td>(-) 30</td>
<td>(-) 30</td>
<td></td>
</tr>
<tr>
<td>Bottom of Well Elevation (Feet MSL)</td>
<td>(-)130</td>
<td>(-)130</td>
<td></td>
</tr>
<tr>
<td>Diameter of Well</td>
<td>12 in.</td>
<td>12 in.</td>
<td></td>
</tr>
</tbody>
</table>
Vertical line shaft pumps will be installed on both wells, with sustainable yields of either 250 or 700 gpm per pump, for either the 0.2 MGD or 1.0 MGD system, respectively.

II. PHYSICAL AND HYDROLOGICAL CHARACTERISTICS

A. Location

The proposed project site, along the North Shore of Oahu, is being cultivated in sugar cane at the present time. The lands surrounding the project site are entirely sugar cane fields and gulch land.

B. Climate

The climate in and around Waialua is generally mild. The mean annual temperature is 73 degrees F and the average annual rainfall is approximately 30.5 inches, with humidity varying from 60 percent to 80 percent.

C. Topography

The proposed transmission line will follow the alignment of the existing haul cane road. This road is approximately 20 feet wide, with open ditches on both sides of the road. The roadway is graded and surfaced with compacted, oiled gravel. Opaeka'a Stream crosses the haul cane road approximately 2000 feet mauka of Kamehameha Highway (along Twin Bridge Road). A reinforced concrete bridge structure crosses the stream. There are, on the downstream side of the road bridge structure, bridge piers of the abandoned railroad crossing. The piers are used to support a Waialua Plantation irrigation flume.
The slope of the well/reservoir site is uniform at 10%, and drops from elevation 220 feet to 200 feet from east to west. No outcropping of boulders was noted during a site inspection in January 1979. The transmission line will traverse terrain from elevation 200+ feet to elevation 10 feet at the intersection of Twin Bridge Road and Kamehameha Highway.

D. Geology, Soil and Foundation Conditions

The project site is situated in a geological area classified as "Basalt of Koolau Volcanic Series"1. The volcanic rocks contain bronzite as cores in the monoclinic pyroxene and as resorbed crystals, which indicate that it was formed at an early stage in the magma from the Koolau volcano. The soil classification at the project site is Lahaina Silty Clay (LaC3), which is moderately permeable2.

A soils and foundation investigation was conducted by Geolabs-Hawaii, soils engineers, in October 1979. Their recommendations will be used as a basis for final design of the proposed facility. A similar well/reservoir facility is located approximately 2300 feet south of this project site and was constructed on similar soil with no apparent foundation problems.


E. Earthquake Considerations and Design Parameters

According to the Uniform Building Code, the Hawaiian Islands have been divided into four seismic zones. Zone 0 is least affected by earthquakes, while Zone 3 is the most affected. The island of Hawaii constitutes Zone 3 and is the most active seismic area in the state. Oahu, Lanai and Molokai are situated in Zone 1.

The reinforced concrete reservoir will be designed for Zone 1 earthquake loading.

F. Groundwater Conditions

The BWS has recommended this project site for development as a well and reservoir site based upon their hydrogeological study of the island of Oahu. The piezometric surface of the groundwater in the area of the project site is indicated to be between 10 feet and 20 feet above sea level in the Board's Oahu Water Plan, dated July 31, 1975.

Pump testing was conducted during November 1979 by Water Resources International, Inc., with accompanying water quality analyses performed by Brewer Chemical Corporation (see Appendix for test results). The measured drawdowns, prior to the sustained pump test, are summarized in Table 2. Wells No. 1 and No. 2 were then each pumped continuously for 120 hours at 700 gpm.
TABLE 2
PUMP TESTING DRAWDOWN RESULTS

<table>
<thead>
<tr>
<th>Drawdown</th>
<th>Pumping Rate (gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500</td>
</tr>
<tr>
<td>Well No. 1 (ft.)</td>
<td>0.81</td>
</tr>
<tr>
<td>Well No. 2 (ft.)</td>
<td>1.16</td>
</tr>
</tbody>
</table>

The water quality analyses results indicate a high quality water which readily satisfies the criteria mandated in the State of Hawaii, Department of Health, Public Health Regulations, Chapter 49.

G. Flood Problems, Including Tsunami Inundation Zones

The project is not located in a flood hazard area\(^1\). The well/reservoir site, being approximately 8000 feet from the shoreline and at an elevation of 200+ feet (MSL), is not susceptible to inundation from a tsunami.

H. Land Use and Water Rights

The well/reservoir site is in AG-1 zoned land as defined in the City's Comprehensive Zoning Code (CZC), dated 1969 and as amended. A State Special Use Permit to construct the well/reservoir facility has been approved by the City Department of Land Utilization. Since the project is not located in a Special Management Area, the City's Coastal Zone Standards are not applicable.

September 21, 1979

Mr. Herbert H. Minakami
Chief, Planning and Engineering Division
Board of Water Supply
City & County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Minakami:

This is to acknowledge receipt of the information we requested from you concerning Oceanic Properties' well permit. I appreciate your cooperation and prompt response. Thank you very much.

Very truly yours,

[Signature]

ROBERT T. CHUCK
Manager-Chief Engineer

ETS: ak
September 11, 1979

Mr. Robert T. Chuck  
Manager and Chief Engineer  
Division of Water and Land Development  
P. O. Box 373  
Honolulu, Hawaii 96809

Dear Bob:

Subject: Your Letter of August 29, 1979 on Oceanic Properties Well Permit

Attached is a copy of Oceanic Properties' description of the proposed well. In the future, we will also include copies of the applicant's attachments describing the well and appurtenant details with the copy of the approved well permit.

Very truly yours,

HERBERT H. MINAKAMI  
Chief, Planning and Engineering Division

Attach.
SECTION 15D. PUMPING UNIT

A. GENERAL DESCRIPTION. This section of the specifications covers the furnishing, installing, and testing of the new vertical motor-driven, water-lubricated, deepwell pumping unit.

1. Deepwell Pumping Unit.
   a. Number required:
      One (1)

2. Pump Bowl Assembly.
   a. Pump bowl assembly rated capacity and head:
      1,400 gpm at 900 ft head
   b. Example of pump bowl assembly performance characteristics desired:
      1) 0 gpm at 1,330 ft head
      2) 800 gpm at 1,188 ft head (pump efficiency not less than 72 percent)
      3) 1,200 gpm at 1,023 ft head (pump efficiency not less than 80 percent)
      4) 1,400 gpm at 900 ft head (pump efficiency not less than 78 percent)
      5) 1,600 gpm at 726 ft head (pump efficiency not less than 72 percent)
   c. Pump used to dimension plans and specify pump performance characteristics:
      Johnston 14BC (11 stages)
   d. Maximum pump speed:
      1,800 RPM

3. Discharge Column Assembly.
   a. Discharge column pipe:
      1) Column pipe ASTM designation:
         ASTM A53, Grade B
      2) Pipe nominal diameter:
         10 inches
3) Pipe wall thickness:

0.365 inches (Schedule 40)

b. Discharge column pipe coupling:

1) Size:

10 inches

c. Line shaft:

1) Shaft size:

2-3/16 inches minimum

2) Shaft material:

416 stainless steel

3) Coupling material:

416 stainless steel

4. Discharge Head Assembly.

a. Size of discharge flange:

10 inch pipe flange

b. Class of pipe flange:

250 lb. USAS 16.1-1967

5. Motor.

a. Number required:

One (1)

b. Motor horsepower rating:

450 hp

c. Motor service factor:

1.15

d. Minimum full load motor efficiency:

91 percent

e. Power:

3 phase, 60 hertz, 2,300 volts

f. Maximum motor speed:

1800 RPM
A. **GENERAL.** Work in this section shall be in accordance with Part III, Section 5, Well Drilling, of the Water System Standards and as supplemented and/or modified in these specifications. Drilling and casing are to be undertaken as expeditiously as possible. Installation of pump and motor, and the mechanical, electrical, and support facilities are to be installed at a later date under a separate contract.

D. **DIAMETER.** The well shall be drilled to a diameter sufficient to permit the installation of a 16-inch ID steel casing with an annular space of at least 1-5/8 inches all around the outside of the casing as shown on the plans. All drilling below the bottom of the casing shall be to a minimum diameter as indicated on the plans. Unless otherwise directed by the manager, the bottom elevation of the well shall be as indicated on the plans.

C. **ORDER OF WORK.** The contractor shall proceed in the order specified hereinafter. The depth as called for is approximate, and the manager reserves the right to change the depth, as required, depending on the field conditions.

1. Well drilling to a depth extending from the finish ground elevation to the bottom of the well casing elevation, as shown on the plans.
   a. The contractor shall allow the Board of Water Supply one full working day for electric logging of the hole. The contractor shall give a minimum of two working days advance notification to the Board of Water Supply. The full working day shall fall within the normal Monday to Friday work week, excluding any state or national holidays.

2. Well casing shall be installed as detailed on the drawing.

3. Filling of annular space with grout.

4. Well drilling below bottom of casing shall then be continued through the casing to the elevation of the bottom of well, as shown on the plans. This portion of the well shall not be cased.
   a. The contractor shall allow the Board of Water Supply one full working day for electric logging of the hole. The contractor shall give a minimum of two working days advance notification by the Board of Water Supply. The full working day shall fall within the normal Monday to Friday work week, excluding any state or national holidays.

5. Cleansing of well.


7. Additional well drilling, cleaning, and testing as required in the event that results of the yield and drawdown test are not satisfactory.

8. Final chlorination of well.

D. **CLEANSING OF WELL.** The contractor shall furnish and install a pump capable of pumping 2,000 gpm minimum with a pumping head sufficient to discharge
water from the well above ground surface, with the pump suction set at a maximum of five (5) feet above the bottom of the casing. Pumping and purging the well shall be at a rate of 2,000 gpm or greater. The contractor shall be responsible to make arrangements for the proper and safe disposal of all discharge water.

E. TESTING FOR YIELD-DRAWDOWN AND SUSTAINED PUMPING. The contractor shall furnish and install a pump capable of pumping not less than and preferably greater than 2,000 gpm with a pumping head sufficient to discharge water from the well above ground surface with the pump suction set at 5 feet maximum above the bottom of the casing. The contractor shall be responsible to properly support the test pump and piping. The contractor shall also be responsible to make arrangements for the proper and safe disposal of all discharge water.

Pumping shall be at such rates and for as long a period as the manager requests, up to 72 hours.

F. TESTING FOR YIELD AND DRAWDOWN. The contractor shall test the well for yield and drawdown at the following rates:

1. 1,400 GPM
2. 1,600 GPM
3. 1,800 GPM
4. 2,000 GPM
SECTION 15F. FLOW TUBE AND APPURTENANT EQUIPMENT

A. GENERAL DESCRIPTION. This section of the specifications includes the furnishing and installation of one flow tube, one flow indicator-totalizer-recorder, and appurtenant equipment.

1. Flow Tube.
   a. Number required:
      One (1)
   b. Size of flow tube:
      12 inches
   c. Ratio of throat size to inlet size:
      0.725
   d. BIF Code No. 0181-12-1311
   e. Class of flow tube flange:
      125 lb. USAS 16.1-1967
   f. Location:
      As shown on plans

   a. Number required:
      One (1)
   b. Range tube differential:
      40 inches of water
   c. Capacity range:
      0 to 5.0 mgd
   d. Number of retransmission relays required per instrument:
      Two (2)
   e. Location:
      On gageboard

B. FLOW TUBE. The flow tube shall be a BIF Series 180 Model UVTCI, suitable for installation between two USAS pipe flanges. The flow tube shall be constructed of cast iron and furnished with a bronze liner.
C. FLOW INDICATOR-TOTALIZER-RECORDER. The flow indicator-totalizer-recorder shall be a BIF Flo-Watch Model 301-01, mercury well actuated, designed for flush mounting. The instrument shall have a 15-second cam cycle, and the electric motors for the totalizer and recorder shall operate on 120 volt, 60 hertz power.

The totalizing counters shall be straight reading and have at least seven figures to show total quantity in thousand gallons. The indicator dial graduations shall be uniformly spaced and shall read directly in million gallons per day.

The reading chart shall be 12 inches, 7-day with uniformly spaced graduations reading directly in million gallons per day and arranged for a complete revolution once a week. One hundred weekly charts, a spare pen, and a year's supply of ink shall be furnished with the instrument. In addition to the spare parts called for in these specifications, the Contractor shall provide any other spare parts normally recommended by the manufacturer for each item of equipment. All spare parts shall be properly boxed and tagged with the following information:

1. Description of spare part and part number
2. Identification of equipment for which spare part is intended
3. Location of equipment
4. Supplier and local representative of spare part

E. SHOP DRAWINGS. The Contractor shall submit six (6) sets of shop drawing of the flow tube, flow indicator-totalizer-recorder and manometer slab to the Developer for approval.
Mr. Herbert Minakami  
Chief, Planning & Engineering Div.  
Board of Water Supply  
City & County of Honolulu  
630 S. Beretania St.  
Honolulu, Hawaii 96843  

Dear Mr. Minakami:

Well Permit to James G. Caldwell,  
Oceanic Properties, Inc.

Thank you for your cooperation in sending us a copy of the Well Application and approved Well Permit issued to Oceanic Properties, Inc. for two new wells near Haleiwa. Such fine cooperation facilitates our record-keeping responsibilities for maintaining state-wide ground water records.

We would also appreciate receiving a copy of the applicant's 11-page description of the proposed well construction indicated in Item 4c of their application.

In the future, we would appreciate also your sending us a copy of applicant's attachments relating to Item 4c, "Description of well and appurtenant details".

Very truly yours,

[Signature]

ROBERT T. CHUCK  
Manager-Chief Engineer

August 29, 1979
August 6, 1979

Mr. Robert Chuck
Manager and Chief Engineer
Department of Land and
Natural Resources
Division of Water and Land
Development
P. O. Box 373
Honolulu, Hawaii 96809

Dear Mr. Chuck:

Subject: Well Permit to Mr. James G. Caldwell, Oceanic Properties, Inc.

Enclosed for your information and files are copies of the well application and the approved well permit issued to Oceanic Properties, Inc. for the drilling of a new well at TMK: 6-4-1: portion of 01.

Please call Chester Lao at [redacted] if you have any questions regarding this permit.

Very truly yours,

HERBERT H. MINAKAMI
Chief, Planning and Engineering Division

Encl.
TO: Mr. James G. Caldwell  
Project Manager  
Oceanic Properties, Inc.  
P.O. Box 2990  
Honolulu, Hawaii 96802

Your application of July 17, 1979 to drill a well at Haleiwa has been approved in accordance with our Rules and Regulations for the Protection, Development and Conservation of Water Resources in the City and County of Honolulu.

You are hereby granted a permit to drill two (2) wells at TMK 6-4-1: portion 01 in accordance with the plans and specifications submitted with your application and the following conditions:

1. Mr. Chester Lao of the Board of Water Supply shall be notified before any work covered by this permit commences.

2. This permit shall become valid upon the receipt of a Permittee Bond in the amount of $5000.

KAZU HAYASHIDA  
Manager and Chief Engineer  
Board of Water Supply

JUL 24 1979  
Date of Permit
APPLICATION FOR DRILLING, MODIFYING, RECASING OR REUSING WELLS

INSTRUCTIONS: Please send 1 copy to Honolulu Board of Water Supply, who will distribute to other agencies concerned. In filling out, refer to Rules and Regulations of the Honolulu Board of Water Supply adopted on May 10, 1976 and applicable rules and regulations of the State Department of Health.

OWNER: (See BWS Rules and Regulations Chapter III, Sec. 3-305, Item 1a)

CASTLE & COOKE, INC.

ADDRESS:
P. O. Box 2990
Honolulu, Hawaii 86802

1. APPLICATION FOR WELL: (See Chapter III, Sec. 3-305, Item 1)

   Drill   x   Reuse   
   Modification   Recase   
   Change in use

2. WORK TO BE PERFORMED BY: (See Chapter III, Sec. 3-311)

   Water Resources International, Inc. a certified Well Drilling Contractor. Suite 2085, 2828 Paa Street,
Honolulu, Hawaii 96819
3. USE OF WELL: (See Chapter III, Sec. 3-305, Item 1c)

The drilling, casing and testing of two (2) wells at the location shown on the plan.

4. ATTACHMENTS: (Each copy of the application shall have a complete set of attachments)

a. Location of well: Waialua-Haleiwa

   Tax Map Key: 6-4-01: por. 01

b. Land area served: (Attach map showing exact location of well and area served. See Chapter III, Sec. 3-305, Items 1b and 1d)

   see attached maps marked Exhibit 1 - 4 (inclusive)

c. Description of well and appurtenant details:

   (See Chapter III, Sec. 3-305, Item 1e)

   Description is made by: 11 page detailed specifications attached hereto.

   b) draft proposal of items and quantity of work, attached hereto.

   c) Well site plan dated July 3, 1979, attached hereto.
5. The Owner hereby agrees to install, operate, and maintain control of the well in accordance with the laws of the State of Hawaii and the Rules and Regulations of the Honolulu Board of Water Supply and the State Department of Health.

The Owner hereby understands that a fee of One Hundred Dollars ($100.00) and a permittee bond of the amount not greater than Twenty-five Thousand Dollars ($25,000.00), said amount of the bond to be set by the Engineer, are required for the drilling or excavation of each new well. The $100.00 fee per well shall be payable to the Board and shall accompany this application. The amount of the permittee bond shall be stipulated when the well owner is notified that his permit has been granted.

(See Chapter III, Sec. 3-305, Items 2 and 2a)

6. The Owner hereby agrees to the following special conditions for this well:

Date Submitted

Signature of Owner

Name of applicant if other than Owner

Project Manager
Oceanic Properties, Inc.
SECTION SP 6  DETAILED SPECIFICATIONS FOR DRILLING, CASING AND TESTING OF WELLS FOR THE HALEIWA WATER SYSTEM (PAALAAKAI HOUSING PROJECT)

6.1 SCOPE OF WORK: The work shall include:
The drilling, casing and testing of two (2) wells at the locations shown on the plans.

6.2 ACCESS TO JOB SITE: Access to the well site shall be as shown on the plans. The Contractor shall be responsible for any damages to existing facilities or plant life designated for preservation.

6.3 SITE PREPARATION: The Contractor with the approval of the Manager shall excavate and grade the well site as necessary for his operations. The site shall be graded to the finish ground elevation as shown in the plans and provisions shall be made for its satisfactory surface drainage. No blasting will be permitted on this project.

6.3.1 PAYMENT: Payment for site preparation, including excavation and grading work, will be made at the price bid in the Bid of which the item is a part for actual work performed as specified above and elsewhere herein.

6.4 MOBILIZATION-DEMOBILIZATION: Upon receiving the notice to begin work, the Contractor shall convey to the job site as shown in the plans all well drilling equipment for the satisfactory drilling, casing and testing of the well as specified elsewhere herein.

Demobilization shall commence upon the completion and acceptance of the well as specified elsewhere herein.

6.4.1 PAYMENT: Payment for mobilization-demobilization shall be made at the price bid in the Bid for actual work performed as specified above and elsewhere herein.

6.5 DISPOSAL OF WATER: The Contractor shall carefully examine the proposed work site and make the necessary arrangements with the proper authorities or private individuals or corporations in reference to the disposal of waste water due to his operation.

The Contractor understands that no compensation will be paid to him due to any difficulty he may have incidental to the disposal of waste water and all damages resulting therefrom shall be the responsibility of the Contractor.
ORDER OF WORK: The Contractor shall proceed in the order specified hereinafter. The depth as called for is approximate and the Manager reserves the right to change the depth, as required, depending on the field conditions. The order of work for the well shall be as follows:

1. Well drilling shall be to a depth extending from the finish ground elevation to the bottom of the casing and shall be of sufficient diameter for the complete installation of the well casing including grouting as shown on the plans.

2. Electric logging shall be performed by the Manager upon completion of the well drilling to the final casing depth as shown on the plans or as modified by the Manager. One full working day shall be allowed to permit electric logging of the well. The full working day shall fall within the normal Monday to Friday work week excluding any holidays. The Contractor shall give two days advance notification.

3. Well casing shall be installed as detailed on the drawing and as specified elsewhere herein.

4. Grouting of annular space shall be done as specified elsewhere herein.

5. Plumbness and alignment shall be done as specified elsewhere herein.

6. Well drilling below the bottom of casing shall then be continued through the casing to the elevation of the bottom of the well as shown on the plans or as modified by the Manager. This portion of the well shall not be cased.

7. Cleansing of well shall then be done as specified elsewhere herein.

8. Additional well drilling, cleansing and testing, as required, shall be done as specified elsewhere herein.

9. Testing for yield and drawdown shall be then performed as specified elsewhere herein at the following rates or as modified by the Manager:
   a. 500 gpm
   b. 600 gpm
   c. 700 gpm
   d. 800 gpm
   e. 1,000 gpm
10. Testing of well at a sustained pumping rate shall be made at a rate specified by the Manager and as specified elsewhere herein.

11. Clean-up shall be as specified elsewhere herein.

6.7 WELL DRILLING: Under this contract, the Contractor shall drill the well complete and satisfactory to the Manager. The portion of the well to be cased shall be drilled to such a diameter so as to permit the installation of a steel casing as shown on the plans and have an annular space between the outside of the casing and the drilled hole of not less than 1-1/2 inches. Bentonite or any similar material used in the contract operations shall be approved by the Manager before use. The use of an approved cleansing agent for the removal of bentonite or similar materials shall be approved by the Manager.

During the progress of the work, the Contractor shall keep a log of the well and deliver to the Manager a sample of material taken at each change of formation. The Contractor shall also submit a daily report describing the characteristics of material encountered, the work done each day, such as depth drilled, casing set, etc., the water level in the well at the beginning and end of each shift, observable details with reference to the entrance of water into the well from the aquifer, and other such pertinent data as may be required by the Manager.

The Contractor shall, at all times during the progress of the work, shield the well in such a manner so as to prevent persons from falling into or tampering with the well and to prevent the entrance of foreign matter. The Contractor shall exercise extreme care in the performance of his work in order to prevent the breakdown or collapse of geologic formations into the well.

6.7.1 PAYMENT: Payment for drilling the well to a depth extending from the finish ground elevation to the bottom of the casing as shown on the plans will be made at the unit price bid in the Bid for actual depth in feet of well drilled after the plumbness and alignment requirement have been satisfied.

The unit price bid shall include full compensation for all materials, labor and equipment necessary to complete the well drilling as required by the Manager and the furnishing of data as specified herein.
WELL CASING: The Contractor shall furnish and install temporary casing, if necessary, for the successful drilling of the well and remove the same as directed by the Manager. Temporary casing shall be of such weight and design necessary to prevent entrance of undesirable material, to prevent cave-ins, to be reasonably water tight, and to permit installation without distortion or rupture.

The permanent casing shall be new steel pipe conforming to American Water Works Association publication AWWA C201-66 "Fabricated Electrically Welded Steel Water Pipe". The physical properties of the steel used in the fusion welded pipe shall conform to ASTM Specification A-283, Grade B. Casing diameter and thickness shall be as shown on the plans. Individual lengths of casing shall be provided with beveled ends for butt welding.

Length of individual pieces shall not be less than 10 feet nor more than 40 feet except the last length at the top which shall be cut to suit. Casing shall be cleaned of all scale, rust and oil.

Abutting ends of adjacent casing shall be welded. Welding shall be performed by mechanics previously qualified by tests prescribed in the American Welding Society Standard Qualification Procedure for this type of work. Technique of welding employed, the appearance and quality of welds and methods of correcting defective work shall conform to the American Welding Society Code for Arc Welding for Building Construction, Section 4, Workmanship. Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign matter except that mill scale which will withstand vigorous wire brushing may remain. Joint surface shall be free from fins and tears. Adjacent lengths of casing shall be held in proper alignment while the joint is being welded. A steel casing shoe shall be welded to the bottom portion of the permanent casing as shown on the plans.

The completely installed casing shall be tested for plumbness and alignment in the presence of the Manager as specified elsewhere herein and any corrections in plumbness and alignment found necessary shall be the Contractor's responsibility before the casing is secured to its final position, preparatory to grouting.

PAYMENT: Payment for well casing will be made at the unit price bid in the Bid for the actual lineal feet of casing installed after plumbness and alignment requirements have been satisfied.
The Contractor shall receive no specific compensation for the furnishing, installation and removal of the temporary casing, and all costs shall be in the various items in the Bid.

The unit price bid shall be full compensation for all materials, labor, tools, and equipment necessary for the furnishing and installing of steel casing and shoe, in place complete, including the grouting of the annular space, as shown on the plans.

6.9

GROUTING OF ANNULAR SPACE: The annular space outside the casing shall be filled as shown on the plans or as directed by the Manager.

6.9.1

GROUT: Grout shall consist of portland cement and not more than six gallons of mixing water per cubic foot of cement. At the approval of the Manager, the alternate material for grout consisting of one part of portland cement, one part of medium-grained clean sand and not more than six gallons of mixing water per cubic foot of cement may be used.

The grout shall be placed around the casing in one continuous operation, starting from the bottom of the space to be grouted towards the ground surface. Grouting shall be by a method approved by the Manager. The use of pump or air pressure for forcing the grout into place shall be employed if satisfactory results are not obtained by gravity placement. The grout shall be placed in a manner that will avoid segregation of grout materials inclusion of foreign matter or bridging of grout materials. No drilling operation or other work in the well will be permitted within 72 hours after the filling of the annular space. If quick setting cement is used, this period may be reduced to 24 hours. The Contractor shall insure that no grout shall enter the open hole.

6.9.2

PAYMENT: Payment for the filling of the annular space will not be made directly but shall be included in the unit price bid in the Bid for the actual lineal feet of well casing installed.

6.10

PLUMBNESS AND ALIGNMENT: The well shall be drilled circular and casing set plumb and true to line. In compliance with this requirement, the Contractor shall furnish all labor, tools and equipment and shall conduct the tests described elsewhere herein in a manner prescribed by and to the satisfaction of the Manager.
The "Totco" Directional Double Recorder may be used for the plumbness test only. Test for plumbness and alignment shall be made in the presence of the Manager after the casing has been completely installed and grouted and before its acceptance. Additional tests, however, may be made by the Contractor during the performance of the work.

Plumbness and alignment shall, except as hereinafter modified, be in accordance with the requirements of American Water Works Association Specification A100-66 "Standard Specifications for Deep Wells". The maximum deviation from the vertical shall not be more than six inches per any 100 feet of depth. A log of the drift at 20-foot intervals shall be kept for the well casing.

The alignment shall be tested by lowering into the well to the bottom of the well casing, a section of pipe 40 feet long or a dummy of the same length. The diameter difference between the outside diameter of the dummy or plumb and the inside diameter of the casing shall not exceed 1/2 inch. If a dummy is used, it shall consist of a spindle of 8-inch minimum inside diameter and three rings. The band width of each ring shall be a minimum of 12 inches. The rings shall be truly cylindrical and shall be spaced one at each end of the spindle and one ring at the center thereof.

Errors in plumbness and alignment shall be corrected by the Contractor at his own expense and should he fail to make the necessary corrections, the Manager may refuse to accept the well. In no event shall the provisions of this paragraph be waived.

6.10.1 PAYMENT: The Contractor shall receive no specific compensation for making tests for plumbness and alignment and the costs of all such tests shall be included in the various items in the Bid.

6.11 ABANDONMENT OF WELL: In the event that the Contractor shall fail to drill the well to the depth specified by the Manager or should he abandon the well because of imperfections in plumbness or alignment, loss of tools or for any other cause, he shall remove the casing, if necessary, and fill the abandoned hole with rock, aggregate and cement grout as the Manager may specify.

6.11.1 PAYMENT: The Contractor shall not be compensated for any work done on the well that is abandoned. Any partial payment made for work done on a well which is later abandoned shall be deducted from the amount which becomes payable for work done on a new well.
6.12 WELL DRILLING BELOW BOTTOM OF CASING: After the filling of the annular space has been completed, well drilling below the bottom of the casing shall then be continued through the casing with a minimum diameter and to the elevation of the bottom of the well as shown on the plans. Well drilling shall be as specified elsewhere herein.

6.12.1 PURGING OF WELL: The well shall be purged clean to the satisfaction of the Manager and shall be performed at the completion of drilling to the bottom of the well as directed by the Manager.

6.12.2 PAYMENT: Payment for continuation of well drilling below the bottom of the casing to the elevation of the bottom of the well as shown on the plans or as modified by the Manager will be made at the unit price bid in the Bid for the actual lineal feet of depth drilling.

Purging shall be incidental to the project and the cost thereof shall be included in the various items bid in the Bid.

The unit price bid shall be full compensation for all materials, labor, tools, and equipment necessary to complete the well drilling as required, inclusive of the purging, the furnishing and introducing of the cleansing agent and the furnishing of data as specified elsewhere herein.

6.13 ADDITIONAL WELL DRILLING, CLEANSING AND TESTING: The Manager may order the Contractor to drill the well below the final depth as shown on the plans or the final elevation as determined in the field, in increments of not more than 25 feet. The method and procedure for this additional well drilling shall be as specified under WELL DRILLING BELOW BOTTOM OF CASING.

It shall be understood that whenever additional drilling is called for, the Contractor shall upon completion of additional drilling conduct purging operation as directed by the Manager.

6.13.1 PAYMENT: Payment for additional drilling will be made at the same unit price bid as WELL DRILLING BELOW BOTTOM OF CASING for the actual lineal feet or depth drilled below the final depth as shown on the plans or final elevation as determined in the field. The unit price bid shall be full compensation for all labor, materials, equipment, tools, and incidentals necessary to complete the drilling as required, inclusive of purging and the furnishing of data as specified elsewhere herein.
6.14 CLEANSING OF WELL: Preparatory to pumping tests, the Contractor shall pump and surge the well as specified hereinafter.

The Contractor shall furnish and install a pump with a pumping head sufficient to discharge water from the well above ground surface with the suction end of the pump set to a depth as specified by the Manager and a discharge capacity sufficient to cleanse the well satisfactorily.

The cleansing process of pumping and surging by starting and stopping the pump intermittently, shall continue until the water pumped from the well shall be substantially free from sand, stones, drill cuttings, clay, foreign materials, and until the turbidity is less than 10 on the silica scale as described in Standard Method of Water Analysis.

The Contractor shall then pump continuously for a period of 30 minutes. This 30-minute pumping is repeated until the water pumped remains clear throughout the period of 30 minutes to the satisfaction of the Manager. The Contractor shall provide suitable equipment and devices approved by the Manager to measure the discharge from the well in gallons per minute (gpm).

The cleansing of the well shall not be considered completed, if sand, stones, drill cuttings, clay, or foreign materials drop into the well after 30 minutes of continuous pumping.

In the event that bentonite or any similar materials is used in the contract operation, the approved cleansing agent shall be allowed to remain in the well for a minimum period of 24 hours, after which the well shall be purged by pumping. Pumping shall continue until the well is free of mud and detergent.

The cleansing process shall be conducted upon the completion of any additional drilling as authorized by the Manager.

The cleansing operation shall be incidental to the project and the cost thereof shall be included in the various items in the Bid.

6.15 SET-UP FOR SHORT TERM YIELD-DRAWDOWN AND SUSTAINED PUMPING TESTS OF WELL: This item of work shall consist of furnishing, installing and removing pumping units, discharge lines and devices for measuring flow and the drawdown, and all other incidentals necessary for the proper testing of the well for yield-drawdown and sustained pumping.
6.15.1  PUMPING UNIT: The pumping unit installed for the pumping tests shall operate at a noise level conforming to the provisions of the Comprehensive Zoning Code of the City and County of Honolulu, dated July 2, 1969 and all supplements, and Public Health Regulation Chapter 44B, Community Noise Control for Oahu, of the Department of Health, State of Hawaii, and shall meet the head and capacity requirements called for elsewhere herein.

6.15.2  PAYMENT: Payment for set-up and yield-drawdown and sustained pumping tests of the well will be made at the unit price bid in the Bid per set-up. A set-up shall be the complete installation and removal of the pump and all necessary appurtenances for the proper testing of the well as directed by the Manager. Any adjustments or changes to equipment for the proper testing of the well shall be considered incidental and the cost thereof shall be included in the unit price bid in the Bid per set-up.

The unit price bid shall be full compensation for the furnishing of all labor, materials, tools, and equipment, including all other incidental work necessary for the installation and removal of equipment to conduct pumping test as called for elsewhere herein.

The testing of the pumping unit prior to the yield-drawdown tests shall be considered incidental and the cost thereof shall be included in the unit price bid in the Bid per set-up.

It shall be understood that whenever the Manager authorizes any additional tests, the Contractor shall perform the necessary operations for each additional set-up, if required, and payment thereof will be made at the unit price bid in the Bid per set-up.

6.16  TESTING FOR YIELD DRAWDOWN AND SUSTAINED PUMPING: After the cleansing operation on the well has been approved, the Contractor shall make the necessary arrangements for conducting a yield-drawdown test. The Manager may order the Contractor to make such additional yield-drawdown tests as deems necessary. All tests shall be run with similar equipment and in a like manner to that hereinafter described.

During each test, the Contractor shall conduct a continuous pumping and observation operation to determine the yield, drawdown and chloride content. He shall furnish and install a pump capable of pumping not less than 100 gpm with a pumping head sufficient to discharge water from the well above ground surface with the suction end of the pump set to a depth specified by the Manager. The discharge piping shall be properly supported.
The Contractor may use any power source that he chooses for operating the pump. The pumping unit shall be capable of operating uninterrupted for a period of at least 120 hours and shall be within the sound pressure levels for each octave band frequency as specified in the Comprehensive Zoning Code and Occupational Safety and Health Act.

The Contractor shall provide suitable equipment and devices to measure the water level in the well under static and operating conditions, to measure the discharge from the well in gpm and to control the rate of flow from the well. The type of equipment and method to be employed in measuring the discharge from the well shall be subject to the approval of the Manager prior to the installation of the pump.

Pumping tests shall be conducted at rates so specified elsewhere herein.

A duration of pumping at each rate for the yield-drawdown test shall be long enough to allow the water level in the well to stabilize. Sufficient time shall be allowed to make all necessary adjustments, measurements and collection of water samples.

A sustained pumping test shall be carried out after a period of approximately 24 hours following the completion of the short term yield-drawdown pumping test. This test shall be a period of continuous pumping at a rate as specified by the Manager. Duration of tests shall be determined by water quality changes and shall not exceed 120 hours for the well drilled.

During each test, water table elevations and rates of pumping shall be determined at such intervals as the Manager may direct. The Contractor shall take water samples for determination of chloride content as the Manager may request.

PAYMENT: Payment for testing for yield-drawdown and sustained pumping will be made at the unit price bid per hour in the Bid for the total number of hours of actual pumping. The hours of pumping to be paid for shall be the number of hours of actual pumping from the beginning to the end of the tests as directed by the Manager.

Payment shall not be made for any premature termination of pumping tests due to failure of pumping equipment and appurtenances.

The unit price bid shall be full compensation for all labor, materials, tools, equipment, and other incidental necessary to complete the tests.
It is understood that the Contractor shall perform additional tests whenever ordered by the Manager at the same unit price bid per hour in the Bid. Each test shall be run with similar equipment in accordance with the procedure described elsewhere herein.

6.17 COMPLETION OF WELL: The well shall be bailed clean of all oil. All foreign matter shall be removed to attain the final depth as shown on the plans or as modified by the Manager and a welded cap as shown on the plans shall be provided and installed before approval is granted to remove the drilling machine and equipment.

6.17.1 PAYMENT: Payment for the welded cap will not be made directly and shall be included in the various items bid in the Bid.

6.18 CLEAN UP: At the completion of the project, the Contractor shall remove all blocks, pipes, materials not incorporated in or necessary to the completed well and leave the site in a neat and orderly condition satisfactory to the Manager.

Payment for clean up shall be included in the unit price bid for the various items in the Bid.

6.19 PERMITS AND LICENSES: The Contractor shall procure all permits and licenses, pay all charges and fees and give all notices necessary and incidental to the due and lawful prosecution of the work.

HALEIWA WELL NO. 2 (3405-04)

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HALEIWA WELL NO. 2 (3405-04)

Location: TMK: 6-4-01: 1
Elevation at Ground: +208 ft.
Elevation at Bottom of Well: -128 ft.
Elevation at End of Casing: -28 ft.
Diameter of Casing: 12 in. ID.

Date of Sustained Pumping Test: November 3-8, 1979

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<td></td>
</tr>
<tr>
<td>1120</td>
<td>1017</td>
<td>2.08</td>
<td>68</td>
<td>71.3</td>
<td>Started pumping</td>
</tr>
<tr>
<td>1125</td>
<td>1010</td>
<td>2.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1130</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stopped pumping</td>
</tr>
<tr>
<td>1132</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

November 27, 1979
M:vc
Laboratory Analysis Report

To: Water Resources International  
Attention: Mr. Douglas Craddick  
Address: Suite 2085, 2828 Pain Street  
Samples Of: well water

Sampled By: client  
Sampling Date: 11/8/79  
Time: 9:00am-11:00am  
Receipt Date: 11/8/79  
Time: 11:00am

Date Sample Analyzed  
Time Sample Analyzed  
Sample Type

Sample Description  

<table>
<thead>
<tr>
<th></th>
<th>Paalan Kai #1</th>
<th>Paalan Kai #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbidity</td>
<td>NTU 0.3</td>
<td>NTU 0.3</td>
</tr>
<tr>
<td>Fluoride</td>
<td>mg/l &lt;0.1</td>
<td>mg/l &lt;0.1</td>
</tr>
<tr>
<td>Nitrate N</td>
<td>1.88</td>
<td>2.18</td>
</tr>
<tr>
<td>Arsenic</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Barium</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Cadmium</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.009</td>
<td>&lt;0.002</td>
</tr>
<tr>
<td>Lead</td>
<td>0.006</td>
<td>0.023</td>
</tr>
<tr>
<td>Mercury</td>
<td>µg/l 0.224</td>
<td>µg/l 1.75</td>
</tr>
<tr>
<td>Selenium</td>
<td>mg/l &lt;0.01</td>
<td>mg/l &lt;0.01</td>
</tr>
<tr>
<td>Silver</td>
<td>µg/l 0.004</td>
<td>µg/l 0.004</td>
</tr>
<tr>
<td>Total Coliform</td>
<td>MPN/100 &lt;1</td>
<td>2</td>
</tr>
<tr>
<td>Endrin</td>
<td>µg/l &lt;0.01</td>
<td>µg/l &lt;0.01</td>
</tr>
<tr>
<td>Lindane</td>
<td>µg/l &lt;0.01</td>
<td>µg/l &lt;0.01</td>
</tr>
<tr>
<td>Methoxychlor</td>
<td>µg/l &lt;0.01</td>
<td>µg/l &lt;0.01</td>
</tr>
<tr>
<td>Toxaphene</td>
<td>µg/l &lt;0.01</td>
<td>µg/l &lt;0.01</td>
</tr>
<tr>
<td>2,4-D</td>
<td>µg/l &lt;0.01</td>
<td>µg/l &lt;0.01</td>
</tr>
<tr>
<td>2,4,5-T Silvex</td>
<td>µg/l &lt;0.01</td>
<td>µg/l &lt;0.01</td>
</tr>
<tr>
<td>Total Chlorides</td>
<td>µg/l 70.1</td>
<td>µg/l 76.2</td>
</tr>
</tbody>
</table>

Laboratory Remarks: µg/l is the same as parts per billion.