# APPENDIX I

# LOCAL (CLUSTER) SYSTEMS

## 1.1 DESCRIPTION OF CLUSTER SYSTEMS

Part of Phase 2 of the Core Plan involves the construction of small wastewater treatment systems, or cluster systems. Each system provides collection, treatment and disposal of wastewater in a small neighborhood. Four of the cluster systems (that follow) serve neighborhoods that are in the watershed of an impacted coastal embayment. The goal of this facet of the CWMP is to reduce watershed nitrogen loading to improve coastal water quality many years before the sewer extensions reach these regions in the later phases. The collection area for each system is, in general terms, immediately upgradient of the water body, thereby providing timely improvement (but not complete remediation) of water quality. The degree of impact has not been modeled. It will be the completion of sewering in the Core Plan and conveyance to a centralized facility that will comply with the appropriate nitrogen reduction to meet the TMDLs. A fifth cluster system will serve the watershed of a freshwater body, unlike the four other cluster systems that reduce nutrient loading to coastal embayments. The Town wishes to protect the good water quality in Bakers Pond whose watershed is not readily served by the proposed Core Plan sewer system, which will service freshwater bodies with impaired water quality. Therefore, a cluster system is proposed for the Bakers Pond watershed, with the goal of significantly reducing phosphorus loading there to forestall the degradation that has occurred in other ponds.

### 1.1.1 General Characteristics

The wastewater collection infrastructure for each of the cluster systems fall within roadways slated for sewering as part of the Core Plan. Proposed pump station locations for the Core Plan will overlap with those for the cluster systems. The treatment process facilities may be contained completely below grade depending on the technology selected. An above-ground control panel

may be the only visible addition post-construction. In other cases, a few above-grade tanks and a small building may be required, but appropriately screened with fencing and landscaping. The proposed effluent disposal technology in all cases is subsurface leaching. This may result in additional green area adjacent to the treatment facilities, or may be located in a mowed right-of-way, or put to dual use with parking or athletic activities. A conventional gravity sewer would collect the wastewater, supplemented by grinder pumps and low pressure sewers where appropriate.

### 1.1.2 Cluster System around Little Cove

Little Cove is a sub-watershed in the Nauset system. A small-scale system in this watershed would serve 29 properties. Figure I-1 depicts the extent of the service area for this cluster system. The expected annual average flow is 5,900 gpd; that translates to a design flow of 14,000 gpd. This system would be designed around a target effluent nitrogen concentration of 5 mg/l. This system would require a groundwater discharge permit. Treatment of the wastewater could be achieved with a multi-stage fixed-film process or a membrane bioreactor. Other key statistics of this system are provided side-by-side with the other cluster systems in Table I-1.

### 1.1.3 Cluster System around Lonnie's Pond

Lonnie's Pond is a sub-watershed in the Pleasant Bay system. A small-scale system in this watershed would serve 31 properties. Figure I-2 depicts the extent of the service area for this cluster system. The expected annual average flow is 5,500 gpd; that translates to a design flow of 14,000 gpd. This system would be designed around a target effluent nitrogen concentration of 5 mg/l. This system would require a groundwater discharge permit. Treatment of the wastewater could be met with a multi-stage fixed-film process or a membrane bioreactor. Other key statistics of this system are provided side-by-side with the other cluster systems in Table I-1.

### 1.1.4 Cluster System around Areys Pond

Areys Pond is a sub-watershed in the Pleasant Bay system. A small-scale system in this watershed would serve 27 properties. Figure I-3 depicts the extent of the service area for this

cluster system. The expected annual average flow is 3,400 gpd; that translates to a design flow of 9,900 gpd. This system would be designed around a target effluent nitrogen concentration of 8 mg/l. This system would require Board of Health review and approval under Title 5. Treatment of the wastewater could be achieved with a fixed-film process. Other key statistics of this system are provided side-by-side with the other cluster systems in Table I-1.

**Table I-1**

**Characteristics of Cluster Systems**

| | **Sub-watershed to be Served** | | | |
|---|---|---|---|---|
| **Characteristics** | **Little Cove** | **Lonnie's Pond** | **Areys Pond** | **Paw Wah Pond** |
| | | | | |
| Major watershed | Nauset System | Pleasant Bay | Pleasant Bay | Pleasant Bay |
| Properties to be served | 29 | 31 | 27 | 37 |
| Flows, gpd | | | | |
| Design | 14,000 | 14,000 | 9,900 | 21,000 |
| Expected annual average | 5,900 | 5,500 | 3,400 | 9,400 |
| Target effluent N conc., mg/l | 5 | 5 | 8 | 5 |
| N removal, lb/yr | 379 | 439 | 187 | 611 |
| N removal, as % of TMDL | unknown | 67 | 60 | 67 |
| Percentage of properties within 10-yr travel time of embayment | unknown | about 90% | nearly 100% | about 60% |
| Centralized sewer phase | 4 | 3 and 5 | 5 | 5 |
| Land acquisition | yes | yes | yes | yes |
| Effluent disposal area, sq.ft. | 7,000 | 7,000 | 27,000 | 10,700 |
| Impact on undisturbed land | | | | |
| Sewers and pump stations | no | no | no | yes |
| Treatment facility | no | maybe | yes | yes |
| Effluent disposal | no | yes | yes | yes |
| Pump stations within floodplains | no | no | yes | yes |
| Facilities within 100 feet of wetlands | yes | yes | yes | yes |
| Presence of: | | | | |
| Rare species habitat | no | no | no | no |
| Historic/archaeological resources | no | no | yes | no |
| | | | | |

### 1.1.5 Cluster System around Paw Wah Pond

Paw Wah Pond is a sub-watershed in the Pleasant Bay system. A small-scale system in this watershed would serve 29 properties. Figure I-4 depicts the extent of the service area for this cluster system. The expected annual average flow is 5,900 gpd; that translates to a design flow of 14,000 gpd. This system would be designed around a target effluent nitrogen concentration of 5 mg/l. This system would require a groundwater discharge permit. Treatment of the wastewater could be achieved with a multi-stage fixed-film process or a membrane bioreactor. Other key statistics of this system are provided side-by-side with the other cluster systems in Table I-1.

### 1.1.6 Cluster System around Bakers Pond

Bakers Pond is a sub-watershed in the Pleasant Bay system. A small-scale system in this watershed would serve 7 properties. Figure I-5 depicts the extent of the service area for this cluster system. The expected annual average flow is 1,400 gpd; that translates to a design flow of 2,640 gpd. This system would require Board of Health review and approval under Title 5. Treatment of the wastewater would be achieved with a conventional Title 5 system. Phosphorus enrichment in this watershed is the primary concern. Septic system effluent immediately upgradient of the pond is a primary source. Unlike the other four cluster systems, nitrogen enrichment is not a critical factor. Additionally, the driving factor behind the installation of the Bakers Pond cluster system is not level of treatment, but relocation of effluent disposal. Therefore, conventional Title 5 treatment and disposal is appropriate. Relocating the effluent disposal from immediately upgradient of the pond, to a downgradient location, provides protection from nutrient enrichment. A portion of the pond shoreline extends into the Town of Brewster. Providing wastewater collection for upgradient parcels in Brewster would aid in the preservation of Bakers Pond water quality and should be explored prior to the design of Phase 2.

## 1.2 DEGREE OF NITROGEN REMOVAL

The degree of nitrogen removal provided at the cluster systems was evaluated to strike a balance between cost and water quality improvement. A consensus was reached at a meeting with DEP

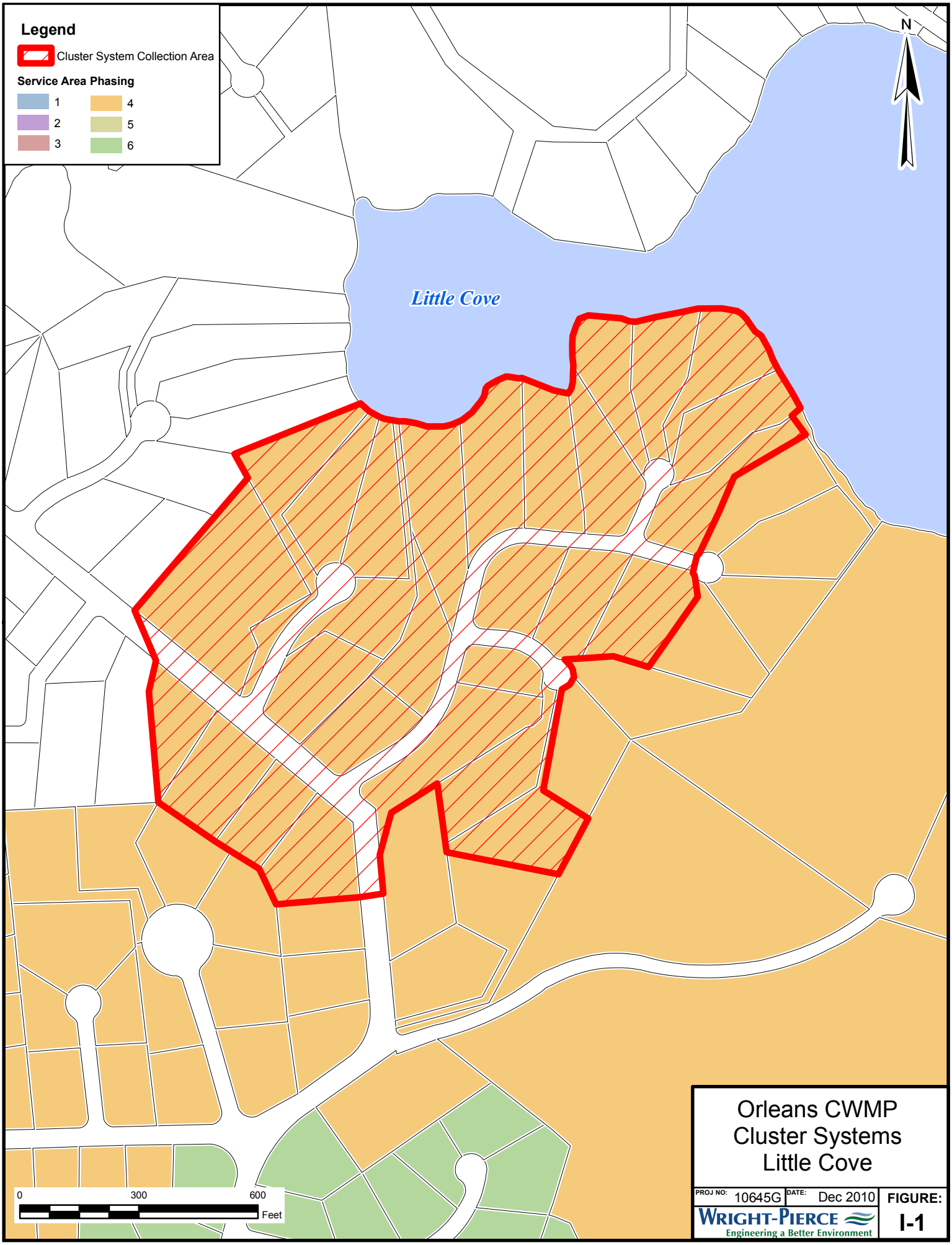
and the Cape Cod Commission that small-scale systems could reach effluent nitrogen concentrations of 5 or 10 mg/l. If these concentrations are regularly met (feasible with appropriate oversight and maintenance) these cluster systems could achieve 60% or more of the TMDL in their respective sub-watersheds. Prior to the construction of these cluster systems in Phase 2 of the project, the Town will work with MEP to quantify the water quality improvement that is expected as a result of the nitrogen load reduction these systems provide. At that time, the Town will weigh the costs against the improvement and decide if some or all of the cluster systems should be built. As Core Plan phases are completed, an evaluation of the extent of new sewer required in watersheds with cluster systems should be conducted to determine if the cluster systems should remain in operation, or be replaced by sewers leading to the centralized facility.

## 1.3 IMPLEMENTATION STEPS

Each of the sites identified for wastewater facilities have been reviewed by the Massachusetts Historical Commission. Undisturbed portions of the sites are either within, or proximate to, areas where archaeological resources could be present. The archaeological sensitivity is primarily due to the environmental setting (proximity to water and in level areas with well-drained soils). A reconnaissance archaeological survey should be conducted to assess all of the cluster sites. The Town has committed to this work and set a budget in its capital plan for surveys during the design phase of the project.

## 1.4 CAPITAL COSTS

Capital costs for the cluster systems have been estimated in three categories: 1) collection, 2) treatment and disposal, and 3) land costs. The collection costs for the 4 coastal cluster systems are technically associated with the Core Plan, because the portion of the overall sewer system that would lead to the cluster system would be constructed as part of the central collection system if the cluster systems are not built. Treatment and disposal costs have been separately estimated (see Table 11-7) to provide a basis for deciding if early nitrogen control is cost effective for the systems serving coastal water bodies. Land costs for treatment and disposal sites are included with other project land costs in Table 11-7 and the associated text provides the basis for the land cost estimates.


Legend
Cluster System Collection Area
Service Area Phasing
1
2
3
4
5
6
N
Little Cove
0
300
600
Feet
Orleans CWMP
Cluster Systems
Little Cove
PROJ NO: 10645G
DATE: Dec 2010
FIGURE:
I-1
WRIGHT-PIERCE
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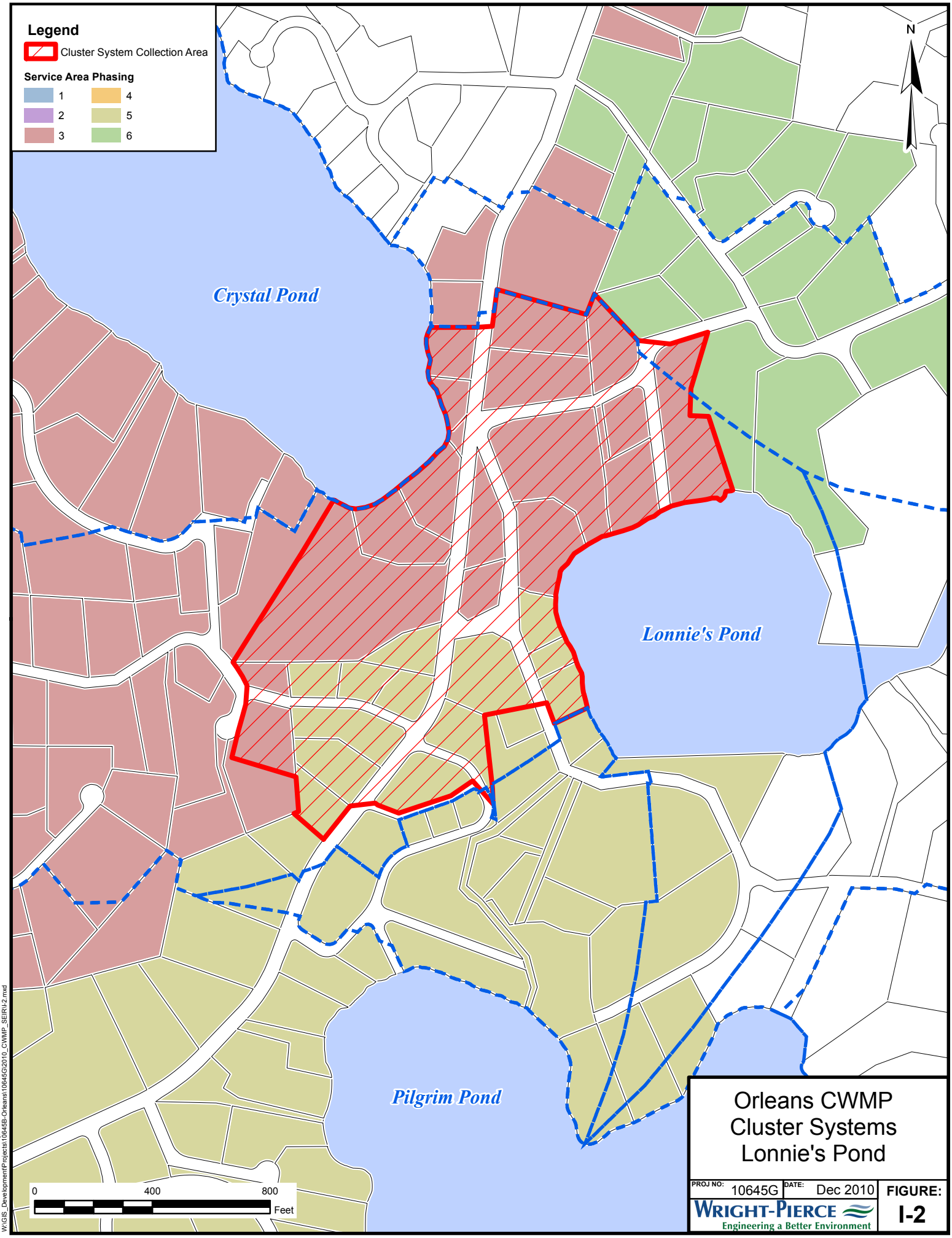
Legend
Cluster System Collection Area
Service Area Phasing
1
2
3
4
5
6
N
Crystal Pond
Lonnie's Pond
Pilgrim Pond
0
400
800
Feet
Orleans CWMP
Cluster Systems
Lonnie's Pond
PROJ NO: 10645G
DATE: Dec 2010
FIGURE: I-2
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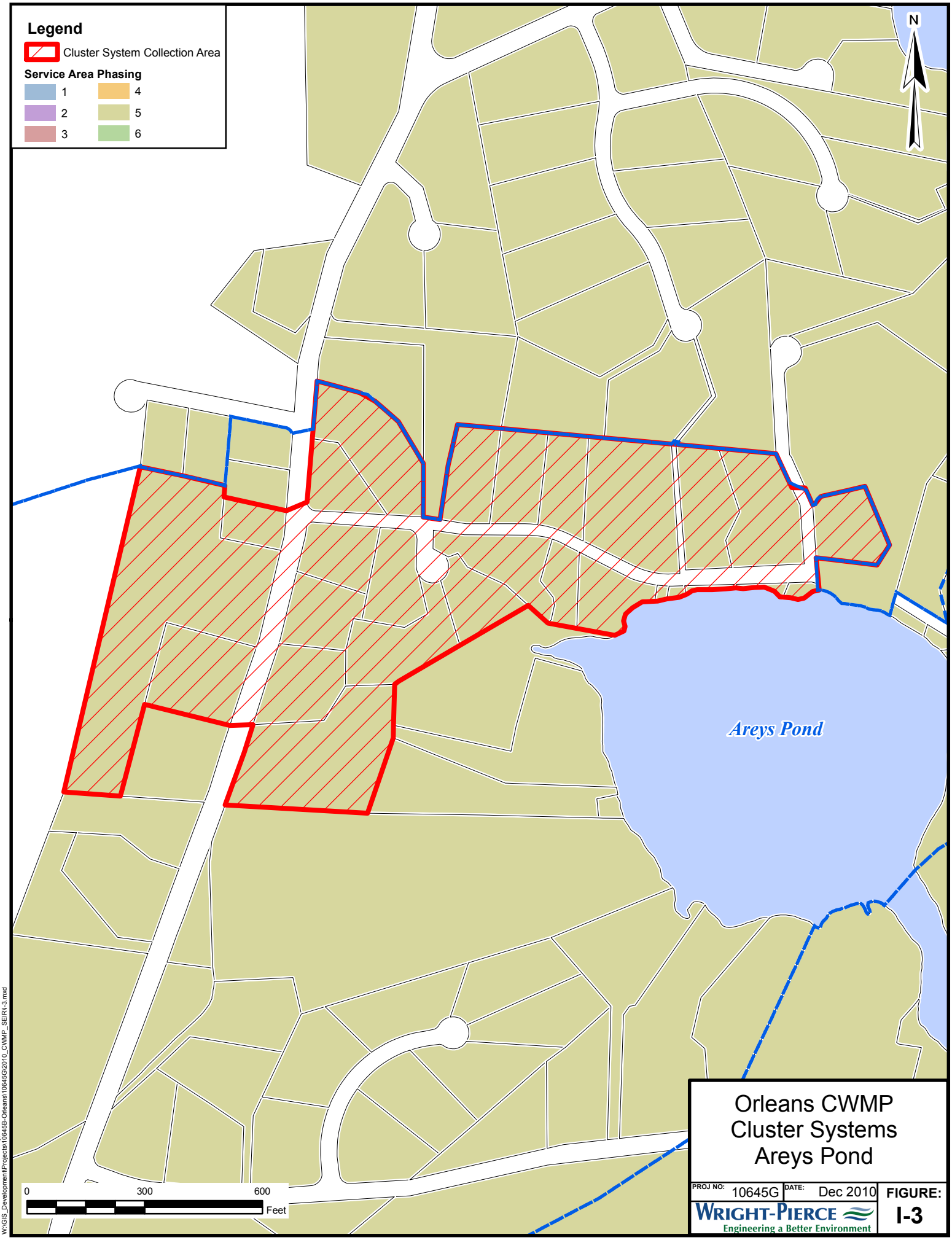
Legend
Cluster System Collection Area
Service Area Phasing
1
2
3
4
5
6
N
Areys Pond
0
300
600
Feet
Orleans CWMP
Cluster Systems
Areys Pond
PROJ NO: 10645G
DATE: Dec 2010
FIGURE:
I-3
WRIGHT-PIERCE
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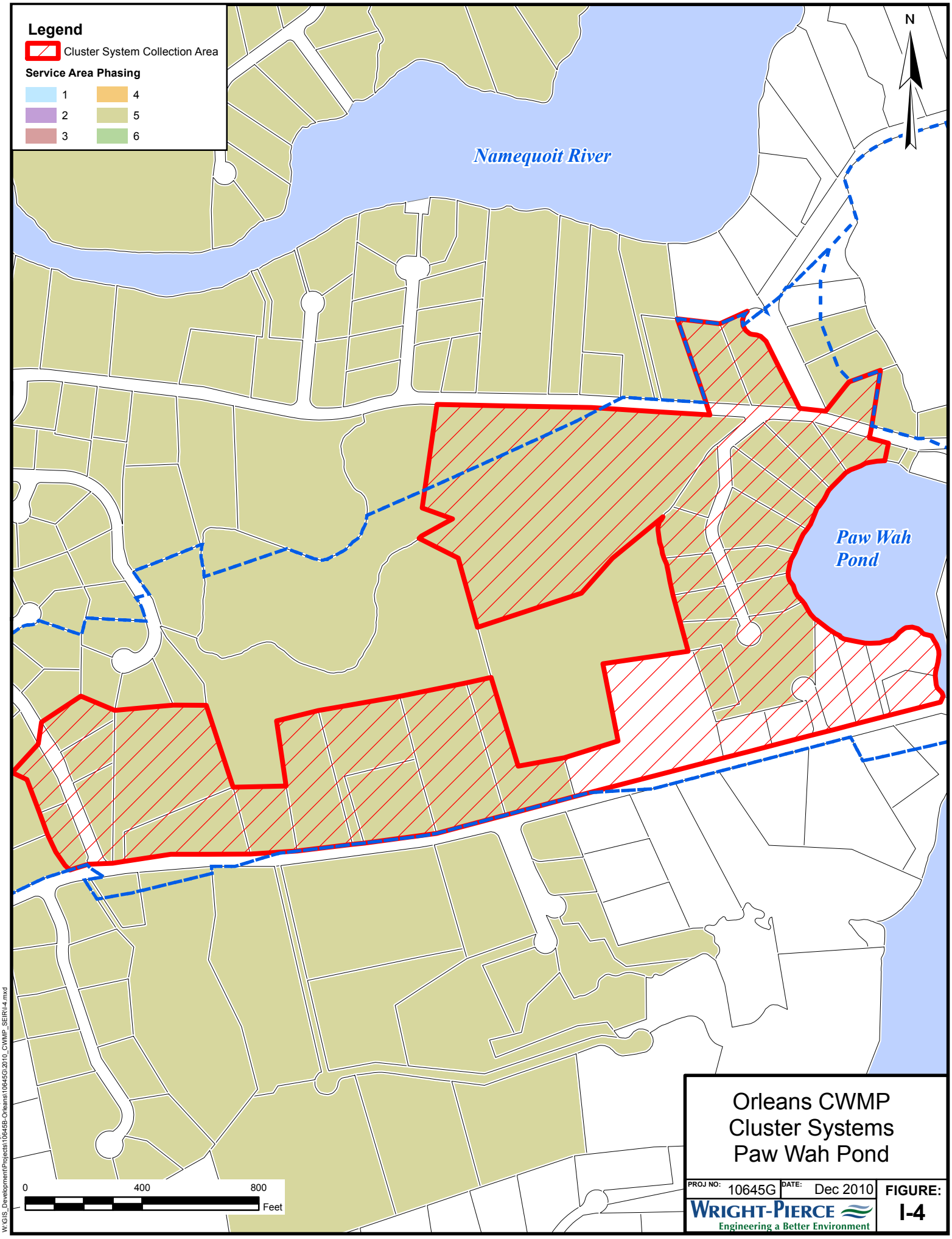
Legend
Cluster System Collection Area
Service Area Phasing
1
2
3
4
5
6
N
Namequoit River
Paw Wah Pond
0
400
800
Feet
Orleans CWMP
Cluster Systems
Paw Wah Pond
PROJ NO: 10645G
DATE: Dec 2010
FIGURE: I-4
WRIGHT-PIERCE
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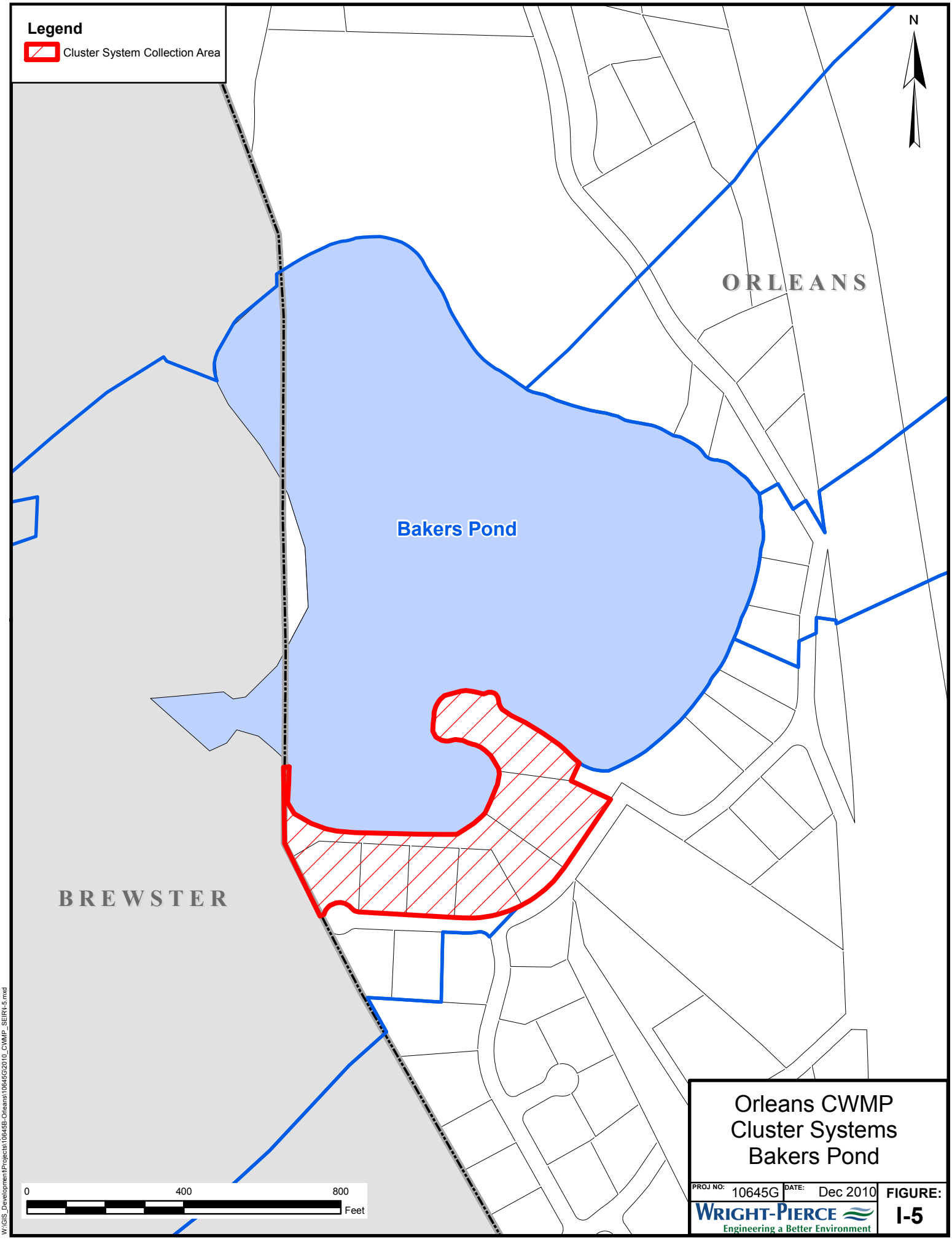
Legend
Cluster System Collection Area
N
ORLEANS
Bakers Pond
BREWSTER
0
400
800
Feet
Orleans CWMP
Cluster Systems
Bakers Pond
PROJ NO: 10645G
DATE: Dec 2010
WRIGHT-PIERCE
Engineering a Better Environment
FIGURE:
I-5
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