UNOFFICIAL TRANSLATION

THAI AGRICULTURAL STANDARD

TAS 7422-2010

GOOD AQUACULTURE PRACTICES FOR MARINE SHRIMP HATCHERY AND NURSERY

National Bureau of Agricultural Commodity and Food Standards
Ministry of Agriculture and Cooperatives
50 Phaholyothin Road, Ladyao, Chatuchak, Bangkok 10900
Telephone (662) 561 2277 Fax (662) 561 3357
www.acfs.go.th

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Technical Committee on the Elaboration of Thai Agricultural Standard for Marine Shrimp

1. Mrs. Nantiya Unprasert  
   Deputy Director General,  
   Department of Fisheries  
   Chairperson

2. Ms. Varin Tanasomwang  
   Coastal Fisheries Research and Development Bureau,  
   Department of Fisheries  
   Member

3. Mrs. Oratai Silapanapaporn  
   National Bureau of Agricultural Commodity and Food Standards  
   Member

4. Mr. Somboon Laoprasert  
   Marine Shrimp Culture Research Institute,  
   Department of Fisheries  
   Member

5. Ms. Nantipa Pansawat  
   Faculty of Fisheries, Kasetsart University  
   Member

6. Associate Professor Somkiat Piyaratititworakul  
   Department of Marine Science,  
   Faculty of Science, Chulalongkorn University  
   Member

7. Associate Professor Jirasak Tangtrongpiros  
   Aquatic Animal Disease Research Center,  
   Faculty of Veterinary Science, Chulalongkorn University  
   Member

8. Mrs. Umpai Harnkraiwilai  
   Board of Trade of Thailand  
   Member

9. Mr. Bunjonk Nissapawanich  
   Thai Eastern Shrimp Farmers’ Association  
   Member

10. Mr. Mati Nitipon  
    Thai Shrimp Association  
    Member

11. Mr. Decha Bunluedet  
    Thai Aquaculture Association  
    Member

12. Mr. Surapol Pratuangtham  
    Thai Marine Shrimp Farmer’s Association  
    Member

13. Mr. Surapong Harnkraiwilai  
    Thai Frozen Foods Association  
    Member

14. Mr. Manat Larpphon  
    Office of Standard Development,  
    National Bureau of Agricultural Commodity and Food Standards  
    Member and Secretary
Marine shrimp is an important product to Thai economy. The Ministry of Agriculture and Cooperatives had issued the Notification on the Thai Agricultural Standard on Good Aquaculture Practices for Marine Shrimp Farm (TAS 7401-2009) as guidance for shrimp farmers. The Agricultural Standards Committee therefore deems it necessary to establish the Thai Agricultural Standard on Good Aquaculture Practices for Marine Shrimp Hatchery and Nursery by developing guidance as the first step to fulfill the operations along the supply chain to be recognized by both domestic and international consumers.

This standard is based on the following documents:


NOTIFICATION OF THE MINISTRY OF AGRICULTURE AND COOPERATIVES

SUBJECT: THAI AGRICULTURAL STANDARD:
GOOD AQUACULTURE PRACTICES FOR MARINE SHRIMP
HATCHERY AND NURSERY
UNDER THE AGRICULTURAL STANDARDS ACT B.E. 2551 (2008)

Whereas the Agricultural Standards Committee deems it necessary to establish an agricultural standard on Good Aquaculture Practices for Marine Shrimp Hatchery and Nursery as a voluntary standard in accordance with the Agricultural Standards Act B.E. 2551 (2008) to promote such agricultural commodity to meet its standard on quality and safety.

By virtue of Section 5, Article 15 and Section 16 of the Agricultural Standards Act B.E. 2551 (2008), the Minister of Agriculture and Cooperatives hereby issues this Notification on the Establishment of Thai Agricultural Standard: Good Aquaculture Practices for Marine Shrimp Hatchery and Nursery (TAS 7422-2010), as a voluntary standard, details of which are attached herewith.

Notified on 4 October B.E. 2553 (2010)
Mr. Theera Wongsamut
Minister of Agriculture and Cooperatives
THAI AGRICULTURAL STANDARD

GOOD AQUACULTURE PRACTICES FOR MARINE SHRIMP
HATCHERY AND NURSERY

1. SCOPE

This Thai Agricultural Standard applies to Good Aquaculture Practices (GAP) at all stages of farm practices in marine shrimp hatchery and nursery including harvesting, collecting and post-harvest handlings prior to transportation in order to produce good quality of fry for farm culture by taking into account of food safety, environmental integrity and social responsibility.

2. DEFINITIONS

For the purpose of this standard:

2.1 **Marine shrimp** means shrimp in genus *Penaeus* (*Penaeus* spp.), *Metapenaeus* (*Metapenaeus* spp.) and *Litopenaeus* (*Litopenaeus* spp.) such as black tiger shrimp (*Penaeus monodon*), white shrimp (*Litopenaeus vannamei*).

2.2 **Marine shrimp hatchery and nursery** means the premises used for marine shrimp hatchery and nursery consisting of areas for broodstock culturing, fry hatchery and nursery, and feed preparation, building, seawater pump station, ponds or reservoirs for water preparation and reservation, aerators and standby aerators, standby electricity generator (optional), fry packing facility, laboratory (optional) and any necessary sanitary facilities for fry hatchery and nursery.

2.3 **Marine shrimp broodstock** means the fertile adult marine shrimp from wild-caught, imported, or reared for breeding purpose.

2.4 **Marine shrimp fry** mean marine shrimp larvae and post larvae.

2.5 **Larvae** mean the marine shrimp fry that are newly hatched from eggs and undergone metamorphosis through 3 larval stages; nauplius, zoa and mysis within 8-11 days.

2.6 **Post larvae (PL)** mean the marine shrimp fry that undergo mysis stage and reach post larval stage at which its abdominal appendages are fully developed as same as adult. In addition, “PL” is the abbreviation of “post larvae”, followed by the number of days that the fry develop after larval stage e.g. “PL 21” means post larvae aged 21 days.

2.7 **Veterinary drug** means any substance applied or administered to any food-producing animal, whether used for therapeutic, prophylactic, or diagnostic purposes or for modification of physiological functions or behaviour.
2.8 **Hazardous Substances** mean chemicals that are used in aquaculture in accordance with the Hazardous Substances Act B.E. 2535 (1992) and its amendments overseen by the Department of Fisheries.

2.9 **Major requirement** means the mandatory requirement that must be fully complied with. In case of non-compliance, it will seriously affect the quality of fry as well as the safety of consumers. It means also the requirement that must be complied with relevant laws and regulations.

2.10 **Minor requirement** means the important principle of standard. In case of non-compliance, it will affect the quality and health of fry, safety of consumers as well as the environment and social responsibility.

2.11 **Recommendation** means practices that are recommended for sustainable shrimp hatchery and nursery. In case of non-compliance, it may affect the health of fry, as well as the environment and social responsibility.

### 3. REQUIREMENTS AND INSPECTION METHODS

Requirements and inspection methods are shown in Table 1.

**Table 1 Requirements and Inspection Methods**

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<th>Items</th>
<th>Requirements</th>
<th>Inspection Methods</th>
<th>Compliance levels</th>
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<tr>
<td>1. Farm site and registration</td>
<td>1.1 Farm shall not be located in the environment that has a risk of contamination which will affect the quality and health of fry as well as the safety of consumer.</td>
<td>1.1.1 Visual inspection of the environmental condition. 1.1.2 In case where the farm is located in the environment that has a risk of contamination which will affect the health of broodstock and/or fry and safety of consumer, water treatment as well as soil or water analysis prior to hatchery and nursery operations.</td>
<td>Major requirement</td>
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<td>Items</td>
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| 1.2 Water quality should be appropriate or able to be treated as recommended for hatchery and nursery as follows:  
- Dissolved Oxygen (DO) not less than 5 mg/l  
- pH 7.5 to 8.5  
- Salinity for hatchery 28 - 35 g/kg (or ppt)  
- Salinity for nursery 0.5 - 40 g/kg (or ppt) | 1.2 Check water quality (DO, pH and salinity). | Recommendation |
| 1.3 Conveniently access to transportation both outside and inside the farm for quick operations and transport of fry. | 1.3 Visual inspection. | Recommendation |
| 1.4 Farmer shall be registered with the Department of Fisheries. | 1.4 Check registration. | Major requirement |
| 1.5 Farmer shall have land rights or land use permit. | 1.5 Check document or evidence. | Major requirement |
| 1.6 Farm shall be located outside the mangrove and/or legally conserved wetlands. | 1.6 Check document or evidence. | Major requirement |
| 1.7 Farm shall not be located in the prohibited area. | 1.7 Check document or evidence. | Major requirement |
| 2. Broodstock management | 2.1 Source of broodstock origin shall be identified. | 2.1.1 Check record of broodstock origin.  
2.1.2 Check copy of movement document in case of purchasing broodstock from outside. | Major requirement |
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| 2.2   | Broodstock shall be fertile, healthy, and disease-free or non-disease carrier. | 2.2.1 Visual inspection of broodstock conditions.  
2.2.2 Check record of broodstock management and utilization in hatchery.  
2.2.3 Check the approved health document stating the disease-free (Optional). | Minor requirement |
| 2.3   | Stocking density of broodstock shall be appropriate. | 2.3 Check record of stocking density of broodstock. | Minor requirement |
| 2.4   | After the first spawning, female broodstock shall be used for hatching within a reasonable period of time corresponding to shrimp species. | 2.4 Check record of broodstock hatching. | Major requirement |
| 2.5   | Fresh and/or live feed should be in good quality. | 2.5.1 Check record of broodstock feeding.  
2.5.2 Visual inspection on feed. | Recommendation |
| 2.6   | Feeding of fresh and/or live feed to broodstock shall be prepared and kept in a hygienic manner. | 2.6.1 Check record of broodstock feeding.  
2.6.2 Visual inspection. | Major requirement |
| 3.1   | Manual of hatchery and nursery management shall be provided and implemented accordingly. | 3.1.1 Inspect the details of the manual according to hatchery and nursery activities.  
3.1.2 Check evidence of operations according to the manual referred to in 3.1.1 | Major requirement |
<p>| 3.2   | Periodically check water quality shall for hatchery and nursery as specified in the manual. | 3.2 Check water quality test report. | Minor requirement |</p>
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<tr>
<td>3.3</td>
<td>Vacating and/or preparing the pond shall be carried out before new crop.</td>
<td>3.3 Visual inspection on pond conditions Check record of such operations.</td>
<td>Major requirement</td>
</tr>
<tr>
<td>3.4</td>
<td>Stocking density for nursery shall be appropriate.</td>
<td>3.4 Check record of stocking density.</td>
<td>Minor requirement</td>
</tr>
<tr>
<td>3.5</td>
<td>Inlet water shall be filtered in order to prevent the entry of exotic species.</td>
<td>3.5 Visual inspection on the water filtration system.</td>
<td>Minor requirement</td>
</tr>
<tr>
<td>3.6</td>
<td>Adequate aerators or appropriate aeration systems shall be provided in the ponds.</td>
<td>3.6 Visual inspection on the aerators and aeration systems.</td>
<td>Minor requirement</td>
</tr>
<tr>
<td>3.7</td>
<td>Registered formulated feeds that are of good quality and unexpired shall be used. In case formulated feed is prepared on farm, feeding inputs used for such formulated feed shall be clearly stated, provided that legally prohibited feeding inputs shall not be used.</td>
<td>3.7.1 Visual inspection on the feed condition. 3.7.2 Inspect the registration, the manufacturing and expiry date of formulated feed. 3.7.3 Check relevant documents regarding the formulated feed preparation on farm.</td>
<td>Major requirement</td>
</tr>
<tr>
<td>3.8</td>
<td>Efficient feeding management should be provided to meet the requirement of the fry.</td>
<td>3.8 Check record of the quantity of feed given and the leftovers.</td>
<td>Recommendation</td>
</tr>
<tr>
<td>3.9</td>
<td>Feed shall be stored in an area that can prevent the contamination and maintain the quality of feed.</td>
<td>3.9 Visual inspection on feed storage area.</td>
<td>Minor requirement</td>
</tr>
<tr>
<td>3.10</td>
<td>Water quality in the ponds shall be analysed on a regular basis.</td>
<td>3.10 Check record of water quality analysis in the ponds.</td>
<td>Minor requirement</td>
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<td>3.11</td>
<td>Preventive measures against the entry of exotic species and disease carrier animals shall be taken during the pond preparation, water preparation, and hatchery and nursery operations.</td>
<td>3.11 Visual inspection and check record of preventive measures against exotic species and disease carrier animals.</td>
<td>Minor requirement</td>
</tr>
<tr>
<td>3.12</td>
<td>Fry health shall be monitored regularly.</td>
<td>3.12.1 Check record of fry health. 3.12.2 Visual inspection on the behaviour and symptom shown in fry.</td>
<td>Minor requirement</td>
</tr>
<tr>
<td>3.13</td>
<td>In case where the fry show any sign of symptom and/or poor health, the disease diagnosis, causation analysis and corrective actions shall be carried out or destroyed.</td>
<td>3.13.1 Check records of disease diagnosis, causation analysis and corrective actions or destruction. 3.13.2 Interview farmers.</td>
<td>Minor requirement</td>
</tr>
<tr>
<td>3.14</td>
<td>Preventive measures and control of disease outbreak shall be in place.</td>
<td>3.14.1 Check record of preventive measures and control of disease outbreak. 3.14.2 Check training document, evidence or knowledge on fry health and preventive measures.</td>
<td>Major requirement</td>
</tr>
<tr>
<td>3.15</td>
<td>In case of disease outbreak, farmers shall inform the competent authority immediately.</td>
<td>3.15 Check record or evidence of the incident.</td>
<td>Major requirement</td>
</tr>
<tr>
<td>4.1</td>
<td>In case where the use of veterinary drugs, chemicals, hazardous substances and probiotics is necessary, use only those that are registered with the competent authority and apply them correctly.</td>
<td>4.1 Check registration of veterinary drugs, chemicals, hazardous substances and probiotics used.</td>
<td>Major requirement</td>
</tr>
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<td>Items</td>
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<td>4.2</td>
<td>In case where the use of veterinary drugs or chemicals is necessary, it shall be used according to the label instruction.</td>
<td>4.2 Check record of veterinary drugs and chemical usage.</td>
<td>Major requirement</td>
</tr>
<tr>
<td>4.3</td>
<td>Any prohibited veterinary drugs, chemicals, hazardous substances and probiotics shall not be used.</td>
<td>4.3.1 Check record of veterinary drugs, chemicals, hazardous substances and probiotics used. 4.3.2 Visual inspection on the storage area.</td>
<td>Major requirement</td>
</tr>
<tr>
<td>4.4</td>
<td>Veterinary drugs, chemicals, hazardous substances and probiotics shall be stored appropriately to prevent deterioration.</td>
<td>4.4 Visual inspection on the storage area of veterinary drugs, chemicals, hazardous substances and probiotics.</td>
<td>Major requirement</td>
</tr>
<tr>
<td>5.1</td>
<td>Quality of discharge water from hatchery and nursery shall be complied with relevant laws and regulations.</td>
<td>5.1 Check record of test results of discharge water.</td>
<td>Major requirement</td>
</tr>
<tr>
<td>5.2</td>
<td>Control systems against the release of saline water from the ponds into the freshwater area shall be in place to prevent polluting the environment.</td>
<td>5.2.1 Check the control systems. 5.2.2 Interview people living in the surrounding community or nearby farms.</td>
<td>Major requirement</td>
</tr>
<tr>
<td>6.1</td>
<td>Fuel and lubricant shall be stored properly and securely.</td>
<td>6.1 Visual inspection on the storage area.</td>
<td>Major requirement</td>
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<tr>
<td>6.2</td>
<td>Machines used on farm shall be in good condition without any leakage of fuel or lubricant into the water source.</td>
<td>6.2 Check the condition of machine and its operation.</td>
<td>Major Requirement</td>
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| 6.3                         | Used lubricant shall be placed in an appropriate container and discarded properly. | 6.3.1 Interview the workers.  
6.3.2 Check conditions and records of how to discard the used lubricant. | Major requirement       |
| 6.4                         | There shall be a safe electrical system on farm.                             | 6.4 Check on electricity system.                                                    | Major requirement    |
| 6.5                         | Energy saving and/or renewable energy shall be in place.                     | 6.5 Check energy usage.                                                             | Recommendation       |
| 7.1                         | Proper disposal of garbage, refuse, veterinary drug containers and hazardous substances shall be implemented in order to prevent cross-contamination and animal digging. Also, preventive measures against disease carrier animals shall be in place. | 7.1.1 Visual inspection on the waste disposal area.  
7.1.2 Check relevant records. | Major requirement       |
<p>| 7.2                         | All production inputs, materials and tools should be kept so as to prevent deterioration or harbour of the disease carrier animals. | 7.2 Visual inspection on the storage area.                                           | Minor requirement    |
| 7.3                         | Bathrooms and toilets shall be hygienic and preventing contamination to the hatchery and nursery ponds. | 7.3 Visual inspection on the prevention against contamination.                     | Major requirement    |
| 7.4                         | Pets are not allowed in the production areas.                                | 7.4 Visual inspection.                                                              | Major Requirement    |</p>
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<tr>
<td>8. Harvest, collecting and post-harvest handlings prior to distribution</td>
<td>8.1 During the harvest and post-harvest, fry shall be hygienically managed and handled to prevent contamination.</td>
<td>8.1.1 Visual inspection on the management. 8.1.2 Check records of management procedures and handlings during the harvest and post-harvest.</td>
<td>Minor Requirement</td>
</tr>
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<td>8.2 Veterinary drug residues or prohibited chemical residues shall not be found in fry.</td>
<td>8.2 Check analysis report of veterinary drugs and prohibited chemical residues.</td>
<td>Major requirement</td>
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<td></td>
<td>8.3 If chemicals are used, they shall be used properly in terms of type and quantity.</td>
<td>8.3 Check record of chemicals used during the harvest and collecting.</td>
<td>Major requirement</td>
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<td>8.4 Packing methods, containers, equipment and packing density shall be appropriate to the size of fry and the duration of transport.</td>
<td>8.4.1 Check operating manual regarding the fry packing. 8.4.2 Interview and visual inspection of fry packing. 8.4.3 Check record of fry packing.</td>
<td>Minor requirement</td>
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<td>8.5 Fry Movement Document (FMD) shall be presented upon request.</td>
<td>8.5 Check copy of FMD.</td>
<td>Major requirement</td>
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<td>9. Labour and welfare</td>
<td>9.1 Workers shall be legally employed.</td>
<td>9.1 Check employment record.</td>
<td>Major requirement</td>
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<td>9.2 Wages shall be abided by law.</td>
<td>9.2 Check wage payment record.</td>
<td>Major requirement</td>
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<td>9.3 Appropriate welfare for workers should be provided.</td>
<td>9.3.1 Visual inspection. 9.3.2 Interview the workers.</td>
<td>Recommendation</td>
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| 9.4   | Appropriate safety precautions and personal protective equipment should be provided for safety operations. | 9.4.1 Visual inspection.  
9.4.2 Interview the workers. | Recommendation |
| 9.5   | Workers shall be trained on the safety operation. | 9.5.1 Check training record.  
9.5.2 Inspect the relevant evidence. | Recommendation |
| 10.1  | Farm site shall not obstruct the customary access and/or interfere in the living and activities of the local community. | 10.1.1 Visual inspection.  
10.1.2 Interview people in the surrounding community. | Major Requirement |
| 10.2  | There should be activities to promote good relationship with the local community. | 10.2.1 Interview people in the surrounding community.  
10.2.2 Check document and evidence. | Recommendation |
| 10.3  | Farm owner should participate in activities of farmer organizations of hatchery and nursery or other related professional areas. | 10.3.1 Inspect the evidence of participation in the activities of farmer organizations.  
10.3.2 Interview the organization of which farm owner is a member. | Recommendation |
<p>| 10.4  | Farm owner should attend the conference, seminar, or training programme related to the development of shrimp hatchery and nursery operations including the areas of environmentally friendly practices, health and welfare of animals, and food safety. | 10.4 Check certificate or evidence of attending the conference, seminar or training. | Recommendation |</p>
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<td>11. Record keeping</td>
<td>11.1 The following information shall be recorded:</td>
<td>11.1 Check records.</td>
<td>Major requirement</td>
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<td>- Broodstock origin, usage and feeding.</td>
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<td>- Pond preparation</td>
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<td>- Preventive measures against and control of disease outbreak.</td>
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<td>- The use of veterinary drugs, chemicals, hazardous substances, and probiotics.</td>
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<td>- The use of chemicals during harvest.</td>
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<td>- Employment and wage payment.</td>
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<td>11.2 Other necessary information and relevant data shall be recorded and kept for further</td>
<td>11.2 Check records and record keeping.</td>
<td>Minor requirement</td>
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<td>inspection, such as record of problems, causes and corrective actions.</td>
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4. **Judgment criteria**

Judgment for inspection according to the standard requirements is as follows:

4.1 “Major requirements” shall be all complied.

4.2 “Minor requirements” shall be complied not less than 70%.

4.3 “Recommendations” shall be complied not less than 60%.

4.4 A follow-up of 4.2 and 4.3 of the successive year shall present the improvement at least 10%, or it shall be regarded as non-compliance.

In addition, inspection methods and scoring system shall follow the criteria and conditions set by certification body.
5  Guidance on good aquaculture practices for marine shrimp hatchery and nursery

The guidance on good aquaculture practices for marine shrimp hatchery and nursery is intended to provide farmers with good management practices so as to achieve good quality of fry for further farm culture as well as safety for consumers. The details are described in Appendix A.
APPENDIX A

Guidance for Marine Shrimp hatchery and nursery
(Section 5)

A.1 Farm site and registration

Site selection is the priority factor in marine shrimp hatchery and nursery businesses for an efficient operation. A suitable site shall be located by the sea accessible to infrastructures. Source of water shall be in a clean condition, far from source of pollution and appropriate for the use in hatchery and nursery activities in terms of quality and quantity. The recommendations are as follows:

A.1.1 In principle, the farm site shall be far from any source of pollution, such as industrial or agricultural zone, or community, which will affect the surrounding environment of the farm located either upstream or downstream. However, such suitable farm site for agriculture and shrimp aquaculture is limited due to the expansion of industry and community. Therefore, the selection of farm site far from source of pollution nowadays becomes difficult.

In case where there is a risk from the source of pollution, samples of soil, water and others shall be randomly collected for analysis of possible residues thereof. For instance, water and soil samples shall be collected from paddy area, where there is an evidence of pesticide use, for analysis.

In addition, farmer shall know land use history, such as types of chemicals previously used as well as the species and the methods used to culture the fry as far as possible in order to know a possible adverse effect on the aquaculture and thus to set an effective preventive measure prior to the hatchery and nursery operations.

Another issue that shall be considered is the flooding. Preventive measures against flooding shall be carefully considered and prepared in advance since toxic or hazardous substances from outside may be swept along the flood into the farm.

In case the farm is found to be at risk from sources of pollution, the farm shall set preventive measures or solution against such risk in the farm, e.g. the use of water with closed recirculation system or from other safe water sources.

A.1.2 Farm site should meet technical requirements to efficiently achieve the management. The guidance for the selection of farm site is as follows:

A.1.2.1 Water in the hatchery and nursery ponds should be at the optimum depth. There shall be management for sufficient oxygen.

A.1.2.2 Water quality in the ponds should be met or can be treated as recommended in Appendix B.
A.1.2.3 Farm should be located by the sea with normal tide. Water should be of suitable quality or can be treated and be sufficient for farm operations.

A.1.2.4 Farm should have good water circulation between the farm and water sources from outside. Efficient circulation of water among reservoirs, hatchery and nursery ponds, and treatment ponds shall be properly designed. Also, energy saving should be considered during water pumping between inside and outside the farm, including among hatchery and nursery ponds and reservoirs.

In addition, farm should be considered to have a year round supplies of water for operations, or at least sufficient for operations within the production period. At present water source for aquaculture is limited, if the farm can reserve sufficient water from sources outside throughout the year or have its own water supply. The farm is considered to be appropriate for hatchery and nursery operations.

A.1.3 Farm site should be accessed by the convenient transportation, such as pave road, river or canal to facilitate the transportation with less injury of fry, such that the quicker transportation, the lesser injury to the fry. The convenient access to the farm is not only beneficial for farm input delivery but also to fry purchasing. The convenient transportation within the farm will also facilitate the fry transferring from pond to pond, i.e., between the nursery ponds or cages as well as the recuperation ponds prior to distribution by minimizing the transportation time and fry injury.

A.1.4 Farmer shall register farm at the nearby local office of the Department of Fisheries according to the rules. The registered information will be recorded as a database for the official to locate the farm and to provide services. In addition, farmer shall also demonstrate the evidence of legal land use rights and holding or renting for farm registration.

A.1.5 Farmer shall operate the hatchery and nursery in the land complied with relevant laws. Farm shall not be located in a mangrove conservation area. This includes legal land use rights and holding or renting.

A.1.5.1 Legal land rights are as follows:
(1) Land title or deed or
(2) Nor Sor 3 or
(3) Nor Sor. 3 Gor or
(4) Sor Por Gor 4-01 (Agricultural Land Reform Office (ALRO 4-01)) or
(5) Sor Kor 1 or
(6) Gor Sor Nor 5 in case located in industrial zone or
(7) Por Sor 23 in case located in the reserved forest or
(8) Sor Tor Gor in case located in the reserved forest or
(9) Other relevant documents indicating legal rights to use the land
A.1.5.2 In case farmer does not own the land, evidence of land use permit or aquaculture permit such as land lease, land rent or documents permitting of use for aquaculture shall be available.

A.1.6 Farm site shall be located outside the mangrove conservation areas and/or legally conserved wetlands.

A.1.7 Farm site shall be located outside the prohibited area such as freshwater area according to the Enhancement and Conservation of National Environmental Quality Act.

A.2 Broodstock management

A.2.1 In case of purchasing broodstock from outside, movement document of the broodstock shall be made available for tracing if there is any incident. In case the broodstock are from wild caught, a purchasing document indicating the origin shall be available. In case the broodstock are imported, the health certification shall be attached.

A.2.2 Farmer shall select good quality of broodstock such as complete sexual maturation, appropriate age, healthy, good growing, tolerance to the environmental stress and parasitic infectious diseases, high spawning or hatching rates, good hatching history and good characteristics, e.g. complete appendages, regular body form, non-inherited congenital malformation, disease-free or non-disease carrier. The above mentioned characteristics will provide good quality of fry that are healthy, good and fast growing, tolerance to the environmental stress and parasitic infectious diseases, which is suitable for culturing for further consumption.

A.2.3 Stocking density of broodstock should be appropriate with the size of culturing area as follows:

1. White shrimp, not exceed 10 shrimp/m².
2. Black tiger shrimp from wild caught, not exceed 5-7 shrimp/m².
3. Black tiger shrimp from farm culture, not exceed 10 shrimp/m².

A.2.4 After the first spawning, female broodstock shall be used for hatching within a reasonable period of time corresponding to shrimp species as follows:

1. White shrimp, not exceed 4 months.
2. Black tiger shrimp from wild caught, not exceed 1 month.
3. Black tiger shrimp from farm culture, not exceed 3 months.

A.2.5 Quality of fresh and/or live feed should be inspected such as freshness or randomly analyzed for the severe viral infection, i.e., White Spot Virus, Yellow Head Virus, Taura Syndrome Virus, Infectious Hypodermal and Haematopoietic Necrosis Virus or other virus potentially harmful to the shrimp production.

A.2.6 Fresh and/or live feed feeding to broodstock shall be prepared and kept in a hygienic manner. There shall be enough washing, such as washing with clean water, and kept in good
condition in order to maintain its freshness and nutritional value. Live feed should be washed to ensure no carrying of any disease to broodstock.

A.2.7 Feeding and feed amount given to broodstock should be recorded.

A.2.8 Good quality of feed given to broodstock should contain suitable nutritional value corresponding to the shrimp species. The information can be obtained from technical publication, aquaculture manual or expert advice. The use of unsuitable feed quality could result in the reduction or non-development of eggs and sperms of broodstock.

A.3 General management

Good management plan of hatchery and nursery operations will prevent contamination, environmental deterioration, farm discharge and impact on coastal biodiversity, and increase the production efficiency. Good hatchery and nursery management may be done by the use of disease resistant broodstock. The collecting of broodstock from wild caught should consider using the methods that do not destroy the environment and natural resources. In addition, the stocking density of fry in the nursery ponds is also an important factor towards management. In case of high stocking density, large amount of feed given to the fry may cause water quality deterioration leading to shrimp stress and disease susceptibility. The guidance for good hatchery and nursery management is as follows:

A.3.1 Farmer shall develop procedural manual of shrimp hatchery and/or nursery in accordance with the requirements of the standard, such as farm layout, broodstock management, fry production plan, pond and water preparation, fry feeding and health care, fry collecting or harvesting, fry preparation prior to distribution and fry packing. Workers shall be trained on the use of manual and proper practices. The manual should be clear and understandable. In case where any document and standard are referred to in the manual, those documents shall be available for use together with the manual.

A.3.2 For the efficient management, quality of water source used in the farm should be analyzed at appropriate intervals as specified in the manual in order to control water quality as recommended in Appendix B.

A.3.3 Pond vacating and/or improvement shall be carried out in suitable condition prior to a new crop.

A.3.4 Appropriate stocking density of fry for hatchery and nursery operations should not exceed 100 larvae/litre of water for black tiger shrimp or 250 larvae/litre for white shrimp.

A.3.5 Materials and tools such as seine and net shall be used to screen out exotic species and disease vectors into the pond during water preparation period. The recommendations on water preparation for hatchery and nursery operations are as follows:

Seawater to be used for hatchery and nursery shall be clean. Inlet seawater of salinity range between 28-32 mg/g is pumped into reservoir ponds/tanks and allowed to precipitate, and then to
chlorinate by adding chlorine at 20-30 g/ton of seawater. In case reservoir ponds/tanks are not available, the chlorine could be directly added to seawater at 50-100 g/ton, followed by aeration for one day. Chlorinated seawater should be tested for residual chlorine by using potassium iodide (KI). If the water is clear, it shows that the residual chlorine is not present. On the other hand, if the seawater turns yellow, it indicates that residual chlorine is still present, in such case, the water should be let to stand until the residual chlorine dissipates naturally or it can be dechlorinated by using sodium thiosulfate (Na$_2$S$_2$O$_3$) at 5-10 g/ton of seawater. After the precipitation and chlorine disinfection, quality of seawater should be tested to ensure whether it is suitable for use in the hatchery and nursery or not. If the water quality is improper, it can affect the spawning and hatching rates of broodstock as well as the growth and survival rates of fry.

A.3.6 Aerators shall be installed to maintain suitable living condition of fry by locating the aerators in the proper position to provide sufficient oxygen throughout the pond.

A.3.7 Feed for hatchery and nursery is categorized into three groups, namely live feed, fresh feed and formulated feed.

A.3.7.1 Live feed means living animals and plants in the pond directly fed to fry, such as artemia, plankton, barnacle and marine mollusc.

A.3.7.2 Fresh feed means feed made from animal or plant origin without processing in the same manner as formulated feed.

A.3.7.3 Formulated feed means manufactured feed for aquatic animals in accordance with the Animal Feed Quality Control Act B.E.2525 (1982).

A.3.7.4 Farmer shall use only formulated feed, supplements and vitamins registered with the regulatory authority and still valid. In case the use of feed, such as formulated feed, supplements and vitamins from manufacturers or distributors, such feed shall be registered regulatory authority with clear label of nutritional values, manufacturing and expiry dates, and other relevant information according to laws and regulations. Therefore, prior to the best use of formulated feed, farmer should observe the condition of feed and label from tampering. The feed shall not contain high moisture, mold, and shall not expire.

A.3.7.5 Feeding inputs used for feed preparation on farm, e.g. fishmeal, soybean meal, rice bran, broken-milled rice, and/or live feed shall be free from prohibited veterinary drugs and substances under the laws in order to prevent the contamination thereof. Thus farmer can check the test report of the contamination of prohibited veterinary drugs and substances in each lot of the purchased feeding inputs or consider other information and evidence.

A.3.8 Feeding should be efficiently managed to meet the requirement of the fry.

A.3.9 Feed storage area shall be separately located, dry, clean and at an appropriate temperature in order to avoid the feed damage or quality deterioration as well as to prevent contamination and the entry of disease-carrier animals such as birds, rats and other animals.

A.3.10 Water quality in the ponds shall be analysed on a regular basis. Suitable water quality control shall be in accordance with Appendix B.
A.3.11 Preventive measures against the entry of exotic species and disease carrier animals shall be provided during the pond and water preparation, and hatchery and nursery operations.

A.3.12 Fry health and water quality should be monitored regularly. If there is any problem found in the fry, the diagnosis of such disease should be carried out immediately.

A.3.13 If abnormal signs of fry health are found, the causation analysis of such signs shall be carried out before using of veterinary drugs or chemicals. When the causes are found, corrective actions on farm management and/or pond environmental control should be implemented as the first priority.

In case the use of veterinary drugs or chemicals is necessary to treat the sick fry, only those veterinary drugs and chemicals registered with the regulatory authority shall be used and their label instructions shall be strictly followed. Prohibited veterinary drugs and chemicals are not allowed. The use of veterinary drugs and chemicals and their withdrawal periods shall strictly follow the instruction indicated on the label and accompanied document. Also information on the chemical use shall be recorded every time. In addition, veterinary drugs shall be used when the diagnosis is confirmed by the supervision of veterinarian or fishery biologist who is an expert on aquatic animal diseases. The use of expired veterinary drugs is prohibited and the records of veterinary drugs used should be kept for at least two years.

A.3.14 Strict control measures against disease transmission from pond to pond and farm to farm shall be in place, such as disinfection of all tools used on farm, assignment of individual worker responsible for the infected pond, and cessation of water exchange of such infected pond.

A.3.15 Normally, if the dead fry is found, the cause of death shall be investigated immediately. In case of disease outbreak causing massive mortality, farmers shall inform the competent authority immediately and the dead fry shall be appropriately destroyed, e.g. disinfection of water in the hatchery ponds using chlorine. The effluent shall be treated before discharging into the open environment.

A.4 Use of veterinary drugs, chemicals, hazardous substances and probiotics

Uses of veterinary drugs and chemicals shall be regarded as the last resort for fry health management when infected with diseases because the residues of veterinary drugs and certain chemicals in the shrimp may pose potential risks to human health. In fact, fry health can be improved and recovered from diseases through better culturing management. Prevention and treatment depend on the causes of disease. Recommendations are as follows:

A.4.1 In case the use of veterinary drugs, chemicals, hazardous substances and probiotics is necessary, only those registered with the regulatory authority shall be used correctly according to the official recommendations.

A.4.2 In case the use of veterinary drugs or chemicals is necessary, it shall be used strictly according to the label instructions.

A.4.3 Prohibited veterinary drugs, chemicals, hazardous substances and probiotics by regulatory authority and those banned by importing countries shall not be used.
A.4.4 Veterinary drugs, chemicals, hazardous substances and probiotics shall be stored correctly according to the instructions indicated on the labels and accompanied document. Prescribed veterinary drugs shall be kept separately from non-prescribed veterinary drugs. The storage condition shall be able to prevent deterioration of veterinary drugs and any harm to humans. Storage shelves of veterinary drugs shall not be made of moisture-absorbent materials and the liquid containers shall be stored on the lower shelves.

A.5 **Effluent Management**

Effluent from farm contains high levels of nutrients, microorganisms, planktons, and other substances. Good effluent management can help improve quality and reduce quantity of effluent. Efforts shall be made to improve the quality of effluent to meet the standard as required by laws. The recommendations are as follows:

A.5.1 In case the farm size is 10 rai or larger, the effluent shall be treated or subject to quality control before discharging. The effluent parameters shall meet specifications as required by laws as follows:

1. pH 6.5-9.0
2. Biochemical Oxygen Demand (BOD) not exceeded 20 mg/l
3. Suspended solids (SS) not exceeded 70 mg/l
4. Ammonia (NH$_3$-N) not exceeded 1.1 mgN/l
5. Total phosphorus not exceeded 0.4 mgP/l
6. Hydrogen Sulfide (H$_2$S) not exceeded 0.01 mg/l
7. Total Nitrogen not exceeded 4.0 mgN/l

**Source:** Notification of the Ministry of Natural Resource and Environment Re: Specification of the Standard Controlling Discharge of Effluent from Coastal Aquaculture Pond under the Royal Gazette Vol. 121, Special Section 49D, dated 1 May B.E. 2549 (2006)

A.5.2 Control systems against the release of saline water from the ponds into the freshwater area shall be in place to prevent polluting the environment.

A.5.3 Materials and tools, such as net or seine shall be used to filter inlet and outlet water in order to prevent the potential escape of fry from the farm.

A.6 **Energy and fuel**

Fuel, oil and grease are normally used for lubrication of machinery, such as vehicles, water pumps, aerators and other machines in the farm. Some fuels are flammable and/or explosive. Farmer shall pay much attention on potential danger to workers. Moreover, inadvertent spillage or disposal of those fuels may cause an effect on the fry and pollution to wider areas. The recommendations are as follows:

A.6.1 Fuels and lubricants should be labeled and stored far away from flammable and explosive materials and beware of spillage.

A.6.2 Draining of lubricant out of engines shall be done carefully and avoid leakage or spillage.
A.6.3 Tools and equipment for cleaning after a fuel spillage shall be provided and easily accessible.

A.6.4 There shall be an electrical system on farm, which is safe for workers.

A.6.5 Using of water pumps and aerators shall be under conservative measures and energy saving.

A.7 Farm sanitation

Farm normally produces large amounts of wastes that could be a source of pollution. If the wastes are not managed properly, it may cause unpleasant smell and pose health hazard to people living in the farm and surrounding areas. Kitchen wastes, expired foods and other waste materials might attract garbage eating animals, such as disease carrier animals. In addition, farm sanitation is necessary for maintaining good quality of fry and being free of diseases. Daily maintenance of farm sanitation will greatly contribute to farm management in compliance with the requirements of this standard. Recommendations are as follows:

A.7.1 Garbage and refuse shall be separately kept for proper disposal and to prevent the contamination to the hatching and nursing ponds.

A.7.2 Orderly keep the production inputs, materials and equipment so as not to harbour disease carrier animals and maintain to be ready for use.

A.7.3 Bathrooms and toilets shall not be located near the hatchery and nursery ponds. If it is unavoidable, they shall be kept distance from the water system used for hatchery and nursery operations. Toilet waste shall be hygienically disposed and ensured that there is no seepage causing subsequent contamination to the water system. The contamination of bacteria causing foodborne illness shall be strictly and regularly monitored. Prompt corrective actions shall be in place by taking the water samples for coliform analysis. The amount of total coliforms shall not exceed 1000 MPN/100 ml (Most Probable Number per 100 millilitres) and the amount of fecal coliforms shall not exceed 70 cfu/100 ml (Colony Forming Unit per 100 millilitres). If the amount of these coliforms exceeds the level, it indicates that the water system is contaminated with the discharge from toilets or residence and the human or animal excrement.

A.7.4 Pets are not allowed in the hatchery and nursery areas. In case guard dogs are needed for protecting farm property, much attention should be paid to dog droppings not to contaminate the farm area, and the cleanliness should be regularly maintained.

A.8 Harvest, collecting and post-harvest handlings prior to distribution

Harvesting is a vital stage to control the fry quality and to prevent the pollution. Good practices for harvest and collecting, such as quick harvesting and collecting, providing sufficient aeration and proper transportation, will be able to maintain fry quality and reduce fry injury. In addition, the distribution of fry to neighbouring shrimp farms with short transportation times is one of the good methods that could maintain fry quality and reduce fry
injury. Recommendations for harvest, collecting and post-harvest handling practices are as follows:

A.8.1 There shall be a plan for harvesting, collecting and rapid transportation by focusing on keeping fry quality and reducing fry injury. Farmer shall harvest the fry while they are healthy in order to maintain their premium quality as well as to prevent them from contamination during the harvest, collecting and post-harvest handlings prior to distribution. In addition, any prohibited substances shall not be used during the harvest.

A.8.2 Appropriate amount of chemicals shall be used during the harvest or post-harvest.

A.8.3 Workers who are responsible for harvesting and collecting the fry shall not be infected with any contagious disease. Containers and methods used for harvesting, collecting and transportation shall not cause any adverse effect on fry quality and storage quality. Containers shall not be placed directly on the ground or floor. All equipment used for fry transportation shall be clean, made of corrosion resistant materials and in functional condition. All equipment shall be cleaned right after each use and maintained the cleanliness to prevent the accumulation of microorganisms.

A.8.4 All prohibited veterinary drug and chemical residues shall not be found in the fry.

During the nursery operation, random samples of fry should be collected for analysis of both prohibited and allowed veterinary drugs and chemical residues in an official or officially recognised laboratory conforming to international standard at least once a year. The prohibited veterinary drugs and chemicals shall not be found.

A.8.5 Fry packing

Packing of fry in plastic bags and transportation are also important. Fry packing should not be too dense. The recommendations for fry packing are as follows:

(1) Use spoon to the transfer fry (count the number of fry per one spoon) from the dip net to the container filled with 2.5 litres of clean water. Activated carbon may be added at 2 g/litre of water.

(2) Transfer the fry that are counted in (1) into a plastic bag.

(3) Fill oxygen into the plastic bags at 1:1 by volume and tightly seal the plastic bags.

(4) Appropriate packing density of fry with length of 10-13 mm should be at 1,200-1,500 fry/litre of water. Temperature during transportation should be maintained at 24-28ºC depending on the duration of transportation.

(5) Plastic bags containing fry shall be neatly arranged in the transport vehicle and moved to fry transfer station (optional).

Transportation bags and foam boxes should be disinfected by dipping them into disinfectant solutions, such as povidone iodine at a concentration of at least 1000 ml/l. Then, the transportation bags are placed on ice within a foam box at approximately 5-9 bags/box or depending on the foam box sizes to maintain a temperature during the transportation according to its duration and fry packing requirements. Then, the numbers of foam boxes are arranged in the vehicle in accordance with the purchasing order and tied firmly with the vehicle using ropes.
A.8.6 The Fry Movement Document (FMD) issued by the Department of Fisheries or officially designated agency is required to present to buyers and other relevant stakeholders to know the origin of fry for further culture and consumption.

A.9 Labour and welfare

Working in the farm is rather dangerous as the usage of equipment and materials exposes to risk. Moreover, wages and welfare of workers are not fully complied with the relevant labour laws by most farm owners. The recommendations are as follows.

A.9.1 Workers shall be legally employed and abided by labour laws.

A.9.2 Minimum wages shall be provided according to laws.

A.9.3 Appropriate welfare for workers should be provided, such as accommodation, potable and non-potable water, medicines and other facilities.

A.9.4 Appropriate safety environmental condition and personal protective equipment for working should be provided. Good ventilation of dwellings and sufficient amount of bathrooms and toilets corresponding to the numbers of workers should be provided.

A.9.5 Workers shall be trained on the safety operation and First-Aid, such as electric shock, bleeding, drowning and other possible accidents.

A.10 Social and environmental responsibilities

The problems between the shrimp farmers and local community as well as between the employer and employee are very complicated. Large commercial scale farm can reduce those problems through good farm management. However, most of the shrimp farms in Thailand are relatively small scale. Thus, farmer organizations could be an effective approach to the enhancement of effective farm management. According to the information on the development of shrimp farming in Thailand, it was found that the gathering of shrimp farmers to exchange their views and experiences on the techniques and farm management could greatly contribute to the development of shrimp farming. In addition, technical knowledge on farm and environmentally friendly management require practical training. The recommendations are as follows:

A.10.1 Farm site shall not obstruct the customary access and/or interfere in the living and activities of the local community.

A.10.2 Farmer shall participate in social activities to promote good relationship with the local community.

A.10.3 Farm owner should participate in activities of farmer organizations, such as clubs or cooperatives related to shrimp hatchery and nursery.

A.10.4 Local resources should be efficiently utilized. Mangrove plantation activities should be promoted. These will help strengthening the good relationship with local community and reduce an adverse effect on the environment.
A.10.5 Meeting or technical training courses on farm management, utilization of production inputs for fry production as well as training on relevant laws and regulations for shrimp culturing industry shall be encouraged.

A.11 Record keeping

Record keeping and updating are necessary for efficient farm management and continuous improvement as well as the ability to trace and track when encountered problems in a certain stage of fry production. These will enable the review of records for improving the production systems to be more effective or enhancing fry production efficiency in the next crops, or in case the farm encounters the problems such as disease outbreak. Also, the record keeping is beneficial to farmer from which the causes of problems can be identified, and thus the corrective actions can be established for the next crop. In addition, records should be analysed every time after the completion of each hatchery and nursery cycle and maintained for at least 2 years after the date of recording.
### APPENDIX B

**Recommendations on water quality suitable for marine shrimp hatchery and nursery**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Recommended Level</th>
</tr>
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<tbody>
<tr>
<td>Temperature</td>
<td>28°C to 32°C</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>≥ 5 mg/l</td>
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<tr>
<td>pH</td>
<td>7.0 to 8.5</td>
</tr>
<tr>
<td>Salinity for hatchery</td>
<td>28 g/kg to 35 g/kg</td>
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<tr>
<td>Salinity for nursery</td>
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<tr>
<td>Calcium hardness (as CaCO₃)</td>
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<tr>
<td>Total Alkalinity (as CaCO₃)</td>
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</tr>
<tr>
<td>Ammonia (NH₃)</td>
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<td>Nitrite (NO₂⁻)</td>
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<tr>
<td>Nitrate (NO₃⁻)</td>
<td>≤ 60 mg/l</td>
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<tr>
<td>Total suspended solid</td>
<td>≤ 100 mg/l</td>
</tr>
<tr>
<td>Coliforms</td>
<td>≤ 1,000 MPN/100 ml</td>
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<tr>
<td>(Most Probable Number per 100 millilitres)</td>
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</tr>
<tr>
<td>Fecal coliforms</td>
<td>&lt; 70 cfu/100 ml</td>
</tr>
<tr>
<td>(colony forming unit per 100 millilitres)</td>
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</tr>
</tbody>
</table>
APPENDIX C

UNITS

The units and symbols used in this standard and the units recognized by the International System of units (Le Système International d’ Unités) or SI are as follows:

<table>
<thead>
<tr>
<th>Type of Measurement</th>
<th>Name of Unit</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>millimetre</td>
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</tr>
<tr>
<td>Weight</td>
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<tr>
<td>Volume</td>
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<tr>
<td>Mass</td>
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<tr>
<td>Concentration</td>
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<tr>
<td></td>
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<td>ml/l</td>
</tr>
<tr>
<td>Temperature</td>
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</table>