OLD COLONY PLANNING COUNCIL

# Climate Change Roadway Drainage and Runoff Study

The Status of Stormwater Mapping in the OCPC Region

December 2012

**PREPARED BY OLD COLONY PLANNING COUNCIL**
**70 SCHOOL STREET, BROCKTON, MA 02301**
**UNDER MASSDOT CONTRACT #69649**

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***The views and opinions of the Old Colony Planning Council expressed herein do not necessarily state or reflect those of the U. S. Department of Transportation.***

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## The State of Stormwater Mapping in the OCPC Region

In FFY 2011, Old Colony Planning Council undertook a Roadway Drainage and Runoff Study, which outlined the measures that communities will be expected to take upon the issuance of the Environmental Protection Agency's (EPA) National Pollution Discharge Elimination System (NPDES) Phase II Permit program. This program regulates non-point source water pollution generated by urbanized area municipalities through their municipal separate storm sewer systems (MS4s). The initial permit was issued in 2003 and expired in 2008. The new permit, currently in draft form, is expected to be released in the fall of 2012.

The 2003 National Pollution Discharge Elimination System (NPDES) Phase II Permit calls for the creation of an Illicit Discharge Detection and Elimination (IDDE) program. Among the requirements to identify and mitigate non-stormwater discharges of pollutants, the permit specifies that communities must begin work towards the identification and mapping of all outfalls and receiving water bodies. No timeline was set on when this identification and mapping must be completed. The new permit will demand completion of this system mapping (Section 2.4.4.6) within two years of the permit's effective date.

The details of the mapping requirement state that:

> *2.4.4.6.a. The map shall include the entire separate storm sewer system, including pipes, catch basins, interconnections to other small MS4s, and treatment structures associated with the separate storm sewer system and other structures associated with the system. The map shall show outfalls and receiving waters. The map shall provide a comprehensive depiction of key infrastructure and factors influencing proper system operation and the potential for illicit sanitary sewer discharges.*

The draft permit also contains further details on data which is recommended, but not required. For example, locations of suspected illicit discharges could be mapped, or a geodatabase may contain a record of the last date of maintenance for a particular drainage structure.

Although the draft permit allows the map in a hard copy form, there are several reasons to consider storing it electronically in a geographic information system (GIS). First, GIS is useful for large datasets. Data can be created, displayed, edited, or removed with a minimum of effort. Secondly, it can be integrated with other geographic data to improve understanding of the community's stormwater system in relation to its other resources. Lastly, it can be distributed easily to those who need it over the internet, and can even be viewed on some devices, like laptops and smartphones, from a remote location in the field.

In 2005, MassGIS released the Standard for Water, Waste Water, and Storm Water Infrastructure (Levels I and II) to guide GIS data creation of these assets. The Standard provides communities with uniform attribute data that is comparable to neighboring communities and scalable to include future development.

Due to differences in access to technology and a community's other financial commitments, it is not always realistic to reach a high standard of GIS mapping. Some communities have been able to map their stormwater infrastructure using GIS software, while others may have paper maps or none at all. The goal of the Old Colony Planning Council is to survey the current status of stormwater mapping throughout the region, and provide recommendations and assistance to communities so that they will adequately fulfill the NPDES Phase II Permit requirements.

The permit specifies that the map "shall include the entire separate storm sewer system". Ideally, towns would have most or all of the following in geodatabase or shapefile format.

***MS4 Infrastructure***: The MS4 is a network of water conveyances including catch basins, gutters, ditches, artificial channels, storm drains, pipes, junctions, manholes and connections to other MS4s such as another community or another regulated stormwater operator. It also includes stormwater remediation measures such as leaching structures, oil and gas separators, drainage easements, and detention/retention ponds. If any part of the system is a combined sewer-stormwater system, this must also be indicated. This is a required item for permit compliance.

**Figure 1. MS4 Infrastructure Mapped**

The permit recommends recording details about the infrastructure, such as the materials used, direction of flow, condition, age, or dimensions. Additionally, areas where problems have been recorded, such as leakage or low flow rates, as well as recent repairs or cleaning, can be located. For this data, GIS can be very useful. Tables of data can linked to the geographic features in a geodatabase.

***Catchment delineations***: Like a watershed, each outfall collects water from a particular area of the community. Roadway runoff will flow towards collection points such as storm drains or catch basins, as determined by the local topography and the built environment. A single outfall may have several contributory storm drains which collect roadway runoff. This area from which stormwater is collected is the catchment area.

Determining catchment areas may be time-consuming and difficult. Since there could possibly hundreds of catchments to delineate, the process may be very time consuming. High quality elevation data is essential to determine catchment divides. The majority of the Old Colony region has had LiDAR collected within the past two years, which is available for download from MassGIS. This data can be used to determine elevations and flow direction, although advanced GIS functions may need to be run to accomplish this.

***Outfalls***: The catchment delineations are necessary for a community to more easily identify potential locations of illicit discharges. Catchment areas that have known or suspected illicit discharges should be identified as Problem Catchments and ranked as low, medium, or high risk. These rankings can be based

on past reports of illicit discharges, concentrations of industrial activity, aging infrastructure, or several other factors suggested in the draft permit.

Outfalls for these Problem Catchments should be the first investigated for the outfall inventory. The location should be recorded, preferably using a mobile GPS unit. It may be difficult to locate and record outfalls. Southeastern Massachusetts, as one of the earliest settled areas in the United States, has a great deal more archaic infrastructure than other areas of the country, and it is also possible that the locations of some outfalls may be lost. In addition, dense overgrowth or swampy conditions may exist at the location. The map of the MS4 should assist in identifying places where an outfall must exist and the general area where it may be found.

When it is located, information about the dimensions, flow, material and condition of the outfall should be recorded. The condition of the discharged water should be observed and noted where there is an odor, color, turbidity, floating solid pollutants, or an oil sheen.

Unlike the map of the MS4, outfall mapping must begin by the second year of the permit, and at least 25 percent of the outfalls must be identified each year. Full outfall mapping must be complete by the expiration of this permit.

***Waterbodies:*** Receiving waters must be identified by name. A great deal of this data was compiled for OCPC's FFY 2011 Climate Change Roadway Drainage and Runoff Study. This geodatabase includes all significant bodies of water and streams at a 1:1,000 scale. This dataset can be made available to our communities for stormwater mapping.

The draft permit recommends the inclusion of seasonal high water table elevations where they may impact combined sanitary sewer overflows. Seasonal water table fluctuations in Massachusetts are generally minor, but significant rain events like the March 2010 storms that dropped fifteen inches of rain in a single month can cause rises in lake levels and sewage backup. Also recommended are orthophotos and topography, which are both freely available from MassGIS. Topography is available as a 3-meter contour line shapefile or as LiDAR GeoTIFFs.

In addition to these mapping tasks, the permit requires a Phosphorus Control Program, which requires that other geographic features be included in the mapping to regulate phosphorus discharge into receiving waters.

## Status by Community

Using the annual reports submitted by each community to the EPA, we can identify towns that have not had the financial or human resources to adequately prepare for the permit's requirements. What follows is a summary of each town's stormwater mapping status.

***Abington***: The Town of Abington is currently attempting to identify funding sources to begin GIS mapping of storm drains. According to the most recent annual report, large parts of the drainage system are mapped on paper, but funding must be acquired to convert them into a GIS format. In the spring of 2012, the Town entered into a contract for high resolution aerial photos for use in outfall mapping.

***Avon***: Avon is the smallest town in area in the Old Colony region; however, it is heavily industrialized and has a great deal of impervious surface. According to the 2012 Annual Report, the town needs to estimate a cost of converting an existing paper map of the MS4 into a GIS format and secure funding for this task.

***Bridgewater***: In the 2012 Annual Report, the Town of Bridgewater claims that all roadways and water bodies have been mapped in GIS, as well as the sub-watershed draining into Carver Pond in the center of the town. The town has purchased GIS software and is collaborating with Bridgewater State College's geography department to have an intern work on the mapping. As of May 2012, 152 catch basins and 57 outfalls had been mapped. More mapping of catch basins, outfalls and piping will be necessary.

Bridgewater must also consider mapping the connections it has with the town's two institutional MS4 operators, Bridgewater State College and the Bridgewater Correctional Complex.

***Brockton***: The City of Brockton has, by far, the most drainage infrastructure of any community in the Old Colony Region, both by total amount and by percentage of the city's area. It also has a great deal of impervious surface in the form of parking lots and more than 330 miles of paved roads (according to the 2011 MassDOT Road Inventory). Brockton also has an institutional MS4 operator, Massasoit Community College, within its municipal boundaries. The city currently has mapping completed for the entire drainage system, sewers, and outfalls.

***Duxbury***: The newest OCPC community, the Town of Duxbury, contracted with a consulting firm to complete a map of the town's drainage system. Using a mobile GIS unit, many of the manholes, catch basins, and outfalls were collected. The town has moved on to identifying outfalls where pollution has been detected, and remediation projects.

***East Bridgewater***: The Town of East Bridgewater contracted with a consultant about two years ago to complete a full GIS map of the drainage system at a 1:100 scale. Only very recent developments may not be mapped.

***Easton***: The Town of Easton has scanned existing drainage maps and located manholes, catch basins, and outfalls using a GPS. This data collection is nearly complete. Attributes of the drainage network have not yet been recorded, such as flow or condition.

***Halifax***: The Town of Halifax has completed some mapping of catch basins, but progress is slow due to a lack of resources to dedicate to mapping. The Town owns a Trimble mobile GIS unit, which could assist public works personnel, but training may be necessary.

***Hanson***: The Town of Hanson has recently approved funding to hire a consultant for preliminary culvert mapping. The GIS mapping of catch basins and outfalls is occurring on an ongoing basis.

***Kingston***: The Town of Kingston, contracting with Cartographic Associates, Inc., has developed an online GIS page displaying many of the town's geographic data layers. In addition to water and sewer infrastructure, the town also has mapped outfalls, storm drains, catch basins and pipe connections. The interactive GIS map was developed using Microsoft Silverlight, and as such may not be compatible across all internet browsers.

***Pembroke***: The Town of Pembroke has been very proactive in their mapping efforts, completing the outfall mapping before the expiration of the first permit. They have mapped more than 2500 catch basins and 900 storm drain manholes. On hard copy maps, they have mapped the drainage network with flow directions included.

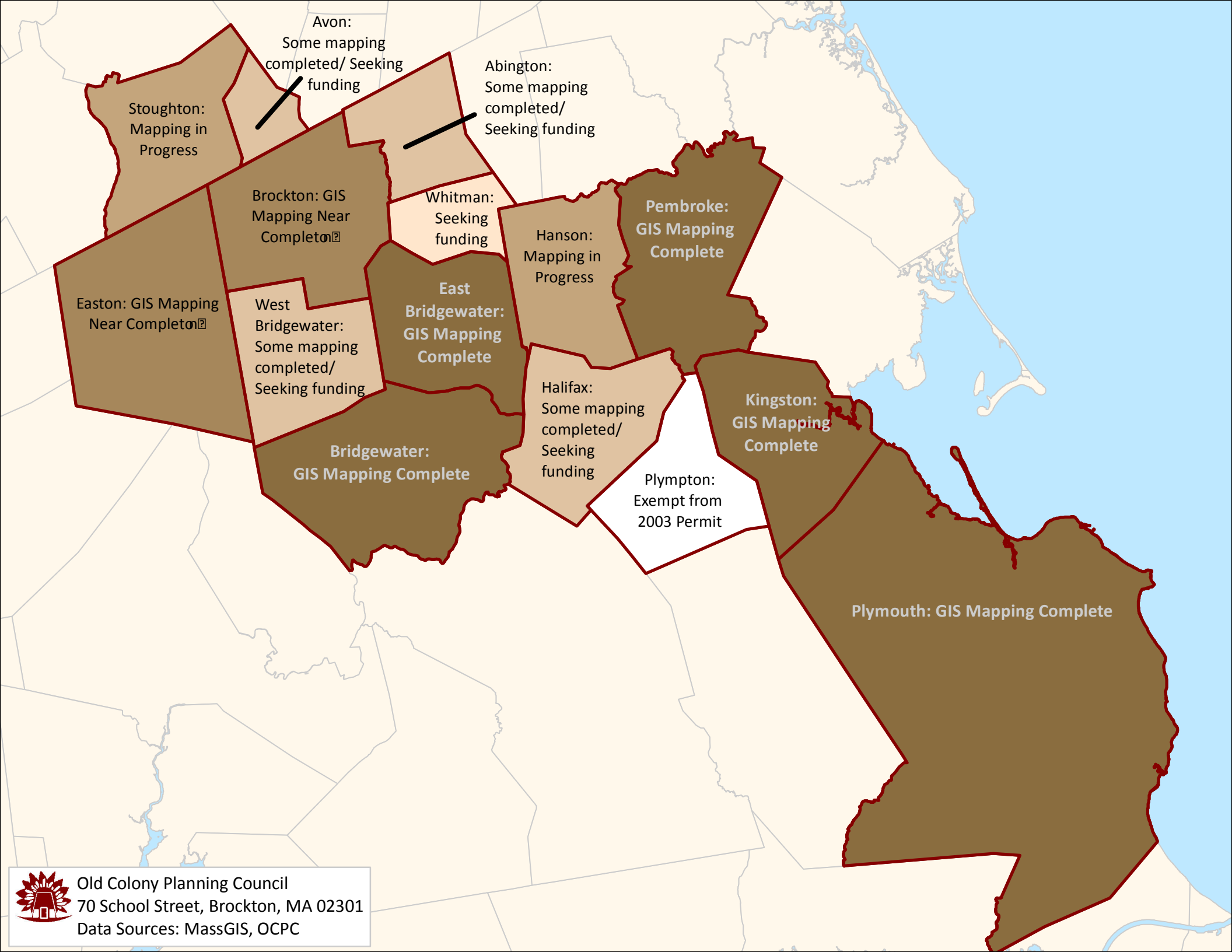
***Plymouth***: As the largest town in Massachusetts by area, The Town of Plymouth has a large total amount of stormwater infrastructure spread across a wide area, ranging from the urbanized downtown to the rural south. Plymouth has already completed mapping for catch basins and outfalls. A geodatabase has been created which contains catch basins and storm drains, manholes, outfalls, leaching structures, gas and oil separators, drainage easements, pipes and junctions. Catchment area mapping and the addition of some infrastructure attributes must still be completed for the new permit.

***Plympton***: The Town of Plympton was not entirely located in a census-designated Urbanized Area (UZA) in 2003. As determined by the 2000 Census, only the northernmost part of Plympton, near Silver Lake, was considered urbanized. Therefore, the town was exempt from the Small MS4 General Permit. The new updated UZA from the 2010 Census may change Plympton's status relative to the reissued permit.

***Stoughton***: The Town of Stoughton has recently contracted with a consultant to begin mapping stormwater facilities. Stoughton is densely developed in its center and along major routes such as Route 139, Route 138 and Route 27, and therefore has a greater density and amount of stormwater infrastructure than most other towns in the Old Colony region. The Department of Public Works, as well as the consultant, will work towards completing the mapping requirement on an ongoing basis before the permit is released.

***West Bridgewater***: The Town of West Bridgewater, despite its location on Route 24, remains a lightly developed town, but much of its stormwater drains into the Hockomock Swamp, which is considered an Area of Critical Environmental Concern. The town has begun to construct a map of the MS4. Currently, the town is seeking funding to expand GIS use across more town departments.

***Whitman***: The Town of Whitman is currently performing its stormwater mapping internally. Despite having GIS software available to the town, stormwater data has not been mapped extensively in the GIS.


Avon:
Some mapping completed/ Seeking funding
Abington:
Some mapping completed/
Seeking funding
Stoughton:
Mapping in Progress
Brockton: GIS Mapping Near Completon
Whitman:
Seeking funding
Hanson:
Mapping in Progress
Pembroke:
GIS Mapping Complete
Easton: GIS Mapping Near Completon
West Bridgewater:
Some mapping completed/
Seeking funding
East Bridgewater:
GIS Mapping Complete
Halifax:
Some mapping completed/
Seeking funding
Kingston:
GIS Mapping Complete
Bridgewater:
GIS Mapping Complete
Plympton:
Exempt from 2003 Permit
Plymouth: GIS Mapping Complete
Old Colony Planning Council
70 School Street, Brockton, MA 02301
Data Sources: MassGIS, OCPC

## Future of the OCPC Roadway Drainage and Runoff Study

Whether the NPDES Phase II Permit is released in 2012 or later, communities must be prepared for future monitoring of stormwater runoff pollution. Continued development and population growth will increase the number of vehicle miles traveled, and subsequently increase the impact on our local ecosystems. The unpredictable results of climate change could greatly change the type or amount of precipitation in our region, causing damage not only to our natural resources, but to our roadway infrastructure. Stormwater management best practices dovetail with other initiatives, such as smart growth. Many of the long-term low-impact design practices suggested in the 2011 Roadway Drainage and Runoff Study, such as locating amenities in close proximity to population centers or public transit facilities, are also congestion reducing measures and transit-oriented development principles.

These idealized solutions, however, are often executed slowly if it all. Communities may struggle to dedicate scarce resources toward the development of a comprehensive stormwater management program. The mapping element of the permit can be greatly simplified with GIS technology, although some communities have neither the funding, personnel nor the expertise in GIS to effectively take advantage of the technology. For the future of the Roadway Drainage and Runoff Study, Old Colony Planning Council will identify communities that are not yet up to speed on this data collection, and we will identify their current GIS capabilities, and work to provide them with assistance, training and data where applicable.