Process for Cleaning Maps Using ArcGIS Tools:

1. Open the "Dirty" Map in a new ArcGIS project. Using the Catalog pane on the left, Add the appropriate shapefile to the current map. Then in the Contents pane on the right, Right-click on the map, and choose Data>ExportFeatures. This will allow you to rename the shapefile and create a fresh copy attached to this ArcGIS project. We will refer to this copy of the shapefile as SHP1. Note the number of entries in SHP1. We will refer to this number as NUM1.
2. Run the Geoprocessing tool Polygon to Line to examine the current number of gaps and boundaries.
    a. Input Features should be the shapefile you are working to clean, SHP1
    b. Output Feature Class should be named whatever you choose, we will refer to it as SHP1_PolygonToLine.
    c. Leave the box Identify and store polygon neighboring information checked.
    d. Open the Attribute Table for SHP_PolygonToLine.
    e. Select by Attribute all objects in SHP_PolygonToLine with LEFT_FID = -1.
    f. Note the number of elements with LEFT_FID=-1, this gives us the max number of area in which there are gaps.
    g. Note: Without creating a bounding box, this table will also include all units on the border of the shape, which should rightfully have LEFT_FID = -1.
3. Run the Geoprocessing tool Fill Gaps to automatically fill gaps of below a certain size in your map.
    a. Input Features should be SHP1.
    b. Maximum Gap Area should be selected based on the type of map you are dealing with. It is always better to start with a low tolerance here and slow increase until finding an appropriate measure.
    c. For the South Carolina precinct map, we used 0.05 square miles as the tolerance in this step.
    d. Fill Option should be "Fill By Length"
    e. Leave the box Fill Unenclosed Gaps unchecked.
4. Run the Geoprocessing tool Polygon to Line to examine the new number of gaps and boundaries.
    a. Input Features should be the shapefile you are working to clean, SHP1
    b. Output Feature Class should be named a newname, we will refer to it as SHP1_PolygonToLine2.
    c. Leave the box Identify and store polygon neighboring information checked.
    d. Open the Attribute Table for SHP_PolygonToLine2.
    e. Select by Attribute all objects in SHP_PolygonToLine2 with LEFT_FID = -1.
    f. Compare this with the number found in step 2. This number should have decreased. If the number does not decrease re-do step 3 with a larger tolerance for Maximum Gap.
    g. With all elements with LEFT_FID = -1 selected, look at the map and identify any blue areas selected that do not lie on the boundary of the shape. It may be beneficial to zoom out very far to see the dots. If there are a large number of dots (>20), re-do step 3 with a larger Maximum Gap Area.

    h. If there is a reasonable number of area to fix by hand, for each of these dots, you should use the Edit Tool, Align Edge to fix the large gaps appropriately.
        i. Under the Edit Tab, in Manage Edits, Turn No Topology to Map Topology
        ii. Then Under Features>Modify use Align Edge
        iii. Turn Map Topology back to No Topology.
5. At this point all interior gaps on the map should be fixed. Run the Geoprocessing tool Polygon to Line one more time to examine the correct number of boundary polygons.
    a. Input Features should be the shapefile you are working to clean, SHP1
    b. Output Feature Class should be named a newname, we will refer to it as SHP1_PolygonToLine3.
    c. Leave the box Identify and store polygon neighboring information checked.
    d. Open the Attribute Table for SHP_PolygonToLine3.
    e. Select by Attribute all objects in SHP_PolygonToLine2 with LEFT_FID = -1.
    f. If a bounding shape was added to the map the number of selected attributes should be zero.
    g. Otherwise, make a note of the proper number of objects with LEFT_FID = -1. We refer to this number as BND_PLYGNS
6. Run the Geoprocessing tool Pairwise Intersect to identify areas in which the two or more polygons overlap.
    a. Input Features should be our current shapefile SHP1
    b. Output Feature Class should be a new name to represent just the intersections. We will refer to this as INTERSECT1
    c. Join Attributes should be set to All Attributes
    d. Output Type should be set to Same as input.
7. Run the Geoprocessing tool Symmetrical Difference to remove the intersections in SHP1.
    a. Input Features should be our current shapefile SHP1
    b. Update Features should be our map of intersections INTERSECT1
    c. Output Features Class should be the map we will output. We will refer to this as SHP2
    d. Attributes to Join should be set to all Attributes
8. Open the Attribute Table of SHP2
    a. If there are more objects than NUM1, we have unintentionally split polygons into pieces. We will Merge these polygons back together using the Geoprocessing tool Merge.
    b. For all objects in SHP2 with OBJECTID greater than NUM1, identify a uniquely identifying field for these polygons. For example, with the precinct map, polygons who has the same PCode and County were meant to be the same polygon.
    c. Under the Edit Tab, in Manage Edits, Turn No Topology to Map Topology
    d. Under Features>Modify use Merge to combine these polygons back together.
    e. Select multiple polygons that should be one by Selecting by Attribute and using the uniquely identifiable information.
    f. Continue this process until all polygons have been placed back together.
9. Run the Geoprocessing tool Polygon to Line to examine gaps that have been created due to eliminating intersections.
    a. Input Features should be the shapefile you are working to clean, SHP2

b. Output Feature Class should be named whatever you choose, we will refer to it as SHP2_PolygonToLine.
c. Leave the box Identify and store polygon neighboring information checked.
d. Open the Attribute Table for SHP2_PolygonToLine.
e. Select by Attribute all objects in SHP2_PolygonToLine with LEFT_FID = -1.
f. If the number of selected attributes is larger than BND_PLYGNS, we have unintentionally created gaps.

10. Run the Geoprocessing tool Fill Gaps to automatically fill these gaps of below a certain size in your map.
    a. Input Features should be SHP2.
    b. Maximum Gap Area should be selected based on the type of map you are dealing with. It is always better to start with a low tolerance here and slow increase until finding an appropriate measure. This should be significantly smaller than the tolerance used in step 3.
    c. For the South Carolina precinct map, we used 0.025 square miles as the tolerance in this step.
    d. Fill Option should be "Fill By Length"
    e. Leave the box Fill Unenclosed Gaps unchecked.
11. Run the Geoprocessing tool Polygon to Line to examine the new number of gaps and boundaries.
    a. Input Features should be the shapefile you are working to clean, SHP2
    b. Output Feature Class should be named a newname, we will refer to it as SHP2_PolygonToLine2.
    c. Leave the box Identify and store polygon neighboring information checked.
    d. Open the Attribute Table for SHP2_PolygonToLine2.
    e. Select by Attribute all objects in SHP2_PolygonToLine2 with LEFT_FID = -1.
    f. If the number of attributes selected is equal to BND_PLYGNS we are done.
    g. If the number is greater than BND_PLYGNS by a large amount, redo step 10 with a slightly larger tolerance.
    h. If the number is greater than BND_PLYGNS by a small amount, these gaps can again be manually fixed by hand.
        i. Under the Edit Tab, in Manage Edits, Turn No Topology to Map Topology
        ii. Then Under Features>Modify use Align Edge
        iii. Turn Map Topology back to No Topology.