

# **Geographical Information System-Assisted Water Availability Analysis for Grenada**

## **MAP COMPENDIUM**

**Developed under the project**

**Promoting Rainwater Harvesting in Caribbean Small Island Developing States**

**Funded by**

**United Nations Environment Programme (Nairobi)**

**Executed by**

**Caribbean Environmental Health Institute**

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# Introduction

**The data presented in this compendium is intended to assist planners in water sector development initiatives through identification of areas over Grenada that will require investment in water augmentation measures (based on water availability) such as rainwater harvesting. The data presented is preliminary and will require validation through field observation. It must be noted that the analyses was restricted to mainland Grenada, given the lack of comparable rainfall data for Carriacou and Petit Martinique.**

All primary GIS data was sourced from the Land Use Division of the Ministry of Agriculture, Lands, Forestry and Fisheries, Grenada. Analytical work was carried out by the Caribbean Environmental Health Institute. Most of the spatial analyses were conducted using IDRISI GIS software. Cartographic production was done in ArcView GIS.

The methodological guide to development of the map outputs is available on the Caribbean Environmental Health Institute's website at [www.cehi.org.lc](http://www.cehi.org.lc), or contact the Institute in St. Lucia at Tel: (758) 452-2501.



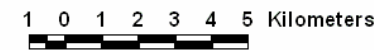
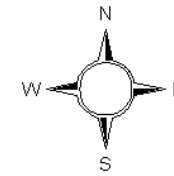
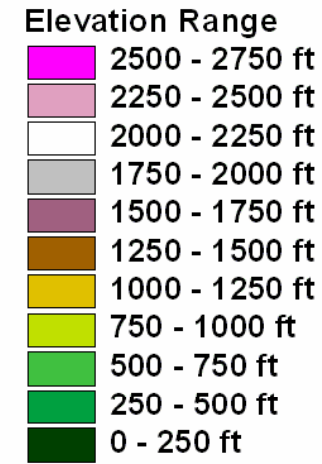
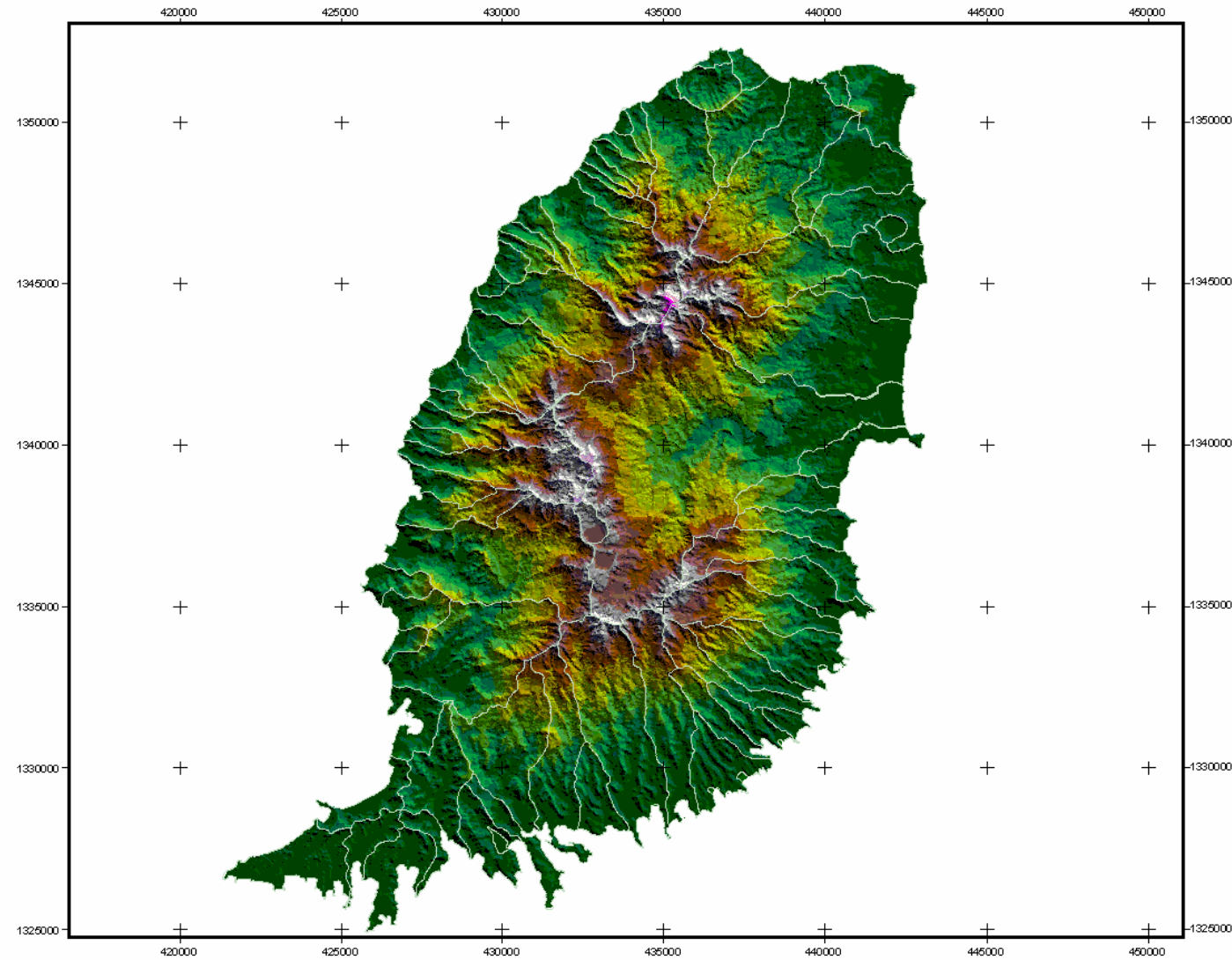
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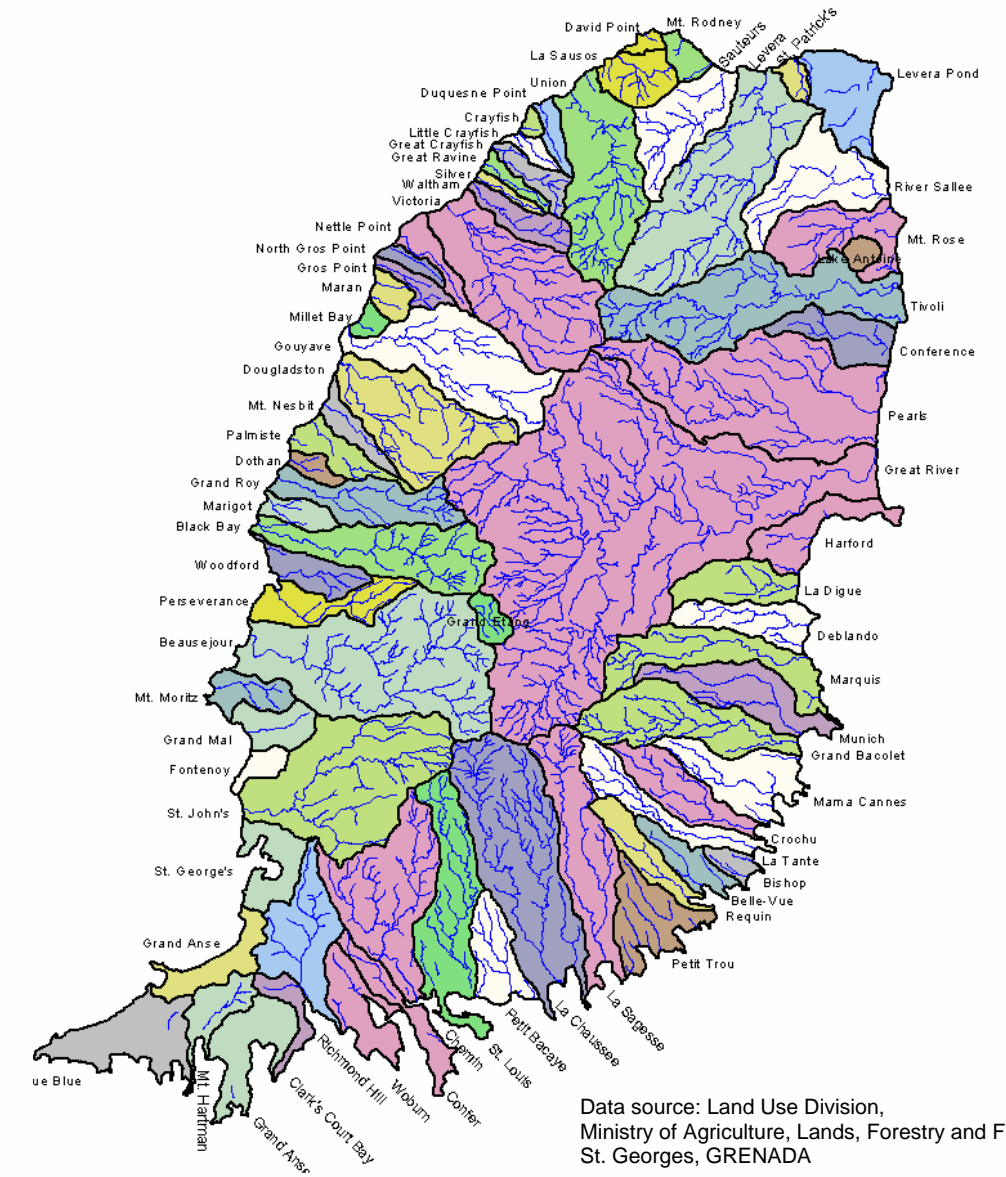


# Grenada Topography



Data source: Land Use Division,  
Ministry of Agriculture, Lands, Forestry and Fisheries.  
St. George's GRENADA

# Grenada Watersheds



Data source: Land Use Division,  
Ministry of Agriculture, Lands, Forestry and Fisheries  
St. George's, GRENADA



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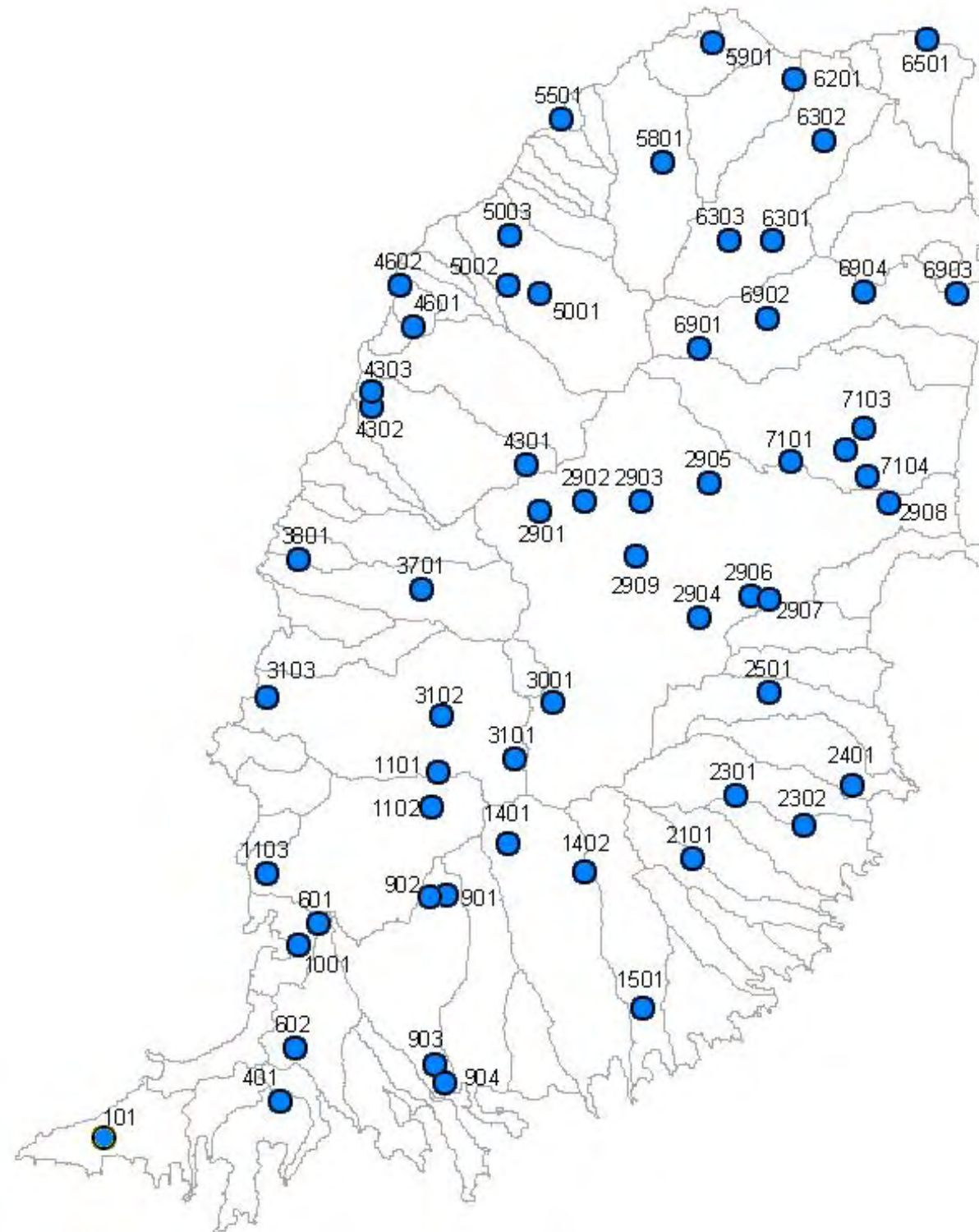
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# Grenada Rainfall Stations



## Average Monthly Rainfall (mm)

Station ID	Station Name	Years on record	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
101	Point Salines Met Stat	1927-45; 1985-91; 1993-2004	40.0	30.2	30.5	26.5	48.8	166.2	157.9	143.3	177.0	148.8	175.0	125.1	1269.3
401	Mt.Hartman	1992-2004	40.1	60.4	38.0	49.1	53.0	145.7	119.5	163.1	113.5	162.9	142.5	132.8	1220.6
601	Richmond Hill	1941-55	83.4	96.6	48.6	50.8	109.0	206.4	241.2	197.7	210.3	213.4	226.8	179.0	1863.2
602	Woodlands	1936-53	87.1	69.1	51.1	47.8	112.5	205.2	237.2	190.1	186.4	224.1	221.4	173.4	1805.3
901	Mardigras W.T.P.	1992-2004	133.3	77.4	77.5	96.3	125.3	246.0	207.1	257.2	221.3	242.8	251.9	171.5	2107.6
902	Mardigras Agric. Stat.	1987-95	148.1	111.6	128.9	69.3	130.4	237.6	322.7	231.2	237.9	228.1	331.0	191.2	2368.1
903	CARDI Agromet Stat	1983-2004	89.3	64.6	51.0	50.9	76.5	181.0	222.0	208.0	182.0	190.1	217.6	135.8	1668.6
904	Calivigny	1945-59	103.8	87.4	35.8	47.5	87.5	164.4	194.5	181.9	162.4	199.1	207.4	153.8	1625.6
1101	Vendome WTP	1949-59; 1976-78; 1987-2004	100.0	83.6	50.3	60.1	75.5	191.6	221.3	210.1	195.7	229.1	278.0	162.2	1857.5
1102	Bon Accord WTP	1992-98; 2000-2004	205.6	114.1	87.8	109.6	149.8	338.2	316.4	320.6	218.2	290.9	294.6	228.0	2674.0
1103	Queens Park	1987-2004	81.5	51.9	41.3	55.4	56.8	197.0	228.6	177.4	190.2	205.5	219.1	112.1	1616.9
1401	Les Avocates WTP	1928-59; 1992-2004	199.5	190.6	157.6	148.0	205.9	384.8	444.2	386.7	365.5	426.9	476.1	373.5	3759.3
1402	Ashenden Cocoa Station	1947-2004	154.2	129.6	89.9	96.0	119.4	231.6	253.1	242.3	234.9	269.9	290.5	230.6	2342.0
1501	La Sagesse	1992-97; 2003	95.8	86.5	41.6	22.9	77.7	206.8	136.3	145.5	199.8	148.1	284.9	127.8	1573.7
2301	Mamma Cannes WTP	1990-2004	98.5	64.5	69.6	94.5	94.6	233.9	208.3	225.3	210.9	255.1	322.0	154.7	2031.9
2401	Hope Estate	1938-59; 1987-2004	79.5	68.8	47.8	63.4	86.3	175.2	190.4	187.0	181.5	190.4	252.8	142.2	1665.3
2901	Belvidere Estate	1931-59; 1990-2004	286.2	176.7	137.9	188.5	224.3	361.4	401.0	407.7	439.3	417.1	458.2	378.0	3876.3
2902	Pecher(Morne Longue)	1990-2004	173.5	113.1	112.7	136.9	125.8	265.4	215.9	297.2	342.8	343.1	318.9	234.6	2680.1
2903	Windsor Estate	1990-99	145.2	123.6	94.9	98.1	129.4	282.6	254.0	348.6	380.5	299.1	266.3	207.3	2629.6
2904	Capitol Estate	1990-2004	139.2	92.5	76.7	109.7	124.8	287.0	247.1	235.4	282.6	254.5	363.1	196.7	2409.3
2905	Mirabeau W.T.P.	1992-2004	153.9	93.9	79.2	98.4	122.5	285.0	220.5	274.6	288.1	293.1	310.8	213.4	2433.4
2906	Mirabeau Agromet Stat.	1961-2004	127.0	89.2	77.9	94.3	99.7	219.6	235.7	244.2	258.1	268.9	292.3	213.5	2220.3
2907	Brandon Hall WTP	1992-2004	113.2	78.3	59.4	105.8	119.0	233.9	208.9	230.4	231.2	227.7	256.3	225.3	2089.7
2908	Paradise Estate	1986-2004	77.3	44.5	53.8	57.0	60.8	167.3	156.7	153.1	213.7	221.0	268.8	132.6	1606.5
2909	Nianganfoix	1927-48; 1951-59	199.7	129.6	97.5	128.1	165.3	256.5	281.4	279.9	826.3	338.6	391.6	298.8	3393.4
3101	Grand Etang National Park	1987-2004	201.9	159.9	149.2	157.2	142.3	331.4	341.3	294.1	284.3	288.6	413.0	247.4	3010.6
3102	Annandale W.T.P.	1941-59; 85; 87-2004	211.6	179.4	126.3	138.9	187.3	328.9	492.3	371.5	339.2	354.8	423.3	309.4	3463.1
3103	Beausejours	1992-2004	210.6	138.0	112.5	137.2	136.4	318.4	305.5	344.1	283.6	332.4	345.1	233.1	2896.8
3701	Concord Waterfalls	1990-2004	204.5	128.8	113.4	144.3	145.0	385.4	329.4	361.6	346.6	359.3	408.1	251.0	3177.2
3801	Knoll Black Bay	1986-2004	100.0	73.4	53.9	59.1	59.3	232.1	241.0	252.0	239.8	233.9	256.7	141.4	1942.6
4301	Clozier	1990-2004	192.4	159.2	117.0	142.8	165.8	352.1	318.3	343.1	332.7	385.6	386.3	249.7	3145.0
4302	Dougladston WTP	1986; 88-2004	140.8	103.8	78.5	83.0	88.0	277.4	274.7	283.2	289.8	307.2	319.3	171.2	2416.7
4303	Dougladston Estate	1942-50; 1976-78; 1987-2004	131.0	97.6	78.1	80.6	116.5	282.9	312.6	332.7	306.1	300.1	290.8	210.3	2539.3
4601	Maran Cocoa Station	1947-59; 1987-2003	155.5	104.4	76.9	73.3	108.1	259.0	283.1	297.5	280.9	261.6	334.3	209.4	2444.3
4602	Maran Estate	1927-51; 2004	178.5	125.2	89.2	112.2	145.0	265.0	302.6	329.9	317.7	299.0	340.9	288.8	2794.2
5001	Tufton Hall Estate	1986-89; 92-2004	148.6	108.7	100.2	77.6	82.1	293.5	251.8	289.7	304.7	335.7	331.2	235.3	2559.1
5002	Tufton Hall W.T.P.	1995-2004	213.8	138.0	136.9	144.2	142.5	309.7	312.6	381.0	318.1	402.7	321.9	238.6	3060.1
5003	Diamond Estate	1987-94	133.2	97.6	56.3	63.4	71.8	228.2	225.0	279.0	351.6	309.4	420.2	193.3	2428.9
5801	Samaritan	1990-2004	153.4	81.9	61.4	90.8	100.5	201.3	201.2	234.5	285.3	283.1	295.5	163.8	2152.5
5901	Mt Alexander	1986-2004	66.6	42.9	38.5	43.5	52.3	158.2	157.4	160.6	205.6	189.9	219.9	128.1	1463.5
6201	Lower Marli	1941-59; 91-2004	96.6	69.0	48.9	55.2	90.9	160.8	180.8	206.5	182.4	209.3	249.4	156.4	1706.3
6301	Mt Reuil Estate	1986-2004	109.8	78.4	65.9	62.1	79.9	211.0	189.4	211.7	271.5	223.1	293.1	169.3	1965.4
6302	Snell Hall	1990-2004	98.9	65.8	47.3	57.2	71.8	177.3	170.8	192.8	250.0	184.9	221.3	140.1	1678.0
6303	Plaisance	1927-55	174.7	124.8	63.5	91.0	133.8	209.5	228.0	274.0	250.9	298.8	376.0	262.0	2487.0
6501	Levera	1987-2004	73.6	39.7	38.2	37.5	54.3	127.6	233.6	155.9	193.5	156.6	177.6	102.6	1390.8
6901	Kublai Cable & Wireless	1990-2004	187.0	125.6	124.1	101.3	136.1	302.8	316.1	312.2	333.8	269.3	336.1	224.1	2768.6
6902	Peggy's Whim	1986-2004	138.8	76.5	84.8	90.6	95.2	230.0	248.1	226.3	292.0	269.6	325.9	185.1	2262.7
6903	River Antoine Estate	1986-2004	64.5	56.7	46.1	47.3	45.5	124.9	123.5	127.5	154.8	140.1	158.8	101.5	1191.1
6904	Belmont	1927-43	108.6	62.7	52.0	66.1	94.8	152.1	172.5	182.1	213.9	234.9	259.6	170.3	1769.6
7102	Boulogne Cocoa Station	1941-59; 86-2004	95.2	75.8	55.7	68.1	95.5	171.7	187.7	198.9	216.9	235.7	243.6	166.3	1811.1
7103	Pearls Airport	1981-84; 2003	85.3	106.8	27.9	45.4	107.0	215.0	202.9	212.7	162.3	180.8	191.3	129.6	1667.1
7104	Dumfermline	1941-56	113.6	92.1	53.5	60.6	105.3	168.0	178.9	195.9	180.1	195.1	257.5	190.6	1791.3

Data source: Land Use Division, Ministry of Agriculture, Lands, Forestry and Fisheries, St. George's, Grenada

**NOTE:** The September data for the Nianganfoix station (2909) was determined to be erroneous.



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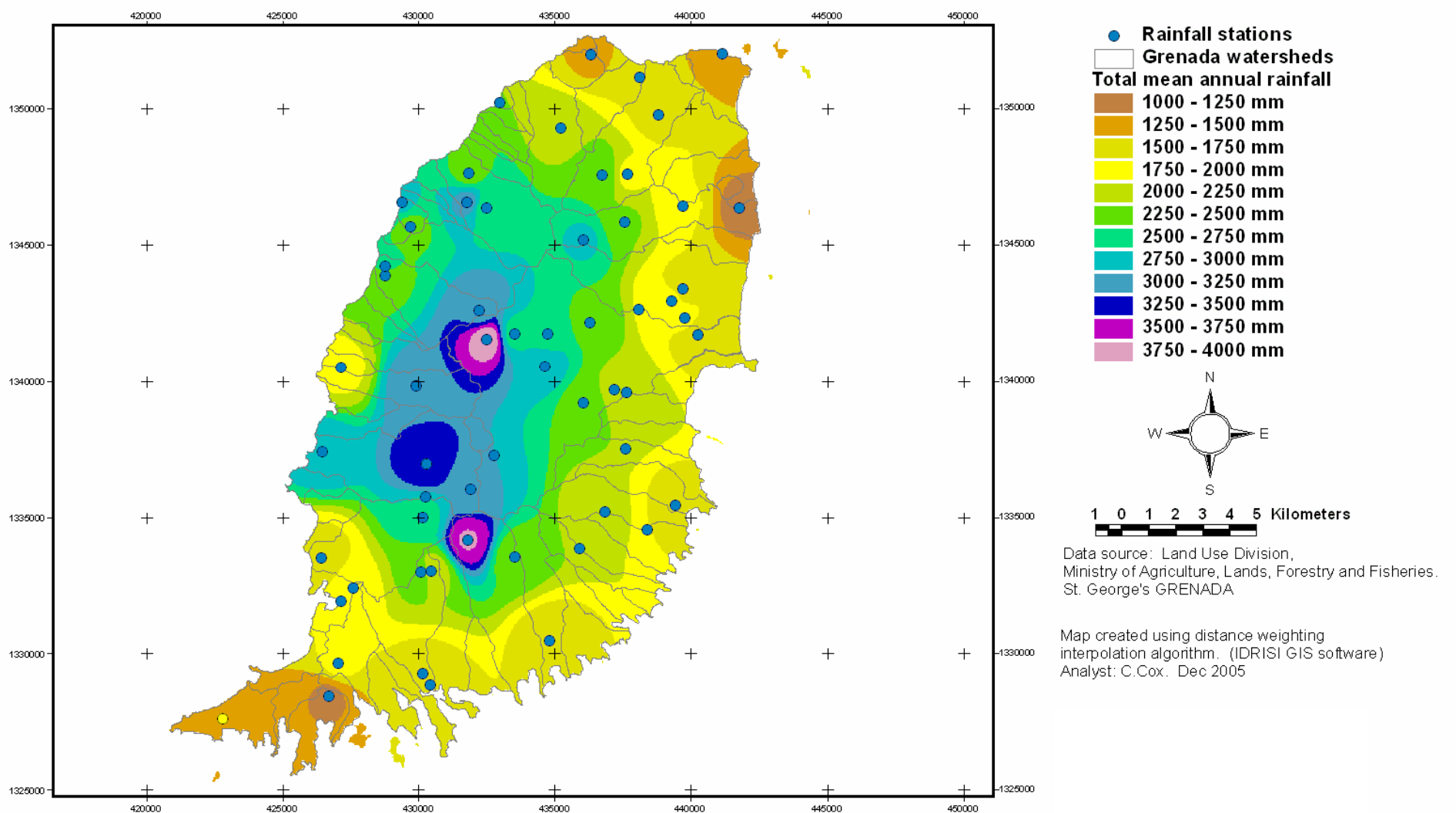
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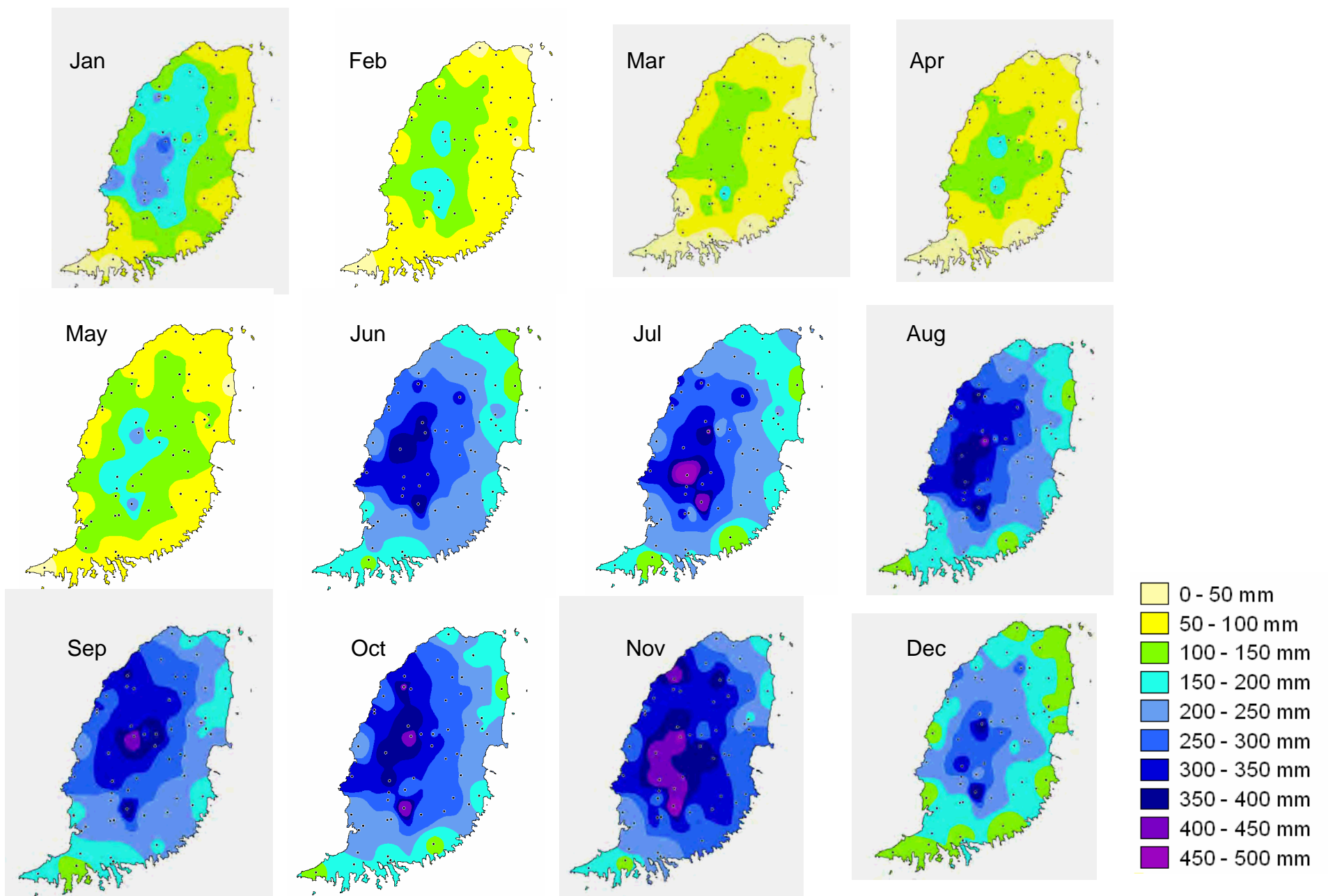


# Grenada Mean Annual Rainfall

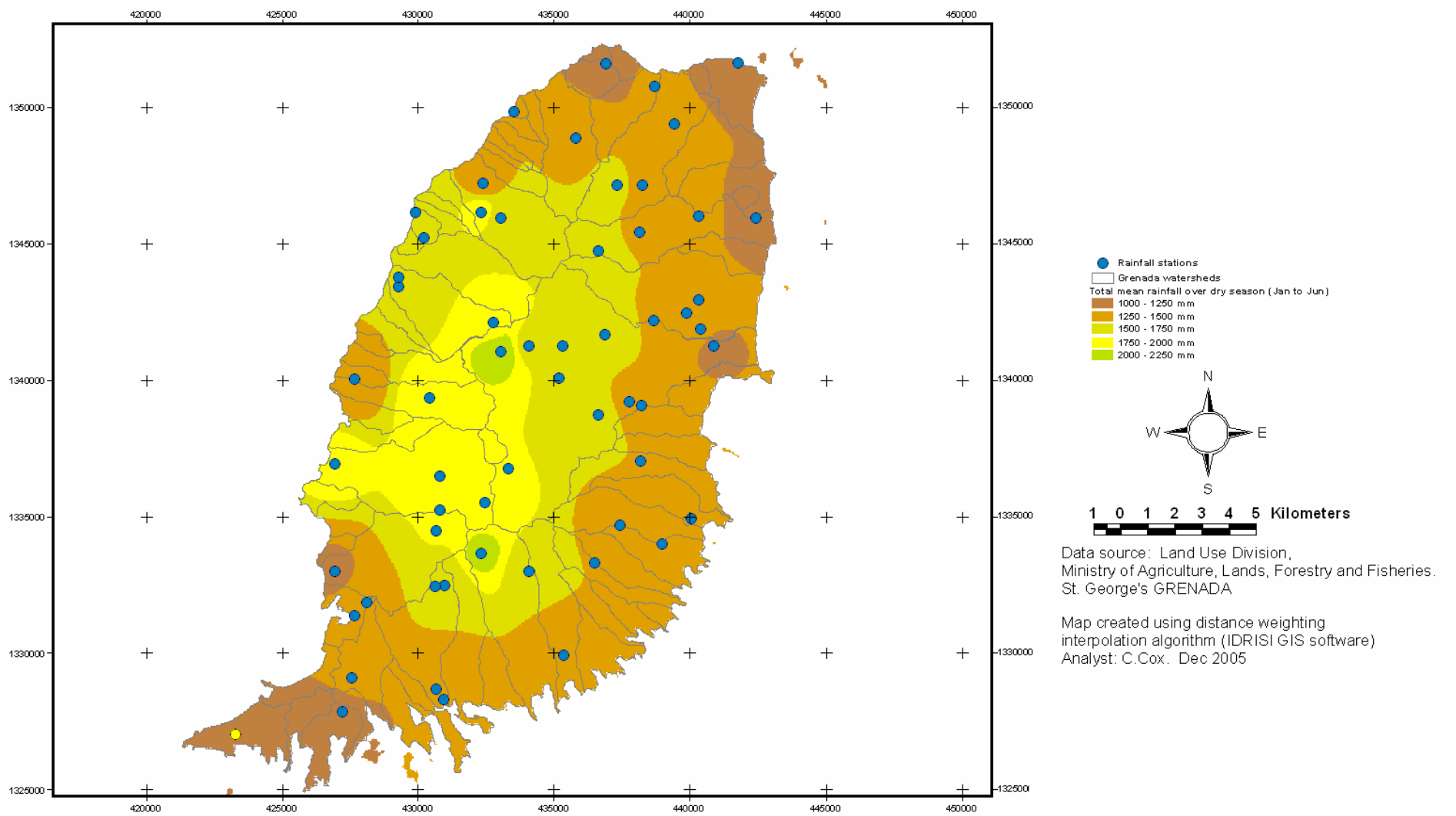


# Grenada Monthly Mean Rainfall

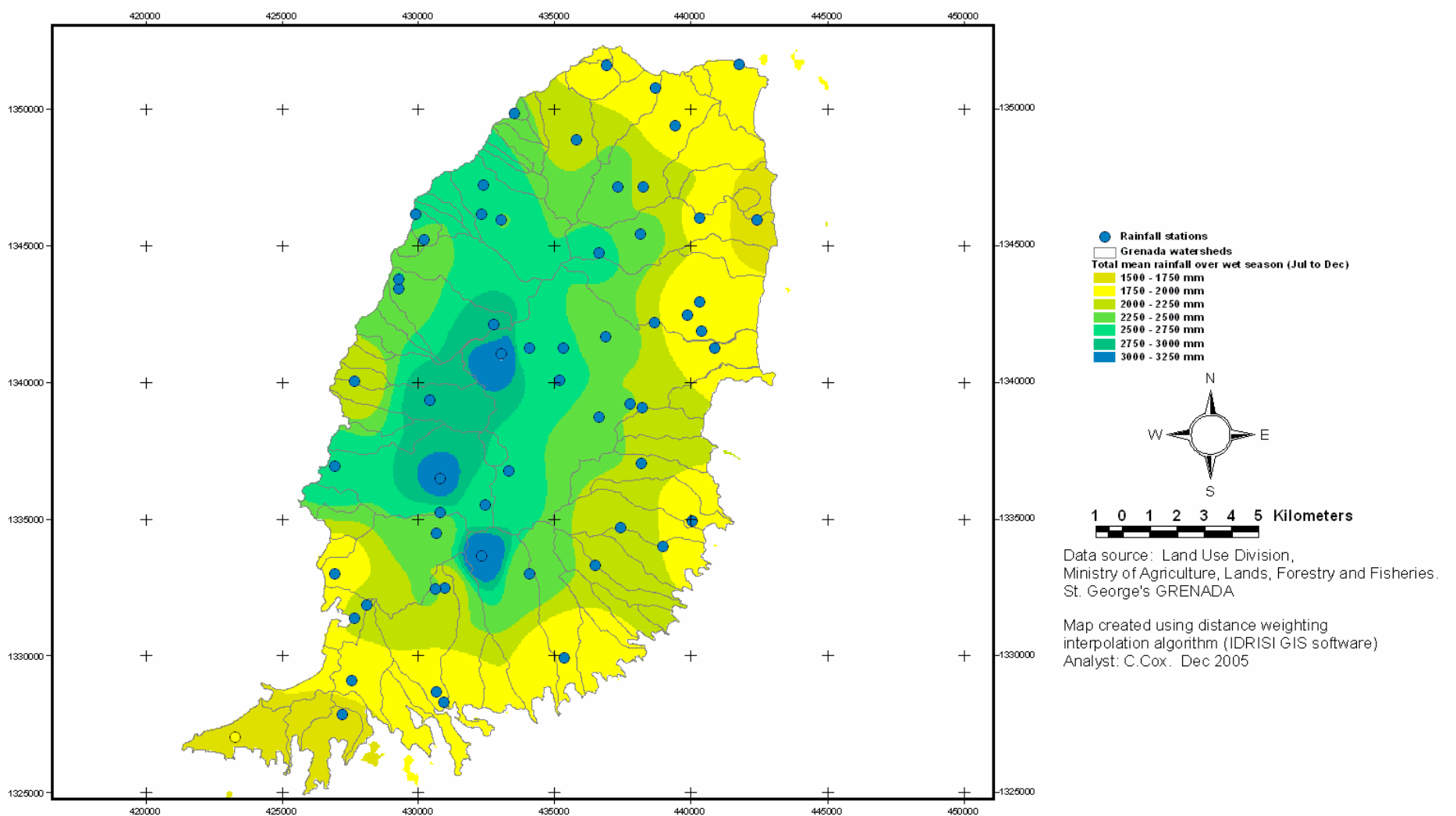
(derived from inverse distance weighting interpolation of rainfall station point observations)



# Grenada Mean Dry Season Rainfall (January to June)



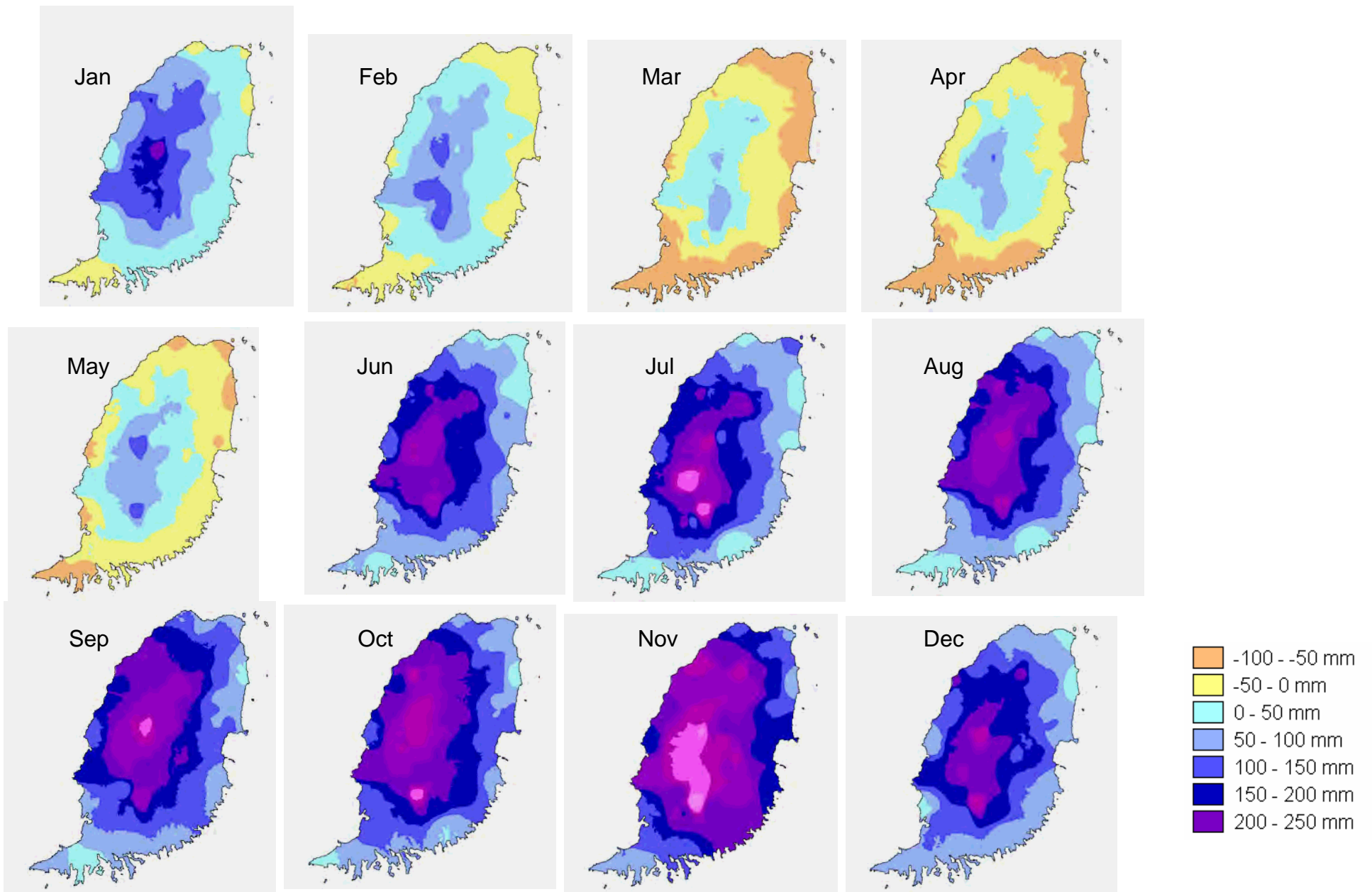
# Grenada Mean Wet Season Rainfall (July to December)





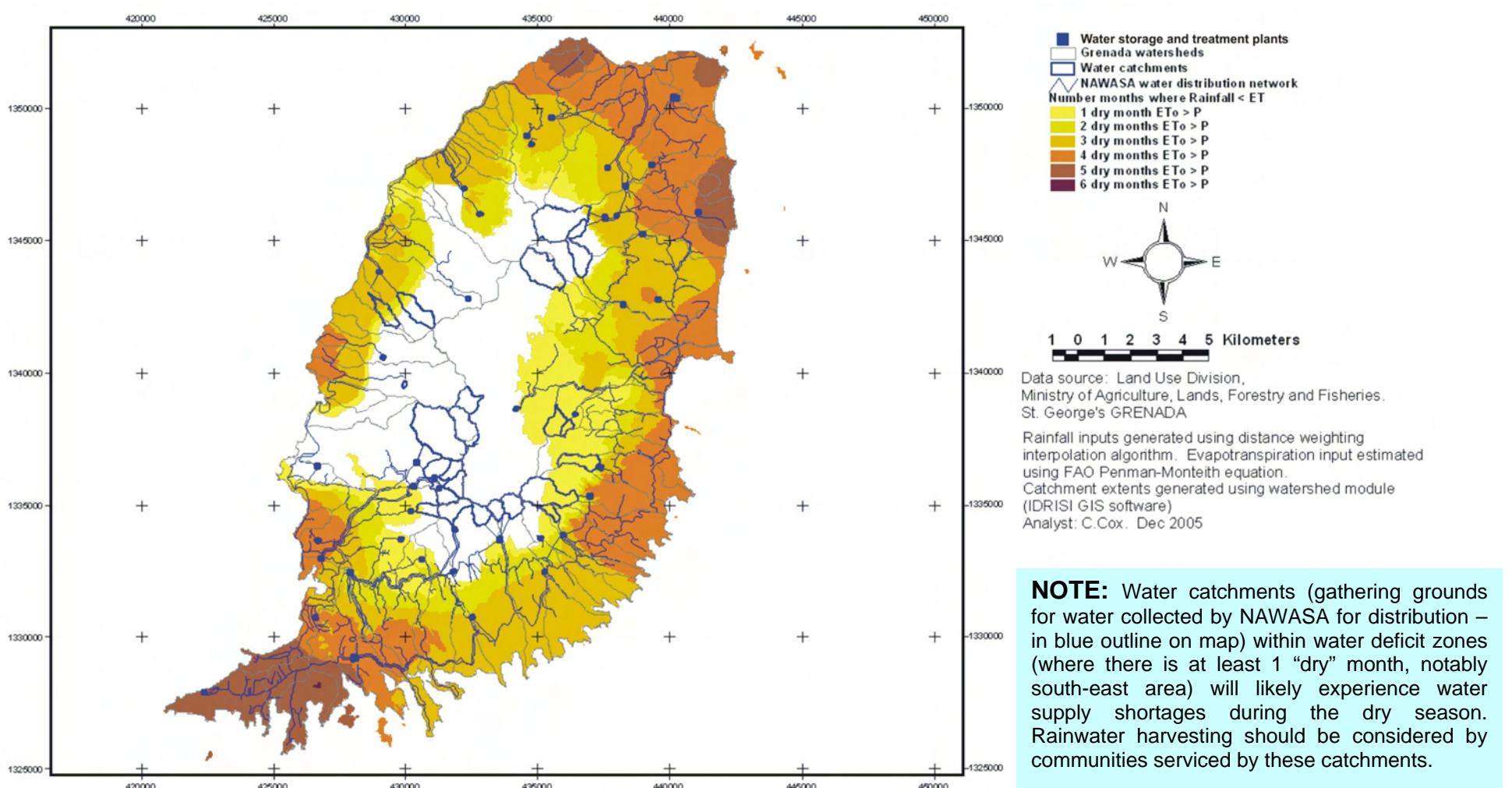
# Monthly mean rainfall deficit/surplus for Grenada

(difference between rainfall and potential evapotranspiration expressed in millimeters)



# Grenada Water Deficit – Number of Consecutive Dry Months

(mean monthly rainfall inputs are below estimated monthly evapotranspiration losses)



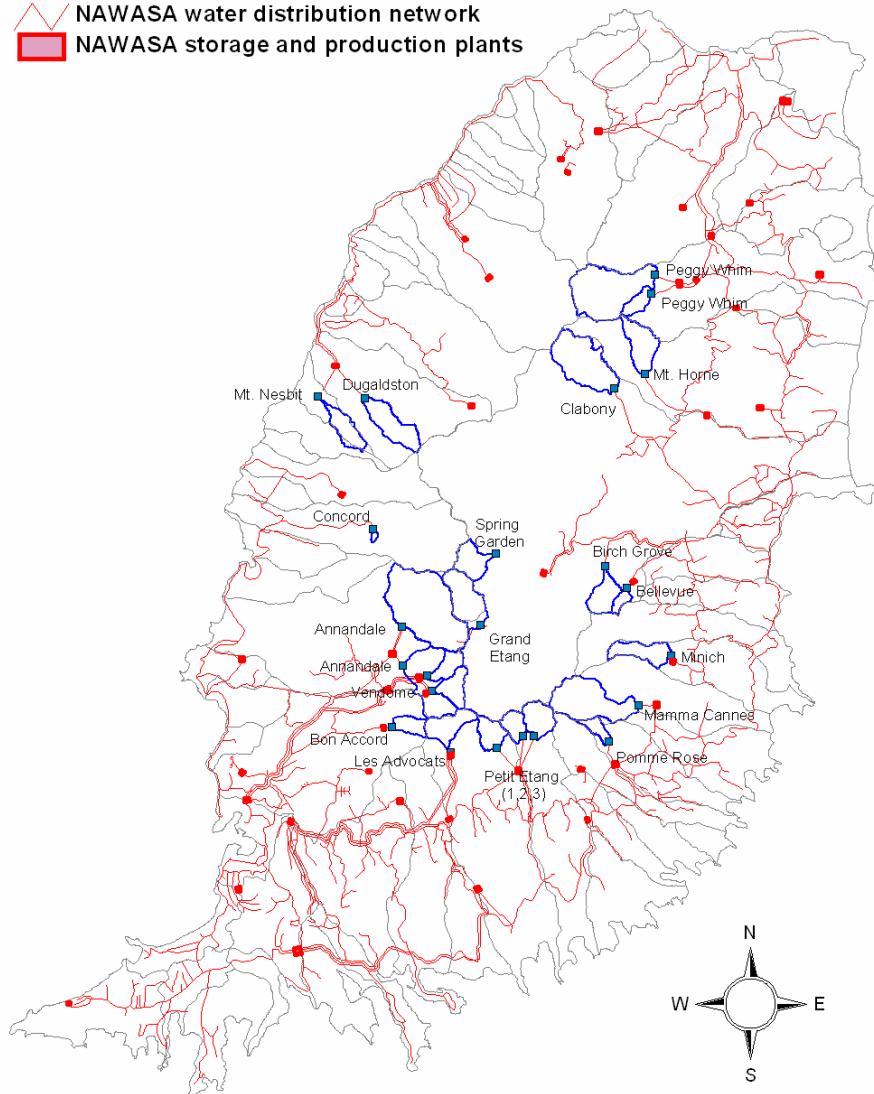


# Raw water supply (runoff) estimates for National Water and Sewerage Authority (NAWASA) catchment areas in Grenada

(based on simplified water balance model for statistically driest (March) and wettest (November) months)

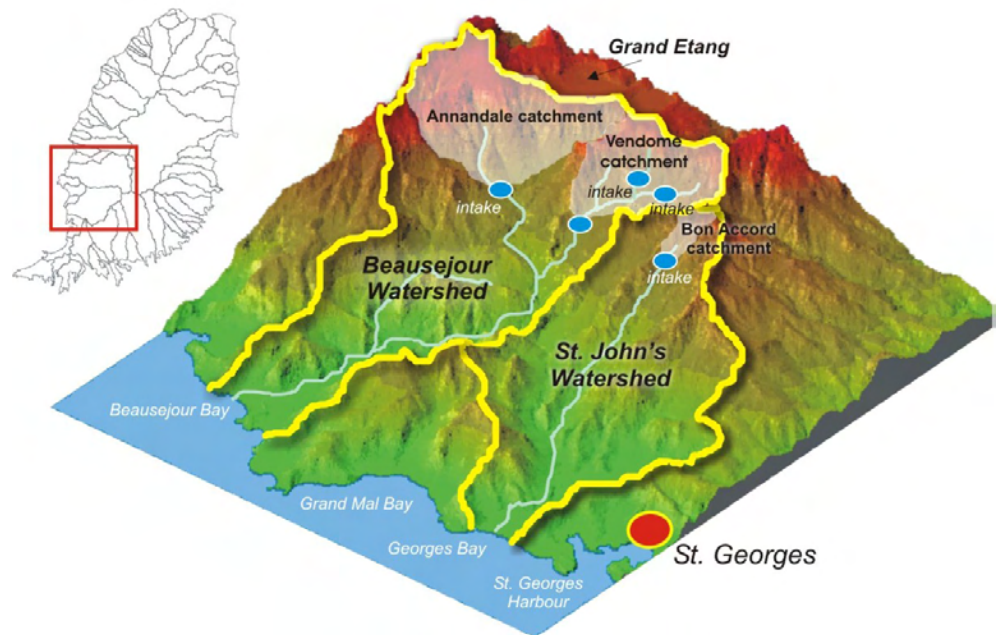
## Grenada Water Supply Distribution Network

- Grenada watersheds
- NAWASA intakes
- Water catchments
- NAWASA water distribution network
- NAWASA storage and production plants



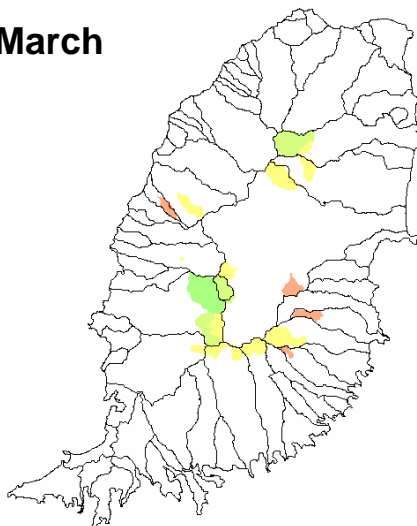
Water catchments are drainage areas upstream of intake structures (abstraction points installed on rivers) that contribute water that is collected by NAWASA for distribution. The catchment boundaries are in blue outline on map (left).

The graphic below is a three-dimensional representation of the water catchment areas within the Beausejour and St. John's watersheds on the western side of Grenada (refer to map at left).

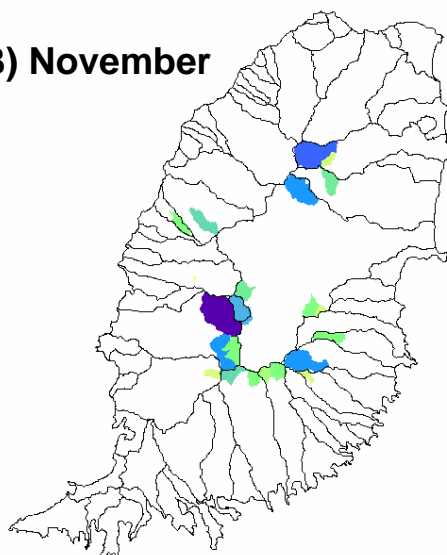


## Estimated raw water yield from water catchment areas

(A) March



(B) November



### Cubic metres per day

- deficit (-1500 to 0 m3/d)
- 0 - 1500
- 1500 - 3000
- 3000 - 4500
- 4500 - 6000
- 6000 - 7500
- 7500 - 9000
- 9000 - 10500
- 10500 - 12000
- 12000 - 13500
- 13500 - 15000
- 15000 - 16500
- 16500 - 18000
- 18000 - 19500
- 19500 - 21000
- 21000 - 22500
- 22500 - 24000
- 24000 - 25500
- 25500 - 27000
- 27000 - 28500
- 28500 - 30000
- 30000 - 31500
- 31500 - 33000
- 33000 - 34500

NAWASA Intake ID #	Source Name	Estimated March mean yield (m <sup>3</sup> /day)	Estimated November mean yield (m <sup>3</sup> /day)
21	Mt. Nesbit	-123	4,581
22	Concord	36	446
20	Dugaldston	466	8,731
7	Les Advocats	1,478	8,618
16	Bon Accord	225	2,994
5	Annandale (south)	2,131	14,110
5	Annandale (north)	4,204	33,912
15	Grand Etang	1,688	11,810
6	Vendome (north)	1,055	5,773
6	Vendome (south)	854	4,668
12	Spring Garden	747	6,581
8	Petit Etang (west)	756	5,216
8	Petit Etang (central)	334	3,360
8	Petit Etang (east)	420	5,278
10	Mamma Cannes	78	14,941
9	Pomme Rose	-62	2,130
17	Clabony	1,225	14,408
14	Bellevue	-24	1,690
13	Birch Grove	-130	5,390
18	Mt. Horne	711	7,016
19	Peggy Whim	2,413	19,494
19	Peggy Whim	360	2,739
11	Minich	-248	5,599

**NOTE:** Negative numbers for March are deficits and implies that the runoff component of the water balance equation may be reduced to zero where evapotranspiration exceeds rainfall based on mean data (refer to methodology document for details)